(For Official Use Only)

Annual Progress Report 2021

All India Coordinated Research Project on Rapeseed-Mustard

ICAR-Directorate of Rapeseed-Mustard Research

(Indian Council of Agricultural Research)

Sewar, Bharatpur 321 303 (Rajasthan) India

Correct citation:

AICRP (Rapeseed-Mustard). 2021. Annual Progress Report.
ICAR-Directorate of Rapeseed-Mustard Research, Sewar, Bharatpur 321 303 Rajasthan

Compiled and Edited by:

Seasonal Conditions	:	Dr. M. D. Meena and Mrs. Mamta Sikarwar
Genetics and Plant Breeding	:	Dr. K. H. Singh, Dr. Bhagirath Ram, Dr. Priyamedha, Sh.Karnal Singh, Sh. Krishna Kant Singh
Agronomy	:	Dr. R. S. Jat and Dr.R.L.Choudhary
Plant Pathology	:	Dr. P.D. Meena and Dr. Pankaj Sharma
Entomology	:	Dr. Sarwan Kumar, PAU,Ludhiana
Plant Physiology	:	Dr. Pushp Sharma, PAU, Ludhiana and Dr. Lalit Krishan Meena,Dr Har Vir Singh
Biochemistry	:	Dr.(Mrs.) Anubhuti Sharma and Dr. Sujith Kumar
Front Line Demonstrations	:	Dr. A.K. Sharma and Dr. Vinod Kumar

Chief Editor: Dr. P.K. Rai and Dr. K.H. Singh

Published by: ICAR-Directorate of Rapeseed-Mustard Research, Sewar, Bharatpur 321 303 (Rajasthan), India

Acknowledgement

It's a matter of great pleasure and honour for me to express my sincere thanks and gratitude to Dr. Trilochan Mohapatra, Secretary DARE, Government of India and Director General, ICAR, Dr.T. R. Sharma, Deputy Director General (Crop Science), Dr. Sanjeev Gupta, Assistant Director General (Oilseeds & Pulses), Dr. D. K. Yadav, Assistant Director General (Seeds) and other ADGs of the Council for their consistent guidance, suggestions and support extended for the planning and effective implementation of All India Coordinated Research Project on Rapeseed-Mustard.

My profound thanks to all the collaborators from 22collabarating and 25 voluntary centres under the umbrella of AICRP-RM programme during 2020-21. I extend my sincere appreciation to scientists who did monitoring and for giving valuable suggestions for further improvement of the programme and express my gratitude to all the Vice-Chancellors and Directors of Research of the concerned SAUs, Directors of ICAR/other institutes, Directors of State Department of Agriculture for their valuable and timely cooperation in the successful implementation of the envisaged research and development activities.

The overall seasonal weather conditions during crop season of 2020-21, across the rapeseed-mustard production zones were quite normal and favourable for crop growth and development. Good rains were received during monsoon in the month of September at almost all the centers. Performance of 165strains, including 11 of toria, 08 of yellow sarson and 140 of Indian mustard, 05 of gobhi sarson and 01 of taramira was tested in nineteen performance evaluation trials consisting of toria (1), yellow sarson (1), gobhi sarson (1), taramira (1) and Indian mustard (16) at 45 locations across the 6 agro-climatic zones of the country. 194.35q breeder seed of 64 rapeseed - mustard varieties was produced, indicating a surplus availability of 116.44q.

Application of 150% NPK recorded markedly higher seed yield of mustard at KHD, LDH, HSR, SGN, DOL, KOT, MOR, SKN, BHU and SHL which was 99.7, 307, 67, 33, 380, 64, 148, 72, 83 and 330% higher over the control, respectively. Whereas, at KNG 100% NPK + 40 kg S/ha and at PNT 100% NPK + FYM @ 2.5 t/ha recorded significantly higher seed yield of mustard which was 209.7 and 184% higher over the control.

Pre-emergence application of oxadiargyl 0.045 kg a.i./ha at Ludhiana, fluazifop-p-butyl 0.125 kg a.i./ha at 25-30 DAS at Hisar, quizalofop 0.05 kg a.i./ha at 15-20 DAS at Pantanagar, pendimethalin 1.0 kg a.i./ha at SK Nagar. Found promising planting of mustard on raised beds recorded markedly higher mustard seed yield over the conventional tillage at Chatha, (5.6%), Kanpur (11.0%), Pantnagar (15.7%) and Morena (20.9%). Also, recorded the highest system productivity at Chatha, Pantnagar and Morena. Among the cropping systems, green gram-mustard system recorded highest seed yield and system productivity at all the locations.

Application of two irrigations recorded highest seed yield compared to no irrigation and one irrigation at all the locations. Seed inoculation with MRD 17 at Morena (18.5%) and Nagpur (22.0%); with Biophos and Biophos^{+} at Bawal (12.3%); with CRIDA MI-I at Sriganganagar (24.6%), Banda (18.9%) and Varanasi (42.8%), with CRIDA MI-II at Chatha (23.3%), Dholi (31.1%), Jobner (18.7%) and SK Nagar (24.9%) significantly increased seed yield over the control. Application of 100% RDF significantly recorded higher mustard seed yield at all the locations. The combination of biofertilizers; PSMO + Azotobacter+ KMB + ZSB recorded significantly higher seed yield at Chatha, Sriganganagar, Pantnagar, Morena, Kota, Varanasi, SK Nagar, Bhubneswar, Bawal, Bharatpur, Khudwani and Shillongani. Whereas, ZSB at Kangra, Hisar and Dholi, and KMB at Imphal recorded markedly higher seed yield over the rest of the biofertilizers. Net returns were also increased with the use of biofertilizers at all the locations.

My sincere thanks and appreciation to all the principal investigators, associated scientists and other colleagues at the ICAR-DRMR especially Drs. K. H. Singh, P.D.Meeana, Pankaj Sharma, A. K. Sharma, Bhagirathram,Vinod Kumar, Ram Swarup Jat, Anubhuti Sharma, Priyamedha, M.D.Meena, L.K.Meena, Harvir Singh, Karnal Singh and Ms Mamta Sikrawar of ICAR-DRMR and Drs. Sarvan Kumar and Pushp Sharma of PAU Ludhiana for their painstaking efforts in compiling the data and timely brining out the report in the present form.

Last but not the least, help rendered by the technical, administrative and supporting staff of DRMR, particularly by Mr. R. C. Meena, Mr. S.B.Sharma, Mrs. Veena Sharma, Mr Krishnakant Singh and Mr. Lala Ram is thankfully acknowledged.

(P. K. Rai)
Director

July 30, 2021
ICAR-DRMR, Bharatpur

CONTENTS

सारांश

मौसम

वर्ष 2020–21 के दौरान सरसों फसल के लिये मौसम अनुकूल रहा। सितम्बर माह में देश के लगभग सभी केन्द्रों में अच्छी बारिश हुई। दिसम्बर एवं जनवरी माह में हिमाचल के बजौरा केन्द्र में न्यूनतम तापमान –0.5 डिग्री सेल्सियस एवं –0.9 डिग्री सेल्सियस दर्ज किया गया। इस वर्ष कीड़ों एवं बीमारियों का प्रकोप भी बहुत कम रहा, जिसके कारण फसल की पैदावार अच्छी हुई।

आनुवांशिकी एवं पादप प्रजनन

किस्मों का सुधार/विकास

अखिल भारतीय राई सरसों समन्वित परियोजना के अन्तर्गत देश के 13 राज्यों के 16 विभिन्न अनुसंधान केन्द्रों पर राई–सरसों की उन्नत किस्मों के विकास हेतु कार्यक्रम कृषि पारिस्थितिकी तंत्र की आवश्यकताओं के अनुरूप किया गया। 165 किस्मों का मूल्यांकन 45 केन्द्रों, जिसमें 24 स्वैच्छिक एवं निजी केन्द्र सम्मिलित है, पर 21 समन्वित परीक्षणों में किया गया।

जननद्रव्य संसाधन प्रबंधन

कुल 5935 प्रारूपों जिनमें तोरिया (757), लाहा (4076), पीली सरसों (446), गोभी सरसों (223), भूरी सरसों (78), करन राई (82), तारामीरा (33), *ब्रेसिका काऊडेटस* (01), *ब्रेसिका नाइग्रा* (26), *ब्रेसिका रूगोसा* (23), *रेफेनस काऊडेटस* (01) एवं अन्य वन प्रजाति (12) के प्रारूपों को उचित संकरण विधि द्वारा सुरक्षित रखा गया। तोरिया (34), लाहा (148), पीली सरसों (116), भूरी सरसों (28) एवं करन राई (35) के कुल 395 नये प्रारूप को एकत्र किया गया एवं लाहा (935), तोरिया (89), पीली सरसों (250), गोभी सरसों (07), भूरी सरसों (41), करन राई (06) , तारामीरा (80) और *ब्रेसिका रूगोसा* (23), के 1438 प्रारूपों का मूल्यांकन किया गया। मूल्यांकन के आधार पर विभिन्न गुणों के लिए उपयोगी जननद्रव्यों की पहचान की गई।

संकरण एवं चयन

अधिक उपज, शीघ्र पकने वाली, बीज–आकार, कीट–रोग प्रतिरोधकता, उच्चताप सहनशीलता, गुणवत्ता एवं अधिक तेल मात्रा के आधार पर तोरिया (74), पीली सरसों (94), लाहा (811) के 979 नए क्रॉसेस नवगांव, चट्ठा, भा कृ अं सं नई दिल्ली कानपुर, पंतनगर, मुरेना, हिसार, श्रीगंगानगर, लुधियाना, वाराणसी एवं एस.के. नगर में बनाए गए। तोरिया में समष्टि (पॉपुलेशन) सुधार कार्यक्रम, कम्पोजिट बनाकर एवं चयन पश्चात् समष्टि बनाकर किया गया। पीली सरसों के लिये पंतनगर एवं कानपुर में संकरण तथा 389 एकल पौधे पृथक्करणीय पीढियों में चयन किया गया। लाहा के 8692 एकल पौधे एवं 864 पुंज (बल्क) पृथक्करणीय एवं अग्रिम पीढ़ियों में से चयन किये गये।

अग्रिम प्रजनन स्तर का मूल्याकंन

तोरिया के 69 प्रभेदों का कानपुर, हिसार, चट्ठा एवं ढोली में मूल्याकंन किया गया। पंतनगर में मानक पी०टी० 303 की तुलना में 15.29 प्रतिशत पैदावार वृद्वि दर्ज की गई। पीली सरसों के कुल 60 प्रभेदों को कानपुर, पंतनगर एवं ढोली में जॉचा गया और पंतनगर में पीताम्बरी की तुलना में 15.84 प्रतिशत अधिक उपज वृद्वि हुई। लाहा के 687 प्रभेदों को 06 केन्द्रो चट्ठा, हिसार, लुधियाना, पंतनगर, ढोली एवं वाराणसी पर 33 परीक्षणों में जॉचा गया। पंतनगर में क्रान्ती की तुलना में 27.02 प्रतिशत उपज में वृद्धि पाई गई। गोभी संरसो के कुल 49 प्रभेदों का हिसार(19), लुधियाना(21) चट्ठा(09) उपज में वृद्धि में मूल्यांकन किया गया।

संकर विकास

आईसीएआर-डीआरएमआर भरतपुर, आईसीएआर-आईएआरआई नई दिल्ली, पीएयू लुधियाना और सीसीएस एचएयू हिसार सहित चार केंद्रों पर "संकरों पर कंसोर्टिया रिसर्च प्लेटफॉर्म" के तहत 2020-21 के दौरान हाइब्रिड विकास के प्रयास जारी रहे। एआईसीआरपीआरएम के विभिन्न परीक्षणों में आईसीएआर–

डीआरएमआर से 07, पीएयू से 04, सीसीएसएचएयू से 03 और आईसीएआर-आईएआरआई से 02 सहित कुल 16 प्रायोगिक संकरों का मूल्यांकन किया गया था। भारतीय सरसों के बीस प्रायोगिक संकरों का मूल्यांकन सभी चार केंद्रों पर प्रतिकृति ब्लॉक डिजाइन में किया गया था। तीन स्थानों पर औसत बीज उपज के आधार पर हिसार से दो संकर; आरएच 2007 और आरएच 2008 ने सर्वोत्तम हाइब्रिड चेक डीएमएच 1 से 11% अधिक प्राप्त किया। अन्य आशाजनक संकर DRMRHJ 3720, DRMRHJ 2518, पूसा MH 118, RHH 2004 और RHH 2006 थे, जिन्होंने क्रमशः 5, 5, 4, 6 और 4 प्रतिशत मानक हेटेरोसिस व्यक्त किया।

संवर्धित ब्लॉक डिजाइन में मूल्यांकन किए गए 42 प्रायोगिक संकरों में से चार प्रयोगात्मक संकर; DRMRHJ 508, DRMRHJ 1003, PHR 8037, PHR 8081 और RHH 2013 ने सर्वोत्तम चेक हाइब्रिड DMH 1 को क्रमशः 13, 11, 6, 10 और 8 प्रतिशत से पीछे छोड़ दिया।विभिन्न जीन पूलों से पहचाने गए इनब्रेड के बीच 2019-20 के दौरान सभी चार केंद्रों पर संवर्धित ब्लॉक डिजाइन में 153 एफ1 क्रॉस का प्रयास किया गया। तीन स्थानों पर औसत बीज उपज के आधार पर सर्वोत्तम जांच डीएमएच 1 पर >10% बीज उपज हेटेरोसिस के लिए 27 एफ1 क्रॉस की पहचान की गई। 192 ए लाइन और 89 आर लाइन का रखरखाव किया गया। 202 और 141 बैकक्रॉस को क्रमशः ए और आर लाइनों की पीढ़ी को आगे बढ़ाने का प्रयास किया गया था। विषमयुग्मजी संयोजनों की पहचान करने के लिए अगले वर्ष के मूल्यांकन के लिए 340 F1 क्रॉस उत्पन्न किए गए। 70 इनब्रेड लाइनों को कृषि संबंधी लक्षणों के लिए चित्रित किया गया था और साथ ही साथ आनुवंशिक विविधता का अध्ययन करने और विविध जीन पूल में उनके चित्रण के लिए एसएसआर मार्करों के साथ जीनोटाइप किया गया था।विभिन्न केंद्रों पर स्टेशन परीक्षणों में 569 प्रायोगिक संकरों का मूल्यांकन किया गया और हेटेरोटिक संयोजनों में >15% हेटेरोसिस की पहचान की गई।आनुवंशिक विविधता के आधार पर 88 इनब्रेड लाइनों को तीन विविध जीन पूलों में चित्रित किया गया था।

प्रजनक बीज उत्पादन

कृषि मंत्रालय, भारत सरकार द्वारा वर्ष 2020–21 के लिए प्रस्तावित 64 अनुमोदित किस्मों का प्रजनक बीज विभिन्न केन्द्रों पर आवंटित किया गया। 82.93 क्विंटल प्रजनक बीज की मांग की तुलना में 194.35 क्विंटल (जिसमें पिछले वर्ष का बीज सम्मिलित है) प्रजनक बीज तैयार किया गया।

समन्वित परीक्षण

तोरिया (11), पीली सरसों (08), लाहा (138), तारामीरा (01) एवं गोभी सरसों (05) के 165 उन्नत प्रभेदों को देश के 6 कृषि जलवायु क्षेत्रों में 18 उपज परीक्षणों हेतु 45 स्थानों पर जॉचा गया। जिसके आधार पर कुल 20 जिसमें पीली सरसों (02),गोभी सरसों (01) एवं लाहा (17) सम्मिलित है, को अग्रिम स्तर की जाँच के लिए प्रोन्नत किया गया।

सर्वोत्तम जॉच किस्म की तुलना में 10 प्रतिशत अधिक उपज एवं तेल मात्रा वाले राई सरसों के उत्कृष्ट प्रभेद

जोन 01	जोन 02	जोन 03	जोन 04	जोन 05
पीली सरसों आई.वी.टी.,				
				आरएमवाईएस 2 (1259,26.3) पीवाईएस -2018-12 (1096,9.9)
सरसों, आई.वी.टी., समय से पहले बुवाई (सिंचित)				
	पीआरई -2018-10 (2257,12.3)			
सरसों, आई.वी.टी., समय पर बुवाई (सिंचित)				
	आरएच 1975			

	(2834,14.04) आरएच 1974 (2865,15.3)			
सरसों, आई.वी.टी., समय पर बुवाई (असिंचित)				
	डीआरएमआरसीआई 128(2328,5.1)**			
सरसों, ए.वी.टी.I, समय पर बुवाई (असिंचित)				
	आरएच 1424 (2578,17.7)			
सरसों, आई.वी.टी., देरी पर बुवाई				
		डीआरएमआर 2018-19 (1871,2.8)**		
सरसों, आई.वी.टी., (गुणवत्ता)				
	आरएच (ओई)1807 (2301,9.3) जेसी36# (2231,6.03) पीडीजेड-15# (2188,1.2) पीडीजेड-14# (2306,6.6)	जेसी 36# (2080) पीडीजेड-15#(2050) पीडीजेड-14#(2325,2.06) 0आइजे5001#(2286,0.3)		
सरसों ए.वी.टी., (गुणवत्ता) I+ II				
	एलईएस 60 (2606) आरएच (ओई)1706 (2689)			
सरसों डब्लू.आर.आर.				
	पीबी(ए4ए 5)-842 वरुना (ए4ए 5) - 936-279 रोहिनी(ए4ए 5)-491	वरुना (ए4ए 5) -936-279 रोहिनी(ए4ए 5)-491		
लवणीय/क्षारीय **ए.वी.टी. I**				
सीएस 2005-143 (2341, 13.4)				
गोभी सरसों ए.वी.टी. I + II				
एकेजीएस 19-8 (1844, 9.4)				

कोष्ठक के अन्दर दर्शायी संख्या क्रमशः उत्पादन किलोग्राम/हैक्टेयर एवं उपज वृद्धि है।
** सफेद रोली प्रतिरोधी/## डबल.लो.प्रभेद के आधार पर उन्नति।

शस्य विज्ञान

वर्ष 2020-21 के दौरान पांच क्षेत्रों (जोनों) में 28 समन्वय केंद्रों पर सस्य विज्ञान संबंधी अनुसंधान के छह प्रमुख क्षेत्रों पर परीक्षण किए गए। इन परीक्षणों से प्राप्त परिणामों को संक्षेप में प्रस्तुत किया गया है:

3.1 राई-सरसों आधारित फसल प्रणालियों में दीर्घकालीन उर्वरता परीक्षण

इन परिणामों में सरसों की पैदावार पर उर्वरता के विभिन्न स्तरों के दीर्घकालिन प्रभाव को दर्शाया गया हैं। खुड़वानी, लुधियाना, हिसार, श्रीगंगानगर, ढोली, कोटा, मुरैना, एस.के. नगर, भुवनेश्वर तथा शिल्लोंगनी केन्द्रों पर 150 प्रतिशत एन.पी.के. के प्रयोग से सरसों की स्पष्ट रूप से उच्चतर पैदावार दर्ज की गई जो कंट्रोल उपचार से क्रमश: 100, 307, 67, 33, 380, 64, 148, 72, 83 एवं 330 प्रतिशत अधिक रही। जबकि, कांगड़ा में

100 प्रतिशत एन.पी.के. + 40 किलोग्राम गंधक प्रति हेक्टेयर तथा पंतनगर में, 100 प्रतिशत एन.पी.के. + 2.5 टन प्रति हैक्टर गोबर की खाद के एकीकृत प्रयोग से सार्थक रूप से अधिक पैदावार प्राप्त हुई जो कंट्रोल उपचार से क्रमश: 210 एवं 184 प्रतिशत अधिक रही।

3.2 राई-सरसों में खरपतवार प्रबंधन के लिए शाकनाशीयों का मूल्यांकन

लुधियाना में ऑक्साडियारगिल @ 0.045 किलोग्राम सक्रिय तत्व प्रति हैक्टर, हिसार में बुआई के 25-30 बाद फ्लूजीफॉप-पी-ब्यूटाइल @ 0.125 किलोग्राम सक्रिय तत्व प्रति हैक्टर, पंतनगर में बुआई के 15-20 बाद क्विजलोफॉप @ 0.05 किलोग्राम सक्रिय तत्व प्रति हैक्टर, एस.के. नगर और भुवनेश्वर में पेंडीमेथालिन @ 1.0 किलोग्राम सक्रिय तत्व प्रति हैक्टर के बीज अंकुरण पूर्व अनुप्रयोग से सरसों की पैदावार में वीडी चेक (खरपतवार-सहित) उपचार की तुलना में क्रमशः 32, 35, 52, 55 और 66 प्रतिशत की वृद्धि हुई। जबकि, लुधियाना में ऑक्साडियारगिल @ 0.09 किलोग्राम सक्रिय तत्व प्रति हैक्टर, पंतनगर में क्विज़लोफॉप @ 0.05 किलोग्राम सक्रिय तत्व प्रति हैक्टर और एस.के. नगर में पेंडीमेथालिन @ 1.0 किलोग्राम सक्रिय तत्व प्रति हैक्टर के बीज अंकुरण पूर्व छिड़काव से उच्चतम खरपतवार नियंत्रण दक्षता दर्ज की गई।

3.3 राई-सरसों की होनहार (प्रोमिसिंग) प्रविष्टियों का सस्य-मूल्यांकन।

वर्ष 2020-21 के दौरान विभिन्न उर्वरता स्तरों के तहत गुणवत्ता वाली सरसों, गोभी सरसों और तारामीरा की नई प्रविष्टियों का परीक्षण किया गया।

गुणवत्ता सरसों: पीडीजेड 12 और आरसीएच 1 प्रविष्टियों ने हिसार (4.3 और 11.7 प्रतिशत) और श्रीगंगानगर (16.9 और 35.0 प्रतिशत) में चेक पीडीजेड 1 की तुलना में अधिक बीज उपज दर्ज की। लुधियाना में, पीडीजेड 12, पीडीजेड 11 और आरसीएच 1 ने चेक पीडीजेड 1 की तुलना में क्रमशः 5.2, 15.6 और 18.6 प्रतिशत अधिक बीज उपज दर्ज की। जबकि, नई दिल्ली में किसी भी प्रविष्टि ने चेक पीडीजेड 1 से बेहतर प्रदर्शन नहीं किया।

गोभी सरसों: प्रविष्टि जीएसएच 1699 ने कांगड़ा और धौला कुआं में जीएसएल 1 (20.1 और 28.2 प्रतिशत), क्रांति (80.5 और 188 प्रतिशत) और जीएससी 6 (8.8 और 29.6 प्रतिशत) की तुलना में अधिक बीज उपज दर्ज की। इसने (जीएसएच 1699) चट्ठा में क्रांति (3.4 प्रतिशत), लुधियाना में जीएसएल 1 (5.2 प्रतिशत) और बजौरा में जीएसएल 1 और क्रांति (क्रमशः 29.9 और 23.8 प्रतिशत) से अधिक बीज उपज दर्ज की।

तारामीरा: प्रविष्टि आरटीएम 1624 ने नवगांव (14.2, 11.5 और 10.7 प्रतिशत), जोबनेर (15.0, 24.7 और 12.7 प्रतिशत), और डिग्गी (11.7, 27.2 और 13.9 प्रतिशत) में सर्वोत्तम चेक प्रविष्टियों टी 27, आरटीएम 314 और आरटीएम 1351 से अधिक पैदावार दर्ज की।

3.4 वर्तमान और भविष्य की जलवायु के तहत राई-सरसों आधारित संसाधन कुशल और जलवायु के प्रति लोचदार फसल प्रणालीयों का विकास

चट्ठा (5.6 प्रतिशत), कानपुर (11.0 प्रतिशत), पंतनगर (15.7 प्रतिशत) और मुरैना (20.9 प्रतिशत) में पारंपरिक जुताई पद्धती की तुलना में उभरी क्यारियों पर सरसों की बुआई करने पर स्पष्ट रूप से उच्चतर पैदावार दर्ज की गई। चट्ठा, पंतनगर और मुरैना में उच्चतम प्रणाली (सिस्टम) उत्पादकता भी उभरी क्यारियों

पर बुआई करने पर दर्ज की गई। विभिन्न फसल प्रणालियों में, मूंग -सरसों प्रणाली ने सभी स्थानों पर उच्चतम बीज उपज और प्रणाली उत्पादकता दर्ज की।

3.5 सूक्ष्मजीवों के माध्यम से राई-सरसों में सूखा और ताप सहनशीलता बढ़ाना

दो सिंचाई के अनुप्रयोग से सभी स्थानों पर बिना सिंचाई और एक सिंचाई की तुलना में सरसों की उच्चतम बीज उपज दर्ज की गई। बीज का टीकाकरण मुरैना (18.5 प्रतिशत) और नागपुर (22.0 प्रतिशत) में एमआरडी 17 के साथ; बावल में बायोफॉस और बायोफॉस+ के साथ (12.3 प्रतिशत); श्रीगंगानगर (24.6 प्रतिशत), बांदा (18.9 प्रतिशत) और वाराणसी (42.8 प्रतिशत) में सीआरआईडीए एमआई-I के साथ, चट्ठा (23.3 प्रतिशत), ढोली (31.1 प्रतिशत), जोबनेर (18.7 प्रतिशत) और एस.के. नगर (24.9 प्रतिशत) में सीआरआईडीए एमआई-II के साथ करने पर बीज उपज में कंट्रोल उपचार की तुलना में उल्लेखनीय वृद्धि प्राप्त हुई।

3.6 राई-सरसों की उत्पादकता और मृदा स्वास्थ्य को बढ़ाने में तरल जैव-उर्वरकों की प्रतिक्रिया पर अध्ययन

उर्वरता के विभिन्न स्तरों में, 100 प्रतिशत आरडीएफ के प्रयोग से सभी स्थानों पर सरसों की सार्थक रूप से अधिक पैदावार दर्ज की गई। चट्ठा, श्रीगंगानगर, पंतनगर, मुरैना, कोटा, वाराणसी, एस.के. नगर, भुवनेश्वर, बावल, भरतपुर, खुड़वानी और शिल्लोंगनी केन्द्रों पर जैव उर्वरकों के संयोजन; पीएसएमओ + एज़ोटोबैक्टर + केएमबी + जेडएसबी के प्रयोग से सरसों की सार्थक रूप से उच्चतर पैदावार दर्ज की गई। जबकि, कांगड़ा, हिसार और ढोली में जेडएसबी और इम्फाल में केएमबी के प्रयोग से अन्य जैव उर्वरकों की तुलना में अधिक बीज उपज दर्ज की। सभी स्थानों पर जैव उर्वरकों के उपयोग से शुद्ध लाभ में भी वृद्धि हुई।

पादप रोग विज्ञान

वर्ष 2020–21 के दौरान, सभी जगह काला धब्बा एवं सफेद रोली रोग का प्रकोप औसत से तीव्र पाया गया। हालाँकि, पंतनगर में इनका प्रकोप कम से मध्यम पाया गया। चूर्णिल आसिता रोग का प्रकोप एस.के.नगर और पंतनगर में औसत से तीव्र रहा। तना गलन रोग का प्रकोप मुरैना, हिसार, लुधियाना, भरतपुर व पंतनगर में सामान्य से औसत पाया गया।

राई–सरसों जननद्रव्य की विभिन्न रोगों से प्रतिक्रिया

प्राकृतिक परिस्थितियों में पांच केद्रों पर एवीटी 1 और एवीटी 2 की 35 जननद्रव्य में से 9आई 5001 (गुणवत्ता संकर), डीआरएमआर 2017–16 (ब्रेसिका जुंसिया), एकेएमएस 19–8 और एचएनएस 0702 (ब्रेसिका नेपस) पर सफेद रतुआ रोग के प्रति प्रतिरोधी पायी गई। जबकि कृत्रिम परिस्थितियों में डीआरएमआर 2017–16, 9आई 5001 (गुणवत्ता संकर), और एकेजीएस 19–8 , एचएनएस 0702, जीएसएच 1699, जीएसएच 2180, जीएसएच 2196 (ब्रेसिका नेपस) जननद्रव्य मुरैना, हिसार और पंतनगर स्थानों पर सफेद रतुआ रोग प्रतिरोधी पाये गये। जननद्रव्य केएमआर (ई) 19–2, एनपीजे–230, एसकेएम–1626, डीआरएमआर 2017–16, पीडीजेड 12 और 9आई 5001 (गुणवत्ता संकर), पंतनगर में मृदूरोमिल आसित रोग प्रतिरोधी पाये गये।

रोग नर्सरी

प्राकृतिक परिस्थितियों में सरसों के 38 जननद्रव्य में से डीआरएमआरक्यू –1–22, डीआरएमआरक्यू 202, डीआरएमआर 2018–25, पीएमडब्ल्यू 18 और पीएबी 14–7 सफेद रतुआ के 10 प्रतिशत प्रकोप से नीचे होने पर प्रतिरोधी पाये गये। रोहिणी चेक में सफेद रतुआ का अधिकतम प्रकोप 26.5 प्रतिशत पाया गया। जबकि डीआरएमआरएसजे –25,

डीआरएमआरक्यू 202, पीएबी 14–7 डीआरएमआरएसजे –21 और डीआरएमआरएसजे –361 जननद्रव्य में मुरैना व गंगानगर स्थानों पर तना गलन रोग के 10 प्रतिशत प्रकोप से नीचे होने पर प्रतिरोधी पाये गये।

काला धब्बा की राष्ट्रीय रोग नर्सरी

45 जननद्रव्य में से कोई भी काला धब्बा रोग प्रतिरोधी नहीं पाया गया। हालाँकि जननद्रव्य पीएमडब्ल्यू 8, डीआरएमआर 2018–41, डीआरएमआर 2018–37, डीआरएमआर 2018–25 और डीआरएमआर 18–1 (ब्रेसिका जुंसिया) मुरैना, पंतनगर और हिसार में सफेद रतुआ के लिये प्रतिरोधी पाये गये।

सफेद रतुआ की राष्ट्रीय रोग नर्सरी

59 जननद्रव्य में से आरएच 1700–4, वरूणा (ए4ए5)–936–279, रोहिणी (ए4ए5)–491, आरजेके (ए4ए5)–21, डीआरएमआर 2018–17, डीआरएमआर 2018–25 और डीआरएमआर 18–37–13 (ब्रेसिका जुंसिया) जननद्रव्य मुरैना, पंतनगर, हिसार, लुधियाना, व भरतपुर में सफेद रतुआ रोग प्रतिरोधी पाये गये। जबकि जननद्रव्य जैसे डीआरएमआरएसजे 7, डीआरएमआर सीआई 125, डीआरएमआर सीआई 132, डीआरएमआरएसजे 4, डीआरएमआरएसजे 206 डीआरएमआरएसजे 349, डीआरएमआर 18–36–12, डीआरएमआर 2018–41, आरएच 1700, आरएच 1400, आरएच 1400–1, आरएच 1700–1, पीडब्ल्यूआर 13–8, पीबी (ए4ए5)–842 और पीएमडब्ल्यू –18 जननद्रव्य 5 स्थानों पर सफेद रतुआ के 10 प्रतिशत प्रकोप से नीचे होने पर प्रतिरोधी पाये गये। हालाँकि डीआरएमआर 2018–41 और आरएच 1400 पिछले वर्षों 2018–19, 2019–20 एवं 2020–2021 से लगातार सफेद रोग प्रतिरोधी पायी गयी।

तना गलन की राष्ट्रीय रोग नर्सरी

कृत्रिम परिस्थितियों में कोई भी जननद्रव्य पंतनगर, हिसार और भरतपुर स्थानों पर तना गलन रोग के प्रति सहनशील एवं प्रतिरोधी नहीं पाये गये है।

राई–सरसों का प्रांरम्भिक जननद्रव्य परीक्षण

सरसों के कुल 134 आईवीटी जननद्रव्य में से टीएम 188, ओआरएम 2019–01, 0आईजे 1010, डीआरएमआर सीआई 128, 0आईजे 1034, 0आईजे 5001 (ब्रेसिका जुंसिया), जननद्रव्य पाँच स्थानों पर सफेद रतुआ रोग प्रतिरोधी पाये गये। डीआरएमआर 2018–19, रोहिणी (ए4ए5)–936–279, पीबी (ए4ए5)–842 और पीजेके (ए4ए5)–21 सफेद रतुआ रोग प्रतिरोधी पाये गये। जबकि सभी तोरिया, पीली सरसों और गोभी सरसों सफेद रतुआ रोग से मुक्त रहे।

धान–पड़त–सरसों के फसल चक्र **में** काला धब्बा रोग की उपज हानि का आँकलन एवं **प्रबंधन**

विभिन्न उपचारों के मध्य, टेबुकोनाजोल 50 प्रतिशत + ट्राइफ्लोक्सिस्ट्रोबिन 25 प्रतिशत डब्ल्यूजी का पर्णीय छिड़काव 0.5 ग्रा. प्रति लीटर की दर से तथा इसके बाद आईप्रोडियोन 50 डब्ल्यूपी का 0.2 प्रतिशत की दर से काला धब्बा रोग को क्रमशः 54.3 और 52.6 प्रतिशत चेक की तुलना में बढ़ी हुई उपज के साथ कम करने में कारगर पाया गया।

काला धब्बा, सफेद रतुआ, चूर्णिल आसिता व मृदुरोमिल आसिता रोगों की महामारी का अध्ययन

सरसों के पर्ण रोगों की महामारी विज्ञान पर प्रयोग वरुणा और स्थानीय किस्म का उपयोग करके किया गया। कीट और रोगों के प्रबंधन हेतु किसी भी सुरक्षा उपायों को अपनाए बिना 1 अक्टूबर से 19 नवंबर तक शुरू होने वाले साप्ताहिक अंतराल पर आठ अलग–अलग तिथियों पर बुबाई का प्रयोग किया गया।

पंतनगर में वरुणा और क्रांति किस्मों को आठ अलग–अलग तिथियों पर बोया गया। मृदुरोमिल आसिता रोग पहली बार 22 नवंबर को बोई गई फसल पर बुवाई के 8 दिनों के बाद दिखाई दिया। जबकि अगेती बुबाई को छोड़कर अधिकतम मृदुरोमिल आसिता रोग बुवाई के 22 से 23 दिनों के बीच के दोनों किस्मों पर दिखाई दिया। सफेद रोली रोग पहली बार 22 अक्टूबर, 29 अक्टूबर और 12 नवंबर को बोई गई फसल में बुवाई के 50 दिनों के बाद दिखाई दी। जो पिछले साल की तुलना में 12 दिन पहले है। काला धब्बा रोग को पहली बार बुवाई के 50 दिनों के बाद 22 अक्टूबर को

बोई गई फसल पर दोनों किस्मों पर देखा गया। जबकि 01 अक्टूबर की बुवाई में यह बीमारी 56 दिनों के बाद दिखाई दिया। फली पर काला धब्बा रोग पहली बार देर से (19 नवंबर) बोई गई फसल पर 83 दिनों के बाद दिखाई दिया जो पिछले साल की तुलना में 5 दिन पहले है। 01 अक्टूबर बोई गई फसल पर, 122 दिनों बाद तक फली पर रोग लक्षण दिखाई दिए।

शिलोंगनी में वरुणा और टीएम–2 फसल बोई गई। दोनों किस्मों को 29 अक्टूबर से 19 नवंबर तक साप्ताहिक अंतराल पर चार अलग–अलग तिथियों पर प्रारंभिक फसल बोई गई। काला धब्बा रोग पत्तियों पर पहली बार बुवाई के 35 दिनों के बाद 19 नवंबर को टीएम–2 पर देखा गया जो पिछले साल की तुलना में 6 दिन पहले है। काला धब्बा रोग फलियों पर बुवाई के 83 दिनों के बाद 19 नवंबर को टीएम–2 पर जबकि वरुणा बुवाई के 95 दिनों के बाद 29 अक्टूबर को बोई गई फसल पर रोग के लक्षण देखे गये। अधिकतम रोग की गंभीरता बुवाई के 120 दिनों के बाद (26.8 प्रतिशत) 12 नवंबर को टीएम–2 पर दिखाई दी। जो पिछले साल की तुलना में 12 प्रतिशत से कम है। 29 अक्टूबर को बोई गई वरुणा की फसल में 18.7 क्विंटल/हैक्टेयर और 29 अक्टूबर को बोई गई टीएम–2 फसल में 12.7 क्विंटल/हैक्टेयर अधिकतम बीज उपज हुई। इस क्षेत्र में उपज के आंकणों के आधार पर अक्टूबर का अंतिम सप्ताह बुवाई का उचित समय है।

एस के नगर में वरुणा और जीएम–2 किस्मों पर चुर्णिल आसिता रोग 19 नवंबर को बोई गई फसल पर पहली बार बुवाई के 89 दिनों के बाद दिखाई दिया जो पिछले सालों 2019–20 में बुआई के 78 दिनों के बाद, 2018–19 में बुवाई के 83 दिनों के बाद और 2017–18 में बुवाई के 76 दिनों के बाद दिखाई दी। अधिकतम रोग की गंभीरता वरुणा में 97.0 प्रतिशत और जीएम–2 में 90.5 प्रतिशत देखी गई। रोगों के कारण अधिकतम बीज उपज में कमी पछेती बुवाई में हुयी यद्यपि जीएम–2 की फसल में 16.6 क्विंटल/हैक्टेयर और वरुणा में 15.7 क्विंटल/हैक्टेयर अधिकतम बीज उपज प्राप्त हुई।

मुरैना में वरूणा और रोहिणी दोनों किस्मो को साप्ताहिक अंतराल पर आठ तिथियों पर फसल बोई गई। काला धब्बा रोग पत्तियों पर पहली वार 47 दिनों के बाद 19 नबम्बर की बुवाई वरूणा और रोहिणी दोनों किस्मों में यह रोग दिखाई दिया। जबकि यह रोग फलियों पर उसी जगह 90 दिनों के बाद दिखाई दिया। चूर्णित आसिता रोग पहली वार बुवाई के 80 दिनों के बाद दिखाई दिया जबकि यह रोग अधिकतम 51.8 प्रतिशत रोहिणी में बुवाई के 130 दिनों के बाद 19 नबम्बर की बुवाई में दिखाई दिया। सफेद रोली रोग पहली वार 19 नवम्बर की बुवाई में बुवाई के 40 दिनों के बाद रोहिणी में दिखाई दिया तथा 5 नबग्बर और 12 नबम्बर की बुवाई में 120 दिनों तक यह रोग बढ़ा हुआ दिखाई दिया। सफेद रोली रोग की गंभीरता अधिकतम 44.9 प्रतिशत तक 5 नबम्बर की दोनों किस्मों वरूणा और रोहिणी में पायी गयी। जबकि रोहिणी में 40.2 प्रतिशत अधिकतम स्टैग हेड की संख्या 12 नवम्बर की बुवाई में पायी गयी। अधिकतम बीज उपज 15 अक्टूबर की बुवाई में 34 क्विंटल/हैक्टेयर रोहिणी में और 32.9 क्विंटल/हैक्टेयर वरूणा में पायी गयी।

जगदलपुर में वरूणा और सीजी सरसों दोनों किस्मों को साप्ताहिक अतंराल पर आठ अलग–अलग तिथियों पर फसल को अनुशांसित कृषि पद्धतियां का प्रयोग करते हुये बोयी गई। सफेद रोली रोग पहली वार बुवाई के 50 दिनों के बाद दोनों किस्मों पर 12 नबम्बर और 19 नवम्बर को बोई गई फसल पर दिखाई दिया। शुरूआत में काला धब्बा रोग बुवाई के 40 दिनों के बाद 12 नवम्बर की बुवाई वरूणा में और दोनों बुवाई 12 नवम्बर और 19 नवम्बर में यह रोग सीजी सरसों में पाया गया है। चूर्णित आसिता रोग पहली वार दोनों किस्मों वरूणा और सीजी सरसों में 12 नवम्बर एवं 19 नवम्बर की बुवाई में पाया गया है। अधिकतम बीज उपज प्राप्त करने के लिए बुवाई की उपयुक्त समय 1 अक्टूबर से 15 अक्टूबर के बीच में पाया गया।

ढ़ोली में वरूणा और राजेन्द्र सुफ्लाम दोनों किस्मों को साप्ताहिक अतंराल पर आठ अलग–अलग तिथियों में बोया गया। काला धब्बा रोग पत्तियों पर पहली बार बुवाई के 62 दिनों के बाद वरूणा में और बुवाई के 75 दिनों के बाद

राजेन्द्र सुफ्लाम में 1 अक्टूबर की बुवाई में पाया गया। यह रोग पत्तियों पर लगातार 140 दिनों तक दोनों किस्मों में पाया गया।

हिसार में वरूणा और आरएच 30 दोनों किस्मों को साप्ताहिक अतंराल पर आठ अलग–अलग तिथियों में अनुशांसित कृषि पद्धतियों के प्रयोग करते हुये बोयी गई। सफेद रोली पहली बार बुवाई के 36 दिनों के बाद 12 नबम्बर और 19 नबम्बर में बुवाई की गई आरएच 30 में यह रोग पाया गया। यह रोग 12 नबम्बर और 29 अक्टूबर तक की बुवाई में फैल गया। 15 अक्टूबर की बुवाई में पहली वार स्टैग हैड बनना बुवाई के 68 दिनों बाद आरएच 30 में पाया गया। काला धब्बा रोग पहली बार पत्तियों पर बुवाई के 89 दिनों के बाद 8 अक्टूबर एवं 19 नबम्बर की बुवाई में वरूणा और आरएच 30 दोनों किस्मों में पाया गया। तना गलन रोग की शुरूआत पहली व 19 नबम्बर की बुवाई के 70 दिनों बाद वरूणा और आरएच 30 में पाया गया। अधिकतम बीज उपज प्राप्त करने के लिए बुवाई का उपयुक्त समय 1 अक्टूबर को बोयी गई वरूणा में 33.8 क्विंटल/हैक्टेयर और आरएच 30 में 32.9 क्विंटल/हैक्टेयर पाया गया।

झांसी में आरएच 406 और वरूणा दोनों किस्मों को साप्ताहिक अतंराल पर आठ अलग–अलग तिथियों में बुवाई की गई। काला धब्बा रोग पहली बार पत्तियों पर 19 नबम्बर में बुवाई के 58 दिनों के बाद और फलियों पर 5 नबम्बर की बुवाई के 62 दिनों के बाद वरूणा में दिखाई दिया। मृदुरोमिल आसिता रोग पहली बार बुवाई के 100 दिनों के बाद 12 नबम्बर को वरूणा और 29 अक्टूबर को आरएच 30 में दिखाई दिया। जबकि सफेद रोली पहली बार बुवाई के 59 दिनों के बाद 19 नबम्बर को वरूणा में दिखाई दिया। चूर्णित आसिता रोग की शुरूआत बुवाई के 70 दिनों के बाद 19 नबम्बर की बुवाई वरूणा में दिखाई दिया। बुन्देलखण्ड क्षेत्र में अधिकतम बीज उपज प्राप्त करने के लिए बुवाई की उपयुक्त समय अक्टूबर का पहला पखवाड़ा है।

राई–सरसों के प्रमुख रोगों के विरूद्ध कवकनाशियों का प्रभाव

नये कवकनाशियों की प्रभावकारिता का परीक्षण शिलौंगनी, श्रीगंगानगर, पंतनगर, हिसार, भरतपुर, झांसी और ढ़ोली केन्द्रों पर किया गया। जाँच के दौरान टेबुकोनाजोल 50 प्रतिशत + ट्राइफ्लोक्सिस्ट्रोबिन 25 प्रतिशत डब्ल्यूजी 0.1 प्रतिशत की दर से कवकनाशी के प्रयोग करने से काला धब्बा रोग की व्यापकता न्यूनतम (19.1 प्रतिशत) पायी गई। हालाँकि सभी कवकनाशी पत्तियों और फलियों दोनों पर काला धब्बा रोग की गंभीरता को कम करने के लिये प्रभावी पाये गये। मेटलेक्सिल 8 प्रतिशत + मैंनकोजेब 64 प्रतिशत का 0.25 प्रतिशत का घोल का प्रयोग करने से सफेद रोली को नियंत्रण (40.2 प्रतिशत) की तुलना में (21.8 प्रतिशत) कम करने में प्रभावी पाया गया। एजोक्सिस्ट्रोबिन के 0.1 प्रतिशत की दर से घोल से प्रयोग करने से चूर्णित आसिता रोग की गंभीरता में (14.7 प्रतिशत) कमी पाई गई, जबकि नियंत्रण में यह 33.9 प्रतिशत थी। प्रोपिकोनाजोल 25 ईसी 0.1 प्रतिशत की दर से और टेबुकोनाजोल 50 प्रतिशत + ट्राइफ्लोक्सिस्ट्रोबिन 25 प्रतिशत डब्ल्यूजी 0.1 प्रतिशत की दर से कवकनाशी के प्रयोग करने से तना गलन रोग की तीव्रता को क्रमशः (18.3 प्रतिशत और 18.8 प्रतिशत) तक कम करने में प्रभावी पाये गये, जो कि नियंत्रण में 27.8 प्रतिशत थी।

कीट विज्ञान

इस वर्ष 2020–21 में कीटों के विकास के लिए मध्यम से उच्चतम तक मौसम उपयुक्त रहा। आरएमएम 19–06,जेएम 14–8,डीआरएमआरआईजे 31, एचयूजेएम 19–11,औआईजे 1034, डीआरएमआरएचजे 2409, आर टीएम 1624 एवं आर टीएम 314 में चैंपा का आक्रमण 1.5 से कम पाया गया।

राई–सरसों की उपज में कीटों के द्वारा अधिकतम हानि पीएम 31, एस.के नगर (42.7 प्रतिशत), आरएच 725 नई दिल्ली में (38.5 प्रतिशत) जबकि लुधियाना में पीएम 31(28.6 प्रतिशत), ढ़ोली में आरएच 725 (22.9 प्रतिशत), हिसार में पीएम 31 (21.5 प्रतिशत), पंतनगर में पीएम 31 (15 प्रतिशत) एवं मुरैना में आरएच 725 (9.3 प्रतिशत) की उपज में कीटों द्वारा अधिकतम हानि पायी गयी।

ज्यादातर केन्द्रों पर मध्यम से अधिकतम 3वें से 13वें सप्ताह तक सार्थक संख्या में चैंपा दिखाई दिया जो कि 7 से 11 वें सप्ताह में अधिकतम बिन्दु पर पाया गया। लुधियाना में दोनों बुवाई में समय से बुवाई और पछेती बुवाई के अन्तर्गत पत्ता गोभी की सूंडी बहुत कम संख्या में पायी गयी। यह दोनों बुवाई में 7–12वें

सप्ताह में सक्रिय पाया गया। चितकबरा कीट हिसार कम से मध्यम संख्या में 43वें से 47वें सप्ताह में सक्रिय तक पाया गया। जबकि मुरैना में यह 47वें से 50वें सप्ताह में सक्रिय तक रहा। परभक्षी कॉक्सीनेला की सक्रियता कम से मध्यम 50वें से 2वें सप्ताह तक रही। शिलौगनी में आरा मक्खी 50वें से 4वें सप्ताह, फ्लो बीटल 49वें से 10वें सप्ताह तक और परभक्षी कॉक्सीनेला 52वें से 14वें सप्ताह तक सक्रियता पायी गयी।

पंखदार चैंपा की संख्या का अवलोकन सात केन्द्रों द्वारा किया गया। लुधियाना में पंखदार चैंपा 43वें सप्ताह में दिखाई दिया। अधिकतर केन्द्रों पर 50वें –1वें सप्ताह से बढ़ना षुरू हुआ जबकि 5वें 11वें सप्ताह में बहुत अधिक संख्या में पंखदार चैंपा दिखाई दिया। एस.के नगर में (3367.8 चैंपा/ट्रेप) 8वें सप्ताह में बहुत अधिक संख्या में पंखदार चैंपा दिखाई दिया। अधिकतर केन्द्रों पर 12वें सप्ताह से कमी षुरू हो गई तथा 15वें सप्ताह के बाद पंखदार चैंपा विलुप्त हो गया।

जैव एकीकृत नाषीजीव प्रबंधन के मॉड्यूल के विभिन्न उपचारों के अन्तर्गत डाईमैथोएट 30 ई.सी./1 मिली/लीटर दर से छिड़काव के उपरान्त इसके दूसरे उपचार जो 10 दिनो बाद किया गया। वह अधिकांश केन्द्रों जैसे नईदिल्ली, शिलौगनी, हिसार,एस.के नगर, पंतनगर, लुधियाना, ढ़ोली और मुरैना में सबसे अधिक प्रभावशाली पाया गया। जबकि दूसरा मुख्य उपचार एजाडाईरिक्टन 3000 पीपीएम 5 एमएल प्रति लीटर की दर से छिड़काव के उपरान्त इसके दूसरे उपचार जो 10 दिनो बाद शिलौगनी और लुधियाना उपयोग किया गया, अधिक प्रभावशाली पाया गया।

नए कीटनाशी परिक्षणों के प्रयोगों में, थायोमैक्साम 25 डब्ल्यू जी 0.2 ग्राम की दर से अधिकतर केन्द्रों पर जैसे नई दिल्ली, हिसार और लुधियाना में सबसे अधिक चैंपा पर प्रभावशाली पाया गया। इन केन्द्रों पर वृद्धिशील लाभ लागत अनुपात क्रमशः 1.82,23.9 और 59.5 पाया गया।

सरसों के साथ दूसरी फसलो बुवाई का चैंपा की संख्या के प्रभाव वाले यह परिक्षण में पाया गया कि अगर सरसों की चार कतारो के बाद धनिये की चार कतारो की बुवाई की जाए तो अकेली सरसों की बुवाई के मुकाबले सरसों के चैंपा की संख्या में कमी दर्ज की जाती है। शिलौगनी, मुंरैना और हिसार में सरसों + धनिये की बुवाई में चैंपा की संख्या सिर्फ सरसों के मुकाबले कम रही जबकि ढ़ोली,पंतनगर में ऐसा सरसों + सौफ की बुवाई पाया गया।

पादप कार्यिकी

विभिन्न कृषि-जलवायु क्षेत्रों से अजैविक तनावों के लिए सरसों के जीनोटाइप का मूल्यांकन करने के लिए पांच प्रयोग किए गए, जबकि छठा प्रयोग तीन स्थानों पर पीजीआर की बारानी परिस्थितियों में प्रभावकारिता का परीक्षण करने के लिए किया गया था। सूखे और तापमान के तनाव को कम करने के लिए रोगाणुओं की प्रभावकारिता का परीक्षण करने के लिए दो प्रयोग तैयार किए गए थे। अंकुर मृत्यु दर 20% और DW/10 अंकुर ≥ 30mg रेटेड जीनोटाइप नियंत्रित परिस्थितियों में सहनशील। अंकुर मृत्यु दर 20% और DW/10 अंकुर ≥ 30mg रेटेड जीनोटाइप नियंत्रित परिस्थितियों में सहनशील। कानपुर और लुधियाना में तीन जीनोटाइप नामत: SVJH-056 RH1999-42 और DRMRCI133 DRMRCI133 (25mg/10 अंकुर) में शुष्क पदार्थ को छोड़कर चयन मानदंडों को पूरा करते हैं। खेत में बोए गए परीक्षण में, RGN229, DRMRHT1712, NPJ-239, SVJH-006, ORM 2019-01, TM188, BAUM09-12-2, DRMRCI133, RH1999-42 और DRMR1188 में अंकुर मृत्यु दर 20% और DW≥3.0g थी। भरतपुर में शुष्क पदार्थ के लिए DRMRCI133 और NPJ-239 को छोड़कर 3 स्थान जो 2.5g था। पीएम 25 और जेडी-6 दोनों जांचों में भरतपुर, कानपुर और लुधियाना में सूखे पदार्थ 2.5 ग्राम के साथ 25% अंकुर मृत्यु दर थी, जो केवल खेत की स्थिति के तहत एसटीआई और एसएसटीआई ≥60% के साथ मध्यम सहनशीलता दर्शाता है। दो जीनोटाइप RH1999-42 और DRMRCI133 प्रयोगशाला और खेत दोनों स्थितियों में अंकुर अवस्था में उच्च तापमान के प्रति सहिष्णु थे। 30 दिनों के लिए छायांकन के कारण हल्का तनाव जीनोटाइप के भीतर और दो स्थानों पर भी परिवर्तनशील सीमा तक शारीरिक और उपज लक्षणों को प्रभावित करता है। शारीरिक लक्षणों और बीज उपज में कम कमी (≤20%) ने हिसार और लुधियाना में RH1676 को कम प्रकाश तनाव के तहत

आशाजनक जीनोटाइप के रूप में पहचाना। ३५ और ६५ डीएएस पर सिंचाई रोककर लगाए गए नमी के दबाव ने ४ स्थानों पर परीक्षण किए गए इकतीस जीनोटाइप के प्रदर्शन को महत्वपूर्ण रूप से प्रभावित किया। कुल मिलाकर, भरतपुर, हिसार और लुधियाना में NPJ210 और DRMR1188 नमी की कमी के प्रति सहनशील थे। भरतपुर, कानपुर और लुधियाना में केवल एक जीनोटाइप DRMRSJ276 को अत्यधिक सहिष्णु का दर्जा दिया गया था, जबकि JC36 3 स्थानों (भरतपुर, हिसार और लुधियाना) में नमी की कमी के प्रति मध्यम रूप से सहिष्णु था। इन जीनोटाइप ने उच्च क्लोरोफिल सामग्री, आरडब्ल्यूसी, एसपीएडी मूल्यों को बनाए रखा और प्रति सिलिका के बीज में कम गिरावट, वाईएसआई-0.5 के साथ बीज वजन। RH0725 (चेक) को बीज उपज में 20% की गिरावट का सामना करना पड़ा और इसे भरतपुर और हिसार में सूखा सहिष्णु दर्जा दिया गया, जबकि RGN229 (चेक) भरतपुर, हिसार, कानपुर और लुधियाना में अत्यधिक सहिष्णु था। तैंतीस सरसों के जीनोटाइप में से, राज विजय सरसों और जेसी-32 को हिसार और लुधियाना में बीज उपज में कमी 30% और स्थिरता सूचकांकों (HSI≥0.45 और YSI ≥0.7.0) के साथ टर्मिनल हीट स्ट्रेस के प्रति सहनशील का दर्जा दिया गया था। झिल्ली स्थिरता, बीज भार, प्रति सिलिका बीज और कूलर कैनोपियों में अवसाद। भरतपुर और लुधियाना में केवल एक जीनोटाइप DRMR2017-27 ने उच्च ताप स्थिरता सूचकांक (HSI-1.3), YSI (≥.0.75) और 30% की SY गिरावट के साथ थर्मो टॉलरेंस दिखाया। BPR543-2 (चेक) को उच्च सूचकांकों (HSI ≥0.74 और YSI≥.0.8) के साथ भरतपुर और लुधियाना में 20% उपज हानि हुई और इसे अत्यधिक सहिष्णु माना गया। अंकुरण प्रतिशत, अंकुर की लंबाई, शुष्क पदार्थ संचय में कम गिरावट (≤20%) के साथ हिसार और लुधियाना में क्रांति और सीएस54 आशाजनक प्रतीत होता है, जबकि अंकुर शक्ति सूचकांक II में केवल लुधियाना में 30% की गिरावट आई है। 3 स्थानों (भरतपुर, हिसार और लुधियाना) में ट्रेहलोस @ 10 एमएम, यूरिया @ 2%, और केएनओ 3 की दोनों सांद्रता के पत्तेदार आवेदन से बारानी परिस्थितियों में बीज उपज में सुधार हुआ। हिसार और लुधियाना में नमी के दबाव के तहत माइक्रोबियल उपचार के साथ फिजियोलॉजिकल और ऑस्मोप्रोटेक्टेंट्स को बढ़ाया गया। कुल मिलाकर, अधिकतम वृद्धि RWC और SPAD के लिए MKS6, CRIDAII और MRD17 के साथ कुल क्लोरोफिल, CRIDAI और MRD 17 के साथ प्रोलाइन और दोनों स्थानों पर Biophos + Biophos और CRIDAI के साथ कुल शर्करा के साथ थी। सामान्य और देर से बोई जाने वाली परिस्थितियों में माइक्रोबियल फॉर्मूलेशन और स्ट्रेस एडेप्टिव कंसोर्टियम (पूसा संजीवनी) के साथ अध्ययन किए गए लक्षणों के लिए तीन किस्मों (आरएच 725, गिरिराज और पीबीआर 357) में भिन्नता मौजूद है। माइक्रोबियल फॉर्म्युलेशन ने भरतपुर में देर से बोई गई 3 किस्मों और पीबीआर357 में केवल पूसा संजीवनी में बीज उपज में वृद्धि की। हिसार और लुधियाना में तीन किस्मों में दोनों टीकों के साथ बीज की उपज में सुधार हुआ।

जैव रसायन

28 आईवीटी/एवीटी गुणवत्ता परीक्षणों का मूल्यांकन भरतपुर, लुधियाना, कानपुर, हिसार, पंतनगर और कांगड़ा में किया गया था। तेल स्थिरता सूचकांक जो कि मुफाःपुफ़ा का अनुपात है 0.60 (आर एच–749) से 2.97 (जी.एस.एच.-2196) (सी.वी. ≤ 0.28) तक थी। सभी प्रविष्टियाँ का विभिन्न वसीय अम्लों के लिए परीक्षण किया गया। पाल्मेटिक एसिडः 1.87% (आर.जी.एन. -73) से लेकर 4.6% (पीडीजेड -12) (सी.वी. ≤ 0.32) तक है। स्टैरिक एसिडः 0.60 % (आर एच–749) से लेकर 2.05% (एल.इ.एस.-63). (सी.वी ≤ 0.69). ओलेइक एसिडः 10.58 % (आर एच–749) से 59.55 % (जी.एस.एच. -2196). (सी.वी. ≤ 0.22); लिनोलेइक एसिडः 17.20 % (क्रांति) से 43.57 % (पीडीजेड -15) (सी.वी. ≤ 0.15); लिनोलेनिक एसिडः 9.04 % (पीडीजेड -1) से 20.69 % (एलइएस -62) (सी.वी. ≤ 0.25); ईकोसोनोइक एसिडः 0.36 % (पीडीजेड -15) से 7.19 % (ओआइजे 5001) (सी. वी. ≤ 1.0); एरुसिक् एसिडः 0.03% (पीडीजेड -1) से 2.10 % (जी.एस.एच -2196) (सी.वी. ≤ 1.20)। ω6ः ω3

अनुपात 1.15 (आर एच–749) से लेकर 4.11 (एलइएस -58) (सी.वी. $\leq$ 0.33) तक है। एस एफ एःमुफाःपुफ़ा अनुपात 1:06:09 (पीडीजेड -15) से 1:29:15 (आर.जी.एन.-73) के बीच है। संतृप्त और असंतृप्त का अनुपात 1:06 से 1:13पाया गया. आईवीटी/एवीटी प्रविष्टियो का पोषकीय परीक्षण किया गया जिसमें कुल प्रोटीनः 30.18% (जे.सी.-36) से 35.21% (पीडीजेड -14) (सी.वी. $\leq$ 0.08) । मेथियोनीनः 1.55 (क्रांति) से 2.10 (आर एच–749) ग्राम प्रति 100 ग्राम प्रोटीन (सी.वी. $\leq$ 0.40)। ट्रिप्टोफैनः 0.95 (पीडीजेड -14) से 1.37 (पीडीजेड -11) ग्राम प्रति 100 ग्राम प्रोटीन (सी.वी. $\leq$ 0.38); कुल एंटीऑक्सीडेंट क्षमता 16.15 (पीडीजेड–1) से लेकर 23.31 (पीएम -29) मिलीग्राम प्रति ग्राम ए.ए.ई. (सी.वी. $\leq$ 0.27); β कैरोटीन की मात्रा 2.50% (पीडीजेड -15) से लेकर 4.83% (क्रांति) (सी.वी. $\leq$ 0.36) दर्ज की गई।

पीडीजेड -15, पीडीजेड -12, पीडीजेड -1, पीडीजेड -11, पीडीजेड -14, ओआइजे 5001, 9आइजे 5001, जी.एस.एच -1699, जे सी -32, जी.एस.एच -2196, जे सी-36, आर सी एच -1, जी.एस.एच -2180 की कुल ग्लूकोसिनॉलेट मात्रा 30 माइक्रोमोल प्रति ग्राम से कम पायी गई। यह 75.36% आर एच (ओई)-706 से 13.71% (जी.एस.एच -2196) (सी.वी. $\leq$ 0.34)पाया गया. 2.25% से कम फाइटिक एसिड केवल पीडीजेड -15, पीडीजेड -12, पीडीजेड -11, आर एच (ओई)-706 (सी.वी. $\leq$ 0.25) में थी।

अग्रिम पंक्ति प्रदर्शन 2020–21

वर्ष 2020–21 में तिलहनों के अग्रिम पंक्ति प्रदर्शन और अन्य संबंधित गतिविधियों की योजना के तहत 33 अखिल भारतीय राई–सरसों समन्वित अनुसंधान परियोजना के केन्द्रों/भारतीय कृषि अनुसंधान परिषद और कृषि विश्वविद्यालय/गैर सरकारी संस्थाओं/एफ.पी.ओ द्वारा 15 राज्यों के 80 जिलों में सिंचित एवं बारानी अवस्था में राई सरसों के 2517, जिसमें राजस्थान में सर्वाधिक 839 एवं उत्तरप्रदेश, मणीपुर, आसाम तथा मध्य प्रदेश में क्रमशः 340, 300, 231, एवं 170 अग्रिम पंक्ति प्रदर्शनो का आयोजन किया गया। इसमें 2068 राई समूह के फसलों पर तथा 449 सरसों समूह की फसलों पर थे। इस वर्ष सभी प्रदर्शन सम्पूर्ण तकनीकी पर आधारित थे, जिन्हें सिंचित (1879) एवं बारानी (638) अवस्था में लगाया गया था।

सिंचित अवस्था में राई–सरसों की अधिकतम औसत पैदावार 2,606 किलोग्राम प्रति हैक्टेयर हरियाणा में प्राप्त हुई। इसके बाद राजस्थान, गुजरात, पंजाब, उत्तरप्रदेश, मध्य प्रदेश, जम्मू एवं कश्मीर, उत्तराखण्ड, हिमाचल प्रदेश, आसाम, महाराष्ट्र, पश्चिम बंगाल, तेलंगाना एवं उडिसा में क्रमशः 2,372; 2,312; 2,203; 2,185; 1,786; 1,450; 1,396; 1,255; 1,252; 1,208; 1,193; 1,192; एवं 957 किलोग्राम प्रति हैक्टेयर औसत पैदावार दर्ज की गई। सम्पूर्ण तकनीकी प्रदर्शनों से उपज में अधिकतम बढोत्तरी 95.9, 58.3, 55.9, 43.8, 41.0, 31.6, 22.7, 20.2, 18.2, 16.8, 15.0, 13.8 एवं 12.7 प्रतिशत क्रमशः जम्मू एवं कश्मीर, आसाम, उडीसा, उत्तरप्रदेश, हिमाचल प्रदेश, तेलंगाना, पश्चिम बंगाल, महाराष्ट्र, हरियाणा, उत्तराखण्ड, मध्य प्रदेश, राजस्थान तथा गुजरात में प्राप्त हुई।

अधिकतम अतिरिक्त शुद्व लाभ 36,132; 33,890; 20,537; 17,758; 17,241; 17,049; 15,600; 13,471; 11,865; 10,030; 7,913; 7,365; 7,216 एवं 6,085 रूपये प्रति हैक्टेयर क्रमशः उत्तरप्रदेश, जम्मू एवं कश्मीर, हरियाणा, राजस्थान, आसाम, तेलंगाना, हिमाचल प्रदेश, मध्य प्रदेश, उडीसा, गुजरात, उत्तराखण्ड, महाराष्ट्र, पंजाब एवं पश्चिम बंगाल, में प्राप्त हुआ। सिंचित अवस्था में राई–सरसों की उत्पादन लागत सबसे कम 19,200 रूपये प्रति हैक्टेयर जम्मू एवं कश्मीर, में तथा अधिकतम 41,672 रूपये प्रति हैक्टेयर हरियाणा में आई।

बारानी अवस्था में राई–सरसों की अधिकतम औसत पैदावार 1,544 किलोग्राम प्रति हैक्टेयर राजस्थान में प्राप्त हुई। इसके बाद, आसाम, उत्तराखण्ड, जम्मू एवं कश्मीर, मणीपुर, हिमाचल प्रदेश एवं उडीसा में क्रमशः 1,227; 1,125; 1,063; 1,014; 1,012 एवं 993 किलोग्राम प्रति हैक्टेयर औसत पैदावार दर्ज की गई। अधिकतम 56.6 प्रतिशत तक उपज में बढोत्तरी आसाम में प्राप्त हुई। उडीसा, हिमाचल प्रदेश, मणीपुर, जम्मू एवं कश्मीर, उत्तराखण्ड तथा राजस्थान में क्रमशः 45.9, 33.9, 26.0, 19.2, 17.2 तथा 12.0 प्रतिशत तक उपज में बढोत्तरी दर्ज की गई। अधिकतम अतिरिक्त औसत शुद्व लाभ 17,612; 10,485; 9,550; 7,398; 7,036; 6,990 एवं 5,943 रूपये प्रति हैक्टेयर, आसाम, हिमाचल प्रदेश, राजस्थान, मणीपुर, उत्तराखण्ड, एवं उडीसा में प्राप्त हुई। असिंचित अवस्था में राई–सरसों की उत्पादन लागत सबसे कम 13,146 रूपये प्रति हैक्टेयर मणीपुर में तथा अधिकतम 28,275 रूपये प्रति हैक्टेयर उडीसा में आई।

सम्पूर्ण तकनीकी प्रदर्शनों में भारतीय राई की 13, पीली सरसों एवं तोरिया प्रत्येक की 3 तथा गोभी सरसों की 2 उन्नत प्रजातियों को 14 राज्यों में सिंचित अवस्था में प्रयोग किया गया। भारतीय राई के प्रदर्शनों में उत्तरप्रदेश, में सिंचित अवस्था में 45 प्रथम पंक्ति प्रदर्शनों में आर. एच. 725 प्रजाति का प्रयोग था जिससे 45.4 प्रतिशत उपज बढोत्तरी के साथ अधिकतम उपज 2,906 किलोग्राम प्रति हैक्टेयर प्राप्त हुई। इसके बाद उत्तरप्रदेश, में ही 11 प्रदर्शनों में प्रदर्शित सी. एस. 60 प्रजाति की औसत पैदावार 2,856 किलो प्रति हैक्टेयर तथा 43.0 प्रतिशत उपज में बढोत्तरी दर्ज की गई। पंजाब में 5 प्रदर्शनों में प्रदर्शित पी. एच. आर. 126 प्रजाति से न्यूनतम 4.3 प्रतिशत उपज बढोत्तरी दर्ज की गई जबकि न्यूनतम औसत पैदावार 957 किलोग्राम प्रति हैक्टेयर उडीसा मे 30 प्रदर्शनों में प्रदर्शित एन. आर. सी. एच. बी. 101 प्रजाति में दर्ज की गई। हालांकि जम्मू एवं कश्मीर में गिर्राज किस्म से सिंचित अवस्था मे किसान की स्थानीय प्रजाति की तुलना में सर्वाधिक 109.6 प्रतिशत तक उपज बढोत्तरी के साथ औसत पैदावार 1,488 किलोग्राम प्रति हैक्टेयर दर्ज की गई।

सिंचित अवस्था मे उत्तरप्रदेश, मे पीली सरसों की पीताम्बरी प्रजाति, हिमाचल प्रदेश में गोभी सरसों की जी. एस. सी 7 प्रजाति एवं आसाम में तोरिया की टी. एस. 38 प्रजाति से उपज में अधिकतम बढोत्तरी क्रमशः 35.38, 41.0 एवं 58.3 प्रतिशत तक प्राप्त हुई।

भारतीय राई के असिंचित अवस्था में राजस्थान में प्रदर्शित आर. जी. एन. 298 प्रजाति से अधिकतम औसत पैदावार 1,747 किलोग्राम प्रति हैक्टेयर के साथ 9.4 प्रतिशत तक उपज में बढोत्तरी दर्ज की गई। मणीपुर में 112 प्रदर्शनों में प्रदर्शित एन. आर. सी. एच. बी. 101 प्रजाति से न्यूनतम औसत पैदावार 1,012 किलोग्राम प्रति हैक्टेयर के साथ 26.8 प्रतिशत तक उपज में बढोत्तरी प्राप्त हुई। हालांकि आसाम में न. आर. सी. एच. बी. 101 किस्म से असिंचित अवस्था मे किसान की स्थानीय प्रजाति की तुलना में सर्वाधिक 64.6 प्रतिशत तक उपज बढोत्तरी के साथ औसत पैदावार 1,213 किलोग्राम प्रति हैक्टेयर दर्ज की गई।

असिंचित अवस्था मे आसाम मे तोरिया की टी. एस. 38 प्रजाति एवं राजस्थान में तारामीरा की आर. टी. एम. 1351 प्रजाति से उपज में अधिकतम बढोत्तरी क्रमशः 58.6 एवं 21.6 प्रतिशत तक प्राप्त हुई।

असिंचित अवस्था मे हिमाचल प्रदेश में गोभी सरसों की जी. एस. सी 7 प्रजाति एवं जम्मू एवं कश्मीर भूरी सरसों की शालीमार सरसों 2 प्रजाति से उपज में बढोत्तरी क्रमशः 33.9 एवं 19.2 प्रतिशत तक प्राप्त हुई।

Summary

Seasonal Conditions

Weather was favourable for rapeseed- mustard crop during the crop season 2020-21. Good rains were received during monsoon in the month of September at almost all the centres. December to January 2021 were the coldest months and temperatures reached below zero degree centigrade during night at Bajaura. Extremely low temperature (-0.9^0c and -0.5^0c) reported at Bajaura centre. Incidence of diseases and pest was very low resulting high production of the crop.

Genetics and Plant Breeding

Varietal Improvement

Sixteen centres, spread over 13 states, carried out the varietal development activities as per the approved technical programme. The salient achievements during the year 2020-21 in toria (*Brassica rapa* var toria), yellow sarson (*B. rapa* var yellow sarson), gobhi sarson (*B. napus*), Indian mustard (*B. juncea*), karan rai (*B. carinata*) and taramira (*Eruca sativa*) are discussed below:

Genetic Resource Management

A total of 5935 accessions comprising toria (757), Indian mustard (4076), *B.rapa* (151) yellow sarson (446), gobhi sarson (233), brown sarson (78), karan rai (82), taramira (33), *B. caudatus* (01), *B. tournifortii* (03), *B. rugosa* (23), *B. nigra* (26),*S. alba* (01), *Crambe sp* (06), *B chinenesis* (02), *B. fruiticulosa* (02), *Camelina sativa* (01), *Capsella bursapastoris* (02), *Diplotaxis assurgens* (01), *Sisimbrium (BMWR)*(01), *Lapidium sp* (02) and 01 each of *B. oxyrrhina, D. muralis, D. siettiana, D. tenuisilique, E. lyratus, E. canariense, D.viminea, D.7omezcampoi* were maintained through appropriate mating system at Bhubneshawar, Dholi, Hisar, Pantnagar, Ludhiana, Kanpur, Sriganganagar, IARI,New Delhi, Jobner, Morena, Chatha-Jammu, Jagdalpur and SK Nagar (Table 2.1.1). In addition, 395 new accessions comprising toria (34), Indian mustard (148), yellow Sarson (116), brown sarson (28), karan rai (35) and *B. rapa* (01), *B. nigra* (05) *B. rugosa* (23) were collected. Further, 1438 accessions consisting of 935 Indian mustard, 89 toria, 250 yellow sarson, 17 gobhi sarson, 41 brown sarson,06 Karan rai, 80 taramira and 23 *B. rugosa* accessions were evaluated. On the basis of germplasm evaluation, promising accessions were identified for seed yield, earliness, yield components, thermo-tolerant (early and terminal stages), resistance/tolerance to diseases/pests and quality traits in toria at Dholi, Chatha-Jammu and Jagdalpur.

Creation of genetic variability through hybridization/ mutagenesis and selection

Creation of variability is the essence and backbone of the breeding programme. To cater the need of diverse agro-climatic conditions of the country, 74 crosses were attempted in toria, 94 in yellow sarson at Pantnagar, Bhubneshwar, Chattha-Jammu, Kalyani, and Morena 127 in gobhi sarson at Chatha- Jammu and Ludhiana and 811 in Indian mustard at Bhubneshwar, Chatha-Jammu, Sriganganagar, Hisar, IARI New Delhi, Ludhiana, Kanpur, Pantnagar, SK Nagar, Morena, Sriganganagar, Jhansi, Kota and Varanasi to improve seed yield, earliness, seed size, component traits, disease/pest resistance, heat tolerance suitable for late sown condition, drought tolerance, "0" and "00" quality characters and high oil content (Table 2.1.2). Selection of superior plants/bulks at different centres was practised in toria, yellow sarson and Indian mustard. In toria, development of composites population after the selection was the main objective. In yellow sarson, hybridization and selection from segregating generations were attempted at Kanpur, Dholi, Bhubneshwar and Pantnagar. However, few centres reported that due to spread of COVID 19 across the region, the single plant selection could not be performed in better way. In Indian mustard, 8692 single plants

were selected at New Delhi, Jhansi, Kanpur, Bhubneshwar, Chathha-Jammu, Pantnagar, Ludhiana, SK Nagar, Jagdalpur, Kota,, Varanasi and Morena. In Indian mustard, about 864 bulks were selected from segregating and advanced generations.

Evaluation of advanced breeding lines

The advanced breeding lines were evaluated under different station/state /preliminary yield trials at various centres have been presented in Table 2.1.3. 69 strains of toria were tested at Kanpur, Chatha-Jammu, Ludhiana and Dholi. The yield superiority in toria was up to 15.29 % over the check (PT-303) at Pantnagar. In yellow sarson, 60 strains were tested at Kanpur, Pantnagar and Dholi. The yield superiority up to 15.84 % over the check Pitambari was recorded at Pantnagar. In Indian mustard, 687 strains were evaluated at 06 centres; Chatha, Hisar, Ludhiana, Pantnagar, Dholi, and Varanasi in 33 trials. Seed yield superiority up to 27.02 % over the check Kranti was recorded at Pantnagar. Nineteen strains at Hisar, 21 strains at Ludhiana and 09 strains at Chatha of gobhi sarson were evaluated for seed yield and its component characters.

Hybrid development

Efforts for hybrid development continued during 2020-21 under "Consortia Research Platform on Hybrids", at four centres including ICAR-DRMR Bharatpur, ICAR-IARI New Delhi, PAU Ludhiana and CCS HAU Hisar. A total of 16 experimental hybrids, including seven from ICAR-DRMR, 04 from PAU, 03 from CCSHAU and 02 from ICAR-IARI were evaluated in different trials of AICRPRM. Twenty experimental hybrids of Indian mustard were evaluated in replicated block design at all four centres. On the basis of mean seed yield over three locations, two hybrids from Hisar; RH 2007 and RH 2008 outyielded the best hybrid check DMH 1 by 11%. Other promising hybrids were DRMRHJ 3720, DRMRHJ 2518, Pusa MH 118, RHH 2004 and RHH 2006, which expressed 5, 5, 4, 6 and 4 percent standard heterosis, respectively. Out of forty two experimental hybrids evaluated in augmented block design, four experimental hybrids; DRMRHJ 508, DRMRHJ 1003, PHR 8037, PHR 8081 and RHH 2013 outyielded the best check hybrid DMH 1 by 13, 11, 6, 10 and 8 percent, respectively. 153 F1 crosses attempted during 2019-20 among the inbreds identified from diverse gene pools were evaluated in augmented block design at all four centres. 27 F_1 crosses were identified for > 10% seed yield heterosis over best check DMH 1 on the basis of average seed yield over three locations. 192 A lines and 89 R lines were maintained. 202 and 141 backcrosses were attempted to advance the generation of A and R lines, espectively. 340 F_1 crosses were generated for next year evaluation to identify heterotic combinations. 70 inbred lines were characterized for agronomic traits and simultaneously genotyped with SSR markers for studying genetic diversity and their delineation into diverse gene pools. 569 experimental hybrids were evaluated in station trials at different centres and heterotic combinations expressing > 15 % heterosis were identified. 88 inbred lines were delineated into three diverse gene pools on the basis of genetic diversity.

Breeder seed production

Indents of 82.93q breeder seed Production of 64 Rapeseed-Mustard varieties were received from Department of Agriculture and Cooperation (DAC), Ministry of Agriculture and Farmers Welfare, Govt. of India for during 2020-21. The allocation was made to 18 centres for the production of breeder seed during 27thannual group meeting held through virtual-video conferencing. Against the indent of 82.93q, 194.35q breeder seed was produced, indicating a surplus availability of 116.44 q. Breeder seed of 02 varieties RVM-1 and TBM-209 of Indian mustard and one variety Jhumka (YSBNC-1) of yellow sarson could not be produced. Further, less quantity of ONK-1 (Him Sarson) of Gobhi Sarson; RVM-2 and RGN-298 of Indian mustard; Uttara (PT-2002-25) of Toria was produced. In addition, 15.29 q breeder seed of 10 varieties was also produced by different centres. The centre and variety wise details of breeder seed production are reported in Table 2.2.

Coordinated Trials

Performance of 165strains including 11 of toria, 08 of yellow sarson and 140 of Indian mustard, 05 of gobhi sarson and 01 of taramira was tested in nineteen performance evaluation trials consisting of toria (1), yellow sarson (1), gobhi sarson (1), taramira (1) and Indian mustard

(16) at 45 locations across the 6 agro-climatic zones of the country. On the basis of superiority for seed/oil yield/ earliness/quality/ resistance over the best check, 20 strains comprising yellow sarson (02), gobhi sarson (01) and Indian mustard (17) were promoted for advanced stage evaluation.

Rapeseed-Mustard strains promoted for advance stage testing on the basis of higher seed/oil yield/quality (2020-21)

Zone I	Zone II	Zone III	Zone IV	Zone V
Yellow Sarson, IVT				
				RMYS 2 (1259,26.3) PYS-2018-12 (1096,9.9)
Early Mustard, IVT, Irrigated				
	PRE-2018-10 (2257,12.3)			
Mustard, Timely Sown, Irrigated, IVT				
	RH 1975 (2834,14.0) RH 1974(2865,15.3)			
Mustard, Timely Sown, Rainfed, IVT				
	DRMR CI 128 ** (2328,5.1)			
Mustard, Timely Sown, Rainfed, AVT I				
	RH 1424 (2578,17.7)			
Mustard, Late Sown, IVT				
		DRMR 2018-19 (1871,2.8)**		
Mustard, Quality, IVT				
	RH(OE) 1807 (2301,9.3) JC 36# (2231,15.4) PDZ-15# (2188,13.2) PDZ-14# (2306,19.3)	JC 36# (2080,18.9) PDZ-15# (2050,17.3) PDZ-14# (2325,33.0) OIJ5001#(2286,30.7)		
Mustard, Quality, AVT I + II				
	LES 60 (2606,10.3) RH(OE) 1706 (2689,19.3)			
Mustard, White Rust Resistance				
	PB (A4A5)-842(2310,7.2) Varuna (A4A5)-936-279 (2569,6.9) Rohini (A4A5)-491 (2053,14.9)	PB (A4A5)-842(2196,2.2) Varuna (A4A5)-936-279 (2323,3.6)		
Saline/ Alkaline AVT I				
CS 2005-143 (2341, 13.4)				
Gobhi Sarson AVT I+II				
AKGS 19-8 (1844, 9.4)				

Figures in parenthesis indicate seed yield (Kg/ha), percent superiority over best check

** promoted on the basis of White rust resistance; # double low strain

Crop Production

Experiments on six major areas of agronomic practices were conducted during 2020-21 at 28 coordinating centres across the five zones. The results are summarised as;

3.1 Long-term fertility experiment on cropping systems involving rapeseed-mustard

Application of 150% NPK recorded markedly higher seed yield of mustard at KHD, LDH, HSR, SGN, DOL, KOT, MOR, SKN, BHU and SHL which was 99.7, 307, 67, 33, 380, 64, 148, 72, 83 and 330% higher over the control, respectively. Whereas, at KNG 100% NPK + 40 kg S/ha and at PNT 100% NPK + FYM @ 2.5 t/ha recorded significantly higher seed yield of mustard which was 209.7 and 184% higher over the control.

3.2 Evaluation of herbicides for weed management in rapeseed – mustard

Pre-emergence application of oxadiargyl 0.045 kg a.i./ha at Ludhiana, fluazifop-p-butyl 0.125 kg a.i./ha at 25-30 DAS at Hisar, quizalofop 0.05 kg a.i./ha at 15-20 DAS at Pantanagar, pendimethalin 1.0 kg a.i./ha at SK Nagar and Bhubneswar increased mustard seed yield by 32, 35, 52, 55 and 66% over the weedy check, respectively. Whereas, the highest weed control efficiency was recorded with the pre-emergence application of oxadiargyl 0.09 kg a.i./ha at Ludhiana, with quizalofop 0.05 kg a.i./ha at Pantanagar and with pendimethalin 1.0 kg a.i./ha at SK Nagar.

3.3 Agronomic evaluation of promising rapeseed-mustard entries

The agronomic evaluation of new entries of quality mustard, gobhi sarson and taramira were performed under different fertility levels during 2020-21.

Quality mustard: PDZ 12 and RCH 1 recorded higher seed yield over the check PDZ 1 at Hisar (4.3 & 11.7%) and Sriganganagar (16.9 & 35.0%). At Ludhiana, the entries PDZ 12, PDZ 11 and RCH 1 recorded higher seed yield by 5.2, 15.6 and 18.6% over the check PDZ 1. Whereas, at New Delhi none of the test entries performed better than check PDZ 1.

Gobhi sarson: The test entry GSH 1699 recorded higher seed yield at Kangra and Dhaula Kuan over the GSL 1 (20.1 & 28.2%), Kranti (80.5 & 188%) and GSC 6 (8.8 & 29.6%), respectively. It also recorded higher seed yield over the Kranti at Chatha (3.4%), GSL 1 at Ludhiana (5.2%), and GSL 1 and Kranti at Bajaura (29.9 & 23.8%), respectively.

Taramira: The test entry RTM 1624 recorded higher seed yield over the checks T 27, RTM 314 and RTM 1351 at Navgaon (14.2, 11.5 & 10.7%), Jobner (15.0, 24.7 & 12.7%), and Diggi (11.7, 27.2 & 13.9%), respectively.

3.4 Developing resource efficient and resilient rapeseed-mustard based cropping systems under current and future climates

Planting of mustard on raised beds recorded markedly higher mustard seed yield over the conventional tillage at Chatha, (5.6%), Kanpur (11.0%), Pantnagar (15.7%) and Morena (20.9%). Also, recorded the highest system productivity at Chatha, Pantnagar and Morena. Among the cropping systems, green gram-mustard system recorded highest seed yield and system productivity at all the locations.

3.5 Enhancing drought and heat tolerance in rapeseed-mustard through microbes

Application of two irrigations recorded highest seed yield compared to no irrigation and one irrigation at all the locations. Seed inoculation with MRD 17 at Morena (18.5%) and Nagpur (22.0%); with Biophos and Biophos^{+} at Bawal (12.3%); with CRIDA MI-I at Sriganganagar (24.6%), Banda (18.9%) and Varanasi (42.8%), with CRIDA MI-II at Chatha (23.3%), Dholi (31.1%), Jobner (18.7%) and SK Nagar (24.9%) significantly increased seed yield over the control.

3.6 Response of macro and micro nutrient bio-fertilizers in enhancing rapeseed-mustard productivity and soil health

Application of 100% RDF significantly recorded higher mustard seed yield at all the locations. The combination of biofertilizers; PSMO + Azotobacter+ KMB + ZSB recorded significantly higher seed yield at Chatha, Sriganganagar, Pantnagar, Morena, Kota, Varanasi, SK Nagar, Bhubneswar, Bawal, Bharatpur, Khudwani and Shillongani. Whereas, ZSB at Kangra, Hisar and Dholi, and KMB at Imphal recorded markedly higher seed yield over the rest of the biofertilizers. Net returns were also increased with the use of biofertilizers at all the locations.

Plant Pathology

Disease Scenario

During 2020-21, moderate to severe occurrence of Alternaria blight and white rust diseases was recorded at different locations. However, low to the moderate severity of downy mildew was recorded from PNT. Powdery mildew severity was moderate to high at SKN and PNT. Low to moderate incidence of Sclerotinia rot was observed at MOR, HSR, LDH, BPR and PNT.

Screening of *Brassica* germplasm and breeding materials

Among 34 AVT-I and AVT-II breeding lines, 9IJ 5001 (Q hybrid), DRMR 2017-16 (*Bj*) and AKMS 19-8, and HNS 0702 (*Bn*) were found resistant to WR under natural condition at five locations. While under artificial condition, DRMR 2017-16, 9IJ 5001 (*Bj*), and AKGS 19-8, HNS 0702, GSH 1699, GSH 2180, GSH 2196 (*Bn*) were found resistant to WR at MOR, HSR and PNT locations. Entries, KMR (E) 19-2, NPJ 230, SKM 1626, DRMR 2017-16, PDZ 12 and 9IJ5001 of *B. juncea* showed resistance to DM at PNT.

Uniform Disease Nursery for major diseases

Among total 38 entries, DRMRQ-1-22, DRMRQ 202, DRMR 2018-25, PMW 18 and PAB 14-7 of *B. juncea* showed resistance reaction to WR under natural conditions with mean disease severity <10%, whereas highest WR severity was on check Rohini was 26.5%.

While, DRMRSJ 25, DRMRQ 202, PAB 14-7, DRMRSJ 21 and DRMRSJ-361 entries were found tolerant to SR with <10% incidence at MOR and SGN under natural condition.

National Disease Nursery (NDN) for Alternaria blight

Among 45 strains, none of the entries were tolerant to AB. However, PMW 18, DRMRSJ 4, DRMR 2018-41, DRMR-2018-37, DRMR 2018-25 and DRMR 18-1 entries of *B. juncea* showed resistant reaction to WR at MOR, PNT, and HSR locations.

National Disease Nursery (NDN) for white rust

Among 59 entries, RH 1700-4, Varuna (A4A5)-936-279, Rohini (A4A5)-491, RJK (A4A5)-21, DRMR 2018-17, DRMR 2018-25 and DRMR 18-37-13 of *B. juncea* showed immune reaction to WR at MOR, PNT, HSR, LDH and BPR locations. While, some of the promising strains sowed resistance to WR with <10% disease severity were DRMRSJ 7, DRMRCI 125, DRMRCT-132, DRMRSJ 4, DRMRSJ 206, DRMRSJ 349, DRMR 18-36-12, DRMR 2018-41, RH 1700, RH 1400, RH 1400-1, RH 1700-1, PWR 13-8, PB(A4A5)-842 and PMW 18 at five locations.

However, DRMR 2018-41 and RH 1400 were found consistently resistant to WR during 2018-19, 2019-20 and 2020-21.

National Disease Nursery (NDN) for Sclerotinia rot

None of the entries of *B. juncea* showed tolerance/ resistance to SR at PNT, HSR and BPR location under artificial conditions.

Screening of IVT entries of Brassica against different diseases

Among total 134 IVT entries, TM 188, ORM 2019-01, 0IJ 1010, DRMRCI 128, 0IJ 1034, JC 36 and 0IJ 5001 of *B. juncea* were resistant to WR at five locations. However, DRMR 2018-19, Rohini (A4A5)-936-279, PB(A4A5)-842, and PJK(A4A5)-21 were showed resistant reaction to WR, Whereas, almost all the entries of *B. rapa* var. Toria and *B. rapa* var. Yellow Sarson, *B. napus* escaped WR infection.

Assessment of yield loss and management of Alternaria blight in rice-fellow-mustard cropping system

Among different treatments, foliar spray of tebuconazole 50% + trifloxistrobin 25% WG @ 0.5g/l followed by iprodion 50WP @ 0.2% were found effective in reducing AB by 54.3 and 52.6 per cent respectively over check with inceased seed yield.

Epidemiology of Alternaria blight, white rust, powdery and downy mildew

Experiment on the epidemiology of foliar diseases of rapeseed-mustard was laid out using cv. Varuna and local cultivar with eight sowing dates at weekly interval starting from Oct 01 to Nov 19 without adopting any protection measures against pest and diseases at seven locations.

PNT

Two cultivars Varuna and Kranti were sown at eight different sowing dates. Downy mildew disease first appeared 8 DAS on Oct 22 sown Varuna and Kranti cultivars. Whereas, the maximum DM severity was between 20 DAS to 23 DAS on both cultivars except in early sowing. White rust disease first appeared 50 DAS on Oct 22, Oct 29 and Nov 12 sown crop which was 12 days late than last year. Alternaria blight disease was first appeared 50 DAS on Oct 22 on both the cultivars. While, on Oct 01 sown crop, the disease appeared 56 DAS. AB on pods appeared 83 DAS on late (Nov 19) sown crop which is 5-days early than preceding year. On early (Oct 01) sown crop, the symptoms on pod appeared late after 122 days of sowing.

SHL

An experiment was laid out with cvs. Varuna and TM 2. The crop was sown with 4 dates of sowing started from Oct 29 to Nov. 19 at weekly intervals as the rainfall doesn't allow early sowing dates. ABL was first observed at 35 DAS in Nov 19 sown TM 2 which was 6-days early than preceding year. While, ABP appeared at 83 DAS in Nov 19 sown TM 2 which was appeared 95 DAS on Oct 29 sown Varuna. Maximum disease severity was at 120 DAS (26.8%) in Nov 12 on cv TM 2 which was 12% less than previous year. Maximum seed yield was achieved in Oct 29 sown cv Varuna (18.7 q/ha) and 12.7 q/ha of TM 2 (Oct 29). Yield data revealed that ideal sowing time of crop in the region is last week of October.

SKN

Experiment was laid out with cvs. Varuna and GM 2 at weekly intervals. Powdery mildew disease first appeared at 89 DAS instead of 78 DAS, 83 DAS, 76 DAS during 2019-20, 2018-19, 2017-18 respectively, on Nov 19 sown crop of Varuna and GM 2. The maximum disease severity was observed in Nov 19 sown cv Varuna (97.0%) and GM 2 (90.5%). The maximum seed yield reduction due to disease was observed in late sown crop. Although, highest yield was observed in Oct 01 sown GM 2 (16.6 q/ha) and Varuna (15.7 q/ha).

MOR

Experiment was laid out with cvs. Varuna and Rohini with eight dates of sowing at weekly intervals. AB on leaf first appeared 47 DAS in Nov 19 sown Varuna and Rohini. Whereas, AB on silique appeared at 90 DAS on same plots. PM was appeared first at 80 DAS which was maximum 51.8 % reported on cv. Rohini at 130 DAS in Nov 19 sown crop. WR appeared first 40 DAS in Nov

19 sown Rohini and progressed till 120 DAS in Nov 05 and Nov 12 sown crop. WR disease severity was maximum upto 44.9% in Nov 05 sown crop on both cultivars. While, maximum staghead incidence (40.2%) was observed in Nov 12 sown Rohini. The maximum yield (34.0 q/ha) was recorded in Oct 15 sown Rohini and 32.9 q/ha in Varuna.

JAG

Experiment was conducted with cvs. Varuna and CG Sarson with 8 dates of sowing at weekly interval using recommended agronomic practices. WR first appeared at 50 DAS in Nov 12 and Nov 19 sown on both cultivars sown. Initiation of AB was reported at 40 DAS in Nov 12 sown Varuna and CG Sarson in both Nov 12 and Nov 19 sown dates. PM was appeared first at 90 DAS on both cultivars in Nov 12 and Nov 19 sown crop. Optimum date of sowing for obtaining maximum seed yield seems between Oct 01 to Oct 15 sown crop.

DOL

Experiment was laid out with cvs. Varuna and Rajendra Suflam sown with 8 dates of sowing at weekly intervals. AB first observed at 62 DAS and 76 DAS on Varuna and Rajendra Suflam respectively in Oct 01 sown. The disease continued to progress on leaves up to 140 DAS on both the cultivars.

HSR

Experiment was conducted with cvs. Varuna and RH 30 with 8 dates of sowing at weekly interval using recommended agronomic practices. WR first appeared at 36 DAS in Nov 12 and Nov 19 sown RH 30 which was further spread in Nov 12, Oct 29 sown crop. Staghead formation was observed first at 68 DAS on RH 30 sown on Oct 15. AB on leaves was appeared at 89 DAS in Oct 08, Nov 19 sown Varuna and RH 30 cultivars. SR disease initiation was observed first at 70 DAS in Nov 19 sown Varuna and RH 30. Optimum date of sowing for obtaining maximum seed yield 33.8 q/ha of Varuna and 32.9 q/ha of RH 30 was Oct 01 sown crop.

JHS

Experiment was conducted using RH 406 and Varuna cultivars with 8 sowing dates at weekly interval. AB appeared first on leaves at 58 DAS in Nov 19 and seen on pods at 62 DAS in Nov 05 sown Varuna. DM first appeared at 10DAS in Nov 12 sown Varuna and Oct 29 sown RH 406, while WR appeared first at 59 DAS in Nov 19 sown Varuna. PM initiated at 70 DAS in Nov 19 sown Varuna. Optimum time of sowing in the Bundelkhand region for obtaining higher seed yield is first fortnight of Oct.

Efficacy of fungicides against major rapeseed-mustard diseases

Efficacy of newer fungicides was tested at SHL, SGN, PNT, HSR, BPR, JHS and DOL. AB severity was found minimum (19.1%) in Tebuconazole 50% + Trifloxostrobin 25% WG @ 0.1% over check (34.5%). However, all fungicides were found effective for reduction of AB severity both on leaves and pods. While, white rust severity was reduced (21.8%) by metalaxyl 4% + mancozeb 64% @ 0.25% over check (40.3%). PM severity was minimum (14.7%) in Azoxystrobin @ 0.1% over check (33.9%). Both Propiconazole 25% EC @ 0.1% and Tebuconazole 50% + Trifloxostrobin 25% WG @ 0.1% were found effective in reducing SR incidence (18.3% and 18.8% respectively) over check (27.8%).

Entomology

The crop season 2020-21 witnessed moderate to high population development of mustard aphid on different Brassica species. Strain RMM-19-06, JM 14-8, DRMRIJ 31, HUJM-19-11, OIJ1034, DRMRHJ 2409, RTM 1624 and RTM 314 were found promising as these recorded AII <1.5.

The highest yield losses were observed in PM 31 at SK Nagar (42.7%), while at NDH RH 725 suffered 38.5% yield loss due to insect-pests. At LDH, PM 31 suffered 28.6% loss followed by 22.9% in RH 725 at DHO, 21.5% in PM 31 at HSR, 15.0% in PM 31 at PTN and 9.3% in RH 725 at MOR.

Moderate to high population of mustard aphid was reported at most of the centres from 2nd to 13th standard week with peak during 7th to 11th standard week. Very low activity of cabbage caterpillar was recorded both under timely and late sown conditions at LDH. It remained active from 7th-12th standard week under both timely and late sown conditions. Low to moderate population of painted bug was observed from 43rd-47th standard week at HSR, while at MOR, it remained active from 47th-50th standard week. The activity of coccenellid predators was low to moderate during 50th - 2nd standard week. At SHL, sawfly observed during 50th- 4th std. week, flea beetle 49th-10 std. week and coccinellid predators during 52nd-14th std. week.

The alate aphid population was recorded by seven centres. Alate aphid appeared as early as 43rd week at LDH. It started increasing at most of the centres from 50th-1st std. week and reached its peak from 5th-11th std week. The highest peak (3367.8 aphids/ trap) was recorded from SKN during 8th std. week. After 12th std. week a general trend of decline in aphid population was observed which disappeared from most of centres after 15th standard week.

Among bio-intensive IPM module treatments, treatment of dimethoate 30 EC @ 2 ml/l followed by its second application after 10 days was found effective at most of the centres i.e. NDH, SHL, HSR, SK Nagar, PTN, LDH, DHO and MOR. The second best treatment was the spray of Azadirachtin 3000 ppm @ 5 ml/l followed by second spray after 10 days at SHL and LDH. Among the newer insecticides tested, thiamethoxam 25 WG @ 0.2 g/l resulted in maximum control of mustard aphid at most of the centres i.e. NDH, HSR and LDH. The respective IBCR at these centres was 1.82, 23.9 and 59.5.

Effect of plant diversity of aphid population revealed that sowing of 4 rows of coriander after every 4 rows of mustard resulted in significant reduction in mustard aphid population than mustard alone. At SHL, MOR and HSR sowing of mustard+coriander resulted in significantly low population build up of mustard aphid than mustard alone while the similar results were reported for mustard+fennel sowing at DHO and PTN.

Plant Physiology

Five experiments were conducted to evaluate mustard genotypes from different agro-climatic zones to abiotic stresses while sixth experiment was conducted at three locations to test the efficacy of PGR's under rainfed conditions. Two experiments were formulated to test the efficacy of microbes to mitigate drought and temperature stress. Seedling mortality ≤20% and DW/10 seedlings ≥ 30mg rated genotypes tolerant under controlled conditions. Three genotypes namely SVJH-056 RH1999-42 and DRMRCI133 at Kanpur and Ludhiana met the selection criteria except for dry matter in DRMRCI133 (25mg/10seedlings). In the field sown trial, RGN229, DRMRHT1712, NPJ-239, SVJH-006, ORM 2019-01, TM188, BAUM09-12-2 , DRMRCI133, RH1999-42 and DRMR1188 had seedling mortality ≤20% and DW≥3.0g at 3 locations except for DRMRCI133 and NPJ-239 for dry matter at Bharatpur which was ≥2.5g. Both the checks PM 25 and JD-6 had seedling mortality ≤25% with dry matter ≥2.5g at Bharatpur, Kanpur and Ludhiana indicating moderate tolerance with STI and SSTI ≥60% under field condition only. Two genotypes RH1999-42 and DRMRCI133 were tolerant to high temperature at seedling stage both under laboratory and field conditions. Light stress due to shading for 30 days impaired physiological and yield traits to variable extent within the genotypes and also at two locations. Lesser reduction in the physiological traits and seed yield (≤20%) identified RH1676 at Hisar and Ludhiana as promising genotypes under low light stress. Moisture stress imposed by

withholding irrigations at 35 and 65 DAS significantly affected the performance of thirty-one genotypes tested at 4 locations. Overall, NPJ210 and DRMR1188 at Bharatpur, Hisar and Ludhiana were tolerant to moisture stress. Only one genotype DRMRSJ276 was rated highly tolerant at Bharatpur, Kanpur and Ludhiana whereas JC36 moderately tolerant at 3 locations (Bharatpur, Hisar and Ludhiana) to moisture stress. These genotypes maintained higher chlorophyll content, RWC, SPAD values and lesser decline in seeds per siliqua, seed weight with YSI≥0.5. RH0725 (check) suffered decline in seed yield ≤20 % and was rated drought tolerant at Bharatpur and Hisar only whereas RGN229 (check) was highly tolerant at Bharatpur, Hisar, Kanpur and Ludhiana. Out of thirty-three mustard genotypes, Raj Vijay Mustard and JC-32 were rated tolerant to terminal heat stress with seed yield reduction ≤30% and stability indices (HSI≥0.45 and YSI ≥0.7.0) at Hisar and Ludhiana with relatively lesser depression in membrane stability, seed weight, seeds per siliqua and cooler canopies. Only one genotype DRMR2017-27 at Bharatpur and Ludhiana showed thermo tolerance along with high heat stability index (HSI≥1.3), YSI (≥.0.75) and SY decline of ≤30%. BPR543-2 (check) suffered ≤20% yield loss at Bharatpur and Ludhiana with high indices (HSI ≥0.74 and YSI≥.0.8) and was considered highly tolerant. Kranti and CS54 seems promising at Hisar and Ludhiana for salinity tolerance with lesser decline (≤20%) in germination percentage, seedling length, dry matter accumulation while seedling vigour index II declined by ≤30% at Ludhiana only. Foliar application of trehalose @10mM, urea @2%, and both the concentrations of KNO_3 at 3 locations (Bharatpur, Hisar and Ludhiana) improved seed yield under rainfed conditions. Physiological and osmoprotectants enhanced with the microbial treatments under moisture stress at Hisar and Ludhiana. Overall, maximum increase was with MKS6 for RWC and SPAD, total chlorophyll with CRIDAII and MRD17, proline with CRIDAI and MRD 17and total sugars with Biophos +Biophos and CRIDAI at both the locations. Variation exist in the three varieties (RH725, Giriraj and PBR357) for the studied traits with microbial formulation and stress adaptive consortium (Pusa Sanjeevni) under normal and late sown conditions. Microbial formulation enhanced seed yield in the late planted 3 varieties at Bharatpur and only Pusa Sanjeevani in PBR357. Seed yield improved with both the inoculations in the three varieties at Hisar and Ludhiana.

Biochemistry

IVT/AVT entries in quality trials were evaluated at Bharatpur, Kanpur, Kangra, Pantnagar, Hisar and Ludhiana. Among the 27 genotypes (including 4 special entries from ICAR-DRMR) analyzed, oil stability index ranged from 0.60 (RH-749) to 2.97 (GSH-2196) (CV ≤ 0.28). Entries were also analyzed for fatty acid profile. Palmitic acid ranged from 1.87% (RGN-73) to 4.6% (PDZ-12) (CV ≤ 0.32); Stearic acid: 0.60 % (RH-749) to 2.05% (LES-63). (CV ≤ 0.69). Oleic acid: 10.58 % (RH-749) to 59.55 % (GSH-2196). (CV ≤ 0.22); Linoleic acid: 17.20 % (Kranti) to 43.57 % (PDZ-15) (CV ≤ 0.15); Linolenic acid: 9.04 % (PDZ-1) to 20.69 % (LES-62) (CV ≤ 0.25); Eicosanoic acid: 0.36 % (PDZ-15) to 7.19 % (OIJ5001) (CV ≤ 1.0); Erucic acid: 0.03% (PDZ-1) to 2.10 % (GSH-2196) (CV ≤ 1.20); ω6: ω3 ratio ranged from 1.15 (RH-749) to 4.11 (LES-58) (CV ≤ 0.33); SFA: MUFA: PUFA ratio ranged between 1:06:09 (PDZ-15) to 1:29:15 (RGN-73). Saturated and unsaturated ratio ranged between 1:06 to 1:13. Nutritional Profiling of IVT/AVT entries of quality trials were observed. Total protein ranged from 30.18% (JC-36) to 35.21% (PDZ-14) (CV ≤ 0.08); Methionine: 1.55 (Kranti) to 2.10 (RH-749) g/100g protein (CV ≤ 0.40); Tryptophan: 0.95 (PDZ-14) to 1.37 (PDZ-11) g/100g protein (CV ≤ 0.38); Total antioxidant capacity ranged from 16.15 (PDZ-1) to 23.31 (PM-29) mg/g AAE (CV ≤ 0.27); β-carotene ranged from 2.50% (PDZ-15) to 4.83% (Kranti) (CV ≤ 0.36). Estimation of anti-nutritional factors in quality breeding materials includes total glucosinolate content and phytic acid analysis. Total Glucosinolate mean values for five centres (Bharatpur, Pantnagar, Ludhiana, Kangra, Hisar) were <30 µmol/g in genotypes PDZ-15, PDZ-12, PDZ-1, PDZ-11, PDZ-14, OIJ5001, 91J5001, GSH-1699, JC-32, GSH-2196, JC-36, RCH-1, GSH-2180. It ranged from 75.36% (RH (OE)-706) to 13.71% (GSH-2196) (CV ≤ 0.34). Phytic acid content mean values were < 2.25% in PDZ-15, PDZ-12, PDZ-11, and RH (OE)-706 (CV ≤ 0.25).

Frontline demonstrations 2020-21

Under the scheme "Frontline demonstrations and other related activities of Oilseeds" 33 cooperating centres of AICRPRM/ ICAR institutes/ Ag. Universities/NGOs/FPOs conducted 2517 frontline demonstrations (FLDs) on rapeseed-mustard in 80 districts across 15 states during 2020-21. Rajasthan had maximum (839) followed by Uttar Pradesh (340), Manipur (300), Assam (231), and Madhya Pradesh (170) FLDs. 449 FLDs were conducted on rapeseed and 2068 on mustard. All the demonstrations were conducted under whole package demonstrations in two different situations viz., irrigated (1879) and rainfed (638).

The maximum average yield of 2,606 kg/ha from the IP under irrigated conditions was in Haryana followed by 2,372 kg/ha in Rajasthan; 2,312 kg/ha in Gujarat; 2,203 kg/ha in Punjab, 2,185 kg/ha in Uttar Pradesh; 1,786 kg/ha in Madhya Pradesh; 1,450 kg/ha in Jammu & Kashmir; 1,396 kg/ha in Uttarakhand; 1,255 kg/ha in Himachal Pradesh; 1,252 kg/ha in Assam; 1,208 kg/ha in Maharashtra; 1,193 kg/ha in West Bengal; 1,192% in Telangana and 957 kg/ha in Odisha. The maximum yield gap of 95.9% was recorded in Jammu & Kashmir followed by 58.3% in Assam; 55.9% in Odisha; 43.8% in Uttar Pradesh; 41.0% in Himachal Pradesh; 31.6% in Telangana, 22.7% in West Bengal; 20.2% in Maharashtra; 18.2% in Haryana; 16.8% in Uttarakhand; 15.0% in Madhya Pradesh; 13.8% in Rajasthan; and 12.7% in Gujarat. The maximum ANMR/ha were Rs 36,132; Rs 33,890; Rs. 20,537; Rs. 17,758; Rs. 17,241; Rs. 17,049; Rs. 15,600; Rs. 13,471; Rs. 11,865; Rs. 10,030; Rs.7,913; Rs. 7,365; Rs. 7,216 and Rs. 6,085 in Uttar Pradesh, Jammu & Kashmir, Haryana, Rajasthan, Assam, Telangana, Himachal Pradesh, Madhya Pradesh; Odisha, Gujarat, Uttarakhand, Maharashtra, Punjab and West Bengal, respectively. The cost of cultivation ranged from Rs. 19,200/ha in Jammu & Kashmir to Rs. 41,672 /ha in Haryana in IP under irrigated Whole package demonstrations.

The maximum average yield of 1,544 kg/ha from the IP of WP under rainfed conditions was in Rajasthan followed by 1,227 kg/ha in Assam; 1,125 kg/ha in Uttarakhand; 1,063 kg/ha in Jammu & Kashmir; 1,014 kg/ha in Manipur; 1,012 kg/ha in Himachal Pradesh and 693 kg/ha in Odisha. The maximum yield gap of 56.6% was recorded in Assam followed by 45.9% in Odisha; 33.9% in Himachal Pradesh; 26.0% in Manipur; 19.2% in Jammu & Kashmir; 17.2% in Uttarakhand and 12.0% in Rajasthan. The maximum ANMR/ha were Rs 17,662; Rs 10,485; Rs 9,550; Rs 7,398; Rs. 7,036; Rs 6,990 and Rs. 5,943 in Assam, Himachal Pradesh, Rajasthan, Manipur, Uttarakhand and Odisha, respectively. The cost of cultivation ranged from Rs. 13,146/ha in Manipur to Rs. 28,275/ha in Odisha in IP under rainfed Whole package demonstrations.

A total of 13 improved varieties of Indian mustard, 3 each of yellow sarson and toria and 2 of gobhi sarson were used in WP covering 14 states under irrigated condition. Under irrigated condition, improved variety RH 725 demonstrated in 45 FLDs in Uttar Pradesh recorded highest average yield of 2,906 kg/ha with a yield improvement of 45.4% over local (FP) practice followed by CS 60 demonstrated in 11 FLDs in Uttar Pradesh with average seed yield of 2,856 kg/ha with yield improvement 43.0%. The minimum yield improvement of 4.3% was reported from PHR 126 variety from 5 FLDs in Punjab, while minimum average seed yield of 957 kg/ha was reported from NRCHB 101 variety from 30 FLDs in Odisha. However, the variety Giriraj in Jammu & Kashmir under irrigated condition recorded highest yield improvement of 109.6% with average seed yield of 1,488 kg/ha.

The maximum yield improvement of 35.3% from Pitambari variety of yellow sarson in Uttar Pradesh, 41.0 % from GSC 7 variety of gobhi sarson in Himachal Pradesh, 58.3% from TS 38 variety of toria in Assam were recorded under irrigated condition.

Under rainfed condition, the demonstrations with RGN 298 recorded a highest average seed yield of 1,747 kg/ha with yield improvement of 9.4% in Rajasthan under rainfed situation. In Manipur, 112 demonstrations with NRCHB 101 recorded lowest average seed yield of 1,012 kg/ha with yield improvement of 26.8% over FP. However, the variety NRCHB-101 in Assam under rainfed condition recorded highest yield improvement of 64.6% with average seed yield of 1,213 kg/ha.

The maximum yield improvement of 58.6% from TS 38 variety of toria in Assam and 21.6 % from RTM 1351 of taramira in Rajasthan were recorded under rainfed condition.

The yield improvement of 33.9% from GSC 7 variety of gobhi sarson in Himachal Pradesh, 19.2 % from Shalimar sarson 2 variety of brown sarson in Jammu & Kashmir were recorded under rainfed condition.

Monitoring Report

Monitoring of different AICRP-RM centres was undertaken by the scientists of respective centre themselves due to covid 19 pandemic. Each centre was asked to submit monitoring reports in prescribed performa. Salient points from each report are given below :

Centre wise salient observations

Zone I

KNG

Excellent experiments were conducted and crop expression was good.

Zone II

CHT

Trials were properly managed.

Zone III

BPR

All the allotted trials were very well conducted as per the technical programme and expression of crop was very good.

VAR

Trials were conducted as per the technical programme and properly managed.

KPR

Trial was well executed and properly managed.

DOL

Trials were well managed but need to take care weeds, Cannabis infestation was high.

ZONE IV

SKN

Entry MCN 20-21 in IVT (T.S) Irrigated mustard experiment was not germinated in all the three replications.

NGP

All trials in were good condition.

1. Seasonal Conditions

Weather was favorable for the mustard crop during the crop season 2020-21. Good rains were received during monsoon in the month of September at almost all the locations.

Zone I

The extremely low temperature -0.9 and -0.5°Cwas reported at Bajaura center in the month of December, 2020 and January, 2021 whereas maximum temperature ranged from 16.7 to 34.6°C. Good amount ofprecipitation was received from October to April 2020-21 at Bajaura center.

Table: 1.1 Weather conditions during crop season in Zone I

Location	Sep. 20	Oct. 20	Nov. 20	Dec. 20	Jan. 21	Feb. 21	Mar. 21	Apr. 21
Max. Temp. (°C)								
BJR	32.9	30.7	21.6	18.7	16.9	22.1	24.5	25.8
KNG	34.6	32.7	24.9	21.2	20.7	24.2	28.8	29.6
Min. Temp. (°C)								
BJR	16.9	10.2	2.2	-0.9	-0.5	2.5	5.5	6.1
KNG	22.2	17.9	9.9	4.7	4.1	6.2	10.0	12.2
Rainfall (mm) (rainy days)								
BJR	147.0 (13)	NIL	55.6 (5)	14.0 (2)	21.5 (3)	17.7(3)	57.5 (9)	151.2(11)
KNG	30.6(3)	NIL	36.0(3)	33.0(3)	NIL	8.0(2)	6.4(2)	76.7(7)
Max. R.H. (%)								
BJR	84.0	85.0	88.0	90.0	91.0	88.0	89.0	86.0
KNG	84.0	79.0	77.0	84.0	85.0	78.0	84.0	79.0
Min. R.H. (%)								
BJR	45.0	39.0	44.0	29.0	33.0	36.0	35.0	42.0
KNG	69.0	71.0	68.0	72.0	68.0	70.0	64.0	75.0

Zone II

The mean maximum temperature varied from 16.5^0C (Ludhiana) in January,2021 to 38.3^0C (Bawal) in the month of April, 2021. The minimum temperature 3.6^0C reported by Ludhiana center during the month of January, 2021.Good rains were received during crop season at all the centers.High morning humidity was observed at Bawal (94.3%) in the month of January, 2021.

Table: 1.2 Weather conditions during crop season in Zone III

Location	Sep. 20	Oct. 20	Nov. 20	Dec. 20	Jan. 21	Feb. 21	Mar. 21	Apr. 21
Max. Temp. (°C)								
BAW	-	35.9	27.7	21.8	18.3	26.1	32.8	38.3
SGN	37.9	34.7	26.9	21.1	19.0	27.9	31.4	35.9
LDH	33.7	29.4	22.1	16.7	16.5	23.1	27.1	28.7
CHT	34.4	32.2	24.4	18.8	17.5	22.9	28.1	32.4
NDH	35.6	33.9	26.9	22.4	18.0	26.4	32.0	-
Min. Temp. (°C)								
BAW	-	15.6	9.0	6.3	6.0	6.8	14.2	16.8
SGN	24.3	13.7	8.4	4.7	4.4	7.7	13.7	15.4
LDH	20.9	13.6	6.9	3.8	3.6	7.8	12.6	16.4
CHT	24.6	15.2	9.2	6.0	6.6	9.5	12.3	14.3

NDH	24.3	16.6	10.0	6.2	6.0	8.7	15.0	-
Rainfall (mm) (rainy days)								
BAW	-	NIL	1.4	NIL	33.4(3)	NIL	33.8(2)	3.5 (1)
SGN	5.2 (1)	1.0 (1)	1.0 (1)	2.8 (1)	8.9 (2)	NIL	6.8 (1)	4.8 (1)
LDH	69.7 (3)	NIL	75.0 (1)	9 (1)	40.2 (2)	NIL	180.0(2)	435(5)
CHT	19.0 (1)	NIL	35.8 (2)	37.2 (2)	92.0 (50	NIL	18.8 (1)	22.2 (2)
NDH	9.8 (3)	NIL	3.2 (1)	NIL	65.7 (5)	7.0 (2)	0.3 (1)	-
Max. R.H. (%)								
BAW	-	69.5	79.4	85.5	94.3	92.8	71.4	44.8
SGN	80.3	81.4	80.4	88.0	86.3	82.0	80.6	63.2
LDH	71.9	73.7	79.4	80.2	79.3	80.0	74.3	59.1
CHT	84.0	85.0	90.0	94.0	94.0	91.0	81.0	60.0
NDH	85.6	82.7	82.7	89.3	90.7	88.6	80.4	-
Min. R.H. (%)								
BAW	-	16.8	37.4	38.3	57.8	35.5	24.6	11.5
SGN	49.4	36.1	53.3	65.6	64.5	53.0	39.0	24.2
LDH	51.4	38.1	44.4	53.7	61.7	52.5	41.8	35.4
CHT	56.0	36.0	49.0	64.0	70.0	56.0	45.0	27.0
NDH	58.5	37.0	35.5	48.1	62.6	37.7	34.8	-
Sunshine (hours/day)								
BAW	-	8.0	5.6	5.9	4.3	7.5	5.7	8.1
SGN	5.0	3.6	1.6	1.2	-	-	-	-
CHT	7.5	8.4	5.4	3.5	4.0	5.1	5.7	7.1
NDH	7.1	6.9	3.9	5.4	2.9	6.9	6.4	-

Zone III

Meager rains were received during crop season inKota and Varanasi. Maximum temperature ranged from 18.4^{0}C at Pantnagar in January, 2021 to 38.6^{0}C at Bharatpur in April 2021. The minimum temperature ranged from 7.0^{0}C to 26.6^{0}C during the crop season. Dholi centerr eported 100% morning humidity during December, 2020 and January,2021.

Table: 1.3 Weather conditions during crop season in Zone III

Location	Sep. 20	Oct. 20	Nov. 20	Dec. 20	Jan. 21	Feb. 21	Mar. 21	Apr. 21
Max. Temp. (°C)								
PNT	33.7	33.1	27.2	21.1	18.4	25.2	30.5	34.4
KPR	34.5	34.2	27.5	23.4	20.3	27.3	33.2	38.5
BPR	35.8	34.8	26.8	22.8	19.2	27.6	34.0	38.6
KOT	-	34.7	31.2	26.7	23.7	28.3	35.0	-
DOL	31.7	33.2	28.7	22.5	19.4	25.6	32.1	-
MOR	35.0	35.0	28.9	23.9	22.8	30.2	35.1	-
VAR	-	31.4	26.8	23.6	21.3	28.2	33.9	37.1
SBR	32.9	33.8	30.5	23.6	21.6	25.5	32.4	36.4
Min. Temp. (°C)								
PNT	24.7	17.3	10.5	7.0	8.4	8.9	13.2	15.4
KPR	26.6	19.4	12.3	8.7	8.3	10.9	17.1	19.8

BPR	26.2	19.0	11.6	7.6	6.6	8.8	16.1	19.8
KOT	-	19.7	14.5	10.1	7.7	11.1	13.8	-
DOL	25.2	23.7	14.5	9.9	9.5	10.5	16.0	-
MOR	26.0	18.2	11.5	9.1	7.5	12.0	14.9	-
VAR	-	18.9	13.9	10.5	10.0	13.1	18.3	20.4
SBR	25.7	22.6	15.4	10.8	11.0	12.7	19.2	24.4
Rainfall (mm) (rainydays)								
PNT	56.3 (4)	NIL	NIL	2.5 (1)	18.6(2)	4.6 (1)	NIL	4.1 (1)
KPR	62.6 (6)	NIL	38.4(1)	NIL	0.3(0)	4.8 (1)	0.6(4)	10.8 (1)
BPR	100.8(3)	NIL	18.2 (2)	NIL	16.6 (3)	2.3 (1)	1.0 (1)	8.9 (2)
KOT	-	NIL	NIL	17.2	57.0 (4)	NIL	7.0 (1)	-
DOL	259.4(12)	NIL	NIL	NIL	NIL	NIL	NIL	-
MOR	25.0(1)	NIL	18.0(1)	NIL	8.0(1)	NIL	10.0(1)	-
VAR	-	16.2	3.3	0.9	NIL	0.2	NIL	NIL
SBR	238.0 (18)	20.8(2)	NIL	NIL	NIL	NIL	0.4(1)	NIL
Max. R.H. (%)								
PNT	90.0	87.0	92.0	95.0	96.0	92.0	85.0	58.0
KPR	85.0	85.0	85.0	89.0	92.0	86.0	71.0	42.0
BPR	89.5	83.6	84.7	88.6	90.1	86.9	75.1	66.7
KOT	-	77.9	88.7	85.5	92.6	81.3	80.2	-
DOL	96.8	98.3	99.9	100.0	100.0	99.9	99.1	-
MOR	71.5	53.0	53.5	64.3	59.4	69.3	48.2	-
VAR	-	84.0	90.5	92.8	93.6	86.3	78.0	64.0
SBR	81.2	85.5	85.5	89.3	94.2	89.3	82.2	78.0
Min. R.H. (%)								
PNT	63.0	46.0	39.0	58.0	69.0	48.0	35.0	15.0
KPR	60.0	36.0	38.0	42.0	59.0	38.0	31.0	14.0
BPR	78.4	67.2	63.2	66.3	76.4	60.8	39.0	45.1
KOT	-	77.0	68.6	66.4	71.5	61.9	46.5	-
DOL	80.6	76.5	92.1	91.2	89.5	91.1	81.1	-
BND	-	-	-	-	-	-	-	-
MOR	54.0	38.8	40.2	52.3	39.8	38.8	35.1	-
VAR	-	51.0	48.3	56.3	59.0	40.5	34.5	27.7
SBR	68.8	75.0	74.4	76.4	78.8	65.0	55.3	59.4
Sunshine (hours/day)								
PNT	7.4	8.0	6.4	4.8	3.2	6.2	7.8	8.8
KPR	2.0	4.8	4.8	3.2	1.8	6.2	6.7	8.6
BPR	4.1	6.7	3.3	3.4	4.5	8.2	7.1	7.8
KOT	-	7.7	2.0	1.6	6.3	9.2	8.4	-
DOL	-	-	-	-	-	-	-	-
BND	-	-	-	-	-	-	-	-
MOR	-	-	-	-	-	-	-	-
VAR	-	-	-	-	-	-	-	-
SBR	4.3	4.0	3.3	2.6	2.1	4.0	5.5	6.8

Zone IV

The maximum temperature ranged from 25.6^{0}C to 36.8^{0}C, while minimum temperature from 8.5^{0}Cto 24.8^{0}Cat S.K. Nagar during crop season. The maximum 83.0% humidity was reported atNagpur during the month of September, 2020. Bright sunshine hours,ranged from3.4 to 9.7,were observed during the crop season.

Table: 1.4 Weather conditions during crop season in Zone IV

Location	Sep. 20	Oct. 20	Nov. 20	Dec. 20	Jan. 21	Feb. 21	Mar. 21
Max. Temp. (°C)							
SKN	34.8	35.7	33.4	27.8	25.6	36.8	-
NGP	32.9	32.3	31.1	28.2	30.5	32.4	36.7
Min. Temp. (°C)							
SKN	24.8	19.0	12.8	8.5	8.6	13.1	-
NGP	24.6	22.8	17.6	13.9	13.7	15.4	21.2
Rainfall (mm) (rainy days)							
SKN	125.5 (6)	35.0 (2)	NIL	NIL	NIL	NIL	-
NGP	398.1 (3)	71.8 (3)	5.2 (1)	NIL	NIL	3.8 (2)	24.0 (3)
Max. R.H. (%)							
SKN	82.3	69.2	60.5	55.8	63.5	64.5	-
NGP	83.3	79.2	79.5	78.0	72.2	50.5	42.5
Min. R.H. (%)							
SKN	77.5	46.0	25.8	22.3	26.3	26.8	-
NGP	62.8	62.0	61.5	59.8	48.4	29.8	27.3
Sunshine (hours/day)							
SKN	6.5	8.9	9.7	9.1	4.1	3.4	-
NGP	4.3	5.5	6.5	6.5	6.7	7.9	8.7

Zone V

All threecenters reported weather data. Good rains were received during cropseason. The maximum temperature ranged from 23.1^{0}Cto 36.7^{0}C during crop season.The minimum temperature remained 5.6 in the month of December 2020 at Kanke center. Bright sunshine hours ranged from 4.9 to 9.2. Minimum and maximum humidity ranged from 22.7% to 96.0% during crop season.

Table: 1.5 Weather conditions during crop season in Zone V

Location	Sep. 20	Oct. 20	Nov. 20	Dec. 20	Jan. 21	Feb. 21	Mar. 21	Apr. 21
Max. Temp. (°C)								
JAG	-	30.3	29.4	28.5	29.1	30.4	35.4	-
KNK	32.2	30.3	28.1	23.6	24.8	28.7	34.6	36.7
IMP	-	29.2	26.3	23.1	23.3	26.1	28.8	30.4

Min. Temp. (°C)								
JAG	-	20.2	14.9	8.6	11.8	10.5	17.1	-
KNK	23.0	20.4	14.1	5.6	7.0	10.4	16.0	18.7
IMP	-	20.9	12.7	6.5	6.6	8.4	12.8	15.4
Rainfall (mm) (rainy days)								
JAG	-	19 (9)	18.7 (2)	NIL	28.7	34.2 (1)	37.2	-
KNK	132.0 (6)	14.2 (2)	10.2 (2)	NIL	NIL	4.0 (1)	14.4 (2)	NIL
IMP	-	165.8 (10	104.9 (2)	NIL	6.6 (1)	7.5 (2)	55.6 (4)	54.8 (5)
Max. R.H. (%)								
JAG	-	94.0	94.0	95.0	92.0	88.7	77.6	-
KNK	85.1	85.2	85.6	85.3	85.8	86.5	86.6	84.4
IMP	-	93.0	94.0	95.6	96.0	90.9	79.1	75.7
Min. R.H. (%)								
JAG	-	60.0	44.0	36.0	33.0	23.9	22.7	-
KNK	69.6	69.0	68.5	68.2	68.7	69.0	69.2	68.9
IMP	-	67.0	50.5	48.4	41.2	31.6	32.8	36.6
Sunshine (hours/day)								
JAG	-	4.9	6.0	7.2	6.5	8.2	6.3	-
KNK	-	-	-	-	-	-	-	-
IMP	-	5.4	8.1	9.2	7.5	8.4	7.0	7.1

2. Genetics & Plant Breeding

2.1 Varietal Improvement

Sixteen centres, spread over 13 states, carried out the varietal development activities as per the approved technical programme. The salient achievements during the year 2020-21 in toria (*Brassica rapa* var toria), yellow sarson (*B. rapa* var yellow sarson), gobhi sarson (*B. napus*), Indian mustard (*B. juncea*), karan rai (*B. carinata*) and taramira (*Eruca sativa*) are discussed below:

2.1.1 Genetic Resource Management

A total of 5935 accessions comprising toria (757), Indian mustard (4076), *B.rapa* (151) yellow sarson (446), gobhi sarson (233), brown sarson (78), karan rai (82), taramira (33), *B. caudatus* (01), *B. tournifortii* (03), *B. rugosa* (23), *B. nigra* (26),*S. alba* (01), *Crambe sp* (06), *B chinenesis* (02), *B. fruiticulosa* (02), *Camelina sativa* (01), *Capsella bursapastoris* (02), *Diplotaxis assurgens* (01), *Sisimbrium (BMWR)*(01), *Lapidium sp* (02) and 01 each of *B. oxyrrhina, D. muralis, D. siettiana, D. tenuisilique, E. lyratus, E. canariense, D.viminea, D.7omezcampoi* were maintained through appropriate mating system at Bhubneshawar, Dholi, Hisar, Pantnagar, Ludhiana, Kanpur, Sriganganagar, IARI,New Delhi, Jobner, Morena, Chatha-Jammu, Jagdalpur and SK Nagar (Table 2.1.1). In addition, 395 new accessions comprising toria (34), Indian mustard (148), yellow Sarson (116), brown sarson (28), karan rai (35) and *B. rapa* (01), *B. nigra* (05) *B. rugosa* (23) were collected. Further, 1438 accessions consisting of 935 Indian mustard, 89 toria, 250 yellow sarson, 17 gobhi sarson, 41 brown sarson,06 Karan rai, 80 taramira and 23 *B. rugosa* accessions were evaluated. On the basis of germplasm evaluation, promising accessions were identified for seed yield, earliness, yield components, thermo-tolerant (early and terminal stages), resistance/tolerance to diseases/pests and quality traits in toria at Dholi, Chatha-Jammu and Jagdalpur.

2.1.2 Creation of genetic variability through hybridization/ mutagenesis and selection

Creation of variability is the essence and backbone of the breeding programme. To cater the need of diverse agro-climatic conditions of the country, 74 crosses were attempted in toria, 94 in yellow sarson at Pantnagar, Bhubneshwar, Chattha-Jammu, Kalyani, and Morena 127 in gobhi sarson at Chatha- Jammu and Ludhiana and 811 in Indian mustard at Bhubneshwar, Chatha-Jammu, Sriganganagar, Hisar, IARI New Delhi, Ludhiana, Kanpur, Pantnagar, SK Nagar, Morena, Sriganganagar, Jhansi, Kota and Varanasi to improve seed yield, earliness, seed size, component traits, disease/pest resistance, heat tolerance suitable for late sown condition, drought tolerance, “0” and “00” quality characters and high oil content (Table 2.1.2). Selection of superior plants/bulks at different centres was practised in toria, yellow sarson and Indian mustard. In toria, development of composites population after the selection was the main objective. In yellow sarson, hybridization and selection from segregating generations were attempted at Kanpur, Dholi, Bhubneshwar and Pantnagar. However, few centres reported that due to spread of COVID 19 across the region, the single plant selection could not be performed in better way. In Indian mustard, 8692 single plants were selected at New Delhi, Jhansi, Kanpur, Bhubneshwar, Chathha-Jammu, Pantnagar, Ludhiana, SK Nagar, Jagdalpur, Kota,, Varanasi and Morena. In Indian mustard, about 864 bulks were selected from segregating and advanced generations.

2.1.3 Evaluation of advanced breeding lines

The advanced breeding lines evaluated under different station/state /preliminary yield trials at various centres were evaluated and results are presented in Table 2.1.3. 69 strains of toria were tested at Kanpur, Chatha-Jammu, Ludhiana and Dholi. The yield superiority in toria was up to 15.3 % over the check (PT-303) at Pantnagar. In yellow sarson, 60 strains were tested at Kanpur, Pantnagar and Dholi. The yield superiority up to 15.8 % over the check Pitambari was recorded at Pantnagar. In Indian mustard, 687 strains were evaluated at 06 centres; Chatha, Hisar, Ludhiana, Pantnagar, Dholi, and Varanasi in 33 trials. Seed yield superiority up to 27.0 % over the check Kranti was recorded at Pantnagar. Nineteen strains at Hisar, 21 strains at Ludhiana and 09 strains at Chatha of gobhi sarson were evaluated for seed yield and its component characters.

2.1.4 Hybrid Development

Efforts for hybrid development continued during 2020-21 under "Consortia Research Platform on Hybrids", at four centres including ICAR-DRMR Bharatpur, ICAR-IARI New Delhi, PAU Ludhiana and CCS HAU Hisar. A total of 16 experimental hybrids, including seven from ICAR-DRMR, 04 from PAU, 03 from CCSHAU and 02 from ICAR-IARI were evaluated in different trials of AICRPRM. Twenty experimental hybrids of Indian mustard were evaluated in replicated block design at all four centres. On the basis of mean seed yield over three locations, two hybrids from Hisar; RH 2007 and RH 2008 outyielded the best hybrid check DMH 1 by 11%. Other promising hybrids were DRMRHJ 3720, DRMRHJ 2518, Pusa MH 118, RHH 2004 and RHH 2006, which expressed 5, 5, 4, 6 and 4 percent standard heterosis, respectively. Out of forty two experimental hybrids evaluated in augmented block design, four experimental hybrids; DRMRHJ 508, DRMRHJ 1003, PHR 8037, PHR 8081 and RHH 2013 outyielded the best check hybrid DMH 1 by 13, 11, 6, 10 and 8 percent, respectively. 153 F1 crosses attempted during 2019-20 among the inbreds identified from diverse gene pools were evaluated in augmented block design at all four centres. 27 F_1 crosses were identified for > 10% seed yield heterosis over best check DMH 1 on the basis of average seed yield over three locations. 192 A lines and 89 R lines were maintained. 202 and 141 backcrosses were attempted to advance the generation of A and R lines, espectively. 340 F_1 crosses were generated for next year evaluation to identify heterotic combinations. 70 inbred lines were characterized for agronomic traits and simultaneously genotyped with SSR markers for studying genetic diversity and their delineation into diverse gene pools. 569 experimental hybrids were evaluated in station trials at different centres and heterotic combinations expressing > 15 % heterosis were identified. 88 inbred lines were delineated into three diverse gene pools on the basis of genetic diversity.

2.2 Breeder seed production

Indents of 82.93q breeder seed Production of 64 Rapeseed-Mustard varieties were received from Department of Agriculture and Cooperation (DAC), Ministry of Agriculture and Farmers Welfare, Govt. of India for during 2020-21. The allocation was made to 18 centres for the production of breeder seed during 27thannual group meeting held through virtual-video conferencing. Against the indent of 82.93q, 194.35q breeder seed was produced, indicating a surplus availability of 116.44 q. Breeder seed of 02 varieties RVM-1 and TBM-209 of Indian mustard and one variety Jhumka (YSBNC-1) of yellow sarson could not be produced. Further, less quantity of ONK-1 (Him Sarson) of Gobhi Sarson; RVM-2 and RGN-298 of Indian mustard; Uttara (PT-2002-25) of Toria was produced. In addition, 15.29 q breeder seed of 10 varieties was also produced by different centres. The centre and variety wise details of breeder seed production are reported in Table 2.2.

Table 2.1.1 Genetic Resource Management activities

Crop	Centre	No. of accessions procured/ collected	No. of lines maintained	No. of lines Evaluated	Promising accessions identified	Traits for which identified
1	2	3	4	5	6	7
Toria	**Bhubaneswar**	1	156			
	Dholi	--	84	84	IGT-2, IGT-64 , IGT-91, RAUDT-62, RAUDT-15, RAUDT-7 ,RAUDT-67, RAUDT-36,RAUDT-16,RAUDT-74,RAUDT-79,RAUDT-7,DC9401 ,TH-9802,Dwarf Toria, Satha local.	Yield , Earliness , Yield components, Thermo-tolerant (Early and Terminal stages) ; Resistance/Tolerance to Diseases –Pests,and Quality traits like Oil Content.
	Kanpur	-	255	-	-	-
	Pantnagar	33	08		PCPGR7810, PCPGR 7813, SA-1	High seed yield
	Chatha-Jammu	-	44		-	Earliness , high seed yield, resistance/tolerance to diseases-pests and quality
	Morena		31			
	S.K. Nagar		19			
	Jagdalpur		160	05	GPT-1, GPT-43, GPT-61, GPT-83, GPT-110, GPT-119, GPT-125, GPT-127, GPT-142, GPT-150	Earliness, high seed yield, resistance/tolerance to diseases-pests and quality
	Jobner					
Total		**34**	**757**	**89**	-	-
Indian mustard	**Bhubaneswar**		135	135	-	-
	Chatha-Jammu		96		-	-
	Dholi		27	27	MDOC-8; MDOC-53;MDOC-27; TPM-1, RK-8401, NDRE -4; IC-401574; IC-399788; TM-12, BIO94, Domo, Jatai Local, , EC 339000, EC 338997 , EC-399301, PAB 9511, PAB 9534 , IC401574, IC 399788, RAURDA 09-32, RAURDA 09-34, RAURDA 09-78, RAURDA 09-153, RAURDA 09-170, RAURDA 09-172, RAURDA 09-212, RAURDA 09-214.	Yield , Earliness , Yield components, Thermo-tolerant (Early and Terminal stages) ; Resistance/Tolerance to Diseases –Pests,and Quality traits like Oil Content.

	Hisar	-	254	-	-	-
	IARI, New Delhi	-	173	80	M56, RH9811, RH1224, NPJ 231, NPJ 234, NPJ 241, NPJ 242, DRMRIJ20-109, Giriraj	White rust resistance, productivity, yield related traits seed size and high oil content
		46 A/B/R lines	4	46	M 37A, M40A, OA 119A, MJA 9, MA 8812A, M78A	Male sterility and yield related traits
		-	33CMS lines+ 11 maintainers	44	-	Aphid reaction
		-	153 Fertility restorers	153	-	Fertility restoration, productivity traits
		-	152	152	Data is being analyzed	High temperature tolerance
		-	99	99	PM 32, RH 801, RH 1706	Low erucic acid and/or low glucosinolates
Brassica carinata derived *B. juncea* introgression lines		-	191	191	IL 6078, IL 6087, IL 6091, IL 6104, IL 6105, IL 6107, IL6108, IL 6111, IL 6121, IL 6129, IL6139, IL6141, IL6151, IL6177, IL6178, IL6180, IL 6181, IL6183, IL6184, IL6219, IL6229, IL6236, IL6241, IL6246, IL6257, IL6263, IL 6266, IL6165, IL6170	Higher water use efficiency/ Drought tolerance
	Kanpur	-	1465	-	-	-
	Pantnagar	102	102		CRP-11, CRP-12, CRP-17, PRHC-13-7, CRP-8, PWR-13-8, PWR -13-14	Earliness, Immune reaction against white rust
	Sri Ganganagar		80	-	-	Yield, disease
	Morena		161			
	Ludhiana		420+70 (0/00)			
	S.K. Nagar		366			
	Jagdalpur		84	05	BM-15, BM-21, BM-25, BM-30, BM-34, BM-38, BM-41, BM-47, BM-52, BM-68.	High Yield & disease
Total		**148**	**4076**	**932**		
Yellow Sarson	**Dholi**	-	174	174	RAUDYS-89-111, RAUDYS-9701; RAUDYS-9702 ; RS-1; Pendent Local,	Yield , Earliness , Yield components, Thermo-tolerant (Early and Terminal stages) ; Resistance/Tolerance to Diseases –Pests and Quality traits like Oil Content.
	Hisar	-	12	-	-	-

	Pantnagar	116	54	76	GP-2017-422, GP 2017-7, PYSC-12-49, PYSC-12-51, PYSC-12-52, PYSC-55, DRMR 268, DRMR 2332, DRMR 632	Basal branching, long main raceme , long pod length, and Yield Component traits
	Kanpur	-	155	-	-	-
	S.K. Nagar		51			
Total		**116**	**446**	**250**		
Gobhi sarson	**Dholi**	-	17	17	Tower, HNS 0004 and HYOLA 401	-
	Hisar	-	39	-	-	-
	IARI, New Delhi	-	2	-	-	-
	Ludhiana		125			
	Chatha-Jammu	-	36	-	-	-
	S.K. Nagar		14			
Total		-	**233**	**17**		
Brown Sarson	**Dholi**	-	41	41	BSH-1	-
	Pantnagar	28	10	-	BSGP-20, BSGP-25	Basal and profuse branching, branching
	S.K. Nagar		27			
Total		**28**	**78**	**41**		
Karan rai	**Dholi**	-	06	06	Kiran, PBN-2001, PBN-2002, PBN9501, PBC9221	-
	Hisar	-	10	-	-	-
	Pantnagar	35	15		IARI-11, IARI-7. IARI-13	Earliness and dwarf height
	IARI, New Delhi	-	3	-	-	-
	Ludhiana		40			
	SK Nagar		08			
Total		**35**	**82**	**06**		
B rapa	**IARI, New Delhi**	1	1	-		High oleic acid
	Ludhiana		150			
Total		**01**	**151**			
Taramira	**Jobner**		30	80		Seed yield
	IARI, New Delhi	-	1	-	-	-
	SK Nagar		02			
Total		-	**33**	**80**		
R. caudatus	**IARI, New Delhi**	-	1	-	-	-
Total		-	**01**	-		
B. nigra	**IARI, New Delhi**	-	11	-	-	Crossability with *B. rapa* for resynthesis of *B. juncea*

	Pantnagar	05	05			
	Ludhiana		10			
Total		**05**	**26**	-		
B. rugosa	**Pantnagar**	23	23	23	EEC-5, EEC-3, EEC-1	Alternaria blight resistance, Good for vegetable purpose
Total		**23**	**23**	**23**		
S. Alba	**IARI, New Delhi**	-	1	-	-	Aphid reaction
Total			**01**			
Crambe sp	**IARI, New Delhi**	-	6	-	-	Aphid reaction
Total			**06**			
Lapidium sp	**IARI, New Delhi**	-	2	-	-	-
Total			**02**			
B. tournifortii	**IARI, New Delhi**	-	3	-	-	Crossed with *B. nigra*
Total			**03**			
B. chinenesis	**IARI, New Delhi**	-	2	-	-	-
Total			**02**			
B. fruticulosa	**IARI, New Delhi**	-	2	-	-	Aphid reaction
Total			**02**			
Sisimbrium (BWMR)	**IARI, New Delhi**	-	1	-	-	Aphid reaction
Total			**01**			
Camelina sativa	**IARI, New Delhi**	-	1	-	-	Aphid reaction
Total			**01**			
Capsella-bursapastoris	**ICAR-IARI, New Delhi**	-	2	-	-	Aphid reaction
Total			**02**			
Diplotaxis assurgens	**ICAR-IARI, New Delhi**	-	1	-	-	Aphid reaction
Total			**01**			
Brassica oxyrrhina	**IARI, New Delhi**	-	1	-	-	Aphid reaction

Total			**01**			
Diplotaxis muralis	**IARI, New Delhi**	-	1	-	-	Aphid reaction
Total			**01**			
Diplotaxis siettiana	**IARI, New Delhi**	-	1	-	-	Aphid reaction
Total			**01**			
Diplotaxis tenuisilique	**IARI, New Delhi**	-	1	-	-	Aphid reaction
Total			**01**			
Enarthrocarpus lyratus	**IARI, New Delhi**	-	1	-	-	Aphid reaction
Total			**01**			
Erucastrum canariense	**IARI, New Delhi**	-	1	-	-	Aphid reaction
Total			**01**			
Diplotaxis viminea	**IARI, New Delhi**	-	1	-	-	Aphid reaction
Total			**01**			
Diplotaxis 7omez-campoi	**IARI, New Delhi**	-	1	-	-	Aphid reaction
Total			**01**			
Other	**SDAU, SK Nagar**	5		-	-	
Total		**05**	**-**			
Grand Total		**395**	**5935**	**1438**		

Table 2.1.2: Number of crosses, their generation and number of selections practiced.

Centre	Objective (s)	Generation	Pedigree	No. of crosses/ lines	Selection	
					No. of single plants	No. of bulks
1	2	3	4	5	6	7
Crop: Toria						
Bhubaneswar (OUAT RRTTS, Ranital)	Breeding for dwarf, early maturity, high seed & oil yield strains of Toria suitable for rice-fallows	Fresh Cross	**Parents involved:** Uttara, Sushree, Anuradha, Tapeswari TS-38, TKM 18-1,RAUDT 14-9, CAU-Toria1, Parbati.			
		F_3 to F_5	Derived by hybridization between Sushree x PT303, Anuradha x TS-38		15	5
		F_5 to F_9	Advanced generation lines derived from Sushree x PT303, PT303 x Panchali, TS-29 x Panchali		25	6
		Population Improvement	Populatio-1: PT 303, Tapeswari, RAUDT 14-09, TS-38, Parbati, CAU-Toria1, Anuradha.	Intermating among 50 selected plants from population-1, population-2 and Population-3 were done.		
			Population-2: TKM 18-2, PT-2015-10, JT-90-1, Tapeswari, Bhawani, Pant Hill Toria-1, Uttara, PT-508, RAUDT 14-09, Parbati.			
			Population-3: CAU Toria1, Bhawani, Tapeswari, PT-2013-7, PT 303,TKM 18-2, RMT 10-15, T-9, PT-141			
Chatha-Jammu	Early and high yield	**Fresh cross**	RSPT-1,RSPT-6,TL-15,PT-303& Uttara ,Satha local	**08**		
		F_1	Six single crosses using parents RSPT-6, Bhawani,Uttara,PT-303,TL-15&RSPT-9.	**06**		
		F_2	PT-2013-5,PT-2013-8,TS-38,TRS-79,TKM-16-1 With Bhawani, PT-303 & Tapeswari	**15**		
		F_3	RSPT-3, RSPT-11,TL15 & RSPT-8 With Bhawani & satha local	**08**		
		F_4	Composite populations	**12**		
		F_5	Open pollination (Early and late populations)	**07**		
		F_6	RSPT-1, RSPT-2 , RSPT- 6 cross with PT-303 , PTC-2009-3, RAUDT-10 , TL15 ,TL-21 lines.	**10**		
Dholi	To develop early and	9 advanced	Derived by hybridization between Varieties, namely RAUTS-17, PT-303 and T_9 (three) with			

	high yielding strains of toria	generation Station Materials (bulks) evaluated in Advanced Varietal Station Trials	sources of earliness (four) namely Satha local, IGT-2, IGT-64 and IGT-91.		09	
	To develop yellow seeded high seed and oil yield in toria	4 advanced generation Station Materials (bulks) evaluated in Advanced Varietal Station Trials	Derived by hybridization between RAUTS-17 / 89-115, PT 303 / 89-115, T_9 / 89-115		04	
	Development of high yielding Strains of Toria	13 advanced generation Station Materials (bulks) evaluated in Advanced Varietal Station Trials	Derived by hybridization (Details already given above)		16	
Hisar	Breeding of high yielding varieties of Toria and early Raya.	**Fresh crosses**	Twenty new crosses were attempted using RH 1999-12, RH 1999-14, RH 1999-17, RH 1999-42 and PM 28 as agronomically superior backgrounds and RH 725, RH 0406, PM 25 and JD 6 as donor sources.	20		
		F_2	Four F_2 populations were grown in larger plots and desirable single plants have been selected from each F_2 population..	4	✓	
			BC_1 was attempted in 21 F_1 crosses; besides, F_2 seed of these crosses was also harvested.			
		BC_3 and BC_2	BC_3 and BC_2 were attempted in 25 and 24 crosses, respectively.	25 and 24		
		Intermating	First cycle of intermating was attempted in 28 BC_3 crosses.	28		
		Intermating	Third and second cycle of intermating was attempted in 14 and 21 BC_3 crosses, respectively and their seeds have been harvested	14 and 21		
		Intermating	The 5 third intermate progenies were selfed and seed was multiplied.	05		
	Early and late populations	**Population grown in isolation**	The early and late populations of toria were grown in isolation and open pollination was allowed. The early and late maturing plants have been selected.		✓	
	Component traits	**PRT**	Forty two progenies of early raya were evaluated in Progeny Row Trial against two check varieties viz., PM 25 and PM 28 for seed yield and component traits. Single plants possessing desirable traits have been selected.	42	✓	
Kanpur	Early, high yielding	**Population Improvement**	**Population – 1 :** TK 01-1, TK 01-2, PT-303, TK 02-1, TK 9901, PT-507, T_9, Bhawani, ORM (M) 21-1, ORM (M) 7-1, Parbati, Anuradha and ORT-11.	37		✓
			Population- 2 : TK 9902, PT-303, TK-9801, TK-9802, PT-507, T_9, Bhawani, ORM (M) 21-1, ORM (M) 7-1, Parbati, Anuradha and ORT-11.			✓

			Population- 3 : TK-950, TK-9302, PT-303, TK-9702, PT-507, T_9, Bhawani, ORM (M) 21-1, ORM (M) 7-1**,** Parbati, Anuradha and ORT-11.			✓
		F_3	PT-303 x T9, PT-303 x Bhwani, PT-303 x Tapeswari, PT-303 x ORT-11, PT-303 x PT507, PT-303 x Anuradha, T9 x Bhwani, T9 x Tapeswari, T9 x ORT-11, T9 x PT507, T9 x Anuradha , Bhwani x tapeswari , Bhwani x ORT-11, Bhwani x PT507, Bhwani x Anuradha , Tapeswari x ORT-11, Tapeswari x PT507, Tapeswari x Anuradha, ORT-11 x PT507, ORT-11 x Anuradha, PT-507 x Anuradha.	21	420	
Kalyani (WB)	High yield	**Segregating population evaluated**	PT-2015-4 X PT-303; PT-2015-10 X PT-17-3; PT-2016-11 XPT-2016-3; Tapeswari X PT -30, PT-2016-11 X PT -2016-2; PT-2016-11 X PT -2016-4; Tl-15 X PT 30; KBS-49 X PHT-1 X PT-30, PT-2013-7; PT 2015-4; PT 2015-8; PT 2015-10 .	12		
Morena	Identification of good combiners for seed yield and quality	**Fresh crosses**	28 fresh crosses were made during rabi 2020-2021	28		
	Earliness, high seed yield bold seed and quality	**F_1**	Crosses among TKM-19-1, TKM-19-2, PT-303, PT-2015-6, CG Toria-2, BUT-08-06, CAU Toria-1-1, JT-13-8, TL-19, RMT-4-18-18, RMT-10-5-18, Tapeswari, Bhawani, ORT-18-6-16	**16**		
		F_2	Crosses among JT-1, TKM—18-2, RMT-10-15, CAU Toria-1, TKM-18-1, Bhawani, Tapeswari, PT-303, PT-2015-10, PT-2013-1, RVT -1, RVT-2	**14**		
		F_3	JT-1 x BAUT-08-01, TKM 17-1 x JT-1, JT-1 x TKM 17-2, PT-2015-03 x JT-1, PT-303 x JT-1	**5**	25	
		F_4	JT-1 x TS-36, JT-1 x TRL-179 (ASR), JT-1 x RMT-10-9-1, JT-1 x TH-1502, PT-2013-8 x JT-1,	**5**	**20**	
		F_5	JT-1 x PT-303, TKM-15-1 x JT-1, Tapeswari x JT-1	**3**	**14**	
		F_7	JM-3 x JT-1, RMT-10-11 x JT-1, RMT-10-9 x RMT-02-6, RMT-10-13 x JT-1	**4**	**20**	
		F_8	JMT-02-6 x JMT-04-5, JT-1 x JD-6	**2**	**8**	
Pantnagar	**Earliness**	**Fresh crosses**	T-9 x PT-141, T-9 x PT-2020-8, T-9 x PT-2020-9, PT-2020-2 x PT-141, PT-2020-3 x PT-2020-9, PT-2020-4 x PT-2020-9.	**6**	-	-
		F_1	PT-2015-6 × Bhawani, PT-508 × Bhawani, Tapeswari × PT-141, PT-2017-2 × PT-141, PT-2012-5 × Bhawani	**5**	-	**5**
		F_2	(PT-15-6 × PT-16-24) × PT-141, (PT-145× TL-15) × Uttara	**2**		**1**
		F_3	(KBS – 49 × Uttara) × PT-141, PHT-1×PT-145,	**2**		**2**
		F_4	RSPT-2 × Bhawani	**1**		**1**
			Population improvement in PT-141 (recurrent selection)			
	Seed Yield	**Fresh crosses**	PT-2020-1 x PT-2018-8, PT-2020-5 x PT-2020-8, PT-2020-5 x PT-15-4, PT-2020-6 x PT-2019-1, PT-2020-7 x PT-2020-5, PT-2020-7 x PT-2020-2, PT-2020-7 x PT-2015-4, PT-2020-2 x PT-2020-7, PT-2020-2 x PT-2020-9, PT-2016-3 x PT-2020-5, PT-2016-3 x PT-2020-7, PT-2016-3 x PT-2019-1, PT-2020-3 x PT-2019-1, PT-2020-3 x PT-2020-9, PT-2020-4 x PT-2020-9.	**15**		
		F_1	PT-2016-16×Tapeswari, PT-2018-5×PT-30, PT-2018-5×PT-508, PT-2018-1×Uttara, PT-2018-9×Uttara, TCN-19-1×PT-508, TCN-19-4×PT-508, TCN-19-7×PT-508, TCN-19-18×PT-30, Tapeswari × TCN-19-15, PT-30×TCN-19-9, Tapeswari × PT-2016-11	**12**		**6**

		F_2	PT-15-3×PT-16-6, PT-15-3×TKM-17-1, PT-15-3×PT-16-9, PT-17-2 × PT-16-6, PT-17-2× TKM-17-1, PT-17-2× PT-16-9, PT-17-2× PT-17-3, PT-12-5×PT-16-6, PT-12-5× PT-17-3, (PT-15-7 × PT-16-24) × PT-30, (Tapeswari × PT-30) × RAUDT-10-33	**11**		**6**
		F_3	TL-15× Uttara, TL-15×PT-30, PT-15-7 × RAUDT-10-33, PT-15-7 × Uttara, PT-16-11 × PT-16-2, PT-16-11 × PT-16-4, PT-15-4×PT-303, PT-16-11 × PT-16-3, PT-15-10 ×PT-16-10, PT-15-4×Tapeswari, PT-15-7×PT-16-2,PT-15-6×TH-1402,PT-15-10×PT-17-3, Tapeswari×PT-30	**14**		**3**
		F_4	Uttara × PHT-1, Tapeswari × PT-15-3,(PT-16-4 × TKM-16-1) × PT-2012-5	**3**		**1**
		Composite				
		C_0	PTC-2021-1, PTC-2021-2, PTC-2021-3, PTC-2021-4, PT-2021-5	**5**	-	
		C_1	PTC-2020-1, PTC-2020-2	**3**	-	3
	Specific adaptation to hill	**Fresh crosses**	BSGP-6 x PT-2015-6, BSGP-6 x PT-2018-3, BSGP-6 x PT-2018-9, BSGP-25 x PT-2015-7, BSGP-25 x PT-2018-9, BSGP-25 x PT-2018-3, PT-2020-1 x GP-11-162, PT-2020-1 x PCPGR-7810, PT-2020-3 x PCPGR-7785, PT-2020-5 x PCPGR-348, PT-2020-6 x Lahi-1-06, PT-2020-6 x GP-7771,	**17**	-	-
		F_1	PT-2016-16 × PHT-1, PT-2018-1×PHT-1, PT-2018-9×PHT-1, PT-2012-5 × RAUDT-10-33, PT-2012-5 × T-9, PT-2012-5 × PT-2016-11	**5**		**4**
		F_2	Uttara × KBS-49, Uttara × PHT-1, Uttara × PTHC-10-1, PT-16-3 × KBS-49, PT-16-3 × PHT-1, PT-16-3 × PTHC-10-1, PT-15-7 × KBS-49, PT-15-7 × PHT-1, PT-15-7 × PTHC-10-1,	**9**		**8**
		F_3	(KBS-49 × PHT-1) × PT-30, (KBS-49 × Uttara) × PT-30, (KBS 49×PHT-1)×Uttara,	**3**		**2**
		F_4	KBS-49 × PHT-1, PHTC-2010-1 × KBS-48	**2**		**1**
Ludhiana	Productivity and early maturity	Population improvement	No of populations =3	3		
Shillongani			(TS 67 x RMT 10-15) x TS 29, (TS 67 x RMT 10-15) x TS 36, (TS 29 x PT-2013-7)x TS 29, (TS29 x RMT 10-15) x TS 29,(TS 67 x RMT 10-15) x TS 67, (TS 67x RAUDT 14-9) x TS 29, (TS 67x RAUDT 14-9) x TS 67,(TS 67 x RMT 10-15) xTS 36, (TS 29 x PT-2013-7) x TS 29, (TS 29 x NRCHB-101) x TS 29	10		
Crop: Yellow Sarson						
Bhubaneswar (OUAT RRTTS, Ranital)	Bold seeded, Earliness & High seed yield suitable for rice fallows	**Fresh crosses**	Parents: Pitambari , YSH 04-01,NRCYS 05-02 , Pant Sweta	21		
		M_3-generation (EMS-induced mutation breeding)	Parents: NRCYS 05-02 YSH 04-01 Mutagen: 0.5%EMS		84 plants were selected for yield component traits	

Dholi	Development of high yielding Strains for various condition	10 advanced generation Station Materials (bulks) evaluated in Advanced Varietal Station Trials	Derived by hybridization RS-1 / Pendent local, RS 1 /EMYS Local, Pendant local / EMYS Local			
Kanpur	Early maturing and high yielding varieties	F_2	YSKM 15-2 x YSH – 401, YSKM 16-2 x Benoy, YSKM 17-2 x Pitambari , YSKM 18-1 x Benoy, YSKM 18-2 x Pitambari, YSKM 19-1 x YSH-401.	06	144	
		F_3	YSC-63 x NRCYS-05-02, YSC-63 x YSH-401, YSC-63 x Benoy, YSC-63 x Pitambari, YSC-41 x NRCYS-05-02, YSC-41x YSH-401, YSC-41x Benoy, YSC-41x Pitambari,YSC-09x NRCYS-05-02, YSC-09x YSH-401, YSC-09x Benoy, YSC-09x Pitambari,YSC-71x NRCYS-05-02, YSC-71x YSH-401, YSC-71x Benoy, YSC-71x Pitambari, YSKM11-02x NRCYS-05-02, YSKM11-02x YSH-401,YSKM11-02 x Benoy, YSKM11-02 x Pitambari, YSC-76x NRCYS-05-02, YSC-76x YSH-401, YSC-76x Benoy ,YSC-76x Pitambari, YSKM-10-1x NRCYS-05-02, YSC -10-1x YSH-401, YSKM-10-1x Benoy, YSKM-10-1x Pitambari, YSKM-11-1x NRCYS-05-02 ,YSKM-11-1x YSH-401,YSKM-11-1x Benoy, YSKM-11-1x Pitambari, YSC-75x NRCYS-05-02, YSC-75x YSH-401, YSC-75x Benoy, YSC-75x Pitambari, YSKM-10-2x NRCYS-05-02,YSKM-10-2x YSH-401, YSKM-10-2x Benoy,YSKM-10-2x Pitambari, YSK9-01x NRCYS-05-02,YSK9-01x YSH-401,YSK9-01x Benoy, YSK9-01x Pitambari, YSC-80x NRCYS-05-02,YSC-80x YSH-401,YSC-80x Benoy,YSC-80x Pitambari, K88x NRCYS-05-02, K88x YSH-401, K88x Benoy, K88x Pitambari,YSC-15x NRCYS-05-02,YSC-15x YSH-401, YSC-15x Benoy, YSC-15x Pitambari, T42x NRCYS-05-02, T42x YSH-401, T42x Benoy, T42x Pitambari, YSC-18x NRCYS-05-02, YSC-18x YSH-401,YSC-18x Benoy,YSC-18x Pitambari,YSK-03x NRCYS-05-02,YSK-03x YSH-401,YSK-03x Benoy,YSK-03x	100	2154.	
		F_4	YST-151 x T-44,YST-151 x K88, YST-151 x T-3,YST-151 x T-4,YST-151 x B-9,YST-151 x YSK-1, T-44x K88, T-44x T-3, T-44x T-4,T-44x B-9,T-44x YSK-1, K-88x T-3, K-88x T-4, K-88x B-9, K-88x YSK-1,T-3x T-4,T-3x B-9,T-3x YSK-1, T-4x B-9, T-4x YSK-1,B-9x YSK-1.	21	422.	
		F_5	YST-151 x YSK-3,YST-151 x YSK-24,YST-151 x YSK-28,YST-151 x YSK-42, YST-151 x K88,YST-151 x YSK-2,YST-151 x YSK-4,YSK-3x YSK-2,YSK-3x YSK-28,YSK-3x YSK-42, YSK-3 x K88,YSK-3x YSK-2,YSK-3x YSK-4,YSK-24x YSK-28,YSK-24x YSK-42,YSK-24x K88,YSK-24x YSK-2,YSK-24x YSK-4, YSK-28x YSK-42,YSK-28x K88,YSK-28x YSK-2,YSK-28x YSK-4,YSK-42x K88,YSK-42x YSK-2,YSK-42x YSK-4,K88x YSK-2, K88x YSK-4,YSK-2x YSK-4.	28	475.	
Kalyani (WB)	High yield	Segregating population evaluated	PYSC-40-4 X RAUDYS-14-9, PYSC-21-6 X YS-897; PYS-68-6 X NDYS-45-115; PYSC-41-3 X NRCYS-0502 and PYS-16-6 X PYS-6 X B-9, PYSC-1-3-7, PYS-2016-8; PYS-2016-10, PYS-2016-15; PYSC-27-6-3.	10		

Pantnagar	Breeding for high yield	**Fresh crosses**	PYS-2018-1 × DRMR-208, PYS-2018-1 × PYS-842, PYS-2018-1 × PYS-20-7, PYS-18-1× NRCYS-0502, PYS-18-1 × PYS-16-15, PYS-18-4 × DRMR-2332, PYS-18-4 × PYS-20-3, PYS-18-4 × NDYS-12-3, PYS-17-8 × PYS -20-8, PYS-17-8 × PYS-842, PYS-17-8 × NDYS-123, PYS-18-4 × PYS-16-15, PYS-18-4 × PYS-842, PYS-17-8 × DRMR-632, PYS-17-8 × PYS-20-8, PYS-17-8 × NRCYS-0502, PYS-17-8 × PYS-16-15, PYS-17-8 × PYS-18-1, PYS-17-11 × PYS-16-15, PYS-17-11 × PYS-18-8, PYS-17-11 × PYS-20-3, PYS-841 × PYS-16-15, PYS-841 × PYS-18-9, PYS-841 × PYS-16-8, YS-0401 × PYS-16-15, YS-0401 × PYS-6, YS-0401 × PYS-20-8, PYS-841 × PYS-17-4, PYS-841 × YS-89-1, PYS-841 × PYS-16-13,PYS-17-11 × PYS-18-2, PYS-17-11 × PYS-18-3, PYS-17-11 × PYS-17-6 YSGP6 × Pant sweta, YSGP6 × PYS-17-8, YSGP6 × PYS-16-8, YSGP6 × PYS-7, YSGP6 × PYS-16-15, YSGP7 × Pant sweta, YSGP7 × PYS-16-8, YSGP7 × GP 51, YSGP7 × PYS-89-2, PYS-18-3 × PYS-17-8, PYS-18-3 × PYS-842, PYS-18-3 × PYSGP-55, PYS-18-3 × YSH-0401, PYS-18-3 × PYS-18-4, GP-49 × GP-55, GP-49 × GP-52, GP-51 × GP-55, GP-51 × GP-52, PYS-18-1 × GP-49, PYS-18-1 × PYS-841, PYS-18-1 × PYS-17-6, YSGP-51 × PYS-18-4, YSGP-51 × PYS-1, YSGP-51 × PYS-18-1, YSGP-51 × PYS-16-15, YSGP-51 × NDYS-123, YSGP 49 × PYS-6, YSGP 49 × PYS-841, YSGP 49 × YS-89-1, YSGP 49 × PYS-17-6, YSGP 49 × PYS-17-4	**73**		
	High Seed Yield	**F1**	B-9×PYS-2018-4, B-9×PYS-2017-6, B-9×PYS-2017-8, PPS-1×PYS-2018-4, PPS-1×PYS-2017-6, PPS-1×PYS-2017-8, Pant Swata × PYS-2018-4, Pant Sweta × PYS-2017-6, Pant Girija × PYS-2018-4, Pant Girija × PYS-2017-6, Pant Girija × PYS-2017-8, NRCYS-0502×PYS-2018-4, NRCYS-0502×PYS-2018-6, NRCYS-0502×PYS-2017-8, Pitambari × PYS-2018-4, Pitambari × PYS-2017-6, Pitambari × PYS-2017-8, YSH-401×PYS-2018-4, YSH-401×PYS-2018-6, YSH-401×PYS-2017-8	**28**		**22**
		F2	YS-89-7×PYS-16-7, YS-89-7×NDYS-107, YS-89-7×NDYS-123, YS-89-7× PYS-2016-15, Pitambari × NDYS-107, Pitambari × NDYS-2018, Pitambari × PYS-2016-15, NDYS-842× PYS-16-7, NDYS-842× NDYS-2018, NDYS-842× NDYS-123, PYS-17-6× PYS-16-7, PYS-17-6× NDYS-2018, PYS-17-6× NDYS-123, PYS-17-6× PYS-2016-15, PYS-17-11× PYS-16-7, PYS-17-11× NDYS-2018, PYS-17-11× NDYS-123, PYS-17-11× PYS-2016-15, PYS-17-13× NDYS-107, PYS-17-13× NDYS-2018, PYS-17-13× NDYS-123, PYS-17-13× PYS-2016-15,	**22**		**11**
		F3	PYSC-68-6 × NDYS-115, PYSC-14-3 × YS-897, PYS-58-13 × NRCYS-05-02, PYSC-21-6 × YS-89-7, PYSC-40-4 × PYS-842, PYSC-41-3 × NRCYS-05-02, PYSC-40-4 × RAUDYS-14-9, PYSC-68-6 × PYS-842, PYS-841 × RAUDYS-14-9, PYSC-64-5 × RAUDYS-14-9, PYSC-53-5 × RAUDYS-14-9, (PYS-2016-6 x PYS-6) × B-9, (PYS-2016-6 x PYS-6) × RAUDTYS-14-9, (PYS-2016-6 x PYS-6) × NDYS-115, (PYS-2016-8 x B-9) × (PYS-6 x NDYS-137), IC-317444x IC-444231) × PYS-2012-6 } x YS-897	**16**		**8**
		F4	PYS-6 × NDYS-137, PYS-6 × NDYS-123, PYS-6 × NDYS-115, PYS-6 × NDYS-115, DRMRYS-2016-42 × YSH-842, PYS-2016-9 × PYSC-11-4, PYS-2016-9 × PYS-2011-43, PYS-2016-6 × PYS-6, PYS-2011-43 × NDYS-137, PYS-2011-43 × PYS-2012-4, PYS—6 (ML) × NDYS-115, (PYSC-2011-43 × YSH-0401) × Ragini	12 (168 IPS)	154 IPS	
		F5	NDYS-2018 × YSH-401, NDYS-137 × NRCYS-0502, PYSC-11-43 × YSH-401, NDYS-123 × Sweta-401, NDYS-123 × PPS-1	5 (94IPS)	90 IPS	-
		F6	PYS-841 x PYSC-11-47, PYS-6 x PYSC-11-47, NRCYS-502 x PYSC-11-47, NRCYS-502 x PYSC-11-43, PYSC-11-31 x PYSC-11-43	5 (74 IPS)	19 Lines	-
		Advanced lines	-	18		

Crop: Indian mustard						
Bhubaneswar (OUAT RRTTS, Ranital)	Breeding for early, bold seeded, terminal heat tolerance high seed & oil yield strains of mustard	**Fresh Crosses**	Parents involved: NRCHB101, Pusa Bold, Pusa Mustard 25, KMR(E) 19-1, PRE 17-2, BAUM-09-12-1, Pusa Mustard 28, OMR-41-3-5, TM 106, TM 117, TM 208, TM 108-1	67		
	Breeding high yielding genotypes for early, timely and late sown maturity groups	**F_4 to F_8**			151	
	To develop bold, yellow seeded high-yielding genotypes having terminal thermotolerance using EMS-induced mutagenesis	**M_3-generation**	**Parents**: Pusa Bold, Kranti, NRCHB101, Rajendra Suphala Dosage: 0.4% EMS, 8hr and 0.7% for 6hr		**124**	
Sri Ganganagar		Fresh crosses	Laxmi X NRCDR-2, Laxmi X RGN 48, Laxmi X NRCDR-2,Laxmi X DRMRIJ 31,RB 50 X RGN 48,RB 50 X NRCDR-2,RB 50 X DRMRIJ 31,RH 406 X RB 50,RH 406 X RGN 48,RH 725 X RB 50,RH 725 X RGN 48, RH 749 X NRCDR-2, RH 749 X RGN 48, RH 749 X RB 50, RH 749 X DRMRIJ 31, NRCDR-2 X RGN 48, NRCDR-2 X RB 50, NRCDR-2 X DRMRIJ 31,DRMRIJ 31 X RGN 48, DRMRIJ 31 X RB50.	**20**		
		F_1		186		
		F_2		142	077	
		F_3		105	57	
		F_4		90	64	
		F_5		100	73	
		F_6		85		79
Chatha-Jammu	**Breeding for Stress (Moisture Stress)** **High seed yield**	**Fresh crosses**	RH-1658,SKJM-16,PBR-378,RH-1584,RH-1424,PMM 12-2-18,RSPR-01,DRMR 15-35&OMR4-3-5 With RH-406,RGN-48, RB-50 & RH-725	**36**		
		F_1	Attempted using agronomically superior 15 genotypes with RH-761,RB-24& RH725.	**45**		
		F_2	RSPR-69,RSPR-5,RSPR-1,RSPR-3,RH-1209,RH-0923,SKJM-5,SKJM-3 With NRCHB-101,RH-406 & RH-749	**24**		
		F_3	RGN-400,DRMRIJ-16-1,PRE-2013-10,DRMRCI-55,NRCHB-101,RH-1207 WITH RH-406,PM-25&RH-1573	**16**		
		F_4	RSPR-01, RH-30, RSPR-03, RH-749,RSPR-69 & RB-24 with RH-406,RB-50, RH-819 &	**20**		

			DRMR 541-44			
		F_5	NRCDR-2, NRCHB-101, NPJ-112, DRMRIJ-31, PUSA BOLD, RB-50, RH-749 with RSPR-69 , RSPR-01& RSPR-03	**12**		
		F_6	Early and late populations	**05**		
		F_7	RH-30, Pusa Agrani , Pusa Mahak , RB-24 with RSPR-01, RSPR-03 & RSPR-69	**09**		
Dholi	Resistance/ tolerance to diseases high yield and other attributes	18 advanced generation Station Materials (bulks) evaluated in Advanced Varietal Station Trials.	Derived by Interspecific hybridization involving Kranti, Pusa Bold, Varuna, & RAURDL 02-1 of *B. juncea* and PBC9221 (*B. carinata*), EC 339000, EC 338997, ONK-1, HNS 0004 and HYOLA 401 (*B. napus*)			
Hisar	Breeding for component characters	Fresh crosses	Eighteen new crosses were attempted using agronomically superior genotypes viz., RH 1934, RH 1978, RH 1899-54, RH 1903, RH 1676, RH 2020 and RH 2015 as base population and HEB-1, MCN 20-5 and MCN (R) 20-8 as donor sources in one set. In another set 12 new crosses were attempted by using HEB-1 as agronomical superior back ground and RH 725, MCN 20-5, RH 1974, RH 1999-14, RH 1999-42, WRR 20-9, RH 1979, RH 1928, RH 1935, RH 1954, RH 2024 and RH 2003 as donor sources.	18		
		F_2	F_2 populations were grown in larger plots and desirable single plants have been selected from each F_2.	20		
		Generation advancement; BC_{1s}	Twenty four F_{1s} were grown for generation advancement; BC_{1s} were attempted in these crosses and F_2 seed of these crosses was also harvested and threshed.	24		
		BC_3 and BC_2	BC_3 and BC_2 were attempted in 62 and 43 crosses, respectively.	62 and 43		
		Inter mating	Third, second and first cycle of inter mating was attempted in 52, 93 and 122 BC_3 progenies, respectively.	52, 93 and 122		
		BC_3	Seven BC_3 progenies after third intermate were selfed and seed was multiplied for further testing in Small Scale Trials.	7		
		PRTs	Seven Progeny Row Trials comprising 42 progenies each were evaluated against two check varieties viz., RH 725 and RH 0749 for seed yield and component traits. Single plants possessing desirable traits have been selected.	42		✓
	Breeding for disease resistant varieties	Fresh crosses	Six new crosses were attempted using agronomically superior genotypes viz., RH 1934, RH 1978, RH 1899-54, RH 1903, RH 1676, RH 2020 and RH 2015 as base population and WRR 20-9 as donor source for white rust resistance..	06		
		F_2	Five F_2 populations were grown in larger plots and desirable single plants have been selected from each F_2	05		
		BC_1 F_1	Seven F_{1s} were grown and BC_1 was attempted in these crosses. Besides, F_2 seed of these crosses have also been harvested.	07		✓
		BC_3 and BC_2	BC_3 and BC_2 were attempted in 16 and 8 crosses, respectively.	16 and 08		✓

		Inter mating	Third, second and first cycle of inter mating was attempted in 13, 17 and 20 BC_3 crosses, respectively and their seeds were harvested.	13, 17 and 20		✓
		PRTs	Forty two progenies were evaluated against two checks (RH 725 and RH 0749) in one Progeny Row Trial for seed yield and disease tolerance. Single plants possessing desirable traits have been selected.	42		✓
	Breeding for '0' and '00' varieties	**Fresh crosses**	Six new crosses were attempted using agronomically superior genotypes viz., RH 1934, RH 1978, RH 1899-54, RH 1903, RH 1676, RH 2020 and RH 2015 as base population and RH (OE) 1808 as donor source for '0 erucic acid'.	06		✓
		F_2	F_2 populations were grown in larger plots and desirable single plants have been selected and these will be subjected to fatty acid analysis.	02		✓
		BC_1 F_1	Seven F_{1s} were grown and BC_1 was attempted in these crosses. Besides, F_2 seed of these crosses have also been harvested.	07		✓
		BC_3 and BC_2	BC_3 and BC_2 were attempted in 16 and 7 crosses, respectively.	16 and 07		✓
		Inter mate	Second and first inter mate was attempted in 12 and 9 low erucic acid BC_3 progenies respectively and seed was multiplied	12 and 09		✓
		LST/SST	One Large Scale Trial (Q) having 14 strains for low erucic acid and two checks was conducted and results are being compiled.	14 and 02		✓
	Development of hybrids in Indian mustard	F_1	255 new test hybrids based upon *Ogura* CMS system and 48 hybrids based upon *Mori* CMS system were evaluated against three checks. The data analysis is in progress.	255 and 48		✓
		Diversification of A and R lines	10 new agronomical superior genotypes were used for diversification of R lines in *Ogura* CMS system	10		✓
			Generations were advanced for incorporation/diversification of *Ogura* CMS system into 55 different genetic backgrounds	55		✓
		A and R line Maintenance	13 A lines of *Mori* and 14 A lines of *Ogura* CMS system were maintained. 39 R lines of *Mori* CMS and 91 R lines for *Ogura* CMS system were maintained.	39 and 91		✓
		Evaluation of hybrids	255 new test hybrids based upon *Ogura* CMS system and 48 hybrids based upon *Mori* CMS system were evaluated against three checks. The data analysis is in progress.	255 and 48		✓
		SST	Four Small Scale Trials comprising 16 experimental hybrids in each trial and two checks, RH 725 and 45S46 were conducted and results are being compiled..	16		✓
	Breeding for aphid tolerant varieties of Indian mustard	Fresh Crosses	Four new crosses were attempted using agronomically superior genotypes viz., HEB-1 and RH 2020 as base population and RH 7846 and T-6342 as donor sources for aphid tolerance.	04		✓
		F_2	Four F_2 populations were grown in larger plots and desirable single plants have been selected from each population.	04		
		BC_3 and BC_2	BC_3 and BC_2 were attempted in 15 and 8 crosses, respectively.	15 and 08		
		BC_1 F_1	Six F_{1s} were grown and BC_1 was attempted in these crosses. Besides, F_2 seed of these crosses have also been harvested.	06		
		Intermittent	Ten progenies after third intermate were selfed and seed was multiplied.	10		
		Intermittent	Third, second and first cycle of intermating was attempted in 19, 24 & 4 BC_3 crosses, respectively.			
		PRTs	Forty two progenies were evaluated against two checks in one Progeny Row Trial for seed yield and aphid tolerance. Single plants possessing desirable traits have been selected.			

IARI, New Delhi	**Development of Indian mustard varieties suitable for timely sown (irrigated and rainfed) conditions**	Fresh single crosses attempted	Improved Genotypes/varieties (Pusa 119-1-1-2, Pusa 36-1-1-3-2, PM 27, RH 725, NPJ 241, NPJ 243, MST 20-8, RH 749, NRCHB 101, DRMRAB-158, Pusa 34-1-1-1-1, NPJ 231, DRMRAB-714, 45S46, Donskaja, Heera, MST 20-13, MST 20-16, MST 20-18, MST 20-19, SEJ 8, AKMS 19-2, MST 19-3, MST 20-9, MST 20-10, MST 20-11, MST 20-12, NPJ 176, PMW 18 etc)	80	-	-
		Fresh multiple crosses attempted	F_1 x F_1 crosses	21	-	-
		Fresh crosses among wild relatives for drought tolerance, alternatia blight/white rust resistance etc.	Synthetic tertraploids (*Eru-rapa*&*Oxy-rapa*) /hexaploid (*Synapis alba/ B. juncea*), *B. tournefortii* (Rawa), PM 25, DRMRIJ 31, PM 30, SEJ 8, NPJ 176 and Pusa Gold etc.	7	-	-
		Crosses attempted in L x T design to find out good combiners	*B. carinata* derived *B. juncea* Introgression lines (ILs)	280	-	-
		F_1	Improved Genotypes/varieties	140	57	-
		Multiple crosses F_1	Multiple crosses among improved *B. juncea* genotypes	69	76*****	
		F_2	Conventional single crosses among improved *B. juncea*/ *B. juncea*	120	98*****	-
		F_3	Conventional single crosses among improved *B. juncea*/ *B. juncea*	105	89*****	-
		MCF_3	Conventional crosses (single/multiple); *D. erucoides/B. rapa (DDAA)//B. juncea// B. juncea* (YSG, TN 3, PM 25, NPJ 203, NPJ 212, RH 749, EC 30, EC 62, RH 1566, KM 126 etc)*; B. juncea/B. carinata derived ILs; B. juncea//* Turnip*/B. juncea///B. juncea*	65	75*****	-
		F_4	Improved *B. juncea*/ Improved *B. juncea like* PM 25, PM 27, YSG,NPJ 207, NPJ 208; Improved *B.juncea*/ Resynthesised *B. juncea*; *D. erucoides /B. rapa (DDAA)//B. juncea// B. juncea*	72	118*****	
		F_5	Multiple crosses among *B. juncea* genotypes like Pusa Jagannath, Pusa Agrani, PM 25, PM 30	12	15*****	
		MCF_5	*Turnip/B. juncea///B. juncea*; *B. juncea*/*B. juncea* ILs/Improved *B. juncea*, PM 25, PM 26, PM 27, SEJ 8, RH 749, Pusa Bold	34	35*****	2*****
		F_6	Improved *B. juncea* like Pusa Jagannath, DRMRIJ 31, NPJ 180, RH 749, SEJ 8, Pusa Tarak, PM 25 etc.	33	32*****	8*****
		F_6	*B. carinata* derived *B. juncea* Introgression lines (ILs) for WUE	191	29*****	-
		F_7	Single and multiple crosses among *B. juncea/ B. juncea* (BioYSR, NPJ 161, RGN 48, PBR 2008-5, NPJ 161, NPJ 176, EC 399299, NPJ 113, P Agrani, P Karishma, NPJ 112, RC 781, PBR 357, DRMRIJ 31, NPJ 156, RC 781, SEJ 8 etc)	38	4*****	31*****
		Synthetic *B. juncea* (S_2 lines)	NRCPB rapa 8 x *B. nigra*	48	36	-
	Development of Hybrid in Indian Mustard	A x R (F1s)	Involving CMS lines with *mori*, *eru* and *ber* cytoplasms	49	-	-
		Paired crosses (Back crosses 3 pairs each)	Back crosses for maintenance and development of CMS lines	72 (3 pairs each)	48	-
		BC_5F_1 and BC_3F_1	Backcross for restorer development	5	-	-

		BC_6F_2	Identification of individual plants with Fertility Restoration (*Rf*) gene in homozygous dominant state	52	52 x 3=156	-
	Development of short duration mustard varieties suitable for early sown	Fresh crosses attempted	Crosses were attempted using M25, IC355399, IC597894, DRMRIJ17-46, Heera, NPJ 210, KMR E 19-2, IM 22, Pro 5111, NRCHB101, RH599-41, PM26, 45S46, KMR(L)18-5 genotypes	38	-	-
		F_1 (Interspecific crosses)	*B. juncea* x *B. rapa*	4	4	-
		F_2	Improved genotypes, entries from local programme, AICRP-RM trials and exotic germplasm.	20	52	-
		F_3	*B. juncea* genotypes viz., DRMR 4005, PM 25, P Agrani, NPJ 176, SEJ 8, PDZ 9, E 7009A, PRE13-10, RH 1573, RH 1590, PM 28, EC 766602, NPJ 209, NPJ 210, NPJ 215, NPJ 216, EC 61, Pro5111, NPJ 207, NPJ 208, Bio 902, RB 50, BM 97 were used as parents in the crosses.	142	75	-
		F_4	BCEF 17-20-1, PM 25, RB 50, BM 97, PM 28, NPJ 161, PM 26, Laxmi, BCEF 100-18-1-1, Bio 902, NPJ 207 were used	41	22	-
		F_5	Improved *B juncea* genotypes such as PM 27, Laxmi, NPJ 102, Varuna, BEC 144, Bio 902, RH 1301 NPJ 176 and PM 26 were used	25	27	-
		F_6	Improved *B juncea* genotypes viz., LES 1-27, EC 597325, PM 25, NPJ 176, SEJ 8, P. Agrani, Laxmi, PM 27, NRCDR 02 were used as parents in attempting crosses	25	5	21
		F_7	Improved genotypes such as Kranti, Pusa Mustard 25, NPJ 176, Pusa Agrani, Laxmi, NRCDR 02, NRCHB 101, NPJ 124, RGN 48 etc.	23	4	14
	Development of short duration mustard varieties suitable for late sown	F_1 (Interspecific crosses)	*B. juncea* x *B. carinata*	1	1	-
		F_2	Improved genotypes such as NPJ 221, RH 1209, NPJ 198, DRMRB17-15, NPJ 222, IC 766428, NRCHB 101, EC 766602, DRMRIJ 31, NPJ 216, BM 118, NPJ 210, Heera, RLC 3, RH 1585, NPJ 198 were used as parents	15	39	-
		F_3	DRMR 4005, P Agrani, NRCHB 101, E7009A, PRE 13-10, PM 25, RH 1573, PM 28, PM 26, RH 1590, RH 1573, PDZ 9, EC 766602, NPJ 216, SVJ 8, NPJ 210, Non-waxy mutant, PRO 5111, NPJ 209 were used	83	76	-
		F_4	PM 25, NPJ 161, PM 26, BCEF 17-20-1, PM 28, RB 50, BM 97, NPJ 156, EJ 17, NPJ 208, Laxmi, BECF 100-18-1-1 were used to generate populations	59	54	-
		F_5	PM 26, DRMR 4104, RH 1368, NPJ 102, P Jagannath, Varuna, BEC 144, Bio902, Pusa Vijay, GM 2, RB 50, Laxmi, PM 27 were taken as parents	51	60	-
		F_6	Improved genotypes such as PM 25, PM 26, RH 1301, IC261627, PM 27, EJ 15, IC 766143, EC 597325, LES 1-27, NPJ 173 were taken as parents	26	4	15
		F_7	*B. juncea* viz., P Agrani, Laxmi, NPJ 176, NPJ 173, NRCHB 101, PBR 357, RGN 48 were used as parents to generate segregants	16	2	9
	Enhancement of oil and meal quality in Indian mustard	Fresh interspecific crosses attempted	PDZ-11, BRS10 (*Brassica macrocarpa*)	1	-	-
		Fresh single crosses attempted	Quality genotypes including Heera, PDZ-6, PDZ-11, PDZ-12, RH-801, PM-30, PM-32, LES-60, RH1706, RLC-3 were used	14	-	-
		Fresh multiple crosses attempted	Crosses between F1s involving quality parents viz., PDZ-6, DMH-1, 45S46, PDZ-11, LES-60, PM-32, RLC-2, RLC-3, RH-801, RH1706, Giriraj, RCH-1 were used	18	-	-

		F_1	Improved genotypes, conventional varieties, low erucic and/or low glucosinolates varieties such as LES 54, PDZ 6, PDZ 11, RH 749, 45S46, RH 801, RH 1706 etc. were used.	20	10	-
		Multiple crosses F_1	F_1s x F_1s and F_1s x Improved genotypes possessing quality traits	27	12*	-
		F2	Improved quality genotypes such as NPJ 203, PDZ 11, PDZ 12, RLC 2, RLC 3 were used for generating segregating populations	24	251*	-
		F3	RLC 3, LES 57, PM 30, Pusa Vijay, PDZ 6, LES 56, E16-7072 etc. were used	57(0)+88(00)	57(0)+126(00)*	-
		F4	Genotypes PM 30 and RLC 3 were used to generate progenies	33(0)+11(00)	77(0)+22(0 0)*	-
		F5	Parents viz., 00WR97-1, PDZ 6, LES 52, RLC 3 were used	15(0)+6(00)	34(0)+18(0 0)*	-
		F6	PM 21, EJ 15, PM 30, RLC 3, Kranti, EC 597325, LES 51 were involved in generating progenies	37(0)+24(00)	39(0)+42(0 0)*	29(0)+18(00)*
		F7	EC 597325, Heera, LES 1-27, PM 30 were involved	24(0)+6(00)	7(0)+5(00)*	15(0)+4(0 0)*
	0/00 trait with white rust resistance	Fresh direct crosses attempted	PM-25,PM-26,PM-32, Heera, PDZ-1, RLC-3	12	-	-
		BC1 attempted	PM-22, Jagannath, NPJ-198, NRCHB-101, DRMRIJ-31, Donskaja, Heera, PDZ-1, RLC-3	65	-	-
	* Single plants and bulks shall be further rejected on the basis of yield performance, seed shape, size and oil content before sowing of breeding material in *Rabi* 2021-22.					
Jhansi	Breeding for High seed yield	**Fresh Crosses**	RH 725 x Bio YSR, RH-725 x RVM-2, RH 725 x NDYR 10, Giriraj x NDYR 10, RH 749 x NDYR 10, RH-406 x RGN-298, Pusa Vijay x BPR-543-2, RGN-298 x BPR- 540-6, RH-749 x DRMR-150-35, RGN-298 x DRMR-150-35.	10		
		F_2	Juncea YS x RE 14, Juncea x RE 551, HB 9918 x RE 18, HB 9918 x RE 14, EH 2 x RE 44, EH 2 x RE 551, MJB 3 x Donskaja, MJB 3 x RE 8, MJB 3 x RE 13 and IJ 31 x RE 44.	10	12-15 single plants from each cross	10
		F_3	HB 9925 x RGN 73, HB 9925 x RH 749, DRMR-IJ-31 x RGN- 73, DRMR-IJ-31 x EH_2, DRMR-IJ-31 x DRMR-IJ-17-40, DRMR-IJ-31 x RH- 749, MJB-10 x EH_2, MJB-10 x DRMR-IJ-17-40, MJB-11 x RGN-73, MJB-5 x RH-749.	10	Best progenies from each F_3 population has been selected to advance the generations	
Ludhiana	*Brassica juncea* (Conventional and timely sown)	• Productivity and oil content. • To improve genet diversity for enhanced heterosis	Fresh crosses	55		

			F_1	120		
			F_2	95		
			F_3	100		
			F_4	80		
			F_5	20		
		White rust	F_1	5		
	Brassica juncea (Quality)	To enhance variability in canola quality germplasm for higher yield and oil content	Fresh crosses	68		
			F_1	90		
			F_2	96		
			F_3	90		
			F_4	40		
			F_5	26		
			Advanced lines (0/00)	120		
		Mutation breeding for biotic stress	M2 with Gamma rays	250		
	Hybrid development (Conventional)	CMS lines developed/ maintained		150		
		Restorer lines developed/maintained		5		
	Hybrid *Brassica juncea* (Quality)	CMS lines developed/ maintained		100		
		Restorer lines developed/maintained		2		
	RIL populations developed/ maintained	Quality characters	NUDHYJ-4 x RL 1359 RL1359 x CBJ001	Two		
Kanpur	Early maturing, high yielding, bold/medium, brown/yellow seeded varieties,	Fresh crosses	**Set – I:** Twenty one crosses (7 Parental diallel excluding reciprocals) using TM-117, TM-179, TM-106, TM-108, TM-108-1, RGN-298 and Rohini were attempted F_0 seeds of 21 crosses were procured which will be grown in coming next season to raise F_{1s} population **Set – II:** Twenty one crosses (7 Parental diallel excluding reciprocals) using PR-20, PR-21, Azad Mahak, KMR17-5, KMR17-4, NDR-501, andKMR(L)17-6 were attempted F_0 seeds of 21 crosses were procured which will be grown in coming next season to raise F_{1s} populations. **Set – III:** Forty five crosses (10 Parental diallel excluding reciprocals) using RH-749, Varuna, NRCDR-2, Urvashi, IJ-31, Maya, RH-406, Azad Mahak, KMR17-3 and KMR17-4 were	264		

			attempted F_0 seeds of 45 crosses were procured which will be grown in coming next season to raise F_{1s} populations. **Set – IV:** Forty five crosses (10 Parental diallel excluding reciprocals) using RH-749, Giriraj, Varuna, Kanti, NPJ-112, RH-119, HUJM 10-6, NDR-8, HUJM-99-01 and RLC-7 were attempted F_0 seeds of 45 crosses were procured which will be grown in coming next season to raise F_{1s} populations. **Set – V:** Forty five crosses (10 Parental diallel excluding reciprocals) using Basanti, Varana, Urvashi, NRCDR-2, KMR-19-1, KMR19-2, RH-749, IJ-31, RH-406 and Azad Mahak were attempted F_0 seeds of 45 crosses were procured which will be grown in coming next season to raise F_{1s} populations. **Set – VI:** Forty five crosses (10 Parental diallel excluding reciprocals) using Varana, KMR-17-3, KMR16-1, TPM-106, Guccha Rai, Mathura Rai, Lotni Gota, Kranti, Giriraj and SeJ-2 were attempted F_0 seeds of 45 crosses were procured which will be grown in coming next season to raise F_{1s} populations. **Set – VII:** Twenty one crosses (7 Parental diallel excluding reciprocals) using Urvashi, PM-27 Pusa agrani, RH-749, KMR15-2, Pusa bahar and Durgamani were attempted F_1 seeds of 21 crosses were procured which will be grown in coming next season to raise F_2 populations. **Set –VIII:** Twenty one crosses (7 Parental diallel excluding reciprocals) using Maya, Basanti, PM-28, PM-29, PM-30, Rohini and Kanti wereattempted F_1 seeds of 21 crosses were procured which will be grown in coming next season to raise F_2 populations.			
		F_2	NRCDR-2 x NRCHB-101, NRCDR-2 x Pusa mustard-2, NRCDR-2 x RLM-198, NRCDR-2 x KMR-13-4, NRCDR-2 x KMR-14-4, NRCDR-2 x Pusa bold, NRCHB-101 x Pusa mustard-21, NRCHB-101 x RLM-198, NRCHB-101 x KMR-13-4 ,NRCHB-101 x KMR-14-4, NRCHB-101 x Pusa bold, Pusa mustard-21 x RLM-19, Pusa mustard-21 x KMR-13-4, Pusa mustard-21 x KMR-14-4, RLM-198 x Pusa bold, RLM-198 x KMR-13-4 ,RLM-198 x KMR-14-4 ,KMR-13-4 x KMR-14-4, KMR-13-4 x Pusa bold, KMR-14-4 x Pusa bold.	20	**403**	
		F_3	NRCDR-2 x Pusa jai kisan, NRCDR-2 x JM-2 , NRCDR-2 x Geeta, NRCDR-2 x Urvashi, NRCDR-2 x RGN-73, NRCDR-2 x Maya, NRCDR-2 x CS-52, Pusa jai kisan x JM-2, Pusa jai kisan x Geeta, Pusa jai kisan x Urvashi, Pusa jai kisan x RGN-73, Pusa jai kisan x Maya, Pusa jai kisan x CS-52, JM-2 x Geeta, JM-2 x Urvashi,JM-2 x RGN-73, JM-2 x Maya, JM-2 x CS-52 ,Geeta x Urvashi, Geeta x RGN-73, Geeta x Maya, Geeta x CS-52, Urvashi x RGN-73 , Urvashi x Maya, Urvashi x CS-52,RGN-73x Maya, RGN-73x CS-52, Maya x CS-52.	28	583	
		F_4	Varuna x Pusa bold, Varuna x RLM 198, Varuna x Rajat, Kranti x Rajat, Pusa bold x RLM 198, Pusa bold x Maya, Vardan x Pusa bold, Vardan x NDR-8501, Vardan x Laha-101, Vaibhav x Pusa bahar, Vaibhav x Pusa bold, Vaibhav x NDR-8501, Vaibhav x Laha-101, Pusa bahar x Pusa bold, Pusa bahar x NDR-8501, Pusa bahar x Laha-101, Pusa bold x NDR-8501, Pusa bold x Laha-101, NDR-8501 x Laha -101.	19	417	
		F_5	Varuna x Pusa bold, Varuna x RC-781, Varuna x RH-198, Varuna x Pusa Jagannath, Varuna x Jawahar mustard-1, NUDH x Pusa bold, NUDH x RC-781, NUDH x RH-198, NUDH x Pusa Jagannath, NUDH x Jawahar mustard-1,	10	223	
		F_6	Varuna x Urvashi, Varuna x Maya, Varuna x Kranti , Varuna x NDR-8501, Varuna x Pusa bold, Varuna x Aravali , Urvashi x Maya, Urvashi x Kranti , Urvashi x NDR-8501, Urvashi x Pusa bold , Urvashi x RH-30, Maya x Kranti, Maya x NDR-8501, Maya x Pusa bold, Maya x RH-30,	16	329	

			Kranti x NDR-8501.			
		F_7	Kranti x Pusa bold, Seeta x Varuna, Seeta x Pusa bold, Seeta x Aravali, Seeta x Sej-2, Pusa bold x Sej-2, Pusa bold x Durgamani, Pusa bold x Aravali, Ashirwad x Varuna , Ashirwad x Maya, Ashirwad x Kanti, Ashirwad x Jawahar-1, Ashirwad x Vaibhav, Rohini x Vardan, Rohinix Basanti, Rohini x Maya, Rohini x Pusa bold, Rohini x Kranti, Rohini x Pusa basant.	19	408	
		F_8	Varuna x Rohini, Varuna x NDR 8501, Varuna x RH-30, Varuna x RLM -198, Varuna x KR-5610, Varuna x CSR-1017,Varuna x Pusa basant, , Rohini x B-85, Rohini x Mathura Rai, Rohini x NDR-8501, Rohini x RH-30, Rohini x RLM-198,Rohini x KR-5610, Rohini x CSR-1017, Maya x Urvashi,Maya x Basanti, Maya x RC-781, Pusa bold x Urvashi, Vardan x Maya, Vardan x Basanti, Vardan x Kranti, Pusa basant x Kranti,Pusa basant x NDR-8501, Vaibhav x Jawahar mustard-1, and Vaibhav x Basanti.	25	556	
Morena	Identification of good combiners for seed yield and WRR quality	**Fresh crosses**	72 fresh crosses were made during rabi 2020-21	72		
	High seed yield and quality	**F_1**	Crosses among RGN-73, Kranti, PM-25, PM-26, PM-27, PM-28, DRMRIJ-31, RH-749, JMWR-908-1	**84**		
		F_2	Crosses among NRCDR-2, Pusa Jagannath, JM-1, JM-2, JM-3, DRMRIJ-31, NRCHB-101, RB-50, RH-406, RVM-1	**7**	**25**	
		F_3	RH-749 x RVM-3, JM-3 x RH-749, JMM-09-3 x RVM-3, JMM-09-1-1 x Kranti	**4**	**30**	
		F_4	DRMRIJ-15-85 x MRNJ-77, RDZ-6 x MRNJ-77,RVM-2 x RDZ-6, RVM-2 x DRMRIJ-15-85, JMM-927 x RGN-73, DRMRIJ-15-85 x JM-4,	**6**	**20**	
		F_5	44 S 31 x Kranti,, 44 S 31 x RGN-73, PM-28 x Pusa Mustard- 25, RH-1134 x RGN-73, Pusa Mustard- 25 x PM-28, Pusa Mustard- 25 x RVM-2	**6**	**25**	
		F_6	MRNJ-73 x RVM-1, MRNJ-98 x JM-4, MRNJ-96 x JM-3, MRNJ-90 x JM-3, MRNJ-90 x RVM-1, MRNJ-91 x JM-2, MRNJ-92 x JM-2, MRNJ-96 x JM-4, MRNJ-97 x JM-3, MRNJ-98 x JM-1, MRNJ-98 x RVM-1, MRNJ-100 x JM-3, MRNJ-70 x JM-1, MRNJ-73 x JM-4, MRNJ-73 x RVM-2, MRNJ-77 x JM-2, MRNJ-78 x JM-1, MRNJ-83 x JM-2, MRNJ-84 x RVM-1, MRNJ-85 x JM-1, MRNJ-87 x JM-3,	**21**	**35**	
		F_7	JM-4 x MRNJ-101, JM-1 x MRNJ-101, JM-2 x MRNJ-1, JM-2 x MRNJ-137, JM-2 x MRNJ-131, JM-3 x MRNJ-101, JM-3 x MRNJ-84, JM-4 x MRNJ-137, JM-4 x Rohini, RVM-1 x MRNJ-101, RVM-2 x MRNJ-101, RVM-2 x MRNJ-84, RMM-09-3 x MRNJ-1, RMM-09-3 x MRNJ-137, RMM-09-3 x MRNJ-84, RMM-09-3 x MRNJ-131	**16**	**20**	
Pantnagar	Early Sowing	Fresh crosses	PRE-13-3 x PRE-20-12, PRE-13-3 x CRP-8, PRE-13-3 x CRP-12, PRE-13-3 x PRHC-14-15, PRE-13-3 x PRHC-14-1-1, PRE-16-2 x PRE-20-12, PRE-16-2 x CRP-8, PRE-16-2 x CRP-12, PRE-16-2 x PRHC-14-15, PRE-16-2 x PRHC-14-1-1, PRE-16-5 x PRE-20-12, PRE-16-5 x CRP-8, PRE-16-5 x CRP-12, PRE-16-5 x PRHC-14-15, PRE-16-5 x PRHC-14-1-1, PRE-16-1 x PRE-20-12, PRE-16-1 x CRP-8, PRE-16-1 x CRP-12, PRE-16-1 x PRHC-14-5, PRE-16-1 x PRHC-14-1-1, PRE-19-7 x PRE-20-12, PRE-19-7 x CRP-8, PRE-19-7 x CRP-12, PRE-19-7 x PRHC-14-15, PRE-19-7 x PRHC-14-1-1, CRP-11 x PRE-20-12, CRP-11 x CRP-8, CRP-11 x CRP-12, CRP-11 x PRHC-14-15, CRP-11 x PRHC-14-1-1, PRHC-13-7 x PRE-20-12, PRHC-13-7 x CRP- 8, PRHC-13-7 x CRP-12, PRHC-13-7 x PRHC-14-15, PRHC-13-7 x PRHC-14-1-	40		

			1, CRP-17 x CRP-8, CRP-17 x CRP-12, CRP-17 x PRHC-14-15, CRP-17 x PRHC-14-1-1, SKM1512 x PRE-20-12, SKM1512 x CRP-8, SKM1512 x CRP-12, SKM1512 x PRHC-14-15, SKM1512 x PRHC-14-1-1.			
		F1	PR-19×CRP-8, PR-19×PRHC-14-10, PM-25×CRP-5, PM-25×PRHC-14-5, PRE-18-14×CRP-10, PRE-18-14×PRHC-14-1-1, PRE-18-8×CRP-15, PR-20×CRP-3, PR-20×PRHC-6-3, NRCHB-101×CRP-1, NRCHB-10×PRHC-14-5-4, PR-16-4×CRP-3, PR-16-4×PRHC-14-1-1, PR-21CRP-1, PM-27×CRP-8, PM-27×PRHC-14-10, PM-28×CRP-3, PM-28×PRHC-14-5, DRMRIJ-16-51×PR-19, DRMRIJ-16-15×CRP-5, DRMRIJ-16-15×PRHC-14-1-1, DRMRIJ-16-15×PM-25, PRE-17-2×PM-27, PRE-17-2×DRMRIJ-16-51, PRE-17-1×PM-25, PRE-17-1×DRMRIJ-16-51, PRE-18-1×PM-25, PRE-18-1×DRMRIJ-16-51, PRE-18-3×PM-27, PRE-18-7×PM-25, PRE-18-9×DRMRIJ-16-51, PRE-18-12×DRMRIJ-16-51, PRE-18-13×DRMRIJ-16-51, PRE-18-13×PM-25, PRE-17-1×PM-25	**35**		**24**
		F2	NDRE-4×DRMR-IJ-16-51, NDRE-4×DRMR-IJ-16-56, PM-28×DRMR-IJ-16-51, PM-28×DRMR-IJ-16-56, DRMR-IJ-16-51×PR-19, DRMR-IJ-16-51×PM-25, DRMR-IJ-16-51×NDRE-4, RH-1656×PR-19, RH-1656×PM-25, RH-1656×NDRE-4, PRE-16-2×DRMR-IJ-16-51, PRE-16-2×RH-16-56, PRE-16-2×PM-27, PRE-2017-2×DRMR-IJ-16-51, PRE-2017-2×PM-25, PRE-2017-2×RH-16-56, PRE-2017-8×NDRE-4, PRE-2017-8×NPJ-112, PRE-2017-7×NPJ-112, (RH-1209×GP1-8)×NPJ-112, (RH-1209×GP-1-8)×PR-20, (RH-1209×GP-1-14)×NDRE-4, (RH-1209×GP-1-4)×PR-19, (RH-1209×GP-1-7)×NPJ-112, (RH-1209×GP-1-4)×PR-19, (PR-2015-1×CRP-3)×PR-19, (PR-2015-1×CRP-3)×PR-20, (PR-2015-1×CRP-3)×Albeli, (Giriraj×GP-I-123)×PR-20, (Giriraj×GP-I-123)×RH-749, (PRHC-13-7×CRP-1)×Albeli, (PRHC-13-7×CRP-1)×PR-20, (NPJ-203×GP-I-7)×Albeli, (PRE-10-7×CRP-1)×PR-20, (PRE-10-7×CRP-1)×RH-749, (PRE-10-7×CRP-1)×NPJ-112, (PRE-13-13×PR-20)×NDRE-4, (PRE-13-13×PR-20)×NPJ-112, (PR-19×CRP-1)×Albeli	**39**		**15**
		F3	PR-15-1 × GP-1-3, RH-1209 × GP-1-7, PR-15-1 × GP-3, PR-15-1 × GP-1-5, Giriraj × GP-I-22, Giriraj × GP-I-7, Giriraj × GP-I-14, Giriraj × GP-I-5, PR-21 × GP-I-7, RH-1209 × GP-I-3, RH-1209 × GP-I-22, Giriraj × GP-I-3, Giriraj × GP-I-23, PR-19 × EJ-17, JD-6 × GP-I-3, NPJ-203 × GP-I-7, PRE-10-7 × CRP-1, NPJ-203 × GP-1-3, NPJ-203 × GP-1-22, PR -21 × GP-I-3, NPJ-203 × CRP-3, PRE-12-4 × GP-I-3, NPJ-203 × GP-1-5, PR-21 × GP-I-8, PR-2012-4 × CRP-3, PR-2012-4 × GP-I-14, JD-6 × CRP-3, PR-21 × GP-I-22, NPJ-203 × GP-1-23, RH-406 ×PRE-2013-13, PR-21 × CRP-3, Griraj × CRP-3, PR-12-4 × GP-I-5, PR -19 × CRP-I, PR-2015-1 × GP-I-23, PR-2015-1 × GP-I-14, PR-12-4 × GP-I-7, PR-12-4 × GP-I-22, PR-21 × GP-I-4, (PRE-13-10 x Krishna) x CRP-1-14, 392 From conversion, Rohini × PRHC-13-7-10, PR-2013-2 × PRHC-14-10, PR-2013-2 × PRHC-13-7-10	**44**		**23**
		F4	PRE-13-19 × PBML-2, PRE-13-10 × Krishna, PRE-13-19 × Divya-88, PR-2016-5 × IC-427689, PRHC-13-7 (MH) × PRHC-13-7(DH), PRHC-13-7 (MH) × PRHC-13-7(DH), PRHC-13-7 (MH) × PRHC-13-7(DH), PRE-10-7 × PRHC-13-7, PRHC-13-7 (MH) × PRHC-13-7(DH), PRHC-13-7 (MH) × PRHC-13-7(DH)	10		5
		F5	Albeli × NPJ-112, PR-21 × NDRE-4, PRE-11-6 × Albeli, PRE-12-11 × Albeli, RGN-145 × NDYR-8	5	68 IPS	-
		F6	PRE-2011-15 x RRN-778, PRE-2011-15 x Maya, Divya 55 x NPJ-112, DRMR-675-39 x NPJ-112, Maya x NPJ-112	5 (123IPS)	-	40 Lines

		F7	(PRE-2010-19×EJ-17)×Maya, (PRE-2010-19×NDRE-4)×Maya, (PRE-2010-19×EJ-17)×Albeli, NPJ-112 xPRE-2010-15, PRE-2010-19 x PRE-2010-15, NDRE-4 x(PRE-2010-15× RGN-73), PRB-08-5xPRE-2010-15, Albeli xPRE-2010-15	31	-	15 Lines
		Advanced line		33		18 lines
	Timely sowing	**Fresh crosses**	Giriraj × YR-9, Giriraj × PRHC-13-7-5, Giriraj × PRHC-13-7-10, Giriraj × PRB-16-1, Giriraj × PR-17-11, PR-17-2 × YR-9, PR-17-2 × PRHC-13-7-5, PR-17-2 × PRHC-13-7-10, PR-17-2 × PRB-16-1, PR-17-2 × PR-17-11, PR-17-5 × YR-9, PR-17-5 × PRHC-13-7-5, PR-17-5 × PRHC-13-7-10, PR-17-5 × PRB-16-1, PR-17-5 × PR-17-11, PR-19-8 × YR-9, PR-19-8 × PRHC-13-7-5, PR-19-8 × PRHC-13-7-10, PR-19-8 × PRB-16-1, PR-19-8 × PR-17-11, PR-17-11 × RB-101, PR-17-11 × Giriraj, PR-17-11 × Albeli, PR-17-11 × PR-20, PR-19-2 × RB-101, PR-19-2 × Giriraj, PR-19-2 × Albeli, PR-19-2 × PR-20, PR-19-9 × AKMS-19-2, PR-19-9 × Giriraj, PR-19-9 × Albeli, PR-19-9 × PR-20, PR-17-8 × AKMS-19-2, PR-17-8 × Giriraj, PR-17-8 × Albeli, PR-17-8 × PR-20, RGN-73× AKMS-19-2, RGN-73 × Giriraj, RGN-73 × Albeli, RGN-73 × PR-20, PR-15-5 × AKMS-19-2, PR-15-5 × Giriraj, PR-15-5 × Albeli, PR-15-5 × PR-20, PR-16-4 × AKMS-19-2, PR-16-4 × Giriraj, PR-16-4 × Albeli, PR-16-4 × PR-20, PR-16-8 × AKMS-19-2, PR-16-8 × Giriraj, PR-16-8 × Albeli, PR-16-8 × PR-20	**45**	**-**	**-**
		F1	PM-26×Albeli, PM-26×Rajvijay, PM-26×PR-18-6, PR-12-4×PR-18-5, RH-749×Rajvijay, RH-749×Albeli, Krishna × Rajvijay, Krishna × Albeli, Krishna×RH-749, PR-19-11×Rajvijay, PR-19-11×RH-749, PR-19-9×Rajvijay, PR-19-9×RH-749, PR-19-10×Rajvijay, PR-19-10× RH-749, PR-19-2× Rajvijay, PR-19-2×RH-749, PR-18-6×PM-25, PR-18-6×CRP-5, PR-13-2×Rajvijay, PR-13-2×NASP II-22, PR-18-5×RH-749, PR-18-5×PR-12-4, PR-17-2×RGN-73, RH-1599-41×Albeli, RH-1599-41×Rajvijay, RH-1599-41×PR-18-6	**27**		19
		F2	Rohini ×PRHC-13-7-10×PR-20, Rohini ×PRHC-13-7-10×Albeli, Rohini ×PRHC-13-7-10×RH-749, PR-2013-2×PRHC-13-7-10×PR-20, PR-2013-2×PRHC-13-7-10×Albeli, PR-2013-2×PRHC-13-7-10×RH-749, RGN-394×PRHC-13-7-1×Giriraj, RGN-394×PRHC-13-7-1×Albeli, PR-2013-7×PRHC-14-10×PR-20, PR-2013-7×PRHC-14-10×Giriraj, PR-2013-7×PRHC-14-10×RH-1585, RGN-73 × Kranti, KMR-17-3× Kranti, RH-1585× Kranti, PR-15-7× Kranti, RH-749× PR-20, RH-749× PR-12-4, PR-17-5× RH-749, PR-17-8× Albeli	**19**		**16**
		F3	NPJ-208 x NPJ-113, PR-13-2 × PRHC-14-9, PR-2015-5 × EJ-17, PR-2015-5×Divya-22, PR-2015-5 × IC-264133, RGN-394 × PRHC-14-7-1, PR-2013-7 × PRHC-17-7-10, RGN-394 × PRHC-13-7-1, PR-2013-7 × PRHC-14-10, (PR-15-5 x Divya) x PRHC-14-9	**10**		**6**
		F4	PRE-2013-19 x PBML-1, PRE-2013-10 x PR-2012-12, PRE-2013-10 x RH-749, PRE-2013-19 x Maya, PRE-2013-10 x PBML-2, PR-2015-1 × Maya, PR-2015-1 × RGN-73, PR-2016-4 × Rajvijay, PR-2016-3 × Giriraj, PR-2015-1 × Giriraj, PR-2016-5 × Maya, PR-2012-12 x PBML-1, PR-2016-6 × Giriraj, PR-2016-1 × Maya, PR-12-12 x IC-355934, PR-2016-6× IC 520478, PR-20 x IC-355931, F_1 x PR-2012-12, RRN-9-11 x RH-749, Giriraj x NDYR-8, Three way cross:-(PRE-2011-6 x Rajvijay) x RH-1209, (PR -21 x NDRE-4) x RH-749, (PR -21 c) x Divya-88, (KMR-2013-14 × Albeli) × Krishna, (TM-1061 × CAN-83) × PR-2012-12, (Albeli × NPJ-112) × PR-2012-12, (PYR-2012-5 x NDYR-8) × PR-2012-12, (Novgold x NDYR-8) × CS-56, (PYR-2012-5 x NDYR-8) × NPJ-112	**29**		**15**
		F5	ACN-83 × PR-20, Divya 55 × Kranti, RH-1019 × Raj Vijay, NPJ-191 × Albeli, NPJ-191 × Raj Vijay, (RMM-09-4 × NPJ-112) × Albeli, (DRMR-675-3 × PRE-11-15) × Albeli, Giriraj × PR-20	8	119 IPS	-

		F6	Divya-55 × RRN-778, Divya-55 × RB-57, PR-2009-6 × RGN-73, PR-2009-6 × Albeli, (PR-2009-6 × Albeli) × Albeli, (PR-2009-6 × RGN-73) × PR-2009-6, (PR-2009-6 × Albeli) × PR-2009-6, (KMR-13-3 × PR-20) × KMR-13-3	8 (156)	-	23 Lines
		F7	PR-2009-6 × PR-20, PBR-423 × Albeli, PR-2009-6 × NDYR-8, RH-0923 × Albeli, PR-2009-6 × RGN-73, PBR-04-23 × RGN-73, PR-2009-6 × Albeli	34	-	10
	Late sowing	**Fresh crosses**	PRL-17-7 × AKMS-19-2, PRL-17-7 × Giriraj, PRL-17-7 × Albeli, PRL-17-7 × PR-20, PRL-17-12 x NRCHB-101, PRL-17-12 x NPJ-113, PRL-17-12 x PRL-17-3, PRL-2020-1 x NRCHB-101, PRL-2020-1 x NPJ-113, PRL-2020-1 x PRL-17-3, PRL-20-4 x NRCHB-101, PRL-20-4 x NPJ-113, PRL-20-4 x PRL-17-3, PAB-17-16 x NRCHB-101, PAB-17-16 x NPJ-113, PAB-17-16 x PRL-17-3, PRL-20-13 x NRCHB-101, PRL-20-13 x NPJ-113, PRL-20-13 x PRL-17-3, PRL-20-30 x NRCHB-101, PRL-20-30 x NPJ-113, PRL-20-30 x PRL-17-3, PRL-20-29 x NRCHB-101, PRL-20-29 x NPJ-113, PRL-20-29 x PRL-17-3, PRL-20-16 x NRCHB-101, PRL-20-16 x NPJ-113, PRL-20-16 x PRL-17-3, PRL-20-20 x NRCHB-101, PRL-20-20 x NPJ-113, PRL-20-20 x PRL-17-3, PRL-20-22 x NRCHB-101, PRL-20-22 x NPJ-113, PRL-20-22 x PRL-17-3, PAB-17-11 x NRCHB-101, PAB-17-11 x NPJ-113, PAB-17-11 x PRL-17-3	**37**	**-**	**-**
		F1	PRL-17-1×NRCHB-101, PRL-17-1×NPJ-126, PRL-17-2×NRCHB-101, PRL-17-2×NPJ-113, PRL-17-2×NPJ-126, PRL-17-3×NRCHB-101, PRL-17-3×DRMRIJ-16-38, PRL-17-3×DRMRIJ-2017-15, PRL-17-6×NRCHB-101, PRL-17-6×Rajvijay, PRL-17-6×RH-1599-41, NPJ-216×Albeli, NPJ-216×PR-18-6	**13**		**10**
		F2	PRL-2013-9×DRMR-2017-5, PRL-2016-6× DRMR-2017-5, PRL-2016-5× DRMR-2017-5, PRL-2018-5×PRL-2018-19, PRL-2018-14×PRL-2018-19, PRL-2016-5×MCN-2013-9, PRL-2016-5×MCN-2018-5, PRL-2017-1×MCN-2018-5, PRL-2017-1×NRCHB-101, PRL-2017-2×MCN-2018-14, PRL-2017-2×NRCHB-101, Albeli×MCN-15-21, Rajvijay×MCN-15-1, NPJ-112×MCN-15-21, RS-57×PR-13-7, RS-57×PR-13-2	**16**		**12**
		F3	PR-20 × NRCHB-101, RH-1599 × NRCHB-101, PRB-417 × NPJ-113, PRL-2013-17 × Ashirwad, DRMR-2035 × NRCHB-101, NPJ-208 × PR-2012-12, RH-1599 × NPJ-113, NRCHB-101× PRHC-14-8, NPJ-208× Ashirwad, PR-2015-1× GP-1-7, PR-2015-1× GP-1-22, PR-2015-1× GP-1-23	**12**		**10**
		F4	PRD-2013-6 × NPJ-113, NPJ-113 × NRCHB-101, PR-2016-3 x PAB-9511, PR-2016-5 x PWR-2013-8, (Albeli × NPJ-113) × NRCHB-101, (NRCHB-101x Vardan) × NPJ-113	**6**		**5**
		F5	NRCHB-101 × Ashirwad, NRCHB-101 × Vardan, PRL-10-8 × NRCHB-101, PRD-13-2 × NRCHB-101, PRD-13-9 × Ashirwad, PRD-13-9 × NRCHB-101, PRL-12-13 × Raj Vijay	**7**	**86 IPS**	
		F6	PRB-2013-7 × NRCHB-101, PRL-2012-6 × Raj Vijay, PRL-12-13 × RMM-09-4, PRL-12-13 ×NRCHB-101, PRL-12-13 ×Divya 55, NRCHB-101 × Maya, NRCHB-101 × DRMR-675-39, DRMR-675-39 × RRN-778, RB-57 × RRM-09-4	**9 (109 IPS)**	**-**	**22 Lines**
		Advanced lines	**-**	**33**	**-**	**-**
	Yellow seeded	**F1**	PR-20×NDYR-8, PR-20×PYS-9-5, RH-749×NDYR-10, RH-749×PYR-12-5, DRMR-61-106×NDYR-8, DRMR-61-106×PYR-12-5, RGN-73×PYR-95, NDYR-10×Maya, NDYR-10×RH-749, NDYR-10×PR-20	**10**	**-**	**5**
		F2	NDYR-10 × Maya, NDYR-10 × RH-749, NDYR-10 × PR-20, NDYR-10 × NRCHB-101	**4**	**-**	**3**
		F4	(NDYS-12-5 × NDYR-8) × DRMR-101, (NDYR-10 × PRY-2009-8) × PR-2012-12, (PYR-2012-5 × NDYR-8) × PR-2012-12, (Navgold × NDYR-8) × CS-56, (PYR-2012-5 × NDYR-8) × NPJ-112, (NDYS-8 × PYS-2009-5) × PR-19, Griraj x NDYR-8	**7**	**-**	**4**

		F5	NDYR-8 × PYR-2009-5, PYR-2012-5 × NDYR-8, (PRE-11-6 x Raj Vijay) x RH-1209	**3**	**17+2**	**-**
		F6	RH-0923 × NDYR-8, PR-2009-6 × NDYR-8, (PYR-2009-13 × Novgold) × (PYR-2009-13 × Pro-0306)	**3 (11 IPS)**	**-**	**7 Lines**
	***Alternaria* blight resistance**	**Fresh crosses**	Rohini × PAB-9511, Rohini × PHR-2, Rohini × PAB-17-1, Rohini × PAB-17-4, RGN-73 × PAB-9511, RGN73 × PHR-2, RGN 73 × PAB-17-1, RGN 73 × PAB-17-4, NRCHB101 × PAB-9511, NRCHB101 × PHR-2, NRCHB101 × PAB-17-1, NRCHB101 × PAB-17-4,Krishna × PAB 9511, Krishna × PAB-17-1, Krishna × PAB-17-4, Krishna × PHR-2, PR 20 × PAB 9511, PR 20 × PHR1, PR 21 × PAB 9511, PR 21 × PHR1, NPJ-126 × PAB 9511, NPJ-126× PHR-1, Ashirwad× PAB 9511, Ashirwad× PHR1, PRD-14-13 ×AKMS-19-2, PRD-14-13 × Giriraj, PRD-14-13 × Albeli, PRD-14-13 × PR-20PAB-2014-4 x NRCHB-101, PAB-2014-4 x NPJ-113, PAB-2014-4 x PRL-17-3, PAB-14-17 x NRCHB-101, PAB-14-17 x NPJ-113, PAB-14-17 x PRL-17-3, PAB-17-1 x NRCHB-101, PRD-14-25 x NRCHB-101, PRD-14-25 x NPJ-113, PRD-14-25 x PRL-17-3, PRD-14-23 x NRCHB-101, PRD-14-23 x NPJ-113, PRD-14-23 x PRL-17-3,PAB 9511 × PHR1, PAB 9511 × PAB 9534, PAB 9511 × PAB 17-2, PAB 9511 × PAB-17-4, PHR-2 × PAB-17-1, PHR-2 × PAB-17-4.	**44**	**-**	**-**
		F1	PAB-14-4 × EC-399302, EEC-2 × PAB-9511, EEC-3 × PAB-9511, EEC-6 × PAB-9511, EC-399299 × PAB-9511, EC-399299 × EC-399294, PAB-14-15 × MCNL-19-6, PRD-2014-21 × NRCHB 101,PRD-2014-21 × NPJ 126, PAB-2014-4 × RH-1590-41, PAB-2014-25 × MCNL-19-6, PAB-14-1 × DRMR-2017-5, PAB-14-4 × Ashirwad PAB-14-1 × Ashirwad, PRD-2014-21 × NPJ-113, PAB-2014-17 × NRCHB-101, PAB-2014-17 × MCNL-19-6, PAB-14-4 × NRCHB-101, PAB-14-1 × NRCHB-101, PAB-2014-7 × MCNL-19-55, PAB-2014-25 × MCNL-19-55	**19**	**-**	**10**
		F2	PHR-1 × PAB 9511, PAB-06-5 × NRCHB-101, PAB-14-7 × MCN-18-5, PAB-14-21 × NRCHB-101, PAB-14-21 × MCN-18-17, PAB-14-4 × MCN-18-17, PAB-14-4 × MCN-18-5, MCN-14-5 × NRCHB-101, MCN-14-5 × MCN-18-19, PAB-14-4 × PAB 9511, PAB-14-7 × MCN-18-5, PAB-14-5 × MCN-18-19, PAB-14-4 × NRCHB-101, PAB-14-4 × MCN-18-7, PAB-17-1 × PHR-1, PAB-17-1 × PHR-2, PAB-17-2 × NRCHB-101, PAB-17-4 × PHR-1, PAB-17-5 × PAB 9511, PAB-17-5 × PHR-2, PAB-17-5 × PHR-1, PAB-17-15 × PHR-1, PAB-17-21 × PAB 9511, PAB-17-20 × PAB 9511, PAB-17-20 × PHR-2, PAB-17-21 × NRCHB 101	**23**	**-**	**12**
		F3	Varuna × PAB-06-5, EC399301 × PRB-04-3-4, EC399301 × PRB-06-5, EC399301 × Varuna	**4**	**-**	**4**
		F4	PR-2016-6 × PAB 9511, PR-2015-5 × PAB 9511	**2**	**-**	**2**
	White rust resistance	**Fresh crosses**	Rohini × Donskaja, Rohini × PWR 9534, RGN 73 × PWR-13-8-7, NRCHB101 × Donskaja, NRCHB101 × PWR-13-8-7, Krishna × Donskaja, Krishna × PWR 954, Kranti × Donskaja, Kranti × PWR 9538, PR 21 × PWR 13-8-1, PR 21 × Donskaja, PR 20 × PWR 9538, PR 20 × PWR 13-8-1, NRCBH 101× Heera, PR 20 × Donskaja, Donskaja × PWR 9538, DONSKAJA × PWR 13-8-1, PWR 9538 × PWR 13-8-1, Donskaja × PWR 9541, Donskaja × PWR-13-8-7, PWR-13-8-7× PWR 9541	**20**	**-**	**-**
		F1	PWR-13-8 × PHR-1, PWR-13-8 × PHR-2, PWR-13-8 × ABR-14, PWR-3-8 × PAB-9534, (PWR-3-8 × PRB-2006-5) × PRB-2006-5, (Varuna × PWR-13-8) × Varuna, (Varuna × Donskaja) ×Varuna, (EC-399301 × Varuna) × Varuna, PRD-14-1 × Donskaja, EEC-2 × Donskaja, EEC-3 × Donskaja, EEC-6 × Donskaja, EC-399299 × Donskaja, PAB-14-1 × NRCHB-101, PAB-2014-7 × MCNL-19-55, PAB-2014-25 × MCNL-19-55	**15**	**-**	**6**

		F2	PAB 9511 × Donskaja, PAB 9511 × PWR-13-8, PWR-2012 × Donskaja, PWR-2012 × PWR-13-8, PWR-2012 × PAB 9511, PWR 9538 × Donskaja, PWR 9538 × PAB 9511, PHR-1 × Donskaja, PHR-1 × PWR-13-8, PHR-1 × PAB 9511, PAB-06-5 × Donskaja, PAB-06-5 × NRCHB-101, PAB-14-4 × PWR-15-8	**13**	**-**	**7**
		F3	PWR-13-8 × PRB-04-3-4, PWR-13-8 × PRB-06-5, PWR-13-8 × EC 399301, Donskaja × NRCHB 101, Donskaja × PWR-13-8, PWR-13-8 × NRCHB 101 Donskaja × Kranti, PR-16-6 × Donskaja, PWR-13-8-2 × Donskaja, PR-16-5 × Donskaja, PWR-13-8-8-6 × Donskaja, PWR-13-8-14-1 × Donskaja, PR-16-3 × Donskaja, PWR-3-8-8-7 × Donskaja, (EEC-2 × PWR-13-8) × PWR-13-8, (EEC-4 × PWR-13-8) × PWR-13-8, (EEC-7 × PWR-13-8) × PWR-13-8, (EEC-10 × PWR-13-8) × PWR-13-8, (RS-13-8 × PWR-13-8) × PWR-13-8, (FS-13-6 × PWR-13-8) × PWR-13-8, PR-21 × PWR-13-8, PR-2016-5 × PWR-13-8, (IC-320932 × Kiran) × PWR-13-8, (Kranti × PWR-13-8) × PWR-13-8, (Kranti × PWR-13-8) × Kranti, PWR-13-8-8-6 × EC-399299, (NRCHB-101 × PWR-13-8) × NRCHB-101, (NRCHB-101 × PWR-13-8) × PWR-13-8	**22**	**-**	**12**
		F4	Donskaja × PAB 9511	**1**	**-**	**1**
		Advanced lines	**-**	**14**		
S.K.Nagar	Seed yield, boldness, earliness and heat tolerance suitable for late sown conditions	**Fresh crosses**	RMM 10-1-1, SKM 1746, CS 56, GM 1, PM 26, NRCHB 101	30		
	CMS and Restorer programme	**CMS**		36		
	Conversion of restorer	**$BC_{12}F_1$**	11		Maintained / Converted	
		$BC_{11}F_1$	09			
		BC_6F_1	03			
		BC_5F_1	13			
	Restorer study	**F_1**	52			
	Early, high yield, bold seed and high oil content	**F_1**	89			
	Seed yield, seed size, earliness, quality, biotic and abiotic stress resistance	**F_2 to F_7**	661 IPS and 80 bulks were grown		765 IPS	105 Bulks
	High Yield	**F_2 to F_4**	134, 56 grown		374	-
	High Yield & Bold seed	**F_6 to F_7**	63, 19 grown		40	31
	High Yield & Quality	**F_7**	2, 5 grown		-	5
	Early & Temp. Tole.	**F_3 to F_5**	434, grown		309	69
	Interspecific	**F_2 to F_5**	28 grown		42	-
	Promising entries identified					38

Varanasi	**Seed yield, terminal heat stress tolerance and white rust tolerance.**	**New F_1 developed**	70 new F_1s, were made in Line X Tester Fashion for yield, terminal heat stress tolerance and white rust tolerance.	70		
		New BC developed	18 back crosses were raised in replicated trials for white rust resistance	18		
		F_2 Material	10 F_2 materials from DRMR were raised in a trial for selection of the entries are enlisted below: a. EC 597309/ Donskaja b. EC 597309/ RE 8 c. EC 597309/ RE 13 d. EC 597309/ RE 44 e. *Juncea* YS/ Donskaja f. *Juncea* YS/ RE 8 g. *Juncea* YS/ RE 44 h. MJB 3/RE 14 i. MJB 3/ RE 35-4 j. MJB 3/RE 8	10		
		Advanced Lines		13		
		F_1s, F_2& F_3s raised	16 F_1s in replicated trials and 50 F_2s (30/Replicated/irrigated/rainfed) and 20/Replicated/white rust resistance).			
Kota	**Terminal heat tolerance, yield and contributing traits**	**Fresh crosses**	Improved breeding lines/ varieties 7 Lines x 3 Testers (L x T mating)	21	-	-
	Breeding high yielding genotypes for different maturity groups.	**F_1**	12 Lines x 4 Testers (L x T mating)	48	-	-
		F_2		32	153	-
		BIP F_2	Biparental mating	77	312	
		F_3		16	232	
		F_4		12	87	
		F_5		6	23	
Jagdalpur	**Earliness, high seed yield, bold seed and quality.**	**F_3**	Laxmi x Pusa Bold, Pusa Agrim x Pusa Bold, DRMR IJ-31 x Pusa Bold, CG Sarson x Pusa Bold, RH-406 x Pusa Bold, Laxmi x Kranti, Pusa Agrim x Kranti, DRMR IJ-31 x Kranti, CG Sarson x Kranti, RH-406 x Kranti, Laxmi x Varuna, Pusa Agrim x Varuna, DRMR IJ-31 x Varuna, CG Sarson x Varuna, RH-406 x Varuna, Laxmi x PM-27, Pusa Agrim x PM-27, DRMR IJ-31 x PM-27, CG Sarson x PM-27, RH-406 x PM-27.	20	100	
		F_4	Laxmi x Pusa Bold, Pusa Agrim x Pusa Bold, DRMR IJ-31 x Kranti, DRMR IJ-31 x Varuna, Kranti x Varuna, Pusa Agrim x Kranti, DRMR IJ-31 x Pusa Bold, Pusa Agrim x Varuna, Laxmi x Varuna.	9	45	
		F_5	RH-749 x RH-119, RH-749 x RH-406, RH-749 x DRMR IJ-31, RH-749 x NRCHB-101, RH-119 x RH-406, RH-119 x DRMR IJ-31, RH-119 x NRCHB-101, RH-406 x DRMR IJ-31, RH-406 x NRCHB-101, DRMR IJ-31 x NRCHB-101	10	60	
		F_6	NPJ-112 x Laxmi, NPJ-112 x DRMR IJ-31, NPJ-112 x Pusa Bold, NPJ-112 x Kranti, Laxmi x DRMR IJ-31, Laxmi x Pusa Bold, Laxmi x Kranti, DRMR IJ-31 x Pusa Bold, DRMR IJ-31 x Kranti, Pusa Bold x Kranti	10	50	

		F_7	DRMR IJ 11-04 x Laxmi, RGN 332 x NPJ 112, PBR 388 x DRMR IJ-31, KMR(L)12-1 x NRCHB-101, RRN-789 x B-902, Pusa Bold x Bhawani.	6	30	
	Earliness, high seed yield, bold seed and quality	F_8	GPT-1 x GPT-61, GPT-1 x GPT-83, GPT-1 x Indira Toria, GPT-1 x PT-303, GPT-1 x T-9, GPT-61 x GPT-1, GPT-61 x GPT-83, GPT-61 x Indira Toria, GPT-61 x PT-303, GPT-61 x T-9, GPT-83 x Indira Toria, GPT-83 x GPT-1, GPT-83 x GPT-61, GPT-83 x PT-303, GPT-83 x T-9, Indira Toria x GPT-1, Indira Toria x GPT-61, Indira Toria x GPT-83, Indira Toria x PT-303, Indira Toria x T-9, PT-303 x GPT-1, PT-303 x GPT-61, PT-303 x GPT-83, PT-303 x Indira Toria, PT-303 x T-9, T-9 x GPT-1, T-9 x GPT-61, T-9 x GPT-83, T-9 x Indira Toria, T-9 x PT-303.	30	150	
Shillongani			Accn No. 2 x PK 900-3, Accn No. 1 x PK 900-3, Accn No. x K 1000-2, Accn No. 1 x NRCHB-101, NRCHB-101 x SBG 18-12.	5		
Crop: Gobhi sarson						
Chatha-Jammu.	High seed yield & oil contant	**Fresh crosses**	GSH-1699,RSPN-28,RSPN-25,DGS-1,GSH-1707,AKGS-8146,HNS-1102,GSH-1717& AKGS-8217 With GSC-6,GSL-1& AKMS-8141	27		
		F_1	Improved breeding lines/varieties	12		
		F_2	Advanced fixed genotypes with GSC-6,GSL-1&RSPN-25	18		
		F_3	CNH-11-1,RSPN-28,CNH-11-13,HNS0901,RSPN-25 With GSC-6,GSL-1&DGS-1	15		
		F_4	GSL-1 xRSPN-28, GSL-1xRSPN-29, DGS-1 x GSC-101, , RSPN-25 xRSPN-28,RSPN-25 x GSC-101.	05		
Ludhiana	To enhance variability in canola quality germplasm for yield and early maturity	**Fresh crosses**		100		
		F_1		5		
		F_3		12		
	Determinate, early maturity and high productivity	**F_1**		5		
		F_3		25		
	Hybrid development	**CMS lines developed/ maintained**		50		
		Restorer lines developed/maintained		2		
	RIL populations developed/ maintained	**Quality, productivity and earliness**	GSL1x Rivette GSL1x Monty	02		
Crop: Karan rai						
Ludhiana	RIL populations developed/ maintained	**Earliness and productivity**	AR29 X PC 5	01		

Table 2.1.3 Evaluation of advanced breeding lines at different centres.

Centre	Name of trials	No. of trials	No. of strains tested	Name of best strain excelling the check	Yield (kg/ha)	Check	Superiority over the check (%)	Specific objective
1	2	3	4	5	6	7	8	9
Crop: Toria								
Kanpur	**PYT**	01	12	TKM 20-107,20-108,20-109	1620.4	Tapeshwari and Bhawani		High seed yield
				TKM 20-110	1581.8			
				TKM 20-101. TKM 18-101	1543.2			
				TKM 20-102	1466.0)			
	SVT	01	10	TKM 18-2, , TKM 18-1	1658.9	Tapeshwari and Bhawani		High seed yield
				TKM 16-1	1581.8			
				TKM 19-1	1550.9			
				TKM 16-2	1543.2			
Pantnagar	**ST-I**	1	18	PT-2018-8	1673	PT-303 (1451)	15.3	Earliness and high yield
				PT-2016-9	1648		13.6	
				PT-2017-2	1642		13.2	
	ST-II	1	12	PT-2020-9	1701	PT-303 (1500)	13.4	High yield
				PT-2020-7	1667		11.1	
				PT-2020-5	1648		9.8	
	SVT	1	09	TP-202	1942			
				TP-203	1819			
				TP-209	1539			
Chatha-KS	**Station trial**	01	08					
Dholi	**CSVT**	01	07 (3+4)	RAUDT-14-09		Tapeshwari, PT-303, Bhawani, RAUTS-17		To Release Varieties for Bihar
				RAUDT-14-04				
Crop: Yellow Sarson								
Dholi	**CSVT (YS)**	01	07(3+4)	RAUDYS-14-09		Pitambari, YSH-0401, NRCYS -05-02 & Swarna		To Release Varieties for Bihar
				RAUDYS-14-15				
Pantnagar	**ST-I**	1	10	PYS-2016-7	1765	NRCYS0502 (1562)	12.9	High yield
				PYS-2018-1	1968		25.9	
				PYS-2019-2	1778		13.8	

	ST-II	1	16	PYS-2020-2	1543	Pitambari (1364)	13.1	High yield
				PYS-202-3	1580		15.8	
				PYS-202-7	1660		21.6	
	SVT	1	07	YPS-301	2087			
				YSP-302	1857			
				YSP-307	1679			
Kanpur	**PYT**	01	12	YSKM 20-209	1967.6	Pitambari and YST -151		Early maturity, high seed yield
				YSKM 20-203	1774.7			
				YSKM 20-201	1736.1			
				YSKM 20-207	1697.5			
	SVT	01	08	YSKM 18-2	1890.4	Pitambari		Seed yield
				YSKM 17-1	(1813.26 Kg/ha)			
				YSKM 17-2	(1697.52 Kg/ha)			
				YSKM 16-1	(1658.94 kg/ha.)			
Crop: Indian Mustard								
Chatha	Station trial	01	22					
Hisar	FYT	01	10			PM 28		Seed yield and its component characters
	SST	01	12			PM 25 and PM 28.		
Ludhiana	MLT (Timely sown)	01	16	JC 1, JC 16, JC 36, JC 32, PBR 939 and PBR 385		PBR-357,RCH-1,RLC-3		Productivity Assessment
	MLT (Rainfed)	01	10	PBR 357, PBR 552, PBR 450, PBR 385, PBR 561 and PBR 540		PBR-97		Productivity Assessment under moisture stress conditions
	MLT (Late sown)	01	5	PBR 396 and PBR 422		RLM-619 GIRIRAJ		Productivity Assessment and terminal heat stress
	MLT-State trial (Quality)	01	16	HO 81, HO 91 and HO 92		RCH 1,RLC 3		High oleic acid
	HST-(Hybrid trials)	01	16	PHR 8063, PHR 8024, PHR 8022, PHR 8023 and PHR 8041		DMH 1,PHR 126,PBR 357		High yield and quality
	HST-1	01	20	PHR 8031, PHR 8076, PHR 3278, PHR 8002, PHR 8032, PHR 8041 and PHR 8010		DMH 1 PHR 126 PBR 357		High yield and quality

	HST-2	01	20	PHR 5175		DMH 1,PHR 126,PBR 357		High yield and quality
	HST-3	01	24	PHR 3281, PHR 4457 and PHR 8098		DMH 1,PHR 126,PBR 357		High yield and quality
	HST-4	01	24	PHR 8081 and PHR 8425		DMH 1,PHR 126,PBR 357		High yield and quality
Pantnagar	ST-1	1	14	PRE-2018-1	1807	PR-19 (1574)	14.2	Earliness and high yield
				PRE-2018-7	1880		19.4	
				PRE-2019-5	1790		13.7	
	ST-11	1	20	PRE-2020-7	2059	PR-19 (1679)	21.6	Earliness and high yield
				PRE-2020-16	1961		16.8	
				PRE-2020-15	1981		18.0	
	ST-III	1	14	PR-2016-1	2223	Kranti (1750)	27.0	Timely sown and High yield
				PR-2019-1	2130		21.7	
				PR-2019-3	2176		24.3	
	ST-IV	1	18	PR-2020-9	2116	Kranti (1717)	23.2	Timely sown and High yield
				PR-2020-16	2025		17.9	
				PR-2020-14	1973		14.9	
	ST-V	1	18	PYR-2019-4	1675	RGN-73 (1442)	16.2	Yellow seed color
				PYR-2020-11	1608		11.5	
	ST-VI	1	18	PRL-2017-6	1550	Kranti (1375)	12.8	Late sown and high yield
				PAB-2014-4	1682		22.3	
				PAB-2017-1	1736		25.6	
	PYT-VII	1	33					Late sown and high yield
	SVT	1	08	RP-403	2456			
				RP-402	2321			
				RP-401	2000			
	P.Y.T. (Late sown)	01	12	KMR (E) 20-306 & 20-309	1851.8.	NDRE-4 and Kanti	14.3	Early sown Mustard
				KMR (E) 20-303	1736.1		7.1	
				KMR (E) 20-301	1658.9		2.4	
				KMR (E)20-304 & 308	1620.4			
	S.V.T	01	10	DRMRCI-98 and and	1851.8	Kanti and NDRE-4	17.1	Early sown Mustard
				KMR (E) 16-1 & 17-1	1697.5		7.3	
				KMR (E) 17-2,18-2 & DRMRCI-96	1620.4		2.4	
				NDRE-4	1581.8			
	P.Y.T.	01	12	KMR 20-403 and	2803.5	Maya and Urvashi	4.8	Timely sown Mustard
				KMR 20-407	2726.3			

				KMR 20-402	2700.6			
				KMR 20-405 & 20-406	2674.9			
	S.V.T.	01	8	KMR 19-3	2803.5	Urvashi (2314.8)	14.73	Timely Sown Mustard
				KMR 17-3	2726.3		1.9	
				KMR 17-4	2674.9			
	P.Y.T.	01	12	KMR (LS) 20-501	2160.5		16.6	Late sown
				KMR (LS) 20-502 & 20-508	1929.0		04.2	
				KMR (LS) 20-507	1877.6			
				KMR (LS) 20-509	1851.8			
	S.V.T.	01	10	KMR (LS) 15-5	2211.9	Ashirwad and Vardan	17.8	Late sown
				KMR (LS) 17-5	1954.7		04.1	
				KMR (LS) 16-5 and 18-6	1903.3		1.7	
				KMR (LS) 15-6	1877.6			
Dholi	CSVT	01	7 (2+5)	RAURD-214		PM-25, Pusa Mahak, Kranti, Varuna &RGN-73		To Release Varieties for Bihar
				RAURD-14-18				
Varanasi	Station Trails							
	Station Trail I	1	12	HUJM (E) 20-4 (MCN 10-11 X ASHIRWAD)	1747.1	PM 25, PM 28, JD 6		Early Sown
				HUJM (E) 20-1 (NDRE 4 X VARUNA)	1644.6			
				HUJM (E) 20-6 (MCN 10-11 X HUJM 99-01)	1505.1			
	Station Trial	1	18	HUJM-20-9 (MC+N 10-11 X HUJM 05-03),	3148.9	Kranti, Giriraj & NRCHB 101		Timely Sown
				HUJM -10-6 (HUJM-007 X MUTANT OF LOCAL)	3143.3			
				HUJM-20-6 (MCN 10-11 X HUJM 99-03)	3137.8			
	Station Trial III	01	17	HUJM-20-6 (MCN 10-11 X HUJM 9903)	2306.7	NRCHB-101 & Giriraj		Late Sown
				HUJM-20-15 (TM 130)	2197.8			
				HUJM-20-9(MCN 10-11 X HUJM 05-03)	2171.1			
	PVT-II	01	37	PR 19 X RH 8813	3205.6	Kranti, NRCHB-10, Giriraj, RH-406		
				MAYA X NDRE 4	1842.9			
				VARDAN X PM 25	1569.3			

						and RH-749		
	PVT-III	01	88	MAYA X PUSA BOLD	3424.6	Kranti, RH-749, Giriraj, RH-406 and NRCHB-101		
				VARUNA X HUJM 9901	3066.3			
				SEJ 2 X HUJM 9964	2835.2			
	PVT VI	01	42	DIBYA X ABR 4	3214.93	Kranti, RH-749, Giriraj, RH-406 and NRCHB-101		
				DIBJA X HUJM 9964	2449.13			
				PR 19 X HUJM 9964	2319.00			
	PVT V	01	26	MCN 6-22 X ABR 4 (9511)	2446.55			
				HUJM 09-13-2	1432.70			
				HUJM 10-24	1432.50			
	PVT VI	01	38	ASHIRWAD X HUJM 9901-2-1-1	2635.95	Kranti, RH-749, Giriraj, RH-406 and NRCHB-101		
				ISH 7-3-2 X HUJM 9903-4-1-2	2112.86			
				MCN 03-35-2-1-2-2-1-1-1-2	1710.00			
	Advanced lines		09					
Crop: Gobhi Sarson								
Hisar	LST	04	10			RH 0749, RH 725, PM 26 and RVM 2.		Seed yield and its component characters
	SSTs	04						
	FYT	02						
Chatha	Station trial	01	09					--
Ludhiana								
	Hybrid State Trial	01	21	GSH 2155, GSH 1723, GSH 1725, GSH 1720, GSH 1703 and GSH 1680		GSC 6 GSC 7 GSH 1707		High yield and quality

Table 2.2. Breeder Seed Production of indented Rapeseed-Mustard varieties during 2020-21

S. No.	State	Producing centre	Crop	Name of variety	Year of notification	DAC indent (q)	Actual allocation as per BSP-1 target(q)	Actual Production (q)	Production surplus(+)/ Deficit(-) over BSB-1 Target
1	Chhattisgarh	IGKVV Jagdalpur	Indian mustard	Chhattisgarh Sarson	2010	3.95	3.95	4.40	0.45
2	Gujarat	SDAU, SKNagar	Indian mustard	Gujarat Mustard -3	2016	0.75	0.75	0.90	0.15
3	H.P.	Kangra	Gobhi Sarson	ONK-1 (Him Sarson)	2019	1.20	1.20	0.72	-0.48
4	Haryana	CCS HAU Hisar	Indian mustard	RH-725	2018	4.81	4.81	6.50	1.69
5	Haryana	CCS HAU Hisar	Indian mustard	RH 406	2013	0.55	0.55	2.80	2.25
6	Haryana	CCS HAU Hisar	Indian mustard	RH 0749	2013	0.77	0.77	6.25	5.48
7	Haryana	CCS HAU Hisar	Indian mustard	RH-761	2019	0.67	0.67	3.30	2.63
8	Haryana	CCS HAU Hisar	Indian mustard	Laxmi (RH-8812)	1997	0.62	0.62	0.80	0.18
9	Haryana	CCS HAU Hisar	Indian mustard	RH-30	1985	1.54	1.54	4.35	2.81
10	Haryana	CCS HAU Hisar	Yellow Sarson	YSH 0401	2009	1.00	1.00	1.54	0.54
11	Haryana	ICAR-CSSRI Karnal	Indian mustard	CS-58	2017	0.45	0.45	10.00	9.55
12	Haryana	ICAR-CSSRI Karnal	Indian mustard	CS-60	2018	1.30	1.30	10.00	8.70
13	Jammu & Kashmir	SKUAT, Jammu	Toria	RSPT-06	2019	0.05	0.05	0.15	0.10
14	Jharkhand	BAU, Ranchi	Indian mustard	BAUR9502- (Shivani)	2005	0.13	0.13	0.60	0.47
15	Madhya Pradesh	ZARS, Morena	Indian mustard	RVM-1	2016	1.00	1.00	0.00	-0.00
16	Madhya Pradesh	ZARS, Morena	Indian mustard	RVM-2	2013	5.04	5.04	5.00	-0.04
17	Madhya Pradesh	ZARS, Morena	Toria	Raj Vijay Toria-1	2017	0.02	0.02	2.50	2.48
18	New Delhi	IARI, New Delhi	Indian mustard	Pusa Mustard-32		0.40	0.40	0.50	0.10
19	New Delhi	IARI, New Delhi	Indian mustard	Pusa Double Zero Mustard-31 (PDZ-1)	2016	5.00	5.00	5.50	0.50
20	New Delhi	IARI, New Delhi	Indian mustard	Pusa Mustard-25 (NPJ112)	2010	2.92	2.92	3.50	0.58
21	New Delhi	IARI, New Delhi	Indian mustard	Pusa Mustard-26 (NPJ113)	2011	8.69	8.69	9.00	0.31
22	New Delhi	IARI, New Delhi	Indian mustard	Pusa Mustard-27 (EJ17)	2011	4.20	4.20	4.50	0.30
23	New Delhi	IARI, New Delhi	Indian mustard	Pusa Mustard 28 (NPJ124)	2012	2.67	2.67	4.00	1.33
24	New Delhi	IARI, New Delhi	Indian mustard	Pusa Mustard-30 (LES-43)	2013	3.30	3.30	5.00	1.70
25	New Delhi	IARI, New Delhi	Indian mustard	PusaTarak	2009	0.10	0.10	0.20	0.10
26	New Delhi	IARI, New Delhi	Indian mustard	PusaMahak (JD-6)	2004	0.50	0.50	2.28	1.78
27	New Delhi	IARI, New Delhi	Indian mustard	Pusa Vijay (NPJ 93)	2008	0.15	0.15	2.50	2.35
28	New Delhi	IARI, New Delhi	Indian mustard	PusaJaikisan (Bio-902)	1994	0.13	0.13	0.60	0.47
29	New Delhi	IARI, New Delhi	Indian mustard	Pusa Bold	1985	1.18	1.18	2.40	1.22
30	Orissa	OUAT Bhubaneswar	Toria	Sushree	2015	2.55	2.55	2.60	0.05
31	Punjab	PAU, Ludhiana	Indian mustard	PBR- 357	2013	0.03	0.03	0.10	0.07
32	Punjab	PAU, Ludhiana	Indian mustard	RLC-3	2016	0.03	0.03	0.20	0.17
33	Punjab	PAU, Ludhiana	Toria	TL-17	2016	0.03	0.03	0.20	0.17
34	Punjab	PAU, Ludhiana	Gobhisarson	GSC-7	2014	0.18	0.18	1.00	0.82
35	Punjab	PAU, Ludhiana	Gobhi Sarson	GSC-6		0.01	0.01	0.02	0.01

36	Punjab	PAU, Ludhiana	African mustard	BJC-1 (PC-6)		0.03	0.03	0.10	0.07
37	Rajasthan	DRMR, Bharatpur	Indian mustard	Giriraj (DRMRIJ 31)	2013	4.09	4.09	9.65	5.56
38	Rajasthan	DRMR, Bharatpur	Indian mustard	DRMR 601 (NRCDR 601)	2010	0.05	0.05	0.30	0.25
39	Rajasthan	DRMR, Bharatpur	Indian mustard	NRCHB-506	2009	0.02	0.00	0.00	0.00
40	Rajasthan	DRMR, Bharatpur	Indian mustard	NRCDR 2	2007	0.15	0.15	0.25	0.10
41	Rajasthan	DRMR, Bharatpur	Indian mustard	NRCHB 101	2009	2.03	2.03	4.88	2.85
42	Rajasthan	DRMR, Bharatpur	Indian mustard	DRMR 150-35	2020	0.14	0.14	0.20	0.06
43	Rajasthan	DRMR, Bharatpur	Yellow Sarson	NRCYS 05-02	2009	0.15	0.15	0.30	0.15
44	Rajasthan	SK RAU, Sriganganagar	Indian mustard	RGN-298	2014	0.47	0.47	0.10	-0.37
45	Rajasthan	SK RAU, Sriganganagar	Indian mustard	RGN-236	2011	2.00	2.00	0.10	1.90
46	Rajasthan	SK NAU, Jobner	Taramira	RTM-1351	2018	0.52	0.52	6.50	5.98
47	Rajasthan	SK NAU, Jobner	Taramira	RTM-1355 (Jwala Tara)	2017	0.50	0.50	0.82	0.32
48	Uttar Pradesh	CSAUA&T Kanpur	Indian mustard	Rohini	1986	5.40	5.40	9.90	4.50
49	Uttar Pradesh	CSAUA&T Kanpur	Indian mustard	Varuna (T-59)	1976	0.60	0.60	10.55	9.95
50	Uttar Pradesh	CSAUA&T Kanpur	Toria	Tapeshvari TK 06-1	2014	1.57	1.57	6.92	5.35
51	Uttar Pradesh	CSAUA&T Kanpur	Toria	T-9	1975	0.32	0.32	1.49	1.17
52	Uttar Pradesh	CSAUA&T Kanpur	Yellow Sarson	Pitambari (RYSK-05-02)	2010	0.70	0.70	1.48	0.78
53	Uttarakhand	GBPUAT, Pantnagar	Indian mustard	Pant Rai-21	2017	0.20	0.20	1.10	0.90
54	Uttarakhand	GBPUAT, Pantnagar	Toria	Pant Hill Toria-1	2017	0.15	0.15	2.00	1.85
55	Uttarakhand	GBPUAT, Pantnagar	Toria	Pant Toria-508 (PTE-2008-2)	2017	0.45	0.45	7.00	6.55
56	Uttarakhand	GBPUAT, Pantnagar	Toria	PT-507	1990	0.20	0.20	1.00	0.80
57	Uttarakhand	GBPUAT, Pantnagar	Toria	PT-303	1985	0.50	0.50	7.20	6.70
58	Uttarakhand	GBPUAT, Pantnagar	Yellow sarson	Pant Pili Sarson -1	2010	0.70	0.70	5.50	4.80
59	Uttarakhand	GBPUAT, Pantnagar	Yellow sarson	Pant Sweta (PYS 2007-10)	2017	0.67	0.67	7.00	6.33
60	Uttarakhand	GBPUAT, Pantnagar	Toria	Uttara (PT-2002-25)	2010	2.55	2.55	2.50	-0.05
61	West Bengal	PORS, Behampore	Yellow sarson	Benoy (B 9)	1980	2.38	2.38	3.00	0.62
62	West Bengal	BCKV, Kalyani	Indian mustard	TBM-209 (TrombayBidhan Mustard-204) TM-204	2019	0.15	0.15	0.00**	0.00**
63	West Bengal	PORS, Behampore	Indian mustard	Agrani (B-54)	2003	0.27	0.27	0.60	0.33
64	West Bengal	PORS, Behampore	Yellow Sarson	Jhumka (YSBNC-1)	1998	0.05	0.05	0.00**	0.00**
	Total					**82.93**	**82.91**	**194.35**	**116.44**

*Not notified; ** Not reported

Additional Breeder Seed Produced

S. No.	State	Crop	Name of variety	Actual Production (q)
	Gujarat			
1.	**SDAU SK Nagar**	Indian mustard	GM 1	0.60
2.			GM 2	0.60
3.			GDM 4	1.25
4.			GDM 5	0.20
5.	**ICAR-CSSRI, Karnal, Haryana**		CS-54	1.50
6.			CS-56	1.50
	Uttar Pradesh			
7.	**C. S. Azad University of Agriculture & Technology, Kanpur-208002(U.P.)**		Urvashi	2.00
8.			Maya	2.54
	M.P.			
9.	**ZARS, Morena**	Indian mustard	RVM-3	5.00
	Punjab			
10.	**PAU, Ludhiana**	Toria	TL-15	0.10
	Total			**15.29**

2.3 Coordinated Trials

Performance of 165strains, including 11 of toria, 08 of yellow sarson and 140 of Indian mustard, 05 of gobhi sarson and 01 of taramira was tested in nineteen performance evaluation trials consisting of toria (1), yellow sarson (1), gobhi sarson (1), taramira (1) and Indian mustard (16) at 45 locations across the 6 agro-climatic zones of the country. On the basis of superiority for seed/oil yield/ earliness/quality over the best check, 20 strains comprising yellow sarson (02), gobhi sarson (01) and Indian mustard (17) were promoted for advanced stage evaluation. The performance of the strains was tested against following national check (NC), zonal check (ZC) and the latest release (LR) varieties/hybrids.

Trial	NC	ZC	LR
Toria	PT 303	Bhawani	Tapeswari
Yellow sarson	YSH 401	Benoy, NRCYS 05-2	Pitambari
Indian mustard			
Early mustard	Pusa Mustard 25	JD 6 PRO 5111 (Hybrid Check)	Pusa Mustard 27, Pusa Mustard 28, GM 1, NRCHB 101
Timely sown irrigated	Kranti	RCC 4, RH 749, Maya, Bio 902	Giriraj, RGN 73, GDM 4,
Rainfed	Kranti	RGN 229, NRCHB 101	RH 0761, DRMR 150-35,
Late sown	Kranti	PM 26, NRCHB 101	RGN 236, CS 56
Hybrid	Kranti	RGN 73, RH 749,GDM 4	DMH 1, 45S46
Quality	Kranti	RGN 73, RH 749, PDZ 1 (Double low check)	Pusa Mustard 29, Pusa Mustard 30
Salinity	Kranti	CS 54	Giriraj, CS 60
White Rust Resistance	-	RH 749, Maya	Giriraj, RGN 73
Gobhi Sarson	Kranti	GSL 1	GSC 6
Taramira	T 27	RTM 314	RTM 1351

Table 2.3.1. Performance of toria strains in IVT Zone-III

S.No.	Code	Strain	Seed Yield (Kg/ha)					Plant Stand				Days to Maturity					1000-Seed Wt. (g)			
			KPR	PNT	MOR	DOL	Mean	KPR	PNT	MOR	DOL	KPR	PNT	MOR	DOL	Mean	KPR	PNT	MOR	DOL
			1	2	3	4	(1-4)	1	2	3	4	1	2	3	4	(1-4)	1	2	3	4
1	TCN-20-1	PT 303(NC)	1427	1535	2667	1358	**1747**	118	136	166	168	98	94	110	95	99	3.3	3.4	4.7	5.0
2	TCN-20-2	TKM-20-2	1389	1203	3197	1127	**1729**	120	124	171	169	97	100	114	98	102	3.4	3.1	4.8	4.6
3	TCN-20-3	BAUT 08-08	1350	1478	2632	1250	**1678**	122	136	175	167	95	92	104	95	97	3.3	3.2	4.5	4.2
4	TCN-20-4	RMT-19-14	1582	1169	3048	1384	**1796**	125	148	171	169	98	101	117	98	104	3.2	3.0	4.6	4.2
5	TCN-20-5	CG toria 3	1350	1459	2440	1157	**1602**	120	146	174	167	94	92	106	92	96	3.3	3.3	4.2	4.5
6	TCN-20-6	PT-2015-8	1350	1711	2299	1528	**1722**	124	143	171	169	96	92	108	95	98	3.5	3.6	4.8	4.7
7	TCN-20-7	TKM-20-1	1582	1345	2669	1080	**1669**	118	120	172	168	98	100	111	99	102	3.0	3.3	4.6	3.2
8	TCN-20-8	ORT 2019-01	1273	1454	2777	1111	**1654**	120	153	174	164	94	99	108	97	99	2.9	3.0	4.4	4.7
9	**TCN-20-9**	**Tapeswari (LR)**	**1620**	**1668**	**2788**	**1327**	**1851**	**123**	**153**	**175**	**170**	**98**	**96**	**105**	**96**	**99**	**3.1**	**3.3**	**4.7**	**4.5**
10	TCN-20-10	CG toria 4	1154	1464	2277	1235	**1532**	118	129	173	168	94	94	107	92	97	3.3	3.2	4.6	3.9
11	TCN-20-11	Bhawani (ZC)	1196	1260	2302	1127	**1471**	123	157	174	168	93	91	103	90	94	3.6	3.2	4.5	3.8
12	TCN-20-12	RMT-19-17	1505	1274	3057	1250	**1771**	121	158	168	172	98	100	113	98	102	3.8	2.9	4.5	5.9
13	TCN-20-13	PT-2015-09	1389	1735	2494	1157	**1694**	120	154	172	168	95	93	109	94	98	3.9	3.1	5.1	5.6
14	TCN-20-14	JT-14-5	1273	1481	2587	1031	**1593**	125	132	165	169	96	91	95	90	93	3.3	3.2	4.4	4.7
		GM	**1389**	**1445**	**2660**	**1223**	**1679**													
		CD (5 %)	259	239	257	206														
		CV (%)	11.1	9.8	5.7	10.0														
		DOS	29.9.20	6.10.20	6.10.20	8.10.20														

Table 2.3.2. Performance of toria strains in IVT Zone-V Rainfed

S.No	Code	Strain	Seed Yield (Kg/ha)							Plant Stand						Days to Maturity							1000-Seed Wt. (g.)					
			KNK	BHU	SHL	JAG	IMP	KLN	Mean	KNK	BHU	SHL	JAG	IMP	KLN	KNK	BHU	SHL	JAG	IMP	KLN	Mean	KNK	BHU	SHL	JAG	IMP	KLN
			1	2	3	4	5	6	(1-6)	1	2	3	4	5	6	1	2	3	4	5	6	(1-6)	1	2	3	4	5	6
1	**TCN-20-1**	**PT 303(NC)**	**1027**	**1012**	**969**	**1586**	**1074**	**1243**	**1152**	**170**	**130**	**226**	**226**	**156**	**142**	**83**	**85**	**86**	**72**	**103**	**92**	**87**	**2.9**	**4.1**	**3**	**3**	**3.4**	**3.3**
2	TCN-20-2	TKM-20-2	862	804	605	1099	846	1153	895	167	126	187	141	154	147	81	82	88	71	108	97	88	2.8	3.2	2	3	2.8	3.4
3	TCN-20-3	BAUT 08-08	1059	953	593	1673	1259	864	1067	151	127	179	220	164	133	84	83	88	70	102	96	87	2.9	3.6	2.5	3.2	3.5	3
4	TCN-20-4	RMT-19-14	961	866	586	1284	1012	745	909	181	124	195	256	168	140	82	81	90	73	105	96	88	2.2	3.9	1.5	3	3.3	3
5	TCN-20-5	CG toria 3	754	835	506	1383	1204	736	903	156	123	165	186	151	144	81	83	86	66	103	90	85	2.7	3.4	3	2.9	3.1	2.9
6	TCN-20-6	PT-2015-8	964	912	944	1321	1074	840	1009	147	123	221	209	173	148	82	83	86	65	101	94	85	2.9	3.8	2	3.3	3.5	3.6
7	TCN-20-7	TKM-20-1	874	805	488	877	951	736	789	144	121	162	184	127	142	84	81	92	74	107	98	89	2.7	3.5	3	3.1	3	3
8	TCN-20-8	ORT 2019-01	738	845	599	1148	1272	1017	937	162	122	191	253	179	149	83	81	92	72	106	94	88	2.1	3.1	2.5	2.9	2.8	2.7
9	TCN-20-9	Tapeswari (LR)	1013	812	469	1395	1469	1045	1034	173	123	156	233	154	148	84	82	90	73	107	93	88	3.2	3.9	2	3.2	2.8	2.8
10	TCN-20-10	CG toria 4	1135	861	778	1352	1531	889	1091	179	125	211	220	159	145	82	84	86	67	104	91	86	2.7	4.1	2	3.1	3.1	3
11	TCN-20-11	Bhawani (ZC)	722	825	580	1000	1562	1283	995	169	124	168	213	185	146	81	82	89	69	104	94	86	2.4	3.5	2.5	2.5	3.1	2.9
12	TCN-20-12	RMT-19-17	976	1060	463	1278	1204	1079	1010	157	132	153	203	178	151	84	84	89	74	106	97	89	2.2	4.1	1.5	3.3	3	3.1
13	TCN-20-13	PT-2015-09	710	919	654	1549	1019	923	962	143	123	173	203	172	145	81	82	89	69	105	93	86	2.3	3.7	2	3	3.3	3.1
14	TCN-20-14	JT-14-5	783	959	704	1278	914	966	934	158	126	208	200	152	147	80	81	86	65	106	90	85	2.6	3.4	2.5	3.1	3.2	3.1
		GM	**898**	**891**	**638**	**1302**	**1171**	**966**	**978**																			
		CD 5%	181	56	134	271	221	194																				
		CV (%)	12	3.7	12.5	12.4	11.2	12																				
		DOS	7.10.20	14.11.20	13.11.20	14.10.20	13.11.20	26.10.20																				

Table 2.3.3 Performance of yellow sarson strains in IVT Zone-III

S.No.	Code	Strain	Seed yield (kg/ha)					Plant Stand				Days to Maturity				1000-seed wt. (g)			
			KPR	PNT	MOR	DOL	Mean	KPR	PNT	MOR	DOL	KPR	PNT	MOR	DOL	KPR	PNT	MOR	DOL
			1	2	3	4	(1-4)	1	2	3	4	1	2	3	4	1	2	3	4
1	YSCN-20-1	DRMRYS 202	1775	1733	2636	1235	**1845**	120	128	133	168	123	118	114	125	4.9	3.9	5.4	5.1
2	YSCN-20-2	RMYS 1	1620	1215	2437	648	**1480**	121	127	160	169	120	120	119	121	4.2	3.3	5.6	5.6
3	YSCN-20-3	YSKM-20-1	1775	1417	2005		**1732**	125	125	142	5	124	118	120	0	4.0	3.4	4.8	0.0
4	**YSCN-20-4**	**Pitambari (LR)**	**1659**	**1783**	**2731**	**1067**	**1810**	**122**	**159**	**149**	**166**	**122**	**120**	**116**	**125**	**4.2**	**3.2**	**5.1**	**6.0**
5	YSCN-20-5	DRMRYS 201	1620	1400	2568	1003	**1648**	124	133	140	171	121	119	109	121	3.9	3.7	5.1	4.4
6	YSCN-20-6	PYS-2017-6	1427	1792	2279	895	**1598**	125	137	149	168	120	116	111	120	4.5	3.7	5.3	5.6
7	YSCN-20-7	RMYS 2	1659	1583	2694	964	**1725**	121	135	134	169	124	116	110	123	4.4	4.0	5.8	5.8
8	YSCN-20-8	PYS-2018-02	1659	1933	2501	612	**1676**	124	136	143	168	123	124	110	125	4.7	3.9	5.0	5.2
9	YSCN-20-9	NRCYS-05-02(ZC)	1736	1675	2611	1144	**1792**	125	153	151	169	121	115	106	123	4.6	3.5	5.0	4.9
10	YSCN-20-10	YSH-401 (NC)	1427	1475	2884	944	**1683**	120	150	143	171	120	117	114	123	4.6	3.6	5.3	4.5
11	YSCN-20-11	YSKM-20-2	1736	1667	2131		**1845**	124	119	147	4	121	119	119	0	4.8	3.4	5.4	0.0
		GM	**1645**	**1607**	**2498**	**946**	**1674**												
		CD (5%)	242	289	365	141													
		CV (%)	8.6	10.5	8.5	10.7													
		DOS	29.9.20	6.10.20	30.10.20	8.10.20													

Table 2.3.4, Performance of yellow sarson strains in IVT Zone-V (RF)

S.No.	Code	Strain	Seed yield (kg/ha)							Plant Stand					Days to maturity					1000-Seed wt. (g)				
			SHL$	IMP	KNK	KLN	BHU	Mean		SHL	IMP	KNK	KLN	BHU	SHL	IMP	KNK	KLN	BHU	SHL	IMP	KNK	KLN	BHU
			1	2	3	4	5	(2-5)		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1	YSCN-20-1	DRMRYS 202	407	1109	852	996	959	**979**		153	134	180	146	126	94	83	92	94	83	4.0	3.3	2.5	4.6	4.0
2	YSCN-20-2	RMYS 1	617	1041	735	815	872	**866**		183	144	177	143	127	96	86	92	104	82	3.0	3.6	2.1	4.0	3.4
3	YSCN-20-3	YSKM-20-1	340	0	855	1243	944	**761**		153	-	180	140	125	97	-	97	102	83	3.5	-	1.4	3.7	3.6
4	YSCN-20-4	Pitambari (LR)	519	1041	922	979	937	**970**		173	149	177	141	130	96	86	94	104	81	2.5	3.0	2.2	3.9	3.5
5	YSCN-20-5	DRMRYS 201	765	1084	872	897	923	**944**		182	150	179	144	127	95	86	95	97	81	2.0	3.4	2.3	4.0	3.6
6	YSCN-20-6	PYS-2017-6	414	1201	858	1012	1001	**1018**		153	163	178	145	133	96	86	94	94	85	3.5	3.2	2.2	4.0	4.1
7	**YSCN-20-7**	**RMYS 2**	**488**	**1615**	**945**	**1519**	**956**	**1259**	*	**163**	**162**	**180**	**146**	**128**	**94**	**87**	**91**	**100**	**83**	**2.0**	**3.5**	**2.8**	**4.6**	**3.7**
8	**YSCN-20-8**	**PYS-2018-02**	**494**	**1572**	**738**	**1045**	**1028**	**1096**	*	**164**	**146**	**175**	**145**	**127**	**96**	**89**	**97**	**106**	**84**	**3.0**	**2.9**	**1.3**	**4.4**	**3.8**
9	**YSCN-20-9**	**NRCYS 05-02(ZC)**	**580**	**1238**	**919**	**807**	**1026**	**997**		**171**	**137**	**178**	**141**	**129**	**93**	**86**	**93**	**97**	**86**	**2.0**	**3.9**	**3.0**	**3.8**	**4.0**
10	YSCN-20-	YSH-401 (NC)	407	1102	901	959	1017	**995**		162	158	171	141	132	95	87	96	105	87	3.0	3.1	2.3	3.8	4.1
11	YSCN-20-	YSKM-20-2	241	0	864	988	875	**682**		141	-	178	141	129	97	-	95	106	82	2.5	-	2.2	4.4	3.8
		GM	**479**	**1000**	**860**	**1024**	**958**	**960**																
		CD (5%)	162	186	97	204	50																	
		CV (%)	19.7	10.9	6.6	11.7	3.1																	
		DOS	13.11.20	14.11.20	8.10.20	26.10.20	14.11.20																	

$ Data of SHL excluded from computation of mean due to high C.V.of the expt.

* Strain outyielding the best check by a margin of more than or equal to 10 percent on the basis of seed yield

Table 2.3.5. Performance of early Indian mustard strains in IVT Zone-II

S.No.	Code	Strain	Seed Yield (Kg/ha)						Plant Stand				Days to Maturity					1000-Seed Wt. (g)			
			HSR	LDH	CHT	NDH	Mean		HSR	LDH	CHT	NDH	HSR	LDH	CHT	NDH	Mean	HSR	LDH	CHT	NDH
			1	2	3	4	(1-4)		1	2	3	4	1	2	3	4	(1-4)	1	2	3	4
1	**MCN (E)-20-01**	**PRE-2018-10**	**2453**	**2062**	**2063**	**2450**	**2257**	*	**116**	**134**	**122**	**96**	**115**	**117**	**127**	**128**	**122**	**5.1**	**4.4**	**4.0**	**5.3**
2	MCN (E)-20-02	DRMRHT 1712	2187	1735	1518	1661	**1775**		119	129	123	121	127	114	130	134	**126**	5.1	4.3	3.8	5.0
3	MCN (E)-20-03	TM 188	1891	1994	1510	1339	**1683**		116	131	119	122	126	104	134	141	**126**	4.0	3.9	3.5	4.2
4	MCN (E)-20-04	KMR(E) 20-2	2388	2025	1852	2367	**2158**		114	128	124	123	131	102	131	139	**126**	3.9	3.3	3.6	3.1
5	MCN (E)-20-05	PHR 8031 (hybrid)	2098	2068	2070	2306	**2135**		118	130	123	129	125	101	130	139	**124**	4.0	4.1	3.5	3.5
6	MCN (E)-20-06	NPJ-240	1915	1716	1502	3017	**2037**		115	132	118	132	116	116	125	112	**117**	4.6	4.9	3.3	5.5
7	MCN (E)-20-07	PM 25 (NC)	1992	1630	1539	2705	**1966**		113	136	128	125	116	115	126	115	**118**	4.8	4.8	4.4	5.2
8	MCN (E)-20-08	RH 1999-21	2134	2074	1733	2733	**2168**		115	134	130	127	116	107	123	136	**121**	4.1	3.9	3.6	4.6
9	MCN (E)-20-09	RMM-19-06	2175	1747	1716	2628	**2066**		119	134	124	120	130	104	130	136	**125**	4.3	4.5	3.7	4.4
10	**MCN (E)-20-10**	**PM 28 (LR)**	**1844**	**1772**	**1675**	**2750**	**2010**		**112**	**136**	**126**	**109**	**117**	**102**	**128**	**126**	**118**	**4.2**	**3.7**	**4.2**	**4.8**
11	MCN (E)-20-11	KMR(E) 20-1	2299	1877	1877	3000	2263		115	136	123	104	126	109	127	134	**124**	4.2	4.0	3.2	4.4
12	MCN (E)-20-12	SVJH-006 (hybrid)	2270	2025	1589	2894	**2194**		113	137	119	120	129	103	128	137	**124**	4.6	4.6	4.1	4.9
13	MCN (E)-20-13	JD 6 (ZC)	2281	2296	2050	2467	**2274**		114	132	131	122	127	102	132	136	**124**	4.0	5.4	4.4	4.5
14	MCN (E)-20-14	NPJ-239	1956	1710	1823	2622	**2028**		115	138	130	114	116	120	130	109	**119**	4.4	4.9	3.5	4.8
15	MCN (E)-20-15	DRMRSJ 112	1968	1790	2032	2728	**2129**		114	129	128	114	120	115	132	134	**125**	4.5	4.3	3.4	5.2
16	MCN (E)-20-16	PRE-2018-8	1992	1877	1844	2616	**2082**		113	131	127	104	117	112	133	112	**118**	4.5	4.0	3.9	4.8
17	MCN (E)-20-17	DRMRCI-129	1956	1883	1823	2467	**2032**		117	132	124	130	121	106	132	137	**124**	4.4	4.0	3.7	4.7
18	MCN (E)-20-18	KGMH-3811(hybrid)	2163	1901	2087	2628	**2195**		116	134	123	102	127	109	134	135	**126**	5.3	3.9	5.0	6.8
19	MCN (E)-20-19	BAUM 09-12-2	1874	1889	1801	2133	**1924**		118	136	120	129	118	105	125	132	**120**	4.2	3.3	4.2	4.1
20	MCN (E)-20-20	SKM 1746	1885	1796	1713	1795	**1797**		114	131	126	130	120	113	123	133	**122**	5.4	4.2	5.1	5.9
21	MCN (E)-20-21	RH 1999-12	1743	1741	1827	2744	**2014**		116	132	134	123	118	101	124	129	**118**	4.9	5.3	4.2	5.3
22	MCN (E)-20-22	PHR 8024 (hybrid)	2246	1815	2043	2194	**2074**		116	135	125	110	130	103	127	135	**124**	4.0	4.3	4.4	4.6
23	MCN (E)-20-23	PRO 5111 (hybrid check)	1856	1790	1605	2539	**1948**		117	136	129	123	117	113	122	113	**116**	4.0	3.3	3.6	5.4
24	MCN (E)-20-24	ORM 2019-06	2139	1679	1651	1294	**1691**		115	138	137	99	130	103	133	140	**127**	4.6	5.7	4.6	3.9
		GM	**2071**	**1870**	**1789**	**2420**	**2038**														
		CD (5 %)	324	292	240	344															
		CV (%)	9.5	9.8	8.2	8.6															
		DOS	13.9.20	15.9.20	24.9.20	14.9.20															

* Strain outyielding the best check by a margin of more than or equal to 10 percent on the basis of seed yield

Table 2.3.6a. Performance of early Indian mustard strains in IVT Zone-III

S.No.	Code	Strain	Seed Yield (kg/ha)							Plant Stand					
			MOR	PNT	JHS	KPR	BPR	DOL	Mean	MOR	PNT	JHS	KPR	BPR	DOL
			1	2	3	4	5	6	(1-6)	1	2	3	4	5	6
1	MCN (E)-20-01	PRE-2018-10	3156	2186	1161	1736	3789	1294	**2220**	149	140	110	121	104	166
2	MCN (E)-20-02	DRMRHT 1712	3002	1595	1196	1813	2300	1312	**1870**	132	143	97	119	79	166
3	MCN (E)-20-03	TM 188	2379	1278	1375	1427	2428	1052	**1657**	138	119	108	115	88	165
4	MCN (E)-20-04	KMR(E) 20-2	3118	1289	1253	1620	2169	1358	**1801**	132	139	105	118	82	164
5	MCN (E)-20-05	PHR 8031 (hybrid)	3418	1692	1216	1698	2763	1373	**2027**	141	153	104	120	107	169
6	MCN (E)-20-06	NPJ-240	2849	1885	1168	1543	2783	1127	**1892**	162	130	86	124	101	165
7	**MCN (E)-20-07**	**PM 25 (NC)**	**3416**	**1568**	**1218**	**1698**	**3036**	**1296**	2039	**160**	**144**	**101**	**122**	**99**	**166**
8	MCN (E)-20-08	RH 1999-21	3511	1294	1269	1659	3228	1296	**2043**	162	141	98	120	96	164
9	MCN (E)-20-09	RMM-19-06	3318	1514	1055	1736	2686	1420	**1955**	158	139	90	119	93	164
10	MCN (E)-20-10	PM 27 (LR)	3252	1455	1069	1620	2731	1019	**1858**	162	143	92	123	86	168
11	MCN (E)-20-11	KMR(E) 20-1	3214	1531	1179	1698	3106	1378	**2017**	164	135	81	118	103	166
12	MCN (E)-20-12	SVJH-006 (hybrid)	3386	1600	1045	1505	2950	1235	**1953**	150	140	84	124	110	169
13	MCN (E)-20-13	JD 6 (ZC)	2773	1536	1357	1620	2954	1451	**1949**	147	139	96	121	99	170
14	MCN (E)-20-14	NPJ-239	2539	1869	1173	1582	2422	1188	**1796**	163	149	104	120	93	167
15	MCN (E)-20-15	DRMRSJ 112	2953	1536	1172	1466	3217	1188	**1922**	159	165	107	118	108	165
16	MCN (E)-20-16	PRE-2018-8	2387	1627	1056	1505	2781	1021	**1729**	158	141	93	120	100	169
17	MCN (E)-20-17	DRMRCI-129	3508	1396	1024	1698	3131	1265	**2004**	144	129	88	122	107	170
18	MCN (E)-20-18	KGMH-3811(hybrid)	3430	2094	1124	1620	3733	1651	**2276**	139	131	94	119	109	164
19	MCN (E)-20-19	BAUM 09-12-2	3759	1391	1050	1698	2861	1373	**2022**	147	157	85	122	91	166
20	MCN (E)-20-20	SKM 1746	3354	1493	841	1582	2764	1451	**1914**	155	162	84	120	101	167
21	MCN (E)-20-21	RH 1999-12	3305	1783	1043	1852	3283	1559	**2138**	153	152	81	118	106	167
22	MCN (E)-20-22	PHR 8024 (hybrid)	3881	1837	1136	1775	2812	1358	**2133**	147	132	89	124	100	167
23	MCN (E)-20-23	PRO 5111 (hybrid check)	2954	1949	1119	1312	3342	1312	**1998**	146	156	103	118	106	166
24	MCN (E)-20-24	ORM 2019-06	3826	1353	1007	1736	3350	1590	**2144**	153	146	107	124	104	166
		GM	**3195**	**1615**	**1138**	**1633**	**2942**	**1315**	**1973**						
		CD (5 %)	292	283	220	214	783	182							
		CV (%)	5.5	10.6	12.1	7.8	12.1	8.4							
		DOS	6.10.20	6.10.20	10.10.20	29.9.20	7.10.20	9.10.20							

Table 2.3.6b. Performance of early Indian mustard strains in IVT Zone-III

S.No.	Code	Strain	Days to Maturity							1000-Seed wt. (g)					
			MOR	PNT	JHS	KPR	BPR	DOL	Mean	MOR	PNT	JHS	KPR	BPR	DOL
			1	2	3	4	5	6	(1-6)	1	2	3	4	5	6
1	MCN (E)-20-01	PRE-2018-10	118	110	141	122	128	126	**124**	6.8	3.7	5.2	4.9	4.8	4.7
2	MCN (E)-20-02	DRMRHT 1712	125	114	136	124	133	128	**127**	7.0	3.5	4.7	4.4	4.6	5.1
3	MCN (E)-20-03	TM 188	126	120	140	120	139	130	**129**	6.7	3.6	4.8	4.3	5.1	4.9
4	MCN (E)-20-04	KMR(E) 20-2	132	118	142	122	140	132	**131**	5.2	2.5	4.6	4.0	3.8	4.7
5	MCN (E)-20-05	PHR 8031 (hybrid)	133	118	138	120	141	132	**130**	5.3	3.0	4.4	4.0	4.2	4.7
6	MCN (E)-20-06	NPJ-240	117	105	135	118	124	125	**121**	6.7	3.7	5.6	4.8	4.7	5.3
7	**MCN (E)-20-07**	**PM 25 (NC)**	**116**	**109**	**138**	**119**	**127**	**128**	**123**	**7.5**	**3.7**	**5.1**	**4.7**	**4.7**	**4.8**
8	MCN (E)-20-08	RH 1999-21	124	113	138	120	125	131	**125**	6.4	2.6	4.5	4.8	4.1	3.6
9	MCN (E)-20-09	RMM-19-06	131	118	138	125	139	135	**131**	7.0	3.1	4.3	4.9	4.6	5.2
10	MCN (E)-20-10	PM 27 (LR)	131	116	139	119	133	132	**128**	6.3	2.7	4.5	3.9	3.8	4.8
11	MCN (E)-20-11	KMR(E) 20-1	124	116	137	120	130	129	**126**	7.3	3.0	3.9	3.8	4.7	4.7
12	MCN (E)-20-12	SVJH-006 (hybrid)	128	112	133	121	134	131	**127**	8.0	3.3	5.4	4.1	5.2	5.6
13	MCN (E)-20-13	JD 6 (ZC)	127	114	139	125	138	133	**129**	6.8	3.5	2.4	4.3	4.6	4.4
14	MCN (E)-20-14	NPJ-239	116	109	138	119	119	133	**122**	6.5	3.6	4.9	3.6	4.1	4.7
15	MCN (E)-20-15	DRMRSJ 112	126	114	137	120	135	125	**126**	6.6	3.5	4.0	4.3	4.8	5.4
16	MCN (E)-20-16	PRE-2018-8	115	105	139	121	123	132	**122**	6.3	3.5	4.3	4.8	4.5	4.6
17	MCN (E)-20-17	DRMRCI-129	131	118	138	124	144	125	**130**	7.1	3.1	3.7	4.4	5.1	5.0
18	MCN (E)-20-18	KGMH-3811(hybrid)	126	118	142	120	141	130	**130**	9.1	4.6	4.2	4.3	6.9	5.5
19	MCN (E)-20-19	BAUM 09-12-2	126	115	137	124	135	128	**128**	7.1	3.2	4.8	4.9	4.2	4.2
20	MCN (E)-20-20	SKM 1746	125	114	135	121	131	130	**126**	8.9	3.8	4.0	4.0	6.2	5.4
21	MCN (E)-20-21	RH 1999-12	127	112	134	126	133	129	**127**	7.7	2.9	4.5	4.7	4.5	4.7
22	MCN (E)-20-22	PHR 8024 (hybrid)	129	120	138	125	143	128	**130**	7.1	3.0	5.2	4.7	4.0	4.8
23	MCN (E)-20-23	PRO 5111 (hybrid check)	111	109	137	123	133	125	**123**	5.6	2.7	4.7	4.0	5.4	4.2
24	MCN (E)-20-24	ORM 2019-06	131	130	138	126	121	133	**130**	9.1	4.1	4.9	4.8	4.5	4.5

Table 2.3.7. Performance of early Indian mustard strains in IVT Zone-IV

S.No.	Code	Strain	Seed Yield (kg/ha)					Plant Stand				Days to maturity				
			SKN	NGP	MDR	JNG	Mean	SKN	NGP	MDR	JNG	SKN	NGP	MDR	JNG	Mean
			1	2	3	4	(1-4)	1	2	3	4	1	2	3	4	(1-4)
1	MCN (E)-20-01	PRE-2018-10	2015	1939	2272	2355	**2145**	145	164	169	178	109	116	119	88	**108**
2	MCN (E)-20-02	DRMRHT 1712	2214	2058	2855	2138	**2316**	146	168	166	169	108	116	124	90	**110**
3	MCN (E)-20-03	TM 188	2183	1761	3150	1588	**2170**	129	162	170	179	111	116	126	98	**113**
4	MCN (E)-20-04	KMR(E) 20-2	2533	2123	3217	2252	**2531**	136	172	165	173	109	118	125	98	**113**
5	MCN (E)-20-05	PHR 8031 (hybrid)	2621	1959	4176	1950	**2677**	149	167	167	172	112	115	120	90	**109**
6	MCN (E)-20-06	NPJ-240	2037	1733	2381	2379	**2133**	130	160	167	176	109	114	117	80	**105**
7	**MCN (E)-20-07**	**PM 25 (NC)**	**2421**	**2339**	**3702**	**2083**	**2636**	**136**	**172**	**167**	**179**	**109**	**119**	**109**	**80**	**104**
8	MCN (E)-20-08	RH 1999-21	2495	2069	3550	2289	**2601**	160	168	165	173	110	116	112	84	**106**
9	MCN (E)-20-09	RMM-19-06	3018	1813	4527	2180	**2885**	134	163	166	175	113	116	120	99	**112**
10	MCN (E)-20-10	GM 1 (LR)	2602	1898	2844	1896	**2310**	142	164	163	179	110	116	122	99	**112**
11	MCN (E)-20-11	KMR(E) 20-1	2357	2179	3482	2120	**2534**	140	167	167	177	112	117	123	91	**111**
12	MCN (E)-20-12	SVJH-006 (hybrid)	2262	2335	4060	2089	**2687**	152	172	165	177	112	120	124	95	**113**
13	MCN (E)-20-13	JD 6 (ZC)	2674	2439	3802	2373	**2822**	143	178	169	177	112	120	120	97	**112**
14	MCN (E)-20-14	NPJ-239	1920	1838	3128	2283	**2292**	128	163	166	176	106	117	110	79	**103**
15	MCN (E)-20-15	DRMRSJ 112	2154	1958	3409	2434	**2489**	126	167	169	175	111	115	118	96	**110**
16	MCN (E)-20-16	PRE-2018-8	2198	1904	2936	2156	**2298**	135	164	164	176	110	116	109	85	**105**
17	MCN (E)-20-17	DRMRCI-129	2755	1865	3770	2114	**2626**	131	161	167	175	111	116	121	99	**112**
18	MCN (E)-20-18	KGMH-3811(hybrid)	2424	2342	3068	2591	**2606**	135	170	166	176	107	119	122	97	**111**
19	MCN (E)-20-19	BAUM 09-12-2	2161	2109	3051	2331	**2413**	148	171	165	171	113	116	123	95	**112**
20	MCN (E)-20-20	SKM 1746	2773	2317	2822	2603	**2629**	142	174	164	173	108	118	120	95	**110**
21	MCN (E)-20-21	RH 1999-12	2354	1789	3201	2204	**2387**	150	161	166	177	111	114	120	90	**109**
22	MCN (E)-20-22	PHR 8024 (hybrid)	2525	2074	3371	2603	**2643**	150	169	168	179	111	116	123	96	**112**
23	MCN (E)-20-23	PRO 5111 (hybrid check)	2220	1835	2612	2114	**2195**	130	162	170	178	110	116	108	81	**104**
24	MCN (E)-20-24	ORM 2019-06	2244	2038	3424	1455	**2290**	139	168	162	177	114	116	123	101	**114**
		GM	**2382**	**2030**	**3284**	**2191**	**2471**									
		CD (5 %)	424	216	374	291										
		CV (%)	10.8	11.2	6.9	8.1										
		DOS	9.10.20	10.10.20	9.10.20	10.10.20										

Table 2.3.8a. Performance of early Indian mustard strains in IVT Zone-V

S.No.	Code	Strain	Seed Yield (Kg/ha)							Plant Stand					
			IMP	SHL #	BHU$	JAG	KNK	KLN	Mean	IMP	SHL	BHU	JAG	KNK	KLN
			1	2	3	4	5	6	(1,4-6)	1	2	3	4	5	6
1	MCN (E)-20-01	PRE-2018-10	2093	735	1214	2204	1295	1578	**1792**	168	183	126	249	185	161
2	MCN (E)-20-02	DRMRHT 1712	1551	679	1504	2599	1275	1240	**1666**	184	181	128	255	186	164
3	MCN (E)-20-03	TM 188	827	772	1229	1914	1351	858	**1237**	172	178	129	246	183	167
4	MCN (E)-20-04	KMR(E) 20-2	963	432	1210	2247	1552	1173	**1484**	176	147	131	227	185	156
5	MCN (E)-20-05	PHR 8031 (hybrid)	907	265	1113	2296	1631	982	**1454**	169	128	126	255	181	161
6	MCN (E)-20-06	NPJ-240	1191	494	1221	2228	1389	1102	**1478**	183	150	130	228	192	168
7	MCN (E)-20-07	PM 25 (NC)	1185	364	1169	2284	1435	809	**1428**	189	134	126	256	183	159
8	MCN (E)-20-08	RH 1999-21	1463	370	1110	2562	1870	1027	**1730**	185	126	124	310	192	169
9	MCN (E)-20-09	RMM-19-06	1506	586	1022	2204	1709	1138	**1639**	184	168	127	214	188	166
10	**MCN (E)-20-10**	**NRCHB 101 (LR)**	**1870**	**981**	**1400**	**2512**	**1945**	**1373**	**1925**	**183**	**226**	**133**	**222**	**190**	**154**
11	MCN (E)-20-11	KMR(E) 20-1	1377	438	1299	2475	1644	1413	**1727**	162	164	127	291	189	168
12	MCN (E)-20-12	SVJH-006 (hybrid)	1716	401	1452	2735	1770	1538	**1939**	181	158	131	245	191	164
13	MCN (E)-20-13	JD 6 (ZC)	1414	444	1652	2123	1415	1364	**1579**	182	160	130	245	192	158
14	MCN (E)-20-14	NPJ-239	1123	722	1260	2500	1377	1102	**1526**	160	172	130	228	192	163
15	MCN (E)-20-15	DRMRSJ 112	1346	691	1260	2358	1366	1462	**1633**	170	161	127	277	188	168
16	MCN (E)-20-16	PRE-2018-8	1290	531	1062	2451	1470	1071	**1571**	156	160	125	273	189	158
17	MCN (E)-20-17	DRMRCI-129	1012	722	1301	2259	1423	1042	**1434**	164	174	128	253	191	163
18	MCN (E)-20-18	KGMH-3811(hybrid)	1358	642	1524	2321	1418	1000	**1524**	148	164	131	221	192	161
19	MCN (E)-20-19	BAUM 09-12-2	1772	321	1442	2130	1511	964	**1594**	181	131	130	240	183	160
20	MCN (E)-20-20	SKM 1746	1549	333	1421	2537	1470	996	**1638**	169	134	129	239	184	166
21	MCN (E)-20-21	RH 1999-12	1111	327	1446	2284	1606	922	**1481**	185	134	132	217	183	158
22	MCN (E)-20-22	PHR 8024 (hybrid)	1469	463	1404	2247	1853	1342	**1728**	170	150	129	245	184	164
23	MCN (E)-20-23	PRO 5111 (hybrid	1932	500	1001	2537	1731	1351	**1888**	159	145	126	230	187	162
24	MCN (E)-20-24	ORM 2019-06	1475	426	1374	2111	1542	1418	**1637**	181	145	129	251	194	163
		GM	**1396**	**527**	**1295**	**2338**	**1544**	**1178**	**1614**						
		CD (5 %)	293	157	85	396	238	239							
		CV (%)	12.8	18.1	4.0	10.3	9.6	12.3							
		DOS	13.11.20	13.11.20	13.11.20	5.11.20	16.10.20	26.10.20							

data of SHL excluded from computation of mean due to high CV

$ data of BHU excluded from computation of mean due to CV less than 5.0 in field experimentation

Table 2.3.8b. Performance of early Indian mustard strains in IVT Zone-V

S.No	Code	Strain	Days to Maturity							1000-Seed Wt.(g)					
			IMP	SHL #	BHU$	JAG	KNK	KLN	Mean	IMP	SHL	BHU	JAG	KNK	KLN
			1	2	3	4	5	6	(1,4-6)	1	2	3	4	5	6
1	MCN (E)-20-01	PRE-2018-10	112	102	101	100	115	105	**108**	3.8	4.0	3.8	6.2	4.5	5.1
2	MCN (E)-20-02	DRMRHT 1712	113	107	105	104	116	105	**109**	4.0	4.5	4.4	5.9	4.6	4.5
3	MCN (E)-20-03	TM 188	113	112	99	114	118	106	**113**	3.9	2.5	4.0	6.2	5.2	3.7
4	MCN (E)-20-04	KMR(E) 20-2	114	107	100	107	118	110	**112**	3.0	2.0	3.8	5.8	3.7	3.6
5	MCN (E)-20-05	PHR 8031 (hybrid)	114	111	98	107	118	112	**113**	3.1	4.0	3.9	5.5	3.3	3.9
6	MCN (E)-20-06	NPJ-240	111	103	102	100	114	106	**108**	4.8	4.0	4.0	5.1	4.9	4.6
7	MCN (E)-20-07	PM 25 (NC)	111	103	99	105	113	102	**108**	4.1	4.5	3.7	6.0	4.1	4.5
8	MCN (E)-20-08	RH 1999-21	112	105	100	102	113	105	**108**	3.4	4.0	3.9	5.3	3.8	3.8
9	MCN (E)-20-09	RMM-19-06	113	109	98	112	118	112	**114**	3.8	4.5	4.0	6.1	3.8	4.2
10	**MCN (E)-20-10**	**NRCHB 101 (LR)**	**113**	**107**	**104**	**105**	**115**	**108**	**110**	**4.8**	**5.0**	**4.3**	**6.0**	**5.8**	**5.5**
11	MCN (E)-20-11	KMR(E) 20-1	112	105	103	102	114	108	**109**	3.6	5.0	3.8	5.5	4.5	4.3
12	MCN (E)-20-12	SVJH-006 (hybrid)	111	109	105	102	113	106	**108**	4.2	4.5	4.4	6.1	5.1	4.6
13	MCN (E)-20-13	JD 6 (ZC)	113	105	107	107	117	108	**111**	4.0	4.5	4.5	5.8	5.2	4.1
14	MCN (E)-20-14	NPJ-239	111	104	103	105	113	103	**108**	4.2	3.0	3.9	5.6	4.4	4.3
15	MCN (E)-20-15	DRMRSJ 112	115	108	99	112	117	106	**112**	4.4	4.0	4.1	5.9	4.5	3.9
16	MCN (E)-20-16	PRE-2018-8	112	102	102	100	114	104	**107**	3.9	5.0	3.8	5.9	4.3	4.4
17	MCN (E)-20-17	DRMRCI-129	113	112	104	107	118	112	**113**	3.9	4.0	4.2	6.2	6.2	4.1
18	MCN (E)-20-18	KGMH-3811(hybrid)	114	107	106	109	116	110	**112**	4.9	5.5	4.2	5.8	4.9	5.7
19	MCN (E)-20-19	BAUM 09-12-2	115	107	103	105	118	108	**112**	3.5	4.5	4.0	5.6	4.4	3.7
20	MCN (E)-20-20	SKM 1746	113	104	104	107	118	107	**111**	4.8	4.0	4.1	6.5	5.0	5.2
21	MCN (E)-20-21	RH 1999-12	115	106	105	109	115	104	**111**	4.7	5.5	4.3	5.8	4.8	3.9
22	MCN (E)-20-22	PHR 8024 (hybrid)	113	107	103	109	117	110	**112**	3.8	2.0	4.0	6.0	4.2	4.0
23	MCN (E)-20-23	PRO 5111 (hybrid check)	114	102	99	100	116	103	**108**	3.7	3.5	3.8	6.3	4.2	3.2
24	MCN (E)-20-24	ORM 2019-06	116	112	101	109	118	112	**114**	4.5	4.5	4.0	5.8	6.3	5.1

Table 2.3.9. Performance of early Indian mustard strains in IVT Zone-VI

S.No.	Code	Strain	Seed Yield (Kg/ha)			
			RAI	DWD#	HYD#	Mean
			1	2	3	(1-3)
1	MCN (E)-20-01	PRE-2018-10	453	965	479	**632**
2	MCN (E)-20-02	DRMRHT 1712	565	757	533	**618**
3	MCN (E)-20-03	TM 188	472	1046	612	**710**
4	MCN (E)-20-04	KMR(E) 20-2	535	1046	388	**656**
5	MCN (E)-20-05	PHR 8031 (hybrid)	430	717	691	**613**
6	MCN (E)-20-06	NPJ-240	546	825	469	**613**
7	MCN (E)-20-07	PM 25 (NC)	423	964	563	**650**
8	MCN (E)-20-08	RH 1999-21	528	1216	449	**731**
9	MCN (E)-20-09	RMM-19-06	297	739	437	**491**
10	**MCN (E)-20-10**	**NRCHB 101 (LR)**	**374**	**1050**	**691**	**705**
11	MCN (E)-20-11	KMR(E) 20-1	401	1061	553	**672**
12	MCN (E)-20-12	SVJH-006 (hybrid)	312	979	595	**629**
13	MCN (E)-20-13	JD 6 (ZC)	391	1036	519	**648**
14	MCN (E)-20-14	NPJ-239	540	1345	654	**846**
15	MCN (E)-20-15	DRMRSJ 112	497	920	588	**668**
16	MCN (E)-20-16	PRE-2018-8	572	904	704	**726**
17	MCN (E)-20-17	DRMRCI-129	518	979	474	**657**
18	MCN (E)-20-18	KGMH-3811(hybrid)	633	1072	578	**761**
19	MCN (E)-20-19	BAUM 09-12-2	632	1091	484	**736**
20	MCN (E)-20-20	SKM 1746	503	987	506	**665**
21	MCN (E)-20-21	RH 1999-12	495	875	509	**626**
22	MCN (E)-20-22	PHR 8024 (hybrid)	459	1085	494	**679**
23	MCN (E)-20-23	PRO 5111 (hybrid check)	508	1098	467	**691**
24	MCN (E)-20-24	ORM 2019-06	298	770	679	**582**
		GM	**474**	**980**	**547**	**667**
		CD (5 %)	81	258	233	
		CV (%)	13.5	16.0	26.6	
		DOS	12.11.20		27.11.20	

data of HYD and DWD centres excluded from computation of mean due to high CV
not suiatble for consideration due to low seed yield

Table 2.3.10. Performance of early Indian mustard strains in AVT-I Zone-II

S.No.	Code	Strain	Seed Yield (Kg/ha)					Plant Stand				Days to Maturity				Mean	1000-Seed Wt. (g)			
			HSR	LDH#	CHT	NDH	Mean	HSR	LDH	CHT	NDH	HSR	LDH	CHT	NDH		HSR	LDH	CHT	NDH
			1	2	3	4	(1, 3-4)	1	2	3	4	1	2	3	4	(1, 3-4)	1	2	3	4
1	**MCN (E)-20-25**	**PM 28 (LR)**	**1956**	**1995**	**1764**	**2860**	**2194**	**250**	**130**	**276**	**211**	**123**	**118**	**131**	**121**	**125**	**4.0**	**4.0**	**3.6**	**4.7**
2	MCN (E)-20-26	PM 25 (NC)	2063	1801	1605	2660	**2109**	252	127	272	226	122	121	127	115	**121**	4.6	4.9	3.5	5.2
3	MCN (E)-20-27	RH 1999-42	2571	2106	1938	2527	**2345**	248	134	268	222	114	115	125	122	**120**	4.6	5.4	4.4	4.9
4	MCN (E)-20-28	PM 28 (Filler)	1974	1551	1716	2884	**2191**	245	138	284	220	123	128	128	122	**124**	3.9	4.1	3.9	4.6
5	MCN (E)-20-29	JD 6 (ZC)	1844	1919	1812	2504	**2053**	248	125	273	204	124	129	130	139	**131**	3.8	4.7	3.6	4.7
		GM	**2082**	**1875**	**1767**	**2687**	**2179**													
		CD (5 %)	344	329	208	356														
		CV (%)	10.6	11.4	7.6	8.6														
		DOS	13.9.20	15.9.20	24.9.20	14.9.20														

data of LDH centre excluded form computation of mean due to significant differences between same genotype used as check/Filler

Table 2.3.11a. Performance of early Indian mustard strains in AVT-I+AHT-I Zone-III

S.No.	Code	Strain	Seed Yield (Kg/ha)								Plant Stand						
			KPR	MOR	BPR#	VAR	DOL#	JHS	BND$	Mean	KPR	MOR	BPR	VAR	DOL	JHS	BND
			1	2	3	4	5	6	7	(1-2,4,6)	1	2	3	4	5	6	7
1	MCN (E)-20-30	RMM 10-1-1	1461	1813	1146	2208	1518	1521	3168	**1750**	210	284	178	384	333	189	360
2	MCN (E)-20-31	RH 1999-42	1513	2281	1153	2497	1302	1703	2959	**1998**	204	294	176	372	336	211	353
3	MCN (E)-20-32	JD 6 (ZC)	1563	2326	1035	2244	1074	1495	3051	**1907**	207	281	154	385	336	210	370
4	MCN (E)-20-33	DRMRCI 116	1550	2505	1064	2294	1370	1570	2878	**1980**	212	292	166	376	332	202	376
5	MCN (E)-20-34	DRMR HJ 2403 (hybrid)	1649	2682	1318	2559	1240	1317	3214	**2052**	208	290	177	373	334	222	359
6	MCN (E)-20-35	KMR (E) 19-2	1563	2257	1243	2291	1119	1463	3525	**1893**	203	302	160	381	336	162	356
7	MCN (E)-20-36	PHR 8022 (hybrid)	1488	2242	1250	2117	1119	1321	2629	**1792**	207	288	171	396	337	228	374
8	MCN (E)-20-37	PRE 17-2	1488	2155	1063	1754	1194	1427	3023	**1706**	208	298	158	396	336	192	383
9	**MCN (E)-20-38**	**PM 28 (LR)**	**1699**	**2167**	**988**	**2487**	**1408**	**1328**	**2739**	**1920**	**211**	**300**	**139**	**355**	**337**	**201**	**359**
10	MCN (E)-20-39	PRO 5111 (hybrid check)	1476	2162	1075	2239	1200	1303	3477	**1795**	204	297	165	382	333	169	372
11	MCN (E)-20-40	KMR (E) 19-1	1438	1988	953	2378	1188	1230	3494	**1758**	207	304	157	382	333	136	364
12	MCN (E)-20-41	PM 25 (NC)	1451	1836	1119	1893	1229	1294	3306	**1618**	207	302	156	381	333	207	356
13	MCN (E)-20-42	PRE 17-5	1488	2212	1032	2278	1391	1383	2971	**1840**	212	302	153	394	330	184	374
14	MCN (E)-20-43	NPJ 229	1451	1784	1159	2073	1119	1413	3045	**1680**	203	297	154	368	332	161	370
15	MCN (E)-20-44	DRMRCI 96	1438	2075	988	2013	1194	1740	3397	**1817**	207	295	160	390	336	188	376
16	MCN (E)-20-45	NPJ 230	1451	1826	1057	1752	1175	1242	3134	**1568**	209	304	148	388	337	207	362
		GM	**1510**	**2144**	**1103**	**2192**	**1240**	**1422**	**3126**	**1817**							
		CD (5 %)	173	240	440	313	158	271	551								
		CV (%)	8.3	7.8	14.0	10.7	9.2	13.8	12.5								
		DOS	29.9.20	10.10.20	6.10.20	9.10.20	9.10.20	10.10.20	30.10.20								

data of BPR and DOL centre excluded from computation of mean due to average yield of the trial is less than the state's average

$ data of BND excluded from computation of mean due to late sowing

Table 2.3.11b. Performance of early Indian mustard strains in AVT-I+AHT-I Zone-III

S.No.	Code	Strain	Days to Maturity								1000-Seed wt. (g)						
			KPR	MOR	BPR#	VAR	DOL#	JHS	BND$	Mean	KPR	MOR	BPR	VAR	DOL	JHS	BND
			1	2	3	4	5	6	7	(1-2,4,6)	1	2	3	4	5	6	7
1	MCN (E)-20-30	RMM 10-1-1	126	130	146	122	136	142	120	**130**	3.7	4.6	4.8	5.7	4.8	4.8	4.2
2	MCN (E)-20-31	RH 1999-42	124	127	124	121	128	139	112	**128**	4.0	4.6	4.3	5.7	4.7	5.9	4.0
3	MCN (E)-20-32	JD 6 (ZC)	125	129	139	123	130	142	119	**130**	3.9	4.5	4.8	5.9	5.1	4.4	5.3
4	MCN (E)-20-33	DRMRCI 116	128	130	140	122	131	135	122	**129**	4.1	7.2	5.1	5.9	4.5	5.5	4.6
5	MCN (E)-20-34	DRMR HJ 2403 (hybrid)	122	132	139	126	129	135	120	**129**	3.8	7.1	4.8	5.6	5.2	5.6	4.5
6	MCN (E)-20-35	KMR (E) 19-2	123	127	130	126	129	138	115	**128**	4.0	7.0	6.0	5.5	4.7	4.5	5.4
7	MCN (E)-20-36	PHR 8022 (hybrid)	121	130	140	114	131	142	120	**127**	4.1	5.8	4.2	6.0	4.8	4.6	3.9
8	MCN (E)-20-37	PRE 17-2	120	122	124	114	125	143	111	**125**	4.0	6.3	3.9	5.6	6.0	4.7	3.8
9	**MCN (E)-20-38**	**PM 28 (LR)**	**124**	**121**	**122**	**116**	**127**	**134**	**112**	**124**	**3.8**	**5.6**	**4.4**	**5.5**	**4.8**	**5.2**	**3.9**
10	MCN (E)-20-39	PRO 5111 (hybrid check)	126	122	125	118	128	128	110	**124**	4.3	6.2	4.1	4.7	4.1	5.0	3.0
11	MCN (E)-20-40	KMR (E) 19-1	123	128	127	121	129	141	115	**128**	4.0	6.9	4.8	5.2	5.0	4.8	4.2
12	MCN (E)-20-41	PM 25 (NC)	122	122	121	120	124	143	112	**127**	3.8	6.6	4.6	5.8	5.4	4.6	4.1
13	MCN (E)-20-42	PRE 17-5	124	121	124	118	126	139	112	**125**	3.1	4.5	4.4	5.8	5.0	5.9	3.9
14	MCN (E)-20-43	NPJ 229	122	117	125	116	126	135	112	**122**	3.3	4.9	4.6	5.6	4.6	4.5	4.3
15	MCN (E)-20-44	DRMRCI 96	124	123	129	120	130	133	120	**125**	4.3	5.1	4.7	5.8	5.7	6.1	4.9
16	MCN (E)-20-45	NPJ 230	121	119	122	118	125	133	111	**123**	3.9	6.7	4.5	5.6	5.9	4.8	3.9

Table-2.3.12. Performance of Indian mustard strains in IVT timely sown (irrigated), Zone - I

S.No.	Code	Strain	Seed Yield (kg/ha)					Plant Stand				Days to Maturity				1000 Seed Wt. (g)	
			KNG	DLK$	UNA	BJR$	Mean	KNG	DLK	UNA	BJR	KNG	DLK	UNA	BJR	KNG	BJR
			1	2	3	4	(1,3)	1	2	3	4	1	2	3	4	1	4
1	MCN-20-1	NPJ-242	1288	1025	967	1076	**1127**	233	251	242	68	153	133	130	164	4.4	5.5
2	MCN-20-2	ACNMM-23	1392	768	1152	1087	**1272**	232	252	246	94	149	129	125	165	4.2	3.9
3	MCN-20-3	RGN-491	1387	1112	1042	1279	**1215**	234	252	242	93	156	129	124	164	4.3	5.2
4	**MCN-20-4**	**Kranti (NC)**	**1312**	**868**	**1064**	**1067**	**1188**	**235**	**251**	**246**	**86**	**154**	**131**	**129**	**166**	**3.9**	**4.4**
5	MCN-20-5	DRMR 2018-17	1353	1018	1021	1221	**1187**	233	250	242	77	143	127	123	164	4.3	8.7
6	MCN-20-6	TM 274	1257	967	955	1183	**1106**	235	251	246	76	162	127	123	169	4.9	4.5
7	MCN-20-7	Giriraj (LR)	1210	893	1065	1199	**1138**	234	251	246	78	157	131	128	165	5.5	6.2
8	MCN-20-8	PR-2017-5	1265	1147	1083	975	**1174**	235	254	243	87	158	133	90	166	4.3	6.4
9	MCN-20-9	RH 1975	1382	974	1069	951	**1225**	232	251	244	82	151	130	126	167	4.4	5.0
10	MCN-20-10	PBR 507	1324	1102	1083	1025	**1203**	234	250	243	84	155	129	130	169	5.5	4.5
11	MCN-20-11	RMM-19-18	1376	972	1136	1421	**1256**	234	253	247	**77**	154	128	124	165	4.4	4.2
12	MCN-20-12	SKM 1728	1332	972	1050	1272	**1191**	234	252	246	89	155	127	122	165	4.1	3.8
13	MCN-20-13	KMR-20-4	1216	939	1123	897	**1169**	232	251	243	78	154	128	125	169	4.2	4.6
14	MCN-20-14	ORM 2019-02	1304	1082	1022	1080	**1163**	234	249	244	92	149	128	125	166	3.8	5.0
15	MCN-20-15	RCC 4 (ZC)	1334	1121	992	1349	**1163**	234	252	245	86	155	130	126	167	3.4	4.4
16	MCN-20-16	RH 1974	1217	1037	1018	1347	**1117**	232	251	243	88	156	130	127	168	4.4	5.5
17	MCN-20-17	SKM 1620	1297	946	1075	913	**1186**	234	253	245	77	155	130	126	167	5.4	5.3
18	MCN-20-18	PRB-2012-3	1517	981	1237	1357	**1377**	233	253	245	85	157	130	128	166	4.6	3.8
19	MCN-20-19	RGN-483	1378	750	994	712	**1186**	234	253	243	91	156	130	129	166	4.4	5.3
20	MCN-20-20	DRMRCI-127	1272	966	886	728	**1079**	232	252	243	91	159	135	130	167	4.5	5.1
21	MCN-20-21	JM-14-8	1202	1103	1113	1274	**1157**	233	54	113	32	157	128	125	171	3.9	3.9
22	MCN-20-22	HUJM-19-11	1322	1052	1116	1137	**1219**	233	254	245	**81**	157	128	124	168	4.5	5.2
23	MCN-20-23	BAUM-08-17	1277	1079	938	1429	**1107**	231	251	248	76	156	130	127	166	4.3	9.8
24	MCN-20-24	KMR-20-3	1226	1228	1154	1093	**1190**	231	254	245	98	156	135	131	166	4.4	5.0
25	MCN-20-25	DRMRHT 1318	1223	953	927	1279	**1075**	233	253	245	71	150	131	129	165	3.8	4.7
26	MCN-20-26	NPJ-241	1149	968	974	1102	**1061**	232	251	245	84	155	131	128	162	4.3	5.4
27	MCN-20-27	AKMS-20-1	1167	1007	1111	929	**1139**	234	251	247	98	158	131	128	165	4.4	5.1
		GM	**1295**	**1001**	**1051**	**1125**	**1173**										
		CD (5%)	222	273	164	440											
		CV(%)	11	17	10	24											
		DOS	24.10.20	26.10.20	30.10.20	22.10.20											

$ data of DLK and BJR centre excluded from computation of mean due to high CV

only two valid locations data, hence no promotion of strain(s)

Table-2.3.13a. Performance of Indian mustard strains in IVT timely sown (Irrigated), Zone - II

S.No.	Code	Strain	Seed Yield (Kg/ha)										Plant Stand							
			HSR	LDH	NDH	CHT	SGN	MOD	ABR	BAW	Mean		HSR	LDH	NDH	CHT	SGN	MOD	ABR	BAW
			1	2	3	4	5	6	7	8	(1-8)		1	2	3	4	5	6	7	8
1	MCN-20-1	NPJ-242	2654	2416	2795	1780	2221	2630	2778	2674	**2493**		120	130	134.3	119	187	123	125	119
2	MCN-20-2	ACNMM-23	2712	2407	2886	1864	2183	2243	2154	2637	**2386**		122	129	131.7	126	195	114	119	113
3	MCN-20-3	RGN-491	3042	2325	2905	1839	2157	2056	2383	2375	**2385**		121	133	142.3	118	196	123	128	130
4	MCN-20-4	Kranti (NC)	2813	1617	2350	1883	2531	2202	2295	2360	**2256**		123	137	145.3	121	185	112	126	135
5	MCN-20-5	DRMR 2018-17	2420	1704	2658	1936	1912	2288	2266	2331	**2189**		125	118	150	126	186	116	127	145
6	MCN-20-6	TM 274	2805	1581	3022	1944	1956	2033	2593	2212	**2268**		123	126	137.7	124	190	124	127	125
7	MCN-20-7	Giriraj (LR)	2721	2551	2687	2078	1915	1977	2459	2303	**2336**		120	134	135.7	119	188	120	128	132
8	MCN-20-8	PR-2017-5	2509	2161	3190	1935	2317	2257	2579	2582	**2441**		124	136	160	118	192	122	128	140
9	**MCN-20-9**	**RH 1975**	**3600**	**2251**	**3486**	**2072**	**2602**	**2879**	**3013**	**2767**	**2834**	*	**121**	**130**	**147**	**128**	**200**	**117**	**127**	**140**
10	MCN-20-10	PBR 507	2897	2276	3148	1818	2932	2504	2536	2517	**2578**		122	137	150	126	201	114	117	134
11	MCN-20-11	RMM-19-18	2949	2362	2564	1919	2859	2235	2739	2723	**2544**		120	138	153.3	119	204	112	116	135
12	MCN-20-12	SKM 1728	2700	2457	3038	1942	2325	2481	2527	2822	**2536**		122	128	138.3	131	197	127	124	138
13	MCN-20-13	KMR-20-4	2591	1650	3022	1751	2273	2418	2831	2433	**2371**		123	137	143.7	127	186	122	128	117
14	MCN-20-14	ORM 2019-02	2875	1638	3235	1927	2278	2187	2960	2586	**2461**		122	126	141.3	121	185	118	124	111
15	**MCN-20-15**	**RH 749 (ZC)**	**2636**	**2634**	**2945**	**1939**	**2257**	**2648**	**2516**	**2307**	**2485**		**120**	**131**	**147.7**	**124**	**194**	**124**	**129**	**118**
16	**MCN-20-16**	**RH 1974**	**3688**	**2864**	**3579**	**1894**	**2218**	**2757**	**3042**	**2875**	**2865**	*	**123**	**131**	**143.7**	**124**	**193**	**121**	**128**	**114**
17	MCN-20-17	SKM 1620	3123	2367	3123	1770	2365	2144	3017	2694	**2575**		121	135	138.7	132	193	108	128	119
18	MCN-20-18	PRB-2012-3	2776	2438	3275	2031	2363	2429	2950	2560	**2603**		120	136	149.3	120	192	120	128	116
19	MCN-20-19	RGN-483	3603	2346	3222	1903	2032	2578	2947	2506	**2642**		123	131	140.7	129	185	115	127	125
20	MCN-20-20	DRMRCI-127	2713	2169	2990	1876	2785	1910	2530	2486	**2432**		120	128	140.3	119	204	105	118	122
21	MCN-20-21	JM-14-8				1869	1024				**1447**					124	176			
22	MCN-20-22	HUJM-19-11	2902	2411	3277	1700	2433	2181	2443	2527	**2484**		123	134	137	122	183	121	115	112
23	MCN-20-23	BAUM-08-17	2971	2041	3009	1934	2097	2552	2583	2318	**2438**		121	141	147	121	192	124	120	122
24	MCN-20-24	KMR-20-3	3512	1687	2730	1910	2246	2084	2818	2829	**2477**		122	124	145	126	194	129	129	138
25	MCN-20-25	DRMRHT 1318	2550	2198	2189	1821	2280	2196	2554	2510	**2287**		119	119	149.3	121	189	128	117	133
26	MCN-20-26	NPJ-241	2975	2152	3060	1899	2098	2111	2823	2615	**2467**		122	137	137	129	187	118	128	130
27	MCN-20-27	AKMS-20-1	2680	2251	3244	1950	2321	2714	2909	2588	**2582**		120	182	134.3	131	195	125	128	111
		GM	**2900**	**2191**	**2986**	**1896**	**2259**	**2334**	**2663**	**2544**	**2472**									
		CD (5%)	463	924	461	332	264	231	372	371										
		CV(%)	10.4	10.8	10.0	10.9	7.3	6.4	9.1	9.5										
		DOS	12.10.20	21.10.20	16.10.20	23.10.20	24.10.20	21.10.20	19.10.20	18.10.20										

* Strain outyielding the best check by a margin of more than or equal to 10 percent on the basis of seed yield

Table-2.3.13b. Performance of Indian mustard strains in IVT timely sown (Irrigated), Zone - II

S.No.	Code	Strain	Days to Maturity								1000 Seed Weight (g)							
			HSR	LDH	NDH	CHT	SGN	MOD	ABR	BAW	HSR	LDH	NDH	CHT	SGN	MOD	ABR	BAW
			1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
1	MCN-20-1	NPJ-242	129	138	136.7	145	149	148	139	139	5.5	5.3	5.7	3.4	5.8	5.7	5.5	5.2
2	MCN-20-2	ACNMM-23	133	140	143	144	151	149	141	142	5.1	5.0	5.4	4.4	5.0	5.2	5.5	4.9
3	MCN-20-3	RGN-491	134	139	144	143	153	144	145	140	5.4	4.9	5.2	4.8	5.2	4.5	5.8	5.5
4	MCN-20-4	Kranti (NC)	133	139	140.7	142	148	148	141	143	4.4	3.9	4.2	4.2	4.6	4.8	4.8	5.3
5	MCN-20-5	DRMR 2018-17	129	140	141	146	147	140	139	141	5.3	5.1	5.5	4.2	5.8	5.8	5.6	5.4
6	MCN-20-6	TM 274	134	139	145.3	147	150	149	145	144	6.8	4.7	6.5	5.0	5.0	6.6	5.9	6.4
7	MCN-20-7	Giriraj (LR)	138	138	140.7	145	152	147	140	143	6.2	4.6	5.9	4.9	5.2	5.6	6.0	5.6
8	MCN-20-8	PR-2017-5	134	139	142.3	144	153	149	140	143	4.6	3.6	4.2	3.6	5.0	4.7	5.1	5.1
9	**MCN-20-9**	**RH 1975**	**134**	**138**	**141.3**	**146**	**149**	**148**	**141**	**140**	**5.7**	**5.2**	**5.1**	**4.4**	**5.6**	**5.2**	**5.9**	**5.2**
10	MCN-20-10	PBR 507	132	138	143.3	147	151	148	145	142	5.7	5.3	5.0	4.6	4.8	6.1	5.5	4.8
11	MCN-20-11	RMM-19-18	133	139	141.3	142	148	145	139	142	4.4	4.2	4.1	4.3	5.6	5.2	5.1	4.7
12	MCN-20-12	SKM 1728	133	142	142.7	146	147	147	143	143	4.9	4.4	5.1	4.2	5.4	5.0	5.9	5.3
13	MCN-20-13	KMR-20-4	135	141	145	143	149	148	144	144	4.9	4.8	4.8	4.1	5.2	5.2	5.3	4.9
14	MCN-20-14	ORM 2019-02	134	138	144	148	153	144	146	143	5.0	5.1	4.7	4.2	5.6	4.5	5.3	6.3
15	**MCN-20-15**	**RH 749 (ZC)**	**133**	**138**	**143.7**	**146**	**152**	**150**	**143**	**142**	**6.5**	**5.1**	**6.4**	**3.8**	**5.2**	**6.7**	**6.0**	**5.7**
16	**MCN-20-16**	**RH 1974**	**131**	**140**	**140**	**148**	**151**	**147**	**138**	**139**	**6.1**	**5.4**	**6.0**	**4.6**	**6.0**	**5.8**	**6.1**	**5.3**
17	MCN-20-17	SKM 1620	135	138	144	144	150	144	144	141	5.9	4.3	6.1	5.6	6.2	6.1	5.7	4.8
18	MCN-20-18	PRB-2012-3	132	136	145	142	153	145	145	141	4.5	5.8	4.3	3.5	4.6	4.3	4.7	4.7
19	MCN-20-19	RGN-483	135	136	144.3	146	151	151	145	143	4.7	4.8	4.2	3.6	4.8	5.7	5.1	5.2
20	MCN-20-20	DRMRCI-127	136	135	141.7	148	153	147	143	144	5.4	4.2	4.4	4.6	5.2	5.2	5.3	5.1
21	MCN-20-21	JM-14-8				146	151							5.4	4.2			
22	MCN-20-22	HUJM-19-11	135	137	143.7	146	150	147	144	142	5.6	4.9	5.9	4.9	6.0	5.6	5.8	6.5
23	MCN-20-23	BAUM-08-17	135	140	142.7	148	149	148	142	143	5.2	4.5	4.9	3.9	5.0	5.0	5.2	5.4
24	MCN-20-24	KMR-20-3	136	133	145.7	147	148	150	143	143	5.1	4.5	5.7	3.6	5.6	7.2	5.5	5.3
25	MCN-20-25	DRMRHT 1318	134	137	141.3	145	149	150	142	141	5.0	4.8	4.3	3.8	5.2	4.9	5.1	5.5
26	MCN-20-26	NPJ-241	135	139	140.3	144	152	148	139	142	4.9	4.4	4.9	3.4	5.4	4.8	5.6	4.9
27	MCN-20-27	AKMS-20-1	133	134	143.3	143	153	148	144	143	5.3	5.1	5.0	5.5	6.4	5.8	5.4	5.2

Table2.3.14a. Performance of Indian mustard strains in IVT timely sown (irrigated), Zone - III

S.No.	Code	Strain	Seed Yield (Kg/ha)									Plant Stand							
			MOR	PNT	KPR	VAR	KOT	BND	JHS	DOL	Mean	MOR	PNT	KPR	VAR	KOT	BND	JHS	DOL
			1	2	3	4	5	6	7	8	(1-8)	1	2	3	4	5	6	7	8
1	MCN-20-1	NPJ-242	3288	1981	2620	1959	2976	3840	1263	1001	**2366**	176	130	123	186	161	156	130	169
2	MCN-20-2	ACNMM-23	3568	1401	2513	2475	2967	3322	1362	1313	**2365**	172	139	120	178	153	159	133	164
3	MCN-20-3	RGN-491	2954	1938	2377	2243	2427	3384	1449	1136	**2238**	180	141	122	186	166	167	124	165
4	MCN-20-4	Kranti (NC)	3644	1994	2407	1731	2620	3492	1467	1171	**2316**	171	137	125	190	161	175	133	163
5	MCN-20-5	DRMR 2018-	2955	2154	2329	2336	2522	3014	1953	843	**2263**	174	140	121	196	162	177	152	168
6	MCN-20-6	TM 274	2973	1638	2621	1932	2268	3351	2021	976	**2222**	177	133	119	200	162	173	147	169
7	MCN-20-7	RGN 73(LR)	2845	1648	2400	2081	2860	3068	1931	1127	**2245**	174	135	120	199	164	153	156	166
8	MCN-20-8	PR-2017-5	3009	1806	2597	1852	2480	3349	1606	1154	**2232**	177	138	120	190	164	170	141	162
9	MCN-20-9	RH 1975	3866	2179	2591	2346	2541	3660	1751	857	**2474**	172	136	124	188	167	168	147	168
10	MCN-20-10	PBR 507	3749	2247	2612	2297	2739	3368	1790	1361	**2520**	175	131	118	183	170	168	153	164
11	MCN-20-11	RMM-19-18	3575	1584	2689	1994	2751	2973	1529	1661	**2344**	179	134	121	178	160	158	159	166
12	MCN-20-12	SKM 1728	4066	2147	2749	2165	2928	4033	1378	1145	**2577**	178	130	121	193	181	155	151	167
13	MCN-20-13	KMR-20-4	3169	1772	2554	1974	2974	2450	1766	1372	**2254**	176	128	120	192	171	159	133	167
14	MCN-20-14	ORM 2019-02	3629	1577	2623	2266	2780	3246	2052	1518	**2461**	173	139	122	183	171	177	149	171
15	**MCN-20-15**	**Maya (ZC)**	**3482**	**1796**	**2591**	**2250**	**2975**	**3957**	**1408**	**1307**	**2471**	**178**	**139**	**124**	**191**	**170**	**165**	**154**	**171**
16	MCN-20-16	RH 1974	3440	1587	2708	2699	2769	3776	2404	1131	**2564**	179	128	123	181	173	165	137	169
17	MCN-20-17	SKM 1620	3023	2513	2520	2129	3069	3861	2006	1286	**2551**	171	134	121	192	171	175	135	166
18	MCN-20-18	PRB-2012-3	3195	2097	2437	2453	2999	3393	1611	1264	**2431**	175	132	124	188	172	168	138	170
19	MCN-20-19	RGN-483	3175	2019	2552	2184	2729	3132	1784	1141	**2339**	179	139	119	192	163	172	146	167
20	MCN-20-20	DRMRCI-127	3482	1389	2292	1981	1880	3693	2205	1159	**2260**	173	133	120	190	171	179	157	164
21	MCN-20-21	JM-14-8			2434				209	1082	**1242**			118				30	164
22	MCN-20-22	HUJM-19-11	3337	2548	2484	3098	2381	3630	1605	1388	**2559**	177	137	125	171	164	152	148	170
23	MCN-20-23	BAUM-08-17	3323	1599	2380	1732	2208	3133	1440	1213	**2128**	178	139	122	189	169	166	157	164
24	MCN-20-24	KMR-20-3	3126	1791	2338	2482	2543	2973	1643	1059	**2244**	178	134	120	193	165	166	169	161
25	MCN-20-25	DRMRHT	3130	1438	2316	1816	2299	2945	1522	973	**2055**	179	141	124	194	163	158	150	167
26	MCN-20-26	NPJ-241	3660	1450	2357	1969	2382	3593	1663	1274	**2294**	177	136	120	196	174	183	161	168
27	MCN-20-27	AKMS-20-1	3181	1895	2426	2921	2318	2957	1601	1488	**2349**	175	131	123	172	159	158	142	166
		GM	**3340**	**1853**	**2501**	**2206**	**2630**	**3369**	**1645**	**1200**	**2343**								
		C.D. (5%)	615	333	326	471	326	554	312	179									
		CV (%)	12.0	11.6	8.2	13.8	8.0	10.7	12	9.3									
		DOS	29.10.20	21.10.20	21.10.20	28.10.20	27.10.20	30.10.20	28.10.20	16.10.20									

Table2.3.14b. Performance of Indian mustard strains in IVT timely sown (irrigated), Zone-III

S.No.	Code	Strain	Days to Maturity								1000-Seed Wt. (g)							
			MOR	PNT	KPR	VAR	KOT	BND	JHS	DOL	MOR	PNT	KPR	VAR	KOT	BND	JHS	DOL
			1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
1	MCN-20-1	NPJ-242	125	136	134	128	131	123	130	135	6.6	4.3	5.1	5.6	5.2	4.9	5.7	6.0
2	MCN-20-2	ACNMM-23	133	133	131	126	132	123	132	134	6.6	3.6	4.2	5.2	5.5	4.8	5.1	5.3
3	MCN-20-3	RGN-491	130	138	135	129	134	124	131	137	6.3	4.2	4.9	5.4	5.6	4.7	5.1	5.7
4	MCN-20-4	Kranti (NC)	125	134	134	126	131	124	130	137	5.1	3.2	5.0	5.3	4.3	4.1	4.7	5.0
5	MCN-20-5	DRMR 2018-17	128	135	133	128	132	123	132	138	7.0	4.8	4.9	5.1	5.8	5.4	5.5	5.8
6	MCN-20-6	TM 274	134	141	135	130	134	126	130	139	7.5	4.9	5.2	6.1	6.2	6.5	6.3	4.6
7	MCN-20-7	RGN 73(LR)	131	143	134	128	132	127	136	139	5.2	3.5	4.9	5.2	5.1	4.4	4.7	5.8
8	MCN-20-8	PR-2017-5	130	134	131	129	132	123	130	135	5.1	3.3	5.3	4.8	4.7	4.2	5.0	4.1
9	MCN-20-9	RH 1975	125	135	135	130	132	124	128	136	6.7	4.4	5.2	5.8	5.5	4.8	5.7	5.7
10	MCN-20-10	PBR 507	130	139	136	129	134	125	133	139	6.6	4.5	4.9	5.6	5.9	4.6	5.0	5.2
11	MCN-20-11	RMM-19-18	132	139	135	129	132	124	130	137	5.7	3.3	5.0	5.4	4.6	3.6	5.5	4.8
12	MCN-20-12	SKM 1728	131	139	135	129	133	123	132	135	6.5	3.9	4.8	5.7	5.7	5.2	5.7	4.8
13	MCN-20-13	KMR-20-4	134	139	135	127	137	125	132	139	6.1	3.4	5.0	5.3	5.1	4.1	5.1	4.6
14	MCN-20-14	ORM 2019-02	128	138	131	127	134	122	134	136	6.1	3.5	4.7	5.1	5.3	4.9	5.3	4.6
15	MCN-20-15	Maya (ZC)	127	139	134	129	131	122	131	136	6.3	3.8	4.9	5.3	5.3	4.7	5.7	4.7
16	MCN-20-16	RH 1974	130	133	136	128	134	124	128	134	7.2	4.6	5.0	5.1	5.9	5.9	6.2	5.9
17	MCN-20-17	SKM 1620	133	138	133	131	135	126	129	139	6.7	5.0	4.9	4.5	6.3	5.6	5.7	5.6
18	MCN-20-18	PRB-2012-3	130	138	132	127	134	126	129	139	5.3	3.6	4.8	4.8	4.3	3.9	5.4	4.6
19	MCN-20-19	RGN-483	129	140	134	129	137	127	136	137	5.3	3.8	5.1	5.4	4.7	4.4	4.9	5.5
20	MCN-20-20	DRMRCI-127	132	136	135	131	133	125	133	135	6.1	3.9	5.0	5.3	5.6	4.2	5.4	5.1
21	MCN-20-21	JM-14-8			132				136	138			4.8				5.4	4.6
22	MCN-20-22	HUJM-19-11	127	141	133	129	134	125	130	138	7.0	4.8	4.8	5.5	5.9	4.8	6.1	5.3
23	MCN-20-23	BAUM-08-17	131	136	134	130	133	127	132	137	5.7	3.9	5.1	4.6	5.0	4.5	5.4	4.8
24	MCN-20-24	KMR-20-3	135	144	132	128	139	126	132	142	6.3	4.3	5.0	5.9	5.8	4.2	5.4	4.3
25	MCN-20-25	DRMRHT 1318	130	135	133	131	132	125	133	138	6.1	3.6	4.8	5.5	5.2	4.2	5.2	5.7
26	MCN-20-26	NPJ-241	131	136	134	132	131	124	132	138	5.8	3.5	4.8	4.9	4.9	4.4	5.2	4.4
27	MCN-20-27	AKMS-20-1	130	139	132	129	134	122	133	139	6.2	3.7	4.9	5.5	5.4	4.6	6.0	4.9

Table2.3.15. Performance of Indian mustard strains in IVT timely sown (irrigated), Zone - IV

S.No.	Code	Strain	Seed Yield (Kg/ha)					Plant Stand				Days to Maturity				1000- Seed wt (g)			
			SKN	NGP	MDR	WSM	Mean	SKN	NGP	MDR	WSM	SKN	NGP	MDR	WSM	SKN	NGP	MDR	WSM
			1	2	3	4	(1-4)	1	2	4	4	1	2	3	4	1	2	3	4
1	MCN-20-1	NPJ-242	2389	2203	4552	2119	**2816**	148	166	169	182	114	112	115	105	6.0	4.0	5.6	5.5
2	MCN-20-2	ACNMM-23	3436	2496	3155	1421	**2627**	152	175	167	180	114	111	122	93	5.6	4.7	5.3	5.2
3	MCN-20-3	RGN-491	2730	1949	3955	1971	**2651**	161	166	165	170	119	107	120	102	5.3	4.7	4.5	5.3
4	MCN-20-4	Kranti (NC)	2401	2030	2775	1829	**2259**	171	160	167	172	115	110	122	99	4.4	4.8	4.6	4.9
5	MCN-20-5	DRMR 2018-17	2652	2170	3329	1889	**2510**	172	166	166	168	115	111	123	102	5.9	4.5	5.6	6.4
6	MCN-20-6	TM 274	2721	1881	2857	1476	**2234**	163	160	168	177	115	108	128	91	6.7	4.7	5.5	6.3
7	**MCN-20-7**	**GDM 4 (LR)**	**2652**	**2289**	**3793**	**1892**	**2656**	**163**	**166**	**167**	**177**	**115**	**110**	**117**	**104**	**5.3**	**5.4**	**4.3**	**5.2**
8	MCN-20-8	PR-2017-5	2836	1793	3422	1771	**2455**	173	156	167	165	113	109	117	102	4.7	4.4	4.5	4.7
9	MCN-20-9	RH 1975	2301	1969	3663	1935	**2467**	154	165	164	174	117	109	120	102	5.7	5.2	5.0	5.0
10	MCN-20-10	PBR 507	2991	2168	3287	1623	**2517**	161	165	164	173	118	111	125	100	5.9	5.6	4.6	5.2
11	MCN-20-11	RMM-19-18	2933	1814	3553	1465	**2441**	163	160	167	165	114	107	125	101	4.8	4.9	4.0	5.7
12	MCN-20-12	SKM 1728	2567	2543	4085	1928	**2781**	166	176	166	179	114	113	122	104	5.5	6.0	4.8	4.0
13	MCN-20-13	KMR-20-4	2643	2172	3192	1598	**2401**	172	165	168	179	117	110	123	104	5.3	5.0	4.9	5.1
14	MCN-20-14	ORM 2019-02	2889	2423	4253	1923	**2872**	154	175	165	174	115	112	123	105	5.2	6.0	4.8	4.7
15	MCN-20-15	BIO 902 (ZC)	2338	2328	3666	1619	**2488**	148	169	168	179	119	112	124	99	6.1	6.2	5.9	6.0
16	MCN-20-16	RH 1974	2595	2160	3075	1702	**2383**	143	167	165	171	114	110	118	97	6.0	5.3	6.2	6.1
17	MCN-20-17	SKM 1620	2623	2032	4204	2079	**2734**	175	162	165	168	117	110	123	105	6.1	6.1	6.3	4.8
18	MCN-20-18	PRB-2012-3	2591	1927	3276	1653	**2362**	178	162	165	166	117	107	122	97	4.3	3.5	4.5	5.0
19	MCN-20-19	RGN-483	2580	2463	3840	1486	**2592**	165	174	162	163	120	114	121	98	4.7	4.4	5.2	6.0
20	MCN-20-20	DRMRCI-127	3064	2282	3427	1893	**2667**	158	165	166	166	116	110	124	104	5.4	5.3	5.5	6.0
21	MCN-20-21	JM-14-8			2757		**2757**			165				124				6.0	
22	MCN-20-22	HUJM-19-11	2944	2231	2997	1443	**2404**	126	162	161	174	118	114	124	100	6.0	6.1	5.4	5.4
23	MCN-20-23	BAUM-08-17	3078	2073	3858	1769	**2695**	147	163	164	174	118	111	122	100	5.2	5.7	5.2	5.3
24	MCN-20-24	KMR-20-3	2551	1957	3734	1823	**2516**	173	161	160	177	120	111	124	102	5.5	6.1	4.3	5.3
25	MCN-20-25	DRMRHT 1318	2659	2276	3529	1554	**2504**	151	167	169	179	116	112	124	95	5.0	4.5	4.9	4.5
26	MCN-20-26	NPJ-241	2955	1864	4088	1602	**2627**	151	163	163	182	115	109	118	99	5.0	5.9	4.3	5.9
27	MCN-20-27	AKMS-20-1	2988	2104	3194	1810	**2524**	163	166	170	185	117	112	120	100	5.3	4.8	4.6	5.6
		GM	**2735**	**2138**	**3538**	**1741**	**2538**												
		CD (5%)	398	281.2	504	273													
		CV (%)	9.5	8.5	8.9	10.2													
		DOS	16.10.20	28.10.20	21.10.20	28.10.20													

Table 2.3.16. Performance of Indian mustard strains in AVT-I Timely sown (irrigated) Zone - I

S.No.	Code	Strain	Seed Yield (Kg/ha)					Plant stand				Days to maturity				1000 Seed wt. (g)	
			KNG	DLK	UNA$	BJR#	Mean	KNG	DLK	UNA	BJR	KNG	DLK	UNA	BJR	KNG	BJR
			1	2	3	4	(1-2)	1	2	3	4	1	2	3	4	1	4
1	MCN 20-28	RCC 4 (ZC)	1025	968	967	472	**997**	329	364	366	96	154	134	130	166	3.1	3.4
2	MCN 20-29	RH 1676	1022	1062	966	681	**1042**	329	365	362	104	155	131	128	165	4.6	5.9
3	MCN 20-30	Kranti (Filler)	961	1162	949	509	**1062**	326	364	364	86	155	129	124	164	3.4	4.9
4	MCN 20-31	PBR 385	1052	1212	1024	869	**1132**	330	366	363	112	153	131	127	164	3.9	5.4
5	MCN 20-32	Giriraj (LR)	931	1156	952	411	**1044**	328	366	364	88	154	131	126	164	3.6	4.5
6	MCN 20-33	RGN 443	1170	900	1063	972	**1035**	331	365	364	113	154	129	125	167	4.1	4.9
7	MCN 20-34	AKMS 19-2	1350	1301	1255	552	**1326**	328	365	364	116	159	136	133	165	4.0	5.4
8	MCN 20-35	DRMR 2017-16	1220	806	1104	704	**1013**	331	364	365	97	155	130	125	166	4.4	5.0
9	MCN 20-36	Kranti (NC)	1013	1093	1124	520	**1053**	328	366	364	78	149	130	127	166	5.2	5.5
10	MCN 20-37	PR 2016-4	1132	1206	1056	794	**1169**	329	364	366	121	155	131	127	166	4.8	5.8
11	MCN 20-38	SKM 1626	993	1320	1157	608	**1157**	332	365	365	108	155	136	130	167	5.1	5.3
12	MCN 20-39	PR 2016-8	1024	581	1138	788	**803**	326	365	364	82	155	135	131	171	4.6	5.6
13	**MCN 20-40**	**RH 749 (ZC)**	**1206**	**975**	**1179**	**367**	**1091**	**329**	**365**	**364**	**107**	**156**	**139**	**132**	**165**	**5.8**	**7.3**
		GM	**1085**	**1057**	**1072**	**634**	**1071**										
		CD (5%)	106	160	111	507											
		CV (%)	5.9	10.3	7.2	47.5											
		DOS	19.10.20	26.10.20	19.10.20	23.10.20											

data of BJR centre excluded from computation of mean due to high CV

$ data of UNA centre excluded from computation of mean due to sgnificant difference between same strain used as check/filler only two valid locations data, hence no promotion

Table2.3.17. Performance of Indian mustard strains in AVT-I Timely sown (irrigated), Zone - IV

S.No.	Code	Strain	Seed Yield (Kg/ha)					Plant Stand				Days to Maturity				1000- Seed Weight			
			SKN	NGP	MDR	WSM	Mean	SKN	NGP	MDR	WSM	SKN	NGP	MDR	WSM	SKN	NGP	MDR	WSM
			1	2	3	4	(1-4)	1	2	4	4	1	2	3	4	1	2	3	4
1	**MCN-20-41**	**GDM 4 (LR)**	**2791**	**2180**	**4264**	**1580**	**2704**	**278**	**303**	**336**	**281**	**110**	**118**	**118**	**96**	**5.1**	**5.5**	**4.6**	**4.3**
2	MCN-20-42	NPJ 231	2414	1829	3830	1819	**2473**	264	289	330	283	111	116	118	105	5.2	6.1	5.7	5.2
3	MCN-20-43	BIO 902	2988	2020	3770	1701	**2620**	272	294	337	283	112	120	125	103	6.9	6.5	5.7	6.1
4	MCN-20-44	Kranti (NC)	2694	1952	3857	1815	**2579**	285	288	342	283	113	114	123	101	4.5	5.2	3.8	4.4
5	MCN-20-45	BIO 902 (ZC)	2943	2089	3477	1680	**2547**	269	299	338	278	116	120	124	102	6.8	6.5	5.7	6.1
		GM	**2766**	**2014**	**3840**	**1719**	**2585**												
		CD (5%)	321	105.5	372	153													
		CV (%)	7.5	6.8	6.2	11.6													
		DOS	16.10.20	30.10.20	21.10.20	28.10.20													

Table-2.3.18a. Performance of Indian mustard strains in IVT Timely sown (rainfed), Zone - II

S.No.	Code	Strain	Seed Yield (Kg/ha)							Plant Stand				
			HSR	SGN	LDH	BAW	ABR	Mean		HSR	SGN	LDH	BAW	ABR
			1	2	3	4	5	(1-5)		1	2	3	4	5
1	MCNR-20-1	RGN-486	3172	2175	1893	2285	2262	**2357**		118	188	128	122	122
2	MCNR-20-2	RGN 229 (ZC)	2451	2391	1469	2139	2366	**2163**		121	193	133	117	114
3	MCNR-20-3	PBR 450	2707	1794	1597	2628	2379	**2221**		118	184	134	118	113
4	MCNR-20-4	NPJ-244	2967	2144	1621	2435	2633	**2360**		118	196	140	117	118
5	MCNR-20-5	DRMRSJ 276	2132	1260	1342	2356	1803	**1779**		116	183	134	119	119
6	MCNR-20-6*	JM-13-3		1143				**1143**			178			
7	MCNR-20-7	RH 1921	3282	2046	1412	2758	2435	**2386**		120	188	133	123	117
8	MCNR-20-8	DRMRIJ 18-62	3152	1511	1786	2254	2299	**2200**		117	177	128	113	118
9	**MCNR-20-9**	**DRMRCI-128**	**2593**	**2046**	**2082**	**2482**	**2435**	2328	*	**118**	**189**	**135**	**120**	**122**
10	MCNR-20-10	RGN-500	2825	2285	1346	2415	2498	**2274**		119	194	140	116	114
11	MCNR-20-11	RH 0761 (LR)	2782	2250	1354	2368	2194	**2189**		115	191	135	118	116
12	MCNR-20-12	DRMRHT 1913	2317	2242	1395	2455	2005	**2083**		117	188	126	125	116
13	MCNR-20-13	RH 1920	2392	2179	2185	2699	2356	**2362**		116	187	131	121	115
14	MCNR-20-14	CAU-RM-4-1-1	2435	2058	1543	2589	1784	**2082**		118	182	129	136	116
15	**MCNR-20-15**	**Kranti (NC)**	**2269**	**2030**	**2148**	**2526**	**2097**	2214		**118**	**184**	**128**	**130**	**116**
16	MCNR-20-16	TM 264	2380	1653	1922	2309	2090	**2071**		118	183	133	116	120
17	MCNR-20-17	NPJ-243	2234	1570	1267	2293	1770	**1827**		117	174	127	124	114
18	MCNR-20-18	DRMRHJ 908	2620	2081	1630	2660	**2177**	2233		117	193	131	129	115
		GM	**2630**	**1937**	**1647**	**2450**	**2211**	**2126**						
		CD (5%)	556	312	297	310	414							
		CV (%)	13.0	9.7	11.9	8.1	11.2							
		DOS	14.10.20	24.10.20	18.10.20	18.10.20	19.10.20							

* Strain outyielding/at par the best check for seed yield and possess resistance against white rust

Table2.3.18b. Performance of Indian mustard strains in IVT Timely sown (rainfed), Zone - II

S.No.	Code	Strain	Days to Maturity					1000 - Seed Weight (g)				
			HSR	SGN	LDH	BAW	ABR	HSR	SGN	LDH	BAW	ABR
			1	2	3	4	5	1	2	3	4	5
1	MCNR-20-1	RGN-486	138	150	140	139	136	5.5	4.6	4.8	5.6	6.1
2	MCNR-20-2	RGN 229 (ZC)	140	151	143	140	138	5.4	5.2	4.6	4.8	6.2
3	MCNR-20-3	PBR 450	136	150	146	139	133	6.1	5.2	5.7	5.2	6.2
4	MCNR-20-4	NPJ-244	135	149	150	138	133	5.6	5.8	4.9	5.9	6.6
5	MCNR-20-5	DRMRSJ 276	136	147	146	140	130	5.8	6.0	4.5	6.2	5.9
6	MCNR-20-6	JM-13-3		156					5.4			
7	MCNR-20-7	RH 1921	137	146	150	140	134	7.0	5.4	4.2	6.6	6.4
8	MCNR-20-8	DRMRIJ 18-62	134	145	150	140	131	4.2	3.8	4.1	4.6	5.1
9	**MCNR-20-9**	**DRMRCI-128**	**138**	**149**	**141**	**140**	**138**	**4.9**	**4.6**	**5.2**	**5.1**	**5.6**
10	MCNR-20-10	RGN-500	136	147	142	141	139	4.2	4.8	4.9	4.2	5.4
11	MCNR-20-11	RH 0761 (LR)	135	148	143	140	134	6.1	5.2	5.5	5.3	6.4
12	MCNR-20-12	DRMRHT 1913	134	149	152	138	134	4.6	4.4	4.3	5.2	5.2
13	MCNR-20-13	RH 1920	134	145	148	139	140	6.4	4.0	5.1	6.3	6.4
14	MCNR-20-14	CAU-RM-4-1-1	133	149	152	138	132	4.4	3.8	5.0	5.0	5.8
15	MCNR-20-15	Kranti (NC)	135	152	150	136	133	4.5	4.6	3.9	4.6	5.1
16	MCNR-20-16	TM 264	136	146	146	138	133	6.1	5.6	6.7	6.5	5.5
17	MCNR-20-17	NPJ-243	135	144	151	140	130	5.2	4.6	6.3	5.4	6
18	MCNR-20-18	DRMRHJ 908	134	145	149	140	131	5.3	4.8	6.8	5.4	5.5

Table 2.3.19. Performance of Indian mustard strains in IVT Timely sown (rainfed), Zone - V

S.No.	Code	Strain	Seed Yield (Kg/ha)						Plant Stand					Days to Maturity					1000-Seed Wt. (g)				
			IMP	SHL$	BHU#	JAG	KNK	Mean	IMP	SHL	BHU	JAG	KNK	IMP	SHL	BHU	JAG	KNK	IMP	SHL	BHU	JAG	KNK
			1	2	3	4	5	(1,4-5)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1	MCNR-20-1	RGN-486	1158	1401	938	2809	1359	**1775**	160	233	129	195	191	113	112	101	118	123	4.4	5.5	3.7	4.6	4.2
2	**MCNR-20-2**	**NRCHB 101 (ZC)**	**1356**	**574**	**928**	**2827**	**1142**	**1775**	**146**	**163**	**126**	**301**	**194**	**113**	**103**	**98**	**110**	**117**	**4.2**	**5.5**	**3.8**	**4.4**	**6.0**
3	MCNR-20-3	PBR 450	1102	710	909	2383	1447	**1644**	155	163	124	333	188	115	112	100	122	118	4.4	4.5	3.5	4.7	4.8
4	MCNR-20-4	NPJ-244	886	1389	1110	3000	1232	**1706**	161	204	130	294	188	113	112	102	120	119	4.5	5.0	3.9	4.6	5.2
5	MCNR-20-5	DRMRSJ 276	1059	1444	1207	2296	1389	**1581**	169	204	129	285	188	114	112	102	118	122	4.9	5.0	4.1	5.5	5.3
6	MCNR-20-6	JM-13-3			950	1790	1010	**1400**	0	0	131	351	189	0	0	97	122	124	0.0	0.0	3.6	6.4	5.0
7	MCNR-20-7	RH 1921	1436	1296	961	2580	1284	**1767**	146	174	130	340	194	114	112	100	120	121	5.2	6.0	3.7	4.5	5.2
8	MCNR-20-8	DRMRIJ 18-62	1109	370	1002	2136	1337	**1527**	134	137	129	302	195	112	108	99	110	118	3.6	4.5	3.9	4.3	4.2
9	MCNR-20-9	DRMRCI-128	923	722	1190	2741	1420	**1695**	158	150	134	301	192	114	112	102	114	118	4.3	4.0	3.7	6.1	4.1
10	MCNR-20-10	RGN-500	899	852	1247	1988	1229	**1372**	180	167	135	279	188	113	112	104	118	121	3.7	5.0	4.1	6.0	4.0
11	MCNR-20-11	DRMR 150-35 (LR)	948		870	1389	1036	**1124**	137	0	126	271	187	113	0	100	122	123	3.6	0.0	3.5	5.0	4.1
12	MCNR-20-12	DRMRHT 1913	1146	562	1273	2407	1362	**1639**	155	160	134	308	184	113	112	106	116	120	3.8	4.0	3.8	4.9	4.5
13	MCNR-20-13	RH 1920	905	802	1140	2037	1238	**1393**	170	178	127	303	184	114	112	105	118	118	5.0	5.5	3.6	4.8	4.6
14	MCNR-20-14	CAU-RM-4-1-1	1405	494	1034	2593	1409	**1802**	155	155	124	317	190	113	108	102	110	118	4.3	4.0	3.5	4.3	4.2
15	MCNR-20-15	Kranti (NC)	868	556	1260	2506	1444	**1606**	149	170	131	350	188	114	108	105	114	117	3.6	4.5	4.0	4.3	4.3
16	MCNR-20-16	TM 264	1065	611	1213	2833	1299	**1733**	148	168	133	288	186	114	106	103	118	118	4.5	5.5	3.9	**5.2**	5.2
17	MCNR-20-17	NPJ-243	1306	1049	971	2617	1221	**1715**	162	198	130	338	186	114	106	101	114	119	4.3	5.0	3.6	4.4	4.9
18	MCNR-20-18	DRMRHJ 908	1121	802	1208	3333	1311	**1922**	165	196	132	370	193	114	108	104	114	119	3.9	5.5	3.8	4.4	4.6
		GM	**1100**	**852**	**1079**	**2459**	**1287**	**1621**															
		CD (5%)	247	245	64	320	184																
		CV (%)	14.3	20.2	3.6	7.8	**8.9**																
		DOS	25.11.20	28.11.20	15.11.20	17.11.20	24.10.20																

$ data of SHL excluded from computation of mean due to high CV

data of BHU excluded from computation of mean due to CV less than 5.0 in field experiment

Table-2.3.20. Performance of Indian mustard strains in AVT I Timely sown (Rainfed), Zone - II

S.No.	Code	Strain	Seed Yield (Kg/ha)						Plant Stand				Days to maturity				1000 Seed Weight (g)			
			HSR	SGN$	LDH	BAW	Mean		HSR	SGN	LDH	BAW	HSR	SGN	LDH	BAW	HSR	SGN	LDH	BAW
			1	2	3	4	(1, 3-4)		1	2	3	4	1	2	3	4	1	2	3	4
1	MCNR-20-19	RH 725 (LR)	2274	2280	1588	2202	**2021**		259	382	274	263	134	145	154	139	6.0	5.0	5.0	6.3
2	**MCNR-20-20**	**RH 1424**	**3159**	**2193**	**1769**	**2807**	**2578**	*	**251**	**396**	**273**	**264**	**133**	**144**	**150**	**138**	**5.3**	**5.8**	**4.2**	**6.9**
3	MCNR-20-21	RGN 229 (	2392	2422	1792	2349	**2178**		263	394	276	255	137	149	146	140	6.0	3.8	4.9	4.8
4	MCNR-20-22	Kranti (NC)	2663	2071	1349	2168	**2060**		260	390	281	246	134	147	153	139	5.0	4.2	4.3	3.9
5	**MCNR-20-23**	**RGN 229 (ZC)**	**2494**	**2032**	**1714**	**2364**	**2191**		**261**	**386**	**279**	**245**	**137**	**150**	**143**	**141**	**5.6**	**4.8**	**5.1**	**4.7**
		GM	**2596**	**2199**	**1642**	**2378**	**2206**													
		CD (5%)	392	273	271	426														
		CV (%)	9.7	8.1	10.7	11.5														
		DOS	14.10.20	25.10.20	18.10.20	18.10.20														

$ data of SGN centre excluded from computation of mean due to significant differences between same genotype used as check/filler

Table 2.3.21. Performance of Indian mustard strains in IVT Late sown (irrigated) Zone - II

S.No.	Code	Strain	Seed Yield (Kg/h)						Plant Stand					Days to Maturity					1000-Seed Wt. (g)				
			HSR	LDH	SGN	NDH	ABR	Mean	HSR	LDH	SGN	NDH	ABR	HSR	LDH	SGN	NDH	ABR	HSR	LDH	SGN	NDH	ABR
			1	2	3	4	5	(1-5)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1	MCNL-20-1	HUJM-19-18	1720	1660	1672	818	1929	**1560**	127	129	187	98	118	123	159	134	118	131	3.9	4.5	4.8	3.0	4.9
2	MCNL-20-2	KMR (L) -20-6	1820	1623	1599	855.3	2212	**1622**	121	123	184	143	121	124	157	130	119	135	3.9	3.9	4.2	3.8	4.8
3	MCNL-20-3	DRMRCI-130	1820	1784	2590	1285	2256	**1947**	121	124	201	136	120	122	159	128	118	135	3.8	4.8	4.6	4.1	5.1
4	MCNL-20-4	PM 26 (ZC)	1300	1685	2584	1229	2073	**1774**	120	127	198	132	124	119	157	129	118	131	4.1	3.9	3.8	3.0	4.5
5	MCNL-20-5	NPJ-246	1767	1698	1729	1167	1755	**1623**	120	124	184	139	119	118	150	131	117	135	3.6	4.5	3.8	3.6	4.5
6	MCNL-20-6	RH 1999-19	1933	1500	1746	1461	2387	**1805**	123	125	186	138	124	120	157	130	120	132	3.7	4.1	4.0	3.4	5.0
7	MCNL-20-7	DRMRHJ 2520	1708	1827	1576	1489	2025	**1725**	124	127	190	150	118	122	155	129	123	136	4.3	3.4	4.0	3.2	4.7
8	MCNL-20-8	RGN-488	1921	1815	1893	808.7	2160	**1719**	126	125	192	134	125	124	151	130	125	137	3.9	5.2	4.2	3.3	4.8
9	MCNL-20-9	RGN 236 (LR)	1897	1500	2624	1225	2204	**1890**	120	123	196	140	121	124	156	132	125	134	4.7	4.6	4.6	3.3	4.5
10	**MCNL-20-10**	**Kranti (NC)**	**1939**	**2117**	**2346**	**1225**	**2086**	**1943**	**127**	**130**	**200**	**141**	**120**	**120**	**158**	**133**	**121**	**133**	**3.9**	**5.1**	**3.6**	**3.6**	**4.3**
11	MCNL-20-11	PAB-2014-4	1643	1802	1932	916	1464	**1551**	126	126	191	137	120	125	158	135	125	136	3.3	4.2	3.8	3.6	3.7
12	MCNL-20-12	TM 179-2	2009	1500	1281	1267	1623	**1536**	128	129	174	143	116	120	155	134	122	131	3.4	3.9	5.2	4.2	4.8
13	MCNL-20-13	KMR (L) -20-5	1537	1580	2294	994	1796	**1640**	126	128	197	132	118	122	155	131	125	134	3.5	3.9	4.2	3.1	4.6
14	MCNL-20-14	DRMR 2018-19	1702	1432	2080	1396	2320	**1786**	128	124	190	145	128	120	152	132	125	130	4.2	4.3	5.0	4.0	5.1
15	MCNL-20-15	RH 1999-22	2134	1630	1876	1626	2006	**1854**	121	130	187	132	119	119	158	129	119	129	4.3	4.1	3.8	2.8	4.6
16	MCNL-20-16	RGN-494	1826	1809	2170	826.7	1838	**1694**	123	128	192	137	122	124	151	130	125	135	4.8	4.1	3.6	3.4	4.6
17	MCNL-20-17	NPJ-245	1365	1346	2119	1547	2056	**1687**	127	126	189	140	118	120	151	134	119	130	3.4	3.4	4.0	3.2	4.8
18	MCNL-20-18	PRL-2017-2	2069	1870	1593	823.3	2375	**1746**	131	127	187	135	124	125	152	130	125	135	4.3	3.5	3.4	2.7	5.0
		GM	**1784**	**1677**	**1983**	**1164**	**2031**	**1728**															
		CD (5%)	330	314	279	205	364																
		CV (%)	11.1	11.3	8.5	10.6	10.8																
		DOS	24.11.20	21.11.20	24.11.20	26.11.20	19.11.20																

Table 2.3.22. Performance of Indian mustard strains in IVT Late Sown (Irrigated) Zone - III

S.No.	Code	Strain	Seed Yield (Kg/ha)								Plant Stand						Days to Maturity						1000-Seed Wt.(g)					
			MOR	PNT	KPR	VAR	DOL	SBR	Mean		MOR	PNT	KPR	VAR	DOL	SBR	MOR	PNT	KPR	VAR	DOL	SBR	MOR	PNT	KPR	VAR	DOL	SBR
			1	2	3	4	5	6	(1-6)		1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
1	MCNL-20-1	HUJM-19-18	1496	1388	1775	2493	1262	1862	**1713**		135	144	121	128	166	186	118	123	126	132	115	113	4.7	4.3	3.7	3.8	4.1	5.5
2	MCNL-20-2	KMR (L) -20-6	1478	1527	1980	2181	1228	1982	**1729**		139	152	124	160	167	180	121	130	125	132	116	114	4.1	3.7	3.5	3.5	4.3	4.2
3	MCNL-20-3	DRMRCI-130	1628	1821	1955	2684	1160	2360	**1935**		137	154	123	158	169	199	120	129	127	132	118	114	4.4	3.7	3.8	3.7	4.0	4.6
4	MCNL-20-4	NRCHB 101 (ZC)	1441	1781	1595	2516	1191	1991	**1752**		131	125	123	148	164	195	119	124	122	130	115	112	4.1	4.3	4.2	3.9	4.7	5.6
5	MCNL-20-5	NPJ-246	1276	1600	1672	2215	1370	1804	**1656**		137	154	120	160	170	196	118	123	124	131	110	112	3.5	3.5	3.6	4.3	5.2	4.8
6	MCNL-20-6	RH 1999-19	1654	1238	1543	2323	1231	2284	**1712**		131	142	118	180	164	195	116	117	122	132	117	111	3.7	3.4	3.9	3.5	5.4	4.1
7	MCNL-20-7	DRMRHJ 2520	1412	1794	1929	2200	1275	2264	**1812**		138	121	125	177	164	196	120	130	126	132	110	114	3.3	3.7	3.9	3.5	3.9	4.1
8	MCNL-20-8	RGN-488	1316	1556	1599	2110	1025	2520	**1687**		140	146	120	168	169	196	122	130	119	133	114	121	3.4	3.8	3.7	3.4	4.4	4.4
9	**MCNL-20-9**	**CS 56 (LR)**	**1530**	**1469**	**1620**	**2950**	**1392**	**1962**	**1820**		**140**	**144**	**122**	**136**	**169**	**196**	**123**	**128**	**120**	**132**	**116**	**120**	**3.8**	**4.2**	**3.6**	**3.2**	**4.9**	**4.3**
10	MCNL-20-	Kranti (NC)	1354	1669	1723	2413	1327	2193	**1780**		136	152	119	154	169	195	121	126	122	131	116	114	2.9	3.3	4.0	3.7	4.3	3.8
11	MCNL-20-	PAB-2014-4	1130	1763	1543	1445	1003	2113	**1500**		142	154	122	162	165	196	126	137	121	135	114	120	3.0	3.4	3.9	3.5	4.9	3.4
12	MCNL-20-	TM 179-2	1672	1212	1620	2367	1059	2353	**1714**		141	143	124	139	164	195	124	126	120	131	115	111	4.7	3.8	3.8	4.1	4.8	6.2
13	MCNL-20-	KMR (L) -20-5	1533	1380	1698	2206	1090	1890	**1633**		140	145	121	166	167	197	122	132	121	133	115	119	3.4	3.7	4.2	3.4	4.1	4.0
14	MCNL-20-	DRMR 2018-19	1739	1516	1929	2385	1185	2472	**1871**	*	147	150	125	148	170	197	120	124	127	129	111	113	4.2	4.3	3.9	3.1	5.4	4.9
15	MCNL-20-	RH 1999-22	1727	1249	1569	2312	1182	2383	**1737**		135	142	122	168	167	195	116	118	122	128	114	111	3.0	2.9	4.0	4.4	4.4	3.7
16	MCNL-20-	RGN-494	1467	1580	1672	2067	1222	2325	**1722**		140	156	122	161	161	196	117	130	126	131	113	119	3.4	3.7	3.6	3.9	4.1	3.8
17	MCNL-20-	NPJ-245	1648	1364	1646	1983	1241	2160	**1674**		144	142	120	175	167	196	116	122	124	130	114	111	3.5	3.7	3.7	5.5	4.7	4.2
18	MCNL-20-	PRL-2017-2	1244	1721	1980	1926	1373	2346	**1765**		148	146	124	177	170	195	118	124	127	133	111	118	2.8	3.3	3.9	3.4	6.1	3.6
		GM	**1486**	**1535**	**1725**	**2265**	**1212**	**2181**	**1734**																			
		CD (5%)	194	222	237	377	192	545																				
		CV (%)	7.7	8.7	8.6	10.5	9.5	14.3																				
		DOS	27.11.20	19.11.20	18.11.20	15.11.20	23.11.20	14.11.20																				

* Strain outyielding/at par the best check for seed yield and possess resistance against white rust

Table 2.3.23. Performance of Indian mustard hybrids in IHT, Zone-II

S.No.	Code	Strain	Seed Yield (kg/ha)							Plant Stand						Days to Maturity						1000-Seed Wt.(g)					
			HSR	LDH	PAL	NDH	MDG	GUG	Mean	HSR	LDH	PAL	NDH	MDG	GUG	HSR	LDH	PAL	NDH	MDG	GUG	HSR	LDH	PAL	NDH	MDG	GUG
			1	2	3	4	5	6	(1-6)	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
1	MH 20-01	DRMRHJ 1108	3014	2358	2413	3019	2893	3259	**2826**	120	137	122	161	132	249	137	136	138	146	138	141	4.9	5.0	4.3	4.1	5.0	4.1
2	MH 20-02	RH 749 (ZC)	2719	2206	2329	3045	2772	2552	**2604**	124	135	116	155	132	234	136	142	137	145	140	140	6.6	5.4	5.6	6.4	5.7	5.4
3	MH 20-03	Pusa MH-61	2167	2123	1925	2682	2667	2439	**2334**	126	132	123	151	132	249	133	138	137	144	135	141	5.5	5.3	5.0	4.9	5.4	5.0
4	**MH 20-04**	**45S46 (Check)**	**2943**	**2761**	**2446**	**3509**	**2855**	**3593**	**3018**	**120**	**131**	**116**	**141**	**130**	**209**	**132**	**145**	**137**	**134**	**133**	**139**	**5.4**	**4.4**	**4.6**	**5.4**	**5.7**	**4.7**
5	MH 20-05	0IJ1010	2762	2506	2867	3201	2829	4107	**3046**	121	133	117	137	132	251	132	143	137	130	131	139	4.1	4.2	3.8	3.9	5.1	3.8
6	MH 20-06	SVJH-66	3396	2177	2299	2759	3890	3261	**2964**	120	128	114	154	131	239	135	150	136	146	135	138	5.7	4.8	5.0	4.4	6.2	4.9
7	MH 20-07	RHH 2001	3160	2004	2520	2964	3684	3393	**2954**	128	136	120	136	131	244	135	140	135	136	136	140	4.4	5.7	4.1	4.3	5.7	3.8
8	MH 20-08	DRMRHJ 1403	2971	2177	2094	3325	2770	2826	**2694**	130	133	125	135	132	272	138	139	135	135	139	142	4.7	4.3	4.5	5.2	4.4	3.8
9	MH 20-09	RHH 2003	2927	2358	2517	3294	2854	3567	**2920**	122	132	122	148	131	251	134	140	137	143	135	143	4.6	4.6	4.2	4.5	5.1	4.1
10	MH 20-10	Pusa MH-57	2230	2037	1682	2692	2555	2338	**2256**	123	132	116	154	129	247	132	144	139	133	134	137	4.4	4.8	4.4	4.4	4.8	4.2
11	MH 20-11	RHH 2002	2833	2724	2073	2924	2712	3415	**2780**	121	135	127	152	132	248	135	141	137	142	136	142	4.6	4.3	4.3	4.0	5.7	3.8
12	MH 20-12	18J029C	2518	1872	2335	3299	2625	3217	**2644**	124	133	114	144	133	215	132	146	135	131	135	136	4.6	5.4	4.4	5.1	5.5	4.4
13	MH 20-13	RMX 9906	2967	2280	2415	3396	3208	3401	**2945**	120	140	110	150	131	247	135	152	137	141	139	139	5.5	5.5	4.8	5.3	5.8	4.8
14	MH 20-14	DRMRHJ 2409	2841	2202	2247	3214	3201	3807	**2919**	126	139	123	155	132	279	136	142	135	138	134	139	4.9	5.0	4.4	4.0	5.0	4.2
15	MH 20-15	PHR 8095	2754	1827	2523	3152	2770	3441	**2745**	123	136	128	152	130	268	139	138	139	147	138	142	4.0	4.7	3.8	3.8	4.1	3.7
16	MH 20-16	RMX 9903	2991	1872	2398	2787	2900	3610	**2759**	124	136	117	144	132	221	136	145	136	135	130	140	4.9	4.3	4.4	4.7	5.4	4.4
17	MH 20-17	DRMRHJ 3101	2876	2473	2189	3084	2575	3175	**2729**	121	134	114	118	130	220	136	140	137	143	136	142	5.0	4.6	4.3	3.8	5.7	4.5
18	MH 20-18	0IJ1034	2876	3025	2463	3027	3403	3888	**3114**	121	128	123	144	133	205	135	151	134	133	138	140	4.3	5.2	4.1	4.2	5.7	4.1
19	MH 20-19	PHR 8076	2624	1872	2425	2931	2823	3649	**2721**	123	132	120	157	131	249	135	136	138	146	137	142	3.9	4.8	3.8	3.4	4.5	3.8
20	MH 20-20	SVJH-68	3459	2206	2213	3005	3678	3539	**3017**	126	139	114	117	132	212	136	146	140	132	133	140	5.7	4.5	4.8	5.8	6.0	5.5
21	MH 20-21	DMH-1 (Check)	2754	2556	2586	3082	2753	4326	**3010**	123	135	116	144	133	220	135	138	137	135	145	139	3.9	4.9	3.6	3.6	4.3	3.4
22	MH 20-22	Kranti (NC)	3266	2045	2464	2939	3894	3452	**3010**	124	132	118	148	132	248	138	140	136	143	137	141	4.5	4.6	4.1	4.0	5.8	3.9
		GM	**2866**	**2257**	**2337**	**3060**	**3014**	**3375**	**2818**																		
		CD (5%)	438	372	417	400	452	375																			
		CV (%)	9.2	10.0	11.1	7.9	9.1	6.9																			
		DOS	12.10.20	18.10.20	27.10.20	16.10.20	23.10.20	25.10.20																			

Table 2.3.24a. Performance of Indian mustard hybrids in IHT, Zone-III

S.No.	Code	Strain	Seed Yield (kg/ha)									Plant Stand							
			MOR	PNT	KPR	BPR	KOT	VAR	DOL	JHS	Mean	MOR	PNT	KPR	BPR	KOT	VAR	DOL	JHS
			1	2	3	4	5	6	7	8	(1-8)	1	2	3	4	5	6	7	8
1	MH 20-01	DRMRHJ 1108	3412	2132	2495	2900	2177	2120	1226	1972	**2304**	135	145	119	121	99	146	114	183
2	MH 20-02	RGN 73 (ZC)	3137	1851	2341	2970	2748	2342	1314	1907	**2326**	135	135	122	119	97	144	115	154
3	MH 20-03	Pusa MH-61	2712	1738	2521	1911	2174	1717	1033	2151	**1995**	136	130	122	129	95	146	115	188
4	**MH 20-04**	**45S46 (Check)**	**3280**	**2232**	**2238**	**2907**	**3166**	**2175**	**1251**	**2251**	2437	**134**	**128**	**117**	**116**	**102**	**142**	**118**	**166**
5	MH 20-05	0IJ1010	3490	2193	2726	3078	3244	2008	1726	2205	**2584**	131	122	120	112	102	141	116	162
6	MH 20-06	SVJH-66	3108	1507	2263	2504	2825	2082	1331	2330	**2244**	133	123	124	116	103	143	115	201
7	MH 20-07	RHH 2001	3727	1539	2701	2970	3066	1919	1186	2341	**2431**	134	134	121	124	103	143	116	145
8	MH 20-08	DRMRHJ 1403	2781	1688	2572	2770	2621	1981	1139	2192	**2218**	134	142	120	134	106	143	118	151
9	MH 20-09	RHH 2003	3653	1883	2623	2893	2562	1944	1576	2093	**2403**	137	124	119	123	100	146	114	223
10	MH 20-10	Pusa MH-57	2511	1485	2186	2415	1517	1683	1139	1895	**1854**	133	114	124	137	101	138	117	164
11	MH 20-11	RHH 2002	3611	2209	2160	3248	2680	2248	1152	2107	**2427**	131	147	121	139	103	141	118	211
12	MH 20-12	18J029C	3312	1833	2289	2800	2787	2312	1221	2406	**2370**	134	136	120	107	104	145	117	155
13	MH 20-13	RMX 9906	3669	2119	2341	2785	3130	2556	1440	1648	**2461**	131	123	124	104	102	144	116	167
14	MH 20-14	DRMRHJ 2409	4258	1874	2418	3159	2876	2218	1358	2475	**2579**	133	146	120	137	107	149	119	213
15	MH 20-15	PHR 8095	3149	1996	2392	2519	2734	2142	1193	1834	**2245**	132	138	118	124	101	148	117	212
16	MH 20-16	RMX 9903	3489	1643	2392	2719	2979	2569	1046	2409	**2406**	135	129	121	133	103	144	115	184
17	MH 20-17	DRMRHJ 3101	2644	1956	2160	2593	2656	2626	1291	1814	**2218**	136	145	124	107	110	145	117	181
18	MH 20-18	0IJ1034	3626	1648	2238	2893	3126	2636	1262	2026	**2432**	133	133	119	123	109	135	120	191
19	MH 20-19	PHR 8076	3517	1965	2289	2444	2901	2160	1180	1610	**2258**	134	143	120	134	104	144	116	214
20	MH 20-20	SVJH-68	3553	2693	2443	2974	3322	2508	1350	2124	**2621**	134	125	126	104	107	149	118	157
21	MH 20-21	DMH-1 (Check)	3445	2105	2649	2615	2703	2291	1248	2187	**2405**	132	140	123	107	106	140	118	160
22	MH 20-22	Kranti (NC)	2904	1598	2366	2378	2269	2043	1262	1658	**2060**	133	147	121	116	105	145	117	180
		GM	**3318**	**1904**	**2400**	2747	**2739**	**2195**	**1269**	**2074**	2331								
		CD (5%)	451	256	256	459	288	355	176	433									
		CV (%)	8.2	8.2	6.7	12.2	6.4	10.1	8.4	13.0									
		DOS	29.10.20	21.10.20	21.10.20	10.10.20	27.10.20	29.10.20	19.10.20	27.10.20									

Table 2.3.24b. Performance of Indian mustard hybrids in IHT, Zone-III

S.No.	Code	Strain	Days to maturity								1000-Seed Wt.(g)							
			MOR	PNT	KPR	BPR	KOT	VAR	DOL	JHS	MOR	PNT	KPR	BPR	KOT	VAR	DOL	JHS
			1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
1	MH 20-01	DRMRHJ 1108	132	140	135	130	133	132	132	136	5.0	3.7	3.9	4.8	5.1	4.7	4.8	4.7
2	MH 20-02	RGN 73 (ZC)	134	142	134	135	137	133	131	129	5.1	3.7	3.9	4.3	4.1	5.6	4.7	5.2
3	MH 20-03	Pusa MH-61	128	139	136	130	134	128	126	130	6.1	4.4	4.0	6.0	5.7	5.5	5.3	5.2
4	MH 20-04	45S46 (Check)	120	135	135	115	129	125	124	136	5.9	4.3	3.9	5.5	5.3	4.5	4.4	5.6
5	MH 20-05	0IJ1010	124	136	137	117	131	126	124	131	4.2	3.5	4.0	4.3	4.2	4.4	3.3	4.9
6	MH 20-06	SVJH-66	122	137	134	120	132	125	125	131	5.9	4.3	3.8	4.9	5.9	4.6	4.2	5.1
7	MH 20-07	RHH 2001	125	139	136	120	131	128	122	131	4.8	3.8	3.9	4.6	4.7	4.5	5.0	4.7
8	MH 20-08	DRMRHJ 1403	133	140	135	132	133	130	124	132	4.9	3.6	3.8	4.6	4.4	4.7	4.7	4.5
9	MH 20-09	RHH 2003	132	137	137	122	133	130	129	137	4.9	3.4	4.0	5.0	4.9	4.1	4.5	5.1
10	MH 20-10	Pusa MH-57	126	143	135	116	132	126	124	140	4.9	3.3	4.0	4.7	4.9	4.5	3.9	4.5
11	MH 20-11	RHH 2002	127	138	136	122	134	128	125	135	4.6	3.2	3.7	4.8	4.9	3.5	4.9	4.7
12	MH 20-12	18J029C	120	136	133	113	130	126	123	127	5.5	4.0	3.9	4.5	5.5	4.6	3.9	5.5
13	MH 20-13	RMX 9906	123	135	133	120	133	127	124	136	5.5	4.0	4.0	5.0	5.9	4.3	3.2	5.3
14	MH 20-14	DRMRHJ 2409	126	138	132	122	133	128	122	130	5.4	3.8	3.9	4.7	5.4	4.7	5.3	5.1
15	MH 20-15	PHR 8095	128	141	135	135	139	132	132	133	4.3	3.1	3.9	4.0	4.7	3.6	3.7	4.9
16	MH 20-16	RMX 9903	127	135	134	119	131	126	120	135	5.4	3.6	3.8	5.0	5.2	4.1	4.4	4.7
17	MH 20-17	DRMRHJ 3101	126	141	137	122	136	129	126	132	5.2	4.0	3.7	4.8	5.2	4.7	3.2	4.8
18	MH 20-18	0IJ1034	124	135	135	117	132	128	124	135	4.8	3.6	3.9	4.8	4.8	3.9	4.2	4.5
19	MH 20-19	PHR 8076	122	139	133	132	134	132	128	132	4.5	3.4	4.0	3.9	4.6	3.1	5.2	5.1
20	MH 20-20	SVJH-68	124	137	134	117	134	128	123	134	6.5	4.6	4.3	5.7	5.8	4.8	5.8	5.7
21	MH 20-21	DMH-1 (Check)	123	139	138	122	131	126	124	131	3.9	3.3	3.9	3.8	4.2	3.5	3.2	4.5
22	MH 20-22	Kranti (NC)	132	137	135	122	133	129	124	135	4.6	3.4	4.0	4.1	5.0	4.5	4.0	5.1

Table 2.3.25a. Performance of Indian mustard hybrids in IHT, Zone-IV

S.No.	Code	Strain	Seed Yield (kg/ha)				Plant Stand			Days to maturity			1000-Seed Wt.(g)		
			SKN	MDR	NGP	Mean	SKN	MDR	NGP	SKN	MDR	NGP	SKN	MDR	NGP
			1	2	3	(1-3)	1	2	3	1	2	3	1	2	3
1	MH 20-01	DRMRHJ 1108	2896	4165	1823	**2961**	114	127	114	115	122	102	4.9	5.1	5.3
2	MH 20-02	GDM 4 (ZC)	2539	3447	2239	**2742**	113	125	116	115	121	103	5.1	4.6	5.3
3	MH 20-03	Pusa MH-61	2519	3550	1850	**2640**	111	121	119	116	123	99	5.4	4.9	5.4
4	MH 20-04	45S46 (Check)	3339	3269	2260	**2956**	105	129	113	112	126	103	5.6	5.5	4.7
5	MH 20-05	0IJ1010	2954	4068	1941	**2988**	109	125	114	112	119	101	4.4	4.6	5.7
6	MH 20-06	SVJH-66	2948	2749	2096	**2597**	110	126	117	111	127	101	5.5	5.0	5.6
7	MH 20-07	RHH 2001	3422	3494	1950	**2955**	117	123	115	111	125	103	4.6	4.2	4.7
8	MH 20-08	DRMRHJ 1403	2830	2930	2131	**2630**	125	125	113	116	129	104	4.9	4.0	5.5
9	MH 20-09	RHH 2003	2955	3922	1932	**2936**	115	126	119	115	126	102	5.7	4.5	5.2
10	MH 20-10	Pusa MH-57	1902	3111	1627	**2213**	105	124	119	112	128	101	5.1	5.7	5.1
11	MH 20-11	RHH 2002	3198	4206	1988	**3131**	119	126	113	113	126	104	4.8	4.0	4.7
12	MH 20-12	18J029C	2865	3194	2332	**2797**	118	126	115	107	120	102	5.3	4.9	4.5
13	MH 20-13	RMX 9906	3042	3305	2006	**2784**	105	126	117	111	121	101	5.4	5.6	5.1
14	MH 20-14	DRMRHJ 2409	2831	3902	1747	**2827**	108	126	117	113	124	96	4.8	4.4	5.0
15	MH 20-15	PHR 8095	3371	4280	2108	**3253**	118	126	117	119	126	103	4.1	4.7	4.8
16	MH 20-16	RMX 9903	3676	4019	2116	**3270**	109	126	114	112	126	101	5.1	5.0	5.4
17	MH 20-17	DRMRHJ 3101	3017	3249	1755	**2674**	105	124	114	115	131	101	5.0	3.8	5.6
18	MH 20-18	0IJ1034	3276	3596	2027	**2966**	107	122	116	112	111	102	4.7	4.4	5.2
19	MH 20-19	PHR 8076	2598	3572	1757	**2642**	115	123	114	117	125	99	4.2	4.0	4.9
20	MH 20-20	SVJH-68	3327	3223	2484	**3011**	103	127	113	113	113	104	6.2	6.0	5.3
21	MH 20-21	DMH-1 (Check)	3415	3121	1651	**2729**	113	124	115	113	119	98	3.9	3.6	4.8
22	**MH 20-22**	**Kranti (NC)**	**3772**	**3831**	**1873**	**3159**	**120**	**127**	**115**	**115**	**117**	**103**	**4.6**	**4.6**	**4.5**
		GM	**3031**	**3555**	**1986**	**2857**									
		CD (5%)	525	362	217										
		CV (%)	10.5	6.2	11.5										
		DOS	16.10.20	21.10.20	29.10.20										

Table 2.3.25b. Percent sterile plants in different entries of IHT

S.No.	Code	Strain	Zone II					Zone III						Zone IV		Mean
			HSR#	LDH	NDH	MDG	PAL	BPR	DOL	VAR	JHS	PNT	MOR	SKN#	NGP	
			1	2	3	4	5	6	7	8	9	10	11	12	13	(1,3-11,13)
1	MH 20-01	DRMRHJ 1108	13	35	33	11	40	20	0	38	24	42	0	42	43	24
2	MH 20-02	(ZC)	0	25	0	0	0	0	0	0	0	0	0	15	0	0
3	MH 20-03	Pusa MH-61	9	20	5	6	15	0	8	0	12	22	0	33	17	8
4	MH 20-04	45S46 (Check)	0	25	8	5	20	10	0	0	4	0	0	38	0	4
5	MH 20-05	0IJ1010	0	10	1	0	0	0	0	0	2	0	0	10	0	0
6	MH 20-06	SVJH-66	10	35	11	4	20	15	2	15	4	44	0	27	45	15
7	MH 20-07	RHH 2001	22	40	60	6	90	100	0	77	38	76	0	98	83	50
8	MH 20-08	DRMRHJ 1403	10	25	9	7	10	20	7	0	8	16	0	28	17	10
9	MH 20-09	RHH 2003	0	40	1	0	5	0	0	0	6	0	0	15	0	1
10	MH 20-10	Pusa MH-57	0	40	0	0	15	15	0	0	5	24	0	37	16	7
11	MH 20-11	RHH 2002	0	40	1	0	5	0	0	0	0	0	0	10	0	1
12	MH 20-12	18J029C	8	5	2	0	5	0	0	0	4	0	0	8	40	5
13	MH 20-13	RMX 9906	13	10	7	5	10	5	8	0	9	16	0	22	22	9
14	MH 20-14	DRMRHJ 2409	9	35	14	12	30	5	4	0	16	26	0	30	12	12
15	MH 20-15	PHR 8095	7	30	15	14	15	5	3	0	7	0	0	38	0	6
16	MH 20-16	RMX 9903	13	25	15	15	20	10	0	17	12	27	0	25	28	14
17	MH 20-17	DRMRHJ 3101	23	50	50	0	70	40	0	33	21	51	0	38	67	32
18	MH 20-18	0IJ1034	14	15	14	15	35	25	0	42	27	59	0	43	46	25
19	MH 20-19	PHR 8076	5	25	4	4	10	0	0	0	14	0	0	20	0	3
20	MH 20-20	SVJH-68	11	15	15	9	20	15	0	0	25	27	0	30	16	13
21	MH 20-21	DMH-1 (Check)	6	10	6	11	5	0	3	0	12	0	0	37	0	4
22	MH 20-22	Kranti (NC)	0	20	0	0	5	0	5	0	0	0	0	22	0	1

data of LDH and SK Nagar excluded from computation of mean

Table 2.3.26. Performance of Quality Indian mustard strains in IVT, Zone-II

S.No.	Code	Strain	Seed Yield (kg/ha)							Plant Stand					Days to Maturity					1000-Seed Wt. (g)				
			HSR	LDH	NDH	SGN	BAW	Mean		HSR	LDH	NDH	SGN	BAW	HSR	LDH	NDH	SGN	BAW	HSR	LDH	NDH	SGN	BAW
			1	2	3	4	5	(1-5)		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1	**QM-20-1**	**RH(OE)-1807**	**3046**	**1844**	**2136**	**2003**	**2474**	**2301**	*	**125**	**134**	**135**	**198**	**111**	**131**	**138**	**143**	**153**	**139**	**4.3**	**4.1**	**3.3**	**4.2**	**4.7**
2	QM-20-2	Kranti (NC)	2640	2058	1736	1976	2384	**2159**		127	145	153	194	139	137	138	149	154	140	4.1	4.4	3.5	3.8	4.2
3	QM-20-3	LES-63	2569	2658	1840	1625	1761	**2091**		125	138	124	184	113	137	133	144	151	141	6.2	4.1	4.6	5.6	5.4
4	**QM-20-4**	**JC 36#**	**2691**	**2625**	**1881**	**1835**	**2124**	**2231**	*	**128**	**133**	**141**	**197**	**129**	**136**	**133**	**154**	**152**	**140**	**3.2**	**4.7**	**2.9**	**3.8**	**4.0**
5	QM-20-5	LES-62	2636	2115	1906	1438	1974	**2014**		125	132	126	188	114	133	138	151	150	142	5.9	4.2	4.5	4.0	5.3
6	**QM-20-6**	**PM 29 (LR)**	**2703**	**2062**	**1800**	**1980**	**1974**	**2104**		**122**	**132**	**124**	**191**	**121**	**138**	**130**	**149**	**154**	**142**	**5.8**	**5.1**	**4.5**	**5.6**	**4.9**
7	**QM-20-7**	**PDZ-15#**	**2770**	**2177**	**2240**	**1575**	**2179**	**2188**	*	**123**	**136**	**127**	**190**	**115**	**135**	**141**	**139**	**150**	**138**	**3.9**	**4.2**	**3.6**	**3.8**	**3.9**
8	QM-20-8	PDZ 1 (Double low check)	2557	1658	2062	1377	2013	**1933**		123	141	116	182	110	137	143	140	149	140	3.2	4.7	3.0	4.2	3.7
9	QM-20-9	JC 32#	2301	2070	1886	1583	2045	**1977**		123	138	122	184	105	135	138	139	153	139	3.5	4.6	3.0	3.8	4.2
10	**QM-20-10**	**PDZ-14#**	**2754**	**2593**	**1904**	**1766**	**2514**	**2306**	*	**122**	**139**	**133**	**188**	**125**	**135**	**131**	**143**	**150**	**139**	**3.8**	**3.5**	**2.9**	**3.6**	**3.5**
11	**QM-20-11**	**RH 749 (ZC)**	**2537**	**2058**	**1945**	**1892**	**2376**	**2162**		**122**	**139**	**140**	**191**	**136**	**136**	**132**	**145**	**151**	**138**	**6.5**	**5.1**	**5.8**	**5.6**	**6.0**
12	**QM-20-12**	**RH(OE)-1804**	**2703**	**1971**	**2126**	**1896**	**2482**	**2236**		**122**	**133**	**137**	**190**	**125**	**136**	**141**	**142**	**149**	**139**	**5.2**	**4.5**	**4.5**	**4.8**	**4.7**
13	**QM-20-13**	**0IJ5001#**	**2522**	**1975**	**1928**	**1797**	**2400**	**2124**		**123**	**140**	**132**	**187**	**114**	**138**	**139**	**144**	**148**	**139**	**3.5**	**4.3**	**3.0**	**4.0**	**3.5**
		GM	**2648**	**2143**	**1953**	**1750**	**2208**	**2140**																
		CD (5%)	336	408	270	213	388																	
		CV (%)	7.5	11.3	8.1	7.2	10.4																	
		DOS	12.10.20	18.10.20	21.10.20	25.10.20	18.10.20																	

Strain inducted with double low characteristics

* Strain(s) having low erucic acid content in oil and /or low glucosinolate content in seed meal and at par/outyielding the best check

Table 2.3.27a. Performance of Quality Indian mustard strains in IVT, Zone-III

S.No.	Code	Strain	Seed Yield (kg/ha)							Plant Stand				
			MOR	PNT	KPR	BPR	DOL	Mean		MOR	PNT	KPR	BPR	DOL
			1	2	3	4	5	(1-5)		1	2	3	4	5
1	QM-20-1	RH(OE)-1807	3302	1238	1672	2595	1541	**2069**		167	156	119	128	166
2	QM-20-2	Kranti (NC)	3320	1756	1980	2199	1693	**2190**		165	150	122	120	170
3	QM-20-3	LES-63	2905	1701	2135	1761	1210	**1942**		171	142	123	115	167
4	**QM-20-4**	**JC 36#**	**3152**	**1480**	**1672**	**2595**	**1500**	**2080**	*	**174**	**149**	**120**	**123**	**163**
5	QM-20-5	LES-62	2814	1611	1698	1921	1543	**1917**		149	148	121	120	169
6	**QM-20-6**	**PM 30 (LR)**	**3194**	**1410**	**2212**	**2329**	**1407**	**2110**		**168**	**147**	**118**	**125**	**166**
7	**QM-20-7**	**PDZ-15#**	**3549**	**1528**	**1723**	**2299**	**1148**	**2050**	*	**166**	**127**	**120**	**117**	**168**
8	**QM-20-8**	**PDZ 1 (Double low check)**	**2546**	**1251**	**1826**	**2039**	**1077**	**1748**		**165**	**149**	**119**	**124**	**163**
9	QM-20-9	JC 32#	3178	1542	2212	1962	1117	**2002**		164	143	118	113	165
10	**QM-20-10**	**PDZ-14#**	**3727**	**1950**	**2058**	**2707**	**1182**	**2325**	*	**156**	**131**	**119**	**126**	**171**
11	**QM-20-11**	**RGN 73 (ZC)**	**3611**	**1576**	**2083**	**2654**	**1463**	**2278**		**170**	**147**	**121**	**114**	**169**
12	QM-20-12	RH(OE)-1804	3330	1846	2006	2400	1333	**2183**		166	160	125	118	160
13	**QM-20-13**	**0IJ5001#**	**3549**	**1735**	**1980**	**2689**	**1475**	**2286**	*	**165**	**144**	**121**	**128**	**169**
		GM	**3244**	**1587**	**1943**	**2319**	**1361**							
		CD (5%)	446	293	178	261	223							
		CV (%)	8.1	10.9	5.5	6.7	9.6							
		DOS	30.10.20	21.10.20	28.10.20	12.10.20	21.10.20							

inducted as double low strains

* Strain(s) having low erucic acid content in oil and /or low glucosinolate content in seed meal and at par/outyielding the best check

Table 2.3.27b. Performance of Quality Indian mustard strains in IVT, Zone-III

S.No.	Code	Strain	Days to Maturity					1000-Seed Wt. (g)				
			MOR	PNT	KPR	BPR	DOL	MOR	PNT	KPR	BPR	DOL
			1	2	3	4	5	1	2	3	4	5
1	QM-20-1	RH(OE)-1807	130	131	133	133	130	5.5	3.1	3.3	4.4	5.3
2	QM-20-2	Kranti (NC)	122	138	135	134	128	5.3	3.5	3.6	4.3	4.7
3	QM-20-3	LES-63	121	137	134	135	134	7.1	4.3	3.2	4.8	3.1
4	**QM-20-4**	**JC 36#**	**124**	**136**	**132**	**135**	**130**	**4.5**	**2.9**	**3.7**	**3.8**	**3.8**
5	QM-20-5	LES-62	128	134	134	134	135	6.6	4.1	3.7	5.4	4.3
6	**QM-20-6**	**PM 30 (LR)**	**126**	**134**	**135**	**134**	**128**	**5.1**	**3.4**	**3.7**	**4.4**	**4.3**
7	**QM-20-7**	**PDZ-15#**	**117**	**135**	**134**	**137**	**134**	**5.0**	**3.1**	**3.7**	**4.2**	**4.3**
8	**QM-20-8**	**PDZ 1 (Double low check)**	**128**	**135**	**133**	**137**	**136**	**3.5**	**2.7**	**3.8**	**3.5**	**4.4**
9	QM-20-9	JC 32#	118	136	135	136	135	3.8	3.3	4.0	3.5	5.1
10	**QM-20-10**	**PDZ-14#**	**124**	**135**	**134**	**136**	**128**	**4.0**	**2.8**	**3.9**	**3.4**	**5.2**
11	**QM-20-11**	**RGN 73 (ZC)**	**132**	**142**	**136**	**137**	**135**	**4.8**	**3.6**	**3.6**	**4.6**	**5.0**
12	QM-20-12	RH(OE)-1804	125	131	134	135	131	5.2	3.6	4.0	5.0	5.0
13	**QM-20-13**	**0IJ5001#**	**126**	**135**	**132**	**136**	**134**	**4.0**	**3.3**	**3.7**	**3.5**	**5.9**

Table 2.3.28. Performance of Quality Indian mustard strains in AVT-I+II, Zone- II

S.No.	Code	Strain	Seed Yield (Kg/ha)						Plant Stand				Days to Maturity				1000-Seed Wt. (g)			
			NDH	HSR	LDH	SGN	Mean		NDH	HSR	LDH	SGN	NDH	HSR	LDH	SGN	NDH	HSR	LDH	SGN
			1	2	3	4	(1-4)		1	2	3	4	1	2	3	4	1	2	3	4
1	**QM-20-14**	**PDZ 12#$**	**2297**	**2844**	**2358**	**2037**	**2384**		**269**	**263**	**276**	**376**	**138**	**135**	**143**	**149**	**2.8**	**3.7**	**4.6**	**3.4**
2	**QM-20-15**	**PM 29 (LR)**	**2074**	**2657**	**1986**	**2273**	**2247**		**263**	**259**	**285**	**384**	**145**	**139**	**149**	**150**	**4.2**	**5.7**	**5.3**	**6.2**
3	**QM-20-16**	**PDZ1(Double low check)**	**2646**	**2649**	**2299**	**1856**	**2362**		**262**	**260**	**285**	**370**	**138**	**138**	**146**	**152**	**2.6**	**3.2**	**4.7**	**3.4**
4	**QM-20-17**	**LES 60**	**2892**	**2364**	**2137**	**3033**	**2606**	*	**264**	**264**	**284**	**404**	**141**	**137**	**149**	**150**	**4.1**	**5.3**	**5.5**	**5.2**
5	**QM-20-18**	**RCH 1#$**	**2806**	**2640**	**2403**	**2891**	**2685**		**264**	**258**	**279**	**392**	**140**	**138**	**148**	**149**	**2.7**	**3.4**	**5.1**	**3.2**
6	**QM-20-19**	**RH (OE) 1706$$**	**2864**	**3364**	**2080**	**2449**	**2689**	*	**267**	**268**	**278**	**374**	**140**	**133**	**143**	**147**	**3.5**	**4.5**	**4.4**	**4.4**
7	QM-20-20	Kranti (NC)	2747	2504	1731	2229	**2303**		286	269	285	376	140	137	146	153	3.4	4.3	5.8	4.2
8	**QM-20-21**	**RH 749 (ZC)**	**2779**	**2400**	**2117**	**2405**	**2425**		**273**	**262**	**279**	**378**	**143**	**136**	**140**	**151**	**5.9**	**6.4**	**5.0**	**5.8**
9	QM-20-22	9IJ5001#	1370	2728	1949	1193	**1810**		263	262	277	364	149	146	142	154	2.1	2.6	4.7	3.4
10	**QM-20-23**	**PDZ 11#$**	**3175**	**2819**	**2190**	**1874**	**2514**		**271**	**261**	**286**	**380**	**138**	**136**	**147**	**150**	**3.5**	**4.0**	**5.2**	**3.6**
		GM	**2565**	**2697**	**2125**	**2224**	**2403**													
		CD (5%)	354	437	291	246														
		CV (%)	9.5	11.1	9.5	7.6														
		DOS	21.10.20	12.10.20	18.10.20	24.10.20														

* Strain(s) having low erucic acid content in oil and /or low glucosinolate content in seed meal and at par/outyielding the best check

$AVT II strain

strains inducted a sdouble low

$$ AVT I Repeat entry

Table 2.3.29a. Performance of Quality Indian mustard strains in AVT-I, Zone - III

S.No	Code	Strain	Seed Yield (Kg/ha)							Plant Stand					
			PNT	KPR	MOR	BPR	VAR	DOL	Mean	PNT	KPR	MOR	BPR	VAR	DOL
			1	2	3	4	5	6	(1-6)	1	2	3	4	5	6
1	**QM-20-24**	**(ZC)**	**2057**	**2298**	**3311**	**2130**	**2189**	**1244**	**2205**	**274**	**220**	**305**	**221**	**381**	**334**
2	QM-20-25	Kranti (NC)	1748	2158	3171	1915	1727	1521	**2040**	238	219	305	237	388	338
3	**QM-20-26**	**PM 30 (LR)**	**1633**	**2513**	**3521**	**2272**	**1615**	**1240**	**2132**	**266**	**217**	**305**	**240**	**388**	**333**
4	QM-20-27	LES 60	2137	1935	3546	2139	2188	1264	2201	260	223	310	235	376	335
		GM	**1893**	**2226**	**3387**	**2114**	**1930**	**1317**	**2145**						
		CD (5%)	220	220	292	214	368	154							
		CV (%)	7.3	6.3	5.3	6.4	7.0	8.4							
		DOS	21.10.20	28.10.20	30.10.20	12.10.20	30.10.20	17.10.20							

Table 2.3.29b. Performance of Quality Indian mustard strains in AVT-I, Zone - III

S.No	Code	Strain	Days to Maturity						1000-Seed Wt. (g)					
			PNT	KPR	MOR	BPR	VAR	DOL	PNT	KPR	MOR	BPR	VAR	DOL
			1	2	3	4	5	6	1	2	3	4	5	6
1	**QM-20-24**	**RGN 73 (ZC)**	**144.5**	**134**	**128**	**142**	**130**	**132**	**3.8**	**3.9**	**5.1**	**3.6**	**2.8**	**5.1**
2	QM-20-25	Kranti (NC)	136.75	132	125	136	127	126	3.5	3.7	4.8	3.9	2.9	4.6
3	**QM-20-26**	**PM 30 (LR)**	**135.5**	**135**	**124**	**137**	**128**	**125**	**3.3**	**4.1**	**5.1**	**4.1**	**2.6**	**5.2**
4	QM-20-27	LES 60	140.25	133	127	143	129	130	4.3	3.9	5.8	5.3	2.5	5.6

Table 2.3.29c. Erucic acid Content (%) of entries being evaluated in IVT/AVT Quality trials

S. No.	Code	Genotype	Erucic acid content (%)								Glucosinolate content (µmole/g)						
			BPR	PNT	KNG	LDH	HSR	KPR	NDH	Mean	BPR	PNT	KNG	LDH	HSR	NDH	Mean
			1	2	3	4	5	6	7	(1-7)	1	2	3	4	5	6	(1-6)
1	QM-20-1	RH(OE)-1807	3.0	1.1	2.9	4.8	1.1	1.8	2.4	2.5	71.5	67.7	86.8	73.3	51.9	41.2	65.4
2	QM-20-2	Kranti (NC)	46.4	47.6	42.4	50.1	40.8	47.0	42.1	45.2	58.9	66.3	69.0	80.1	58.9	36.2	61.6
3	QM-20-3	LES-63	0.3	0.1	0.1	0.5	0.2	0.3	0.0	0.2	65.2	66.0	59.6	69.2	75.9	36.2	62.0
4	QM-20-4	JC 36#	5.0	6.0	3.5	4.0	6.0	3.8	4.2	4.6	17.6	18.0	24.2	20.0	27.9	15.3	20.5
5	QM-20-5	LES-62	0.3	0.0	1.1	0.0	0.7	0.7	0.0	0.4	58.1	54.3	64.8	75.9	43.8	32.4	54.9
6	QM-20-6	PM 29 (LR)	0.4	0.5	0.5	0.5	0.4	0.5	0.0	0.4	60.9	45.0	87.3	97.5	47.7	45.6	64.0
7	QM-20-7	PDZ-15#	0.2	0.0	0.5	0.3	0.0	0.1	0.4	0.2	16.0	14.1	15.4	21.3	21.1	11.6	16.6
8	QM-20-8	PDZ 1 (Double low check)	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	18.8	21.9	22.9	19.2	23.0	17.1	20.5
9	QM-20-9	JC 32#	13.1	13.0	11.8	13.6	12.6	11.9	0.0	10.9	18.0	21.6	18.5	15.9	26.8	11.8	18.7
10	QM-20-10	PDZ-14#	0.6	0.8	0.9	0.3	1.0	1.0	0.3	0.7	15.3	17.2	17.9	15.8	23.2	12.9	17.0
11	QM-20-11	RH 749 (ZC)	52.0	33.9	49.6	53.1	40.9	39.0	38.0	43.8	61.7	45.9	76.8	87.8	51.7	38.0	60.3
12	QM-20-12	RH(OE)-1804	5.6	8.0	5.0	5.0	6.2	6.7	0.5	5.3	59.8	41.1	71.1	85.7	43.1	44.3	57.5
13	QM-20-13	0IJ5001#	10.0	10.5	12.0	11.8	8.2	12.6	6.2	10.2	18.9	25.5	21.8	20.4	27.2	31.0	24.2
14	QM-20-14	PDZ 12#$	0.5	0.7	0.9	0.0	0.9	0.5	0.0	0.5	24.4	19.4	20.4	23.7	19.8	16.3	20.6
15	QM-20-15	PM 29 (LR)	0.4	0.5	0.5	0.5	0.4	0.5	0.0	0.4	60.9	45.0	87.3	97.5	47.7	51.9	65.1
16	QM-20-16	PDZ 1(Double low check)	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	18.8	21.9	22.9	19.2	23.0	16.8	20.4
17	QM-20-17	LES 60	0.1	0.2	0.2	0.0	0.2	0.2	0.0	0.1	60.4	47.2	75.7	97.8	58.4	43.7	63.9
18	QM-20-18	RCH 1#	1.0	1.0	0.9	0.9	1.1	1.0	0.2	0.9	17.5	21.3	16.3	17.5	27.7	8.7	18.2
19	QM-20-19	RH (OE) 1706	0.4	0.0	0.1	0.6	0.1	0.5	3.1	0.7	70.7	85.0	73.6	86.7	59.7	42.7	69.7
20	QM-20-20	Kranti (NC)	46.4	47.6	42.4	50.1	40.8	47.0	49.3	46.2	58.9	66.3	69.0	80.1	58.9	46.9	63.3
21	QM-20-21	RH 749 (ZC)	52.0	33.9	49.6	53.1	40.9	39.0	44.4	44.7	61.7	45.9	76.8	87.8	51.7	58.9	63.8
22	QM-20-22	9IJ5001#	0.5	0.0	0.1	0.8	0.1	0.2	0.0	0.2	13.7	17.9	16.9	14.0	15.3	11.2	14.8
23	QM-20-23	PDZ 11#	0.4	0.2	0.0	0.7	0.0	0.5	0.6	0.3	15.4	14.2	14.9	13.4	15.1	12.0	14.2
24	QM-20-24	PM- 30	38.4	41.6	32.1	45.6	31.2	35.3	0.0	32.0	60.7	81.2	61.2	78.2	51.8	0.0	66.6

Table2.3.30. Performance of Indian mustard strains in AVT-I Under saline/alkaline conditions

S.No.	Code	Strain	Seed Yield (kg/ha)							Plant Stand		1000- Seed Wt. (g)		
			AGR	HSR	KAR	PNP	LKW	Mean		KAR	PNP	KAR	PNP	LKW
			1	2	3	4	5	(1-5)		3	4	3	4	5
1	CSCN-20-1	Kranti (NC)	1724	1547	1391	1379	1377	**1483**		242	220	4.1	3.9	3.9
2	CSCN-20-2	Kranti (Filler)	1793	1556	1392	1380	1383	**1501**		243	221	4.1	3.9	3.9
3	**CSCN-20-3**	**CS 2005-143**	**2440**	**2447**	**2321**	**2364**	**2134**	**2341**	*	**274**	**244**	**5.9**	**5.5**	**5.1**
4	CSCN-20-4	Giriraj (Check)	1760	1575	1421	1417	1405	**1516**		242	220	4.4	4.2	4.0
5	CSCN-20-5	CS-54 (Check)	1913	1789	1598	1676	1698	**1735**		248	228	5.4	5.5	5.0
6	**CSCN-20-6**	**CS-60 (LR)**	**2143**	**2077**	**2067**	**2082**	**1949**	**2064**		**269**	**241**	**5.5**	**5.5**	**5.0**
		GM	**1962**	**1832**	**1698**	**1716**	**1658**	**1773**						
		CD (5%)	347	295	259	265	258							
		C.V. (%)	11.7	10.7	10.1	10.2	10.3							
		ECe/ pH**	10 dS/m	10.2 dS/m	9.3	12 dS/m	9.2							
		DOS	29.10.20	20.10.20	19.10.20	11.10.20	20.10.20							

* Strain outyielding the best check by a margin of more than or equal to 10 percent on the basis of seed yield

Table 2.3.31. Performance of Mustard: White Rust Resistance, Zone-II

S.No.	Code	Strain	Seed Yield (kg/ha)							Plant Stand					Days to Maturity					1000-Seed Wt.(g)				
			LDH	HSR	SGN	NDH	CHT	Mean		LDH	HSR	SGN	NDH	CHT	LDH	HSR	SGN	NDH	CHT	LDH	HSR	SGN	NDH	CHT
			1	2	3	4	5	(1-5)		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1	WRR 20-1	Pusa Jaikisan(Parent)	2264	2766	2066	3324	1833	**2450**		289	260.5	384	271.3	283	146	137	154	144.3	148	4.2	6.6	5.8	7.2	4.0
2	**WRR 20-2**	**PB(A4A5)-842**	**1821**	**2719**	**2192**	**2928**	**1889**	**2310**	*	**280**	**258.5**	**376**	**285.5**	**279**	**147**	**139**	**150**	**144.5**	**146**	**5.1**	**6.0**	**5.8**	**5.4**	**3.9**
3	WRR 20-3	RH 749 (ZC)	2363	3008	2298	3077	2049	**2559**		285	259.5	408	296.5	281	141	138	148	145	147	4.7	6.4	4.8	6.7	5.1
4	**WRR 20-4**	**Varuna (A4A5)-936-279**	**2381**	**2903**	**2426**	**3293**	**1841**	**2569**	*	**267**	**262.75**	**394**	**307**	**268**	**147**	**137**	**149**	**144**	**145**	**4.3**	**5.1**	**4.6**	**4.8**	**4.5**
5	**WRR 20-5**	**Giriraj (LR)**	**2420**	**3078**	**2306**	**3422**	**2197**	**2685**		**295**	**259.5**	**386**	**291.3**	**287**	**146**	**138**	**151**	**145**	**148**	**4.6**	**6.3**	**5.4**	**6.2**	**4.7**
6	**WRR 20-6**	**Rohini(A4A5)-491**	**1699**	**2323**	**1581**	**2622**	**2041**	**2053**	*	**297**	**267**	**364**	**301**	**292**	**134**	**141**	**154**	**146**	**149**	**3.8**	**5.0**	**4.8**	**4.9**	**4.3**
7	WRR 20-7	Pusa Bold (Parent)	1833	2448	1765	3032	1688	**2153**		298	260.75	370	304.8	276	143	138	151	144.8	148	4.9	6.2	5.8	6.7	5.5
8	WRR 20-8	Varuna (Parent)	1946	2697	2245	3392	1727	**2401**		297	256.5	388	324.8	284	147	137	150	144	149	4.7	5.2	5.2	5.1	4.4
9	WRR 20-9	PJK(A4A5)-21	2128	2436	1538	2957	1745	**2161**		280	256	366	261	269	148	135	151	143.5	149	4.1	6.5	5.0	6.9	5.7
10	WRR 20-10	Rohini (Parent)	1403	1995	1255	2272	2008	**1786**		278	263.75	356	302.3	286	134	137	149	146.8	147	5.3	5.2	5.2	5.3	4.9
		GM	**2026**	**2637**	**1967**	**3032**	**1902**	**2313**																
		CD (5%)	266	341	239	352	199																	
		CV (%)	9.1	8.9	8.4	8.0	7.2																	
		DOS	19.10.20	11.10.20	24.10.20	16.10.20	22.10.20																	

* Strain outyielding/ at par the parent and poggessing resistance against white rust

Table 2.3.32a. Performance of Mustard: White Rust Resistance, Zone-III

S.No.	Code	Strain	Seed Yield (kg/ha)							Plant Stand					Days to Maturity					1000 Seed Weight (g)				
			KPR	PNT	MOR	DOL	BPR	Mean		KPR	PNT	MOR	DOL	BPR	KPR	PNT	MOR	DOL	BPR	KPR	PNT	MOR	DOL	BPR
			1	2	3	4	5	(1-5)		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1	WRR 20-1	Pusa Jaikisan(Parent)	2183	1569	3257	1343	3153	**2301**		224	258	351	330	223	134	140	131	122	134	3.4	5.3	8.6	4.6	6.4
2	**WRR 20-2**	**PB(A4A5)-842**	**1959**	**1788**	**3005**	**1175**	**3052**	**2196**	*	**221**	**271**	**350**	**335**	**255**	**135**	**142**	**134**	**130**	**132**	**3.3**	**4.6**	**7.2**	**4.4**	**5.2**
3	WRR 20-3	Maya (ZC)	2216	1649	2539	1134	3309	**2169**		219	276	344	332	223	132	138	132	128	134	4.1	3.9	6.2	4.1	4.9
4	**WRR 20-4**	**Varuna (A4A5)-936-279**	**2149**	**1536**	**3228**	**1175**	**3524**	**2323**	*	**223**	**261**	**328**	**335**	**239**	**130**	**138**	**130**	**127**	**132**	**3.5**	**3.6**	**5.5**	**4.1**	**4.4**
5	**WRR 20-5**	**RGN 73 (LR)**	**2207**	**1760**	**2911**	**1134**	**3514**	**2305**		**217**	**257**	**338**	**335**	**244**	**132**	**141**	**135**	**130**	**135**	**3.4**	**3.8**	**4.9**	**5.5**	**4.0**
6	WRR 20-6	Rohini(A4A5)-491	2108	1470	2105	1175	2661	**1904**		220	263	344	325	219	135	143	136	131	135	4.2	4.3	4.9	4.3	4.0
7	WRR 20-7	Pusa Bold (Parent)	2075	1630	2919	1308	2807	**2148**		223	255	340	333	229	134	142	134	126	134	4.1	4.9	6.5	4.2	5.5
8	WRR 20-8	Varuna (Parent)	2464	1302	2954	1481	3003	**2241**		220	227	345	336	221	136	137	125	134	134	3.8	3.5	5.9	6.4	4.5
9	WRR 20-9	PJK(A4A5)-21	2183	1296	3085	1134	2874	**2114**		223	246	343	337	236	132	141	131	124	131	3.3	4.5	7.9	4.0	5.6
10	WRR 20-10	Rohini (Parent)	2001	1333	2962	1238	2207	**1948**		221	251	330	338	231	134	142	133	122	134	3.9	4.3	5.4	4.9	4.2
		GM	**2154**	**1533**	**2896**	**1230**	**3010**																	
		CD (5%)	175	181	225	165	394																	
		CV (%)	5.6	8.2	5.3	9.2	9.0																	
		DOS	28.10.20	28.10.20	31.10.20	21.10.20	21.10.20																	

* Strain outyielding/ at par the parent and poggessing resistance against white rust

Table 32b: Reaction of WRR strains to WR (artificail condition), DM, PM & SR (natural condition) NDN for White Rust

S.No.	Code	Strain	% WR servrity on leaf (100 DAS)						%Staghead incidence			% DM (20 DAS)	% SR incidence		
			MOR	PNT	HSR	LDH	BPR	Mean	MOR	PNT	Mean	PNT	MOR	PNT	Mean
			1	2	3	4	5	(1-5)	1	2	(1-2)		1	2	(1-2)
2	WRR 20-2	PB(A4A5)-842	0.0	0.0	0.0	0.0	24.3	**4.9**	0.0	0.0	**0.0**	33.1	71.6	46.5	**59.0**
3	WRR 20-3	Maya (ZC)													
4	WRR 20-4	Varuna (A4A5)-936-279	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	29.9	31.6	37.7	**34.6**
5	**WRR 20-5**	**RGN 73 (LR)**													
6	WRR 20-6	Rohini(A4A5)-491	4.6	0.0	0.0	0.0	0.0	**0.9**	0.0	0.0	**0.0**	28.3	37.8	40.6	**39.2**
7	WRR 20-7	Pusa Bold (Parent)	35.3	36.2	40.5	14.4	39.3	**33.1**	34.2	24.7	**29.5**	52.2	26.6	26.4	**26.5**
8	WRR 20-8	Varuna (Parent)	39.3	34.7	39.2	12.4	39.2	**33.0**	38.3	20.6	**29.4**	46.4	30.0	62.6	**46.3**
9	WRR 20-9	PJK(A4A5)-21	0.0	0.0	0.0	3.4	0.0	**0.7**	0.0	0.0	**0.0**	20.6	36.3	26.6	**31.4**
10	WRR 20-10	Rohini (Parent)	36.4	43.5	44.4	11.5	39.2	**35.0**	34.2	28.3	**31.3**	37.7	20.7	29.9	**25.3**

Table 2.3.33 Performance of Gobhi Sarson strains in AVT- I+II

S.No.	Code	Strain	Seed Yield (Kg/ha)							Plant Stand					Days to Maturity					1000-seed weight (g)			
			DLK	KNG	CHT	LDH	BJR	Mean		DLK	KNG	CHT	LDH	BJR	DLK	KNG	CHT	LDH	BJR	KNG	CHT	LDH	BJR
			1	2	3	4	5	(1-5)		1	2	3	4	5	1	2	3	4	5	2	3	4	5
1	NCN-20-1	HNS 702	1187	1561	2042	2119	1628	**1707**		360	310	268	290	155	135	152	152	160	169	4.0	3.3	3.7	4.3
2	NCN-20-2	Kranti (NC)	811	1101	1602	2026	1437	**1395**		365	311	272	287	149	129	150	149	164	163	4.1	3.6	3.4	4.3
3	NCN-20-3	GSH 1699#	866	1550	2119	2483	1667	**1737**		366	312	269	284	165	147	172	155	158	169	3.3	3.2	3.2	3.7
4	NCN-20-4	GSH 2196	927	1623	2042	2306	1858	**1751**		364	308	275	294	171	145	156	154	154	169	3.1	3.6	3.1	4.2
5	**NCN-20-5**	**GSC6 (Quality check)**	**1086**	**1429**	**2004**	**2062**	**1843**	**1685**		**365**	**312**	**269**	**280**	**162**	**144**	**158**	**155**	**155**	**171**	**3.6**	**3.1**	**3.9**	**4.1**
6	NCN-20-6	GSH 2180	1067	1761	1678	2168	1564	**1648**		366	308	274	288	162	148	166	154	152	170	3.9	3.8	3.1	3.4
7	**NCN-20-7**	**AKGS 19-8**	**1377**	**1667**	**1996**	**2417**	**1761**	**1844**	*	**363**	**308**	**268**	**297**	**165**	**143**	**160**	**152**	**161**	**170**	**3.9**	**3.7**	**3.4**	**4.7**
8	NCN-20-8	GSL-1 (NC/ZC)	1212	1473	1980	1972	1611	**1650**		362	312	276	285	160	147	168	154	155	170	3.1	3.9	3.0	3.9
		GM	**1067**	**1521**	**1933**	**2194**	**1671**	**1677**															
		CD (5%)	192	117	186	281	450																
		CV (%)	12.2	5.2	6.5	8.7	15.4																
		DOS	26.10.20	10.10.20	14.10.20	19.10.20	23.10.2																

* Strain outyielding the best check by a margin of more than or equal to 10 percent on the basis of seed yield

AVT II strain

Table 2.3.34. Performance of Taramira strains in AVT- II

S.No.	Code	Strain	Seed yield (kg/ha)						Plant Stand					Days to maturity					1000-Seed wt. (g)				
			BAW#	NAV	JOB	MOR	DIG	MEAN	BAW#	NAV	JOB$	MOR	DIG	BAW#	NAV	JOB$	MOR	DIG	BAW#	NAV	JOB$	MOR	DIG
			1	2	3	4	5	(2-5)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1	TM-20-1	RTM-314 (ZC)	451	982	1037	1267	939	**1056**	243	302	309	327	297	140	138	133	128	143	3.4	3.41	3.48	4.2	3.3
2	TM-20-2	RTM 1351 (Filler)	300	1101	1012	1150	990	**1063**	221	276	281	347	289	141	135	132	130	137	4.2	3.57	3.49	5.0	3.7
3	TM-20-3	RTM-1624	276	1351	1265	997	1248	**1215**	216	280	270	340	290	136	130	129	129	134	4.0	3.85	3.8	4.0	3.9
4	TM-20-4	RTM 1351 (LR)	359	1004	882	1102	1006	**999**	233	284	264	339	287	139	134	132	131	138	4.4	3.86	3.44	4.8	3.9
5	**TM-20-5**	**T-27 (NC)**	**383**	**977**	**991**	**1421**	**952**	**1085**	**216**	**301**	**318**	**344**	**304**	**140**	**140**	**136**	**133**	**144**	**3.6**	**3.35**	**3.05**	**3.4**	**3.7**
		GM	**354**	**1083**	**1037**	**1187**	**1027**	**1084**															
		CD (5%)	55	157	129	152	162																
		CV (%)	10.0	9.4	8.1	8.2	10.2																
		DOS	18.10.20	22.10.20	22.10.20	31.10.20	24.10.20																

data of BAW centre excluded from computation of mean due to grand mean of expt is less than 50 % of state average

Agronomy

Experiments on six major agronomic aspects were conducted during 2020-21 at 28 coordinating centres across the five zones. The results are presented below:

3.1 Long-term fertility experiment on cropping systems involving rapeseed-mustard

The experiment was initiated in 2011-12 and conducted for 10th year at 12 centres in 5 Zones. In Zone I, the experiment was conducted at Khudwani and Kangra centres. At Khudwani, application of 150% NPK recorded markedly higher seed yield (1200 kg/ha) compared to control, 100% PK, NP and NK, and on par with 100% NPK + 40 kg S/25 kg ZnSO4/1 kg B/2.5 t FYM/ha (Table 3.1.1). Application of 100% NPK + 40 kg S/ha recorded significantly higher seed yield (1914 kg/ha) compared to rest of the treatments at Kangra. Application of 150% NPK at Khudwani and 100% NPK + 40 kg S/ha at Kangra increased mustard seed yield by 99.7 and 209.7% over the control. In Zone II, the experiment was conducted at Ludhiana, Hisar and Sriganganagar. Application of 150% NPK recorded highest seed yield at LDH (1861 kg/ha), HSR (2181 kg/ha) and SGN (2116 kg/ha) which was 307, 67 and 33% higher over control, respectively.

Table 3.1.1 Seed yield (kg/ha) of rapeseed-mustard under different fertility levels in Zone- I and II

Treatments	Zone I		Zone II		
	KHD	KNG	LDH	HSR	SGN
Control	601	618	457(36.9)	1309(39.8)	1597
100% PK	815	727	1062 (37.1)	1665(39.6)	1719
100% NPK	1124	1434	1418 (38)	1903(39.2)	1850
150% NPK	1200	1704	1861 (37.9)	2181(39.4)	2116
100% NPK + 40 kg S/ha	1167	1914	1605 (37.9)	1932(40)	1932
100% NPK + 25 kg ZnSO4/ha	1160	1618	1640 (37.8)	1835(39.4)	1887
100% NPK + 1 kg B/ha	1145	1472	1511 (38.3)	2007(39.9)	1863
100% NPK + 2.5 t FYM/ha	1170	1648	1571 37.7)	1994(39.2)	2054
100% NP	937	1326	1359 (38.1)	1939(39.3)	1743
100% NK	914	1402	1398(37)	2061(39.3)	1713
CD (p = 0.05)	145	152	217	395	278
Date of sowing	Oct 20	Oct 16	Nov 23	Oct 26	Oct 22
Variety	Shalimar sarson-2	GSC-7	PBR 357	RH 749	RH 749
RDF (NPKS kg/ha)	80:50:40:25	120:60:40	100:30:15	80:30:20	75:40:0:20
Year of start	2011-12	2019-20	2011-12	2011-12	2018-19
Preceding crop	Rice	Maize	Maize	P. millet	P. millet

*Oil content (%) in parenthesis

In Zone III, the experiment was conducted at Dholi, Kota, Morena and Pantnagar centres (Table 3.1.2). Application of 150% NPK recorded significantly highest seed yield at DOL (1869 kg/ha), KOT (2268 kg/ha) and MOR (2380 kg/ha) which was 380, 64 and 148% higher over the control, respectively. Whereas, at PNT, application of 100% NPK + FYM @ 2.5 t/ha recorded significantly highest seed yield (2161 kg/ha) which was 184% higher over the control. In Zone IV, the experiment was conducted at SK Nagar. Application of 150% NPK recorded markedly

higher seed yield at SKN (1984 kg/ha), which was 72% higher over the control. In Zone V, the trial was conducted at Bhubneswar and Shillongani centres. Application of 150% NPK recorded significantly higher seed yield at BHU (1030 kg/ha) and SHL (1300 kg/ha) which was 83 and 330% higher over the control, respectively.

Table 3.1.2 Seed yield (kg/ha) of rapeseed-mustard under different fertility levels in Zone III, IV and V

Treatments	Zone III				Zone IV	Zone V	
	DOL	KOT	MOR	PNT	SKN	BHU	SHL
Control	389	1383	961	760	1152	564	302
100% PK	897	1619	1340	1233	1375	723	368
100% NPK	1623	2130	2023	801	1578	862	805
150% NPK	1869	2268	2380	1735	1984	1030	1300
100% NPK + 40 kg S/ha	1792	2225	2008	2010	1814	997	890
100% NPK + 25 kg ZnSO4/ha	1690	2137	1980	1962	1636	935	810
100% NPK + 1 kg B/ha	1536	2170	1862	1938	1684	939	1082
100% NPK + 2.5 t FYM/ha	1758	2262	2204	2161	1766	888	1100
100% NP	881	1900	1849	1795	1702	789	600
100% NK	836	1822	1839	1710	1558	712	583
CD (p = 0.05)	148	344	331	339	287	159	109
Date of Sowing	Nov 19	Oct 23	Oct 20	Oct 15	Oct 27	Dec 17	Nov 20
Variety	Rajendra Sufalam	Giriraj	JM 3	NDRE 4	GM 3	NRCHB 101	TS 36
RDF (NPK kg/ha)	80:40:40	80:40:30	80:40:20	120:40:00	50:50:20	80:40:40	60:30:30
Year of start	2011-12	2017-18	2011-12	2011-12	2011-12	2017-18	2017-18
Preceding crop	Rice	Urdbean	P.millet	Maize	Moong	Rice	Rice

Not conducted at Kanke centre

Based on six years pooled data analysis at SK Nagar centre, it is inferred that application of 150% NPK recorded maximum seed yield and net returns compared to control and 100% NPK (Fig. 3.1.1). Thus, it may be concluded that mustard crop should be fertilized either by 150% NPK or 100% NPK + 40 kg S/ha or 100% NPK + FYM @ 2.5 t/ha for obtaining higher seed yield and economic returns in moong-mustard cropping sequence in North Gujarat agroclimatic region.

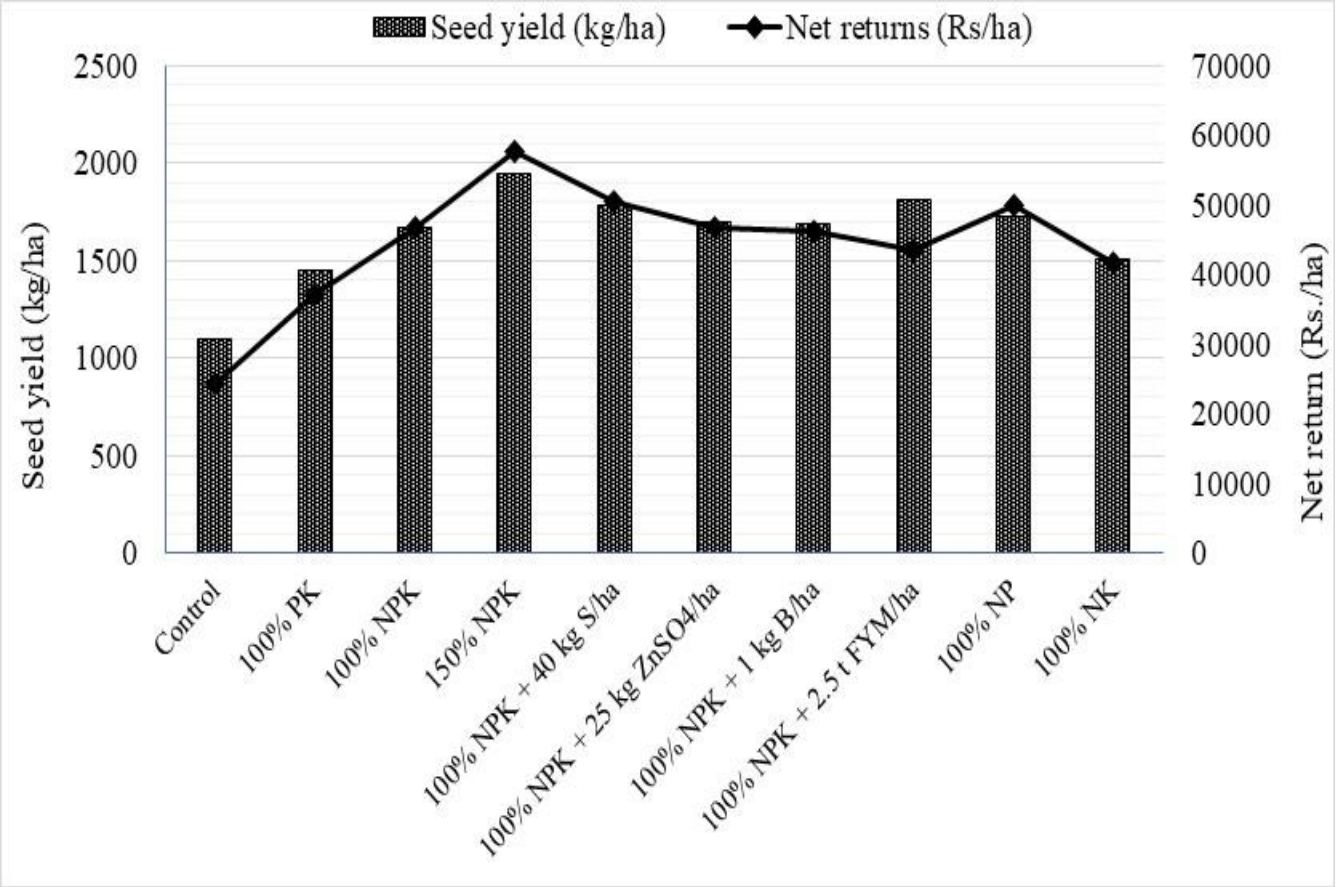

Fig. 3.1.1. Effect of fertility levels on seed yield and economics of mustard at SK Nagar (6-year mean values)

Results based on 10-year pooled data analysis at Morena centre showed that application of 150% NPK found most productive and recorded maximum seed yield compared to rest of the treatments (Fig. 3.1.2).

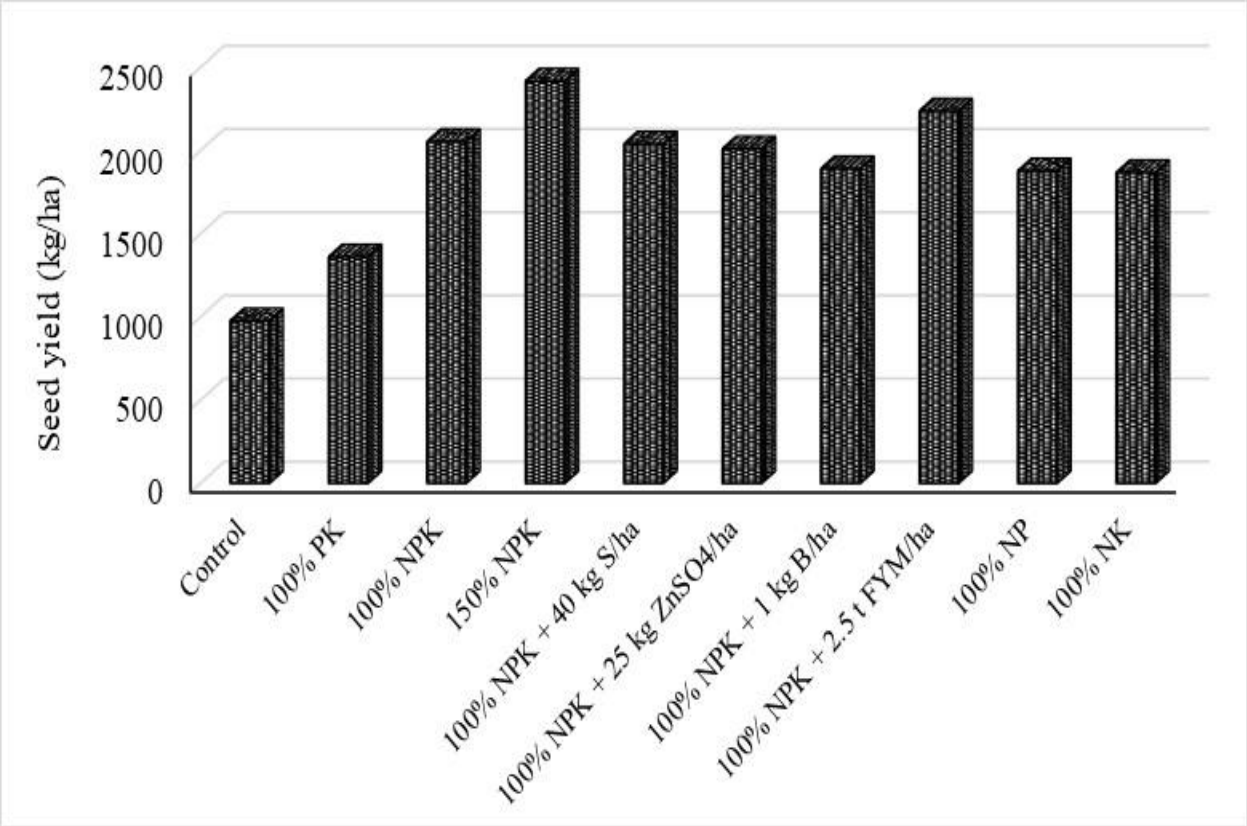

Fig. 3.1.2. Effect of fertility levels on seed yield of mustard at Morena (10-year mean values)

3.2 Evaluation of herbicides for weed management in rapeseed-mustard

The experiment was conducted at six centres during 2020-21. At Ludhiana, except pendimethalin 1.0 kg a.i./ha all other pre and post emergence herbicides found equally effective and recorded higher seed yield over the weedy check. Application of oxadiargyl 0.045 kg a.i./ha recorded significantly highest seed yield (2970 kg/ha) which was 32% higher over the weedy check (2257 kg/ha) at Ludhiana (Table 3.2.1). However, weed control efficiency (WCE) was maximum with the oxadiargyl 0.09 kg a.i./ha at Ludhiana (Table 3.2.2). At Hisar, post emergence application of fluazifop-p-butyl 0.125 kg a.i./ha at 25-30 DAS found most effective and recorded highest seed yield (2766 kg/ha) which was 35% higher over the weedy check. Though, fluazifop-p-butyl 0.125 kg a.i./ha at 25-30 DAS found at par with pendimethalin (PE) and quizalofop (Post E) application at Hisar. At Pantnagar, post emergence application of quizalofop 0.05 kg a.i./ha at 15-20 DAS recorded significantly highest seed yield (2060 kg/ha) over rest of the treatments except pendimethalin 1.0 kg a.i./ha. Post emergence application of quizalofop 0.05 kg a.i./ha at Pantnagar increased seed yield by 52% over the weedy check (Table 3.2.1). The maximum WCE was recorded with quizalofop 0.05 kg a.i./ha followed by pendimethalin 1.0 kg a.i./ha at Pantnagar (Table 3.2.2). At SK Nagar, pre emergence herbicides found more effective than post emergence and recorded highest seed yield with pendimethalin 1.0 kg a.i./ha (2198 kg/ha). Application of pendimethalin 1.0 kg a.i./ha at SK Nagar increased seed yield by 55% over the weedy check (Table 3.2.1). The maximum WCE was also recorded with pendimethalin 1.0 kg a.i./ha at SK Nagar (Table 3.2.2). At Bhubneswar, all the herbicide treatments (pre and post emergence) were on par, though, the highest seed yield was recorded

with pendimethalin 1.0 kg a.i./ha (1015 kg/ha). Application of pendimethalin 1.0 kg a.i./ha at Bhubneswar increased seed yield by 66% over the weedy check.

Table 3.2.1: Seed yield of mustard as influenced by different herbicide levels

Treatment	Seed yield (kg/ha)				
	LDH	HSR	PNT	SKN	BHU
Pendimethalin 1.0 kg a.i./ha (PE)	2125	2485	1994	2198	1015
Pendimethalin 0.5 kg a.i./ha (PE)	2639	2462	1754	1913	936
Oxadiargyl 0.09 kg a.i./ha (PE)	2742	2274	1667	2179	977
Oxadiargyl 0.045 kg a.i./ha (PE)	2970	2227	1490	2088	914
Fluazifop-p-butyl 0.125 kg a.i./ha (PostE)	2635	2766	1767	1616	952
Quizalofop 0.050 kg a.i./ha (PostE)	2890	2397	2060	1531	904
Weedy check	2257	2045	1357	1420	612
Weed free	3142	2723	2372	2303	1067
CD (p=0.05)	446	407	292	411	148
DOS	Oct 25	Oct 21	Oct 24	Oct 27	Dec 06
Variety	RCH 1	RH725	PR 20	GDM-4	NRCHB101

PE: Pre-emergence; PostE: Post-emergence

Table 3.2.2: Weed control efficiency of different herbicides in mustard

Treatment	Weed Control Efficiency (%)		
	LDH*	PNT**	SKN***
Pendimethalin 1.0 kg a.i./ha (PE)	-11.1	85.9	85.1
Pendimethalin 0.5 kg a.i./ha (PE)	-17.5	75.1	74.9
Oxadiargyl 0.09 kg a.i./ha (PE)	29.4	59.6	71.9
Oxadiargyl 0.045 kg a.i./ha (PE)	1.1	56.9	67.3
Fluazifop-p-butyl 0.125 kg a.i./ha (PostE)	1.9	57.9	23.2
Quizalofop 0.050 kg a.i./ha (PostE)	-18.1	86.3	19.6
Weedy check	0.0	0.0	0.0
Weed free	100	100	100

PE: Pre-emergence; PostE: Post-emergence
*at 30 DAS and based on weed count data, **at maturity; *** at 50 DAS

At Imphal, application of pendimethalin 1.0 kg a.i./ha, though, on par with oxyflurofen 0.09 kg and fluazifop-p-butyl 0.125 kg a.i./ha recorded highest seed yield (1850 kg/ha) (Table 3.2.3). Pendimethalin 1.0 kg a.i./ha at Imphal increased seed yield by 118% over the weedy check. Weed control efficiency was also higher with pendimethalin 1.0 kg a.i./ha compared to other treatments.

Table 3.2.3: Seed yield and WCE as influenced by different herbicide levels at Imphal

Treatment	Seed yield (kg/ha)	WCE (%)*
Pendimethalin 1.0 kg a.i./ha (PE)	1850	84.71
Pendimethalin 0.5 kg a.i./ha (PE)	1490	56.82
Oxyflurofen 0.09 kg a.i/ha (PE)	1817	78.58

Oxyflurofen 0.045 kg a.i./ha (PE)	1183	28.32
Fluazifop-p-butyl 0.125 kg a.i./ha (PostE)	1557	67.52
Quizalafop 0.050 kg a.i./ha (PostE)	1383	40.13
Weedy check	850	0.00
Weed free	1970	100.00
CD (p=0.05)	334	-
DOS	Nov. 21	
Variety	NRCHB 101	

PE: Pre-emergence; PostE: Post-emergence; *At maturity
Note: Changed treatments

3.3 Agronomic evaluation of promising rapeseed-mustard entries

The agronomic evaluation of new entries of quality mustard (PDZ 12, PDZ 11 and RCH 1), gobhi sarson (GSH 1699) and taramira (RTM 1624) under different fertility levels were performed during 2020-21 at different locations against the respective checks.

Quality mustard: Three entries of quality mustard (PDZ 12, PDZ 11 and RCH 1) were evaluated against the checks at New Delhi, Hisar, Ludhiana and Sriganganagar centres under different fertility levels (Table 3.3.1). At New Delhi, all the test entries performed poor and recorded 5-12% lower seed yield than the quality check PDZ 1. At Hisar, entry PDZ 12 and RCH 1 recorded 4.3 and 11.7% higher seed yield over the check PDZ 1, whereas, entry PDZ 11 recorded 12% lower seed yield than check PDZ 1. At Ludhiana, all the entries (PDZ 12, PDZ 11 and RCH 1) recorded 5.2, 15.6 and 18.6% higher seed yield over the check PDZ 1. At Sriganganagar, entry PDZ 12 and RCH 1 recorded 16.9 and 35% higher seed yield over the PDZ1, whereas, PDZ 11 recorded 3% lower seed yield than the check PDZ 1.

Application of 150% RDF significantly increased seed yield over 100% and 125% RDF at New Delhi and Ludhiana. At Hisar, application of 125% RDF recorded higher seed yield compared to 100% and 150% RDF. At Sriganganagar, seed yield increased non-significantly with 150% RDF over 100% and 125% RDF.

Table 3.3.1: Seed yield (kg/ha) of quality mustard as influenced by different fertility levels

Entries/ Varieties (E)	**Fertility levels (F)**			
	100% RDF	**125% RDF**	**150% RDF**	**Mean**
New Delhi				
PDZ 12	2575	2795	2942	2771
PDZ 11	2775	2867	3133	2925
RCH 1	2842	3133	3017	2997
RH 749	2658	2850	3267	2925
PM 29	2817	2667	2917	2800
Kranti	3042	3250	3025	3106
PDZ 1	2968	3133	3392	3164
Mean	2811	2956	3099	-
CD (p=0.05)	E= 256; F=133; E x F = NS; F x E = NS			
DOS: Oct 16; Recommended fertility level- 80 kg N, 40 kg P_2O_5, 40 kg K_2O; 30 kg S/ha				

Hisar				
PDZ 12	2198	2380	2195	2258
PDZ 11	1905	1939	1867	1904
RCH 1	2354	2702	2197	2418
RH 749	2459	2525	2262	2416
PM 29	2381	2499	2238	2372
Kranti	2309	2373	2120	2267
PDZ 1	2147	2292	2058	2165
Mean	2250	2387	2134	-
CD (p=0.05)	E= 199; F=172; E x F = NS			
DOS: Oct 22; Recommended fertility level- 80 kg N, 30 kg P_2O_5, 20 kg K_2O/ha				
Ludhiana				
PDZ 12	1931	2266	2406	2201
PDZ 11	2181	2471	2604	2419
RCH 1	2352	2448	2650	2483
RH 749	2401	2587	2704	2564
PM 29	2212	2300	2458	2323
Kranti	2058	2221	2322	2200
PDZ 1	2015	2111	2153	2093
Mean	2164	2343	2471	-
CD (p=0.05)	E= 240; F= 87; E x F = NS			
DOS: Oct. 24; Recommended fertility level- 100 kg N, 30 kg P_2O_5, 15 kg K_2O/ha				
Sriganganagar				
PDZ 12	1482	1739	2093	1771
PDZ 11	1351	1569	1500	1473
RCH 1	1749	2183	2201	2044
RH 749	2047	1900	2014	1987
PM 29	1850	2022	1661	1844
Kranti	1781	1430	1786	1666
PDZ 1	1598	1403	1543	1515
Mean	1482	1739	2093	-
CD (p=0.05)	E= 259; F=NS; E x F = 346			
DOS: Oct 22; Recommended fertility level- 75 kg N, 40 kg P_2O_5, 20 kg S/ha				

Gobhi sarson: Gobhi sarson entry GSH 1699 was evaluated at Kangra, Dhaula Kuan, Chatha, Ludhiana and Bajaura against the checks under different fertility levels (Table 3.3.2). At Kangra, GSH 1699 recorded seed yield 20.1, 80.5 and 8.8% higher over the checks GSL 1, Kranti and GSC 6, respectively. At Dhaula Kuan, the test entry recorded seed yield 28.2, 188 and 29.6% higher over the GSL 1, Kranti and GSC 6, respectively. At Chatha, GSH 1699 recorded higher seed yield over Kranti (3.4%) only, and lower yield compared to other checks. At Ludhiana, GSH 1699 recorded higher seed yield over GSL 1 (5.2%) only, and lower yield than the checks Kranti and GSC 6. At Bajaura, GSC 6 recorded higher seed yield (2571 kg/ha) compared to GSH 1699 (2362 kg/ha). GSC 1699 recorded higher seed yield over GSL 1 (29.9%) and Kranti (23.8%) at Bajaura.

Application of 150% RDF significantly increased seed yield over 100% RDF and remained at par with 125% RDF at Kangra, Chatha, Ludhiana and Bajaura. At Dhaula Kaun, fertility levels did no influence seed yield markedly.

Table 3.3.2: Seed yield (kg/ha) of gobhi sarson entries as influenced by different fertility levels

Entries/ Varieties (E)	Fertility levels (F)			
	100% RDF	125% RDF	150% RDF	Mean
Kangra				
GSH 1699	2194	2245	2246	2228
GSL 1	1792	1940	1832	1855
Kranti	1151	1223	1328	1234
GSC 6	1809	2088	2242	2047
Filler	1678	1704	1726	1703
Mean	1725	1840	1875	-
CD (p=0.05)	E= 165; F=46; E x F = NS			
DOS: Dec 18; Recommended fertility level- 50 kg N, 25 kg P_2O_5, 25 kg K_2O/ha				
Dhaula Kuan				
GSH 1699	1481	1037	1268	1440
GSL 1	1324	555	1250	1123
Kranti	1528	537	778	500
GSC 6	1250	407	1157	1111
Filler	1083	814	1250	1061
Mean	976	1074	1094	-
CD (p=0.05)	E= 133; F=NS; E x F = NS			
DOS: Oct 30; Recommended fertility level- 120 kg N, 60 kg P_2O_5, 40 kg K_2O/ha				
Chatha				
GSH 1699	1148	1358	1367	1291
GSL 1	1252	1417	1468	1379
Kranti	1135	1285	1315	1245
GSC 6	1383	1533	1548	1488
Filler	1350	1500	1525	1458
Mean	1254	1419	1445	-
CD (p=0.05)	E= 145; F=37; E x F = NS			
DOS: Nov 03; Recommended fertility level- 80kg N, 40 kg P_2O_5, 20 kg K_2O/ha				
Ludhiana				
GSH 1699	1646	1814	1860	1774
GSL 1	1506	1740	1816	1687
Kranti	2122	2497	2583	2401
GSC 6	1767	1986	2117	1957
Filler	1791	2000	2141	1977
Mean	1766	2007	2103	-
CD (p=0.05)	E= 311; F= 122; E x F = NS			
DOS: Oct 23; Recommended fertility level- 100 kg N, 30 kg P_2O_5, 15 kg K_2O/ha				

Bajaura				
GSH 1699	2009	2435	2642	2362
GSL 1	1623	1840	1991	1818
Kranti	1697	1929	2099	1908
GSC 6	2191	2685	2837	2571
Filler	1031	1207	1293	1177
Mean	1710	2019	2172	-
CD (p=0.05)	E= 241; F= 168; E x F = NS			
DOS: Oct 25				

Taramira: Taramira entry RTM 1624 evaluated at Bawal, Navgaon, Morena, Jobner and Diggi against the checks T 27, RTM 314 and RTM 1351 under different fertility levels (Table 3.3.3). The test entry outperformed at Navgaon, Jobner and Diggi centres, however, yielded less at Bawal and Morena centres compared to checks. At Navgaon, the RTM 1624 recorded seed yield 14.2, 11.5 and 10.7% higher over the checks T 27, RTM 314 and RTM 1351, respectively. At Jobner, the test entry recorded seed yield 15.0, 24.7 and 12.7% higher over the checks T 27, RTM 314 and RTM 1351, respectively. At Diggi, the entry RTM 1624 recorded seed yield 11.7, 27.2 and 13.9% higher over the checks T 27, RTM 314 and RTM 1351, respectively.

Application of 150% RDF significantly increased seed yield over 100% RDF and remained at par with 125% RDF at Bawal, Navgaon, Morena, Jobner and Diggi locations.

Table 3.3.3: Seed yield (kg/ha) of taramira as influenced by different fertility levels

Entries/ Varieties (E)	**Fertility levels (F)**			
	100% RDF	**125% RDF**	**150% RDF**	**Mean**
Bawal				
RTM 1624	461	590	614	555
T 27	476	599	630	568
RTM 314	622	748	784	718
RTM 1351	600	732	777	703
Filler	482	601	629	570
Mean	528	654	686	-
CD (p=0.05)	E= 106; F=111; E x F = NS			
DOS: Oct 21; Recommended fertility level- 30kg N, 30 kg S/ha				
Navgaon				
RTM 1624	1352	1479	1500	1444
T 27	1205	1282	1305	1264
RTM 314	1225	1323	1336	1295
RTM 1351	1226	1335	1354	1305
Filler	1099	1193	1214	1169
Mean	1221	1322	1342	-
CD (p=0.05)	E= 122; F=69; E x F = NS			
DOS: Nov 14; Recommended fertility level- 60kg N, 30 kg P_2O_5, 30kg K_2O/ha				
Morena				
RTM 1624	1136	1401	1468	1335

T 27	1431	1539	1547	1506
RTM 314	1338	1408	1513	1420
RTM 1351	1528	1627	1698	1618
Filler	1270	1310	1360	1313
Mean	1341	1457	1517	-
CD (p=0.05)	E= 75; F=86; E x F = 27.5			
DOS: Nov 09; Recommended fertility level- 80 kg N, 40 kg P_2O_5, 20 kg K_2O/ha				
Jobner				
RTM 1624	1200	1301	1317	1272
T 27	1043	1127	1148	1106
RTM 314	951	1040	1069	1020
RTM 1351	1074	1153	1159	1129
Filler	966	1077	1111	1052
Mean	1047	1139	1161	-
CD (p=0.05)	E= 117; F=60; E x F = NS			
DOS: Oct 23; Recommended fertility level- 30 kg N, 20 kg P_2O_5				
Diggi				
RTM 1624	1179	1277	1291	1249
T 27	1052	1145	1158	1118
RTM 314	909	1000	1034	982
RTM 1351	1029	1126	1134	1096
Filler	998	1085	1117	1067
Mean	1033	1127	1147	-
CD (p=0.05)	E= 89; F= 59; E x F = NS			
DOS: Oct 24; Recommended fertility level- 30 kg N, 20 kg P_2O_5				

3.4 Developing resource efficient and resilient rapeseed- mustard based cropping systems under current and future climates

Seed yield: Planting of mustard on raised beds recorded markedly higher seed yield (1675 kg/ha) over zero tillage (ZT) (1398 kg/ha). However, remained at par with conventional tillage (CT) (1587 kg/ha) at Chatha (Table 3.4.1). Raised bed planting increased seed yield by 19.8 and 5.6% compared to ZT and CT, respectively. Among cropping systems, green gram-mustard system recorded significantly higher mustard seed yield over pearl millet-mustard (14.2%) and maize-mustard (16.5%), however, non-significantly higher over sesame-mustard system (5.0%) at Chatha. At Kanpur, raised bed planting of mustard increased mustard seed yield by 80.7 and 11.0% significantly over ZT and CT, respectively. Green gram-mustard cropping system recorded markedly higher seed yield of mustard over urd-mustard (2.3%) and maize-mustard (3.8%) system at Kanpur. Raised bed planting produced significantly higher mustard seed yield over ZT (35.4%), however, non-significantly higher over CT (15.7%) at Pantnagar. Green gram-mustard cropping system recorded significantly higher mustard seed yield over maize-mustard (27.5%) and non-significantly higher over urd-mustard system (8.5%) at Pantnagar. At Morena, raised bed planting of mustard recorded significantly higher mustard seed yield over ZT (48.9%) and CT (20.9%). Green gram-mustard cropping system recorded non-significantly higher mustard seed yield at Morena.

Table 3.4.1: Effect of cropping systems and planting methods on seed yield (kg/ha) of Indian mustard

Cropping systems (CS)	Tillage system (TS)			Mean
	Raised bed planting	Zero Tillage	Conventional tillage	
Chatha				
Pearl millet- mustard	1593	1352	1482	1476
Sesame- mustard	1725	1450	1642	1606
Green gram- mustard	1842	1508	1708	1686
Maize- mustard	1542	1283	1517	1447
Mean	1675	1398	1587	-
CD (p=0.05)	TS=115; CS=95; Interaction =NS			
DOS: Nov 14; Recommended fertility level- 80 kg N, 40 kg P_2O_5, 20 kg K_2O/ha				
Kanpur				
Green Gram - mustard	2353	1298	2151	1934
Urd- mustard	2315	1279	2077	1890
Maize- mustard	2283	1268	2033	1862
Mean	2317	1282	2087	-
CD (p=0.05)	TS=20; CS=29; Interaction =NS			
DOS: Nov 11; Recommended fertility level- 120 kg N, 60 kg P_2O_5, 60 kg K_2O /ha				
Pantnagar				
Maize-mustard	1766	1336	1611	1571
Green Gram -mustard	2376	1655	1978	2003
Urd-mustard	2106	1622	1811	1846
Mean	2083	1538	1800	-
CD (p=0.05)	TS=157; CS=166; Interaction =NS			
DOS: Oct 18 ; Recommended fertility level- 120 kg N, 40 kg P_2O_5, 20 kg K_2O/ha				
Morena				
Pearl millet-Mustard	2166	1400	1140	1569
Sesame-Mustard	1828	1320	1542	1563
Green gram-Mustard	2258	1437	1997	1897
Maize-Mustard	2131	1424	1923	1826
Soybean-Mustard	2086	1451	1874	1804
Cluster bean-Mustard	2079	1392	1904	1792
Mean	2091	1404	1730	-
CD (p=0.05)	TS=131; CS=337; Interaction =124			
DOS: Nov 05; Recommended fertility level- 80 kg N, 40 kg P_2O_5, 20 kg K_2O/ha				

System productivity: Raised bed planting recorded significantly higher system productivity over ZT (23.7%)and CT (5.0%) at Chatha (Table 3.4.2). Among cropping systems, green gram-mustard system recorded markedly higher system productivity over pearl millet-mustard (40.4%), sesame-mustard (24.4%) and maize-mustard (28.1%) at Chatha. At Pantnagar, raised bed planting of mustard produced significantly higher system productivity over ZT (45.1%) and CT (12.1%). Green gram-mustard cropping system recorded significantly higher system productivity over maize-mustard (49.6%) and urd-mustard (10.2%) system at Pantnagar. Raised

bed planting and green gram mustard/cluster bean-mustard cropping system recorded non-significantly higher system productivity at Morena.
Thus, raised bed planting of mustard and green gram-mustard cropping system found most productive at all the locations.

Table 3.4.2: Effect of cropping systems and planting methods on system productivity (kg/ha) of Indian mustard-based cropping systems

Cropping systems (CS)	Tillage system (TS)			Mean
	Raised bed planting	Zero Tillage	Conventional tillage	
Chatha				
Pearl millet- mustard	2572	2118	2367	2352
Sesame- mustard	2887	2310	2769	2655
Green gram- mustard	3636	2822	3452	3303
Maize- mustard	2737	2312	2684	2578
Mean	2958	2391	2818	-
CD (p=0.05)	TS=111; CS=124; Interaction =NS			
DOS: Nov 14; Recommended fertility level- 80 kg N, 40 kg P_2O_5, 20 kg K_2O/ha				
Pantnagar				
Maize-mustard	3170	1740	2948	2619
Green Gram -mustard	4586	3185	3983	3918
Urd-mustard	3973	3158	3536	3556
Mean	3910	2694	3489	-
CD (p=0.05)	TS=283; CS=244; Interaction =NS			
DOS: Oct 18 ; Recommended fertility level- 120 kg N, 40 kg P_2O_5, 20 kg K_2O/ha				
Morena				
Pearl millet-Mustard	3582	2581	3105	3089
Sesame-Mustard	2888	1988	2411	2429
Green gram-Mustard	3786	2529	3377	3231
Maize-Mustard	3400	2348	3162	2970
Soybean-Mustard	3281	2269	2926	2825
Cluster bean-Mustard	3649	2541	3514	3235
Mean	3431	2376	3083	-
CD (p=0.05)	TS=NA; CS=NA; Interaction =NA			
DOS: Nov 05; Recommended fertility level- 80 kg N, 40 kg P_2O_5, 20 kg K_2O/ha				

NA: Not available

3.5 Enhancing drought and heat tolerance in rapeseed-mustard through microbes

Irrigation frequency significantly influenced mustard seed yield at all the locations (Table 3.5.1). Application of two irrigations markedly increased seed yield compared to no irrigation and one irrigation at Sriganganagar (31.4 & 15.3%), Hisar (15.0 & 6.5%), Ludhiana (32.9 & 9.9%), Banda (55.0 & 18.2%), Varanasi (42.7 & 17.5%), Jobner (50.6 & 24.5%), Nagpur (101.2 & 21.0%) and SK Nagar (84.6 & 39.5%), respectively. At Chatha, Bawal, Dholi and Morena,

application of two irrigations significantly increased mustard seed yield by 62.3, 17.4, 37.9 and 8.0% over no irrigation, respectively but, remained on par with one irrigation.

Seed inoculation with microbes significantly increased seed yield at all the locations except at Hisar and Ludhiana (Table 3.5.1). Seed inoculation markedly increased seed yield with MRD 17 at Morena (18.5%) and Nagpur (22.0%), with Biophos and Biophos^{+} at Bawal (12.3%), with CRIDA MI-I at Sriganganagar (24.6%), Banda (18.9%) and Varanasi (42.8%), with CRIDA MI-II at Chatha (23.3%), Dholi (31.1%), Jobner (18.7%) and SK Nagar (24.9%) over the control. At Ludhiana MKS 6 and at Hisar CRIDA MI-I recorded non-significantly higher seed yield over the control.

Interaction: Interaction effects of irrigation levels and microbial inoculation showed significant increase in seed yield at Sriganganagar, Hisar, Banda, Morena and SK Nagar. At Sriganganagar, seed yield increased over no inoculation and no irrigation, one irrigation and two irrigations by 57.2, 54.8 and 31.6% with two irrigation+CRIDA MI-II, by 27.9, 22.7 and 5.3% with two irrigation+MRD 17 at Hisar, by 85.8, 52.8 and 16.2% with two irrigation+CRIDA MI-I at Banda, by 28.1, 22.5 and 17.8% with two irrigation+MRD 17 at Morena, and by 139, 103 and 10.8% with two irrigation+MKS 6 at SK Nagar, respectively.

Table 3.5.1: Seed yield (kg/ha) of Indian mustard as influenced by irrigation levels and microbial inoculants

Irrigation frequency (I)	**Microbial inoculants (M)**						**Mean**
	MRD 17	MKS6	Biophos and Biophos^{+}	CRIDA MI-I	CRIDA MI- II	Control	
Chatha							
No irrigation	933	921	984	1005	1050	892	964
One irrigation	1437	1403	1523	1548	1569	1217	1450
Two irrigations	1525	1555	1620	1650	1668	1370	1565
Mean	1299	1293	1375	1401	1429	1159	-
CD (p=0.05)	I=129; M=83; Interaction=NS						
DOS: Oct 26 ; Recommended fertility level- 80 kg N, 40 kg P_2O_5, 20 kg K_2O/ha							
Sriganganagar							
No irrigation	1509	1597	1901	1780	1728	1652	1694
One irrigation	1822	2018	1975	2405	1686	1678	1931
Two irrigations	2398	1962	2004	2423	2597	1974	2226
Mean	1910	1859	1960	2203	2004	1768	-
CD (p=0.05)	I=254; M=171; Interaction=132						
DOS: Oct 25 ; Recommended fertility level- 75 kg N, 40 kg P_2O_5, 20 kg S/ha							
Hisar							
No irrigation	2114	2104	2247	2214	2268	2165	2185
One irrigation	2264	2496	2121	2600	2410	2258	2358
Two irrigations	2770	2282	2478	2407	2502	2631	2512
Mean	2383	2294	2282	2407	2394	2351	-
CD (p=0.05)	I=134; M=NS; Interaction=197						
DOS: Oct 14 ; Recommended fertility level- 80 kg N, 30 kg P_2O_5, 20 kg K_2O/ha							
Ludhiana							
No irrigation	1551	1497	1646	1618	1585	1402	1550

One irrigation	1916	2016	1837	1842	1907	1726	1874
Two irrigations	2202	2182	2052	1984	2102	1837	2060
Mean	1890	1898	1845	1815	1865	1655	-
CD (p=0.05)	I=80; M=NS; Interaction=NS						
DOS: Oct 26 ; Recommended fertility level- 100 kg N, 30 kg P_2O_5, 15 kg K_2O/ha							
Bawal							
No irrigation	1724	1758	1943	1743	1807	1698	1778
One irrigation	1942	1987	2176	1960	2010	1950	2004
Two irrigations	2052	2074	2243	2062	2083	2014	2088
Mean	1906	1940	2121	1922	1967	1888	-
CD (p=0.05)	I=162; M=117; Interaction=NS						
DOS: Oct 23 ; Recommended fertility level- 80 kg N, 30 kg P_2O_5, 20 kg K_2O/ha							
Banda							
No irrigation	1680	1710	1900	1940	1960	1620	1800
One irrigation	2460	2580	2370	2390	2360	1970	2360
Two irrigations	2640	2810	2960	3010	2740	2590	2790
Mean	2260	2370	2410	2450	2350	2060	-
CD (p=0.05)	I=40; M=50; Interaction=150						
DOS: Oct 26 ; Recommended fertility level- 120 kg N, 40 kg P_2O_5, 20 kg K_2O/ha							
Dholi							
No irrigation	1145	1280	1214	1304	1354	1052	1225
One irrigation	1297	1513	1909	1965	1618	1278	1597
Two irrigations	1656	1661	1495	1730	2074	1520	1689
Mean	1366	1485	1539	1666	1682	1283	-
CD (p=0.05)	I=156; M=257; Interaction=NS						
DOS: Nov 18 ; Recommended fertility level- 80 kg N, 40 kg P_2O_5, 40 kg K_2O/ha							
Morena							
No irrigation	2870	2466	2678	2789	2567	2405	2629
One irrigation	2979	2575	2787	2898	2676	2514	2738
Two irrigations	3080	2676	2888	2999	2777	2615	2839
Mean	2976	2572	2784	2895	2673	2511	-
CD (p=0.05)	I=103; M=91; Interaction=39						
DOS: Nov 13 ; Recommended fertility level- 150 kg N, 50 kg P_2O_5, 25 kg K_2O/ha							
Varanasi							
No irrigation	1133	1035	1274	1319	1280	935	1163
One irrigation	1300	1233	1544	1655	1613	1135	1413
Two irrigations	1620	1435	1802	1902	1858	1344	1660
Mean	1351	1234	1540	1625	1584	1138	-
CD (p=0.05)	I=95; M=146; Interaction=NS						
DOS: Nov 23 ; Recommended fertility level- 120 kg N, 60 kg P_2O_5, 60 kg K_2O/ha							
Jobner							
No irrigation	979	1002	1020	1041	1067	873	997
One irrigation	1169	1195	1216	1273	1303	1082	1206
Two irrigations	1460	1501	1517	1566	1589	1380	1502

Mean	1203	1233	1251	1293	1320	1112	-
CD (p=0.05)	I=95; M=86; Interaction=NS						
DOS: Oct 27 ; Recommended fertility level- 60 kg N, 40 kg P_2O_5, 0 kg K_2O/ha							
Nagpur							
No irrigation	510	500	457	477	487	374	467
One irrigation	812	789	753	771	802	735	777
Two irrigations	1044	948	961	951	908	830	940
Mean	788	746	724	733	732	646	-
CD (p=0.05)	I=64; M=36; Interaction=NS						
DOS: Nov 12 ; Recommended fertility level- 80 kg N, 40 kg P_2O_5, 40 kg K_2O/ha							
SK Nagar							
No irrigation	629	1001	718	789	1019	699	809
One irrigation	1151	1093	1022	1125	1209	824	1071
Two irrigations	1356	1672	1493	1383	1553	1509	1494
Mean	1045	1255	1078	1099	1261	1010	-
CD (p=0.05)	I=154; M=107; Interaction=186						
DOS: Oct 30 ; Recommended fertility level- 50 kg N, 00 kg P_2O_5, 00 kg K_2O/ha							

The experiment was conducted with only MRD 17 and MKS 6 inoculants at Imphal and Jhansi centres (Table 3.5.2). At Imphal, two irrigations markedly increased seed yield by 37.6 over no irrigation. Seed inoculation with MKS 6 recorded significantly higher seed yield by 25.0% over no inoculation at Imphal. At Jhansi, two irrigations markedly increased seed yield by 81.6% over no irrigation. No seed inoculation recorded non-significantly higher seed yield over MKS 6 and significantly higher over MRD 17 at Jhansi.

Table 3.5.2: Seed yield (kg/ha) of Indian mustard as influenced by irrigation levels and microbial inoculants at Imphal and Jhansi centres

Irrigation frequency (I)	**Microbial inoculants (M)**			**Mean**
	MRD 17	MKS6	Control	
Imphal				
No irrigation	1071	1179	1050	1100
One irrigation	1244	1647	1237	1376
Two irrigations	1481	1715	1347	1514
Mean	1265	1514	1211	-
CD (p=0.05)	I=237; M=223; Interaction=NS			
DOS: Nov 23 ; Recommended fertility level- 60 kg N, 30 kg P_2O_5, 30 kg K_2O/ha				
Jhansi				
No irrigation	731	757	824	771
One irrigation	1115	1178	1211	1168
Two irrigations	1371	1388	1429	1396
Mean	1072	1108	1155	-
CD (p=0.05)	I=81; M=42; Interaction=NS			
DOS: Nov 07 ; Recommended fertility level- 80 kg N, 40 kg P_2O_5, 40 kg K_2O, 20 kg S/ha				

Note: not conducted as per technical programme

Application of two irrigations recorded maximum RWC (%) at Nagpur and Hisar (Table 3.5.3). However, at SK Nagar, non-significantly higher RWC was recorded in case of no irrigation. Microbial inoculants significantly influenced RWC at Nagpur and non-significantly at SK Nagar. Inoculation with Biophos and Biophos^{+} at Hisar, with MRD 17 at Nagpur and CRIDA MI-II at SK Nagar recorded highest RWC.

Application of two irrigations recorded maximum net returns at Chatha, Jhansi, Varanasi, Jobner, Nagpur, Imphal, Bawal and Banda over no irrigation. Seed inoculation increased net returns with CRIDA MI-II at Chatha (35.8%), Jobner (31.6%) and Bawal (71.8%), with no inoculation at Jhansi, with CRIDA MI-I at Varanasi (79.7%) and Banda (23.5%), with MRD 17 at Nagpur (47.8%), and with MKS 6 at Imphal (99.6%) compared to control.

Table 3.5.3: Relative water content and net returns of Indian mustard as influenced by irrigation and microbial inoculants

	RWC (%)			Net returns (Rs/ha)							
	Hisar*	**Nagpur***	**SK Nagar****	**Chatha**	**Jhansi#**	**Varanasi**	**Jobner**	**Nagpur**	**Imphal#**	**Bawal**	**Banda**
Irrigation frequency											
No irrigation	61.3	50.7	82.9	26550	17148	33545	24178	6127	8968	25176	81545
One irrigation	56.7	66.1	84.5	48126	40792	43796	32716	17427	20185	40338	112340
Two irrigations	63.8	78.8	85.4	52479	52978	53989	45469	24144	25304	43732	135985
CD (p=0.05)	NA	1.5	NS	NA	3798	NA	4405	2997	NA	7619	2177
Microbial inoculants											
MRD 17	64.3	68.8	83.5	41083	34457	39350	32613	18554	15175	29824	106639
MKS6	60.3	66.7	83.2	40827	36523	33705	34020	16651	26169	35603	112548
Biophos and Biophos^{+}	66.5	64.6	84.1	44676	-	48377	34678	15663	-	38152	115027
CRIDA MI-I	58.3	65.7	84.5	45852	-	52458	36683	15928	-	44067	117500
CRIDA MI-II	54.5	63.6	86.2	47154	-	50463	37915	16044	-	44780	112863
Control	41.9	61.8	84.2	34719	39939	29186	28820	12557	13113	26065	95162
CD (p=0.05)	NA	1.75	NS	NA	1994	NA	3975	1664	NA	11537	2798

*Not mentioned stage of observation, **At 65 DAS before irrigation, NA: Not available,
#Treatment missing

3.6 Response of macro and micro nutrient bio-fertilizers in enhancing rapeseed-mustard productivity and soil health

The experiment was initiated during 2020-21 at 16 locations. Application of 100% RDF significantly increased mustard seed yield at Kangra, Chatha, Pantnagar, Moena, Dholi, Varanasi, SK Nagar, Shillongani, Bawal and Bharatpur compared to control (165.3, 108.2, 80.9, 68.4, 32.3, 45.2, 44.6, 57.0, 25.9 and 66.1%, respectively) and 75% RDF (18.4, 14.4, 9.9, 3.3, 5.1, 14.9, 13.9, 29.6, 6.9 and 13.7%, respectively) (Table 3.6.1). Whereas, at Khudwani, Hisar, Sriganganagar, Kota, Bhubneswar and Imphall seed yield increased significantly with 100% RDF over control (33.5, 8.3, 19.6, 46.2, 105.8 and 7.5%, respectively) and non-significantly over 75% RDF.

Seed inoculation with combination of biofertilizers PSMO + Azotobacter+ KMB + ZSB recorded significantly higher seed yield at Chatha (1303 kg/ha), Sriganganagar (2315 kg/ha), Pantnagar (2178 kg/ha), Morena (3249 kg/ha), Kota (2004 kg/ha), Varanasi (1680 kg/ha), SK Nagar (1756 kg/ha), Bhubneswar (967 kg/ha), Bawal (2068 kg/ha) and Bharatpur (2339 kg/ha), and non-significantly higher at Khudwani (1552 kg/ha) and Shillongani (762 kg/ha). Whereas, ZSB at Kangra (1615 kg/ha), Hisar (2658 kg/ha) and Dholi (1859 kg/ha), and KMB at Imphal (1522 kg/ha) recorded markedly higher seed yield over rest of the biofertilizers.

Table 3.6.1 Seed yield (kg/ha) of Indian mustard as influenced by different fertility levels and liquid biofertilizers

Fertility level (F)	Liquid biofertilizers (LB)					Mean
	PSMO	Azotobacter	KMB	ZSB	PSMO + Azotobacter+ KMB + ZSB	
Khudwani						
100% RDF	1656	1644	1688	1632	1726	1669
75% RDF	1720	1540	1196	1335	1820	1522
Control	996	1420	1465	1258	1111	1250
Mean	1457	1535	1450	1408	1552	-
CD (p=0.05)	F=240;LB=NS; Interaction=332					
DOS: Oct 13 ; Recommended fertility level- 80 kg N, 50 kg P_2O_5, 40 kg K_2O, 25 kg S/ha						
Kangra						
100% RDF	2041	2089	1755	2283	1885	2011
75% RDF	1647	1715	1618	1753	1760	1699
Control	764	771	723	808	723	758
Mean	1484	1525	1365	1615	1456	-
CD (p=0.05)	F=86; LB=96; Interaction = LB @ F: 167; F@ LB: 163					
DOS: Oct 17 ; Recommended fertility level- 50 kg N, 25 kg P_2O_5, 25 kg K_2O/ha						
Chatha						
100% RDF	1517	1533	1433	1396	1647	1505
75% RDF	1350	1383	1242	1150	1450	1315
Control	767	775	683	579	813	723
Mean	1211	1231	1119	1042	1303	-
CD (p=0.05)	F=100; LB=124; Interaction=NS					
DOS: Oct 26 ; Recommended fertility level- 80 kg N, 40 kg P_2O_5, 20 kg K_2O/ha						
Hisar						

100% RDF	2572	2663	2687	2591	2756	2654
75% RDF	2646	2627	2684	2580	2697	2647
Control	2203	2618	2268	2801	2359	2450
Mean	2473	2636	2546	2658	2604	-
CD (p=0.05)	F=164; LB=128; Interaction = LB @ F: 244; F@ LB: 254					
DOS: Oct 15 ; Recommended fertility level- 80 kg N, 30 kg P_2O_5, 20 kg K_2O/ha						
Sriganganagar						
100% RDF	2247	2305	2217	2076	2535	2276
75% RDF	2115	2357	1957	1921	2374	2145
Control	2022	1938	2018	1499	2036	1903
Mean	2128	2200	2064	1832	2315	-
CD (p=0.05)	F=164; LB=96; Interaction=215					
DOS: Oct 25 ; Recommended fertility level- 75 kg N, 40 kg P_2O_5, 20 kg S/ha						
Pantnagar						
100% RDF	2378	2253	1824	1680	2884	2204
75% RDF	2184	1776	2006	2002	2064	2006
Control	1196	945	1334	1030	1586	1218
Mean	1919	1658	1721	1571	2178	-
CD (p=0.05)	F=95; LB=146; Interaction = LB @ F: 302; F@ LB: 315					
DOS: Oct 23 ; Recommended fertility level- 120 kg N, 40 kg P_2O_5, 20 kg K_2O/ha						
Morena						
100% RDF	3140	3019	2842	3261	3349	3122
75% RDF	3039	2918	2741	3160	3248	3021
Control	2940	2819	2642	3061	3149	2922
Mean	3040	2919	2742	3161	3249	-
CD (p=0.05)	F=98; LB=124; Interaction=49					
DOS: Nov 13 ; Recommended fertility level- 150 kg N, 50 kg P_2O_5, 25 kg K_2O/ha						
Dholi						
100% RDF	1842	1884	1847	1996	1929	1899
75% RDF	1675	1837	1713	1926	1882	1807
Control	1254	1402	1283	1654	1582	1435
Mean	1590	1708	1615	1859	1798	-
CD (p=0.05)	F=93; LB=79; Interaction=NS					
DOS: Nov 17 ; Recommended fertility level- 80 kg N, 40 kg P_2O_5, 40 kg K_2O/ha						
Kota						
100% RDF	2295	1902	2161	2036	2329	2145
75% RDF	1779	1890	2152	1951	2059	1966
Control	1486	1470	1332	1423	1625	1467
Mean	1854	1754	1882	1803	2004	-
CD (p=0.05)	F=192; LB=194; Interaction=335					
DOS: Oct 23 ; Recommended fertility level- 100 kg N, 50 kg P_2O_5, 30 kg K_2O/ha						
Varanasi						
100% RDF	1894	1850	1758	1789	2005	1859
75% RDF	1668	1576	1539	1623	1677	1617
Control	1305	1316	1205	1217	1357	1280

Mean	1622	1581	1501	1543	1680	-
CD (p=0.05)	F=77; LB=81; Interaction=NS					
DOS: Nov 03 ; Recommended fertility level- 120 kg N, 60 kg P_2O_5, 60 kg K_2O/ha						
SK Nagar						
100% RDF	1802	2024	1977	1794	2004	1920
75% RDF	1660	1649	1690	1584	1840	1685
Control	1297	1362	1222	1334	1425	1328
Mean	1587	1678	1630	1571	1756	-
CD (p=0.05)	F=185; LB=131; Interaction=NS					
DOS: Oct 30 ; Recommended fertility level- 50 kg N, 50 kg P_2O_5, 00 kg K_2O/ha						
Kanke						
100% RDF	1633	1729	1279	1479	1438	1512
75% RDF	550	521	625	938	667	660
Control	136	124	131	138	129	132
Mean	773	791	678	852	745	-
CD (p=0.05)	F=173; B=NS					
DOS: Oct 26 ; Recommended fertility level- 120 kg N, 40 kg P_2O_5, 20 kg K_2O/ha						
Shillongani						
100% RDF	861	891	854	840	905	870
75% RDF	646	750	621	557	780	671
Control	548	580	544	499	600	554
Mean	685	740	673	632	762	-
CD (p=0.05)	F=102; LB=NS; Interaction=NS					
DOS: Nov 13 ; Recommended fertility level- 60 kg N, 30 kg P_2O_5, 30 kg K_2O/ha						
Bhubhaneshwar						
100% RDF	1053	1115	1016	1001	1156	1068
75% RDF	986	1025	966	912	1074	993
Control	522	547	437	420	671	519
Mean	854	896	806	777	967	-
CD (p=0.05)	F=80; LB=63; Interaction=NS					
DOS: Dec 08 ; Recommended fertility level- 80 kg N, 40 kg P_2O_5, 40 kg K_2O/ha						
Imphal						
100% RDF	1180	1380	1523	937	1030	1210
75% RDF	1337	1490	1560	980	1223	1318
Control	1133	1170	1483	840	1003	1126
Mean	1217	1347	1522	919	1086	-
CD (p=0.05)	F=36; LB=53; Interaction=NS					
DOS: Nov 21 ; Recommended fertility level- 60 kg N, 30 kg P_2O_5, 30 kg K_2O/ha						
Bawal						
100% RDF	2055	2016	2059	1972	2265	2073
75% RDF	1920	1888	1911	1853	2128	1939
Control	1647	1596	1626	1553	1812	1646
Mean	1874	1833	1865	1792	2068	-
CD (p=0.05)	F=108; LB=153; Interaction=NS					
DOS: Nov 21 ; Recommended fertility level- 80 kg N, 30 kg P_2O_5, 20 kg K_2O, 40 kg S/ha						

Bharatpur						
100% RDF	2569	2480	2583	2774	2821	2645
75% RDF	2241	2490	2208	2166	2527	2326
Control	1585	1623	1506	1573	1670	1592
Mean	2132	2198	2099	2171	2339	
CD (p=0.05)	F = 182; LB = 125; Interaction = LB @ F: 216; F@ LB: 263					
DOS: Oct 14; Recommended fertility level- 80 kg N, 40 kg P_2O_5, 40 kg K_2O/ha						

Note: Kanke centre data are not correct, and not interpreted

PSMO: Phosphate solubilizing microorganism; KMB: Potassium mobilizing biofertilizer; ZSB: Zinc solubilizing biofertilizer

Application of 100% RDF recorded maximum net returns at Chatha, Kota, Varanasi, Imphal and Bawal centres. Seed inoculation with PSMO+Azotobacter+KSM+ZSB at Chatha, Kota and Varanasi, with KMB at Imphal and ZSB at Bawal recorded highest net returns (Table 3.6.2).

Table 3.6.2 Net returns of Indian mustard as influenced by different fertility levels and liquid biofertilizers

Treatment	**Net returns (Rs/ha)**					
	Chatha	**Kota**	**Varanasi**	**Kanke**	**Imphal**	**Bawal**
Fertility levels						
100% RDF	50679	73135	63602	46791	13632	53918
75% RDF	42891	66172	32479	6781	19671	50719
Control	18672	46984	25193	-14240	15310	37452
CD (p=0.05)	NA	8916	NA	8220	NA	3777
Liquid biofertilizers						
PSMO	38805	61977	36965	13562	16167	41716
Azotobacter	39709	57359	35480	15833	21920	47291
KMB	34542	63276	32741	10327	29688	42867
ZSB	30920	59632	34254	18109	2991	54253
PSMO + Azotobacter+ KMB + ZSB	43093	68241	38811	7721	10256	50686
CD (p=0.05)	NA	8990	NA	5600	NA	3432

NA: Not available

Kanke results not interpreted

PSMO: Phosphate solubilizing microorganism; KMB: Potassium mobilizing biofertilizer; ZSB: Zinc solubilizing biofertilizer

4. Plant Pathology

Disease Scenario

During 2021-21, moderate to severe occurrence of Alternaria blight and white rust diseases was recorded at all locations. Low to moderate prevalence of downy mildew was observed at the cotyledonary stage at PNT. Powdery mildew severity was moderate to high at SKN and PNT. Low to moderate incidence of Sclerotinia rot was observed at MOR, HSR, LDH, BPR and PNT. Different trials were sown on dates as given below:

Centre	Date of sowing of different trials							
	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.9
PNT	23.10.2020 (A and B)	23.10.2020	23.10.2020	24.10.2020	23.10.2020	24.10.2020	-	27.10.2020
HSR	27.11.2020 (B)	27.11.2020	27.11.2020	27.11.2020	27.11.2020	27.11.2020	-	27.11.2020
LDH	02.11.2020 (A and B)	02.11.2020	02.11.2020	02.11.2020	04.11.2020	04.11.2020	-	-
SGN	28.10.2020 (A)	-	28.10.2020	-	28.10.2020	28.10.2020	-	28.10.2020
NDH	09.11.2020 (A)	09.11.2020	-	-	-	-	-	-
MOR	12.11.2020 (A and B)	12.11.2020	13.11.2020	13.11.2020	-	13.11.2020	-	31.10.2020
SKN	20.11.2020 (A)	20.11.2020	-	-	-	20.11.2020	-	-
JAG	29.10.2020 (A)	29.10.2020	-	-	-	29.11.2020	23.11.2020	-
DOL	16.11.2020 (A and B)	16.11.2020	17.11.2020	-	16.11.2020	17.11.2020	18.11.2020	05.11.2020
SHL	17.11.2020 (A and B)	18.11.2020	21.11.2020	-	22.11.2020	21.11.2020	27.11.2020	16.10.2020
BPR	26.10.2020 (B)	-	-	05.11.2020	26.10.2020	-	-	26.10.2020
JHS	-	-	-	-	-	-	-	-
VAR	05.11.2020 (B)	-	05.11.2020	-	-	-	-	-
BND	30.10.2020 (A)	-	-	-	-	-	-	-
NBPGR	-	-	-	-	13.11.2020	-	-	
CHT	-	26.10.2020	26.10.2020	-	-	-	-	-

4.1. Screening of AVT-1 and AVT-2 *Brassica* breeding material

Natural conditions: DOL, SHL, NDH, HSR, JHS, MOR, PNT, SGN, JAG, LDH, BND, SKN and VAR.

Artificial conditions: **AB:** DOL, SHL, PNT, HSR, LDH **WR:** PNT, HSR, MOR and LDH; **DM:** JHS, PNT; **SR:** LDH, HSR, MOR, PNT and BPR.

Total 34 breeding lines with 10 checks were sown in single 3-m row in randomized completely block design (RCBD) with 2 replications. Susceptible checks were used after every two test rows. Under artificial conditions, repeated inoculation was done after collecting inoculum from naturally infected plants for AB to facilitate the secondary spread. For screening against WR and DM, the oosporic material of local isolate was added with seed after grinding hypertrophied plant material collected from the previous year's crop as per standard procedure.

Observations on WR (75 DAS), DM (20 DAS), AB (90 DAS) on leaves (ABL), PM (100 DAS) and SR (% incidence) were recorded at 75 and/or 90-100 days after sowing (DAS) depending upon location under natural and artificial conditions. Number of staghead and Alternaria pod blight (ABP) severity were recorded 15-days before harvest. The results are given in table 4.1.1-5. Data of VAR were not as per the technical programme, and disease severity below 20% in susceptible check of JAG, LDH (ABL), SGN, PNT, LDH (ABP) are therefore, excluded from tables. All disease data recorded in per cent were converted as arc sin transformation value. None of the entries showed tolerance/resistance to AB, PM and SR (Table 4.1.3).

WR: Under natural condition, 9IJ5001 (Q hybrid), DRMR 2017-16, AKMS 19-8, HNS0702, (Bn) were found resistant at all five locations (Table 4.1.2). Under artificial condition DRMR 2017-16, 9IJ5001 (Q hybrid) and RCH1 (Bj), and AKGS 19-8, HNS 0702, GSH 1699, GSH 2180 and GSH 2196 (Bn) were found resistant to WR at MOR, HSR and PNT locations (Table 4.1.5).

DM: KMR(E) 19-2, NPJ 230, SKM 1626, DRMR 2017-16, PDZ 12, 9IJ5001, RCH 1 of *B. juncea* and GSH 2180, GSH 2196, GSH 1699, HNS 0702 and AKGS 19-8 of *B. napus* showed resistance to DM at PNT (Table 4.1.3).

4.2. Uniform Disease Nursery for major diseases

Locations: SHL, MOR, DOL, NDH, PNT, HSR, JAG, LDH, VAR, JHS and SGN.

Total 38 entries, with 9 checks, were sown in a single 3-m row with two replications in RCBD. Susceptible checks were sown after every two test rows. Observations on AB, WR, DM, PM severity and SR incidence were recorded under natural conditions (Tables 4.2.1-3).

WR: DRMRQ-202, DRMR 2018-25, DRMRQ-1-22, PMW 18 and PAB 14-7 of *B. juncea* showed resistance reaction to WR under natural conditions with mean disease severity <10%, with the disease severity on Susceptible check Rohini was 26.5% (Table 4.2.3).

SR: DRMRSJ 25, PAB 14-7, DRMRQ-202, DRMRSJ 361 and DRMRSJ 21 at MOR and SGN were found tolerant to SR with <10% incidence except PNT under natural condition (Table 4.2.2).

4.3 National Disease Nursery (NDN) for Alternaria blight

Locations: PNT, DOL, HSR, LDH, MOR, VAR and SHL.

Total 45 strains including 9 checks were sown in paired rows of 3 m length. Observation on AB was recorded on leaves 90/100 DAS at sillique formation stage and 15 days before harvesting under artificial inoculation conditions at SHL, DOL, PNT and HSR Reaction to AB, WR, and SR was also recorded from same trial (Table 4.3.1-2). DRMR 2018-1, PMW 18, DRMR-2018-37, DRMR 2018-41, DRMR 2018-25, and DRMRSJ-4 of *B. juncea* showed resistant reaction to WR (Table 4.3.2).

4.4 National Disease Nursery (NDN) for white rust

Locations: PNT, MOR, SHL, HSR and BPR (natural condition); LDH, NBPGR (artificial condition)

Total 59 genotypes, with 9 checks, were sown in paired-row of 3 m length between susceptible check. Observation for WR on leaves and stag head formation was recorded at 75, 100 DAS under artificial inoculation conditions. Reaction to AB, SR, DM and PM was also recorded under natural conditions (Table 4.4.1-2).

RH 1700-4, Varuna (A4A5)-936-279, Rohini (A4A5) 491, RJK (A4A5) 21, DRMR 2018-19, DRMR 2018-25 and DRMR 18-37-13 entries of *B. juncea* showed immune reaction to WR at MOR, PNT, HSR, LDH and BPR locations. Some of the promising strains sowing resistance to WR with <10% disease severity were DRMRSJ 7, DRMRCI 125, DRMRCT 132, DRMRSJ 4, DRMRSJ 206, DRMRSJ 349, DRMR 18-36-12, DRMR 2018-41, RH 1700, RH 1400, RH 1400-1, RH 1700-1, PWR 13-8, PB (A4A5) 842 and PMW 18 (5 location). However, DRMR 2018-41 and RH 1400 were found consistently resistant to WR during 2018-19, 2019-20 and 2020-21 (Table 4.4.2). None of the entries of *B. juncea* showed resistance to SR at MOR and PNT.

4.5 National Disease Nursery (NDN) for Sclerotinia rot

Locations: PNT, HSR, LDH, BPR, VAR and SHL

Total 7 entries and 4 checks were sown in paired rows of 3 m length between susceptible check (Rohini, RL 1359 and NRCYS-5-2) and tolerant check NPC 16. Stem inoculation was done to ensure uniform SR infection. Per cent SR incidence artificial was recorded prior to harvest and mean lesion size (cm) was also measured 3 weeks after inoculation. In addition, reaction to AB, WR and DM was also recorded (Table 4.5.1-2). None of the entries of *B. juncea* showed tolerance to SR.

4.6 Screening of IVT entries of Brassica against different diseases

Locations: MOR, DOL, SHL, PNT, HSR, LDH, SGN and JAG

Total 134 strains including 9 checks were sown in single 3m row in RCBD with 2 replications. Susceptible check(s) were used after every 2 test rows. Susceptible variety 'Rohini' was used as filler. Observations on AB, WR, DM, PM, and SR were recorded at 75 and 100 DAS. Staghead incidence and AB severity on pod was recorded 15 days before harvesting. Entries showing resistance/ tolerance to AB, WR, DM, PM and SR under natural conditions are listed in Table 4.6.1-2).

WR: TM 188, ORM 2019-01, 0IJ1010, DRMRCI 128, OIJ 1034, JC 36, and 0IJ5001 of *B. juncea* were found resistant and DRMR 2018-19, Rohini (A4A5) 936-279, PB(A4A5)-842, and PJK(A4A5)-21 were also found resistant to WR at three locations. While,almost all the entries of *B. rapa* ssp. Toria and *B. rapa* ssp. Yellow Sarson*, B. napus* escaped WR infection (Table 4.6.2).

4.7 Assessment of yield loss and management of AB in rice-fellow mustard cropping system

An experiment was conducted to asses the yield losses caused by the major diseases of rapesed-mustard under rice-fellow-mustard cropping system at SHL, JAG, DOL and VAR locations using cv. varuna. Among different teatments at all locations foliar spray of Tebuconazole 50%+ trifloxistrobin 25% WG-FS @ 0.5g/l gave maximum 54.3 per cent AB disease reduction over check followed by Iprodione 50WP -FS @ 0.2% gave 52.6 per cent reduction with incrase in yield by 49.7 and 70.1 per cent, respectively (Table 4.7).

4.8 Epidemiology of DM, WR, AB, SR and PM diseases of Indian mustard

Experiments on the epidemiology of foliar diseases of rapeseed-mustard were laid out at PNT, SHL, SKN, MOR, JAG, DOL and HSR using cvs. Varuna and local variety was sown on eight different dates at weekly interval starting from October 01 to November 19 without adopting any protection measures against pest and diseases (Table 4.8.1-8).

PNT

Two cultivars Varuna and Kranti were sown at eight different dates. Downy mildew disease first appeared 8 DAS on Oct 22 sown Varuna and Kranti cultivars. Whereas, the maximum DM severity was between 20 DAS to 23 DAS on both the cultivars except in early sowing (Table 4.8.1c). WR disease first appeared 50 DAS on Oct 22, 29 and Nov 12 sown Varuna and Kranti (Table 4.8.1a). AB disease was first noticed at 50 DAS in Oct 22 sown crop on both the cultivars. Whereas on Oct 01 sown crop, the disease appeared late i.e. 71 DAS (Table 4.8.1b). AB on pods first appeared 83 DAS on late (Nov 19) sown crop. On early (Oct 01) sown crop, the symptoms on pod appeared late after 122 days of sowing which was 02 days late than last year (Table 4.8.1c).

SHL

Experiment was laid out with cv. Varuna and TM 2. The crop was sown at 4 dates starting from Oct 29 to Nov 19 at weekly intervals to study the epidemiology of diseases. ABL was first observed 35 DAS in Nov 19 sown TM 2. AB on silique first appeared 83 DAS in Nov 19 sown cv TM 2 which appeared 95 DAS in early sown crop on Oct 29 on Varuna. Maximum disease severity was at 26.8% (120 DAS) in Nov 12 sown cv TM 2 (Table 4.8.2). Maximum yield was recorded in Oct 29 sown cv Varuna (18.67 q/ha) and 12.67 q/ha of TM 2. Yield data revealed that the best sowing time of crop in the region is last week of October (Table 4.8.2).

SKN

Experiment was laid out with cv. Varuna and GM 2 sown at 8 sowing dates starting from Oct 01 to Nov. 19 at weekly intervals. Powdery mildew disease first appeared at 89 DAS instead of 79 DAS, 83 DAS, 76 DAS during 2019-20, 2018-19, 2017-18, respectively on Nov 19 sown crop of cv Varuna and cv GM 2. The maximum disease severity was observed in Nov 19 sown cv Varuna (97.0%) and GM 2 (90.5%). The maximum seed yield reduction was observed in late sown crop (Table 4.8.3). Although, highest yield was observed in Oct 01 sown GM 2 (16.59q/ha) and Varuna (15.7q/ha).

MOR

Experiment was laid out with cv. Varuna and Rohini as per technical programme. AB on leaf first appeared 47 DAS in Nov 19 sown cv Varuna and Rohini. Whereas, SR appeared at 90 DAS in late sown crop of Oct 29, Nov.05, Nov.12 and Nov.19(Table 4.8.4a). PM was observed first 80 DAS and was maximum 51.8 % reported in cv Rohini at 130 DAS in Nov 19 sown crop (Table 4.8.4b). WR was appeared first on 40 DAS in Nov. 19 sown Rohini and progressed till 120 DAS in Nov 05, and Nov 12 sown crop. WR disease severity was maximum up to 44.9% in Nov 05 sown both cultivars. Maximum staghead (40.2%) was observed in Nov 12 sown Rohini. Maximum yield (34.0 q/ha) was recorded in Oct 15 sown Rohini and 32.9 q/ha in Varuna (Table 4.8.4b).

JAG

Experiment on epidemiological studies of AB, WR and PM was laid out with cvs. Varuna and CG Sarson as per technical programme. Initiation of AB was reported at 40 DAS in Nov. 12 sown Varuna and CG Sarson and 19 Nov sown CG Sarson. PM was appeared first at 90 DAS on both cultivars in Nov 12 and Nov 19 sown crop. WR first appeared at 50 DAS on both Varuna and CG Sarson sown on Nov 12 and 19. (Table 4.8.5).

DOL

Experiment was laid out using cv. Varuna and Rajendra Suflam with 8 dates of sowing starting from Oct 01 to Nov 19 at weekly intervals. AB was first observed in Oct 01 sown crop at 62 DAS and 76 DAS on Varuna and Rajendra Suflam, respectively. The disease continued to progress on leaves up to 140 DAS on both the cultivars (Table 4.8.6).

HSR

Experiment was conducted with 8 dates of sowing using cvs. Varuna and RH 30. WR appeared first at 36 DAS in Nov 12 sown RH 30 which was further spread in Nov 12 and Oct 29 sown crop (Table 4.8.7a). Staghead formation observed first at 68 DAS on RH 30 in Oct 15 sown crop (Table 4.8.7b). AB appeared first 89 DAS on Oct 08, Nov 19 sown both cultivars (Table 4.8.7c).SR disease initiation was observed 70 DAS in Nov 19 sown cv Varuna and RH 30. Maximum incidence was 51.5% in cv. RH 30 and 49.6% in cv. Varuna sown on Nov 05. While the maximum yield 33.8 q/ha was of Varuna and 32.9 q/ha of RH 30 in Oct 01 sown crop (Table 4.8.7c).

JHS

Experiment was conducted using RH 406 and Varuna cultivars with 8 sowing dates at weekly interval. AB appeared first on leaves at 58 DAS in Nov 19 and seen on pods at 62 DAS in Nov 05sown Varuna (Table 4.8.8a). DM first appeared at 10DAS in Nov 12 sown Varuna and Oct 29 sown RH 406, while WR appeared first at 59 DAS in Nov 19 sown Varuna (Table 4.8.8b). PM initiated at 70 DAS in Nov 19 sown Varuna. Optimum time of sowing in the Bundelkhand region for obtaining higher seed yield is first fortnight of Oct.

4.9 Efficacy of fungicides against major diseases of rapeseed-mustard

The experiment was conducted at 9 locations in plot size 3x5m with 30x10 cm spacing using DRMRIJ 31 cultivar replicated thrice to study the efficacy of fungicides against major diseases. Ten plants from each plot were tagged for recording observations on AB, WR, PM and SR severity/ incidence. Data revealed that AB severity was minimum (19.1%) in Tebuconazole 50% + Trifloxostrobin 25% WG@0.1% in comparison to control (34.5%). Although, all tested fungicides were effective to reduce AB severity over control both on leaves and pods (Table 4.9). WR severity was minimum (21.8%) in Metalaxyl 4% + Mancozeb 64% @ 0.25% over check (40.3%). PM severity was observed minimum (14.7%) in Azoxystrobin @0.1% over control (33.9%). Both Propiconazole 25% EC @0.1% and Tebuconazole 50% + Trifloxostrobin 25% WG@0.1% were found effective in reducing the incidence of SR upto 18.3% and 18.8% respectively, as compared to control (27.8%).

4.10 Survey of farmer's field for disease outbreak

MOR

Survey of farmer's field to observe disease outbreak was conducted during crop season at adjoining areas of Morena district of Madhya Pradesh. During survey, AB disease severity observed very low to moderate in all areas. WR disease was appeared first on 10 Dec in late sown crop. However, the disease was observed moderate to high severity. Staghead formation was observed moderate to severe in late sown crop in all mustard growing areas of Chambal Division. SR disease first appeared on 15 Dec. PM was observed in most of the farmer's field mainly on late sown crop.

SKN

Survey was conducted of four farmer's field to observe the disease outbreak. PM disease was observed severe on late sown crop. In timely sown crop, PM disease severity was observed between 15-25 % and WR disease severity between 5-10 %.

SHL

Survey was conducted of farmer’s field in Nagaon and Morigaon districts of Assam. AB was appeared/observed in second fortnight of December. During the crop season, the disease severity ranged from 3.6 to 33.5 % at the farmer’s field.

Table 4.1.1: Reaction of AVT-I and AVT-II Brassica germplasm to Alternaria Blight under natural condition

Code No.	Entries	% ABL severity (90 DAS)							% ABP (15 days before harvest)				
		SHL	SGN	DOL	PNT	NDH	BND	Mean	SHL	SGN	DOL	PNT	Mean
SBG-20-01	RH 1999-42	31.6	29.0	37.0	33.1	21.4	23.7	**29.3**	19.6	22.9	23.3	34.7	**25.1**
SBG-20-02	KMR (E) 19-2	32.0	30.3	34.7	31.6	20.4	19.1	**28.0**	17.4	24.1	22.2	33.1	**24.2**
SBG-20-03	NPJ 229	30.4	31.4	32.7	28.3	20.9	23.7	**27.9**	18.8	16.4	21.1	34.7	**22.8**
SBG-20-04	PRE 17-2	32.7	27.7	35.6	29.9	24.1	18.1	**28.0**	23.6	9.8	21.8	37.7	**23.2**
SBG-20-05	PRE 17-5	32.5	29.4	33.0	29.9	20.0	15.8	**26.8**	19.1	10.5	20.2	36.2	**21.5**
SBG-20-06	NPJ 231	32.7	26.7	38.5	31.6	19.4	19.7	**28.1**	22.8	16.8	28.4	34.7	**25.7**
SBG-20-07	RGN 443	31.5	27.2	39.0	31.6	30.7	23.6	**30.6**	21.5	20.2	27.5	34.7	**26.0**
SBG-20-08	DRMRHJ 2403	32.5	27.3	40.3	34.7	25.3	25.8	**31.0**	22.9	16.7	28.9	37.7	**26.6**
SBG-20-09	DRMRCI 116	31.1	26.2	42.7	31.6	26.9	23.3	**30.3**	22.3	22.0	32.3	34.7	**27.8**
SBG-20-10	NPJ 230	33.5	31.4	37.7	29.9	30.4	19.1	**30.3**	21.0	19.9	25.5	36.2	**25.7**
SBG-20-11	PHR 8022 (Hybrid)	32.5	22.4	29.3	28.3	33.2	26.9	**28.8**	23.4	19.0	20.0	28.3	**22.7**
SBG-20-12	AKMS-19-2	30.1	32.8	30.1	26.4	29.2	27.8	**29.4**	19.5	17.7	20.0	28.3	**21.4**
SBG-20-13	KMR (E) 19-1	29.6	16.0	41.1	31.6	27.7	26.3	**28.7**	19.3	14.5	24.1	33.1	**22.8**
SBG-20-14	DRMRCI 96	33.9	33.7	42.1	39.2	33.2	22.1	**34.0**	24.3	20.4	29.6	36.2	**27.6**
SBG-20-15	RMM 10-1-1	29.4	22.3	39.8	31.6	31.1	24.7	**29.8**	22.4	14.2	28.3	34.7	**24.9**
SBG-20-16	RH 1424	34.4	36.9	31.1	37.7	28.9	18.8	**31.3**	20.8	28.7	21.3	34.7	**26.4**
SBG-20-17	SKM 1626	29.0	35.3	33.9	36.2	35.9	20.8	**31.8**	19.4	38.2	21.1	33.1	**28.0**
SBG-20-18	DRMR 2017-16	31.7	21.3	34.7	40.7	33.9	26.6	**31.5**	20.8	24.0	22.3	31.6	**24.7**
SBG-20-19	PR 2016-8	33.4	46.3	30.5	34.7	33.6	19.1	**32.9**	22.7	25.3	23.6	29.9	**25.4**
SBG-20-20	CS 2005-143	34.1	27.7	30.5	46.4	33.2	22.0	**32.3**	22.3	25.1	20.1	37.7	**26.3**
SBG-20-21	RH 1676	30.0	27.9	32.7	43.5	38.6	22.1	**32.5**	19.5	20.6	21.5	34.7	**24.1**
SBG-20-22	PDZ 11 (Q)	28.8	31.1	40.0	34.7	27.7	24.0	**31.1**	19.2	29.9	27.9	31.6	**27.1**
SBG-20-23	PDZ 12(Q)	33.6	21.7	39.8	43.5	28.9	24.8	**32.1**	19.9	23.5	27.3	40.7	**27.8**
SBG-20-24	**9IJ5001 (Q Hybrid)**	33.2	32.5	39.7	31.6	28.9	18.8	**30.8**	23.2	24.5	27.5	34.7	**27.5**
SBG-20-25	AKGS 19-8	27.0	40.2	40.1	28.3	30.4	0.0	**27.7**	18.0	24.8	27.6	39.2	**27.4**
SBG-20-26	HNS 0702	34.8	39.2	37.0	33.1	28.9	12.2	**30.9**	23.8	16.8	24.2	43.5	**27.1**
SBG-20-27	RH (OE) 1706	31.8	29.5	37.6	34.7	34.6	23.5	**31.9**	21.1	16.8	24.2	33.1	**23.8**
SBG-20-28	LES 60 (Q)	33.2	34.6	39.3	37.7	29.2	20.9	**32.5**	20.3	21.9	24.5	40.7	**26.9**
SBG-20-29	RTM 1624	34.5	33.8	40.6	37.7	17.9	0.0	**27.4**	23.4	25.4	27.5	40.7	**29.2**
SBG-20-30	**BIOYSR (RC-WR)**	32.5	29.9	40.7	43.5	33.9	24.3	**34.1**	21.1	25.8	28.9	46.4	**30.5**
SBG-20-31	**NRCYS-5-2 (*Br*-YS)**	33.7	36.4	39.1	36.2	21.9	17.8	**30.8**	25.0	32.6	28.5	45.0	**32.8**
SBG-20-32	**PT 303 (*Br*-T)**	32.0	19.0	30.3	34.7	12.9	11.7	**23.4**	22.7	0.0	20.6	40.7	**21.0**
SBG-20-33	**PHR 2 (TC-AB)**	31.1	32.1	34.2	33.1	34.6	14.6	**29.9**	22.0	16.9	21.8	34.7	**23.9**
SBG-20-34	**DLSC 1 (*Bc*)**	32.6	24.9	34.7	20.6	28.9	0.0	**23.6**	21.5	9.4	22.9	20.6	**18.6**
SBG-20-35	**WBN-1(*Br*-BS)**	33.3	29.3	29.7	29.9	26.6	16.3	**27.5**	23.2	19.0	20.7	42.1	**26.3**
SBG-20-36	**RTM 314 (*Es*)**	28.9	28.4	40.2	22.5	27.7	0.0	**24.6**	20.1	19.6	27.4	28.0	**23.8**
SBG-20-37	GSH 1699	23.6	20.4	39.4	40.7	25.8	0.0	**25.0**	18.8	19.8	27.5	45.0	**27.8**
SBG-20-38	RCH 1 (Q)	31.5	23.1	39.0	42.1	24.9	19.4	**30.0**	21.7	21.3	29.5	36.2	**27.2**
SBG-20-39	**RL 1359 (SC)**	32.6	20.7	30.3	33.2	35.9	20.3	**28.8**	23.8	20.5	20.7	31.6	**24.1**
SBG-20-40	GSH 2180	29.0	0.0	38.3	20.6	28.1	0.0	**19.3**	19.2	0.0	27.6	31.6	**19.6**
SBG-20-41	GSH 2196	27.4	0.0	37.2	18.4	32.4	0.0	**19.2**	19.0	0.0	29.8	31.6	**20.1**
SBG-20-42	PBR 385	34.4	29.0	37.5	36.3	26.6	21.8	**30.9**	22.3	23.0	30.8	31.6	**26.9**
SBG-20-43	**Rohini (SC)**	33.7	40.9	38.0	45.0	24.1	24.8	**34.4**	21.1	25.9	30.8	42.1	**30.0**
SBG-20-44	**GSL 1 (*Bn*)**	27.2	38.0	37.8	28.3	24.1	0.0	**25.9**	20.6	20.2	30.3	33.1	**26.1**
CD(*P*=0.05)		**4.1**	**5.3**	**1.6**	**6.4**	**2.7**	**1.9**	**-**	**3.5**	**4.6**	**2.3**	**6.7**	**-**
CV (%)		**6.5**	**9.2**	**2.2**	**9.4**	**-**	**5.5**	**-**	**8.2**	**11.6**	**4.4**	**9.4**	**-**

***Data of JAG, LDH , JHS (AB) and SGN, PNT, LDH (ABP) not included as the disease severity was < 20% in SC**
Data of VAR excluded due to not as per technical programme

Table 4.1.2: Reaction of AVT-I and AVT-II Brassica germplasm to WR under natural condition

Entries	% WR severity (75 DAS)*						% Staghead			
	MOR	SGN	PNT	BND	BPR	Mean	MOR	SGN	PNT	Mean
RH 1999-42	38.6	37.6	33.2	22.1	36.9	**33.7**	45.0	16.6	15.7	**25.8**
KMR (E) 19-2	27.7	20.4	20.6	18.4	27.2	**22.9**	22.8	12.5	20.6	**18.6**
NPJ 229	38.4	31.9	24.7	18.8	30.0	**28.8**	44.0	23.7	24.7	**30.8**
PRE 17-2	27.4	42.6	24.7	13.6	30.6	**27.8**	16.8	29.1	12.9	**19.6**
PRE 17-5	31.8	41.8	30.0	16.4	30.0	**30.0**	22.8	14.1	12.9	**16.6**
NPJ 231	38.8	27.5	28.3	17.4	36.9	**29.8**	31.1	17.1	30.0	**26.1**
RGN 443	37.2	28.6	29.9	21.8	40.4	**31.6**	34.2	13.3	20.6	**22.7**
DRMRHJ 2403	44.0	40.6	29.9	21.2	37.5	**34.6**	55.8	30.0	15.7	**33.8**
DRMRCI 116	34.7	31.5	30.0	20.0	39.3	**31.1**	39.2	18.5	6.5	**21.4**
NPJ 230	29.4	17.8	26.6	18.1	38.6	**26.1**	32.2	19.8	12.9	**21.6**
PHR 8022 (Hybrid)	23.0	28.9	29.9	21.2	39.8	**28.5**	15.0	15.2	18.4	**16.2**
AKMS-19-2	34.2	30.4	34.7	26.8	39.7	**33.2**	40.2	12.7	12.9	**21.9**
KMR (E) 19-1	34.4	34.7	28.3	26.1	31.3	**30.9**	32.2	20.3	18.4	**23.6**
DRMRCI 96	44.3	37.0	36.2	19.4	30.0	**33.4**	58.9	20.7	20.6	**33.4**
RMM 10-1-1	33.5	33.6	28.3	21.5	26.5	**28.7**	22.8	14.6	12.9	**16.8**
RH 1424	36.4	39.2	36.3	14.0	29.4	**31.1**	36.3	18.0	15.7	**23.3**
SKM 1626	34.3	36.5	28.3	18.4	28.6	**29.2**	32.2	16.8	20.6	**23.2**
DRMR 2017-16	0.0	32.8	0.0	20.3	0.0	**10.6**	0.0	19.2	0.0	**6.4**
PR 2016-8	40.5	31.4	42.1	18.4	37.5	**34.0**	46.9	11.7	20.6	**26.4**
CS 2005-143	39.8	30.4	40.7	19.5	37.5	**33.6**	41.2	11.7	15.7	**22.9**
RH 1676	41.0	27.9	37.8	19.1	36.9	**32.5**	44.0	20.8	12.9	**25.9**
PDZ 11 (Q)	6.5	25.0	2.0	18.6	0.0	**10.4**	0.0	17.4	6.5	**8.0**
PDZ 12(Q)	0.0	38.0	4.9	20.9	0.0	**12.8**	0.0	28.7	12.9	**13.9**
9IJ5001 (Q Hybrid)	0.0	9.7	0.0	17.1	0.0	**5.4**	0.0	0.0	0.0	**0.0**
AKGS 19-8	0.0	11.9	0.0	0.0	0.0	**2.4**	0.0	0.0	0.0	**0.0**
HNS 0702	0.0	26.7	0.0	10.9	0.0	**7.5**	0.0	12.3	0.0	**4.1**
RH (OE) 1706	28.2	18.0	37.8	19.7	21.9	**25.1**	28.9	0.0	20.6	**16.5**
LES 60 (Q)	36.6	25.3	37.8	19.4	22.8	**28.3**	34.2	13.4	22.8	**23.5**
RTM 1624	0.0	31.6	0.0	0.0	0.0	**6.3**	0.0	19.0	0.0	**6.3**
BIOYSR (RC-WR)	17.8	17.8	37.8	20.8	22.8	**23.4**	0.0	12.1	18.4	**10.2**
NRCYS-5-2 (*Br*-YS)	4.5	0.0	12.9	17.1	26.5	**12.2**	0.0	0.0	18.4	**6.1**
PT 303 (*Br*-T)	5.4	0.0	15.7	8.9	0.0	**6.0**	0.0	0.0	12.9	**4.3**
PHR 2 (TC-AB)	13.3	0.0	31.6	13.0	30.0	**17.6**	0.0	0.0	20.6	**6.9**
DLSC 1 (*Bc*)	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	**0.0**
WBN-1(*Br*-BS)	0.0	0.0	31.6	14.0	0.0	**9.1**	0.0	0.0	15.7	**5.2**
RTM 314 (*Es*)	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	**0.0**
GSH 1699	0.0	33.1	0.0	0.0	0.0	**6.6**	0.0	12.9	0.0	**4.3**
RCH 1 (Q)	2.7	27.5	12.9	17.1	0.0	**12.0**	0.0	12.0	18.4	**10.2**
RL 1359 (SC)	40.3	28.7	42.1	18.4	30.0	**31.9**	35.2	17.9	22.8	**25.3**
GSH 2180	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	**0.0**
GSH 2196	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	**0.0**
PBR 385	40.0	40.9	34.7	19.4	39.3	**34.9**	35.2	25.3	24.7	**28.4**
Rohini (SC)	36.4	31.3	36.2	21.9	39.3	**33.0**	31.1	16.6	20.6	**22.8**
GSL 1 (*Bn*)	0.0	44.0	0.0	0.0	0.0	**8.8**	0.0	22.0	0.0	**7.3**
CD(*P*=0.05)	**4.2**	**5.2**	**4.8**	**2.3**	**1.6**	**-**	**5.4**	**3.0**	**5.4**	**-**
CV (%)	**9.7**	**10.3**	**10.7**	**7.5**	**3.7**	**-**	**13.3**	**11.3**	**19.8**	**-**

***Data of JAG, LDH, JHS and NDH not included as the WR disease severity was < 20% in SC**

Table 4.1.3: Reaction of AVT-I and AVT-II Brassica germplasm to DM, PM and SR under natural condition

Entries	% DM severity (20 DAS)	% PM severity (100 DAS)				% SR incidence		
	PNT	MOR	SKN	BND	Mean	MOR	DOL	Mean
RH 1999-42	28.3	21.4	63.4	27.0	**37.3**	22.8	0.0	**11.4**
KMR (E) 19-2	0.0	15.7	60.1	25.0	**33.6**	12.9	0.0	**6.5**
NPJ 229	15.7	4.6	67.5	26.8	**33.0**	12.9	0.0	**6.5**
PRE 17-2	20.6	12.7	62.0	22.3	**32.3**	26.6	0.0	**13.3**
PRE 17-5	29.9	17.6	71.5	22.6	**37.2**	9.1	0.0	**4.5**
NPJ 231	28.3	4.6	71.5	20.0	**32.0**	22.8	19.9	**21.3**
RGN 443	24.7	11.9	69.4	23.2	**34.8**	18.4	19.9	**19.2**
DRMRHJ 2403	26.4	9.0	69.4	27.5	**35.3**	12.9	18.6	**15.7**
DRMRCI 116	20.6	6.0	65.8	25.0	**32.3**	18.4	24.5	**21.5**
NPJ 230	0.0	0.0	56.8	19.7	**25.5**	9.1	0.0	**4.5**
PHR 8022 (Hybrid)	15.7	18.2	69.4	27.8	**38.5**	0.0	0.0	**0.0**
AKMS-19-2	26.4	16.6	71.5	33.6	**40.6**	12.9	0.0	**6.5**
KMR (E) 19-1	28.3	4.6	61.7	28.4	**31.6**	22.8	0.0	**11.4**
DRMRCI 96	31.6	6.0	65.3	24.6	**32.0**	15.9	22.7	**19.3**
RMM 10-1-1	15.7	6.0	64.2	30.4	**33.5**	26.6	18.6	**22.6**
RH 1424	15.7	6.0	71.5	19.7	**32.4**	22.8	0.0	**11.4**
SKM 1626	0.0	8.1	64.2	24.2	**32.2**	12.9	0.0	**6.5**
DRMR 2017-16	0.0	12.5	67.5	26.8	**35.6**	0.0	0.0	**0.0**
PR 2016-8	20.6	11.2	69.4	20.0	**33.5**	0.0	0.0	**0.0**
CS 2005-143	20.6	4.6	69.4	23.2	**32.4**	18.4	0.0	**9.2**
RH 1676	20.6	4.6	67.5	23.7	**32.0**	20.7	0.0	**10.4**
PDZ 11 (Q)	20.6	6.7	64.2	25.3	**32.0**	0.0	22.2	**11.1**
PDZ 12(Q)	0.0	20.3	65.8	27.3	**37.8**	0.0	22.2	**11.1**
9IJ5001 (Q Hybrid)	0.0	11.5	67.5	20.0	**33.0**	0.0	0.0	**0.0**
AKGS 19-8	0.0	0.0	32.9	0.0	**11.0**	0.0	0.0	**0.0**
HNS 0702	0.0	3.8	36.2	8.9	**16.3**	0.0	0.0	**0.0**
RH (OE) 1706	28.3	8.1	67.5	24.3	**33.3**	18.4	0.0	**9.2**
LES 60 (Q)	20.6	18.2	76.7	23.7	**39.6**	12.9	0.0	**6.5**
RTM 1624	0.0	0.0	0.0	0.0	**0.0**	0.0	18.6	**9.3**
BIOYSR (RC-WR)	24.7	0.0	64.2	26.8	**30.3**	15.9	18.6	**17.2**
NRCYS-5-2 (*Br*-YS)	24.7	0.0	60.1	18.4	**26.2**	12.9	18.6	**15.7**
PT 303 (*Br*-T)	20.6	0.0	56.8	15.6	**24.1**	64.6	0.0	**32.3**
PHR 2 (TC-AB)	15.7	18.8	71.5	31.7	**40.7**	15.9	0.0	**7.9**
DLSC 1 (*Bc*)	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**
WBN-1(*Br*-BS)	15.7	0.0	32.9	20.7	**17.9**	0.0	0.0	**0.0**
RTM 314 (*Es*)	0.0	0.0	0.0	0.0	**0.0**	64.6	18.6	**41.6**
GSH 1699	0.0	0.0	0.0	0.0	**0.0**	0.0	18.6	**9.3**
RCH 1 (Q)	0.0	24.1	63.4	27.3	**38.3**	0.0	22.2	**11.1**
RL 1359 (SC)	24.7	28.2	71.5	22.1	**40.6**	63.4	0.0	**31.7**
GSH 2180	0.0	0.0	9.2	0.0	**3.1**	0.0	8.3	**4.2**
GSH 2196	0.0	0.0	9.2	0.0	**3.1**	0.0	8.3	**4.2**
PBR 385	20.6	28.0	71.5	25.5	**41.7**	26.6	18.6	**22.6**
Rohini (SC)	20.6	24.1	60.1	37.4	**40.5**	24.7	22.2	**23.5**
GSL 1 (*Bn*)	0.0	0.0	9.2	0.0	**3.1**	0.0	22.2	**11.1**
CD(*P*=0.05)	4.5	10.3	12.0	2.2	-	**6.3**	**6.0**	-
CV (%)	15.4	47.6	11.0	5.5	-	**20.3**	**35.7**	-

***Data of JHS not included as the DM, PM disease severity was < 20% in SC**

Table 4.1.4: Reaction of AVT-I and AVT-II Brassica germplasm to Alternaria Blight under artificial condition

Entries	% ABL severity (90 DAS)						% ABP (15 days before harvest)				
	SHL	DOL	PNT	HSR	LDH	Mean	SHL	DOL	PNT	HSR	Mean
RH 1999-42	33.3	42.7	36.2	33.9	26.0	**34.4**	23.2	31.5	42.1	28.1	**31.2**
KMR (E) 19-2	34.1	40.2	37.7	28.1	20.9	**32.2**	20.1	27.1	45.0	25.8	**29.5**
NPJ 229	32.6	38.2	33.2	31.1	20.2	**31.1**	22.0	26.4	42.1	26.9	**29.3**
PRE 17-2	34.3	40.5	33.1	25.8	21.5	**31.0**	25.8	29.5	45.0	23.3	**30.9**
PRE 17-5	34.6	38.9	36.3	32.9	25.2	**33.6**	21.0	27.1	42.1	27.4	**29.4**
NPJ 231	35.5	43.4	36.3	33.2	27.1	**35.1**	24.9	33.7	40.7	28.1	**31.8**
RGN 443	34.3	44.1	39.2	29.6	25.3	**34.5**	25.9	33.4	42.1	25.8	**31.8**
DRMRHJ 2403	35.3	46.0	39.2	24.9	24.8	**34.0**	27.3	34.7	43.5	21.5	**31.8**
DRMRCI 116	34.6	48.3	43.5	24.2	27.7	**35.7**	26.6	35.5	46.4	22.4	**32.7**
NPJ 230	35.1	43.5	37.7	32.5	26.0	**35.0**	24.9	31.5	47.9	28.9	**33.3**
PHR 8022 (Hybrid)	35.9	35.5	33.2	30.1	28.4	**32.6**	26.6	24.7	43.5	24.9	**29.9**
AKMS-19-2	34.2	36.2	31.6	31.1	24.2	**31.5**	23.5	25.3	39.2	26.6	**28.6**
KMR (E) 19-1	35.7	46.4	31.6	34.0	21.9	**33.9**	23.2	35.5	40.7	29.6	**32.2**
DRMRCI 96	37.2	47.0	46.4	34.6	20.8	**37.2**	28.8	35.6	49.3	28.9	**35.6**
RMM 10-1-1	34.6	45.3	36.3	32.9	22.1	**34.2**	26.6	35.0	45.0	27.4	**33.5**
RH 1424	37.7	37.2	42.1	25.8	23.5	**33.2**	28.1	26.0	46.4	24.2	**31.2**
SKM 1626	33.5	39.1	40.7	24.2	22.9	**32.1**	22.7	28.5	45.0	21.5	**29.4**
DRMR 2017-16	34.9	40.3	43.5	34.6	22.1	**35.1**	23.6	29.3	49.3	30.1	**33.1**
PR 2016-8	37.2	35.9	39.2	32.2	21.2	**33.1**	26.0	27.0	42.1	26.9	**30.5**
CS 2005-143	36.7	36.4	49.3	33.2	24.4	**36.0**	24.6	25.5	52.2	31.1	**33.3**
RH 1676	34.7	38.5	49.3	32.5	22.0	**35.4**	25.0	25.5	52.2	25.8	**32.1**
PDZ 11 (Q)	33.0	45.8	37.7	36.6	23.4	**35.3**	23.3	30.6	43.5	32.9	**32.6**
PDZ 12(Q)	37.8	45.6	49.3	38.6	23.5	**38.9**	22.4	30.5	46.4	33.2	**33.1**
9IJ5001 (Q Hybrid)	38.7	45.4	34.7	39.2	22.4	**36.1**	25.6	30.5	47.9	34.3	**34.6**
AKGS 19-8	31.2	45.0	33.1	17.4	21.4	**29.6**	23.7	30.8	49.3	15.0	**29.7**
HNS 0702	37.9	42.7	39.2	16.2	19.4	**31.1**	27.4	31.5	46.4	15.7	**30.2**
RH (OE) 1706	35.7	43.0	37.7	24.9	23.0	**32.9**	24.9	31.0	45.0	21.0	**30.4**
LES 60 (Q)	37.3	45.0	42.1	32.2	20.8	**35.5**	24.8	32.1	45.0	26.9	**32.2**
RTM 1624	37.9	45.8	40.7	.-	21.7	**36.5**	26.7	32.7	45.0	.-	**34.8**
BIOYSR (RC-WR)	36.1	46.9	49.3	36.6	27.4	**39.3**	24.3	33.5	50.7	31.1	**34.9**
NRCYS-5-2 (*Br*-YS)	37.7	45.1	42.1	34.6	20.8	**36.1**	29.4	32.1	49.3	27.4	**34.5**
PT 303 (*Br*-T)	35.6	36.5	37.7	31.1	24.2	**33.0**	24.7	25.6	43.5	25.8	**29.9**
PHR 2 (TC-AB)	34.7	40.0	37.7	32.9	27.4	**34.5**	24.7	26.0	36.2	26.6	**28.4**
DLSC 1 (*Bc*)	36.2	40.5	31.6	15.0	23.2	**29.3**	24.7	27.6	33.1	12.9	**24.6**
WBN-1(*Br*-BS)	37.1	35.7	36.2	15.7	22.4	**29.4**	26.8	27.3	46.4	12.9	**28.4**
RTM 314 (*Es*)	33.3	46.6	31.6	.-	21.5	**33.2**	23.8	32.4	29.9	.-	**28.7**
GSH 1699	27.5	45.0	43.5	17.4	21.1	**30.9**	22.5	32.9	49.3	16.2	**30.2**
RCH 1 (Q)	36.5	44.1	45.0	33.2	25.6	**36.9**	24.1	32.7	45.0	27.4	**32.3**
RL 1359 (SC)	37.3	36.7	36.2	28.1	26.6	**33.0**	26.8	25.1	39.2	24.9	**29.0**
GSH 2180	33.0	42.8	28.3	16.8	22.4	**28.7**	22.5	31.8	36.3	15.0	**26.4**
GSH 2196	31.6	42.5	22.8	15.0	23.2	**27.0**	21.7	31.9	34.7	12.9	**25.3**
PBR 385	37.5	43.0	39.2	33.2	27.9	**36.2**	24.5	33.0	36.2	26.9	**30.2**
Rohini (SC)	37.1	43.5	47.9	34.0	20.5	**36.6**	24.8	33.4	49.3	27.4	**33.7**
GSL 1 (*Bn*)	33.1	43.7	34.7	15.7	21.4	**29.7**	23.2	34.1	45.0	12.9	**28.8**
CD(*P*=0.05)	**3.6**	**2.1**	**5.8**	**4.0**	**3.5**	**-**	**2.8**	**1.8**	**6.3**	**4.7**	**-**
CV (%)	**5.1**	**2.4**	**7.5**	**7.2**	**7.5**	**-**	**5.6**	**3.0**	**7.1**	**9.9**	**-**

***Data of BPR not included as disease severity was < 20% in SC**

Table 4.1.5: Reaction of AVT-I and AVT-II Brassica germplasm to WR, SR, PM and DM under artificial condition

Entries	% WR severity (75 DAS)				% Staghead			% Sclerotinia rot incidence						% DM (20 DAS)	% PM (100 DAS)
	MOR	PNT	HSR	Mean	MOR	PNT	Mean	MOR	PNT	HSR	BPR	LDH	Mean	PNT	MOR
RH 1999-42	46.1	34.7	37.9	**39.6**	52.7	20.6	**36.7**	22.8	60.1	46.9	20.4	31.4	**36.3**	31.6	29.6
KMR (E) 19-2	35.9	24.7	31.1	**30.6**	40.2	24.7	**32.4**	12.9	61.7	46.1	19.3	18.7	**31.7**	0.0	27.4
NPJ 229	45.0	40.7	33.2	**39.6**	56.8	26.6	**41.7**	12.9	60.1	44.5	20.1	31.2	**33.8**	18.4	25.3
PRE 17-2	34.8	31.6	27.4	**31.3**	37.3	12.9	**25.1**	26.6	53.8	46.2	21.8	25.6	**34.8**	24.7	27.7
PRE 17-5	40.8	40.7	33.9	**38.4**	52.7	15.7	**34.2**	9.1	49.3	40.1	31.5	28.8	**31.8**	31.6	26.2
NPJ 231	46.0	37.7	34.6	**39.4**	62.3	28.3	**45.3**	22.8	40.7	46.1	24.6	32.2	**33.3**	28.3	25.4
RGN 443	43.7	31.6	39.9	**38.4**	52.7	26.4	**39.6**	18.4	45.0	52.1	25.2	38.1	**35.8**	28.3	27.1
DRMRHJ 2403	45.1	39.2	38.6	**41.0**	46.0	18.4	**32.2**	12.9	50.7	54.8	28.7	24.3	**34.3**	28.3	32.8
DRMRCI 116	41.0	33.1	33.2	**35.8**	44.0	18.4	**31.2**	18.4	37.7	50.1	30.4	32.4	**33.8**	24.7	31.8
NPJ 230	35.4	31.6	24.9	**30.6**	34.2	12.9	**23.6**	9.1	80.8	47.4	27.9	25.7	**38.2**	0.0	25.3
PHR 8022 (Hybrid)	17.8	34.7	34.6	**29.0**	15.0	20.6	**17.8**	0.0	47.9	43.1	17.0	29.4	**27.5**	20.6	31.5
AKMS-19-2	45.9	36.2	36.0	**39.4**	53.7	15.7	**34.7**	12.9	49.3	46.6	37.9	38.2	**37.0**	30.0	25.8
KMR (E) 19-1	36.3	31.6	39.2	**35.7**	39.1	20.6	**29.9**	22.8	26.6	56.5	33.8	22.6	**32.4**	29.9	19.9
DRMRCI 96	47.2	39.2	41.2	**42.5**	60.0	22.8	**41.4**	15.9	47.9	52.2	26.3	18.5	**32.2**	33.2	18.2
RMM 10-1-1	39.6	36.2	31.1	**35.6**	46.0	12.9	**29.4**	26.6	50.7	40.6	23.4	23.6	**33.0**	18.4	21.6
RH 1424	43.6	42.1	37.9	**41.2**	51.7	28.3	**40.0**	22.8	37.7	47.7	45.1	22.5	**35.2**	20.6	22.3
SKM 1626	33.0	45.0	33.2	**37.1**	34.2	28.3	**31.3**	12.9	53.8	46.3	28.3	31.1	**34.5**	0.0	18.7
DRMR 2017-16	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0	80.8	43.4	22.3	20.4	**33.4**	0.0	17.8
PR 2016-8	41.0	49.3	34.6	**41.6**	49.8	22.5	**36.1**	0.0	39.2	57.1	28.3	30.3	**31.0**	22.5	28.0
CS 2005-143	46.5	49.3	42.5	**46.1**	60.0	24.7	**42.3**	18.4	47.9	42.0	18.0	25.4	**30.3**	20.6	13.6
RH 1676	48.2	53.8	40.5	**47.5**	63.4	22.5	**43.0**	20.7	60.1	46.8	30.9	33.7	**38.4**	22.8	24.8
PDZ 11 (Q)	0.0	4.1	0.0	**1.4**	0.0	12.9	**6.5**	0.0	57.1	59.1	18.2	25.5	**32.0**	22.5	12.2
PDZ 12(Q)	0.0	6.9	0.0	**2.3**	0.0	18.4	**9.2**	0.0	36.2	44.2	28.7	35.2	**28.9**	0.0	16.4
9IJ5001 (Q Hybrid)	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0	67.5	58.8	30.4	31.5	**37.6**	0.0	15.9
AKGS 19-8	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0	60.1	31.2	62.5	20.9	**34.9**	0.0	0.0
HNS 0702	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0	57.1	32.3	39.8	12.8	**28.4**	0.0	0.0
RH (OE) 1706	26.2	42.1	38.6	**35.6**	16.8	31.6	**24.2**	18.4	47.9	52.9	30.9	16.4	**33.3**	31.6	19.1
LES 60 (Q)	37.9	43.5	36.6	**39.4**	42.1	20.6	**31.4**	12.9	36.2	45.5	38.6	12.6	**29.2**	22.8	32.7
RTM 1624	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0	67.5	70.5	64.0	19.8	**44.4**	0.0	0.0
BIOYSR (RC-WR)	11.8	43.5	0.0	**18.5**	0.0	24.2	**12.1**	15.9	76.7	53.2	31.7	9.5	**37.4**	28.3	8.1
NRCYS-5-2 (*Br*-YS)	4.6	36.3	0.0	**13.6**	0.0	28.3	**14.1**	12.9	61.7	62.6	40.1	15.5	**38.6**	24.7	0.0
PT 303 (*Br*-T)	16.3	18.4	0.0	**11.6**	0.0	15.7	**7.8**	64.6	80.8	42.1	42.4	20.6	**50.1**	24.7	0.0
PHR 2 (TC-AB)	13.2	34.7	35.3	**27.7**	0.0	24.7	**12.3**	15.9	60.1	62.5	18.0	13.3	**34.0**	20.6	22.0
DLSC 1 (*Bc*)	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0	47.9	25.0	55.9	17.6	**29.3**	0.0	0.0
WBN-1(*Br*-BS)	0.0	37.7	0.0	**12.6**	0.0	15.7	**7.8**	0.0	47.9	26.3	45.4	11.4	**26.2**	18.4	0.0
RTM 314 (*Es*)	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	64.6	90.0	71.0	53.6	32.3	**62.3**	0.0	0.0
GSH 1699	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0	47.9	32.5	20.6	15.6	**23.3**	0.0	0.0
RCH 1 (Q)	0.0	24.7	0.0	**8.2**	0.0	18.4	**9.2**	0.0	37.7	46.6	19.5	16.7	**24.1**	0.0	9.8
RL 1359 (SC)	35.1	45.0	34.3	**38.1**	44.0	15.7	**29.9**	63.4	26.6	47.5	27.8	24.4	**37.9**	28.3	28.3
GSH 2180	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0	26.6	31.8	37.7	15.3	**22.3**	0.0	0.0
GSH 2196	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0	29.9	30.5	31.5	12.1	**20.8**	0.0	0.0
PBR 385	37.4	37.7	39.9	**38.3**	47.9	31.6	**39.7**	26.6	32.9	54.8	44.0	22.1	**36.1**	22.5	9.4
Rohini (SC)	46.9	40.7	41.2	**42.9**	62.3	24.7	**43.5**	24.7	47.9	57.6	26.1	36.1	**38.5**	22.8	29.6
GSL 1 (*Bn*)	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0	45.0	33.5	26.4	21.1	**25.2**	0.0	0.0
CD(*P*=0.05)	**3.3**	**5.1**	**3.5**	-	**7.0**	**4.9**	-	**6.3**	**11.9**	**4.7**	**5.7**	**13.4**	-	**4.2**	**4.0**
CV (%)	**6.9**	**9.3**	**7.8**	-	**12.9**	**14.9**	-	**20.3**	**11.4**	**4.9**	**8.3**	**28.1**	-	**12.7**	**10.9**

***Data of LDH not included as disease severity was < 20% in SC**

Table 4.2.1: Reaction of oilseed Brassica germplasm against Alternaria blight in Uniform Disease Nursery (natural condition)

Code No.	Entries	% ABL severity (90 DAS)*									
		SHL	SGN	DOL	PNT	NDH	HSR	LDH	JHS	CHT	Mean
UDN-20-01	RMM-10-1-1	31.8	31.8	34.9	36.3	28.1	28.1	21.7	33.5	26.5	**30.3**
UDN-20-02	DRMRSJ 26	33.0	38.4	36.2	39.2	16.2	33.2	20.4	31.6	37.7	**31.8**
UDN-20-03	RMM-19-06	31.1	28.3	37.3	33.2	14.2	29.6	18.4	27.6	43.5	**29.2**
UDN-20-04	DRMRSJ-21	32.9	32.9	36.0	34.7	28.9	26.6	20.1	36.7	26.9	**30.6**
UDN-20-05	DRMRSJ-1	32.8	27.1	36.6	31.6	27.3	33.9	20.0	37.5	33.7	**31.2**
UDN-20-06	DRMRSJ-206	31.7	26.9	34.6	31.4	22.3	24.9	21.0	29.6	30.5	**28.1**
UDN-20-07	DRMRSJ-7	33.4	32.4	35.0	31.4	18.9	32.5	22.8	40.9	21.1	**29.8**
UDN-20-08	RMM-19-18	33.4	35.9	36.2	34.7	24.9	28.9	23.8	8.5	21.1	**27.5**
UDN-20-09	DRMRSJ-271	33.5	42.0	36.4	34.7	21.9	32.9	22.3	13.3	29.7	**29.6**
UDN-20-10	DRMR 2018-37	33.0	27.0	36.7	34.7	33.2	34.0	18.6	10.5	24.2	**28.0**
UDN-20-11	DRMRSJ-22	32.9	30.9	35.6	29.9	23.1	27.4	18.7	14.6	28.9	**26.9**
UDN-20-12	DRMRSJ-302	32.2	26.2	38.0	37.7	20.9	33.2	20.3	16.8	18.5	**27.1**
UDN-20-13	DRMR 2018-41	32.8	32.9	38.0	39.2	17.9	28.1	19.1	32.4	31.9	**30.3**
UDN-20-14	DRMRSJ-4	32.8	28.4	36.9	34.7	22.1	24.2	19.0	26.3	28.2	**28.1**
UDN-20-15	DRMRSJ-159	34.6	26.0	35.2	36.2	35.9	32.2	21.5	40.2	34.6	**32.9**
UDN-20-16	DRMRSJ-312	33.5	36.2	34.7	28.3	26.9	29.6	20.9	11.6	26.4	**27.6**
UDN-20-17	DRMRSJ 25	33.9	30.9	35.3	33.2	22.3	24.9	19.8	18.1	26.2	**27.2**
UDN-20-18	DRMRSJ-19	33.4	28.1	37.3	37.7	24.5	33.9	20.7	29.8	18.7	**29.3**
UDN-20-19	DRMR 2018-17	32.4	38.3	35.0	28.3	22.3	26.6	21.0	38.2	38.9	**31.2**
UDN-20-20	DRMR 2018-19	33.2	32.4	35.6	31.6	21.9	34.6	23.2	32.3	18.2	**29.2**
UDN-20-21	DRMRSJ-349	34.4	33.5	36.7	29.9	28.5	32.5	22.1	39.1	30.0	**31.8**
UDN-20-22	DRMR 2018-1	34.2	35.9	37.1	36.3	20.4	35.3	24.9	12.6	33.4	**30.0**
UDN-20-23	DRMR 2018-23	35.4	34.0	38.8	36.2	24.5	31.4	21.8	16.2	17.8	**28.4**
UDN-20-24	DRMRSJ-361	33.1	39.9	38.3	30.0	30.7	33.9	20.9	15.9	41.9	**31.6**
UDN-20-25	DRMRQ 204	34.1	40.0	33.7	31.6	23.7	35.3	20.9	36.0	29.1	**31.6**
UDN-20-26	DRMRQ 1-2-37	33.2	13.8	37.4	31.6	32.2	32.9	19.3	37.5	28.1	**29.6**
UDN-20-27	PAB-14-7	34.0	29.7	37.4	24.7	37.9	31.4	19.9	14.8	16.9	**27.4**
UDN-20-28	PAB-14-8	35.5	27.0	35.7	24.7	35.6	27.4	21.5	40.7	13.8	**29.1**
UDN-20-29	**RL 1359 (SC)**	33.7	30.1	36.6	39.2	36.3	32.2	20.1	19.1	39.9	**31.9**
UDN-20-30	**BIOYSR (RC-WR)**	32.3	34.2	36.6	34.7	35.3	34.3	20.7	13.1	35.6	**30.8**
UDN-20-31	DRMR 2018-24	33.4	28.2	36.2	36.2	35.2	34.6	23.4	18.3	36.7	**31.4**
UDN-20-32	DRMR 2018-25	33.2	33.5	36.0	31.6	28.9	32.5	25.2	31.9	39.1	**32.4**
UDN-20-33	DRMRQ 1-22	33.8	26.7	36.0	26.4	34.2	26.9	25.8	33.6	32.3	**30.6**
UDN-20-34	PAB-14-1	36.0	0.0	37.0	28.3	37.3	32.9	21.8	13.5	17.2	**24.9**
UDN-20-35	PAB-14-18	33.9	32.0	33.7	26.4	34.6	34.0	22.0	21.3	15.8	**28.2**
UDN-20-36	PMW 18	34.2	37.4	32.9	31.6	27.3	17.4	20.0	16.4	19.7	**26.3**
UDN-20-37	**PHR 2 (TC-AB)**	33.1	38.2	35.6	29.9	28.9	33.2	20.0	33.7	14.9	**29.7**
UDN-20-38	**DLSC 1 (*Bc*)**	34.2	37.2	36.9	20.6	24.9	17.4	20.3	33.6	13.6	**26.5**
UDN-20-39	DRMR 2018-26	34.1	37.3	38.9	31.6	26.5	27.4	21.2	27.4	12.5	**28.5**
UDN-20-40	DRMR 2018-16	33.0	29.5	37.7	31.6	32.5	32.5	20.9	28.5	23.8	**30.0**
UDN-20-41	PAB-14-4	33.0	32.8	36.7	26.4	36.3	30.1	22.4	33.1	13.6	**29.4**
UDN-20-42	**Rohini (SC)**	32.1	33.0	37.8	34.7	26.9	34.3	20.7	35.0	22.6	**30.8**
UDN-20-43	**GSL 1 (*Bn*)**	26.7	25.6	38.3	24.7	27.0	16.8	20.4	16.3	14.4	**23.4**
UDN-20-44	DRMRQ 202	32.9	24.4	37.4	43.5	28.9	33.2	21.8	16.1	32.1	**30.0**
UDN-20-45	**NRCYS-5-2 (*Br*-YS)**	37.3	33.9	38.5	31.6	20.0	35.3	25.0	20.4	38.9	**31.2**
UDN-20-46	**PT 303 (*Br*-T)**	30.0	34.2	36.7	34.7	17.3	34.0	22.8	19.7	39.2	**29.8**
UDN-20-47	**WBN-1(*Br*-BS)**	34.4	38.4	36.7	20.6	28.9	16.2	21.9	37.8	21.4	**28.5**
CD (*P*=0.05)		**NS**	**6.7**	**2.9**	**5.7**	**3.5**	**4.6**	**3.5**	3.5	**-**	**-**
CV (%)		**5.8**	**10.6**	**4.0**	**8.7**	**-**	**7.6**	**8.1**	10.0	**-**	**-**

***Data of VAR excluded due to not as per the technical program**

Table 4.2.2: Reaction of oilseed Brassica germplasm against Alternaria Pod blight in Uniform Disease Nursery (natural condition)

Entries	% ABP severity (15 days before harvest)								% SR incidence			
	SHL	SGN	DOL	PNT	HSR	JHS	CHT	Mean	MOR	SGN	PNT	Mean
RMM-10-1-1	20.1	20.1	20.1	20.1	20.1	20.1	26.3	**21.0**	12.9	17.8	24.7	**18.5**
DRMRSJ 26	19.2	25.4	26.5	43.5	28.1	23.2	31.7	**28.2**	15.9	23.1	34.7	**24.6**
RMM-19-06	20.4	25.7	28.1	43.5	25.8	25.0	35.2	**29.1**	18.4	16.8	22.5	**19.2**
DRMRSJ-21	20.3	25.8	27.0	37.7	21.5	28.9	22.8	**26.3**	0.0	17.3	12.9	**10.1**
DRMRSJ-1	21.6	22.7	26.5	46.4	30.1	22.4	27.6	**28.2**	12.9	0.0	24.7	**12.5**
DRMRSJ-206	22.9	23.0	25.5	46.4	20.0	21.3	27.5	**26.7**	12.9	18.7	12.9	**14.9**
DRMRSJ-7	20.7	27.5	25.9	40.7	27.4	24.3	11.4	**25.4**	15.9	12.8	15.7	**14.8**
RMM-19-18	20.7	23.9	25.4	43.5	21.0	26.4	17.8	**25.5**	12.9	13.3	20.6	**15.6**
DRMRSJ-271	21.6	35.4	27.2	40.7	28.9	9.4	23.5	**26.7**	12.9	0.0	28.3	**13.7**
DRMR 2018-37	22.1	26.2	27.2	42.1	29.0	**7.9**	15.9	**24.4**	12.9	18.7	30.0	**20.5**
DRMRSJ-22	20.1	20.1	26.5	36.2	21.5	10.0	18.2	**21.8**	0.0	17.6	33.1	**16.9**
DRMRSJ-302	20.6	25.9	29.0	43.5	28.1	10.2	13.2	**24.4**	24.7	18.7	36.2	**26.6**
DRMR 2018-41	22.1	20.2	29.0	40.7	23.3	25.0	27.7	**26.8**	0.0	11.4	31.6	**14.3**
DRMRSJ-4	21.1	23.0	26.5	42.1	20.5	20.1	28.2	**25.9**	0.0	12.2	31.6	**14.6**
DRMRSJ-159	21.8	21.0	25.9	45.0	28.9	25.0	31.2	**28.4**	0.0	12.1	42.1	**18.1**
DRMRSJ-312	20.1	29.7	25.4	37.7	25.8	8.6	25.1	**24.6**	15.9	23.1	26.6	**21.9**
DRMRSJ 25	21.3	21.4	25.7	40.7	21.0	10.5	21.1	**23.1**	0.0	0.0	26.4	**8.8**
DRMRSJ-19	21.9	20.5	28.6	40.7	28.1	24.0	13.9	**25.4**	0.0	19.6	18.4	**12.7**
DRMR 2018-17	19.4	26.5	25.1	36.2	22.4	25.9	31.2	**26.7**	28.3	18.6	36.3	**27.7**
DRMR 2018-19	19.9	23.6	25.1	42.1	31.1	22.8	14.8	**25.6**	18.4	17.8	37.7	**24.6**
DRMRSJ-349	21.0	23.9	27.8	40.7	28.9	32.2	25.8	**28.6**	33.2	30.0	37.7	**33.7**
DRMR 2018-1	21.2	24.2	27.6	39.2	28.1	8.7	26.4	**25.1**	28.3	20.7	28.3	**25.8**
DRMR 2018-23	20.6	24.4	29.3	43.5	30.1	13.4	10.3	**24.5**	22.8	16.3	37.7	**25.6**
DRMRSJ-361	21.5	25.9	29.8	40.7	29.6	12.7	34.6	**27.8**	0.0	11.4	18.4	**9.9**
DRMRQ 204	20.5	24.1	23.2	42.1	32.5	33.0	21.7	**28.1**	12.9	23.8	29.9	**22.2**
DRMRQ 1-2-37	22.4	0.0	27.9	42.1	27.4	31.8	18.0	**24.2**	12.9	25.8	28.0	**22.2**
PAB-14-7	21.3	21.9	27.9	31.6	28.9	9.2	11.4	**21.8**	0.0	0.0	15.7	**5.2**
PAB-14-8	21.2	22.6	25.7	29.9	20.5	29.3	0.0	**21.3**	0.0	19.5	28.0	**15.8**
RL 1359 (SC)	20.1	27.3	26.8	42.1	28.1	13.2	36.1	**27.7**	12.9	16.3	20.6	**16.6**
BIOYSR (RC-WR)	20.5	26.7	27.4	40.7	30.1	10.3	30.2	**26.6**	0.0	16.7	12.9	**9.9**
DRMR 2018-24	20.2	25.2	25.6	42.1	31.4	21.0	31.6	**28.2**	12.9	23.1	20.6	**18.9**
DRMR 2018-25	21.5	19.5	25.8	40.7	28.9	21.1	34.3	**27.4**	0.0	12.8	43.5	**18.7**
DRMRQ 1-22	21.0	23.7	25.8	36.2	24.2	28.4	26.5	**26.5**	0.0	33.8	37.7	**23.8**
PAB-14-1	21.6	0.0	27.1	31.6	28.1	9.5	11.7	**18.5**	0.0	36.3	20.6	**19.0**
PAB-14-18	21.1	21.9	24.1	31.6	29.6	17.3	13.8	**22.8**	0.0	21.7	24.7	**15.4**
PMW 18	21.4	19.2	22.4	34.7	15.0	19.7	8.7	**20.2**	0.0	43.1	42.1	**28.4**
PHR 2 (TC-AB)	22.1	29.7	25.5	31.6	27.4	22.5	6.0	**23.6**	0.0	26.0	20.6	**15.5**
DLSC 1 (*Bc*)	20.4	30.6	26.4	24.7	12.9	22.8	0.0	**19.7**	0.0	14.1	29.9	**14.6**
DRMR 2018-26	21.5	22.2	29.4	40.7	23.3	22.3	11.4	**24.4**	22.8	19.3	33.1	**25.1**
DRMR 2018-16	20.1	24.0	29.3	37.7	27.4	22.0	18.9	**25.6**	24.7	30.0	33.1	**29.3**
PAB-14-4	19.6	25.2	27.6	29.9	28.1	26.8	0.0	**22.4**	18.4	12.6	24.7	**18.6**
Rohini (SC)	20.2	24.9	25.8	37.7	30.1	26.5	23.8	**27.0**	24.7	27.7	42.1	**31.5**
GSL 1 (*Bn*)	19.2	22.5	28.7	40.7	12.9	12.9	15.0	**21.7**	0.0	0.0	31.6	**10.5**
DRMRQ 202	21.7	23.5	25.8	49.3	28.9	13.3	26.5	**27.0**	0.0	0.0	15.7	**5.2**
NRCYS-5-2 (*Br*-YS)	24.7	25.2	29.6	42.1	32.5	18.2	28.9	**28.7**	67.2	19.6	39.2	**42.0**
PT 303 (*Br*-T)	20.1	27.3	27.1	45.0	29.6	18.3	24.7	**27.5**	18.4	13.0	31.6	**21.0**
WBN-1(*Br*-BS)	20.6	24.6	27.1	34.7	15.0	29.0	15.3	**23.8**	18.4	18.3	40.6	**25.8**
CD (*P*=0.05)	**NS**	**4.8**	**3.2**	**5.3**	**5.6**	3.7	-	-	**7.5**	**4.5**	**8.4**	-
CV (%)	**6.3**	**10.2**	**5.9**	**6.6**	**10.8**	11.4	-	-	**29.6**	**12.7**	**14.6**	-

Table 4.2.3: Reaction of oilseed Brassica germplasm to WR, PM and DM under UDN (natural condition)

Entries	% WR severity (75 DAS)							%Stage head (100 DAS)				% DM severity (20 DAS)	% PM severity (100 DAS)		
	MOR	SGN	PNT	NDH	LDH	CHT	Mean	MOR	PNT	HSR	Mean	PNT	SKN	JHS	Mean
RMM-10-1-1	37.6	26.1	26.4	19.4	14.2	37.9	**26.9**	32.2	20.6	33.2	**28.7**	28.3	71.5	26.3	**48.9**
DRMRSJ 26	18.4	29.0	36.2	0.0	12.8	18.0	**19.1**	0.0	22.8	12.3	**11.7**	15.7	71.5	29.6	**50.5**
RMM-19-06	27.2	20.4	28.3	0.0	13.1	37.1	**21.0**	16.8	24.7	16.8	**19.4**	24.7	67.5	31.8	**49.6**
DRMRSJ-21	18.4	20.0	34.7	0.0	16.8	35.3	**20.9**	0.0	18.4	22.4	**13.6**	22.5	71.5	26.8	**49.1**
DRMRSJ-1	3.6	25.7	34.7	20.9	12.6	37.4	**22.5**	0.0	20.6	12.3	**11.0**	43.5	71.5	17.5	**44.5**
DRMRSJ-206	3.6	35.3	9.0	21.9	11.6	24.7	**17.7**	0.0	12.9	0.0	**4.3**	49.3	71.5	25.8	**48.6**
DRMRSJ-7	20.8	27.9	15.7	24.9	15.4	18.0	**20.4**	0.0	15.7	9.6	**8.4**	36.2	71.5	28.9	**50.2**
RMM-19-18	26.2	27.7	22.8	0.0	14.5	29.9	**20.2**	18.4	20.6	30.1	**23.0**	40.7	71.5	14.2	**42.8**
DRMRSJ-271	2.6	28.6	15.7	18.9	11.8	15.8	**15.6**	0.0	18.4	0.0	**6.1**	28.3	71.5	11.4	**41.5**
DRMR 2018-37	3.8	19.3	20.6	14.3	14.0	5.7	**13.0**	0.0	15.7	0.0	**5.2**	36.2	76.7	17.9	**47.3**
DRMRSJ-22	22.5	25.1	22.8	0.0	10.3	23.2	**17.3**	18.4	20.6	12.9	**17.3**	20.6	71.5	22.7	**47.1**
DRMRSJ-302	29.9	23.7	36.2	0.0	14.6	35.9	**23.4**	16.8	24.7	17.4	**19.6**	24.7	64.2	22.6	**43.4**
DRMR 2018-41	2.6	30.5	12.9	15.0	15.0	23.9	**16.6**	0.0	0.0	7.5	**2.5**	22.5	67.5	24.2	**45.9**
DRMRSJ-4	0.0	28.3	15.7	0.0	12.8	0.0	**9.5**	0.0	12.9	0.0	**4.3**	15.7	67.5	18.7	**43.1**
DRMRSJ-159	23.6	23.9	20.6	0.0	4.3	10.9	**13.9**	0.0	12.9	18.4	**10.4**	37.7	70.2	27.8	**49.0**
DRMRSJ-312	3.6	32.1	19.7	21.4	12.2	21.4	**18.4**	0.0	18.4	16.8	**11.7**	49.3	80.8	28.0	**54.4**
DRMRSJ 25	0.0	31.5	36.2	0.0	12.1	23.2	**17.2**	0.0	20.6	12.9	**11.2**	20.6	64.2	23.4	**43.8**
DRMRSJ-19	4.6	25.1	26.6	0.0	11.4	9.8	**12.9**	0.0	20.6	9.6	**10.1**	31.6	80.8	19.8	**50.3**
DRMR 2018-17	36.1	24.7	20.6	0.0	13.0	40.5	**22.5**	34.2	15.7	35.3	**28.4**	24.7	67.5	29.9	**48.7**
DRMR 2018-19	2.6	29.0	31.6	15.6	13.9	0.0	**15.4**	0.0	20.6	21.0	**13.9**	29.9	67.5	28.7	**48.1**
DRMRSJ-349	2.6	29.8	15.7	14.3	4.6	34.3	**16.9**	0.0	15.7	0.0	**5.2**	24.7	80.8	26.5	**53.6**
DRMR 2018-1	3.6	39.1	12.9	20.0	5.3	26.4	**17.9**	0.0	15.7	0.0	**5.2**	29.9	71.5	25.9	**48.7**
DRMR 2018-23	0.0	28.9	34.7	22.3	12.5	27.4	**21.0**	0.0	20.6	7.5	**9.4**	36.2	80.8	21.1	**50.9**
DRMRSJ-361	2.6	16.8	28.3	12.9	6.2	31.1	**16.3**	0.0	12.9	0.0	**4.3**	31.6	67.5	28.0	**47.7**
DRMRQ 204	3.6	34.3	4.1	21.4	14.3	0.0	**12.9**	0.0	0.0	0.0	**0.0**	28.3	60.1	33.0	**46.5**
DRMRQ 1-2-37	2.6	22.8	2.0	20.4	5.9	0.0	**9.0**	0.0	0.0	0.0	**0.0**	31.6	56.8	25.9	**41.3**
PAB-14-7	3.8	0.0	12.9	26.6	0.0	15.5	**9.8**	0.0	15.7	33.2	**16.3**	37.7	71.5	12.5	**42.0**
PAB-14-8	3.8	0.0	24.7	28.8	0.0	0.0	**9.6**	0.0	20.6	0.0	**6.9**	15.7	67.5	20.9	**44.2**
RL 1359 (SC)	26.0	24.4	39.2	30.3	4.6	36.5	**26.8**	12.9	24.7	38.6	**25.4**	0.0	71.5	25.3	**48.4**
BIOYSR (RC-WR)	24.1	28.7	22.5	27.3	5.2	20.0	**21.3**	12.9	18.4	0.0	**10.4**	0.0	71.5	23.0	**47.2**
DRMR 2018-24	5.4	23.9	29.9	24.0	11.0	36.3	**21.8**	0.0	20.6	7.5	**9.4**	45.0	71.5	24.1	**47.8**
DRMR 2018-25	0.0	13.9	0.0	21.9	0.0	12.3	**8.0**	0.0	0.0	0.0	**0.0**	55.4	71.5	25.5	**48.5**
DRMRQ 1-22	0.0	26.4	0.0	18.9	0.0	0.0	**7.5**	0.0	0.0	0.0	**0.0**	34.7	63.4	20.1	**41.7**
PAB-14-1	4.6	0.0	15.7	36.6	0.0	23.5	**13.4**	0.0	22.8	0.0	**7.6**	37.7	65.3	16.5	**40.9**
PAB-14-18	2.6	0.0	20.6	46.3	0.0	27.8	**16.2**	0.0	15.7	39.9	**18.5**	15.7	69.4	13.5	**41.4**
PMW 18	0.0	21.2	2.0	25.7	0.0	9.3	**9.7**	0.0	12.9	0.0	**4.3**	0.0	52.2	11.9	**32.0**
PHR 2 (TC-AB)	3.6	26.9	24.7	35.9	6.1	33.7	**21.8**	0.0	24.7	40.5	**21.7**	28.3	71.5	18.3	**44.9**
DLSC 1 (*Bc*)	0.0	21.2	0.0	0.0	0.0	8.7	**5.0**	0.0	0.0	0.0	**0.0**	0.0	22.5	19.2	**20.8**
DRMR 2018-26	21.0	22.8	22.5	24.5	9.8	31.2	**22.0**	16.8	12.9	38.6	**22.8**	0.0	64.2	13.7	**39.0**
DRMR 2018-16	27.8	33.8	36.2	31.1	13.1	39.5	**30.2**	22.8	28.3	39.2	**30.1**	17.8	64.2	12.4	**38.3**
PAB-14-4	33.7	38.8	26.6	32.5	12.8	30.1	**29.1**	24.1	15.7	34.6	**24.8**	31.6	71.5	13.6	**42.6**
Rohini (SC)	39.7	21.4	29.9	26.9	14.4	39.9	**28.7**	35.3	20.6	42.5	**32.8**	34.7	67.5	20.6	**44.0**
GSL 1 (*Bn*)	0.0	0.0	0.0	21.4	0.0	0.0	**3.6**	0.0	0.0	0.0	**0.0**	0.0	9.2	28.7	**19.0**
DRMRQ 202	2.6	0.0	12.9	0.0	4.8	0.0	**3.4**	0.0	12.9	0.0	**4.3**	55.2	64.2	27.8	**46.0**
NRCYS-5-2 (*Br*-YS)	3.6	0.0	26.6	19.4	0.0	36.3	**14.3**	0.0	22.8	0.0	**7.6**	20.6	57.1	25.7	**41.4**
PT 303 (*Br*-T)	2.6	42.9	12.9	0.0	0.0	0.0	**9.7**	0.0	15.7	0.0	**5.2**	15.7	56.8	23.9	**40.3**
WBN-1(*Br*-BS)	2.6	43.7	0.0	17.2	0.0	0.0	**10.6**	0.0	0.0	0.0	**0.0**	0.0	46.5	28.0	**37.3**
CD(*P*=0.05)	**6.0**	**5.3**	**6.5**	**3.5**	**6.7**	-	-	**4.4**	**5.4**	**5.0**	**-**	**6.0**	**14.3**	**5.8**	**-**
CV (%)	**25.0**	**11.3**	**15.6**	**-**	**40.1**	-	-	**33.0**	**16.2**	**13.2**	**-**	**11.4**	**10.7**	**22.9**	**-**

***Data of JAG (WR), SGN (SH), JHS (WR, SH,DM), MOR (PM) and CHT (SH, SR) are not included as the disease severity/incidence was <20% in SC**

Table 4.3.1: Reaction of oilseed Brassica germplasm against AB in NDN for Alternaria blight (artificial condition)

Code No.	Entries	% ABL severity (90 DAS)						% ABP (15 days before harvest)					
		SHL	DOL	PNT	HSR	CHT	Mean	SHL	DOL	PNT	HSR	CHT	Mean
NDN-20-01	DRMRSJ-1	33.2	35.2	34.7	24.9	45.57	**34.7**	22.2	26.7	39.2	21.0	37.1	29.3
NDN-20-02	DRMRSJ-19	33.0	35.2	37.7	32.5	39.70	**35.6**	23.6	26.7	43.5	27.4	31.4	30.5
NDN-20-03	DRMRSJ-26	34.3	39.1	39.2	29.6	42.88	**37.0**	24.6	31.3	43.5	25.8	39.1	32.9
NDN-20-04	DRMRSJ-271	32.5	39.2	36.2	18.4	36.27	**32.5**	23.9	31.4	40.7	15.0	28.7	27.9
NDN-20-05	DRMRSJ-349	33.3	39.2	26.4	30.1	30.26	**31.8**	20.5	31.4	34.7	28.1	20.5	27.1
NDN-20-06	DRMRSJ-4	32.9	35.6	34.7	32.5	37.41	**34.6**	22.0	27.1	40.7	27.4	29.9	29.4
NDN-20-07	DRMRSJ-159	34.1	35.6	36.2	34.0	41.90	**36.4**	23.8	27.1	45.0	29.6	35.9	32.3
NDN-20-08	DRMRSJ-361	32.2	39.9	34.7	36.6	38.41	**36.4**	21.0	32.1	40.7	32.9	29.3	31.2
NDN-20-09	DRMRSJ-302	32.7	39.9	39.2	35.3	38.00	**37.0**	21.7	32.1	34.7	32.5	29.3	30.1
NDN-20-10	DRMRSJ-7	33.3	41.5	36.2	32.5	37.47	**36.2**	22.1	34.3	37.7	26.9	29.8	30.2
NDN-20-11	DRMRSJ-206	32.5	40.7	28.3	25.8	37.41	**32.9**	20.2	34.0	39.2	24.2	33.0	30.1
NDN-20-12	DRMR 2018-23	33.3	41.8	39.2	32.2	34.02	**36.1**	22.1	34.1	43.5	28.1	26.0	30.8
NDN-20-13	DRMR 2018-41	32.5	39.9	34.7	33.2	38.00	**35.7**	19.9	32.7	40.7	28.9	31.3	30.7
NDN-20-14	DRMRSJ-21	27.4	39.9	36.3	32.5	31.18	**33.5**	18.6	32.7	37.7	27.4	21.0	27.5
NDN-20-15	DRMRM-163	30.5	39.9	37.7	34.0	30.79	**34.6**	20.7	31.4	43.5	29.6	21.6	29.4
NDN-20-16	DRMR 2018-19	32.5	38.3	29.9	26.6	35.30	**32.5**	20.2	31.4	40.7	21.5	29.3	28.6
NDN-20-17	DRMRSJ-25	33.8	40.7	34.7	32.9	33.77	**35.2**	22.6	32.9	43.5	28.1	24.3	30.3
NDN-20-18	DRMRSJ-312	33.1	37.9	29.9	31.1	28.25	**32.0**	21.7	32.5	34.7	26.9	17.9	26.7
NDN-20-19	DRMR 2018-17	32.7	40.7	28.3	32.2	35.55	**33.9**	21.7	32.5	37.7	28.9	28.0	29.8
NDN-20-20	DRMRM-177	34.2	39.6	33.1	34.3	27.97	**33.9**	21.8	31.1	37.7	30.1	16.9	27.5
NDN-20-21	DRMRSJ-22	33.3	39.6	29.9	29.6	29.93	**32.5**	21.1	31.1	34.7	25.8	22.5	27.0
NDN-20-22	DRMR 2018-37	34.0	39.1	37.7	33.2	32.71	**35.3**	22.6	31.4	40.7	28.9	25.9	29.9
NDN-20-23	DRMR 2018-1	33.3	37.4	37.7	36.0	48.39	**38.6**	21.5	29.0	40.7	31.1	41.2	32.7
NDN-20-24	PAB-17-18	32.0	36.3	36.2	32.5	15.45	**30.5**	20.6	27.9	39.2	26.9	0.0	22.9
NDN-20-25	**PT 303 (BrT)**	34.5	37.1	33.1	35.3	44.46	**36.9**	23.8	27.9	47.9	32.5	38.4	34.1
NDN-20-26	**RL 1359 (SC)**	34.2	37.1	40.7	34.0	30.40	**35.3**	22.8	28.5	34.7	29.6	21.4	27.4
NDN-20-27	DRMR 2018-24	32.5	36.0	43.5	34.6	30.46	**35.4**	21.7	27.6	36.2	31.4	18.8	27.1
NDN-20-28	RMM-19-18	34.5	41.0	39.1	33.2	34.82	**36.5**	22.2	33.2	45.0	29.6	28.6	31.7
NDN-20-29	DRMR 2018-26	33.4	39.2	42.1	34.3	39.76	**37.8**	22.1	30.9	40.7	28.9	33.9	31.3
NDN-20-30	**NRCYS-5-2 (BrYS)**	38.3	39.2	42.1	34.6	46.95	**40.2**	24.3	30.9	53.8	31.1	41.8	36.4
NDN-20-31	RMM-19-06	31.9	40.2	37.7	34.0	39.11	**36.6**	22.8	32.4	43.5	28.9	30.1	31.5
NDN-20-32	**BIOYSR (RC-WR)**	33.3	42.0	40.7	36.6	22.79	**35.1**	21.3	34.3	47.9	31.1	6.8	28.3
NDN-20-33	NPJ 247	32.7	39.1	40.7	31.1	26.35	**34.0**	19.7	29.7	43.5	26.6	14.4	26.8
NDN-20-34	DRMR 2018-16	34.2	39.1	37.7	33.9	40.16	**37.0**	21.6	29.7	42.1	31.4	33.2	31.6
NDN-20-35	PAB-17-22	33.2	37.1	34.7	30.1	14.77	**30.0**	21.6	28.3	37.7	28.1	0.0	23.1
NDN-20-36	**DLSC 1 (Bc)**	25.2	38.2	28.3	16.2	11.54	**23.9**	18.5	29.7	31.6	15.0	3.6	19.7
NDN-20-37	PAB-17-20	33.7	37.0	34.7	32.2	17.76	**31.1**	21.4	28.3	33.1	28.9	10.5	24.4
NDN-20-38	PAB-17-23	34.5	37.0	24.7	24.9	12.52	**26.7**	20.7	28.3	28.3	21.0	6.0	20.9
NDN-20-39	**PHR 2 (TC-AB)**	35.0	36.3	37.7	32.5	18.05	**31.9**	21.2	28.3	34.7	26.9	7.9	23.8
NDN-20-40	PMW 18	33.7	42.0	42.1	26.9	34.27	**35.8**	21.6	33.7	31.6	24.9	25.7	27.5
NDN-20-41	PAB-17-15	32.8	42.0	24.7	35.3	13.44	**29.6**	20.8	33.7	47.9	32.5	7.9	28.5
NDN-20-42	**WBN-1(Br-BS)**	26.5	40.1	24.7	16.8	11.97	**24.0**	19.5	33.2	42.1	12.9	10.8	23.7
NDN-20-43	DRMR 2018-25	34.6	38.6	40.7	36.6	28.73	**35.8**	20.3	31.3	47.9	32.9	15.9	29.6
NDN-20-44	**GSL 1(B*n*)**	24.1	38.6	36.3	17.4	32.71	**29.8**	18.3	30.6	40.7	15.0	26.4	26.2
NDN-20-45	**Rohini (SC)**	34.6	42.8	37.7	30.1	33.83	**35.8**	21.0	34.9	43.5	25.8	28.1	30.7
CD(*P*=0.05)		**4.5**	**3.7**	**5.2**	**4.7**	-	**-**	**NS**	**3.8**	**4.8**	**5.0**	-	
CV (%)		**6.7**	**4.7**	**7.3**	**7.5**	-	**-**	**8.0**	**6.0**	**5.9**	**9.1**	-	

***Data of LDH not included as disease severity was < 20% in SC**
Data of VAR excluded due to not submitted as per technical programme

Table 4.3.2: Reaction of oilseed Brassica germplasm against WR, DM, PM & SR in NDN for Alternaria blight (natural condition)

Entries	% WR severity (75 DAS)					% SH			% SR
	MOR	PNT	HSR	CHT	Mean	MOR	CHT	Mean	MOR
DRMRSJ-1	21.4	31.6	16.2	25.6	**23.7**	10.5	13.6	**12.0**	26.6
DRMRSJ-19	17.4	36.2	23.3	19.2	**24.0**	0.0	9.6	**4.8**	15.9
DRMRSJ-26	3.6	36.2	33.2	20.4	**23.4**	0.0	7.5	**3.7**	26.6
DRMRSJ-271	5.4	28.3	0.0	11.2	**11.2**	0.0	0.0	**0.0**	12.9
DRMRSJ-349	3.6	20.6	24.2	13.2	**15.4**	0.0	0.0	**0.0**	15.9
DRMRSJ-4	0.0	28.3	0.0	0.0	**7.1**	0.0	0.0	**0.0**	20.7
DRMRSJ-159	19.2	26.4	19.0	38.9	**25.9**	0.0	22.6	**11.3**	15.9
DRMRSJ-361	13.6	15.7	23.3	20.5	**18.3**	0.0	9.8	**4.9**	18.4
DRMRSJ-302	25.6	43.5	39.9	10.0	**29.7**	10.5	0.0	**5.3**	22.8
DRMRSJ-7	4.6	36.2	0.0	0.0	**10.2**	0.0	0.0	**0.0**	22.8
DRMRSJ-206	21.4	2.0	18.4	30.3	**18.0**	0.0	16.0	**8.0**	18.4
DRMR 2018-23	0.0	36.2	28.1	0.0	**16.1**	0.0	11.2	**5.6**	56.8
DRMR 2018-41	9.4	11.2	0.0	14.5	**8.8**	0.0	0.0	**0.0**	15.9
DRMRSJ-21	16.2	24.2	30.1	33.4	**26.0**	0.0	13.6	**6.8**	22.8
DRMRM-163	25.4	36.3	35.3	39.4	**34.1**	0.0	22.1	**11.1**	34.8
DRMR 2018-19	4.6	29.9	0.0	5.7	**10.1**	0.0	0.0	**0.0**	15.9
DRMRSJ-25	2.6	29.9	24.2	18.1	**18.7**	0.0	8.3	**4.2**	18.4
DRMRSJ-312	22.5	12.9	33.2	7.5	**19.0**	0.0	0.0	**0.0**	18.4
DRMR 2018-17	22.9	28.3	38.6	18.7	**27.1**	10.5	7.5	**9.0**	26.6
DRMRM-177	27.2	36.3	40.5	39.6	**35.9**	12.9	22.2	**17.6**	40.7
DRMRSJ-22	20.4	33.2	16.8	27.2	**24.4**	0.0	12.0	**6.0**	37.8
DRMR 2018-37	0.0	9.3	0.0	7.3	**4.1**	0.0	0.0	**0.0**	24.7
DRMR 2018-1	2.6	9.3	0.0	0.0	**3.0**	0.0	0.0	**0.0**	15.9
PAB-17-18	24.1	37.7	34.0	9.5	**26.3**	7.4	0.0	**3.7**	22.8
PT 303 (BrT)	3.8	0.0	0.0	0.0	**1.0**	0.0	0.0	**0.0**	77.1
RL 1359 (SC)	33.4	52.3	42.5	33.8	**40.5**	32.2	21.1	**26.6**	20.7
DRMR 2018-24	2.6	29.9	30.1	32.0	**23.6**	0.0	18.2	**9.1**	28.3
RMM-19-18	28.3	39.2	41.2	38.8	**36.9**	30.0	22.3	**26.1**	22.8
DRMR 2018-26	24.1	28.3	33.2	34.9	**30.1**	7.4	6.0	**6.7**	26.6
NRCYS-5-2 (BrYS)	4.6	12.9	0.0	29.9	**11.9**	0.0	15.8	**7.9**	61.7
RMM-19-06	14.4	22.5	20.5	9.5	**16.7**	0.0	0.0	**0.0**	22.8
BIOYSR (RC-WR)	21.6	33.1	0.0	21.8	**19.1**	0.0	8.3	**4.2**	30.0
NPJ 247	33.4	37.7	38.6	34.3	**36.0**	16.8	9.5	**13.1**	12.9
DRMR 2018-16	33.9	39.2	41.2	38.2	**38.1**	10.5	22.2	**16.4**	30.0
PAB-17-22	12.5	28.3	33.2	7.9	**20.5**	0.0	0.0	**0.0**	12.9
DLSC 1 (Bc)	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0
PAB-17-20	15.9	50.8	43.1	15.8	**31.4**	0.0	0.0	**0.0**	24.7
PAB-17-23	7.2	40.7	12.9	6.0	**16.7**	0.0	0.0	**0.0**	18.4
PHR 2 (TC-AB)	23.0	26.6	42.5	10.0	**25.5**	0.0	0.0	**0.0**	12.9
PMW 18	0.0	2.0	0.0	0.0	**0.5**	0.0	0.0	**0.0**	0.0
PAB-17-15	5.4	15.7	12.3	6.0	**9.9**	0.0	0.0	**0.0**	0.0
WBN-1(Br-BS)	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0
DRMR 2018-25	2.6	0.0	0.0	0.0	**0.6**	0.0	0.0	**0.0**	20.7
GSL 1(Bn)	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0
Rohini (SC)	39.6	22.8	44.4	39.1	**36.5**	40.2	21.1	**30.7**	77.1
CD (*P*=0.05)	**5.7**	**7.8**	**4.1**	-	-	**5.1**	-	-	**10.2**
CV (%)	**19.4**	**15.7**	**9.3**	-	-	**47.7**	-	-	**20.8**

***Data of LDH (WR, SR), PNT (SH, PM, SR), CHT (SH, SR) and MOR (PM) are not included as the disease severity/incidence was < 20% in SC**

Table 4.4.1: Reaction of oilseed Brassica germplasm against AB in NDN for White Rust (natural condition)

Code No	Entries	% AB severity (90 DAS)*			% ABP severity		
		PNT	HSR	Mean	PNT	HSR	Mean
NDN-20-46	DRMRSJ-7	45.0	33.9	**39.4**	40.7	28.1	**34.4**
NDN-20-47	DRMRDJ-1	39.2	31.1	**35.1**	34.7	26.9	**30.8**
NDN-20-48	DRMRCI 125	36.2	32.9	**34.6**	31.6	27.4	**29.5**
NDN-20-49	DRMRCI 132	40.7	33.2	**36.9**	34.7	29.6	**32.2**
NDN-20-50	DRMRSJ-21	33.1	30.1	**31.6**	24.7	25.8	**25.2**
NDN-20-51	DRMRSJ-159	33.2	32.5	**32.8**	24.7	23.3	**24.0**
NDN-20-52	DRMRSJ-1	36.2	32.2	**34.2**	24.7	26.9	**25.8**
NDN-20-53	DRMRDJ-3	36.2	34.6	**35.4**	29.9	28.9	**29.4**
NDN-20-54	DRMRCI 131	39.2	32.5	**35.8**	42.1	24.9	**33.5**
NDN-20-55	DRMRSJ-312	29.9	32.9	**31.4**	31.6	25.8	**28.7**
NDN-20-56	DRMRSJ-25	33.1	35.3	**34.2**	36.2	27.4	**31.8**
NDN-20-57	DRMRSJ-4	31.6	26.6	**29.1**	34.7	24.2	**29.5**
NDN-20-58	DRMRCI 139	31.6	31.1	**31.3**	28.3	24.9	**26.6**
NDN-20-59	DRMRSJ-271	34.7	32.2	**33.5**	28.3	25.8	**27.0**
NDN-20-60	DRMR-5206	33.1	28.9	**31.0**	31.6	23.3	**27.4**
NDN-20-61	DRMRSJ-19	39.2	23.3	**31.2**	31.6	20.5	**26.0**
NDN-20-62	DRMRSJ-22	26.4	25.8	**26.1**	29.9	20.5	**25.2**
NDN-20-63	DRMRSJ-26	28.3	30.1	**29.2**	31.6	22.4	**27.0**
NDN-20-64	DRMR 2018-37	36.2	37.9	**37.1**	31.6	26.6	**29.1**
NDN-20-65	DRMRSJ-361	33.1	32.5	**32.8**	37.7	24.9	**31.3**
NDN-20-66	DRMRCI 126	36.2	29.6	**32.9**	31.6	21.5	**26.5**
NDN-20-67	DRMRSJ-206	39.2	25.8	**32.5**	34.7	20.0	**27.4**
NDN-20-68	DRMRSJ-302	36.2	27.4	**31.8**	31.6	21.0	**26.3**
NDN-20-69	DRMRSJ-349	31.6	33.2	**32.4**	36.2	29.6	**32.9**
NDN-20-70	DRMRM 18-37-13	31.6	34.0	**32.8**	36.2	28.9	**32.6**
NDN-20-71	DRMR 2018-23	31.6	32.5	**32.0**	24.7	24.2	**24.4**
NDN-20-72	DRMRM 18-35-11	34.7	30.1	**32.4**	36.2	24.9	**30.6**
NDN-20-73	DRMR 2018-25	29.9	28.1	**29.0**	31.6	23.3	**27.4**
NDN-20-74	DRMR 2018-1	34.7	35.3	**35.0**	28.3	25.8	**27.0**
NDN-20-75	DRMR 2018-19	33.1	26.6	**29.9**	31.6	20.5	**26.0**
NDN-20-76	DRMRM 18-36-12	31.6	28.9	**30.2**	36.2	21.5	**28.9**
NDN-20-77	DRMR 2018-41	37.7	34.6	**36.2**	28.3	25.8	**27.0**
NDN-20-78	DRMR 2018-17	33.1	29.6	**31.4**	36.2	21.0	**28.6**
NDN-20-79	DRMR 2018-26	36.2	27.4	**31.8**	28.3	24.2	**26.2**
NDN-20-80	NPJ 247	39.2	26.9	**33.0**	33.1	22.4	**27.8**
NDN-20-81	RH- 1700	31.6	25.8	**28.7**	33.1	21.5	**27.3**
NDN-20-82	RH- 1700-3	36.2	28.9	**32.6**	29.9	24.9	**27.4**
NDN-20-83	PRD-14-4	33.1	32.5	**32.8**	28.3	23.3	**25.8**
NDN-20-84	RH 1400	31.6	26.9	**29.2**	28.3	24.2	**26.2**
NDN-20-85	RH- 1700-4	33.1	33.9	**33.5**	28.3	25.8	**27.0**
NDN-20-86	PRD-14-23	31.6	33.2	**32.4**	31.6	31.1	**31.3**
NDN-20-87	RMM-19-18	33.1	30.1	**31.6**	33.1	28.1	**30.6**
NDN-20-88	PJK (A4A5)-21	28.3	32.5	**30.4**	24.7	26.9	**25.8**
NDN-20-89	RH 1400-1	39.2	36.0	**37.6**	28.3	31.1	**29.7**
NDN-20-90	RH- 1700-1	36.2	32.9	**34.6**	31.6	28.1	**29.8**
NDN-20-91	DRMR 2018-24	37.7	36.6	**37.2**	24.7	32.9	**28.8**
NDN-20-92	PWR-13-8	29.9	33.2	**31.5**	33.1	30.1	**31.6**
NDN-20-93	RMM-19-06	33.1	34.6	**33.9**	31.6	27.4	**29.5**
NDN-20-94	**BIOYSR (RC-WR)**	43.5	32.2	**37.9**	34.7	28.9	**31.8**
NDN-20-95	**PT 303 (B*r*-T)**	42.1	28.9	**35.5**	46.4	24.2	**35.3**
NDN-20-96	Rohini (A4A5)-491	40.7	30.1	**35.4**	31.6	24.9	**28.2**
NDN-20-97	Rohini (Parent)	36.2	32.2	**34.2**	39.2	29.6	**34.4**
NDN-20-98	**DLSC 1 (Bc)**	26.4	15.0	**20.7**	31.6	12.9	**22.2**
NDN-20-99	RH- 1700-2	36.2	31.1	**33.7**	39.2	26.6	**32.9**
NDN-20-100	**PHR 2 (TC-AB)**	45.0	35.3	**40.1**	26.4	32.5	**29.4**
NDN-20-101	**NRCYS-5-2 (B*r*-YS)**	43.5	33.2	**38.4**	60.1	29.6	**44.8**
NDN-20-102	PRD14-27	37.7	34.0	**35.9**	28.3	28.9	**28.6**
NDN-20-103	PB (A4A5)-842	33.1	30.1	**31.6**	34.7	24.2	**29.5**
NDN-20-104	Varuna (A4A5)-936-279	33.1	32.5	**32.8**	28.3	26.9	**27.6**
NDN-20-105	Pusa Bold (Parent)	31.6	32.9	**32.2**	36.2	28.1	**32.2**
NDN-20-106	**Rohini (SC)**	34.7	31.1	**32.9**	28.3	26.6	**27.4**
NDN-20-107	**GSL 1 (Bn)**	33.1	15.7	**24.4**	31.6	12.9	**22.2**
NDN-20-108	**RL 1359 (SC)**	33.1	31.1	**32.1**	31.6	26.6	**29.1**
NDN-20-109	Pusa Jaikisan (Parent)	33.2	32.2	**32.7**	33.2	28.9	**31.0**
NDN-20-110	**WBN-1(B*r*-BS)**	33.1	16.8	**25.0**	37.7	15.7	**26.7**
NDN-20-111	PMW 18	39.2	25.8	**32.5**	34.7	24.2	**29.5**
NDN-20-112	Varuna (Parent)	33.1	30.1	**31.6**	31.6	28.1	**29.8**
NDN-20-113	DRMR 2018-16	37.7	33.2	**35.4**	37.7	29.6	**33.7**
CD(*P*=0.05)		**4.4**	**4.8**	**-**	**3.9**	**4.8**	**-**
CV (%)		**6.3**	**7.9**	**-**	**5.9**	**9.4**	**-**

***Data of LDH not included as disease severity was < 20% in SC**

Table 4.4.2: Reaction of oilseed Brassica germplasm to WR (artificial condition), DM, PM & SR (natural condition) NDN for White Rust

Entries	% WR servrity on leaf (100 DAS)*						% Staghead incidence			% DM (20 DAS)	% SR incidence*		
	MOR	PNT	HSR	LDH	BPR	Mean	MOR	PNT	Mean	PNT	MOR	PNT	Mean
DRMRSJ-7	0.0	18.4	9.6	0.0	0.0	**5.6**	0.0	15.7	**7.8**	60.1	12.9	15.7	**14.3**
DRMRDJ-1	3.6	22.8	20.5	12.2	21.9	**16.2**	0.0	18.4	**9.2**	49.3	22.8	39.2	**31.0**
DRMRCI 125	4.6	2.0	0.0	10.1	0.0	**3.4**	0.0	0.0	**0.0**	34.7	0.0	20.6	**10.3**
DRMRCI 132	26.4	2.0	7.5	5.9	0.0	**8.4**	16.8	0.0	**8.4**	20.6	12.9	37.7	**25.3**
DRMRSJ-21	19.5	36.2	33.2	19.2	19.4	**25.5**	10.5	26.6	**18.5**	34.7	0.0	34.7	**17.4**
DRMRSJ-159	3.6	26.4	0.0	6.3	23.6	**12.0**	0.0	15.7	**7.8**	43.5	22.8	39.2	**31.0**
DRMRSJ-1	14.9	22.8	33.9	12.2	22.8	**21.3**	0.0	15.7	**7.8**	46.4	18.4	45.0	**31.7**
DRMRDJ-3	4.6	22.8	0.0	11.4	23.6	**12.5**	0.0	15.7	**7.8**	37.7	28.3	33.1	**30.7**
DRMRCI 131	0.0	28.3	0.0	3.6	22.8	**10.9**	0.0	20.6	**10.3**	28.3	50.8	43.5	**47.2**
DRMRSJ-312	19.7	22.5	34.6	0.0	22.8	**19.9**	0.0	18.4	**9.2**	49.3	37.8	52.2	**45.0**
DRMRSJ-25	4.6	31.6	0.0	12.7	25.8	**14.9**	0.0	15.7	**7.8**	43.5	31.6	29.9	**30.8**
DRMRSJ-4	0.0	28.3	0.0	4.5	0.0	**6.5**	0.0	24.7	**12.3**	37.7	12.9	46.4	**29.7**
DRMRCI 139	18.2	4.9	0.0	6.7	24.4	**10.9**	0.0	12.9	**6.5**	37.7	9.1	29.9	**19.5**
DRMRSJ-271	0.0	26.4	30.1	6.2	0.0	**12.5**	0.0	22.8	**11.4**	37.7	33.2	40.7	**36.9**
DRMR-5206	23.7	29.9	12.9	15.3	21.2	**20.6**	12.9	20.6	**16.8**	37.7	20.7	29.9	**25.3**
DRMRSJ-19	25.3	33.1	16.8	14.4	22.8	**22.5**	16.8	12.9	**14.8**	24.7	20.7	33.1	**26.9**
DRMRSJ-22	18.6	24.7	36.6	13.4	24.4	**23.5**	16.8	18.4	**17.6**	28.3	15.9	36.2	**26.1**
DRMRSJ-26	21.0	20.6	12.3	11.9	24.4	**18.0**	16.8	18.4	**17.6**	31.6	20.7	59.0	**39.8**
DRMR 2018-37	0.0	28.3	18.4	5.5	22.0	**14.8**	0.0	18.4	**9.2**	52.2	37.8	31.6	**34.7**
DRMRSJ-361	16.2	12.9	15.0	12.9	0.0	**11.4**	0.0	15.7	**7.8**	58.4	43.6	28.3	**35.9**
DRMRCI 126	0.0	18.4	28.9	12.1	22.8	**16.4**	0.0	12.9	**6.5**	31.6	33.2	36.2	**34.7**
DRMRSJ-206	4.6	2.0	0.0	14.3	21.2	**8.4**	0.0	0.0	**0.0**	52.2	28.3	36.2	**32.3**
DRMRSJ-302	23.7	28.3	38.6	17.3	22.0	**26.0**	12.9	20.6	**16.8**	40.7	34.8	33.2	**34.0**
DRMRSJ-349	0.0	20.6	0.0	10.0	0.0	**6.1**	0.0	15.7	**7.8**	40.6	42.1	55.4	**48.7**
DRMRM 18-37-13	0.0	2.0	0.0	0.0	0.0	**0.4**	0.0	0.0	**0.0**	46.4	47.9	60.4	**54.2**
DRMR 2018-23	0.0	36.3	24.9	0.0	0.0	**12.2**	0.0	20.6	**10.3**	49.3	53.7	36.2	**45.0**
DRMRM 18-35-11	27.4	15.7	0.0	13.9	0.0	**11.4**	16.8	12.9	**14.8**	58.4	36.3	29.9	**33.1**
DRMR 2018-25	0.0	0.0	0.0	4.8	0.0	**1.0**	0.0	0.0	**0.0**	31.6	26.6	50.9	**38.7**
DRMR 2018-1	19.6	22.8	12.3	3.6	0.0	**11.7**	10.5	15.7	**13.1**	52.2	30.0	36.2	**33.1**
DRMR 2018-19	3.6	0.0	0.0	0.0	0.0	**0.7**	0.0	0.0	**0.0**	31.6	36.3	42.1	**39.2**
DRMRM 18-36-12	0.0	0.0	15.7	4.6	0.0	**4.1**	0.0	0.0	**0.0**	34.7	90.0	52.5	**71.2**
DRMR 2018-41	0.0	2.0	0.0	0.0	22.8	**5.0**	0.0	0.0	**0.0**	26.4	71.6	26.4	**49.0**
DRMR 2018-17	27.2	22.5	41.2	15.9	30.0	**27.4**	15.0	12.9	**13.9**	20.6	53.7	37.7	**45.7**
DRMR 2018-26	30.5	20.6	33.2	14.6	23.6	**24.5**	20.0	12.9	**16.4**	34.7	30.0	45.0	**37.5**
NPJ 247	23.6	34.7	34.6	15.2	29.3	**27.5**	12.9	20.6	**16.8**	52.2	22.8	20.6	**21.7**
RH- 1700	0.0	0.0	26.6	0.0	0.0	**5.3**	0.0	0.0	**0.0**	20.6	90.0	29.9	**59.9**
RH- 1700-3	0.0	24.7	37.9	8.3	0.0	**14.2**	0.0	15.7	**7.8**	37.7	33.2	26.4	**29.8**
PRD-14-4	24.3	30.0	42.5	16.3	0.0	**22.6**	15.0	20.6	**17.8**	40.7	33.2	26.6	**29.9**
RH 1400	0.0	12.9	0.0	0.0	0.0	**2.6**	0.0	12.9	**6.5**	28.3	90.0	20.6	**55.3**
RH- 1700-4	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	20.6	50.8	53.9	**52.3**
PRD-14-23	33.5	34.7	39.2	8.9	22.8	**27.8**	34.2	20.6	**27.4**	33.2	22.8	22.8	**22.8**
RMM-19-18	23.4	34.7	33.9	4.8	22.8	**23.9**	22.8	15.7	**19.2**	30.0	26.6	36.2	**31.4**
PJK (A4A5)-21	0.0	0.0	0.0	3.4	0.0	**0.7**	0.0	0.0	**0.0**	20.6	36.3	26.6	**31.4**
RH 1400-1	3.6	2.0	0.0	4.3	0.0	**2.0**	0.0	0.0	**0.0**	33.1	18.4	24.7	**21.6**
RH- 1700-1	0.0	24.7	0.0	3.6	0.0	**5.7**	0.0	20.6	**10.3**	53.8	77.1	64.2	**70.6**
DRMR 2018-24	0.0	33.2	38.6	9.3	30.0	**22.2**	0.0	20.6	**10.3**	52.3	39.2	22.5	**30.9**
PWR-13-8	0.0	0.0	12.3	0.0	0.0	**2.5**	0.0	0.0	**0.0**	0.0	28.3	0.0	**14.2**
RMM-19-06	27.6	28.3	29.6	8.1	0.0	**18.7**	20.0	15.7	**17.8**	46.4	36.3	26.6	**31.4**
BIOYSR (RC-WR)	38.1	36.2	39.2	3.9	22.0	**27.9**	42.1	24.7	**33.4**	36.2	37.8	18.4	**28.1**
PT 303 (B*r*-T)	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	20.6	77.1	49.3	**63.2**
Rohini (A4A5)-491	4.6	0.0	0.0	0.0	0.0	**0.9**	0.0	0.0	**0.0**	28.3	37.8	40.6	**39.2**
Rohini (Parent)	36.4	43.5	44.4	11.5	39.2	**35.0**	34.2	28.3	**31.3**	37.7	20.7	29.9	**25.3**
DLSC 1 (Bc)	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0	0.0	39.2	**19.6**
RH- 1700-2	35.7	40.7	38.6	18.1	30.0	**32.6**	38.3	24.7	**31.5**	37.7	33.2	33.1	**33.2**
PHR 2 (TC-AB)	6.0	31.6	34.6	3.6	39.2	**23.0**	0.0	22.8	**11.4**	40.7	24.7	15.7	**20.2**
NRCYS-5-2 (B*r*-YS)	4.6	20.6	0.0	0.0	0.0	**5.0**	0.0	20.6	**10.3**	12.9	50.8	62.6	**56.7**
PRD14-27	23.0	36.2	37.9	4.3	30.0	**26.3**	7.4	12.9	**10.2**	46.4	18.4	26.4	**22.4**
PB (A4A5)-842	0.0	0.0	0.0	0.0	24.3	**4.9**	0.0	0.0	**0.0**	33.1	71.6	46.5	**59.0**
Varuna (A4A5)-936-279	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	29.9	31.6	37.7	**34.6**
Pusa Bold (Parent)	35.3	36.2	40.5	14.4	39.3	**33.1**	34.2	24.7	**29.5**	52.2	26.6	26.4	**26.5**
Rohini (SC)	35.2	40.7	45.0	15.6	39.2	**35.1**	39.2	28.3	**33.8**	43.5	20.7	28.3	**24.5**
GSL 1 (Bn)	0.0	0.0	0.0	0.0	37.5	**7.5**	0.0	0.0	**0.0**	0.0	0.0	37.7	**18.8**
RL 1359 (SC)	24.8	37.7	39.2	7.9	39.3	**29.8**	12.9	31.6	**22.3**	40.7	37.8	22.5	**30.1**
Pusa Jaikisan (Parent)	34.3	28.3	43.1	12.6	39.3	**31.5**	27.7	18.4	**23.1**	58.4	50.8	37.7	**44.2**
WBN-1(B*r*-BS)	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	**0.0**	0.0	0.0	61.1	**30.6**
PMW 18	0.0	2.0	0.0	0.0	31.3	**6.7**	0.0	0.0	**0.0**	24.7	18.4	36.2	**27.3**
Varuna (Parent)	39.3	34.7	39.2	12.4	39.2	**33.0**	38.3	20.6	**29.4**	46.4	30.0	62.6	**46.3**
DRMR 2018-16	39.3	39.2	41.2	16.4	39.3	**35.1**	27.7	24.7	**26.2**	53.8	22.8	53.8	**38.3**
CD(*P*=0.05)	**3.7**	**5.5**	**4.1**	**7.4**	**1.3**	**-**	**3.4**	**4.4**	**-**	**5.6**	**9.0**	**11.4**	**-**
CV (%)	**13.9**	**13.8**	**10.6**	**50.5**	**3.5**	**-**	**17.94**	**14.9**	**-**	**7.7**	**13.41**	**15.6**	**-**

***Data of LDH (WR, SR) and MOR (SR) are not included as disease severity/incidence was < 20% in SC**

Table 4.5.1: Reaction of oilseed Brassica lines against AB (natural condition) in NDN for Sclerotinia rot

Code no.	Entries	% AB severity (90 DAS)*						% POD (15 days before harvest)				
		SHL	SGN	PNT	HSR	LDH	Mean	SHL	SGN	PNT	HSR	Mean
NDN-20-114	DRMRSJ-21	33.5	27.3	33.2	33.9	17.8	**29.1**	25.3	20.3	37.7	27.4	**27.7**
NDN-20-115	DRMRSJ-22	31.7	23.0	29.9	32.2	18.6	**27.1**	25.0	0.0	31.6	24.2	**20.2**
NDN-20-116	DRMR 2018-24	33.0	24.4	34.7	34.0	18.4	**28.9**	25.6	16.6	37.7	28.9	**27.2**
NDN-20-117	DRMR 5206	31.2	28.5	33.2	32.9	16.3	**28.4**	24.9	22.5	43.5	24.9	**29.0**
NDN-20-118	**NPC 16 (TC-SR)**	25.5	0.0	22.5	17.4	16.0	**16.3**	20.9	0.0	24.7	15.0	**15.2**
NDN-20-119	DRMRSJ-25	32.3	0.0	36.3	31.1	16.3	**23.2**	26.1	0.0	37.7	24.2	**22.0**
NDN-20-120	**Rohini (SC)**	32.9	28.1	39.2	35.3	15.3	**30.2**	24.6	0.0	34.7	26.9	**21.6**
NDN-20-121	DRMRSJ-26	30.6	30.5	31.6	33.2	16.3	**28.4**	25.6	15.2	31.6	25.8	**24.5**
NDN-20-122	**NRCYS-5-2 (B*r*-YS)**	36.3	25.5	31.6	36.6	16.3	**29.3**	27.3	25.3	47.9	29.6	**32.5**
NDN-20-123	DRMR 2017-8	32.5	23.7	37.7	35.3	19.8	**29.8**	23.7	21.0	34.7	32.5	**28.0**
NDN-20-124	**RL 1359 (SC)**	32.8	23.9	34.7	34.0	18.3	**28.7**	25.1	17.6	28.3	28.9	**25.0**
CD(*P*=0.05)		**2.0**	**4.3**	**6.1**	**5.1**	**2.3**	**-**	**3.1**	**2.5**	**5.3**	**5.6**	**-**
CV (%)		**3.6**	**8.9**	**8.2**	**7.0**	**5.9**	**-**	**7.2**	**8.8**	**6.6**	**9.5**	**-**

***Data of BPR not included as disease severity was < 20% in SC**

Table 4.5.2: Reaction of oilseed Brassica germplasm to WR, SR and DM under NDN for Sclerotinia rot

Entries	% WR severity (100 DAS)*				%Staghead*	% SR incidence under artificial condition								SR lesion size (cm)					% DM
	PNT	HSR	BPR	Mean	PNT	NBPGR	SHL	SGN	DOL	PNT	HSR	BPR	Mean	SHL	HSR	LDH	BPR	Mean	PNT
DRMRSJ-21	31.6	28.9	23	**27.8**	22.8	90.0	81.1	0.0	76.7	80.8	64.3	32.0	**60.7**	20.7	10.9	12.4	16.1	**15.0**	24.7
DRMRSJ-22	33.1	32.5	21	**28.9**	20.6	76.7	81.1	13.3	80.8	60.1	76.2	25.8	**59.1**	20.8	19.8	11.6	9.9	**15.5**	0.0
DRMR 2018-24	31.6	37.9	25	**31.5**	20.6	90.0	81.1	12.2	29.9	50.9	78.6	27.0	**52.8**	25.5	12.2	15.1	9.8	**15.7**	28.3
DRMR 5206	22.5	34.3	23	**26.5**	15.7	70.4	90.0	0.0	22.5	80.8	73.8	31.2	**52.7**	23.6	19.2	8.8	10.8	**15.6**	31.6
NPC 16 (TC-SR)	0.0	0.0	0	**0.0**	0.0	90.0	72.3	12.8	76.7	50.9	19.0	19.9	**48.8**	15.6	5.3	7.1	10.5	**9.6**	0.0
DRMRSJ-25	34.7	25.8	23	**27.8**	18.4	70.4	81.1	30.0	32.9	57.1	61.9	46.1	**54.2**	18.4	16.9	10.2	12.1	**14.4**	20.6
Rohini (SC)	31.6	40.5	26	**32.7**	20.6	22.5	81.1	25.3	22.5	60.1	69.0	37.7	**45.5**	15.9	9.8	24.3	32.4	**20.6**	28.3
DRMRSJ-26	26.6	30.1	24	**26.8**	15.7	76.7	81.1	18.7	42.1	80.8	71.4	37.2	**58.3**	19.9	18.2	16.3	27.6	**20.5**	31.6
NRCYS-5-2 (B*r*-YS)	22.8	0.0	0.0	**7.6**	15.7	90.0	81.1	37.7	73.4	90.0	92.9	66.8	**76.0**	15.7	15.9	7.3	66.0	**26.2**	20.6
DRMR 2017-8	39.2	39.2	25	**34.5**	24.7	90.0	81.1	32.3	70.4	71.5	85.7	24.4	**65.1**	15.7	11.7	11.3	6.3	**11.3**	24.7
RL 1359 (SC)	37.7	38.6	31	**35.9**	15.7	90.0	81.1	21.7	73.4	61.1	81.0	36.2	**63.5**	23.8	11.8	16.9	11.5	**16.0**	28.3
CD(*P*=0.05)	**7.9**	**5.1**	**5.0**	**-**	**6.8**	**20.2**	**NS**	**2.6**	**38.4**	**24.3**	**9.1**	**6.2**	**-**	**3.9**	**3.4**	**7.4**	**-**	**-**	**2.7**
CV (%)	**11.9**	**8.0**	**6.7**	**-**	**17.1**	**12.0**	**18.8**	**6.3**	**31.1**	**15.9**	**7.0**	**7.7**	**-**	**11.6**	**10.9**	**25.4**	**-**	**-**	**5.4**

***Data of SGN and LDH (WR) are not included as disease severity was < 20% in SC**

Table 4.6.1:Screening of IVT entries of oilseed Brassica against Alternaria blight (natural condition)

Code No.	Entries	% AB severity (90 DAS)*						% ABP (15 days before harvest)					
		SHL	SGN	PNT	DOL	HSR	Mean	SHL	SGN	DOL	PNT	HSR	Mean
SIVT-20-01	KMR (E)- 20-1	30.6	33.5	33.1	38.0	27.4	**32.5**	20.8	23.9	27.6	31.6	24.2	**25.6**
SIVT-20-02	RH 1999-12	29.2	37.4	29.9	39.3	31.1	**33.4**	20.6	31.8	26.9	33.1	25.8	**27.6**
SIVT-20-03	NPJ- 239	32.6	37.8	26.6	39.3	28.9	**33.0**	22.0	27.5	26.9	33.1	22.4	**26.4**
SIVT-20-04	PHR 8024 (hybrid)	33.0	45.6	31.6	38.0	33.2	**36.3**	21.9	43.7	25.8	24.7	27.4	**28.7**
SIVT-20-05	TM 188	30.4	35.8	29.9	39.7	34.3	**34.0**	20.3	16.7	29.6	34.7	32.5	**26.8**
SIVT-20-06	DRMR 2018-17	33.9	38.4	31.6	36.9	30.1	**34.2**	22.3	21.6	26.2	28.3	24.9	**24.6**
SIVT-20-07	SKM 1620	32.3	35.0	33.1	36.9	32.2	**33.9**	22.9	15.2	26.2	31.6	26.9	**24.6**
SIVT-20-08	RH 1974	30.5	15.2	29.9	30.8	33.2	**27.9**	21.0	10.9	22.3	34.7	31.1	**24.0**
SIVT-20-09	RMM-19-18	32.3	32.6	39.2	37.1	29.6	**34.2**	22.2	13.1	26.9	36.2	25.8	**24.8**
SIVT-20-10	NPJ- 241	31.2	32.6	33.1	37.1	34.6	**33.7**	21.5	12.8	26.9	31.6	28.9	**24.3**
SIVT-20-11	PR-2017-5	33.5	40.1	36.2	36.9	25.8	**34.5**	22.7	38.7	25.8	34.7	24.2	**29.2**
SIVT-20-12	KMR (E)- 20-2	32.7	28.7	33.1	36.9	32.5	**32.8**	21.5	7.2	25.8	28.3	25.8	**21.7**
SIVT-20-13	RGN-483	32.8	29.2	36.2	41.9	32.9	**34.6**	22.4	11.2	31.6	28.3	27.4	**24.2**
SIVT-20-14	SKM 1746	34.0	31.2	39.2	39.7	28.1	**34.5**	22.4	20.8	29.4	28.3	24.9	**25.2**
SIVT-20-15	PRE- 2018-8	32.1	29.6	31.6	43.2	34.0	**34.1**	21.7	11.5	33.5	28.3	27.4	**24.5**
SIVT-20-16	KGMH-3811	31.8	22.0	33.1	39.9	31.1	**31.6**	20.4	9.0	29.4	29.9	25.8	**22.9**
SIVT-20-17	DRMRHT 1318	34.9	22.2	42.1	39.9	32.5	**34.3**	24.0	18.0	29.4	37.7	28.9	**27.6**
SIVT-20-18	KMR- 20-3	32.1	22.5	37.7	39.7	33.2	**33.1**	22.7	14.7	29.4	34.7	26.9	**25.7**
SIVT-20-19	TM 274	32.0	47.3	37.7	38.0	27.4	**36.5**	21.4	45.5	27.6	36.3	21.5	**30.4**
SIVT-20-20	RH 1999-21	32.1	39.0	31.6	39.7	32.9	**35.1**	22.8	37.1	29.6	29.9	25.8	**29.0**
SIVT-20-21	NPJ- 242	33.3	31.1	36.3	39.7	26.9	**33.4**	22.7	28.0	29.6	36.2	23.3	**28.0**
SIVT-20-22	RMM-19-06	35.1	16.9	39.2	38.9	32.2	**32.5**	23.6	9.0	28.3	39.2	24.2	**24.9**
SIVT-20-23	DRMRCI- 129	31.5	19.1	33.1	39.7	31.1	**30.9**	21.4	8.6	29.6	42.1	26.9	**25.7**
SIVT-20-24	PRE- 2018-10	32.2	17.8	36.2	38.4	30.1	**30.9**	21.0	15.5	28.3	31.6	28.1	**24.9**
SIVT-20-25	SVJH-006	31.9	33.9	39.2	38.4	33.2	**35.3**	21.4	18.4	28.3	34.7	28.9	**26.4**
SIVT-20-26	BAUM 09-12-2	35.0	20.8	34.7	36.9	32.5	**32.0**	23.1	20.1	26.2	33.1	27.4	**26.0**
SIVT-20-27	HUJM- 19-11	32.0	32.9	36.2	39.7	29.6	**34.1**	21.5	9.0	29.6	37.7	25.8	**24.7**
SIVT-20-28	JM-14-8	33.2	32.8	29.9	38.4	32.9	**33.4**	22.3	13.9	28.3	40.7	24.2	**25.9**
SIVT-20-29	PBR 507	31.8	21.6	40.7	38.9	27.4	**32.1**	21.7	8.1	28.3	49.3	21.0	**25.7**
SIVT-20-30	SKM 1728	32.6	27.0	36.2	42.5	32.2	**34.1**	23.6	9.0	32.2	37.7	26.9	**25.9**
SIVT-20-31	DRMRHT 1712	31.6	20.3	33.1	36.9	33.2	**31.0**	21.9	7.7	26.2	42.1	28.1	**25.2**
SIVT-20-32	NPJ- 240	33.0	38.8	33.1	30.8	28.9	**32.9**	21.6	27.7	21.9	34.7	22.4	**25.6**
SIVT-20-33	PHR 8031(hybrid)	32.2	0.0	33.1	30.6	30.1	**25.2**	21.8	0.0	21.9	34.7	25.8	**20.9**
SIVT-20-34	DRMRCI- 127	34.2	37.7	42.1	30.8	28.1	**34.6**	22.0	23.7	22.3	45.0	23.3	**27.3**
SIVT-20-35	RGN-491	33.5	21.0	33.1	38.7	32.5	**31.8**	22.1	25.6	28.3	40.7	26.6	**28.6**
SIVT-20-36	KMR- 20-4	34.0	30.5	34.7	38.7	33.2	**34.2**	22.9	16.9	28.3	37.7	27.4	**26.6**
SIVT-20-37	PRB- 2012-3	31.9	19.1	33.1	37.1	31.1	**30.5**	21.9	16.9	26.9	37.7	26.9	**26.1**
SIVT-20-38	RH 1975	35.4	34.3	31.4	37.1	32.9	**34.2**	24.4	21.6	26.9	34.7	28.1	**27.1**
SIVT-20-39	ORM 2019-01	32.1	26.7	37.7	33.2	35.3	**33.0**	22.4	15.7	21.1	47.9	28.9	**27.2**
SIVT-20-40	DRMRSJ 112	33.3	41.0	29.9	39.3	29.6	**34.6**	21.9	24.4	29.0	33.1	25.8	**26.9**
SIVT-20-41	ORM 2019-02	33.4	38.6	36.2	38.7	32.5	**35.9**	22.6	20.8	28.3	39.2	26.9	**27.6**
SIVT-20-42	DRMRSJ 276	33.2	35.1	34.7	38.7	32.2	**34.8**	21.5	22.0	27.9	40.7	28.9	**28.2**
SIVT-20-43	NPJ- 244	34.0	27.0	36.2	38.4	33.2	**33.8**	22.4	19.3	27.9	34.7	29.6	**26.8**
SIVT-20-44	RH 1921	33.5	35.0	36.2	39.1	31.1	**35.0**	23.1	26.1	28.6	42.1	26.9	**29.4**
SIVT-20-45	PBR 450	33.3	31.7	37.7	36.9	34.6	**34.8**	22.3	19.9	26.2	46.4	31.4	**29.2**
SIVT-20-46	RHH 2003	33.4	33.9	36.2	36.9	35.3	**35.1**	23.4	15.0	26.2	37.7	28.9	**26.2**
SIVT-20-47	DRMRHJ 1108	32.6	34.6	33.1	36.9	30.1	**33.5**	22.2	33.8	26.5	36.2	26.9	**29.1**
SIVT-20-48	Pusa MH-57	32.6	36.9	28.3	38.4	33.2	**33.9**	22.3	28.9	27.9	37.7	29.6	**29.3**
SIVT-20-49	0IJ1010	33.7	34.2	33.1	36.9	35.3	**34.6**	23.9	28.9	26.2	37.7	27.4	**28.8**
SIVT-20-50	TKM- 20-1	34.1	28.9	36.2	37.1	33.9	**34.0**	23.2	15.7	26.9	45.0	28.1	**27.8**
SIVT-20-51	RMT-19-17	32.8	36.6	43.5	39.7	36.0	**37.7**	21.5	39.9	29.4	40.7	31.1	**32.5**
SIVT-20-52	ACNMM- 23	30.9	27.5	34.7	38.4	32.5	**32.8**	19.6	26.6	27.9	31.6	26.9	**26.5**
SIVT-20-53	DRMRHT 1913	34.5	30.4	36.3	38.4	30.1	**33.9**	22.8	29.5	27.9	37.7	28.1	**29.2**
SIVT-20-54	RGN-486	33.6	39.1	43.5	42.5	35.3	**38.8**	22.3	24.8	32.2	43.5	28.9	**30.4**
SIVT-20-55	JM-13-3	33.5	16.7	29.9	39.9	33.2	**30.6**	22.3	15.2	30.0	33.1	25.8	**25.3**
SIVT-20-56	PHR 8095	32.8	39.1	42.1	39.9	30.1	**36.8**	22.6	21.4	30.0	42.1	26.9	**28.6**
SIVT-20-57	SVJH-66	34.4	31.2	39.2	36.9	32.5	**34.8**	23.3	19.3	26.9	39.2	24.9	**26.7**
SIVT-20-58	RMX9906	32.6	27.3	34.7	36.9	32.9	**32.9**	22.4	17.6	26.2	36.2	28.1	**26.1**
SIVT-20-59	18J029C	32.5	27.7	28.3	38.4	27.4	**30.9**	21.5	16.4	27.9	34.7	24.2	**25.0**
SIVT-20-60	PT- 2018-09	32.7	37.4	52.2	38.4	35.3	**39.2**	21.9	35.9	27.9	42.1	32.5	**32.1**
SIVT-20-61	DRMRCI- 128	32.8	33.1	37.7	39.7	36.6	**36.0**	23.2	29.5	29.6	37.7	29.6	**29.9**
SIVT-20-62	NPJ- 243	31.9	16.2	36.2	39.7	28.9	**30.6**	19.7	30.5	29.6	39.2	25.8	**29.0**
SIVT-20-63	TM 264	32.9	18.2	36.2	39.7	33.2	**32.1**	22.7	13.9	29.6	31.6	28.1	**25.2**
SIVT-20-64	RHH 2002	32.9	31.4	39.2	38.4	32.2	**34.8**	22.8	21.8	27.9	40.7	26.9	**28.0**
SIVT-20-65	DRMRHJ 2409	32.4	39.7	31.6	36.9	37.9	**35.7**	22.5	37.8	25.4	37.7	32.9	**31.3**
SIVT-20-66	0IJ1034	34.4	27.2	33.1	38.7	38.6	**34.4**	23.8	15.0	26.9	36.2	33.2	**27.0**
SIVT-20-67	SVJH-68	34.5	29.0	33.1	38.7	32.5	**33.6**	25.7	27.5	26.9	31.6	24.9	**27.3**
SIVT-20-68	CAU- RM- 4-1-1	33.5	41.9	36.3	38.7	31.1	**36.3**	23.3	39.5	26.9	39.2	26.6	**31.1**

SIVT-20-69	AKMS-20-1	34.2	22.2	29.9	43.1	32.5	**32.4**	24.2	19.5	31.3	33.1	28.9	**27.4**
SIVT-20-70	Pusa MH-61	32.6	48.3	33.1	43.1	33.2	**38.0**	21.9	46.8	31.3	37.7	28.1	**33.1**
SIVT-20-71	PT- 2015-8	35.1	28.0	40.7	37.1	34.6	**35.1**	24.8	9.0	25.4	45.0	29.6	**26.8**
SIVT-20-72	RGN-500	33.3	30.5	42.1	37.1	30.1	**34.6**	23.0	10.2	25.4	43.5	24.9	**25.4**
SIVT-20-73	RHH 2001	31.7	30.1	37.7	38.4	28.9	**33.4**	21.9	19.9	26.2	36.2	25.8	**26.0**
SIVT-20-74	RMX9903	32.3	33.5	39.2	38.4	33.9	**35.4**	21.2	18.9	26.2	39.2	26.9	**26.5**
SIVT-20-75	DRMRHJ 1403	32.9	28.9	34.7	37.1	32.9	**33.3**	22.3	23.9	24.3	37.7	27.4	**27.1**
SIVT-20-76	TKM- 20-2	34.7	0.0	36.2	43.1	33.2	**29.4**	23.7	0.0	32.2	42.1	28.9	**25.4**
SIVT-20-77	RMT-19-14	34.2	20.1	49.3	36.9	35.3	**35.1**	23.0	41.5	26.2	46.4	31.1	**33.6**
SIVT-20-78	PHR 8076	32.4	25.6	37.7	36.9	31.1	**32.7**	22.1	15.5	26.2	36.2	25.8	**25.1**
SIVT-20-79	RH 1920	30.0	20.8	36.2	38.4	27.4	**30.6**	23.1	24.6	28.3	31.6	23.3	**26.2**
SIVT-20-80	DRMRHJ 908	33.5	31.1	34.7	38.4	30.1	**33.6**	23.5	26.9	28.1	37.7	25.8	**28.4**
SIVT-20-81	CG toria 3	34.5	17.6	36.2	38.4	33.9	**32.1**	22.4	0.0	27.9	40.6	28.1	**23.8**
SIVT-20-82	BAUT 08-08	34.0	20.5	39.2	36.9	34.6	**33.0**	22.9	30.8	26.9	50.9	29.6	**32.2**
SIVT-20-83	LES 63	33.8	0.0	37.7	31.6	31.1	**26.8**	22.3	0.0	21.9	37.7	28.9	**22.2**
SIVT-20-84	JC 36#	34.1	0.0	37.7	36.9	32.2	**28.2**	23.1	0.0	26.2	39.2	26.9	**23.1**
SIVT-20-85	0IJ5001#	32.7	0.0	39.2	44.5	33.2	**29.9**	21.8	0.0	34.1	39.2	28.1	**24.6**
SIVT-20-86	PYS- 2018-02	33.3	26.4	40.7	44.5	34.6	**35.9**	21.9	24.1	34.1	42.1	31.4	**30.7**
SIVT-20-87	DRMRYS 201	33.9	29.2	37.7	42.6	34.0	**35.5**	22.2	32.2	32.2	46.4	29.6	**32.5**
SIVT-20-88	DRMR 2018-19	32.1	21.4	34.7	32.3	35.3	**31.2**	20.7	20.1	21.1	31.6	28.1	**24.3**
SIVT-20-89	ORT 2019-01	34.1	22.3	40.7	43.6	36.0	**35.3**	22.3	19.1	32.2	37.7	31.1	**28.5**
SIVT-20-90	PDZ-15#	33.9	39.9	45.0	31.5	38.6	**37.8**	22.1	39.2	21.1	46.4	33.9	**32.5**
SIVT-20-91	YSKM- 20-2	35.4	29.0	36.2	31.5	34.6	**33.3**	22.7	18.4	21.1	33.1	28.9	**24.8**
SIVT-20-92	RH 1999-19	32.5	21.6	34.7	32.3	33.2	**30.9**	21.8	18.9	22.3	37.7	26.9	**25.5**
SIVT-20-93	JT-14-5	34.1	26.6	37.7	31.5	33.9	**32.8**	23.6	19.9	21.1	40.7	28.1	**26.7**
SIVT-20-94	LES 62	33.5	31.7	39.2	31.7	30.1	**33.2**	23.7	23.9	21.1	39.2	25.8	**26.7**
SIVT-20-95	PDZ-14#	32.8	36.6	42.1	38.0	39.2	**37.7**	22.2	27.3	26.2	40.7	32.9	**29.8**
SIVT-20-96	RH (OE)-1807	33.0	39.5	36.2	43.6	31.4	**36.7**	22.8	35.4	33.5	34.7	26.9	**30.7**
SIVT-20-97	RMYS 1	34.2	35.4	40.7	31.2	34.6	**35.2**	23.3	31.9	21.9	37.7	28.9	**28.8**
SIVT-20-98	YSKM- 20-1	34.8	38.3	37.7	31.2	33.2	**35.0**	23.8	32.8	21.9	39.2	27.4	**29.0**
SIVT-20-99	DRMRYS 202	35.1	28.1	36.2	43.6	36.0	**35.8**	20.4	29.2	33.5	43.5	31.1	**31.5**
SIVT-20-100	RH 1999-22	34.1	26.4	39.2	43.6	31.1	**34.9**	22.4	31.4	33.5	36.2	25.8	**29.9**
SIVT-20-101	JC 32#	33.6	30.9	36.2	43.6	37.9	**36.4**	21.7	29.3	33.5	40.7	32.9	**31.6**
SIVT-20-102	RMYS 2	33.0	23.9	37.7	42.6	32.9	**34.0**	21.1	21.0	31.6	37.7	27.4	**27.8**
SIVT-20-103	CG toria 4	34.5	38.6	37.7	42.6	34.0	**37.5**	21.7	21.6	31.6	40.7	29.6	**29.0**
SIVT-20-104	DRMRCI- 130	32.8	32.4	37.7	44.5	30.1	**35.5**	20.6	30.2	34.1	37.7	28.1	**30.2**
SIVT-20-105	RH (OE)-1804	33.0	30.2	33.1	36.9	32.2	**33.1**	21.5	24.3	26.2	28.3	26.9	**25.4**
SIVT-20-106	PYS- 2017-6	35.1	25.1	36.2	38.4	35.3	**34.0**	22.3	16.0	27.9	43.5	28.9	**27.7**
SIVT-20-107	DRMRHJ 2520	33.3	32.6	36.2	38.4	32.9	**34.7**	21.6	27.0	27.9	39.2	28.1	**28.8**
SIVT-20-108	NPJ- 245	32.3	36.3	39.2	37.1	32.5	**35.5**	20.6	35.0	26.9	31.6	27.4	**28.3**
SIVT-20-109	RGN-494	33.2	39.1	37.7	43.1	36.0	**37.8**	21.8	24.1	32.2	36.3	28.9	**28.7**
SIVT-20-110	Rohini (A4A5)-491	32.4	37.3	39.2	39.7	34.3	**36.6**	22.2	31.9	29.6	39.2	30.1	**30.6**
SIVT-20-111	Varuna (A4A5)-936-279	33.0	38.7	36.2	43.1	34.6	**37.1**	23.7	25.8	32.2	37.7	31.4	**30.2**
SIVT-20-112	Pusa Bold (Parent)	32.2	38.4	33.1	36.9	33.2	**34.8**	22.3	25.4	26.2	37.7	28.1	**27.9**
SIVT-20-113	**RL 1359 (SC)**	32.6	0.0	37.7	36.9	31.4	**27.7**	22.1	0.0	26.2	34.7	25.8	**21.8**
SIVT-20-114	**PT 303 (*Br*-T)**	35.0	0.0	36.2	43.6	35.3	**30.0**	22.8	0.0	33.5	43.5	28.1	**25.6**
SIVT-20-115	**NRCYS-5-2 (*Br*-YS)**	35.7	36.6	36.2	43.6	34.0	**37.2**	23.3	35.7	33.5	53.8	29.6	**35.2**
SIVT-20-116	KMR (L)- 20-5	32.9	33.5	33.1	43.6	32.9	**35.2**	21.9	25.8	32.2	36.2	28.9	**29.0**
SIVT-20-117	NPJ- 246	32.4	31.4	33.1	38.0	27.4	**32.5**	21.0	35.7	26.2	37.7	23.3	**28.8**
SIVT-20-118	TM 179-2	32.9	26.7	33.1	37.0	25.8	**31.1**	22.1	32.1	24.3	33.2	21.5	**26.6**
SIVT-20-119	PB (A4A5)-842	32.1	34.4	31.6	31.6	31.1	**32.2**	21.1	29.5	21.1	30.0	26.9	**25.7**
SIVT-20-120	Rohini (Parent)	33.1	34.3	37.7	31.6	28.9	**33.1**	22.1	39.1	21.1	39.2	21.0	**28.5**
SIVT-20-121	**Rohini (SC)**	32.3	31.7	36.2	32.7	32.2	**33.0**	20.9	10.5	22.3	33.1	25.8	**22.5**
SIVT-20-122	**PHR 2 (TC-AB)**	32.9	20.5	33.1	32.7	32.5	**30.3**	22.9	15.2	22.3	31.6	27.4	**23.9**
SIVT-20-123	**DLSC 1 (*Bc*)**	33.9	0.0	26.4	31.4	15.7	**21.5**	23.7	0.0	21.1	31.6	12.9	**17.9**
SIVT-20-124	KMR (L)- 20-6	33.8	24.1	33.1	31.5	28.1	**30.1**	22.8	19.9	21.1	37.7	24.2	**25.1**
SIVT-20-125	PRL- 2017-2	32.7	12.8	36.2	31.6	26.6	**28.0**	23.7	20.7	22.3	37.7	21.5	**25.2**
SIVT-20-126	PJK (A4A5)-21	33.6	24.4	24.7	32.5	24.2	**27.9**	23.3	20.8	22.3	37.7	20.5	**24.9**
SIVT-20-127	**RTM 314 (*Es*)**	33.3	23.6	37.7	38.4	-	**33.3**	22.6	16.9	26.2	43.5	-	**27.3**
SIVT-20-128	Varuna (Parent)	32.4	31.2	34.7	36.9	31.1	**33.3**	22.0	25.6	24.3	39.2	25.8	**27.4**
SIVT-20-129	PAB- 2014-4	32.4	39.5	33.1	43.1	32.2	**36.0**	21.6	24.8	31.6	34.7	26.9	**27.9**
SIVT-20-130	RGN-488	33.0	27.3	36.2	36.9	28.1	**32.3**	22.4	19.5	25.4	39.2	24.9	**26.3**
SIVT-20-131	HUJM- 19-18	33.9	0.0	33.1	44.5	33.2	**28.9**	22.9	0.0	32.9	39.2	27.4	**24.5**
SIVT-20-132	Pusa Jaikisan (Parent)	33.4	28.9	31.4	44.5	29.6	**33.6**	22.3	23.4	32.9	31.6	25.8	**27.2**
SIVT-20-133	**GSL 1 (*Bn*)**	29.1	22.3	28.3	42.6	17.4	**28.0**	19.4	22.5	31.0	33.2	15.0	**24.2**
SIVT-20-134	**BIOYSR (RC-WR)**	33.1	38.0	36.2	43.1	36.6	**37.4**	23.1	36.7	31.3	37.7	31.1	**32.0**
CD(*P*=0.05)		**NS**	**6.0**	**3.7**	**1.8**	**4.5**	**-**	**NS**	**6.0**	**0.4**	**4.1**	**4.5**	**-**
CV(%)		**6.3**	**10.8**	**5.2**	**2.4**	**7.1**	**-**	**9.6**	**14.2**	**0.8**	**5.5**	**8.5**	**-**

***Data of JAG and LDH not included as disease severity was < 20% in SC**

Table 4.6.2: Screening of IVT entries of oilseed Brassica to WR, DM, PM and SR

Entries	% WR severity (75 DAS)*				% Staghead				% DM (20 DAS)	% PM (100 DAS)	% SR incidence*		
	MOR	PNT	HSR	Mean	MOR	SGN	PNT	Mean	PNT	SKN	DOL	PNT	Mean
KMR (E)- 20-1	19.5	20.6	35.3	**25.1**	0.0	22.7	15.7	**12.8**	36.2	56.8	18.6	30.0	**24.3**
RH 1999-12	18.0	33.1	41.2	**30.8**	0.0	19.2	20.6	**13.3**	24.7	56.8	27.3	36.3	**31.8**
NPJ- 239	17.4	18.4	33.2	**23.0**	0.0	16.8	15.7	**10.8**	34.7	50.9	25.5	46.4	**36.0**
PHR 8024 (hybrid)	9.4	20.6	16.8	**15.6**	0.0	17.0	15.7	**10.9**	40.7	76.7	20.3	26.6	**23.4**
TM 188	0.0	4.1	0.0	**1.4**	0.0	12.2	0.0	**4.1**	40.7	63.4	22.2	26.4	**24.3**
DRMR 2018-17	34.9	26.4	34.6	**32.0**	30.0	12.1	20.6	**20.9**	28.3	63.4	21.8	37.7	**29.8**
SKM 1620	18.4	28.3	15.0	**20.6**	0.0	12.9	22.8	**11.9**	40.7	63.4	22.2	29.9	**26.0**
RH 1974	26.3	28.3	40.5	**31.7**	30.0	18.2	18.4	**22.2**	31.6	63.4	16.7	26.4	**21.5**
RMM-19-18	40.8	24.7	39.2	**34.9**	35.3	11.4	15.7	**20.8**	31.6	63.4	22.2	26.6	**24.4**
NPJ- 241	18.7	24.7	42.5	**28.6**	0.0	12.0	15.7	**9.2**	37.7	63.4	18.6	29.9	**24.2**
PR-2017-5	21.8	29.9	34.3	**28.6**	0.0	22.2	20.6	**14.3**	28.3	60.1	18.6	20.6	**19.6**
KMR (E)- 20-2	34.3	26.4	40.5	**33.7**	35.3	16.5	18.4	**23.4**	37.7	63.4	0.0	24.7	**12.3**
RGN-483	18.0	30.0	39.2	**29.1**	0.0	16.4	22.8	**13.1**	31.6	71.5	0.0	20.6	**10.3**
SKM 1746	22.1	29.9	36.0	**29.3**	33.2	27.6	20.6	**27.1**	43.5	67.5	0.0	33.1	**16.6**
PRE- 2018-8	37.9	15.7	42.5	**32.0**	34.2	21.5	0.0	**18.6**	40.7	63.4	0.0	47.9	**23.9**
KGMH-3811	31.1	26.6	38.6	**32.1**	27.7	22.7	24.7	**25.0**	24.7	80.8	0.0	30.0	**15.0**
DRMRHT 1318	36.0	36.2	40.5	**37.6**	37.3	16.3	28.3	**27.3**	31.6	80.8	0.0	26.4	**13.2**
KMR- 20-3	34.2	42.1	37.9	**38.1**	27.7	0.0	31.6	**19.8**	24.7	80.8	0.0	22.5	**11.2**
TM 274	29.0	31.6	35.3	**32.0**	26.6	18.9	12.9	**19.5**	26.4	63.4	0.0	29.9	**14.9**
RH 1999-21	33.4	31.6	39.2	**34.7**	34.2	10.9	24.7	**23.3**	20.6	60.1	0.0	26.4	**13.2**
NPJ- 242	37.3	37.7	37.9	**37.6**	34.2	11.9	20.6	**22.2**	22.5	60.1	0.0	15.7	**7.8**
RMM-19-06	32.5	17.8	28.9	**26.4**	25.3	13.4	15.7	**18.2**	20.6	63.4	22.2	22.8	**22.5**
DRMRCI- 129	35.7	33.2	36.6	**35.2**	25.3	13.6	20.6	**19.8**	28.3	63.4	22.2	26.6	**24.4**
PRE- 2018-10	27.7	28.3	33.9	**29.9**	20.0	17.0	15.7	**17.6**	20.6	60.1	14.2	33.9	**24.0**
SVJH-006	36.9	31.6	32.5	**33.7**	36.3	12.0	24.7	**24.3**	24.7	61.7	14.2	36.2	**25.2**
BAUM 09-12-2	35.2	37.7	41.2	**38.1**	25.3	19.5	28.3	**24.4**	31.6	67.5	12.7	24.7	**18.7**
HUJM- 19-11	43.9	31.6	34.0	**36.5**	46.0	12.9	24.7	**27.9**	0.0	67.5	14.2	20.6	**17.4**
JM-14-8	35.4	31.6	36.0	**34.3**	21.4	12.0	18.4	**17.3**	0.0	NG	14.5	12.9	**13.7**
PBR 507	32.4	40.7	26.6	**33.2**	21.4	0.0	31.6	**17.7**	31.6	60.1	22.2	29.9	**26.0**
SKM 1728	35.5	33.1	39.2	**35.9**	27.7	0.0	20.6	**16.1**	28.3	67.5	22.2	26.4	**24.3**
DRMRHT 1712	31.8	31.6	39.9	**34.4**	30.0	17.6	24.7	**24.1**	20.6	63.4	22.2	15.7	**18.9**
NPJ- 240	33.7	20.6	35.3	**29.9**	27.7	12.0	20.6	**20.1**	28.3	63.4	0.0	57.1	**28.5**
PHR 8031(hybrid)	25.3	24.7	12.9	**21.0**	16.8	17.0	18.4	**17.4**	34.7	63.4	12.7	12.9	**12.8**
DRMRCI- 127	29.5	33.1	33.2	**31.9**	18.4	11.7	24.7	**18.3**	40.7	63.4	12.7	20.6	**16.6**
RGN-491	37.6	37.7	36.0	**37.1**	34.2	17.8	28.3	**26.8**	37.7	63.4	0.0	22.8	**11.4**
KMR- 20-4	22.3	15.7	35.3	**24.4**	12.9	0.0	12.9	**8.6**	36.2	64.2	0.0	26.4	**13.2**
PRB- 2012-3	40.0	29.9	33.9	**34.6**	46.0	11.7	22.8	**26.8**	39.2	67.5	0.0	24.7	**12.3**
RH 1975	35.2	24.7	34.6	**31.5**	34.2	11.5	15.7	**20.5**	36.2	63.4	0.0	26.4	**13.2**
ORM 2019-01	0.0	0.0	0.0	**0.0**	0.0	13.4	0.0	**4.5**	43.5	53.8	0.0	43.5	**21.8**
DRMRSJ 112	37.6	26.4	31.4	**31.8**	36.3	13.3	15.7	**21.7**	28.3	67.5	0.0	42.1	**21.0**
ORM 2019-02	40.3	31.4	33.9	**35.2**	35.3	12.4	20.6	**22.8**	31.6	63.4	0.0	26.4	**13.2**
DRMRSJ 276	41.4	34.7	42.5	**39.5**	22.8	12.0	20.6	**18.5**	24.7	67.5	14.2	26.6	**20.4**
NPJ- 244	31.4	33.1	36.0	**33.5**	31.1	0.0	22.8	**18.0**	39.2	61.1	18.6	24.7	**21.6**
RH 1921	34.0	29.9	37.9	**33.9**	34.2	23.1	18.4	**25.3**	36.2	67.5	25.4	20.6	**23.0**
PBR 450	34.8	22.5	39.2	**32.2**	32.2	11.9	12.9	**19.0**	31.6	60.1	12.7	15.7	**14.2**
RHH 2003	25.0	31.6	12.3	**22.9**	16.8	18.1	15.7	**16.8**	39.2	67.5	12.7	30.0	**21.3**
DRMRHJ 1108	29.3	26.4	33.2	**29.6**	16.8	19.2	15.7	**17.2**	43.5	63.4	0.0	20.6	**10.3**
Pusa MH-57	22.3	33.2	42.5	**32.7**	7.4	12.1	15.7	**11.7**	29.9	60.1	0.0	49.3	**24.6**
0IJ1010	0.0	0.0	0.0	**0.0**	0.0	17.8	0.0	**5.9**	31.6	50.9	0.0	26.4	**13.2**
TKM- 20-1	0.0	0.0	0.0	**0.0**	0.0	18.5	0.0	**6.2**	37.7	36.2	0.0	46.5	**23.2**
RMT-19-17	0.0	0.0	0.0	**0.0**	0.0	12.9	0.0	**4.3**	43.5	53.8	0.0	46.4	**23.2**
ACNMM- 23	26.1	26.4	34.0	**28.8**	12.9	12.1	20.6	**15.2**	24.7	60.1	0.0	49.3	**24.7**
DRMRHT 1913	35.2	31.6	33.2	**33.3**	32.2	16.6	18.4	**22.4**	31.6	60.1	0.0	34.7	**17.4**
RGN-486	5.4	39.2	0.0	**14.9**	0.0	0.0	31.6	**10.5**	34.7	64.2	25.4	20.6	**23.0**
JM-13-3	24.9	31.6	40.5	**32.3**	22.8	0.0	22.8	**15.2**	24.7	-	22.2	20.6	**21.4**
PHR 8095	31.7	31.4	32.2	**31.8**	30.0	11.1	22.8	**21.3**	37.7	67.5	22.2	20.6	**21.4**
SVJH-66	35.2	30.0	37.9	**34.4**	36.3	13.1	15.7	**21.7**	42.1	64.2	22.2	33.2	**27.7**
RMX9906	25.1	31.6	35.3	**30.7**	21.4	12.2	18.4	**17.3**	24.7	67.5	18.6	24.7	**21.6**
18J029C	21.2	29.9	23.3	**24.8**	0.0	18.0	20.6	**12.9**	28.3	63.4	14.2	20.6	**17.4**
PT- 2018-09	0.0	0.0	0.0	**0.0**	0.0	12.2	0.0	**4.1**	12.9	-	14.2	37.7	**25.9**
DRMRCI- 128	0.0	2.0	0.0	**0.7**	0.0	13.3	0.0	**4.4**	28.3	71.5	0.0	20.6	**10.3**
NPJ- 243	19.6	15.7	33.2	**22.8**	0.0	12.0	12.9	**8.3**	31.6	63.4	0.0	28.3	**14.1**
TM 264	38.4	22.5	39.9	**33.6**	41.2	20.5	12.9	**24.8**	24.7	63.4	0.0	33.1	**16.6**
RHH 2002	30.1	30.0	25.8	**28.6**	25.3	18.7	20.6	**21.5**	20.6	63.4	0.0	36.3	**18.1**
DRMRHJ 2409	24.8	20.6	12.3	**19.2**	16.8	17.4	12.9	**15.7**	29.9	63.4	0.0	31.6	**15.8**
0IJ1034	4.6	2.0	0.0	**2.2**	0.0	13.0	0.0	**4.3**	26.4	63.4	0.0	24.7	**12.3**
SVJH-68	20.3	28.3	39.2	**29.2**	0.0	21.2	15.7	**12.3**	34.7	63.4	0.0	15.7	**7.8**

CAU- RM- 4-1-1	20.7	20.6	33.2	**24.8**	0.0	11.8	15.7	**9.2**	42.1	63.4	0.0	36.3	**18.1**
AKMS-20-1	35.5	36.3	39.9	**37.2**	34.2	13.0	20.6	**22.6**	24.7	90.0	0.0	24.2	**12.1**
Pusa MH-61	38.4	31.6	43.1	**37.7**	37.3	17.6	22.8	**25.9**	36.2	67.5	0.0	55.4	**27.7**
PT- 2015-8	0.0	22.5	0.0	**7.5**	0.0	12.1	0.0	**4.0**	24.7	53.8	0.0	47.9	**24.0**
RGN-500	27.5	36.2	36.6	**33.4**	20.0	21.4	31.6	**24.3**	39.2	71.5	0.0	42.1	**21.0**
RHH 2001	18.7	28.0	34.0	**26.9**	0.0	18.3	24.7	**14.3**	36.2	71.5	0.0	24.7	**12.3**
RMX9903	27.1	26.4	36.0	**29.8**	20.0	18.7	15.7	**18.1**	34.7	63.4	0.0	28.3	**14.1**
DRMRHJ 1403	30.5	18.4	38.6	**29.2**	25.3	13.6	12.9	**17.3**	43.5	63.4	0.0	29.9	**14.9**
TKM- 20-2	0.0	33.1	0.0	**11.0**	0.0	13.5	20.6	**11.4**	37.7	-	25.4	39.2	**32.3**
RMT-19-14	0.0	24.7	0.0	**8.2**	0.0	16.6	24.7	**13.8**	0.0	45.0	25.4	45.0	**35.2**
PHR 8076	35.5	31.6	26.6	**31.2**	31.1	11.9	15.7	**19.6**	28.3	63.4	22.2	29.9	**26.0**
RH 1920	32.6	31.6	25.8	**30.0**	33.2	17.9	20.6	**23.9**	45.0	63.4	22.2	18.4	**20.3**
DRMRHJ 908	0.0	28.3	33.9	**20.7**	0.0	12.5	18.4	**10.3**	39.2	63.4	22.2	26.4	**24.3**
CG toria 3	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	**0.0**	28.3	50.9	22.2	32.4	**27.3**
BAUT 08-08	0.0	2.0	0.0	**0.7**	0.0	17.2	12.9	**10.0**	12.9	53.8	14.2	45.0	**29.6**
LES 63	21.8	29.9	41.2	**31.0**	0.0	33.4	24.7	**19.4**	31.6	63.4	14.5	22.5	**18.5**
JC 36#	0.0	2.0	0.0	**0.7**	0.0	0.0	0.0	**0.0**	46.4	63.4	12.7	26.4	**19.5**
0IJ5001#	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	**0.0**	45.0	60.1	25.4	18.4	**21.9**
PYS- 2018-02	0.0	3.3	0.0	**1.1**	0.0	0.0	12.9	**4.3**	0.0	56.8	25.4	55.4	**40.4**
DRMRYS 201	0.0	2.0	0.0	**0.7**	0.0	0.0	0.0	**0.0**	43.5	53.8	18.6	46.5	**32.5**
DRMR 2018-19	0.0	2.0	0.0	**0.7**	0.0	0.0	0.0	**0.0**	28.3	67.5	14.2	64.2	**39.2**
ORT 2019-01	0.0	2.0	0.0	**0.7**	0.0	0.0	0.0	**0.0**	20.6	53.8	25.4	24.7	**25.0**
PDZ-15#	23.1	28.3	7.5	**19.6**	12.9	0.0	20.6	**11.2**	42.1	56.8	25.4	22.8	**24.1**
YSKM- 20-2	0.0	2.0	0.0	**0.7**	0.0	0.0	0.0	**0.0**	0.0	60.1	22.2	18.4	**20.3**
RH 1999-19	30.8	29.9	38.6	**33.1**	25.3	0.0	26.6	**17.3**	31.6	67.5	22.2	37.7	**29.9**
JT-14-5	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	**0.0**	37.7	-	22.2	36.2	**29.2**
LES 62	19.6	26.4	33.2	**26.4**	0.0	25.3	20.6	**15.3**	37.7	63.4	22.2	45.0	**33.6**
PDZ-14#	14.8	29.9	0.0	**14.9**	0.0	18.4	22.8	**13.7**	47.9	60.1	14.2	36.2	**25.2**
RH (OE)-1807	31.1	34.7	40.5	**35.4**	12.9	11.8	20.6	**15.1**	58.4	67.5	14.5	61.7	**38.1**
RMYS 1	0.0	2.0	0.0	**0.7**	0.0	0.0	0.0	**0.0**	24.7	56.8	0.0	55.2	**27.6**
YSKM- 20-1	0.0	2.0	0.0	**0.7**	0.0	0.0	0.0	**0.0**	20.6	53.8	0.0	59.0	**29.5**
DRMRYS 202	0.0	2.0	0.0	**0.7**	0.0	17.6	15.7	**11.1**	34.7	53.8	18.6	46.4	**32.5**
RH 1999-22	34.2	26.4	33.9	**31.5**	27.7	18.8	18.4	**21.7**	31.6	63.4	18.6	49.3	**34.0**
JC 32#	18.2	29.9	0.0	**16.0**	0.0	13.9	24.7	**12.9**	37.7	63.4	22.2	36.2	**29.2**
RMYS 2	35.1	28.3	34.6	**32.7**	27.7	13.9	15.7	**19.1**	33.1	67.5	0.0	20.6	**10.3**
CG toria 4	0.0	2.0	0.0	**0.7**	0.0	17.2	0.0	**5.7**	0.0	57.1	0.0	76.7	**38.4**
DRMRCI- 130	36.1	29.9	33.2	**33.1**	34.2	13.0	22.8	**23.3**	24.7	63.4	0.0	37.7	**18.8**
RH (OE)-1804	28.0	24.7	27.4	**26.7**	25.3	0.0	0.0	**8.4**	46.4	61.1	0.0	66.9	**33.5**
PYS- 2017-6	0.0	2.0	0.0	**0.7**	0.0	0.0	0.0	**0.0**	15.7	61.1	0.0	45.0	**22.5**
DRMRHJ 2520	35.5	33.1	34.6	**34.4**	28.9	20.0	24.7	**24.5**	46.4	76.7	0.0	33.1	**16.6**
NPJ- 245	24.6	22.5	26.6	**24.6**	7.4	0.0	20.6	**9.3**	43.5	64.2	0.0	34.7	**17.4**
RGN-494	19.6	37.7	12.9	**23.4**	0.0	22.5	24.7	**15.7**	37.7	71.5	18.6	24.2	**21.4**
Rohini (A4A5)-491	0.0	0.0	0.0	**0.0**	0.0	13.7	0.0	**4.6**	50.8	67.5	18.6	43.5	**31.1**
Varuna (A4A5)-936-279	0.0	0.0	0.0	**0.0**	0.0	21.2	0.0	**7.1**	43.5	63.4	22.2	39.1	**30.6**
Pusa Bold (Parent)	28.1	36.2	36.6	**33.6**	12.9	12.7	24.7	**16.8**	31.6	60.1	5.8	31.4	**18.6**
RL 1359 (SC)	36.1	30.0	33.2	**33.1**	31.1	0.0	22.8	**18.0**	29.9	67.5	5.8	36.2	**21.0**
PT 303 (*Br*-T)	0.0	17.8	0.0	**5.9**	0.0	0.0	15.7	**5.2**	15.7	64.2	12.7	50.9	**31.8**
NRCYS-5-2 (*Br*-YS)	0.0	2.0	0.0	**0.7**	0.0	0.0	0.0	**0.0**	12.9	53.8	14.2	31.4	**22.8**
KMR (L)- 20-5	30.1	33.1	35.3	**32.8**	21.4	30.0	20.6	**24.0**	34.7	80.8	12.7	28.0	**20.3**
NPJ- 246	5.4	2.0	26.6	**11.4**	0.0	17.3	0.0	**5.8**	24.7	48.3	12.7	22.8	**17.7**
TM 179-2	27.7	15.7	12.3	**18.5**	21.4	20.5	12.9	**18.3**	20.6	63.4	25.4	49.3	**37.4**
PB (A4A5)-842	0.0	2.0	0.0	**0.7**	0.0	13.0	0.0	**4.3**	20.6	63.4	22.2	26.6	**24.4**
Rohini (Parent)	39.3	36.2	31.4	**35.7**	46.0	0.0	31.6	**25.9**	40.7	63.4	22.2	37.7	**29.9**
Rohini (SC)	38.2	33.2	34.0	**35.1**	43.1	0.0	22.8	**22.0**	34.7	67.5	22.2	26.4	**24.3**
PHR 2 (TC-AB)	0.0	29.9	34.6	**21.5**	0.0	0.0	15.7	**5.2**	37.7	71.5	22.2	22.5	**22.3**
DLSC 1 (*Bc*)	0.0	0.0	0.0	**0.0**	0.0	12.4	0.0	**4.1**	0.0	0.0	14.2	15.7	**14.9**
KMR (L)- 20-6	27.8	39.2	41.2	**36.1**	12.9	13.0	28.3	**18.1**	43.5	63.4	14.2	24.7	**19.4**
PRL- 2017-2	0.0	26.4	9.6	**12.0**	0.0	21.3	15.7	**12.3**	31.6	76.7	16.7	39.1	**27.9**
PJK (A4A5)-21	0.0	0.0	12.9	**4.3**	0.0	13.7	0.0	**4.6**	15.7	56.8	16.7	26.6	**21.6**
RTM 314 (*Es*)	0.0	0.0	0.0	**0.0**	0.0	13.4	0.0	**4.5**	0.0	0.0	22.2	75.0	**48.6**
Varuna (Parent)	28.7	33.1	39.9	**33.9**	25.3	12.5	24.7	**20.9**	37.7	60.1	27.3	37.7	**32.5**
PAB- 2014-4	32.8	34.7	34.3	**33.9**	34.2	16.4	28.3	**26.3**	37.7	80.8	25.4	20.6	**23.0**
RGN-488	20.4	36.2	33.2	**30.0**	0.0	17.6	24.7	**14.1**	42.1	80.8	22.2	24.7	**23.4**
HUJM- 19-18	14.8	34.7	38.6	**29.4**	0.0	12.8	15.7	**9.5**	37.7	64.2	22.2	18.4	**20.3**
Pusa Jaikisan (Parent)	36.0	26.4	39.2	**33.9**	21.4	17.9	15.7	**18.3**	31.6	60.1	25.4	31.4	**28.4**
GSL 1 (*Bn*)	0.0	0.0	0.0	**0.0**	0.0	21.0	0.0	**7.0**	0.0	36.2	25.4	26.4	**25.9**
BIOYSR (RC-WR)	36.1	29.9	0.0	**22.0**	24.1	23.4	18.4	**22.0**	37.7	67.5	25.4	20.6	**23.0**
CD(*P*=0.05)	**3.9**	**6.4**	**4.2**	**-**	**5.6**	**3.0**	**4.5**	**-**	**4.6**	**12.7**	**4.9**	**11.0**	**-**
CV (%)	**9.5**	**14.2**	**8.6**	**-**	**18.5**	**12.0**	**14.8**	**-**	**7.5**	**10.3**	**20.2**	**17.1**	**-**

***Data of SGN, LDH (WR, SR), JAG, MOR (SR) are not included as the disease severity/incidence was < 20% in SC**

Table 4.7.1: Assessment of yield loss and management of Alternaria blight in rice-fellow mustard cropping system

Treatments	% AB severity (90 DAS)					% ABP	Seed yield (kg/ha)					1000 Seed weight (g)	% PM (100 DAS)	B:C ratio		IBCR
	DOL	JAG	SHL	Mean	% disease reduction over control	SHL	DOL	JAG	SHL	Mean	% yield increase over control	JAG	JAG	JAG	SHL	SHL
Iprodione 50WP -FS @ 0.2%	11.1	22.3	-	**16.7**	**52.6**	-	1665	1845	-	**1755**	**70.1**	7.3	21.85	2.9	-	-
Tebuconazole 50%+ trifloxistrobin 25% WG-FS @ 0.5g/l	5.5	21.4	21.5	**16.1**	**54.3**	16.6	1780	2022	833	**1545**	**49.7**	6.7	19.74	3.0	2.0	2.75
Soil application of Potash 40 kg/ ha	29.9	26.9	29.6	**28.8**	**18.2**	23.1	1361	2022	639	**1341**	**29.9**	7.2	30.59	3.2	1.5	0.67
ST+FS with *Trichoderma harzianum* @ 10g/ kg seed	16.2	26.6	30.4	**24.4**	**30.7**	22.4	1580	1700	483	**1254**	**21.5**	7.1	29.54	2.4	1.9	9.01
Lower three leaf removal at 45 DAS	22.2	25.6	30.0	**25.9**	**26.4**	22.0	1486	1811	560	**1286**	**24.6**	8.0	29.54	2.7	1.8	4.22
Garlic bulb extract @ 1% w/v (ST+FS)	24.5	24.1	21.5	**23.4**	**33.5**	16.6	1435	1811	851	**1366**	**32.4**	8.6	25.2	2.8	2.3	11.98
PGPR	29.9	26.2	31.7	**29.3**	**16.8**	25.8	1361	1622	463	**1149**	**11.3**	6.7	30.64	2.6	1.4	0.52
Check	40.6	29.3	35.6	**35.2**	**0.0**	27.3	1182	1444	469	**1032**	**0.0**	6.9	37.84	2.3	1.4	-
CD (5%)	**2.7**	**1.8**	**4.3**	-	-	**3.1**	**90.8**	**1.2**	**191.0**	-	-	**0.97**	**1.74**	-	-	-
CV	**6.9**	**4.0**	**8.3**	-	-	**7.9**	**3.5**	**3.8**	**17.3**	-	-	**7.52**	**3.5**	-	-	-

Table 4.8: Epidemiology of Alternaria blight, white rust and downy mildew

Table 4.8.1 a: Epidemiology of white rust (PNT)

Date of sowing	First appearance of WR (DAS)	% WR disease severity																							
		Days after sowing (DAS)																							
Varuna		**50**	**53**	**56**	**59**	**62**	**65**	**68**	**71**	**74**	**77**	**80**	**83**	**86**	**89**	**92**	**95**	**98**	**101**	**104**	**107**	**110**	**113**	**115**	**118**	**121**
1-Oct	**71**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	2.0	2.0	5.0	5.0	5.0	5.0	10.0	15.0	15.0	20.0	25.0	25.0	20.0	15.0	10.0	10.0
8-Oct	**64**	0.0	0.0	0.0	0.0	0.0	1.0	1.0	2.0	2.0	2.0	5.0	5.0	5.0	7.0	7.0	10.0	15.0	20.0	30.0	40.0	45.0	30.0	20.0	10.0	10.0
15-Oct	**57**	0.0	0.0	0.0	1.0	2.0	5.0	5.0	7.0	7.0	10.0	20.0	25.0	30.0	35.0	40.0	45.0	45.0	60.0	60.0	65.0	65.0	40.0	25.0	5.0	5.0
22-Oct	**50**	1.0	1.0	2.0	4.0	5.0	10.0	15.0	20.0	20.0	25.0	25.0	30.0	30.0	35.0	35.0	40.0	45.0	50.0	55.0	60.0	60.0	30.0	10.0	5.0	5.0
29-Oct	**43**	1.0	2.0	3.0	3.0	5.0	5.0	10.0	30.0	40.0	50.0	55.0	55.0	60.0	65.0	65.0	50.0	45.0	45.0	40.0	35.0	35.0	25.0	25.0	25.0	20.0
5-Nov	**54**	0.0	0.0	1.0	2.0	2.0	2.0	5.0	10.0	25.0	40.0	50.0	60.0	65.0	65.0	70.0	55.0	55.0	55.0	50.0	30.0	30.0	20.0	15.0	15.0	15.0
12-Nov	**47**	2.0	2.0	2.0	3.0	30.0	30.0	60.0	60.0	60.0	55.0	50.0	50.0	50.0	40.0	40.0	35.0	35.0	35.0	30.0	25.0	25.0	20.0	10.0	10.0	10.0
19-Nov	**56**	0.0	0.0	1.0	3.0	10.0	15.0	30.0	40.0	55.0	55.0	45.0	40.0	35.0	30.0	30.0	25.0	25.0	25.0	20.0	20.0	20.0	15.0	15.0	15.0	15.0
Kranti																										
1-Oct	**71**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	2.0	2.0	5.0	5.0	10.0	10.0	15.0	20.0	20.0	25.0	30.0	30.0	25.0	20.0	10.0	10.0
8-Oct	**64**	0.0	0.0	0.0	0.0	0.0	1.0	1.0	2.0	2.0	2.0	5.0	5.0	5.0	10.0	10.0	15.0	20.0	25.0	35.0	40.0	45.0	40.0	25.0	10.0	10.0
15-Oct	**57**	0.0	0.0	0.0	1.0	2.0	5.0	5.0	7.0	10.0	15.0	25.0	30.0	35.0	35.0	40.0	45.0	45.0	60.0	60.0	65.0	65.0	40.0	25.0	5.0	5.0
22-Oct	**50**	1.0	1.0	2.0	4.0	5.0	10.0	15.0	20.0	25.0	30.0	30.0	35.0	35.0	35.0	45.0	45.0	50.0	50.0	55.0	60.0	60.0	30.0	10.0	5.0	5.0
29-Oct	**43**	1.0	2.0	3.0	3.0	5.0	5.0	10.0	30.0	45.0	50.0	55.0	55.0	60.0	65.0	65.0	55.0	50.0	45.0	40.0	35.0	35.0	25.0	25.0	25.0	20.0
5-Nov	**54**	0.0	0.0	1.0	2.0	2.0	2.0	5.0	10.0	30.0	40.0	50.0	60.0	65.0	65.0	75.0	60.0	55.0	55.0	50.0	30.0	30.0	20.0	15.0	15.0	15.0
12-Nov	**47**	2.0	2.0	2.0	3.0	30.0	30.0	60.0	60.0	60.0	55.0	50.0	50.0	50.0	40.0	40.0	35.0	35.0	35.0	30.0	25.0	25.0	20.0	10.0	10.0	10.0
19-Nov	**56**	0.0	0.0	1.0	3.0	10.0	15.0	30.0	40.0	55.0	55.0	45.0	40.0	35.0	30.0	30.0	25.0	25.0	25.0	20.0	20.0	20.0	15.0	15.0	15.0	15.0

Table 4.8.1 b: Epidemiology of Alternaria blight disease on leaf (PNT)

Date of sowing	First appearance of ABL (DAS)	% ABL severity (%)																							
		Days after sowing (DAS)																							
Varuna		50	53	56	59	62	65	68	71	74	77	80	83	86	89	92	95	98	101	104	107	110	113	115	118
1-Oct	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	5.0	5.0	5.0	5.0	5.0	5.0	10.0	15.0	15.0	25.0	25.0	40.0	50.0	50.0	65.0	70.0
8-Oct	67	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	2.0	2.0	2.0	5.0	10.0	10.0	20.0	20.0	45.0	50.0	50.0	55.0	60.0	65.0	70.0	75.0
15-Oct	60	0.0	0.0	0.0	0.0	2.0	2.0	2.0	2.0	2.0	2.0	5.0	5.0	10.0	15.0	20.0	40.0	50.0	55.0	55.0	60.0	65.0	65.0	70.0	70.0
22-Oct	50	2.0	2.0	3.0	3.0	3.0	3.0	5.0	10.0	10.0	20.0	20.0	25.0	35.0	35.0	35.0	45.0	50.0	50.0	55.0	55.0	60.0	60.0	65.0	65.0
29-Oct	54	0.0	0.0	1.0	2.0	3.0	3.0	3.0	3.0	3.0	5.0	5.0	10.0	25.0	35.0	35.0	35.0	40.0	45.0	45.0	45.0	50.0	55.0	55.0	55.0
5-Nov	57	0.0	0.0	0.0	1.0	1.0	1.0	2.0	2.0	5.0	5.0	15.0	15.0	15.0	25.0	25.0	30.0	30.0	35.0	35.0	35.0	40.0	40.0	45.0	45.0
12-Nov	53	0.0	1.0	1.0	1.0	1.0	1.0	2.0	5.0	5.0	10.0	10.0	20.0	20.0	20.0	25.0	25.0	25.0	30.0	30.0	30.0	40.0	45.0	45.0	50.0
19-Nov	53	0.0	1.0	1.0	2.0	2.0	2.0	2.0	5.0	5.0	5.0	20.0	20.0	20.0	25.0	25.0	30.0	30.0	30.0	35.0	35.0	40.0	40.0	45.0	45.0
Kranti																									
1-Oct	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	5.0	5.0	5.0	5.0	5.0	5.0	10.0	20.0	20.0	25.0	25.0	40.0	50.0	50.0	65.0	70.0
8-Oct	67	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	2.0	2.0	2.0	5.0	10.0	10.0	20.0	25.0	45.0	50.0	50.0	55.0	60.0	65.0	70.0	75.0
15-Oct	60	0.0	0.0	0.0	0.0	2.0	2.0	2.0	2.0	2.0	2.0	5.0	5.0	10.0	15.0	20.0	45.0	50.0	55.0	55.0	60.0	65.0	70.0	75.0	75.0
22-Oct	50	2.0	2.0	3.0	3.0	3.0	3.0	5.0	10.0	10.0	20.0	20.0	25.0	35.0	35.0	35.0	50.0	55.0	50.0	55.0	55.0	60.0	65.0	70.0	70.0
29-Oct	54	0.0	0.0	1.0	2.0	3.0	3.0	3.0	3.0	3.0	5.0	5.0	10.0	25.0	35.0	35.0	40.0	40.0	45.0	45.0	45.0	50.0	55.0	55.0	55.0
5-Nov	57	0.0	0.0	0.0	1.0	1.0	1.0	2.0	2.0	5.0	5.0	15.0	15.0	15.0	25.0	25.0	30.0	30.0	35.0	35.0	35.0	40.0	40.0	45.0	45.0
12-Nov	53	0.0	1.0	1.0	1.0	1.0	1.0	2.0	5.0	5.0	10.0	10.0	20.0	20.0	20.0	25.0	25.0	25.0	30.0	30.0	30.0	40.0	45.0	45.0	50.0
19-Nov	53	0.0	1.0	1.0	2.0	2.0	2.0	2.0	5.0	5.0	5.0	20.0	20.0	20.0	25.0	25.0	30.0	30.0	30.0	35.0	35.0	40.0	40.0	45.0	45.0

Table 4.8.1 c: Epidemiology of Alternaria pod blight and Downy mildew (PNT)

Date of sowing	First appearance of ABP (DAS)	% ABP severity																	First appearance of DM (DAS)	% DM disease severity									Seed yield (q/ha)
		Days after sowing (DAS)																		Days after sowing									
Varuna		83	86	89	92	95	98	101	104	107	110	113	116	119	122	125	128	131		8	11	14	17	20	23	25	28	31	
1-Oct	122	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	45.0	60.0	60.0	23	0.0	0.0	0.0	0.0	0.0	10.0	10.0	15.0	15.0	24.0
8-Oct	120	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	45.0	55.0	65.0	16	0.0	0.0	0.0	5.0	10.0	10.0	20.0	25.0	10.0	21.3
15-Oct	113	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	20.0	35.0	40.0	45.0	45.0	70.0	9	0.0	5.0	5.0	20.0	40.0	35.0	30.0	25.0	10.0	20.0
22-Oct	106	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	5.0	15.0	35.0	35.0	40.0	45.0	45.0	50.0	8	5.0	5.0	5.0	30.0	55.0	45.0	40.0	35.0	20.0	18.7
29-Oct	102	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	15.0	30.0	35.0	35.0	35.0	40.0	40.0	45.0	45.0	14	0.0	0.0	50.0	65.0	55.0	45.0	40.0	25.0	20.0	16.0
5-Nov	95	0.0	0.0	0.0	0.0	5.0	20.0	20.0	25.0	25.0	25.0	30.0	30.0	30.0	35.0	35.0	35.0	40.0	13	0.0	0.0	60.0	65.0	60.0	45.0	30.0	30.0	25.0	13.3
12-Nov	88	0.0	0.0	2.0	10.0	10.0	10.0	15.0	15.0	15.0	20.0	20.0	20.0	25.0	25.0	30.0	30.0	40.0	13	0.0	0.0	25.0	70.0	65.0	60.0	55.0	45.0	40.0	10.7
19-Nov	81	2.0	5.0	5.0	10.0	10.0	15.0	15.0	15.0	20.0	20.0	20.0	25.0	25.0	25.0	30.0	30.0	30.0	16	0.0	0.0	0.0	40.0	70.0	70.0	50.0	35.0	35.0	8.0
Kranti																													
1-Oct	122	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0	60.0	23	0.0	0.0	0.0	0.0	0.0	10.0	10.0	15.0	15.0	25.3
8-Oct	120	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	45.0	55.0	65.0	16	0.0	0.0	0.0	5.0	10.0	10.0	25.0	25.0	10.0	22.7
15-Oct	113	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	20.0	35.0	40.0	45.0	45.0	70.0	9	0.0	5.0	5.0	25.0	40.0	35.0	30.0	25.0	10.0	21.3
22-Oct	106	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	5.0	15.0	35.0	35.0	40.0	45.0	45.0	50.0	8	5.0	5.0	5.0	30.0	60.0	50.0	45.0	35.0	20.0	20.0
29-Oct	102	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	15.0	30.0	35.0	35.0	35.0	40.0	40.0	45.0	45.0	14	0.0	0.0	55.0	70.0	60.0	45.0	40.0	25.0	20.0	17.3
5-Nov	95	0.0	0.0	0.0	0.0	5.0	20.0	20.0	25.0	25.0	25.0	30.0	30.0	30.0	35.0	35.0	35.0	40.0	13	0.0	0.0	65.0	70.0	65.0	50.0	40.0	30.0	25.0	14.7
12-Nov	88	0.0	0.0	2.0	10.0	10.0	10.0	15.0	15.0	15.0	20.0	20.0	20.0	25.0	25.0	30.0	30.0	40.0	13	0.0	0.0	25.0	70.0	70.0	65.0	55.0	45.0	40.0	12.0
19-Nov	81	2.0	5.0	5.0	10.0	10.0	15.0	15.0	15.0	20.0	20.0	20.0	25.0	25.0	25.0	30.0	30.0	30.0	16	0.0	0.0	0.0	45.0	75.0	75.0	60.0	35.0	35.0	9.3

Table 4.8.2: Epidemiology of Alternaria blight (SHL)

Date of sowing	First appearance of ABL (DAS)	% ABL disease severity Days after sowing (DAS)								First appearance of ABP (DAS)	% ABP disease severity Days after sowing (DAS)								Yield (q/ha)	1000 seed wt (g)
Varuna		40	50	60	70	80	90	100	110		70	80	90	100	110	120	130	140		
1-Oct	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Oct	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Oct	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Oct	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Oct	45	0.0	6.1	8.0	12.1	17.1	19.3	23.1	31.7	95	0	0.0	0.0	6.5	15.7	19.7	0.0	0.0	18.7	5.0
5-Nov	43	0.0	6.5	8.7	14.2	18.2	21.1	27.2	36.9	91	0	0.0	0.0	9.1	16.9	22.2	0.0	0.0	17.3	4.8
12-Nov	39	0.0	6.7	11.3	16.2	19.1	26.2	31.2	39.6	88	0	0.0	7.5	9.6	13.2	25.9	0.0	0.0	16.7	4.3
19-Nov	37	3.9	7.1	12.3	17.3	26.2	29.5	36.9	0.0	85	0	0.0	11.2	17.4	22.8	0.0	0.0	0.0	16.0	4.2
TM 2																				
1-Oct	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Oct	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Oct	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Oct	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Oct	45	0.0	6.7	8.5	12.9	19.3	22.1	25.7	32.1	93	0.0	0.0	0.0	7.5	17.9	19.9	0.0	0.0	12.7	3.4
5-Nov	41	0.0	7.3	9.7	15.1	19.6	24.7	31.2	37.8	90	0.0	0.0	0.0	8.9	19.3	22.8	0.0	0.0	11.3	3.0
12-Nov	37	0.0	7.4	12.1	17.2	21.3	28.4	33.7	41.5	88	0.0	0.0	8.1	11.2	18.7	26.8	0.0	0.0	8.7	2.7
19-Nov	35	4.4	8.1	13.6	18.2	27.1	34.8	39.8	0.0	83	0.0	0.0	12.6	18.1	23.2	0.0	0.0	0.0	8.0	2.6

Table 4.8.3: Epidemiology of Powdery mildew (SKN)

Date of sowing	First appearance (DAS)	% PM disease severity Days after sowing									Seed yield (q/ha)
		90	93	97	100	104	107	111	114	118	
Varuna											
1-Oct	-	-	-	-	-	-	-	-	-	-	15.7
8-Oct	-	-	-	-	-	-	-	-	-	-	11.6
15-Oct	102	-	-	-	-	0.7	1.9	5.0	8.6	12.5	11.1
22-Oct	95	-	-	2.2	6.0	10.5	15.0	19.2	23.5	28.8	10.4
29-Oct	93	-	-	2.3	4.7	7.5	12.0	17.0	23.5	-	9.8
5-Nov	92	-	5.3	10.0	16.0	22.0	44.5	65.5	84.0	-	8.9
12-Nov	91	-	5.4	15.5	37.0	61.0	83.0	93.0	-	-	8.5
19-Nov	89	4.0	17	44.5	69.0	84.0	97.0	-	-	-	7.3
GM-2											
1-Oct	-	-	-	-	-	-	-	-	-	-	16.5
8-Oct	-	-	-	-	-	-	-	-	-	-	15.8
15-Oct	101	-	-	-	-	0.3	1.5	3.9	8.2	10.9	15.1
22-Oct	98	-	-	-	5.0	8.1	12	16.6	20.5	25.2	13.6
29-Oct	93	-	-	1.4	3.4	7.0	11.2	16.5	21.3	-	11.5
5-Nov	92	-	3.1	8.2	14.0	19.5	34.5	54.0	70.5	-	9.5
12-Nov	90	-	3.7	10.5	28.0	50.5	73.5	87.5	-	-	9.1
19-Nov	89	3.0	14.5	37.5	59.0	76.0	90.5	-	-	-	7.9

Table 4.8.4 a: Epidemiology of AB and SR (MOR)

Date of Sowing	First appearance of ABL (DAS)	% ABL severity							First appearance of SR (DAS)	% SR incidence					Plant population	Seed yield (q/ha)	1000-seed weight (gm)
		Days after sowing (DAS)								Days after sowing (DAS)							
Varuna		**40**	**50**	**60**	**70**	**80**	**90**	**100**		**90**	**100**	**110**	**120**	**130**			
1-Oct	**88**	-	-	-	-	0.9	3.1	2.2	**-**	-	-	-	-	-	210	20.2	4.43
8-Oct	**88**	-	-	-	0.0	1.8	2.2	2.7	**-**	-	-	-	-	-	220	32.8	5.01
15-Oct	**85**	-	-	-	0.0	2.2	2.2	3.1	**-**	-	-	-	-	-	248	32.9	5.04
22-Oct	**80**	-	-	0.0	1.8	2.2	2.7	3.6	**120**	-	-	-	10.0	30.0	212	31.9	4.15
29-Oct	**75**	-	-	1.3	1.3	2.7	3.1	-	**98**	5.0	10.0	10.0	15.0	40.0	223	31.3	4.04
5-Nov	**58**	-	0.9	1.8	1.3	3.1	-	-	**95**	5.0	10.0	15.0	15.0	-	230	25.7	3.86
12-Nov	**52**	0.0	0.4	2.2	2.2	3.1	-	-	**92**	10.0	20.0	25.0	-	-	218	21.1	3.65
19-Nov	**48**	0.9	1.8	-	-	-	-	-	**90**	10.0	15.0	-	-	-	227	17.7	3.79
Rohini																	
1-Oct	**90**	-	-	-	-	-	0.9	1.8	**-**	-	-	-	-	-	201	21.5	4.91
8-Oct	**91**	-	-	-	-	-	1.3	2.2	**-**	-	-	-	-	-	246	33.1	4.88
15-Oct	**78**	-	-	-	0.9	2.2	2.7	3.6	**-**	-	-	-	-	-	229	34.0	5.10
22-Oct	**65**	-	-	0.4	0.9	1.3	1.8	-	**120**	-	-	-	10.0	35.0	245	32.3	4.35
29-Oct	**62**	-	-	0.9	1.8	2.2	-	-	**98**	5.0	10.0	15.0	20.0	40.0	247	32.1	4.49
5-Nov	**56**	-	1.8	2.2	3.1	-	-	-	**95**	10.0	10.0	15.0	25.0	-	228	25.9	4.09
12-Nov	**51**	-	2.2	2.7	-	-	-	-	**92**	5.0	20.0	25.0	-	-	242	24.1	4.13
19-Nov	**47**	**1.8**	**2.2**	**-**	**-**	**-**	**-**	**-**	**90**	10.0	15.0	-	-	-	238	22.3	3.71

Table 4.8.4 b: Epidemiology of white rust, SH and PM (MOR)

Date of sowing	First appearance of WR (DAS)	% WR severity									First appearance of SH (DAS)	% staghead incidence			First Appearance of PM (DAS)	% PM severity					
		Days after sowing (DAS)										Days after sowing (DAS)				Days after sowing (DAS)					
Varuna		**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**		**110**	**120**	**130**		**80**	**90**	**100**	**110**	**120**	**130**
1-Oct	**90**	-	-	-	-	-	0.9	1.8	2.7	-	-	-	-	-	**110**	-	-	-	3.1	25.3	26.2
8-Oct	**81**	-	-	-	-	0.9	1.3	2.7	4.9	-	-	-	-	-	**110**	-	-	-	5.3	26.7	27.1
15-Oct	**70**	-	-	-	-	1.3	1.8	2.2	3.6	-	-	-	-	-	**112**	-	-	-	6.2	28.0	28.0
22-Oct	**70**	-	-	-	1.8	2.2	2.7	3.1	4.9	-	**120**	-	6.7	12.5	**96**	-	-	3.3	7.1	29.3	30.7
29-Oct	**60**	-	-	-	0.9	3.6	4.4	4.9	11.6	-	**110**	16.7	20.0	26.7	**87**	-	3.3	3.3	7.6	30.2	31.1
5-Nov	**55**	-	-	0.9	1.8	2.2	3.1	25.8	33.3	42.7	**98**	17.6	23.3	28.6	**87**	-	3.3	7.6	8.9	31.6	32.4
12-Nov	**48**	-	0.0	1.8	4.0	5.3	29.8	34.7	35.1	44.4	**90**	23.3	33.3	36.6	**85**	-	8.4	9.3	10.2	40.4	43.1
19-Nov	**48**	-	1.8	3.1	4.9	12.9	30.7	35.1	36	-	**90**	25.0	36.6	-	**80**	10.2	11.1	17.3	20.4	44.4	50.2
Rohini																					
1-Oct	**90**	-	-	-	-	1.3	1.8	3.6	4.0	-	-	-	-	-	**110**	-	-	-	3.33	25.3	30.1
8-Oct	**81**	-	-	-	1.8	2.2	4.0	5.3	5.8	-	-	-	-	-	**112**	-	-	-	4.9	26.7	31.6
15-Oct	**70**	-	-	-	1.3	1.8	3.6	6.3	14.7	-	-	-	-	-	**115**	-	-	-	5.3	27.1	32.0
22-Oct	**70**	-	-	0.9	1.8	4.9	15.6	17.3	21.3	-	**118**	3.3	6.7	12.5	**98**	-	-	3.3	6.7	31.6	37.3
29-Oct	**60**	-	-	1.3	2.2	3.6	17.8	29.3	33.3	43.1	**115**	13.3	23.3	26.7	**95**	-	-	3.3	7.1	38.2	40.4
5-Nov	**55**	-	0.0	1.3	2.2	25.8	33.8	34.2	35.1	44.9	**100**	17.6	23.3	28.6	**90**	-	3.3	5.3	8.9	39.6	46.2
12-Nov	**48**	-	0.9	3.6	21.8	30.7	34.2	35.6	36.0	-	**90**	23.3	28.6	40.2	**80**	3.33	4.4	6.2	11.1	41.3	49.3
19-Nov	**48**	1.3	4.0	16.4	26.2	31.6	33.8	36.4	36.3	-	**90**	25.0	36.6	-	**80**	3.33	5.8	7.6	16.4	44.4	51.8

Table 4.8.5: Epidemiology of Alternaria blight, WR and PM disease of mustard (JAG)

Date of sowing	Disease appearance of ABL (DAS)	Alternaria leaf blight disease severity (%)									WR appearance (DAS)	% WR severity (DAS)							Disease appearance of PM (DAS)	% PM severity (DAS)				Yield (q/ha)	1000-seed weight (gm)
		Days after sowing																							
Varuna	**DAS**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**DAS**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**DAS**	**90**	**100**	**110**	**120**		
1-Oct	**63**	0.0	0.0	0.0	2.7	4.7	13.7	17.0	7.7	0.0	**78**	0.0	0.0	0.0	0.0	4.2	8.0	0.0	**-**	0.0	0.0	0.0	0.0	16.1	4.11
8-Oct	**67**	0.0	0.0	0.0	0.7	7.3	11.0	3.7	0.0	0.0	**75**	0.0	0.0	0.0	2.4	6.3	10.0	0.0	**-**	0.0	0.0	0.0	0.0	16.5	4.44
15-Oct	**55**	0.0	0.0	0.7	1.3	7.7	12.3	3.0	0.0	0.0	**65**	0.0	0.0	2.2	4.2	12.0	16.2	0.0	**115**	0.0	0.0	0.0	22.5	17.4	4.12
22-Oct	**55**	0.0	0.0	0.7	7.0	10.0	4.0	0.0	0.0	0.0	**62**	0.0	0.0	3.4	6.3	12.6	18.0	0.0	**108**	0.0	0.0	10.6	30.0	13.2	4.41
29-Oct	**55**	0.0	0.0	3.3	4.7	16.7	4.3	0.0	0.0	0.0	**56**	0.0	2.2	6.3	10.0	18.0	22.0	0.0	**105**	0.0	8.4	25.6	36.0	14.2	4.15
5-Nov	**48**	0.0	1.7	7.7	7.0	19.3	15.0	1.3	0.0	0.0	**56**	0.0	2.4	6.0	12.8	22.6	34.0	6.0	**95**	0.0	15.6	30.4	40.0	13.6	4.04
12-Nov	**36**	1.3	7.7	11.7	32.7	30.0	10.0	0.0	0.0	0.0	**45**	3.2	6.4	20.4	26.0	34.0	36.0	8.6	**90**	4.5	20.0	40.6	60.2	10.5	4.8
19-Nov	**40**	0.0	4.0	17.7	33.3	8.3	0.0	0.0	0.0	0.0	**42**	2.0	6.0	10.4	24.1	30.0	38.2	6.0	**86**	16.4	26.4	44.2	64.5	7.4	4.6
CG Sarson																									
1-Oct	**55**	0.0	0.0	5.3	6.0	15.0	20.0	6.0	0.0	0.0	**84**	0.0	0.0	0.0	0.0	4.2	8.0	0.0	**-**	0.0	0.0	0.0	0.0	16.6	4.35
8-Oct	**58**	0.0	0.0	1.3	13.3	15.7	4.7	0.7	0.0	0.0	**75**	0.0	0.0	0.0	2.4	6.3	10.0	0.0	**-**	0.0	0.0	0.0	0.0	17.0	4.35
15-Oct	**46**	0.0	2.0	6.0	10.0	7.7	4.0	0.0	0.0	0.0	**64**	0.0	0.0	2.2	4.2	12.0	16.2	0.0	**110**	0.0	0.0	0.0	20.4	14.9	4.13
22-Oct	**48**	0.0	1.3	11.3	21.0	8.7	0.0	0.0	0.0	0.0	**62**	0.0	0.0	3.4	6.3	12.6	18.0	0.0	**108**	0.0	0.0	6.2	26.3	12.3	4.8
29-Oct	**46**	0.0	11.0	13.7	31.7	7.7	0.0	0.0	0.0	0.0	**56**	0.0	2.2	6.3	10.0	18.0	22.0	0.0	**105**	0.0	4.6	22.2	32.6	12.6	4.11
5-Nov	**46**	0.0	12.7	22.0	21.7	14.7	0.0	0.0	0.0	0.0	**52**	0.0	2.4	6.0	12.8	22.6	34.0	6.0	**92**	0.0	12.8	28.6	36.2	11.8	4.25
12-Nov	**35**	8.7	14.3	35.0	29.3	17.0	0.0	0.0	0.0	0.0	**44**	3.2	6.4	20.4	26.0	34.0	36.0	8.6	**90**	4.0	20.6	38.0	56.2	9.0	4.8
19-Nov	**35**	8.7	23.3	41.7	17.0	14.7	9.3	0.0	0.0	0.0	**42**	2.0	6.0	10.4	24.1	30.0	38.2	6.0	**84**	8.2	22.2	45.2	58.0	8.6	4.2

Table 4.8.6: Epidemiology of Alternaria blight desease (DOL)

Date of sowing	First appearance of ABL (DAS)	% ABL severity									
		Days after sowing									
Varuna		**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**
1-Oct	**62**	0.0	0.0	7.7	13.3	16.6	23.3	31.4	36.6	37.7	38.9
8-Oct	**55**	0.0	2.2	9.1	16.6	23.3	29.9	32.2	36.6	36.6	38.9
15-Oct	**48**	1.1	7.7	13.3	16.6	21.1	28.9	32.2	35.6	40.0	40.0
22-Oct	**41**	2.2	9.1	16.6	22.2	28.9	32.2	35.6	38.9	41.1	45.6
29-Oct	**34**	9.1	12.2	16.6	23.3	31.4	35.6	37.7	40.0	42.8	45.6
5-Nov	**27**	13.3	16.6	22.2	28.9	31.4	40.0	41.1	42.2	42.2	42.2
12-Nov	**20**	16.6	19.6	22.2	28.9	32.2	38.9	40.0	41.1	41.1	41.1
19-Nov	**13**	21.1	23.3	29.9	31.4	35.6	37.7	38.9	40.0	41.1	41.1
Rajendra Suflam											
1-Oct	**76**	0.0	0.0	0.0	2.2	9.1	16.6	22.2	28.9	32.2	35.6
8-Oct	**69**	0.0	0.0	1.1	9.1	12.2	16.6	21.1	29.9	32.2	35.6
15-Oct	**62**	0.0	0.0	7.7	9.1	12.2	16.6	24.4	29.9	36.7	37.7
22-Oct	**55**	0.0	4.4	13.3	16.6	19.6	22.2	28.9	31.4	36.6	38.9
29-Oct	**48**	1.1	7.7	11.1	16.6	21.1	23.3	29.9	31.4	35.6	37.7
5-Nov	**41**	5.5	9.1	13.3	16.6	22.2	28.9	31.4	35.6	37.7	37.7
12-Nov	**34**	11.1	16.6	21.1	23.3	28.9	31.4	33.3	35.6	35.6	37.7
19-Nov	**27**	12.2	16.6	23.3	24.4	28.9	31.4	35.6	37.7	37.7	37.7

Table 4.8.7a: Epidemiology of white rust disease at Hisar

Date of sowing	First appearance of WR (DAS)	% WR severity																										
		Days after sowing																										
Varuna		36	40	43	47	50	54	57	61	64	68	71	75	78	82	85	89	92	96	99	103	106	110	113	117	120	124
1-Oct	74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.9	1.0	1.7	1.7	2.5	2.5	2.5	2.5	3.3	3.3	3.3	3.3	4.2
8-Oct	55	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	1.7	1.7	2.5	2.5	4.2	5.0	5.8	7.5	9.1	12.8	15.6	16.7	17.5	19.1	20.0	20.0	20.0	20.5
15-Oct	48	0.0	0.0	0.0	0.0	0.8	1.7	5.0	13.3	19.1	24.1	29.2	35.8	37.5	39.1	40.0	40.0	40.0	40.8	40.8	41.7	41.7	42.5	42.5	43.3	43.3	43.3
22-Oct	51	0.0	0.0	0.0	0.0	0.0	0.8	4.1	6.7	10.8	13.3	15.8	19.1	26.7	30.0	35.8	37.5	40.0	41.7	43.3	44.1	45.0	45.8	45.8	45.8	-	-
29-Oct	47	0.0	0.0	0.0	0.8	1.7	2.5	5.8	6.7	9.1	10.8	16.7	24.1	33.3	39.1	42.5	43.3	44.1	45.0	45.8	46.7	47.5	47.5	-	-	-	-
5-Nov	40	0.0	0.8	0.9	1.7	3.3	4.2	7.5	10.0	14.1	17.5	25.8	34.1	41.7	44.1	46.7	47.5	48.3	48.3	49.1	49.1	-	-	-	-	-	-
12-Nov	39	0.0	0.8	1.7	2.5	3.3	5.0	6.7	9.1	13.3	16.7	20.5	25.8	29.1	35.8	39.1	41.7	43.3	46.7	-	-	-	-	-	-	-	-
19-Nov	44	0.0	0.0	0.0	0.8	1.7	2.5	3.3	4.2	8.3	11.7	15.8	20.0	22.5	25.8	27.5	27.5	-	-	-	-	-	-	-	-	-	-
RH 30																											
1-Oct	67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.8	0.8	1.7	1.7	1.7	2.5	2.5	2.5	2.5	3.3	3.3	3.3	4.2	4.2	4.2
8-Oct	54	0.0	0.0	0.0	0.0	0.0	0.8	0.9	1.7	2.5	3.3	3.3	4.2	5.8	8.3	9.1	13.3	16.7	18.3	19.1	20.0	20.5	21.1	22.2	23.4	23.4	24.4
15-Oct	43	0.0	0.0	0.8	0.9	1.7	3.3	7.5	15.0	24.1	30.0	34.1	37.5	40.0	42.5	43.3	45.0	45.8	46.7	46.7	47.5	47.5	48.3	48.3	49.1	49.1	49.1
22-Oct	51	0.0	0.0	0.0	0.0	0.0	0.8	5.0	7.5	11.7	14.1	16.7	20.8	28.3	31.7	36.7	38.3	42.5	43.3	45.0	45.8	46.7	46.7	47.5	47.5	-	-
29-Oct	45	0.0	0.0	0.0	0.8	2.5	3.3	6.7	8.3	10.8	13.3	18.3	25.8	34.1	40.0	43.3	45.8	46.7	47.5	48.3	48.3	49.1	49.1	-	-	-	-
5-Nov	38	0.0	0.8	1.7	2.5	4.2	6.7	8.3	11.7	15.0	18.3	27.5	36.7	42.5	45.0	47.5	48.3	49.1	50.0	50.8	50.8	-	-	-	-	-	-
12-Nov	36	0.8	0.8	3.3	4.2	5.0	5.8	8.3	10.0	15.8	18.3	23.3	26.7	33.3	38.3	40.8	44.1	46.7	48.3	-	-	-	-	-	-	-	-
19-Nov	43	0.0	0.0	0.8	1.7	2.5	3.3	5.0	6.7	11.7	15.6	18.7	23.3	27.5	30.0	33.4	36.7	-	-	-	-	-	-	-	-	-	-

Table 4.8.7 b: Epidemiology of staghead incidence at Hisar

Date of sowing	First appearance of SH (DAS)	Staghead incidence (%)																						Seed yield (q/ha)
		Days after sowing																						
Varuna		68	71	75	78	82	85	89	92	96	99	103	106	110	113	117	120	124	127	131	134	138	141	
1-Oct	131	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.0	3.0	3.0	33.8
8-Oct	119	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	11.9	17.8	17.8	17.8	-	-	30.8
15-Oct	79	0.0	0.0	0.0	0.0	0.7	0.7	1.4	2.1	4.3	7.1	11.4	12.8	13.6	15.7	19.3	29.9	35.7	37.1	-	-	-	-	26.6
22-Oct	101	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	3.1	11.0	23.3	23.9	24.5	-	-	-	-	-	-	23.4
29-Oct	94	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	7.5	19.7	40.1	46.2	46.9	-	-	-	-	-	-	-	-	20.6
5-Nov	89	0.0	0.0	0.0	0.0	0.0	0.0	0.7	6.0	19.2	41.0	47.0	47.7	-	-	-	-	-	-	-	-	-	-	19.0
12-Nov	85	0.0	0.0	0.0	0.0	0.0	0.7	6.6	12.5	34.6	35.2	-	-	-	-	-	-	-	-	-	-	-	-	17.5
19-Nov	82	0.0	0.0	0.0	0.0	0.6	4.3	18.5	20.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16.6
RH 30																								
1-Oct	117	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.8	2.7	4.6	4.6	4.6	4.6	4.6	32.9
8-Oct	107	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.5	2.3	9.1	20.5	24.2	25.0	25.0	-	-	30.1
15-Oct	68	0.6	0.6	0.6	0.6	0.6	1.9	2.5	3.1	4.9	7.4	15.4	17.3	21.6	25.3	32.1	38.2	40.1	41.9	-	-	-	-	25.5
22-Oct	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	3.9	12.4	24.0	27.1	41.1	42.6	-	-	-	-	-	23.0
29-Oct	93	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	9.4	24.7	45.9	47.6	48.9	-	-	-	-	-	-	-	-	20.0
5-Nov	82	0.0	0.0	0.0	0.0	0.8	1.5	3.0	9.8	28.8	44.7	49.2	49.8	-	-	-	-	-	-	-	-	-	-	18.0
12-Nov	78	0.0	0.0	0.0	0.7	1.4	2.7	16.9	28.4	37.1	39.9	-	-	-	-	-	-	-	-	-	-	-	-	16.7
19-Nov	78	0.0	0.0	0.0	0.6	3.1	6.7	19.6	22.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16.4

Table 4.8.7c: Epidemiology of Alternaria blight and SR disease at Hisar

Date of sowing	First appearance of AB (DAS)	% ABL severity (DAS)														First appearance of SR (DAS)	% SR incidence																	
		Days after sowing															Days after sowing																	
Varuna		**89**	**92**	**96**	**99**	**103**	**106**	**110**	**113**	**117**	**120**	**124**	**127**	**131**	**134**		**71**	**75**	**78**	**82**	**85**	**89**	**92**	**96**	**99**	**103**	**106**	**110**	**113**	**117**	**120**	**124**	**127**	**131**
1-Oct	**103**	0.0	0.0	0.0	0.0	0.6	0.6	0.8	0.8	1.7	1.7	2.5	3.3	4.2	5.0	**100**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	6.1	8.2	9.2	10.2	12.2	15.3	15.3	15.3
8-Oct	**89**	1.7	2.5	3.3	3.3	4.2	4.2	5.0	5.8	6.7	7.5	8.3	9.1	10.0	-	**91**	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.9	9.0	9.9	11.9	12.8	13.9	15.9	19.8	19.8	20.8	20.8
15-Oct	**99**	0.0	0.0	0.0	0.6	0.6	1.7	2.5	4.2	5.8	8.3	9.1	10.8	11.7	-	**87**	0.0	0.0	0.0	0.0	0.0	2.1	5.0	5.7	9.2	10.7	12.1	12.9	19.3	21.4	25.0	28.0		
22-Oct	**96**	0.0	0.0	0.8	1.7	2.5	5.8	7.5	10.8	13.3	17.5	19.1	-	-	-	**80**	0.0	0.0	0.0	2.5	5.5	6.7	8.0	9.8	11.1	13.5	20.9	23.3	27.6	30.7	-	-	-	-
29-Oct	**95**	0.0	0.0	1.7	3.3	5.0	7.5	11.7	14.1	18.3	19.1	23.3	25.8	-	-	**83**	0.0	0.0	0.0	0.0	2.0	3.4	6.1	8.8	19.1	23.8	25.9	29.3	36.1	-	-	-	-	-
5-Nov	**98**	0.0	0.0	0.0	1.7	3.3	8.3	13.3	22.5	26.7	30.0	-	-	-	-	**79**	0.0	0.0	0.0	1.3	5.3	9.3	19.9	25.2	27.8	32.5	49.6	-	-	-	-	-	-	-
12-Nov	**92**	0.0	1.7	3.3	7.5	9.1	15.8	19.1	21.7	-	-	-	-	-	-	**76**	0.0	0.0	1.5	6.6	9.6	14.0	18.4	20.6	28.7	-	-	-	-	-	-	-	-	-
19-Nov	**89**	0.7	2.5	6.7	11.7	16.7	19.1	-	-	-	-	-	-	-	-	**71**	0.6	3.1	5.6	7.4	11.1	13.7	19.8	-	-	-	-	-	-	-	-	-	-	-
RH 30																																		
1-Oct	**103**	0.0	0.0	0.0	0.0	0.7	1.7	3.3	4.2	4.2	5.0	5.8	6.7	6.7	7.5	**99**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.8	6.4	9.2	11.0	13.8	14.7	14.7	16.5	17.4
8-Oct	**88**	1.7	2.5	3.3	4.2	5.0	5.8	6.7	7.5	9.1	10.8	11.7	12.5	12.5	-	**91**	0.0	0.0	0.0	0.0	0.0	0.0	1.5	3.8	9.1	11.3	12.9	13.6	14.3	16.7	21.2	24.2	24.2	24.2
15-Oct	**97**	0.0	0.0	0.0	1.7	2.5	4.2	7.5	10.0	12.5	13.3	14.1	15.0	15.8	-	**85**	0.0	0.0	0.0	0.0	0.6	2.5	5.5	8.0	11.1	13.0	14.9	16.1	23.5	25.9	30.9	31.5	-	-
22-Oct	**96**	0.0	0.0	0.8	1.7	3.3	7.5	9.1	12.5	14.1	18.3	21.7	-	-	-	**78**	0.0	0.0	0.8	2.3	7.8	8.5	10.1	11.6	14.7	25.6	28.7	29.5	34.9	34.9	-	-	-	-
29-Oct	**89**	0.7	1.7	3.3	6.7	8.3	13.3	17.5	20.8	23.3	25.8	26.7	27.5	-	-	**75**	0.0	0.0	0.0	0.0	2.3	3.9	7.0	10.1	14.0	29.5	34.1	37.2	40.3	-	-	-	-	-
5-Nov	**97**	0.0	0.0	0.0	1.7	3.3	6.7	11.7	19.1	26.7	31.7	-	-	-	-	**79**	0.0	0.0	0.0	2.3	6.1	11.4	25.0	37.1	40.2	46.1	51.5	-	-	-	-	-	-	-
12-Nov	**90**	0.0	1.7	2.5	6.7	10.8	17.5	20.0	22.5	-	-	-	-	-	-	**75**	0.0	0.0	0.7	2.0	4.1	12.2	23.6	27.7	32.4	-	-	-	-	-	-	-	-	-
19-Nov	**89**	0.8	3.3	7.5	13.3	17.5	20.8	-	-	-	-	-	-	-	-	**70**	1.2	1.8	3.1	9.8	13.5	19.6	21.5	-	-	-	-	-	-	-	-	-	-	-

Table 4.8.8a: Epidemiology of Alternaria blight (JHS)

Date of Sowing	First appearance of ABL (DAS)	% ABL severity						First appearance of ABP (DAS)	ABP severity (%)						Seed yield (q/ha)
		Days after sowing							Days after sowing						
RH-406		**60**	**70**	**80**	**90**	**100**	**110**		**70**	**80**	**90**	**100**	**110**	**120**	
1-Oct	**-**	-	-	-	-	-	-	-	-	-	-	-	-	-	16.5
8-Oct	**95**	-	-	-	-	5.8	7.6	115	-	-	-	-	5.8	6.2	12.4
15-Oct	**88**	-	-	-	8.7	10.2	11.8	110	-	-	-	-	9.6	9.8	8.2
22-Oct	**80**	-	-	11.1	15.7	16.3	18.5	92	-	-	-	7.3	8.8	9.3	8.9
29-Oct	**73**	-	-	25.8	27.2	28.5	30.9	82	-	-	9.8	10.6	10.9	11.2	9.8
5-Nov	**59**	22.8	25.4	29	30.3	33.7	34.6	65	15.9	16.1	17.0	17.8	18.0	20.2	7.8
12-Nov	**60**	23.1	26.1	27.2	29.0	32.8	35.2	68	15.3	15.8	16.2	17.0	17.5	18.6	3.6
19-Nov	**58**	16.3	17.0	17.8	18.5	21.3	23.4	71	-	9.6	11.0	11.5	11.7	11.7	2.2
Nov. 26	**64**	-	14.0	15.2	16.4	17.2	17.6	71	-	8.9	9.5	9.8	10.5	11.6	2.1
Varuna															
1-Oct	**-**	-	-	-	-	-	-	-	-	-	-	-	-	-	14.6
8-Oct	**91**	-	-	-	-	8.8	9	110	-	-	-	-	6.5	7.4	11.5
15-Oct	**89**	-	-	-	9.8	10.6	12	106	-	-	-	-	10.2	10.5	10.2
22-Oct	**73**	-	-	12.5	15.9	17.3	18.9	90	-	-	-	11.1	11.8	12.4	6.3
29-Oct	**69**	-	24.9	26	27.9	30	32.6	81	-	-	12.8	13.5	14.2	14.8	4.4
5-Nov	**57**	21.5	23.2	28.3	30.8	34.3	36.6	62	15.3	15.9	16.0	17.4	18.8	19.7	3.2
12-Nov	**60**	23.2	25.8	28.3	30.2	33.3	34.5	65	12.8	14.5	15.2	15.9	16.9	19.0	5.9
19-Nov	**59**	18.5	19.3	19.8	20.5	22.8	24.3	68	-	13.0	13.9	14.5	15.0	15.7	1.8
Nov. 26	**64**	-	12.3	13	13.9	14.1	14.6	68	-	10.3	11	11.9	12.5	12.9	1.8

Table 4.8.8b: Epidemiology of white rust, downy mildew and powdery mildew (JHS)

Date of Sowing	WR appearance (DAS)	% WR severity						Appearance of SH (DAS)	% Staghead					DM appearance (DAS)	% DM severity				PM appearance (DAS)	% PM severity					
		Days after sowing							Days after sowing						Days after sowing					Days after sowing					
RH-406	DAS	60	70	80	90	100	110		90	100	110	120	130		10	20	30	40		70	80	90	100	110	120
1-Oct	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Oct	94		-	-	-	10.8	11.6	130	-	-	-	-	4.2	25	-	-	5.0	-	-	-	-	-	-	-	-
15-Oct	87	-	-	-	15.2	16.8	18.7	120	-	-	-	9.6	9.8	20	-	10.0	-	-	125	-	-	-	-		8.5
22-Oct	76	-	-	20.1	22.7	26.3	26.5	110	-	-	10.3	8.8	7.3	13	-	8.9	-	-	120	-	-	-	-	10.7	
29-Oct	71	-	-	25.8	27.2	28.5	30.9	92	-	11.8	10.6	9.5	7.8	10	7.8	-	-	-	113	-	-	-	-	12.0	
5-Nov	64	-	25.4	26	28.3	30.7	32.6	90	16.1	17.0	17.8	18.0	20.2	15	-	14.5	-	-	89	-	18.3	-	-	-	-
12-Nov	63	-	26.1	27.2	28.3	30.9	33.2	90	15.8	16.2	17	17.5	18.6	13	-	12.8	-	-	90	-	16.9	-	-	-	-
19-Nov	65	-	15.8	16.1	14.5	13.3	12.4	89	12.6	11	10.5	10.0	8.7	33	-	-	-	4.3	84	-	16.4	-	-	-	-
26-Nov	64	-	12.0	11.9	11.4	10.2	9.6	92	11.9	11.5	9.8	8.5	6.6	32	-	-	-	2.2	80	-	7.3	-	-	-	-
Varuna																									
1-Oct	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Oct	90	-	-	-	-	10.8	11.6	130	-	-	-	-	5.1	29	-	-	10.3	-	118	-	-	-	-	10.0	-
15-Oct	83	-	-	-	16.3	18.6	20	120	-	-	-	10	10.5	21	-	-	12.0	-	104	-	-	-	10.9	-	-
22-Oct	80	-	-	21.3	22.9	27.8	29.9	110	-	-	10.3	10.7	10.9	16	-	9.8	-	-	100	-	-	13.5	-	-	-
29-Oct	71	-	-	26.3	27.8	29.2	31.1	92	-	12	12.4	12.9	13	12	-	11.1	-	-	74	-	17.6	-	-	-	-
5-Nov	64	-	26.3	29	30.3	34.2	36.6	90	16.6	17.4	18	18.5	20.8	11	-	15.0	-	-	72	-	25.8	-	-	-	-
12-Nov	60	24.5	26.7	27.5	29.8	32.8	35.2	90	16	16.5	17.8	18.5	18.9	10	13	-	-	-	71	-	22.3	-	-	-	-
19-Nov	59	14.2	16.0	16.9	17.2	17.5	15.9	89	12.8	11.2	11.5	10.3	9	21	-	-	8.7	-	70	18.7	17.6	-	-	-	-
26-Nov	58	10.8	12.9	13.0	11.0	10.6	10.2	92	12	12.3	11.5	10.1	9.2	14	-	-	6.5	-	70	11.1	-	-	-	-	-

*** SR incidence and yield data of DOL excluded due to not as per the technical programme**

Table 4.9.1: Efficacy of fungicides against foliar diseases of rapeseed mustard 2020-21

Treatments	% ABL (90 DAS)*							% AB on pods (15 DBH)					% WR severity (75 DAS)							% Staghead incidence				% PM severity		
	SHL	SGN	PNT	HSR	BPR	JHS	Mean	SHL	SGN	PNT	HSR	Mean	MOR	SGN	BPR	PNT	HSR	JHS	Mean	MOR	SGN	PNT	Mean	MOR	JHS	Mean
Tebuconazole 50%+Trifloxostrobin 25%WG@0.1%	25.2	20.5	11.3	23.7	18.8	15.0	**19.1**	20.1	19.8	8.7	21.9	**17.6**	13.4	30.6	28.9	37.2	31.5	12.5	**25.7**	9.1	11.1	19.9	**13.4**	17.0	10.1	**13.6**
Propiconazole 25% EC@0.1%	27.0	17.0	14.8	25.0	20.8	20.0	**20.8**	21.9	15.4	10.3	23.8	**17.8**	21.9	22.2	38.4	35.2	27.5	18.0	**27.2**	15.0	9.6	18.0	**14.2**	19.1	15.3	**17.2**
Metalaxyl 4%+Mancozeb 64%@ 0.25 %	25.9	25.7	24.0	27.2	23.1	18.0	**24.0**	21.1	24.9	19.0	25.2	**22.6**	22.3	16.9	23	26.4	25.7	16.4	**21.8**	16.2	6.3	12.9	**11.8**	25.8	11.8	**18.8**
Hexaconazole 5 % SC @ 0.1 %	25.9	24.4	18.0	22.6	21.4	13.5	**21.0**	21.6	22.9	11.9	21.2	**19.4**	25.7	31.3	35.7	35.2	28.3	14.9	**28.5**	13.6	10.1	21.3	**15.0**	18.3	12.5	**15.4**
Tebuconazole 25% @ 0.1 %	26.1	24.1	11.9	31.2	20.1	19.3	**22.1**	22.2	20.4	10.3	26.6	**19.9**	24.2	32.5	32.3	34.2	34	13.2	**28.4**	21.4	9.7	19.9	**17.0**	25.8	10.8	**18.3**
Azoxystrobin @0.1%	26.2	25.5	14.8	27.6	10.9	13.4	**19.7**	21.9	19.5	11.3	25.1	**19.4**	23.3	29.8	30.7	35.2	26.8	12.2	**26.3**	19.5	11.1	19.9	**16.8**	17.3	12.0	**14.7**
Mancozeb 40 % + Azoxystrobin 7% @0.1 %	24.7	24.6	19.9	25.4	14.8	14.5	**20.6**	19.2	21.7	13.7	24.6	**19.8**	20.2	29.6	33.6	33.1	29.8	11.1	**26.2**	18.5	10.9	18.0	**15.8**	25.5	11.1	**18.3**
Azoxystrobin 18.2% + Difenoconazole 11.4 %	-	19.8	14.8	24.6	11.9	22.2	**18.6**	-	18.8	11.9	23.4	**18.0**	16.6	26.0	30.7	35.2	29.1	15.3	**25.5**	13.6	7.9	18.0	**13.2**	16.2	13.5	**14.9**
Control	34.4	43.3	31.1	36.0	29.6	32.8	**34.5**	26.9	36.6	24.0	29.8	**29.3**	42.0	46.0	38.5	41.1	42.9	31.1	**40.3**	54.7	20.2	25.3	**33.4**	37.0	30.7	**33.9**
CD 0.05 %	**2.9**	**2.7**	**5.3**	**3.1**	**3.3**	**1.9**	**-**	**2.3**	**1.6**	**3.5**	**3.1**	**-**	**1.7**	**3.62**	**2.6**	**3.7**	**3.2**	**2.5**	**-**	**7.9**	**1.4**	**6.3**	**-**	**2.26**	**2.4**	**2.3**
CV %	**6.0**	**6.2**	**16.9**	**6.5**	**7.4**	**-**	**-**	**6.0**	**4.3**	**15.0**	**7.2**	**-**	**4.9**	**7.1**	**4.2**	**6.1**	**6**	**-**	**-**	**28.4**	**7.5**	**19.6**	**-**	**5.78**	**-**	**-**

*** AB severity data of DOL excluded due to not as per the technical programme**

Table 4.9.2: Efficacy of fungicides against SR and yield of rapeseed mustard 2020-21

Treatments	% SR incidence*						Seed yield (kg/h)								Plant stand	Test weight (g)	B:C ratio	
	MOR	SGN	PNT	HSR	BPR	Mean	MOR	SHL	SGN	PNT	HSR	JHS	BPR	Mean	MOR	MOR	HSR	BPR
Tebuconazole 50%+Trifloxostrobin 25%WG@0.1%	22.8	15.1	21.1	23.2	12.2	**18.8**	3206	1411	2003	1860	1790	1529	2520	**2045.6**	304.0	7.05	2.2	2.5
Propiconazole 25% EC@0.1%	24.1	14.8	18.4	19.2	13.9	**18.3**	3105	1084	2202	1850	1993	1365	2448	**2006.8**	306.3	6.89	2.5	2.7
Metalaxyl 4%+Mancozeb 64%@ 0.25 %	30.0	18.6	28.1	25.0	19.1	**24.3**	3058	1267	2014	1790	1785	786	2310	**1858.5**	306.0	6.67	2.3	2.6
Hexaconazole 5 % SC @ 0.1 %	22.8	17.6	28.4	18.1	17.1	**20.6**	2983	1167	1778	1710	2004	992	2366	**1857.1**	308.3	6.80	2.6	2.7
Tebuconazole 25% @ 0.1 %	31.1	17.1	19.9	26.1	12.7	**21.9**	2855	1156	1963	1847	1667	1447	2495	**1918.5**	305.3	6.57	2.3	2.8
Azoxystrobin @0.1%	28.9	15.5	25.5	25.4	17.1	**22.2**	2987	1373	1907	1780	1767	1254	2387	**1922.2**	312.3	6.85	2.3	2.7
Mancozeb 40 % + Azoxystrobin 7% @0.1 %	27.7	16.2	25.3	27.0	20.6	**23.4**	3013	1467	1947	1800	1754	1423	2290	**1956.2**	308.0	6.70	2.3	2.5
Azoxystrobin 18.2% + Difenoconazole 11.4 %	22.8	11.8	26.1	19.9	18.0	**20.3**	3119	-	2153	1770	1992	832	2350	**2036.1**	311.7	6.96	2.5	2.5
Control	45.0	21.3	28.9	30.7	24.0	**27.8**	2442	858	1644	1533	1410	643	1964	**1499.2**	306.7	6.15	2.1	-
CD 0.05 %	**5.7**	**2.0**	**3.2**	**2.9**	**2.0**	-	335.0	234	212	1	97.3	-	-	-	-	-	-	-
CV %	**11.6**	**6.9**	**7.2**	**7.1**	**4.7**	-	6.5	10.8	6.26	3	3.1	-	-	-	-	-	-	-

5. ENTOMOLOGY

The 2020-21 crop season witnessed moderate to high population development of mustard aphid on different Brassica species.

5.1 Screening of advanced breeding germplasm against mustard aphid

One hundred fifty six strains (IVT) were evaluated against mustard aphid including susceptible/tolerant checks. Aphid pressure was low at **KAN** centre and moderate to severe at **MOR, HSR, SKN, PTN, NDH, LDH, DHO and SHIL** centres. Out of 156 IVT entries, six entries *viz*. RMM-19-06, JM 14-8, DRMRIJ 31, HUJM-19-11, OIJ1034 and DRMRHJ 2409 were found promising having the AAII ≤ 1.5 (Table 5.1A). Among the forty four (AVT I and AVT II) entries screened against mustard aphid, two entries *viz*. RTM 1624 and RTM 314 were found promising since these recorded AAII ≤ 1.5 (Table 5.1B).

5.2 Assessment of yield losses due to insect pests in Brassica crops

The highest yield losses were observed in PM 31 (42.7%) at **SK Nagar** followed by RH 725 (38.5%) and PM 31 (29.2%) at **New Delhi** (Table 5.2). It was followed by 28.6% yield losses in PM 31, 27.8% in PBR 357 at **Ludhiana** and 22.9% in RH 725 at **Dholi**. The highest yield loss among the entries evaluated in other centres was 21.5% in PM 31 at **Hisar**, 15.0% (PM 31) at **Pant Nagar** and 9.3% (RH 725) at **Morena.**

5.3 Population dynamics of various insect-pests on *Brassica* crops

A. Incidence of various insect-pests on *Brassica* crops

At **Hisar**, aphid population was observed from 7th to 14th std. week with peak during 10th and 11th std. week. The aphid population was observed till 14th std. week after which it disappeared from the crop. Low to moderate population of painted bug (0.1-1.5 bugs/ mrl) was observed from 42nd – 47th std. week on DRMR IJ 31, T 27, GSC 6 and BSH 1 under timely sown conditions. Similarly low activity of sawfly was recorded from 47th -50th SMW under timely sown conditions, while no population of cabbage caterpillar was observed. The activity of coccinellid predators was observed from 9th to 13th std. week (Table 5.3.1A-D). At **Dholi**, low to moderate population of mustard aphid was recorded. It remained active from 4th to 10th SMW with peak activity during 7th-8th SMW (Table 5.3.2). At **Pant Nagar** moderate to high population of mustard aphid was recorded on DRMR IJ 31, T 27, GSC 6, BSH 1, *B. nigra*, *B. alba* and Varuna during 3rd to 16th std. week (Table 5.3.3A,B). Under late sown conditions, the peak activity of mustard aphid was observed from 10th-13th SMW. At **Ludhiana**, activity of both mustard aphid and cabbage aphid was recorded with low to moderate activity both under timely and late sown conditions. Under timely sown conditions first appearance of both the species was recorded during 2nd std. week on BSH 1 and remained active till 10th std. week, while under late sown conditions it remained active from 3rd to 11th std. week (Table 5.3.4A, B). Low to moderate activity of cabbage caterpillar was recorded both under timely and late sown conditions. Cabbage caterpillar appeared on 7th std. week on GSC 6 and DRMR IJ 31
under timely sown conditions and remained active till 12th std. week, while under late sown conditions it remained active from 7th to 12th std. week. At

SK Nagar, population of mustard aphid was recorded from 51st to 8th std. week in timely and late sown crop (Table 5.3.5). At **Shillongani** peak population of mustard aphid was recorded in 3rd to 5th std. week, sawfly during 50th to 4th std. week, flea beetle activity from 49th to 12th std. week and coccinellid predators' activity during 52nd and 14th std. week (Table 5.3.7A-D). At **Morena**, mustard aphid remained active from 49th to 13th std. week, while the activity of coccinellid beetles was observed from 50th to 10th std. week. Some activity of painted bug was also recorded from 47th to 50th std week. (Table 5.3.8A-D).

5.3 (B) Monitoring of alate mustard aphids on yellow sticky traps

The alate aphid population was recorded by seven centres. At **Hisar**, the alate population appeared during 1st std. week, peaked (120.2 aphids/ trap) during 11th std. week and disappeared after 14th std. week. At **S.K. Nagar**, alate mustard aphid population appeared during 50th std. week, reached its peak (3367.8 aphids/ trap) during 7th std. week and disappeared after 10th std. week. At **Ludhiana**, alate aphid appeared as early as 43rd std. week and remained active upto 15th std. week with peak (255.6 aphids/ trap) during 13th std. week. At **Pant Nagar**, the alate aphid appeared in 3rd std. week and peaked (188.0 aphids/ trap) during 10th std. week while it disappeared after 12th std. week. At **Kanpur**, it appeared during 10th std. week and disappeared after 12th std. week. At **Morena**, it appeared during 1st std. week, peaked (145.6 aphids/ trap) during 5th std. week and disappeared after 15th std. week. At **Dholi**, its first appearance was recorded during 6th std. week with peak activity (108.0 aphids/ trap) during 10th std. week and disappeared during 12th std. week (Table 5.3.8).

5.4 Efficacy of bio-intensive IPM module against mustard aphid

At **New Delhi,** the treatment T_6: dimethoate 30 EC @ 1 ml/l followed by its second application after 10 days recorded significantly lower aphid population and witnessed maximum reduction in population (78.8 and 45.0%, after first and second spray respectively) as compared to other treatments (Table 5.4.1). This treatment also recorded the maximum yield of 1844.2 kg/ha. At **Shillongani** centre, treatment $T_{6:}$ dimethoate 30 EC @ 1 ml/l followed by its second application after 10 days was the most effective with minimum aphid population of 8.10 aphids/ plant after 5 days of spray followed by T_1: azadirachtin 3000 ppm @ 5 ml/lt with aphid population of 10.8 aphids/ plant. Maximum seed yield of 990.4 kg/ha was obtained in treatment T_6 followed by T_1 (797.2 kg/ha) (Table 5.4.2). At **Hisar**, treatment T_6: dimethoate 30 EC @ 1 ml/l followed by its second application was the most effective treatment with minimum aphid population of 0.9 aphids/ plant followed by T_4: azadirachtin 3000 ppm @ 5 ml/l followed by *V. lecanii* @ 2g/ litre water (10.2 aphids/plant). Maximum seed yield of 1761.5 kg/h was obtained in T_6 followed by 1699.2 kg/ha in T_4 (Table 5.4.3). At **SK Nagar**, T_6 was the most effective treatment with complete control after five days of spray. The maximum seed yield of 2080 kg/h was also obtained in T_6: dimethoate 30 EC @ 1 ml/lt (Table 5.4.4). At **Pant Nagar,** treatments T_6: dimethoate 30 EC @ 1 ml/l was the most effective treatment with maximum seed yield of 1353.9 kg/ha (Table 5.4.5). It was followed by treatments T_4: Azadirachtin followed by application of *V. lecanii* @ 2 g/lt and T_5: *V. lecanii* @ 2 g/lt, with respective yield of 1426.9 and 1387.3 kg/ha. At **Ludhiana**, treatment T_6: dimethoate 30 EC @ 1 ml/l was the most effective with minimum aphid population of

17.4 aphids/ plant (80.2% reduction) after 5 days of spray followed by T_1: azadirachtin 3000 ppm @ 5 ml/lt with aphid population of 30.7 aphids/ plant (66.3% reduction). The maximum seed yield of 1850.0 kg/ha was also obtained in T_6 followed by 1705.6 kg/ha in T_1 (Table 5.4.6). At **Dholi**, T_6 was the most effective treatment with minimum aphid population of 4.4 aphids/ plant followed by T_5: *Verticillium lecanii* @ 2 g/l (5.2 aphids/ plant). Seed yield in T_6 was the maximum (902.0 kg/ha) followed by T_5 (884.0 kg/ha) (Table 5.4.7). At **Morena,** the minimum aphid population of 24.6 aphids/ plant was observed in treatment T_2: azadirachtin followed by *Beauveria bassiana* @ 2 g/l after 10 days of application. It was followed by T_4: azadirachtin followed by *V. lecanii* @ 2g/l (25.4 aphids/plant). The maximum seed yield of 2952.0 kg/ha was recorded in treatment T_2: azadirachtin 3000 ppm @ 5 ml/l followed by *B. bassiana* (Table 5.4.8). Thus, it can be concluded that spray of dimethoate 30 EC @ 1 ml/l and azadirachtin 3000 ppm @ 5 ml/lt are effective in reducing the aphid population under field conditions.

5.5 Bioefficacy of newer insecticides against mustard aphid

At **New Delhi**, spray of thiamethoxam 25 WG @ 0.2 g/l was the most effective treatment with minimum aphid population of 20.0 aphids/ plant and provided more than 80.0 reduction in population after second spray. Yield in this treatment was 1608.0 kg/ha which was at par with the maximum yield of 1648.6 kg/ha in treatment T_4: dimethoate 30 EC @ 1 ml/l (Table 5.5.1). However, at **Shillongani**, imidacloprid 17.8SL @ 0.25ml/lt was the best treatment with minimum aphid population of 8.6 per plant after 7 days of spray and maximum seed yield of 1027.3 kg/ha (Table 5.5.2). At **Hisar,** thiamethoxam 25 WG @ 0.2 g/l was the most effective treatment with minimum population of 2.6 aphids/ plant followed by clothianidine 50 WDG @ 0.12 g/l (2.9 aphids/plant). The maximum seed yield of 1897.4 kg/ha was obtained in the treatment clothianidine 50 WDG followed by 1884.6 kg/ha in thiamethoxam 25 WG (Table 5.5.3A). At **SK Nagar**, dimethoate 30 EC @ 1 ml/l was the most effective treatment with complete aphid control after 5 days of spray. It was followed by thiamethoxam 25 WG @ 1 g/l with 12.83 aphids/ plant. Maximum seed yield of 2059 kg/ha was obtained in dimethoate 30 EC @ 1 ml/l followed by imidacloprid 17.8 SL @ 0.25 ml/l (2014 kg/ha) (Table 5.5.4). At **Pant Nagar**, dimethoate 30 EC @ 1 ml/l was the most effective treatment with minimum aphid population of 15.73 and 2.27 aphids/ plant after first and second spray, respectively and maximum seed yield of 1412.0 kg/ha (Table 5.5.5). At **Ludhiana**, thiamethoxam 25 WG @ 0.2 g/ lt was the most effective treatment with minimum aphid population of 17.1 aphids/ plant after 3 days of spray followed by imidacloprid 17.8 SL @ 0.25 ml/lt (19.2 aphids/ plant) and clothianidine 50 WDG @ 0.12 g/l (18.1 aphids/ plant). The maximum seed yield of 1841.7 kg/ha was obtained in the treatment thiamethoxam 25 WG @ 0.2 g/l (1908.3 kg/ha) followed by clothianidine 50 WDG @ 0.12g/l (1841.7 kg/ha) and imidacloprid 17.8 SL @ 0.25 ml/l (1827.8 kg/ha) (Table 5.5.6). At **Dholi,** dimethoate 30 EC @ 1 ml/l recorded minimum population of 4.8 aphids/ plant after 10 days of spray followed by thiamethoxam 25 WG @ 0.2 g/l (5.8 aphids/ plant) and clothianidine 50 WDG @ 0.12 g/l (6.0 aphids/ plant). Maximum seed yield of 891.0 kg/ha was obtained in dimethoate 30 EC followed by thiamethoxam 25 WG (812.0 kg/ha) (Table 5.5.7). At **Morena,** clothianidine 50 WDG was the most effective treatment with minimum

population of 26.9 aphids/ plant after 3 days of spray followed by dimethoate 30 EC (27.4 aphids/ plant). Maximum seed yield was obtained in clothianidine 50 WDG (2915 kg/ha) followed by thiamethoxam 25 WG (2864 kg/ha) and imidacloprid 17.8 SL (2752 kg/ha) (Table 5.5.8).

5.6 Effect of host plant diversity on abundance of mustard aphid and associated specialist and generalist natural enemies

At **Hisar**, aphid population in the three intercrop treatments was higher than the mustard alone treatment. However, differences in coccinellid predator population were non-significant while significantly high activity of syrphid flies and honey bees was observed in the intercrop treatments over mustard alone. Maximum activity of syrphid fly (7.5 visits/minute) was recorded in mustard+fennel treatment. Similarly, maximum mummified aphids were also recorded in this treatment. The maximum mustard equivalent yield of 2207.4 kg/ha was also recorded in mustard+fennel treatment (Tables 5.5.1A-C). At **Dholi**, the population of mustard aphid in the mustard alone treatment remained lower than all the other intercrop treatments throughout crop season. Minimum population of mustard aphid was recorded in mustard+fennel followed by mustard+chickpea and mustard+coriander (Table 5.6.2A). The maximum activity of aphid parasitoid *Diaeretiella rapae*, lady bird beetles, syrphid fly larvae, Chrysoperla and other predators was recorded in mustard+fennel followed by mustard+chickpea and mustard+coriander. Similarly, maximum yield of 756.0 kg/ha was recorded in mustard+fennel followed by mustard+chickpea (725 kg/ha), mustard+coriander (695 kg/ha) while minimum yield (655.0 kg/ha) was obtained in mustard alone (Table 5.6.2B). At **Pantnagar**, a variable trend in mustard aphid population was observed at different observation intervals with differences in population being non-significant at most of the observation intervals (Table 5.6.3A). The maximum mustard equivalent yield was recorded in mustard+fennel (1505.3 kg/ha) with B:C ratio of 2.54 (Table 5.6.3B). At **Ludhiana**, the population of mustard aphid, cabbage aphid and cabbage caterpillar in the three intercrop treatments remained significantly lower than that in mustard alone. The population of three pests remained minimum in the mustard+coriander treatment followed by mustard+chickpea and mustard+fennel (Table 5.6.4A). The maximum mustard equivalent yield 3442.4 kg/ha was obtained in mustard+chickpea followed by mustard+fennel (2984.3 kg/ha), mustard+fennel (2453.5 kg/ha) as against 1423.6 kg/ha which was significantly lower than the three intercrop treatments (Table 5.6.4B). At **SK Nagar**, the population of mustard aphid in all the four treatments remained comparable at all the observation intervals with no effect of intercropping observed on yield as well (Table 5.6.5A-B). At **Shillongani**, the minimum mean aphid activity at both flowering and siliqua formation stage (28.6 and 20.8 aphids/ plant) was observed in mustard+coriander treatment. It was followed by mustard+fennel treatment (31.2 and 21.7 aphids/plant at flowering and pod formation) and mustard+chickpea (47.3 and 33.6 aphids/plant) as against 63.3 and 47.9 aphids/plant in mustard alone. Similar trend was reflected in yield in different treatments (Table 5.6.6). At **Morena**, the minimum aphid population was observed in mustard+coriander treatment throughout the season followed by mustard+chickpea and mustard+fennel (5.6.7A). However, yield on the three intercrop treatments was lower than that observed in mustard alone (Table 5.6.7B). Thus, it can be inferred from this experiment that intercropping of mustard with coriander/chickpea/fennel results in reduction in mustard aphid population with increased activity of natural enemies.

Table 5.1 (A): Reaction of IVT entries against mustard aphid

S. No.	Code No.	Entries	MOR	HSR	KAN	SKN	PTN	NDH	LDH	DHO	SHIL	Mean
IVT Toria												
1	SBG 20-1	ORT 2019-01	1.6	2.1	0.0	3.4	1.2	3.0	2.8	2.2	2.3	**2.1**
2	SBG 20-2	RTM-19-17	2.2	2.3	0.0	3.4	0.8	3.5	3.5	3.2	2.4	**2.4**
3	SBG 20-3	CG toria 4	1.8	1.6	0.0	3.4	1.2	3.5	3.9	2.2	2.5	**2.2**
4	SBG 20-4	PT-2018-09	3.3	1.1	0.0	3.2	1.2	3.3	4.0	3.0	2.4	**2.4**
5	SBG 20-5	TKM- 20-2	3.6	2.0	0.1	3.2	0.9	3.0	3.1	2.4	1.8	**2.2**
6	**SBG 20-6**	**PT – 303**	2.4	1.2	0.0	3.2	1.2	3.2	1.5	2.6	1.7	**1.9**
7	SBG 20-7	BAUT 08-08	2.6	1.0	0.0	3.3	1.3	3.2	2.5	2.2	2.1	**2.0**
8	SBG 20-8	JT -14-5	1.6	2.4	0.0	3.3	1.3	2.9	2.3	2.2	2.1	**2.0**
9	SBG 20-9	CG toria 3	2.4	1.0	0.1	3.3	1.2	3.0	2.5	3.0	1.7	**2.0**
10	SBG 20-10	PT-2015-8	3.2	2.0	0.1	3.0	1.3	3.3	2.0	3.0	2.0	**2.2**
11	SBG 20-11	TKM- 20-1	3.3	0.3	0.0	3.4	1.3	-	2.3	2.8	2.4	**2.0**
12	SBG 20-12	RMT-19-14	1.2	2.1	0.0	3.2	1.3	3.0	3.3	2.6	2.4	**2.1**
13	**SBG 20-13**	**BSH – 1**	3.2	2.9	0.5	3.2	1.2	2.5	3.9	2.2	2.0	**2.4**
IVT Yellow Sarson												
14	SBG 20-14	RMYS 2	2.8	-	0.0	3.3	1.4	3.5	2.5	2.4	2.2	**2.3**
15	SBG 20-15	DRMRYS 202	3.4	0.4	0.0	3.3	1.3	3.2	3.3	2.6	1.8	**2.1**
16	SBG 20-16	YSKM-20-2	3.3	0.2	0.0	3.3	1.3	-	--	2.4	3.4	**2.0**
17	SBG 20-17	PYS-2018-02	1.2	0.3	0.3	3.1	1.2	2.3	1.8	2.9	2.3	**1.7**
18	**SBG 20-18**	**YSH 401**	3.8	1.2	0.0	3.2	1.3	3.2	2.3	2.9	1.9	**2.2**
19	SBG 20-19	RMYS 1	2.9	1.0	0.0	3.2	1.3	3.2	2.8	3.0	2.3	**2.2**
20	SBG 20-20	DRMRYS 201	1.6	0.2	0.0	3.3	1.2	3.0	2.5	2.6	2.3	**1.9**
21	SBG 20-21	YSKM-20-1	1.1	1.0	0.0	3.3	1.2	-	2.3	2.2	2.2	**1.7**
22	SBG 20-22	PYS-2017-6	2.1	1.1	0.0	3.3	1.3	2.7	2.7	2.6	2.3	**2.0**
23	**SBG 20-23**	**NRCYS 05-02**	1.2	0.9	0.0	3.2	1.2	2.7	2.7	2.1	2.5	**1.8**
IVT Early mustard												
24	SBG 20-24	NPJ-240	3.4	0.9	0.0	3.1	1.1	3.2	2.3	2.1	2.6	**2.1**
25	SBG 20-25	PRE-2018-10	2.1	1.0	0.0	3.0	1.2	3.3	1.9	3.0	2.4	**2.0**
26	SBG 20-26	DRMRHT 1712	1.8	1.1	0.0	3..0	1.2	3.0	1.3	2.9	2.3	**1.7**
27	SBG 20-27	RH 1999-21	1.2	0.7	0.0	3.0	1.3	3.2	1.1	2.2	2.1	**1.6**
28	SBG 20-28	KMR(E) -20-2	1.4	2.5	0.0	3.0	1.3	2.8	2.5	2.6	2.0	**2.0**
29	**SBG 20-29**	**RH - 725**	0.0	0.8	0.0	3.0	1.3	3.0	2.0	3.0	1.8	**1.7**
30	SBG 20-30	PHR 8031 (Hybrid)	3.6	1.0	0.0	3.0	1.2	3.3	1.9	2.4	2.3	**2.1**
31	SBG 20-31	ORM-2019-01	3.2	1.5	0.0	3.0	1.6	3.2	1.9	2.6	2.4	**2.2**
32	SBG 20-32	BAUM 09-12-2	1.0	0.7	0.0	3.0	1.5	3.0	1.0	2.6	2.3	**1.7**
33	SBG 20-33	NPJ-239	1.0	0.4	0.0	3.0	1.5	3.3	1.4	3.0	2.3	**1.8**
34	SBG 20-34	PRE-2018-8	3.8	0.5	0.0	3.0	1.6	3.2	1.2	3.0	2.2	**2.1**
35	SBG 20-35	DRMRSJ 112	2.8	0.8	0.0	2.9	1.6	2.2	1.6	2.2	2.4	**1.8**
36	SBG 20-36	TM 188	2.4	1.9	0.0	3.1	1.2	2.7	1.3	2.4	2.3	**1.9**
37	SBG 20-37	SVJH -006	1.9	2.2	0.0	3.0	1.3	2.5	2.2	2.2	2.5	**2.0**
38	**SBG 20-38**	**45 S 46**	1.4	0.8	0.0	3.1	1.3	3.0	1.3	2.8	2.5	**1.8**
39	SBG 20-39	KMR(E) -20-1	2.6	1.1	0.0	3.1	1.5	3.0	2.3	2.2	2.3	**2.0**
40	SBG 20-40	PHR 8024 (Hybrid)	1.6	0.7	0.0	3.1	1.6	3.0	1.7	2.2	3.2	**1.9**
41	SBG 20-41	RMM-19-06	1.0	0.3	0.0	3.0	1.6	2.5	1.4	2.1	2.0	**1.5**
42	SBG 20-42	DRMRCI -129	2.1	0.2	0.1	3.0	1.3	2.5	1.2	2.1	1.9	**1.6**
43	SBG 20-43	RH 1999-12	1.0	-	0.0	3.3	1.6	2.8	0.8	3.0	1.7	**1.8**
44	SBG 20-44	KGMH-3811	1.2	0.6	0.4	3.1	1.3	3.0	1.4	2.9	2.0	**1.8**
45	SBG 20-45	SKM 1746	1.6	-	0.0	3.0	1.6	2.8	1.1	2.2	2.2	**1.8**
46	**SBG 20-46**	**Kranti (NC)**	2.4	0.5	0.0	3.1	1.6	2.5	1.3	2.6	2.1	**1.8**
IVT Timely Irrigated												
47	SBG 20-47	JM 14-8	0.0	2.3	0.0	-	1.6	-	1.0	2.4	2.0	**1.3**
48	SBG 20-48	KMR -20-4	3.6	2.5	0.0	3.1	1.5	2.8	1.2	2.4	1.3	**2.0**
49	SBG 20-49	AKMS -20-1	1.7	0.6	0.0	3.1	1.6	2.7	1.1	2.2	1.7	**1.6**
50	SBG 20-50	RH 1975	1.2	0.7	0.0	3.0	1.5	3.0	1.8	2.2	2.1	**1.7**
51	SBG 20-51	RGN -483	1.0	0.6	0.0	3.0	1.5	2.8	1.1	2.4	2.0	**1.6**
52	SBG 20-52	NPJ -242	0.0	1.8	0.0	3.0	1.2	2.8	0.6	2.5	2.3	**1.6**
53	**SBG 20-53**	**DRMRIJ 31**	0.4	0.2	0.0	2.9	1.5	3.5	0.8	2.2	2.4	**1.5**
54	SBG 20-54	RMM -19-18	1.8	1.3	0.0	2.9	1.6	3.2	2.1	2.2	2.3	**1.9**
55	SBG 20-55	SKM 1620	1.0	1.0	0.0	2.9	1.1	3.2	1.1	2.6	2.0	**1.7**
56	SBG 20-56	DRMRHI 1318	0.8	3.3	0.0	2.9	1.2	3.3	0.5	2.8	2.2	**1.9**
57	SBG 20-57	TM -274	0.2	1.2	0.0	3.1	1.5	3.5	2.0	2.1	1.6	**1.7**
58	SBG 20-58	PBR 507	0.6	2.5	0.0	3.0	1.5	3.3	1.1	2.1	1.9	**1.8**
59	**SBG 20-59**	**RH 749**	1.2	2.0	0.0	3.2	1.5	2.9	0.7	2.8	1.8	**1.8**

60	SBG 20-60	HUJM -19-11	0.2	0.6	0.0	3.1	1.2	2.1	1.1	3.0	2.0	**1.5**
61	SBG 20-61	PR -2017-5	1.2	0.8	0.0	3.1	1.6	3.0	0.6	2.4	2.0	**1.6**
62	SBG 20-62	NPJ -241	0.4	0.8	0.0	3.1	1.5	3.3	0.7	3.2	2.3	**1.7**
63	SBG 20-63	ORM 2019-02	0.8	0.2	0.0	3.1	1.6	3.0	1.3	2.2	2.0	**1.6**
64	SBG 20-64	DRMRCI -127	0.4	0.7	0.0	3.0	1.3	2.7	2.0	2.2	2.2	**1.6**
65	**SBG 20-65**	**45 S 46**	1.2	1.6	0.0	3.1	1.5	2.8	1.8	3.2	2.2	**1.9**
66	SBG 20-66	RGN -491	0.8	0.8	0.0	3.0	1.6	2.5	1.7	3.0	2.1	**1.7**
67	SBG 20-67	SKM 1728	1.9	0.9	0.0	3.0	1.6	3.0	1.6	3.0	2.1	**1.9**
68	SBG 20-68	KMR -20-3	2.0	0.5	0.1	2.9	1.6	2.7	2.0	2.8	1.8	**1.8**
69	SBG 20-69	ACNMM -23	1.2	0.8	0.0	3.2	1.6	2.8	1.2	2.4	1.8	**1.7**
70	SBG 20-70	DRMR 2018-17	0.2	3.1	0.0	3.2	1.5	2.8	1.5	2.2	2.1	**1.8**
71	**SBG 20-71**	**PDZM 31**	1.3	2.3	0.0	3.4	1.5	3.2	1.5	2.2	2.2	**2.0**
72	SBG 20-72	BAUM 08-17	0.4	2.0	0.0	3.2	1.6	2.8	1.3	3.7	2.0	**1.9**
73	SBG 20-73	RH 1974	0.8	1.8	0.0	3.3	1.2	3.2	1.8	2.8	2.1	**1.9**
74	SBG 20-74	PRB 2012-3	1.0	1.4	0.0	3.2	1.3	3.0	1.5	2.2	2.5	**1.8**
75	**SBG 20-75**	**BSH-1**	2.8	1.1	0.0	3.4	1.6	3.5	3.6	3.4	1.9	**2.4**
IVT Mustard Rainfed												
76	SBG 20-76	DRMRIJ 18-62	1.0	2.7	0.0	3.3	1.6	3.3	1.8	2.6	2.0	**2.0**
77	SBG 20-77	RGN -486	1.0	0.4	0.0	3.3	1.2	3.3	1.9	2.4	2.1	**1.7**
78	SBG 20-78	CAU – RM-4-1-1	2.0	0.5	0.0	3.3	1.5	3.0	1.7	2.1	2.4	**1.8**
79	SBG 20-79	DRMRHT 1913	2.2	0.4	0.1	3.3	1.6	3.2	1.4	2.8	2.3	**1.9**
80	SBG 20-80	NPJ-244	2.4	2.6	0.0	3.4	1.2	3.3	1.7	2.6	2.1	**2.1**
81	**SBG 20-81**	**RGN 229**	1.6	2.6	0.0	3.3	1.6	2.8	1.8	3.0	2.0	**2.1**
82	SBG 20-82	RH -1921	1.2	2.4	0.1	3.4	1.2	3.0	1.7	2.4	2.0	**1.9**
83	SBG 20-83	JM -13-3	1.2	0.1	0.0	3.2	1.6	-	--	3.0	2.0	**1.6**
84	SBG 20-84	DRMRSJ 276	1.0	2.1	0.0	3.4	1.6	3.2	1.4	2.8	2.2	**2.0**
85	SBG 20-85	PBR -450	0.4	0.7	0.0	3.2	1.3	3.2	2.5	2.6	2.0	**1.8**
86	SBG 20-86	NPJ- 243	0.6	0.8	0.3	3.3	1.6	3.7	2.5	2.1	1.8	**1.9**
87	**SBG 20-87**	**RH 725**	2.5	0.7	0.0	3.4	1.3	3.2	0.7	2.7	1.7	**1.8**
88	SBG 20-88	DRMRHJ 908	3.4	2.6	0.0	3.3	1.3	3.2	1.1	2.2	2.0	**2.1**
89	SBG 20-89	RH -1920	2.2	0.4	0.0	3.3	1.6	3.2	0.7	3.1	2.0	**1.8**
90	SBG 20-90	RGN -500	2.0	0.8	0.0	3.3	1.6	2.8	1.5	3.2	2.5	**2.0**
91	SBG 20-91	TM -264	1.6	0.9	0.0	3.3	1.5	2.7	1.8	3.0	2.1	**1.9**
92	SBG 20-92	DRMRCI- 128	3.4	2.6	0.0	3.3	1.5	3.2	3.4	3.0	1.8	**2.5**
93	**SBG 20-93**	**45 S 46**	1.4	2.1	0.0	3.2	1.2	2.8	2.1	2.2	2.0	**1.9**
IVT Mustard Late Sown												
94	SBG 20-94	NPJ -246	2.4	3.2	0.0	3.4	1.3	2.8	1.8	3.2	2.3	**2.3**
95	SBG 20-95	KMR (L) -20-6	0.8	1.6	0.0	3.3	1.3	2.8	1.6	3.5	2.2	**1.9**
96	SBG 20-96	RGN -488	2.9	1.8	0.0	3.2	1.6	3.3	2.8	3.2	2.2	**2.3**
97	SBG 20-97	RH 1999-22	2.0	2.3	0.0	3.2	1.5	3.5	1.8	2.6	2.1	**2.1**
98	SBG 20-98	DRMR 2018-19	2.0	3.1	0.0	3.2	1.6	2.8	2.4	3.1	2.0	**2.2**
99	**SBG 20-99**	**NRCHB - 101**	1.4	3.6	0.0	3.3	1.5	2.7	2.5	2.2	1.9	**2.1**
100	SBG 20-100	PRL -2017-2	1.6	3.5	0.0	3.1	1.6	2.5	3.1	2.6	2.2	**2.2**
101	SBG 20-101	HUJM -19-18	0.8	2.1	0.0	3.2	1.6	2.7	2.5	2.8	2.0	**2.0**
102	SBG 20-102	RGN -494	3.0	1.2	0.0	3.3	1.5	2.5	2.8	2.4	2.0	**2.1**
103	SBG 20-103	DRMRHJ 2520	1.0	2.8	0.0	3.1	1.6	3.0	3.0	3.0	1.4	**2.1**
104	SBG 20-104	PAB -2014-4	1.8	2.2	0.5	3.1	1.5	2.2	2.5	2.6	2.2	**2.1**
105	**SBG 20-105**	**PDZM 31**	1.0	2.7	0.2	3.3	1.5	2.0	2.0	2.8	1.8	**1.9**
106	SBG 20-106	KMR (L) -20-5	1.0	2.4	0.4	3.2	1.6	2.0	2.8	3.0	2.0	**2.0**
107	SBG 20-107	NPJ -245	0.9	2.0	0.0	3.1	1.6	3.7	0.7	2.4	2.2	**1.8**
108	SBG 20-108	RH 1999-19	2.4	2.5	0.0	3.2	1.6	3.3	1.9	2.4	1.9	**2.1**
109	SBG 20-109	DRMRCI -130	2.1	2.4	0.0	3.1	1.6	3.2	0.7	2.6	2.1	**2.0**
110	SBG 20-110	TM 179-2	0.6	2.3	0.0	3.2	1.3	3.0	1.9	3.0	2.3	**2.0**
111	**SBG 20-111**	**PM - 30**	1.0	2.0	0.0	3.3	1.5	2.3	0.7	2.6	2.0	**1.7**
Hybrid Mustard IHT												
112	SBG 20-112	DRMRHJ 1403	1.0	2.6	0.0	3.1	1.5	2.2	0.9	3.2	2.0	**1.8**
113	SBG 20-113	Pusa MH -61	1.6	2.5	0.0	3.1	1.2	2.0	0.7	3.0	1.8	**1.8**
114	SBG 20-114	RHH 2002	3.6	2.5	0.2	3.1	1.5	3.0	0.7	2.2	1.7	**2.1**
115	SBG 20-115	SVJH -68	1.4	3.3	0.2	3.1	1.5	3.2	0.7	2.2	2.0	**2.0**
116	SBG 20-116	OIJ1034	0.8	0.9	0.0	3.0	1.5	2.7	0.7	2.4	1.7	**1.5**
117	SBG 20-117	DRMRHJ 1108	0.8	1.4	0.0	3.2	1.6	2.8	0.7	2.6	1.9	**1.7**
118	**SBG 20-118**	**45 S 46**	2.1	1.2	0.0	3.2	1.3	3.0	0.5	2.2	1.9	**1.7**
119	SBG 20-119	RMX 9903	1.0	0.5	0.0	3.2	1.6	3.2	0.5	2.8	1.9	**1.6**
120	SBG 20-120	PHR 8076	2.2	1.6	0.0	3.1	1.5	2.8	0.6	2.7	2.0	**1.8**
121	SBG 20-121	RHH 2001	3.1	2.3	0.0	3.2	1.5	2.7	0.7	3.0	2.0	**2.1**
122	SBG 20-122	Pusa MH -57	3.0	2.4	0.0	3.1	1.5	3.2	1.3	3.6	2.2	**2.3**
123	SBG 20-123	18J029C	2.1	1.1	0.0	3.2	1.5	3.5	2.3	3.2	2.0	**2.1**
124	SBG 20-124	RHH 2003	1.0	1.4	0.1	3.0	1.6	2.8	3.4	2.8	1.9	**2.0**

125	**SBG 20-125**	**DMH -1**	3.6	2.4	0.4	3.1	1.6	2.7	1.7	3.0	2.7	**2.4**
126	SBG 20-126	DRMRHJ 3101	1.6	0.9	0.2	3.2	1.6	3.0	2.9	2.2	2.2	**2.0**
127	SBG 20-127	SVJH -66	1.8	1.8	0.0	3.1	1.5	3.0	1.4	2.6	2.1	**1.9**
128	SBG 20-128	PHR 8095	1.6	1.6	0.5	3.0	1.3	2.7	1.5	3.4	1.8	**1.9**
129	SBG 20-129	RMX 9906	1.4	1.4	0.0	2.9	1.5	2.8	0.8	2.8	2.7	**1.8**
130	SBG 20-130	OIJ1010	1.6	0.1	0.4	3.0	1.6	3.0	0.7	2.4	2.0	**1.6**
131	SBG 20-131	DRMRHJ 2409	0.2	0.6	0.0	3.2	1.2	2.5	0.7	2.4	1.9	**1.4**
132	**SBG 20-132**	**Kranti (NC)**	1.0	0.1	0.4	3.1	1.6	3.2	0.7	3.2	2.4	**1.7**
Quality Mustard IVT												
133	SBG 20-133	JC 36#	1.9	0.9	0.1	3.2	1.5	3.5	1.1	3.4	2.1	**2.0**
134	SBG 20-134	PDZ- 15 #	2.8	1.8	0.0	3.3	1.6	3.3	0.5	3.0	2.1	**2.0**
135	SBG 20-135	RH (OE)-1807	3.0	2.6	0.0	3.2	1.6	3.6	0.6	3.0	1.8	**2.2**
136	**SBG 20-136**	**PDZ -1**	3.2	1.5	0.0	3.2	1.6	3.2	1.1	2.6	2.1	**2.1**
137	SBG 20-137	LES- 63	2.8	0.5	0.0	3.2	1.3	3.3	0.5	2.8	2.2	**1.8**
138	SBG 20-138	0IJ5001#	1.0	0.3	0.0	3.2	1.5	3.3	0.5	2.6	1.7	**1.6**
139	SBG 20-139	RH (OE)-1804	3.8	0.8	0.0	3.2	1.6	3.0	1.1	2.2	2.2	**2.0**
140	**SBG 20-140**	**45 S 46**	3.5	2.3	0.0	3.1	1.5	3.0	1.2	2.4	1.6	**2.1**
141	SBG 20-141	JC 32#	0.8	2.3	0.5	3.2	1.5	2.6	1.7	2.2	1.9	**1.9**
142	SBG 20-142	PDZ- 14 #	1.2	2.5	0.4	3.2	1.5	2.5	1.1	2.2	2.0	**1.8**
143	SBG 20-143	LES- 62	0.4	2.3	0.0	3.1	1.2	2.7	1.4	2.8	2.1	**1.8**
144	**SBG 20-144**	**Kranti (NC)**	1.0	0.1	0.0	3.2	1.5	3.7	2.9	3.0	2.1	**1.9**
Mustard: White rust resistance												
145	SBG 20-145	PJK (A4A5)-21	1.0	2.0	0.0	3.1	1.5	2.8	0.7	3,0	2.2	**1.7**
146	SBG 20-146	Rohini (A4A5)-491	2.0	1.0	0.0	3.1	1.6	2.8	1.7	3.2	1.8	**1.9**
147	**SBG 20-147**	**45 S 46**	1.6	1.6	0.0	3.2	1.6	3.0	0.8	2.6	1.7	**1.8**
148	SBG 20-148	Varuna (A4A5)-936-279	1.2	1.8	0.0	3.2	1.0	2.7	1.5	2.4	2.3	**1.8**
149	SBG 20-149	PB (A4A5)-842	2.5	1.5	0.0	3.1	1.5	2.3	2.9	3.0	2.0	**2.1**
150	**SBG 20-150**	**Kranti (NC)**	2.8	1.6	0.1	3.3	1.6	2.7	2.8	3.0	1.9	**2.2**
Mustard (Germplasm)												
151	SBG 20-151	DRMRIS-A-18-5	0.8	2.1	0.0	3.2	1.5	3.2	3.8	2.2	2.8	**2.2**
152	SBG 20-152	DRMRIS-A-18-3	2.2	1.8	0.0	3.1	1.6	3.2	2.8	2.5	-	**2.2**
153	**SBG 20-153**	**RH -725**	1.4	0.9	0.0	3.2	1.6	3.3	2.7	2.7	-	**2.0**
154	SBG 20-154	DRMRIS-A-18-11	0.2	1.0	0.0	3.1	1.6	3.0	2.6	2.2	-	**1.7**
155	SBG 20-155	DRMRIS-A-18-4	1.9	2.3	0.0	3.3	1.6	3.2	0.6	2.2	-	**1.9**
156	**SBG 20-156**	**BSH -1**	2.8	2.9	0.0	3.4	1.5	3.0	0.7	3.0	-	**2.2**
Average			**1.7**	**1.5**	**0.0**	**3.2**	**1.4**	**3.0**	**1.7**	**2.6**	**2.1**	**1.9**

Table 5.1 (B): Screening of AVT I and AVT II entries of *Brassica* for resistance against mustard aphid

S. No.	Code No.	Entries	MOR	HSR	KAN	SKN	PTN	NDH	LDH	DHO	SHIL	Mean
AVT I Early Mustard												
1	SAG 20-1	NPJ 229	1.4	1.1	0.0	3.4	1.3	3.8	1.8	2.8	2.3	**2.0**
AVT I + AHT I Early Mustard												
2	SAG 20-2	PRE 17-2	0.6	1.5	0.0	3.4	1.6	3.8	2.9	2.5	1.9	**2.0**
3	SAG 20-3	RH 1999-42	1.0	0.9	0.0	3.3	1.5	3.4	1.1	3.0	2.2	**1.8**
4	SAG 20-4	PHR 5022 (Hybrid)	1.2	1.3	0.2	3.4	1.2	2.8	0.6	2.6	1.8	**1.7**
5	SAG 20-5	KMR (E) 19-1	1.2	2.0	0.1	3.4	1.5	2.7	1.9	2.2	1.9	**1.9**
6	**SAG 20-6**	**PM-25**	1.0	2.7	0.0	3.5	1.6	3.2	0.8	2.5	1.7	**1.9**
7	SAG 20-7	PRE 17-5	2.0	1.2	0.0	3.5	1.5	3.3	0.6	2.7	2.0	**1.9**
8	SAG 20-8	NPJ 230	1.0	1.2	0.2	3.5	1.6	2.3	2.5	2.2	2.4	**1.9**
9	SAG 20-9	RMM 10-1-1	2.0	3.2	0.0	3.5	0.9	2.8	4.1	2.2	2.4	**2.3**
10	**SAG 20-10**	**BSH 1**	2.2	0.9	0.0	3.5	1.2	3.0	4.2	3.4	2.2	**2.3**
11	SAG 20-11	KMR (E) 19-2	1.5	1.2	0.1	3.5	0.9	3.0	2.7	2.8	2.3	**2.0**
12	SAG 20-12	DRMRCI 116	1.0	1.7	0.0	3.5	1.6	3.3	1.7	2.4	2.2	**1.9**
13	SAG 20-13	DRMRCI 96	1.6	0.5	0.0	3.5	1.6	3.3	1.0	2.4	1.5	**1.7**
14	SAG 20-14	DRMR HJ 2403 (Hybrid)	2.1	1.5	0.0	3.5	1.6	3.3	1.3	2.4	2.1	**2.0**
15	SAG 20-15	**JD 6**	2.1	0.3	0.0	3.5	1.6	2.6	1.3	2.4	2.0	**1.8**
AVT I Mustard (Timely Sown Irrigated)												
16	SAG 20-16	AKMS 19-2	1.8	2.6	0.00	3.4	1.5	2.7	2.1	2.2	1.9	**2.0**
17	SAG 20-17	RH 1676	2.1	1.8	0.00	3.5	1.5	2.9	0.8	2.6	1.9	**1.9**
18	**SAG 20-18**	**SKM 1626**	1.6	0.2	0.00	3.5	1.2	3.3	0.7	2.2	1.8	**1.6**
19	SAG 20-19	RGN 443	0.8	1.2	0.00	3.5	1.5	2.3	0.7	2.2	2.1	**1.6**
20	SAG 20-20	PBR 385	1.4	0.7	0.4	3.5	1.6	2.5	2.2	2.8	1.8	**1.9**
21	**SAG 20-21**	**DRMRIJ 31**	0.2	2.0	0.0	3.5	1.6	3.3	2.4	3.0	1.9	**2.0**
22	SAG 20-22	NPJ 231	1.6	3.1	0.0	3.5	1.6	2.6	0.8	3,0	1.9	**1.9**
23	SAG 20-23	PR 2016-8	1.2	1.4	0.0	3.4	1.6	3.5	1.9	2.1	1.2	**1.8**
24	SAG 20-24	PR 2016-4	1.6	1.9	0.0	3.4	1.2	3.5	0.9	2.5	2.1	**1.9**
25	SAG 20-25	DRMR 2017-16	1.2	2.1	0.0	3.4	1.2	3.0	1.0	3.0	2.0	**1.9**

26	**SAG 20-26**	**RGN 229**	1.4	0.3	0.0	3.4	1.3	3.3	0.9	2.6	2.3	**1.7**
AVT I Mustard (Rainfed)												
27	SAG 20-27	RH 1424	0.6	2.8	0.0	3.4	1.5	2.5	1.9	2.6	2.1	**1.9**
AVT I+II (Quality Mustard)												
28	SAG 20-28	PDZ 11	0.4	2.2	0.0	3.4	1.5	3.7	1.1	2.2	2.1	**1.8**
29	SAG 20-29	LES 60	0.0	3.3	0.2	3.4	1.2	2.5	1.9	2.6	2.0	**1.9**
30	SAG 20-30	RCH 1	1.0	3.0	0.0	3.4	1.2	3.3	2.7	3.4	2.6	**2.3**
31	**SAG 20-31**	**PM 30**	2.1	2.1	0.1	3.3	1.5	2.0	1.8	2.8	1.6	**1.9**
32	SAG 20-32	PDZ 12	1.0	2.1	0.0	3.4	1.2	3.2	2.7	2.4	1.9	**2.0**
33	SAG 20-33	9IJ5001	1.2	0.6	0.2	3.4	1.2	2.5	1.6	2.4	1.7	**1.6**
34	SAG 20-34	RH (OE) 1706	0.0	2.5	0.0	3.4	1.5	2.8	1.4	2.4	1.8	**1.8**
35	**SAG 20-35**	**PDZ 1**	0.4	1.8	0.0	3.4	1.6	3.0	2.6	2.4	2.2	**1.9**
AVT I Mustard Saline/alkaline conditions												
36	SAG 20-36	CS 2005-143	2.8	2.4	0.0	3.3	1.5	3.0	1.0	2.2	2.2	**2.0**
AVT I+II *Gobhi Sarson*												
37	SAG 20-37	GSH 2196	0.8	0.6	0.1	3.5	1.6	3.0	2.6	2.6	2.1	**1.9**
38	SAG 20-38	AKGS 19-8	1.4	0.3	0.4	3.3	1.6	1.8	1.3	2.2	2.1	**1.6**
39	SAG 20-39	GSH 1699	2.6	0.6	0.5	3.4	1.5	1.8	3.4	2.2	1.9	**2.0**
40	**SAG 20-40**	**GSH 6**	2.4	0.6	0.0	3.5	1.6	2.7	2.3	2.4	1.8	**1.9**
41	SAG 20-41	GSH 2180	2.1	0.4	0.0	3.5	1.5	3.0	2.3	3.2	1.5	**1.9**
42	SAG 20-42	HNS 702	2.6	1.6	0.0	3.3	1.6	2.8	2.2	2.6	2.2	**2.1**
43	SAG 20-43	RTM 1624	0.8	0.1	0.0	2.7	1.6	3.3	0.5	2.2	1.7	**1.4**
44	**SAG 20-44**	**RTM 314**	2.1	0.2	0.0	2.7	0.8	2.8	0.5	2.8	2.0	**1.5**
Average			**1.4**	**1.5**	**0.1**	**3.4**	**1.4**	**2.9**	**1.7**	**2.5**	**2.0**	**1.9**

Table 5.2: Assessment of avoidable yield losses due to insect pests in *Brassicas*

Centre	**Mustard phid population in unprotected plot**		**Yield (kg/ha)**		**Avoidable yield losses (%)**
			Protected	**Unprotected**	
Hisar					
PM-31	121.4		1954.1	1534.4	21.5
RH 725	98.2		1960.8	1621.3	17.3
RH 30	112.5		1831.9	1578.7	13.8
CD (p=0.05)	**NS**		**84.4**	**64.2**	-
Dholi					
Rajendra Suflam	21.6		998.0	826.0	17.2
PM-31	28.8		882.0	698.0	20.8
RH-725	31.4		846.0	652.0	22.9
CD (p=0.05)	-		**77.1**	**51.1**	-
Ludhiana	**Aphids/ plant**	**Cabbage caterpillars/ plant**			
PM-31	35.1	24.9	2102.1	1500.0	28.6
RH-725	40.0	15.9	2087.4	1629.2	21.9
PBR 357	30.4	17.5	1879.1	1356.3	27.8
CD (p=0.05)	**NS**	**7.2**	**146.7**	**146.7**	-
S.K.Nagar					
PM-31	211.9		2077.0	1189.0	42.7
RH-725	200.9		2045.0	1556.0	23.8
GDM-4	210.6		1938.0	1523.0	21.4
Morena					
PM-31	125.7		2452.0	2275.0	7.2
RH-725	110.4		2869.0	2604.0	9.3
New Delhi					
PM-31	937.5		1230.6	870.8	29.2
RH-725	900.0		1951.9	1198.7	38.5
Pant Nagar					
PM-31	107.5		1331.0	1131.0	15.0
RH-725	103.3		1252.0	1160.0	7.3
Varuna	96.7		1365.0	1187.0	13.0

Table 5.3.1(A): Population dynamics of painted bug on *Brassicas* varieties at Hisar

Population dynamics of painted bug on *Brassica* varieties														
Std Week	**Meteorological observations**						**No. of painted bugs/ m row length (mrl)**							
							Timely Sown				**Late Sown**			
	Temperature (°C)		**RH (%)**		**Sunshine hours**	**Rainfall (mm)**	***B. juncea***	***E. sativa***	***B. napus***	***B. rapa***	***B. juncea***	***E. sativa***	***B. napus***	***B. rapa***
	Max.	**Min.**	**Morn.**	**Even.**			**DRMR IJ 31**	**T 27**	**GGSC 6**	**BSH 1**	**DRMR IJ 31**	**T 27**	**GSC 6**	**BSH 1**
41	35.6	16.3	86	28	7.9	0.0	0.0	0.0	0.0	0.0	-	-	-	-
42	34.2	13.7	76	22	7.1	0.0	0.1	0.0	0.0	0.1	-	-	-	-
43	33.0	12.8	80	26	6.5	0.0	0.1	0.2	0.1	0.4	-	-	-	-
44	30.4	9.8	85	24	5.6	0.0	0.4	0.4	0.3	0.5	-	-	-	-
45	29.7	10.5	91	33	3.2	0.0	0.7	0.9	0.8	1.1	-	-	-	-
46	25.6	12.6	89	50	2.7	18.2	1.0	1.5	1.4	0.9	-	-	-	-
47	23.1	7.7	88	43	6.5	0.0	0.3	0.9	0.2	0.9	0.0	0.0	0.0	0.0
48	23.3	8.4	92	42	6.6	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	25.5	9.1	90	53	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	20.8	5.0	96	63	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	19.7	3.0	92	42	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	19.5	2.6	96	51	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: Weather data provided by the department of Agricultural Meteorology, CCS HAU, Hisar

Table 5.3 (1B). Population dynamics of mustard sawfly on *Brassica* varieties at Hisar

Population dynamics of mustard sawfly on *Brassica* varieties														
Std Week	**Meteorological observations**						**No. of sawfly larvae/ 10 plants**							
							Timely Sown				**Late Sown**			
	Temperature (°C)		**RH (%)**		**Sunshine hours**	**Rainfall (mm)**	***B. juncea***	***E. sativa***	***B. napus***	***B. rapa***	***B. juncea***	***E. sativa***	***B. napus***	***B. rapa***
	Max.	**Min.**	**Morn.**	**Even.**			**DRMR IJ 31**	**T 27**	**GGSC 6**	**BSH 1**	**DRMR IJ 31**	**T 27**	**GSC 6**	**BSH 1**
44	30.4	9.8	85	24	5.6	0.0	0.0	0.0	0.0	0.0	-	-	-	-
45	29.7	10.5	91	33	3.2	0.0	0.0	0.0	0.0	0.0	-	-	-	-
46	25.6	12.6	89	50	2.7	18.2	0.0	0.0	0.0	0.0	-	-	-	-
47	23.1	7.7	88	43	6.5	0.0	0.6	0.0	0.0	0.3	-	-	-	-
48	23.3	8.4	92	42	6.6	1.7	0.3	0.3	0.0	0.0	-	-	-	-
49	25.5	9.1	90	53	5.9	0.0	0.0	0.3	0.6	0.0	0.0	0.0	0.0	0.0
50	20.8	5.0	96	63	5.3	0.0	0.8	0.0	0.0	0.7	0.0	0.0	0.0	0.0
51	19.7	3.0	92	42	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	19.5	2.6	96	51	5.8	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5.3.1(C): Population dynamics of mustard aphid on *Brassica* varieties at Hisar

Population dynamics of mustard aphid on *Brassica* varieties														
Std. Week	**Meteorological observations**						**No. of aphids / top 10 cm central twig**							
							Timely Sown				**Late Sown**			
	Temp.(°C)		**RH (%)**		**Sunshine hours**	**Rainfall (mm)**	***B. juncea***	***E. sativa***	***B. napus***	***B. rapa***	***B. juncea***	***E. sativa***	***B. napus***	***B. rapa***
	Max.	**Min.**	**Morn.**	**Even.**			**DRMR IJ 31**	**T 27**	**GSC 6**	**BSH 1**	**DRMR IJ-31**	**T 27**	**GSC 6**	**BSH 1**
1	17.5	9.6	96	82	1.8	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	15.8	4.6	98	72	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	16.4	6.7	99	74	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	18.8	4.9	96	59	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	22.6	5.2	94	46	7.5	8.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	22.6	5.5	98	53	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	25.2	8.4	100	51	5.6	0.0	0.0	0.0	0.0	0.0	4.1	2.2	3.8	24.1
8	27.6	9.1	97	43	7.1	0.0	0.0	0.0	0.0	0.0	22.4	19.8	26.3	35.2
9	29.3	9.7	93	34	8.4	0.0	0.0	0.0	0.0	0.0	72.3	58.1	66.2	120.5
10	30.7	14.1	91	43	6.8	0.0	0.0	0.0	0.0	0.0	133.1	87.3	107.6	92.8
11	30.7	13.9	89	40	6.0	1.2	0.0	0.0	0.0	0.0	183.5	107.8	155.8	138.2
12	31.4	14.5	88	37	5.9	4.4	Harvested	Harvested	Harvested	Harvested	49.9	29.42	43.0	77.2
13	33.5	14.3	75	26	7.7	0.0					20.7	29.2	25.7	25.2
14	35.0	13.3	69	18	8.2	0.0					4.4	4.1	3.5	3.1

Note: Weather data provided by the department of Agricultural Meteorology, CCS HAU, Hisar.

Table 5.3.1(D): Population dynamics of various predators on *Brassica* varieties at Hisar

Population dynamics of predators on *Brassica* varieties														
Std. Week	Meteorological observations						Coccinellids (Grubs +Beetles)/ Plant							
							Timely Sown				Late Sown			
	Temp. (°C)		RH (%)		Sunshine hours	Rainfall (mm)	*B. juncea*	*E. sativa*	*B. napus*	*B. rapa*	*B. juncea*	*E. sativa*	*B. napus*	*B. Rapa*
	Max.	Min.	Morn.	Even.			DRMR IJ 31	T 27	GSC 6	BSH 1	DRMR IJ-31	T 27	GSC 6	BSH 1
47	23.1	7.7	88	43	6.5	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	23.3	8.4	92	42	6.6	1.7	0.0	0.2	0.0	0.3	0.0	0.0	0.0	0.0
49	25.5	9.1	90	53	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	20.8	5	96	63	5.3	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
51	19.7	3	92	42	6.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
52	19.5	2.6	96	51	5.8	00	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	17.5	9.6	96	82	1.8	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	15.8	4.6	98	72	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	16.4	6.7	99	74	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	18.8	4.9	96	59	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	22.6	5.2	94	46	7.5	8.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	22.6	5.5	98	53	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	25.2	8.4	100	51	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	27.6	9.1	97	43	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	29.3	9.7	93	34	8.4	0.0	0.0	0.0	0.0	0.0	0.3	0.6	0.5	0.8
10	30.7	14.1	91	43	6.8	0.0	Harvested	Harvested	Harvested	Harvested	0.9	1.1	1.3	2.2
11	30.7	13.9	89	40	6.0	1.2					1.6	1.9	2.1	2.6
12	31.4	14.5	88	37	5.9	4.4					2.8	2.7	2.5	3.5
13	33.5	14.3	75	26	7.7	0.0					1.5	3.2	2.8	2.3

Note: Weather data provided by the department of Agricultural Meteorology, CCS HAU, Hisar.

Table 5.3.2: Population dynamics of mustard aphid on *Brassica* crops (Late Sown) at Dholi

Std. Week	Weather parameters				Rainfall (mm)	Aphid population/10 cm twig on				
	Temperature (°C)		RH (%)			DRMR IJ 31	BSH 1	GSC 6	T 27	Rajendra Suflam
	Max.	Min.	Morn.	Even.						
4	16.5	9.4	100.00	92.8	0.0	3.2	3.8	3.6	5.2	1.8
5	18.3	5.7	100.00	94.0	0.0	8.2	11.8	9.2	7.8	5.2
6	24.1	9.4	100.00	89.5	0.0	21.6	27.2	26.8	31.6	18.0
7	26.3	10.9	100.00	92.0	0.0	38.2	42.6	31.4	37.2	29.2
8	27.7	12.2	100.00	91.1	0.0	44.6	51.8	52.6	55.6	38.4
9	30.1	14.3	100.00	92.0	0.0	9.4	11.2	12.6	16.6	7.2
10	30.5	15.0	99.7	90.0	0.0	2.2	2.6	2.0	2.8	1.2
11	30.7	16.5	98.5	85.1	0.0	0.0	0.0	0.0	0.0	0.0
12	34.2	17.8	99.1	71.5	0.0	0.0	0.0	0.0	0.0	0.0
Correlation coefficient (r) DRMR IJ 31	0.31	0.24	0.06	(-0.52)						
BSH 1	0.34	0.21	0.08	(-0.46)						
GSC 6	0.29	0.28	0.12	(-0.54)						
T 27	0.26	0.22	0.08	(-0.42)						
Rajendra Suflam	0.36	0.18	0.04	(-0.54)						

Table 5.3.3(A): Population dynamics of mustard aphid on *Brassicas* at Pant Nagar (Timely sown)

Std. Week	Temperature		Rain fall (mm)	R.H. %		Sun- Shine (Hrs)	Number of aphids/ top 10 cm central twig						
	Max.	Min.		Max.	Min.		DRMR IJ 31	T 27	GSC 6	BSH 1	*B. nigra*	*B. alba*	Varuna
3	18.2	7.5	0.0	96	69	3.7	0.00	0.00	0.67	1.93	0.60	0.0	2.56
4	16.6	8.8	0.0	96	75	1.6	0.00	0.00	4.07	9.80	3.83	9.10	11.30
5	18.8	6.1	0.0	96	61	4.5	0.40	0.50	11.00	19.26	8.82	20.47	19.47
6	23.7	7.8	4.6	94	53	6.7	0.85	0.70	17.30	37.13	13.70	33.03	27.70
7	25.7	9.0	0.0	91	45	7.1	5.27	2.30	23.23	47.57	18.97	42.80	35.93
8	26.9	9.9	0.0	89	48	6.7	8.20	4.40	32.67	50.67	29.27	50.33	45.83
9	29.3	11.2	0.0	90	37	9.2	21.25	3.96	37.90	35.13	36.20	61.43	42.50
10	29.6	14.2	0.0	83	46	7.6	23.10	5.03	30.67	13.73	46.13	44.50	19.47
11	30.3	13.6	0.0	86	36	7.0	15.63	2.10	7.41	4.16	16.42	19.45	3.56
12	32.6	14.1	0.0	82	27	8.0	4.80	0.20	0.89	0.00	2.16	5.60	0.00
13	33.4	14.6	0.0	84	23	7.9	2.68	0.00	0.00	0.00	0.00	0.00	0.00
14													
15													

Table 5.3.3(B): Population dynamics of mustard aphid on *Brassicas* at Pant Nagar (Late sown)

Std. Week	Temperature		Rain fall (mm)	R.H. %		Sunshine Hours	Number of aphids/ top 10 cm central twig						
	Max.	Min.		Max.	Min.		DRMR IJ 31	T 27	GSC 6	BSH 1	*B. nigra*	*B. alba*	Varuna
5	18.8	6.1	0.0	96	61	4.5	0.00	0.00	1.60	0.00	0.00	4.43	2.86
6	23.7	7.8	4.6	94	53	6.7	0.00	0.00	5.74	3.90	0.60	11.34	3.54
7	25.7	9.0	0.0	91	45	7.1	1.20	1.77	14.10	16.70	8.20	27.90	13.70
8	26.9	9.9	0.0	89	48	6.7	2.83	3.70	27.93	19.84	31.83	46.57	15.60
9	29.3	11.2	0.0	90	37	9.2	8.77	5.30	45.30	34.13	60.03	97.86	18.50
10	29.6	14.2	0.0	83	46	7.6	17.20	12.43	66.90	56.80	50.20	161.50	30.20
11	30.3	13.6	0.0	86	36	7.0	27.26	13.93	84.33	72.63	62.60	135.83	53.13
12	32.6	14.1	0.0	82	27	8.0	40.70	6.76	102.70	88.37	73.50	153.70	73.80
13	33.4	14.6	0.0	84	23	7.9	25.93	3.16	114.70	47.16	66.30	94.63	36.33
14	34.4	13.9	0.0	59	14	6.5	10.86	2.00	76.43	19.43	74.76	114.97	17.90
15	37.5	14.1	0.0	59	11	10.0	2.68	1.30	29.50	3.60	61.63	73.56	3.60
16	36.8	17.8	0.0	57	17	6.5	0.00	0.00	8.48	0.00	26.10	32.30	0.00

Table 5.3.4 (A): Population dynamics of mustard aphid and cabbage caterpillar on *Brassicas* at Ludhiana (Timely sown)

SMW*	Weather Parameters						No of aphids/ top 10 cm central twig								Cabbage caterpillars/ plant			
	Temp. (^{0}C)		R.H. (%)		Rainfall (mm)	Sunshine (hrs)	GSC 6		DRMR-IJ 31		BSH 1		T27		GSC 6	DRMR-IJ 31	BSH 1	T27
	Max.	Min.	M	E			MA	CA	MA	CA	MA	CA	MA	CA				
															0.0	0.0	0.0	0.0
51	18.6	3.5	91.0	39.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	15.8	4.2	96.0	63.0	1.8	4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	17.6	10.0	91.0	75.0	11.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	14.0	6.8	93.0	71.0	0.0	1.8	0.0	0.0	0.0	0.0	1.1	2.7	0.0	0.0	0.0	0.0	0.0	0.0
3	16.6	6.9	96.0	70.0	0.0	3.0	0.7	1.0	1.0	2.1	5.9	7.3	0.0	0.0	0.0	0.0	0.0	0.0
4	17.9	6.4	93.0	55.0	0.0	4.6	3.5	3.2	3.1	5.8	13.9	5.3	0.4	0.4	0.0	0.0	0.0	0.0
5	20.6	6.3	89.0	39.0	17.0	6.5	8.4	5.6	15.8	7.1	17.3	14.8	1.4	1.3	0.0	0.0	0.0	0.0
6	21.3	7.3	95.0	58.0	0.0	7.4	1.1	5.5	1.8	10.5	1.4	14.5	4.2	1.8	0.0	0.0	0.0	0.0
7	22.5	10.8	96.0	69.0	0.0	5.4	4.9	11.4	7.9	15.0	4.1	11.6	2.1	3.2	23.2	25.1	0.0	0.0
8	26.8	11.6	96.0	47.0	0.0	7.8	57.6	80.8	55.5	37.6	32.7	27.1	1.6	1.7	22.9	15.8	0.0	0.0
9	27.8	11.9	90.0	38.0	0.0	9.8	82.6	99.3	79.4	89.4	9.6	9.2	0.6	1.6	32.3	45.8	0.0	0.0
10	29.7	15.3	80.0	42.0	0.0	7.4	89.3	97.8	93.5	101.5	1.7	2.5	0.7	0.7	45.4	45.6	0.0	0.0
11	28.6	15.2	81.0	39.0	0.0	4.2	101.6	103.3	47.0	56.3	0.0	0.0	0.0	0.0	30.6	10.5	0.0	0.0
12	29.1	15.2	84.0	35.0	5.0	6.1	50.3	58.5	13.6	16.3	Harv	ested	0.0	0.0	30.2	3.3	0.0	0.0
13	32.2	15.6	73	25	0.0	9.7	37.0	49.0	0.0	0.0			0.0	0.0	0.0	0.0	0.0	0.0
14	32.2	14.6	55.0	16.0	3.0	8.1	0.0	0.0	0.0	0.0			0.0	0.0	0.0	0.0	0.0	0.0

*** SMW: Standard Meteorological Week; MA: Mustard aphid, CA: Cabbage aphid**

Table 5.3.4(B): Population dynamics of mustard aphid and cabbage caterpillar on *Brassicas* at Ludhiana (late sown)

SMW*	Weather Parameters						No of aphids/ top 10 cm central twig								Cabbage caterpillars/ plant			
	Temp. (^{0}C)		R.H. (%)		Rainfall (mm)	Sunshine (hrs)	GSC 6		DRMR-IJ 31		BSH 1		T27		GSC 6	DRMR-IJ 31	BSH 1	T27
	Max.	Min.	M	E			MA	CA	MA	CA	MA	CA	MA	CA				
52	15.8	4.2	96.0	63.0	1.8	4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	17.6	10.0	91.0	75.0	11.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	14.0	6.8	93.0	71.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	16.6	6.9	96.0	70.0	0.0	3.0	0.0	0.0	0.0	0.0	2.1	4.0	0.0	0.0	0.0	0.0	0.0	0.0
4	17.9	6.4	93.0	55.0	0.0	4.6	0.9	0.7	1.2	0.7	9.8	5.9	1.1	0.0	0.0	0.0	0.0	0.0
5	20.6	6.3	89.0	39.0	17.0	6.5	2.7	1.7	0.8	0.6	28.3	21.4	1.1	1.1	0.0	0.0	0.0	0.0
6	21.3	7.3	95.0	58.0	0.0	7.4	2.5	1.5	5.9	4.8	3.0	13.8	3.3	8.6	0.0	0.0	0.0	0.0
7	22.5	10.8	96.0	69.0	0.0	5.4	18.8	23.0	18.8	43.8	4.6	19.8	3.0	1.8	7.9	39.2	2.9	0.0
8	26.8	11.6	96.0	47.0	0.0	7.8	36.5	30.3	72.9	66.9	12.8	13.6	3.6	3.2	31.1	42.1	3.8	0.0
9	27.8	11.9	90.0	38.0	0.0	9.8	72.5	69.5	91.6	87.7	10.2	11.6	1.1	1.1	35.7	39.2	2.6	0.0
10	29.7	15.3	80.0	42.0	0.0	7.4	88.3	82.3	81.2	49.7	3.6	2.7	3.6	2.3	55.9	27.6	0.0	0.0
11	28.6	15.2	81.0	39.0	0.0	4.2	115.0	89.8	56.1	40.6	1.1	0.0	1.4	0.3	42.6	14.9	0.0	0.0
12	29.1	15.2	84.0	35.0	5.0	6.1	69.6	70.0	35.0	14.1	0.0	0.0	0.0	0.0	15.0	8.3	0.0	0.0
13	32.2	15.6	73.0	25.0	0.0	9.7	24.6	42.6	1.3	2.0	Harv	ested	0.0	0.0	3.8	0.0	-	0.0
14	32.2	14.6	55.0	16.0	3.0	8.1	0.0	0.0	0.0	0.0			0.0	0.0	0.0	0.0	-	0.0
15	36.1	17.5	49.0	11.0	0.0	9.5	-	-	-	-			-	-	-	-	-	0.0

*** SMW: Standard Meteorological Week; MA: Mustard aphid, CA: Cabbage aphid**

Table 5.3.5: Population dynamic of various insect pests on *Brassicas* crops at SK Nagar

Std. week	Weather Parameters						Aphids/ top 10cm central twig									
	Temp. (^{o}C)		RH (%)		Rain fall (mm)	Sun Shine (hrs)	DRMR IJ 31		T 27		GSC 6		BSH 1		GDM-4	
	Max.	Min.	Morn	Even			Timely sown	Late sown	Timely sown	Late sown	Timely sown	Late sown	Timely sown	Late sown	Timely sown	Late sown
50	30.7	9.1	58.8	20.0	0.0	7.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	25.5	7.3	56.7	27.9	0.0	9.6	2.3	0.0	0.0	0.0	1.3	0.0	1.0	0.0	0.7	0.0
52	22.9	6.7	51.9	24.9	0.0	9.3	4.4	0.0	0.0	0.0	3.5	0.0	3.2	0.0	2.7	0.0
1	23.2	8.1	67.1	37.4	0.0	9.3	7.5	0.0	0.0	0.0	8.5	0.0	8.6	0.0	5.8	0.0
2	23.5	9.2	67.8	29.0	0.0	8.9	24.7	3.3	0.0	0.0	24.6	3.7	23.3	5.1	17.7	3.0
3	25.9	10.5	64.8	26.8	0.0	9.4	33.4	13.2	0.0	0.0	27.6	14.9	28.0	14.1	26.2	13.5
4	26.3	7.0	60.5	16.8	0.0	9.6	64.0	78.8	5.2	9.1	65.3	79.1	65.3	90.9	60.7	76.1
5	29.2	8.1	57.2	21.3	0.0	10.1	55.3	118.1	32.4	51.5	59.9	125.6	57.1	136.1	56.9	115.1
6	35.2	9.8	59.7	29.0	0.0	9.8	32.5	212.8	44.0	57.0	32.2	261.4	28.5	269.5	25.3	213.0
7	36.8	12.0	62.9	26.5	0.0	9.9	0.0	332.6	7.8	91.6	10.2	340.7	0.0	343.9	0.0	328.0
8	38.2	14.0	64.1	29.7	0.0	10.0	0.0	152.1	0.0	68.3	0.0	161.4	0.0	160.5	0.0	137.9
9	36.5	14.4	67.4	24.0	0.0	9.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	36.8	15.5	68.2	25.0	0.0	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	36.9	16.1	68.7	24.3	0.0	9.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	38.2	18.3	68.9	25.2	0.0	8.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	38.9	18.7	69.8	26.7	0.0	9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5.3.6(A): Population dynamics of mustard sawfly larvae in *Brassicas* at Shillongani

Std. Week	Weather parameters					Sawfly larvae/ plant									
						Benoy		DRMR IJ 31		T 27		GSC 6		BSH 1	
	Temp. (^{0}C)		RH (%)		Rain fall (mm)	Timely	Late	Timely	Late	Timely	Late	Timely	Late	Timely	Late
	Max	Min	Morn	Even											
47	23.0	14.7	92	82	0.0	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
48	27.7	14.4	91	82	0.0	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
49	25.9	9.9	91	77	0.0	0.0	-	0.1	-	0.0	-	0.0	-	0.7	-
50	25.1	9.8	92	72	0.0	0.0	-	0.6	-	0.0	-	0.0	-	1.0	0.0
51	21.9	10.5	93	77	1.0	1.4	0.0	0.9	0.0	0.3	0.0	0.0	0.2	2.1	1.1
52	22.4	7.5	93	77	0.0	2.3	0.8	1.3	0.0	1.3	0.0	1.4	0.1	2.7	2.1
1	21.1	9.7	89	80	7.8	2.6	1.3	0.8	0.9	1.0	1.3	0.7	1.5	1.7	2.0
2	23.1	8.2	85	78	0.0	1.1	3.1	1.2	2.3	1.9	0.8	1.8	1.2	0.8	0.8
3	25.0	9.6	92	72	3.0	0.6	2.0	0.0	1.6	0.6	1.0	1.6	0.0	0.3	0.9
4	21.6	7.7	89	81	0.0	0.0	0.7	0.2	0.0	0.0	0.0	1.1	0.7	0.4	0.1
5	22.3	8.4	90	82	7.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	23.8	8.9	92	73	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	25.4	9.7	88	68	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	25.7	11.0	89	77	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	26.4	12.1	90	71	37.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	25.9	13.3	91	72	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	29.4	14.4	88	73	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	29.6	13.9	89	65	0.0	-	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	31.7	17.2	84	58	3.0	-	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	33.0	15.4	83	58	0.0	-	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5.3.6 (B): Population dynamics of mustard flea beetles in *Brassicas* at Shillongani

Std. Week	Weather parameters					Flea beetles/ plant									
						Benoy		DRMR IJ 31		T 27		GSC 6		BSH 1	
	Temp. (^{0}C)		RH (%)		Rain fall (mm)	Timely	Late	Timely	Late	Timely	Late	Timely	Late	Timely	Late
	Max	Min	Morn	Even											
47	23.0	14.7	92	82	0.0	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
48	27.7	14.4	91	82	0.0	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
49	25.9	9.9	91	77	0.0	1.2	-	0.4	-	0.5	-	1.6	-	2.3	-
50	25.1	9.8	92	72	0.0	2.7	-	2.1	-	1.4	-	1.7	-	2.3	-
51	21.9	10.5	93	77	1.0	1.6	0.0	1.5	0.0	1.3	0.0	2.2	0.0	3.7	0.0
52	22.4	7.5	93	77	0.0	3.7	0.0	3.2	0.0	2.2	1.0	3.4	1.7	5.3	1.8
1	21.1	9.7	89	80	7.8	7.5	0.0	6.4	0.0	4.5	3.5	5.6	2.8	7.4	3.8
2	23.1	8.2	85	78	0.0	6.5	0.0	8.2	0.0	6.3	5.4	8.2	6.3	9.4	8.3
3	25.0	9.6	92	72	3.0	5.2	1.4	5.4	0.6	5.4	4.3	7.4	5.4	6.4	7.6
4	21.6	7.7	89	81	0.0	6.3	2.3	3.3	1.3	2.3	1.5	2.1	2.6	2.4	3.6
5	22.3	8.4	90	82	7.2	10.1	3.7	8.2	2.0	8.2	7.2	7.8	8.9	10.2	10.4
6	23.8	8.9	92	73	0.0	5.3	8.9	6.3	6.6	5.3	4.3	5.1	5.7	6.4	4.6
7	25.4	9.7	88	68	1.0	2.2	12.7	2.2	7.9	2.1	1.1	2.4	1.3	2.4	1.3
8	25.7	11.0	89	77	0.5	1.0	9.3	0.1	3.4	1.0	1.0	1.1	1.7	2.0	1.9
9	26.4	12.1	90	71	37.8	0.1	6.3	0.0	2.7	0.0	0.0	0.0	1.0	1.7	2.0
10	25.9	13.3	91	72	0.5	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7
11	29.4	14.4	88	73	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	29.6	13.9	89	65	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-	0.1
13	31.7	17.2	84	58	3.0	-	0.0	-	0.0	-	0.0	-	0.0	-	0.0
14	33.0	15.4	83	58	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-	0.0

Table 5.3.6(C): Population dynamics of mustard aphid in *Brassicas* at Shillongani

Std. Week	Weather parameters					No of aphids/ top 10 cm central twig									
						Benoy		DRMR IJ 31		T 27		GSC 6		BSH 1	
	Temp. (^{0}C)		RH (%)		Rain fall (mm)	Timely	Late	Timely	Late	Timely	Late	Timely	Late	Timely	Late
	Max	Min	Morn	Even											
47	23.0	14.7	92	82	0.0	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
48	27.7	14.4	91	82	0.0	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
49	25.9	9.9	91	77	0.0	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
50	25.1	9.8	92	72	0.0	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
51	21.9	10.5	93	77	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	1.1
52	22.4	7.5	93	77	0.0	10.3	0.0	0.0	0.0	0.0	1.2	0.1	0.3	0.7	1.3
1	21.1	9.7	89	80	7.8	17.6	20.2	7.6	1.2	6.7	11.3	6.8	7.3	12.6	7.6
2	23.1	8.2	85	78	0.0	32.3	44.7	17.2	17.6	16.3	17.2	20.3	21.4	18.2	31.6
3	25.0	9.6	92	72	3.0	24.6	68.6	31.1	48.2	37.2	47.3	33.7	51.3	41.6	54.2
4	21.6	7.7	89	81	0.0	43.2	91.0	27.3	56.3	37.0	51.1	26.4	62.7	27.2	61.4
5	22.3	8.4	90	82	7.2	15.3	34.6	17.2	34.2	25.0	27.6	25.3	41.3	46.3	42.4
6	23.8	8.9	92	73	0.0	14.2	47.3	10.2	14.7	15.2	17.4	12.3	16.3	21.3	17.4
7	25.4	9.7	88	68	1.0	10.3	41.3	7.1	24.6	9.3	19.2	17.1	17.4	10.2	18.4
8	25.7	11.0	89	77	0.5	1.7	27.6	6.3	13.0	7.4	7.3	5.4	11.4	2.1	12.6
9	26.4	12.1	90	71	37.8	4.6	20.4	7.4	12.2	6.2	4.4	6.2	9.3	4.6	9.4
10	25.9	13.3	91	72	0.5	14.0	31.2	2.4	7.3	1.1	2.1	1.7	4.7	7.8	4.2
11	29.4	14.4	88	73	0.0	0.0	14.0	0.1	1.0	0.2	0.2	0.1	1.7	0.0	2.7
12	29.6	13.9	89	65	0.0	-	1.4	-	1.0	-	1.0	-	1.0	-	2.0
13	31.7	17.2	84	58	3.0	-	0.0	-	0.2	-	0.6	-	0.7	-	1.0
14	33.0	15.4	83	58	0.0	-	1.0	-	0.0	-	0.1	-	0.1	-	0.2

Table 5.3.6(D): Population dynamics of coccinellids (adults+grubs) in *Brassicas* at Shillongani

Std. Week	Weather parameters					Coccinellids (Adults+Grubs)/ plant									
						Benoy		DRMR IJ 31		T 27		GSC 6		BSH 1	
	Temp. (^{0}C)		RH (%)		Rain fall (mm)	Timely	Late	Timely	Late	Timely	Late	Timely	Late	Timely	Late
	Max	Min	Morn	Even											
47	23.0	14.7	92	82	0.0	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
48	27.7	14.4	91	82	0.0	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
49	25.9	9.9	91	77	0.0	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
50	25.1	9.8	92	72	0.0	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
51	21.9	10.5	93	77	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	22.4	7.5	93	77	0.0	0.0	0.2	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.1
1	21.1	9.7	89	80	7.8	0.1	0.4	0.2	1.4	0.2	1.0	0.1	0.4	0.5	0.4
2	23.1	8.2	85	78	0.0	1.4	1.6	1.3	1.7	1.3	0.2	1.2	0.6	1.4	1.4
3	25.0	9.6	92	72	3.0	1.6	1.7	1.2	1.8	1.4	1.2	1.1	1.2	1.4	1.6
4	21.6	7.7	89	81	0.0	1.9	1.8	1.6	1.9	2.0	2.1	2.1	1.7	2.6	1.3
5	22.3	8.4	90	82	7.2	2.1	2.2	2.3	2.3	2.1	2.4	2.6	1.6	2.7	2.7
6	23.8	8.9	92	73	0.0	2.0	2.4	2.1	2.5	2.0	1.8	2.3	2.3	2.4	2.3
7	25.4	9.7	88	68	1.0	1.4	2.0	1.3	1.2	1.5	1.3	1.1	2.1	1.3	2.0
8	25.7	11.0	89	77	0.5	1.3	1.1	0.9	1.0	1.1	1.7	1.0	1.8	1.4	1.7
9	26.4	12.1	90	71	37.8	1.2	1.1	1.2	2.1	0.3	1.4	0.3	1.6	0.6	1.6
10	25.9	13.3	91	72	0.5	1.0	1.0	0.2	1.3	0.1	1.0	0.9	0.9	0.8	0.9
11	29.4	14.4	88	73	0.0	1.4	1.3	0.1	1.0	0.2	0.9	0.1	1.1	0.1	1.0
12	29.6	13.9	89	65	0.0	-	0.0	-	1.3	-	0.8	-	1.0	-	0.0
13	31.7	17.2	84	58	3.0	-	0.1	-	1.2	-	0.9	-	0.8	-	0.2
14	33.0	15.4	83	58	0.0	-	0.1	-	0.1	-	0.0	-	0.7	-	0.0

Table 5.3.7 (A) Population dynamics of mustard aphid on *Brassicas* crops at Morena

Std. Week	Weather parameters				Rainfall (mm)	Aphid population/ top 10 cm central twig on							
	Temperature (°C)		RH (%)			Timely sown				Late sown			
	Max.	Min.	Morn.	Even.		*B. juncea*	*E. sativa*	*B. napus*	*B. rapa*	*B. juncea*	*E. sativa*	*B. napus*	*B. rapa*
						DRMR IJ 31	T 27	GSC 6	BSH 1	DRMR IJ 31	T 27	GSC 6	BSH 1
45	31.5	12.3	51.1	32.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	29.1	12.4	55.7	43.3	18.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	27.6	10.6	53.9	43.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	27.2	10.5	53.1	42.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	28.9	11.1	57.1	48.0	0.0	0.0	1.2	1.0	1.4	0.0	0.0	0.0	1.6
50	24.5	10.7	66.4	54.0	0.0	1.2	1.0	1.2	2.0	2.8	3.0	2.8	3.4
51	20.9	7.5	67.6	52.7	0.0	1.4	1.0	1.4	2.4	1.6	1.0	1.6	2.8
52	21.3	7.1	66.1	54.4	0.0	1.2	1.2	1.4	1.0	1.2	1.8	2.4	0.7
1	21.8	8.2	58.4	39.7	8.0	2.6	1.2	0.8	2.4	1.8	1.4	1.7	2.4
2	20.4	7.9	59.8	39.2	0.0	1.0	0.8	1.2	1.6	1.2	2.8	2.7	1.8
3	21.6	6.7	54.4	38.7	0.0	1.2	0.8	1.9	1.8	1.0	2.8	3.4	1.6
4	23.1	6.4	57.7	40.8	0.0	1.0	1.6	1.4	2.4	1.6	1.6	1.4	2.9
5	26.9	8.1	66.8	40.6	0.0	1.6	2.4	0.6	1.4	1.7	1.9	1.2	1.2
6	27.1	10.2	70.7	42.5	0.0	2.4	1.9	2.8	2.4	1.8	2.9	2.9	2.6
7	29.2	12.3	69.8	34.2	0.0	2.6	2.0	2.6	2.6	2.0	2.5	2.6	2.4
8	29.7	13.0	68.3	34.5	0.0	2.0	2.8	2.4	1.4	2.6	1.6	2.8	2.4
9	34.6	12.5	68.5	44.0	0.0	1.0	2.4	1.6	2.4	2.4	2.1	2.0	2.0
10	34.3	12.7	64.7	38.3	0.0	0.8	2.4	2.6	1.6	2.2	3.1	2.6	1.4
11	34.6	13.6	50.1	37.1	10.0	0.0	0.8	1.0	2.1	1.0	2.0	1.4	2.1
12	34.8	15.8	39.7	33.6	0.0	0.0	0.2	1.0	0.8	1.0	0.2	1.4	1.6
13	36.8	17.5	38.4	31.3	0.0	0.0	0.2	0.2	0.4	0.8	0.0	1.2	1.2

Note: - Weather data provided by Gramin Mausam Krishi Sewa, ZARS, Morena M.P

Table 5.3.7 (B) Population dynamics of painted bug on *Brassicas* crops at Morena

Std. Week	Weather parameters				Rainfall (mm)	Number of painted bugs/ metre row length (mrl)							
	Temperature (°C)		RH (%)			Timely sown				Late sown			
	Max.	Min.	Morn.	Even.		*B. juncea*	*E. sativa*	*B. napus*	*B. rapa*	*B. juncea*	*E. sativa*	*B. napus*	*B. rapa*
						DRMR IJ 31	T 27	GSC 6	BSH 1	DRMR IJ 31	T 27	GSC 6	BSH 1
45	31.5	12.3	51.1	32.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	29.1	12.4	55.7	43.3	18.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	27.6	10.6	53.9	43.1	0.0	0.8	0.4	0.2	0.8	0.8	0.0	0.4	0.8
48	27.2	10.5	53.1	42.0	0.0	0.2	0.4	0.4	1.0	0.8	0.0	0.8	0.0
49	28.9	11.1	57.1	48.0	0.0	0.4	0.8	0.2	0.8	0.0	0.0	0.0	0.0
50	24.5	10.7	66.4	54.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
51	20.9	7.5	67.6	52.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	21.3	7.1	66.1	54.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	21.8	8.2	58.4	39.7	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	20.4	7.9	59.8	39.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	21.6	6.7	54.4	38.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	23.1	6.4	57.7	40.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	26.9	8.1	66.8	40.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	27.1	10.2	70.7	42.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	29.2	12.3	69.8	34.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	29.7	13.0	68.3	34.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	34.6	12.5	68.5	44.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	34.3	12.7	64.7	38.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	34.6	13.6	50.1	37.1	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	34.8	15.8	39.7	33.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	36.8	17.5	38.4	31.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: - Weather data provided by Gramin Mausam Krishi Sewa, ZARS , Morena M.P

Table 5.3.7 (C): Population dynamic of Coccinellids on *Brassicas* crops at Morena

Std. Week	Weather parameters				Rainfall (mm)	Number of cocinellids (Adults+Grubs)/ plant							
	Temperature (°C)		RH (%)			Timely sown				Late sown			
	Max.	Min.	Morn.	Even.		*B. juncea*	*E. sativa*	*B. napus*	*B. rapa*	*B. juncea*	*E. sativa*	*B. napus*	*B. rapa*
						DRMR IJ 31	T 27	GSC 6	BSH 1	DRMR IJ 31	T 27	GSC 6	BSH 1
45	31.5	12.3	51.1	32.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	29.1	12.4	55.7	43.3	18.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	27.6	10.6	53.9	43.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	27.2	10.5	53.1	42.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	28.9	11.1	57.1	48.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	24.5	10.7	66.4	54.0	0.0	0.1	0.1	0.4	0.2	0.1	0.8	1.4	1.2
51	20.9	7.5	67.6	52.7	0.0	0.6	0.4	1.2	1.0	0.7	1.2	0.6	1.2
52	21.3	7.1	66.1	54.4	0.0	0.4	0.4	0.8	0.4	0.2	0.6	0.6	1.4
1	21.8	8.2	58.4	39.7	8.0	1.2	0.2	0.3	1.0	1.8	0.8	1.0	1.6
2	20.4	7.9	59.8	39.2	0.0	0.0	1.2	0.4	0.2	1.4	1.0	0.1	0.1
3	21.6	6.7	54.4	38.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	23.1	6.4	57.7	40.8	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0
5	26.9	8.1	66.8	40.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	27.1	10.2	70.7	42.5	0.0	0.0	0.6	0.6	0.0	0.0	0.0	0.4	0.0
7	29.2	12.3	69.8	34.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.8
8	29.7	13.0	68.3	34.5	0.0	0.2	0.0	0.4	0.0	0.0	0.0	0.0	0.8
9	34.6	12.5	68.5	44.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0
10	34.3	12.7	64.7	38.3	0.0	0.0	0.0	0.0	0.4	0.6	0.0	0.0	0.0
11	34.6	13.6	50.1	37.1	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	34.8	15.8	39.7	33.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	36.8	17.5	38.4	31.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: - Weather data provided by Gramin Mausam Krishi Sewa, ZARS , Morena M.P

Table 5.3.7 (D): Activity of honey bees on *Brassicas* at Morena

Std. Week	Weather parameters				Rainfall (mm)	Number of honey bee visits/ min/ plant							
	Temperature (°C)		RH (%)			Timely sown				Late sown			
	Max.	Min.	Morn.	Even.		*B. juncea*	*E. sativa*	*B. napus*	*B. rapa*	*B. juncea*	*E. sativa*	*B. napus*	*B. rapa*
						DRMR IJ 31	T 27	GSC 6	BSH 1	DRMR IJ 31	T 27	GSC 6	BSH 1
45	31.5	12.3	51.1	32.3	0.0	1.4	1.6	2.4	1.4	1.4	1.6	2.6	1.4
46	29.1	12.4	55.7	43.3	18.0	1.2	1.6	2.4	1.6	0.8	1.2	1.8	1.8
47	27.6	10.6	53.9	43.1	0.0	1.4	2.8	2.8	0.6	0.8	0.8	1.1	1.2
48	27.2	10.5	53.1	42.0	0.0	1.2	1.8	1.5	1.0	0.6	1.0	1.0	1.0
49	28.9	11.1	57.1	48.0	0.0	1.0	2.4	1.9	2.0	0.8	0.6	2.1	0.8
50	24.5	10.7	66.4	54.0	0.0	1.0	1.4	1.6	1.6	1.1	1.2	0.4	1.1
51	20.9	7.5	67.6	52.7	0.0	1.2	1.4	1.9	1.3	1.2	1.2	1.2	1.2
52	21.3	7.1	66.1	54.4	0.0	2.5	1.0	1.6	1.0	0.6	0.8	0.9	1.0
1	21.8	8.2	58.4	39.7	8.0	2.1	0.8	2.8	1.6	0.6	0.8	1.6	1.3
2	20.4	7.9	59.8	39.2	0.0	1.6	0.2	2.5	1.2	0.4	0.4	1.4	1.2
3	21.6	6.7	54.4	38.7	0.0	1.2	1.0	1.8	1.2	0.0	0.0	1.2	1.4
4	23.1	6.4	57.7	40.8	0.0	1.2	0.4	1.0	1.4	1.0	0.4	0.4	1.0
5	26.9	8.1	66.8	40.6	0.0	2.0	0.0	2.7	1.0	0.8	1.0	2.4	1.6
6	27.1	10.2	70.7	42.5	0.0	2.4	0.0	2.4	1.2	0.8	1.0	2.1	2.4
7	29.2	12.3	69.8	34.2	0.0	1.6	0.0	1.4	1.0	0.0	2.1	2.1	2.1
8	29.7	13.0	68.3	34.5	0.0	2.4	0.0	1.4	1.2	0.0	1.0	1.4	0.0
9	34.6	12.5	68.5	44.0	0.0	1.0	0.0	0.8	0.4	0.0	0.4	1.2	1.6
10	34.3	12.7	64.7	38.3	0.0	0.4	0.0	0.0	0.4	0.0	0.4	1.0	1.0
11	34.6	13.6	50.1	37.1	10.0	0.0	0.0	0.0	0.2	0.0	0.1	0.4	0.0
12	34.8	15.8	39.7	33.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	36.8	17.5	38.4	31.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: - Weather data provided by Gramin Mausam Krishi Sewa , ZARS, Morena M.P

Table 5.3.8: Monitoring of alate mustard aphid on sticky traps

Std. week	Mean mustard aphid (alate) population per trap						
	HSR	SKN	LDH	PTN	KAN	MOR	DHO
40	-	-	0.0	-	-	0.0	0.0
41	-	-	0.0	-	-	0.0	0.0
42	-	-	0.0	-	-	0.0	0.0
43	-	-	14.0	-	0.0	0.0	0.0
44	-	-	47.0	-	0.0	0.0	0.0
45	-	-	51.4	-	0.0	0.0	0.0
46	-	-	78.8	-	0.0	0.0	0.0
47	0.0	-	85.0	-	0.0	0.0	0.0
48	0.0	-	33.0	-	0.0	0.0	0.0
49	0.0	0.0	26.2	-	0.0	0.0	0.0
50	0.0	1.4	16.0	-	0.0	0.0	0.0
51	0.0	18.4	13.6	-	0.0	0.0	0.0
52	0.0	64.8	9.2	-	0.0	0.0	0.0
1	0.4	76.0	5.4	-	0.0	10.6	0.0
2	0.6	78.8	5.0	-	0.0	4.8	0.0
3	1.4	210.2	4.8	10.4	0.0	1.6	0.0
4	2.2	332.0	6.8	25.0	0.0	104.2	0.0
5	14.1	776.6	7.0	42.0	0.0	145.6	0.0
6	27.2	1853.6	10.0	67.0	0.0	135.4	7.8
7	42.1	3367.8	9.6	57.0	0.0	142.2	18.6
8	34.3	2953.6	35.2	131.0	0.0	97.8	48.2
9	59.4	986.6	83.8	156.0	0.0	74.6	68.4
10	84.7	62.6	156.0	188.0	4.3	47.5	108.0
11	120.2	0.0	228.4	184.8	16.6	38.6	8.6
12	65.7	0.0	212.4	171.0	8.0	26.0	0.0
13	46.4	0.0	255.6	-	0.0	25.4	0.0
14	9.2	-	118.8	-	-	16.4	0.0
15	-	-	7.4	-	-	10.4	0.0
16	-	-	0.0	-	-	0.0	0.0
17.	-	-	0.0	-	-	0.0	-

Table 5.4.1: Efficacy of bio-intensive IPM module against mustard aphid at New Delhi during 2020-21

Treatment	No. of aphids/10 cm twig before 1st spray	No. of aphids/10 cm twig after 1st spray	Reduc-tion (%)	No. of aphids/10 cm twig before 2nd spray	No. of aphids/10 cm twig after 2nd spray	Reduc-tion (%)	Yield (kg/ha)	IBCR
T_1: Azadirachtin 3000 ppm (CIB registered formulation) @ 5 ml/lit.followed by its second spray after 10 days and further third spray on need basis	70.0	190.0	-169.6	483.3	766.7	-58.9	1161.9	0.55
T_2: Azadirachtin followed by application of *Beauveria bassiana* @ 2g/lit. after 10 days of azadirachtin application	48.3	166.7	-238.0	283.3	466.7	-65.8	1361.7	0.95
T_3: *Beauveria bassiana* followed by its second application after 10 days	70.0	186.7	-167.5	433.3	700.0	-62.0	1377.5	1.01
T_4: Azadirachtin followed by application of *Verticillium laecanii* @ 2g/lit. after 10 days of azadirachtin application	70.0	110.0	-57.9	566.7	800.0	-41.1	1354.2	0.93
T_5: *Verticillium laecanii* @ 2g/l followed by its second application after 10 days	75.0	163.3	-118.1	600.0	833.3	-39.7	1284.4	0.83
T_6: Dimethoate 30 EC @ 1 ml/l followed by its second application after 10 days	63.3	13.3	78.8	58.3	45.0	17.8	1844.2	1.99
T_7: Control (Water spray)	73.3	190.0	-159.5	1550.0	2116.7	-36.5	860.0	0.00
F-probability	**<0.07**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	
LSD (P = 0.05)	**NS**	**59.97**	**70.78**	**188.43**	**274.35**	**45.98**	**82.31**	

Table 5.4.2: Efficacy of biointensive IPM module against mustard aphid at Shillongani during 2020-21

Treatments	Mean aphid population (1st spray)		Mean aphid population (2nd spray, 10 days after 1st spraying)		Yield (kg/ha)
	1 DBS*	5 DAS**	1 DBS	5 DAS	
T_1	62.4	21.1	26.7	10.8	797.28
T_2	60.1	25.7	32.0	20.3	618.54
T_3	59.4	26.1	33.9	17.7	579.28
T_4	53.7	30.2	33.8	22.2	577.77
T_5	59.2	31.2	33.4	26.3	502.58
T_6	62.1	10.9	13.1	8.10	990.43
T_7	62.9	73.3	77.8	77.9	469.09
SEm(+)	**2.14**	**1.59**	**1.37**	**1.48**	**17.92**
$CD_{0.05}$	**4.28**	**3.19**	**2.74**	**2.96**	**35.82**
CV(%)	**16.38**	**14.27**	**10.84**	**14.06**	**-**

*DBS: Days before spray; DAS: Days after spray

Table 5.4.3: Efficacy of biointensive IPM module against mustard aphid at Hisar during 2020-21

Treatments	Aphid population/10 cm top twig					Yield (Kg/ha)	IBCR
	1st Spray			2nd Spray			
	BS	5 DAS	10 DAS	5 DAS	10 DAS		
T_1: Azadirachtin 3000 ppm @ 5 ml/L. followed by its second application after 10 days	50.1	15.3	25.8	10.3	4.2	1661.45	5.7
T_2: Azadirachtin 3000 ppm@5ml/L followed by second spray of *Beauveria bassiana* @ 2g/l after 10 days	52.1	17.4	30.4	17.4	18.3	1492.31	4.4
T_3: *Beauveria bassiana* @ 2g/l followed by its second application after 10 days	48.5	24.5	35.1	18.8	23.8	1461.55	5.4
T_4: Azadirachtin followed by second application of *Verticillium lecanii* @ 2g/l after 10 days	50.7	18.7	23.9	16.4	10.2	1669.23	7.3
T_5: *Verticillium laecanii* @ 2g/l followed by its second application after 10 days	42.1	28.1	35.8	19.1	12.2	1561.23	7.6
T_6: Dimethoate 30 EC @ 1 ml/l followed by its second application after 10 days	47.7	9.3	17.8	3.1	0.9	1761.54	21.8
T_7: Control (water spray)	47.8	85.4	110.6	135.1	88.5	1223.08	-
CD (p=0.05)	NS	6.2	12.55	8.8	5.86	210.19	-

NS=Non-significant; DAS- Days after spray; MSP of mustard: Rs 4200 per quintal

Table 5.4.4: Efficacy of biointensive IPM module against mustard aphid at SK Nagar during 2020-21

Treatment no.	Treatment	Aphid population/ top 10 cm central twig						Yield (kg/ha)	IBCR
		1st spray			2nd spray				
		Before spray	5DAS	10DAS	Before spray	5DAS	10DAS		
T_1	Azadirachtin 3000 ppm (CIB registered formulation) @ 5 ml/l followed by its second spray after 10 days and further third spray on need basis	14.47	52.97	96.23	119.37	188.17	327.17	1690	1.65
T_2	Azadirachtin followed by application of *Beauveria bassiana* @ 2 g/l after 10 days of Azadirachtin application	13.50	59.90	96.70	119.53	190.87	324.43	1657	1.61
T_3	*Beauveria bassiana* followed by its second spray after 10 days	13.13	58.93	94.33	120.77	184.20	325.40	1597	1.30
T_4	Azadirachtin followed by application of *Verticillium laecanii* @ 2 g/l after 10 days of Azadirachtin application	15.20	55.57	89.73	115.73	184.20	329.00	1724	2.13
T_5	*Verticillium laecanii* followed by its second spray after 10 days	14.37	61.53	100.63	119.60	189.50	324.33	1527	0.66
T_6	Dimethoate 30 EC @ 1 ml/l followed by its second spray after 10 days	14.47	0.00	17.47	31.70	0.00	33.83	2080	6.26
T_7	Control (water spray)	14.13	58.77	91.33	140.47	215.93	335.40	1454	-
	C.D. at 5%	NS	NS	7.93	14.88	NS	10.22	261.69	

*DAS: Days after spray

Table 5.4.5: Efficacy of biointensive IPM module against mustard aphid at Pant Nagar during 2020-21

Name of Treatment	No of aphids/ 10 cm central twig				Yield (Kg/ha)	IBCR
	Before 1st spray	5 Days after 1st spray	Before 2nd spray	5 Days after 2nd spray		
T_1 Azadirachtin 3000 ppm (CIB registered formulation) @ 5 ml/l	81.70	51.13	33.77	18.57	1268.25	1.29
T_2 Azadirachtin followed by application of *Beauveria bassiana* @ 2g/l	79.80	45.77	29.30	17.17	1303.97	2.20
T_3 *Beauveria bassiana*@ 2g/l	77.70	42.30	19.60	8.70	1393.65	4.91
T_4 Azadirachtin followed by application of *Verticillium laecanii* @ 2g/l	80.47	41.87	20.27	8.30	1426.98	4.17
T_5 *Verticillium laecanii* @ 2g/l	82.37	40.67	18.60	11.60	1387.30	4.78
T_6 Dimethoate 30 EC @ 1 ml/l	77.83	40.07	20.53	10.77	1353.97	7.02
T_7 Control	77.97	89.17	103.63	104.40	1165.87	-
CD at 5%	**NS**	**1.16**	**4.32**	**0.91**		

Table 5.4.6: Efficacy of bio-intensive IPM module against mustard aphid at Ludhiana during 2020-21

Treatment	Aphid population/ plant		Reduction over control (%)	Yield (kg/ ha)	IBCR
	Before spray	5 days after spray			
T_1: Azadirachtin 3000 ppm @ 5 ml/ l followed by its second spray after 10 days and further third spray on need basis	71.2	30.7	66.3	1705.6	9.2
T_2: Azadirachtin followed by application of *Beauveria bassiana* @ 2g/l after 10 days of azadirachtin application	63.6	36.9	59.4	1658.3	10.2
T_3: *Beauveria bassiana* followed by its second application after 10 days	65.4	44.8	50.8	1552.8	9.2
T_4: Azadirachtin followed by application of *Verticillium lecanii* @ 2g/l after 10 days of azadirachtin application	66.0	43.5	52.2	1550.0	6.7
T_5: *Verticillium lecanii* @ 2g/l followed by its second application after 10 days	66.6	41.3	54.1	1650.0	13.4
T_6: Dimethoate 30 EC @ 1 ml/l followed by its second application after 10 days	66.7	17.4	80.2	1850.0	46.5
T_7: Control (Water spray)	59.4	91.1	--	1338.9	0.0
CD (p=0.05)	**NS**	**9.1**	--	**262.6**	--

Table 5.4.7: Efficacy of bio-intensive IPM module against mustard aphid at Dholi during 2020-21

Treatments	Aphid population before spray	Mustard aphid population/10 cm twig (10 days after spray)	Yield (kg/ha)	IBCR
T_1: Azadirachtin 3000 ppm@5ml/l followed by its second application after 10 days	21.6	16.8	726.00	6.51
T_2: Azadirachtin followed by application of *Beauveria bassiana* @2g/l after 10 days of Azadirachtin application	23.8	18.6	804.00	6.90
T_3: *Beauveria bassiana* followed by its second application after 10 days	15.2	11.6	678.00	6.56
T_4: Azadirachtin followed by application of *Verticillium lecanii*@ 2g/l after 10 days of Azadirachtin application	15.6	6.6	792.00	7.74
T_5: *Verticillium lecanii* @ 2g/l followed by its second application after 10 days	17.4	5.2	884.00	7.86
T_6: Dimethoate 30 EC @ 1 ml/l followed by its second application after 10 days	16.2	4.4	902.00	7.94
T_7: Untreated control (water spray)	30.4	25.2	592.00	-
CD at 5%	4.1	2.9	**94.4**	-

Table 5.4.8: Efficacy of bio-intensive IPM module against mustard aphid at Morena during 2020-21

S.No.	Treatments	Number of aphids/ 10 cm top central twig				Yield (kg/ha)	IBCR
		24hrs Before spray	3 DAS	7 DAS	10 DAS		
1	**T_1:**Azadiraichtin 3000 ppm@5ml/l followed by its second spray after 10 days and further third spray on need basis	72.7	42.6	38.6	32.4	2851	3.2
2	**T_2:** Azadirachtin followed by application of *Beauveria bassiana* @ 2 gm /l after 10 days of Azadirachtin application	58.9	40.6	38.8	24.6	2952	3.0
3	**T_3:** *Beauveria bassiana* followed by its second application after 10 days.	63.9	38.4	32.6	38.5	2825	3.1
4	**T_4:** Azadiraichtin followed by application of *Verticillium lecanii* @2 g/l after 10 days of Azadirachtin application	69.5	42.9	25.2	25.4	2630	2.6
5	**T_5:** *Verticillium lecanii* @ 2 g/l followed by its second application after 10 days	53.6	32.4	35.2	32.9	2577	2.5
6	**T_6:** Dimethoate 30 EC@2 ml/lit followed by its second application after 10 days	48.3	48.4	28.7	26.8	2616	2.3
7	**T_7**: Control (water spray)	48.1	49.4	41.9	41.2	2420	2.8
	CD at 0.5%	**9.68**	**3.31**	**2.93**	**3.47**	-	-

Table 5.5.1: Bioefficacy of newer insecticides against mustard aphid at New Delhi during 2020-21

Treatment	No. of aphids/10 cm before 1st spray	No. of aphids/10 cm after 1st spray	Reduction (%) after 1st spray	No. of aphids/10 cm after 2nd spray	No. of aphids/10 cm after 2nd spray	Reduction (%) after 2nd spray	Yield (kg/ha)	ICBR
T_1: Imidacloprid 17.8 SL @ 0.25 ml/l	96.7	36.7	62.0	170.0	40.0	76.5	1575.3	1.75
T_2: Thiamethoxam 25 WG @ 0.2 g/l	116.7	21.7	81.5	100.0	20.0	80.0	1608.0	1.82
T_3: Acetamaprid 20 SP @ 0.1 g/l	66.7	13.3	79.9	215.0	48.3	77.7	1438.0	1.49
T_4: Dimethoate 30 EC @ 1 ml/l	78.3	16.7	78.3	183.3	41.7	76.7	1648.6	1.90
T_5: Clothianidine 50 WDG @ 0.12 g/l	83.3	28.3	66.4	166.7	41.7	74.8	1398.1	1.30
T_6: Control (Water spray)	86.7	178.3	-105.8	933.3	1333.3	-42.8	711.9	0.00
F-probability	0.096	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
LSD (P = 0.05)	NS	19.22	6.74	95.04	86.03	6.75	49.63	

NS = Non-significant at P = 0.05

Table 5.5.2: Bioefficacy of newer insecticides against mustard aphid at Shillongani during 2020-21

Treatments	Mean Aphid population/ plant				Yield (kg/ha)	IBCR
	1 DBS*	7 DAS**	14 DAS	21 DAS		
Imidacloprid 17.8SL@0.25 ml/l	59.2	8.6	13.1	15.6	1027.32	5.00
Thiamethoxam 25 WG @ 0.2g/l	69.2	20.3	26.9	31.3	885.84	3.74
Acetamaprid 20SP @0.1g/l	59.9	17.5	17.6	19.0	801.59	3.37
Dimethoate 30 EC @1ml/l	56.1	15.4	17.8	20.1	998.10	4.78
Clothianidine 50WDG @ 0.12 g/l	58.7	20.6	25.7	29.6	775.80	1.49
Control (water spray)	61.8	65.7	68.6	74.5	489.40	-
SEm(±)	2.26	1.39	1.28	1.10	21.76	
CD (p=0.05)	4.52	2.77	2.50	2.27	43.16	
CV(%)	12.57	12.65	11.98	9.66		

: *** DBS= Days before spraying** ****DAS= Days after spraying**

Table 5.5.3 (A): Bioefficacy of newer insecticides against mustard aphid at Hisar during 2020-21

Treatments	Aphids/10 cm top twig					Yield (Kg/ha)	IBCR
	1st Spray			2nd Spray			
	BS	5 DAS	10 DAS	5 DAS	10 DAS		
T_1 : Imidacloprid 17.8 SL @ 0.25 ml/l	31.97	5.2	14.6	1.3	0.0	1705.4	18.1
T_2: Thiamethoxam 25 WG @ 0.2 g/l	30.82	2.6	16.9	0.7	0.0	1884.6	23.9
T_3: Acetamaprid 20 SP @ 0.1 g/l	31.98	7.5	20.5	1.2	0.0	1758.9	26.5
T_4: Dimethoate 30 EC @ 1 ml/l	33.90	9.9	22.9	2.1	0.0	1846.1	24.1
T_5: Clothianidine 50 WDG @ 0.12 g/l	34.11	2.9	13.4	0.9	0.0	1897.4	14.2
T_6: Control (water spray)	35.97	46.6	52.3	41.2	36.5	1253.9	
CD (p=0.05)	**NS**	**14.88**	**19.27**	**6.72**		214.49	

NS=Non-significant; DAS- Days after spray

Table 5.5.3 (B): Effect of newer insecticides on activity of ladybird beetle in mustard at Hisar during 2020-21

Treatments	No of ladybird beetles adults and nymphs/plant				
	1st Spray			2nd Spray	
	BS	7 DAS	14 DAS	7 DAS	14 DAS
T_1: Imidacloprid 17.8 SL @ 0.25 ml/l	0.0	0.0	0.5	1.3	2.5
T_2: Thiamethoxam 25 WG @ 0.2 g/l	0.0	0.0	0.6	1.3	2.0
T_3: Acetamaprid 20 SP @ 0.1 g/l	0.0	0.0	0.1	1.4	2.4
T_4: Dimethoate 30 EC @ 1 ml/l	0.0	0.0	0.3	1.2	2.5
T_5: Clothianidine 50 WDG @ 0.12 g/l	0.0	0.0	0.4	1.5	2.5
T_6: Control (water spray)	0.0	0.0	0.5	1.5	3.3
CD (p=0.05)	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**

Table 5.5.4: Bioefficacy of newer insecticides against mustard aphid at SK Nagar during 2020-21

Treat-ment no.	Treatments	Aphid population/ top 10 cm central twig						Yield (kg/ ha)	IBCR
		1st spray			2nd spray				
		Before spray	5DAS	10DAS	Before spray	5DAS	10DAS		
T_1	Imidaclorpid 17.8 SL @ 0.25 ml/l	16.20	13.53	47.83	77.13	38.97	60.67	2014	6.52
T_2	Thiomethoxam 25 WG @ 0.20 g/l	15.63	12.83	45.00	81.87	41.37	59.27	1731	3.42
T_3	Acetamiprid 20 SP @ 0.1 g/l	14.63	17.90	59.03	95.87	119.50	210.57	1895	5.57
T_4	Dimethoate 30 EC @ 1 ml/l	16.00	0.00	16.53	36.47	0.00	25.90	2059	6.37
T_5	Clothionidin 25 EC @ 0.2 g/l	17.17	19.17	61.27	92.50	113.83	223.03	1800	3.05
T_6	Control (water spray)	16.00	20.37	100.23	151.10	181.13	341.43	1422	-
	C.D. at 5%	NS	3.18	9.62	5.24	9.09	11.27	361.09	
	C.V.%	11.13	12.37	9.50	3.19	5.98	3.99	10.76	

Table 5.5.5: Bioefficacy of newer insecticides against mustard aphid at Pant Nagar during 2020-21

Treatment	No of aphids/ 10 cm central twig				Yield (Kg/ha)	IBCR
	First spray		Second spray			
	Before spray	5DAS	Before spray	5DAS		
T_1 Imidacloprid 17.8 SL @ 0.25 ml/l	70.01	21.67	35.43	8.50	1214.0	2.12
T_2 Thiamethoxam 25 WG @ 0.2g/l	69.57	18.23	33.20	2.83	1373.0	8.19
T_3 Acetamaprid 20 SP@ 0.1g/l	69.83	21.13	34.13	4.03	1279.0	6.06
T_4 Dimethoate 30 EC @ 1 ml/l	72.63	15.73	32.17	2.27	1412.0	9.55
T_5 Clothianidine 50WDG @ 0.12g/l	65.10	21.90	28.67	9.47	1135.0	0.89
T_6 Control	67.83	70.63	60.60	48.93	1129.0	-
CD at 5%	**NS**	**1.86**	**15.02**	**2.04**	-	

Table 5.5.6: Bioefficacy of newer insecticides against mustard aphid at Ludhiana during 2020-21

	Treatment	No of aphids/ top 10 cm central twig					Yield (kg/ha)	IBCR
		BS*	3DAS	7DAS	10DAS	14DAS		
T_1	Imidacloprid 17.8 SL @ 0.25 ml/l	62.1	19.2	0.0	0.0	0.0	1827.8	51.3
T_2	Thiamethoxam 25 WG @ 0.2 g/l	69.3	17.1	0.0	0.0	0.0	1908.3	59.5
T_3	Acetamiprid 20 SP @ 0.1 g/l	67.3	21.5	14.2	14.2	13.3	1586.1	34.1
T_4	Dimethoate 30 EC @ 1 ml/l	61.2	28.1	21.4	15.9	13.1	1497.2	21.7
T_5	Clothianidine 50 WDG @ 0.12 g/l	68.0	18.1	0.0	0.0	0.0	1841.7	30.0
T_6	Control	62.1	77.1	83.6	92.2	67.5	1258.3	0.0
	CD (p=0.05)	**NS**	**12.6**	**8.8**	**5.0**	**9.6**	**340.0**	--

* BS: Before spray, DAS: Days after spray

Table 5.5.7: Bioefficacy of newer insecticides against mustard aphid at Dholi during 2020-21

Treatments	Aphid population before spray	Mustard aphid population/10 cm twig (10 days after spray)	Yield (kg/ha)	IBCR
Imidacloprid 17.8SL@0.25 ml/l	16.2	11.2	734.00	7.17
Thiamethoxam 25WG@0.2 g/l	15.0	5.8	812.00	7.86
Acetamaprid 20SP@0.1g/l	12.6	6.8	668.00	6.46
Clothianidine50WDG@0.12g/l	10.4	6.0	762.00	7.52
Dimethoate 30EC@1ml/l	10.0	4.8	891.00	7.92
Untreated control	16.4	26.6	565.00	-
CD at 5%	2.6	1.8	91.4	-

Table 5.5.8: Bioefficacy of newer insecticides against mustard aphid at Morena

S.No.	Treatments	Number of aphids/10 cm central twig				Yield (kg/ha)	IBCR
		24hrs Before spray	3 DAS	7 DAS	10 DAS		
1	**T_1**: Imidacloprid 17.8 SL @0.25ml/l	68.2	30.2	28.6	30.4	2752	2.8
2	**T_2** :Thiamethoxam 25 WG @0.2g/l	50.6	28.6	25.9	24.8	2864	3.2
3	**T_3:** Acetamaprid 20 SP @0.1 g/l	60.5	32.2	24.4	18.3	2604	2.5
4	**T_4:** Diamethoate 30 EC@2 ml/l	69.3	27.4	18.6	18.2	2577	2.8
5	**T_5**: Clothianidine 50 WDG @0.12g/l	47.6	26.9	22.4	18.7	2915	2.7
6	**Control (water spray)**	72.5	36.8	32.8	31.9	2148	2.4
	CD at 0.5%	**3.76**	**4.43**	**3.26**	**2.90**		

Table 5.6.1(A) Effect of host plant diversity on abundance of mustard aphid and the associated specialist and generalist natural enemies at Hisar

Std. Week	No of aphids / plant						NE: Ladybird beetle (adult + larvae)/plant					
	T1	T2	T3	T4	Mean	CD (p=0.05)	T1	T2	T3	T4	Mean	CD (p=0.05)
4	0.0	0.1	0.0	0.0	0.0	NS	-	-	-	-	-	-
5	0.2	0.1	0.0	0.3	0.2	NS	-	-	-	-	-	-
6	2.8	3.3	3.2	2.8	3.0	NS	0	0	0	0	0.0	-
7	8.9	11.1	10.6	9.8	10.1	1.10	0.2	0.1	0.2	0.2	0.2	NS
8	16.7	18.1	18.5	16.6	17.5	1.21	-	0.7	0.7	0.9	0.8	NS
9	23.5	24.8	24.6	28.4	25.3	2.42	0.1	0.7	1.6	0.8	0.8	NS
10	43.5	42.3	40.2	45.5	42.9	0.79	0.5	1	0.2	0.7	0.6	NS
11	55.4	60.3	58.4	64.2	59.6	3.37	0.5	1.2	0.5	0.2	0.6	NS
12	29.7	32.2	31.6	38.6	33.0	0.54	3.8	7.2	5.2	6.2	5.6	NS
13	26.3	27.9	28.2	46.4	32.2	1.20	5.5	10.1	8.5	12	9.0	NS
14	13.6	15.3	15.2	14.2	14.6	0.49	2.3	2.6	2.8	2.5	2.6	NS
15	4.8	5.6	5.4	5.1	5.2	NS	-	-	-	-	-	-
Mean	18.78	20.09	19.66	22.66			1.6	2.6	2.2	2.6		

T1: Mustard alone; T2: Mustard + Fennel; T3: Mustard + Chickpea, T4: Mustard + Coriander

Table 5.6.1(B) Seasonal mean of honey bees, syrphid flies and mummified aphids in mustard with intercrop at Hisar

Tr. No.	Intercrop combination	Honey bee/minute	Syrphid fly adult/minute	Mummified adults of aphid/5cm axis	Yield kg/ha mustard	Yield kg/ha intercrop
1	Mustard alone	8.2	3.0	13.8	1284.6	1284.6
2	Mustard + Fennel	9.2	7.5	19.8	1384.6	382.6
3	Mustard + Chickpea	9.4	4.1	16.3	1105.1	433.6
4	Mustard + Coriander	7.5	4.8	15.3	1271.8	367.1
	Mean	8.6	4.9	16.3	-	-
	CD (p=0.05)	0.65	0.89	1.32	187.08	163.76

MSP: Mustard =46.50 Rs /Kg, Gram =51.00 Rs /Kg, Fennel =100.00 Rs /Kg, Coriander =65.00 Rs /Kg

Table 5.6.1(C) Economics of effect of host plant diversity on abundance of mustard aphid and the associated specialist and generalist natural enemies at Hisar

Tr. No.	Treatments	Mustard equivalent yield (kg/ha)	Gross return (Rs/ha)	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	BCR
1	**2**	**3**	**4**	**5**	**6**	**7**
T_1	Mustard alone	1284.63	59733	30655	29078	1.9
T_2	Mustard + fennel	2207.4	102643	31405	71238	3.2
T_3	Mustard + chickpea	1580.65	73495	31750	41745	2.3
T_4	Mustard + coriander	1784.93	82999	31165	51834	2.6
	CD (p=0.05)	195.47				

MSP: Mustard =46.50 Rs /Kg, Gram =51.00 Rs /Kg, Fennel =100.00 Rs /Kg, Coriander =65.00 Rs /Kg

5.6.2(A) Effect of host plant diversity on abundance of mustard aphid and the associated specialist and generalist natural enemies at Dholi

Treatments	Standard week	Mustard aphid/10 plants	Mummified aphids (parasitized by *Diaeretiella rapae)*	Lady bird beetles	Syrphid fly larvae	Chrysoperla	Others (Rove beetle)
T1 Mustard alone	04	18.60	00	00	00	00	00
T2Mustard+Chickpea		16.50	00	00	00	00	00
T3 Mustard+Coriander		17.00	00	00	00	00	00
T4 Mustard+Fennel		16.00	00	00	00	00	00
T1 Mustard alone	05	29.85	00	1.5	2.00	1.25	2.00
T2Mustard+Chickpea		25.00	00	3.25	2.45	2.25	3.50
T3 Mustard+Coriander		27.85	00	2.25	2.00	1.50	3.00
T4 Mustard+Fennel		24.25	00	3.50	3.25	2.75	2.75
T1 Mustard alone	06	58.85	3.85	9.50	8.65	4.25	5.25
T2Mustard+Chickpea		52.15	4.25	12.25	13.25	5.38	7.85
T3 Mustard+Coriander		52.25	4.20	9.75	9.25	5.15	9.56
T4 Mustard+Fennel		45.45	4.75	15.25	16.50	6.95	9.85
T1 Mustard alone	07	125.00	12.25	18.25	9.75	2.85	5.75
T2Mustard+Chickpea		105.25	14.25	23.25	14.25	3.25	8.00
T3 Mustard+Coriander		110.25	12.80	19.25	10.25	2.80	9.45
T4 Mustard+Fennel		95.25	15.25	26.75	17.25	4.20	10.00
T1 Mustard alone	08	240.00	20.25	23.00	12.25	1.50	6.00
T2Mustard+Chickpea		195.00	21.50	25.00	13.50	1.75	7.25
T3 Mustard+Coriander		210.00	20.50	23.25	12.50	1.25	8.20
T4 Mustard+Fennel		175.00	23.00	29.50	15.75	1.85	9.25
T1 Mustard alone	09	330.25	22.00	25.00	12.25	0.75	6.25
T2Mustard+Chickpea		285.25	25.00	27.85	14.50	1.25	7.35
T3 Mustard+Coriander		295.75	23.00	26.00	13.50	0.75	7.25
T4 Mustard+Fennel		250.25	26.75	29.50	16.50	1.50	8.20
T1 Mustard alone	10	225.00	25.00	26.50	12.25	00	6.50
T2Mustard+Chickpea		195.00	27.85	28.50	13.75	0.50	6.95
T3 Mustard+Coriander		205.00	26.00	27.00	12.75	00	6.45
T4 Mustard+Fennel		165.00	28.00	29.50	15.00	0.75	7.25
T1 Mustard alone	11	95.00	15.25	14.00	4.25	00	1.24
T2Mustard+Chickpea		66.25	16.25	16.25	5.65	00	1.35
T3 Mustard+Coriander		85.00	15.35	14.95	5.00	00	1.32
T4 Mustard+Fennel		56.25	17.05	18.25	6.25	00	1.78
T1 Mustard alone	12	18.05	1.75	4.75	00	00	1.25
T2Mustard+Chickpea		14.25	2.15	5.25	00	00	1.35
T3 Mustard+Coriander		15.00	1.95	5.00	00	00	1.25
T4 Mustard+Fennel		6.25	2.45	6.25	00	00	1.75

Table 5.6.2 (B) Yield of mustard in different treatments at Dholi centre

Treatments	Yield (kg/ha)
T1 Mustard alone	655
T2Mustard+Chickpea	725
T3 Mustard+Coriander	695
T4 Mustard+Fennel	756

Table 5.6.3(A) Effect of host plant diversity on abundance of mustard aphid and the associated specialist and generalist natural enemies at Pantnagar

Std. Week	No of aphids / plant					Natural enemies (*Coccinella* spp.)					Number of mummified aphids/10plants				
	T1	T2	T3	T4	CD (p=0.05)	T1	T2	T3	T4	CD (p=0.05)	T1	T2	T3	T4	CD (p=0.05)
3	5.67	2.33	3.33	4.00	**NS**	0.67	1.33	1.00	0.67	**NS**	0.00	0.00	0.00	0.00	**0**
4	9.00	4.33	3.67	4.00	**NS**	1.33	1.00	0.67	1.00	**NS**	0.00	0.00	0.00	0.00	**0**
5	19	13.66	13	11.33	**6.56**	0.67	1.33	1.67	1.67	**NS**	0.00	0.00	0.00	0.00	**0**
6	27	20	24.33	20.66	**NS**	1.33	1.33	1.67	1.00	**NS**	2.67	1.67	2.00	1.33	**NS**
7	38	33.33	36.66	35	**NS**	2.33	2.00	2.33	2.67	**NS**	5.33	3.33	4.00	3.33	**NS**
8	46.66	49.66	53.33	50.33	**3.92**	1.67	3.00	2.00	3.33	**1.48**	7.67	7.33	7.33	7.00	**NS**
9	47.33	54.33	56.66	55	**NS**	2.33	3.33	2.33	3.33	**NS**	11.00	9.67	10.33	9.33	**1.59**
10	45	46.66	53.33	47.66	**NS**	3.00	4.33	3.33	4.33	**0.99**	17.00	16.67	15.33	13.67	**2.55**
11	29.33	28	34.33	30.66	**4.45**	2.00	2.00	1.33	2.00	**NS**	12.00	10.67	9.67	8.33	**1.37**
12	15	16	17.66	16	**NS**	0.67	0.33	0.67	1.00	**NS**	6.67	4.33	2.33	3.33	**2.57**
13	6	3	6.66	4.66	**NS**	0.67	1.00	1.33	0.33	**NS**	2.33	1.00	1.33	1.67	**NS**

Table 5.6.3(B) Economics of effect of host plant diversity on abundance of mustard aphid and the associated specialist and generalist natural enemies at Pantnagar

Tr. No.	Treatments	Mustard equivalent yield (kg/ha)	Gross return (Rs/ha)	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	BCR
1	**2**	**3**	**4**	**5**	**6**	**7**
T_1	Mustard alone	1207.14	56132.14	27000	29132.14	2.07
T_2	Mustard + fennel	1505.36	69999.34	27500	42499.34	2.54
T_3	Mustard + chickpea	1062.41	49401.98	28100	21301.98	1.76
T_4	Mustard + coriander	886.85	41238.36	27800	13438.36	1.48
	C.D. at 5%	**0.0679**				

MSP: Mustard =46.50 Rs /Kg, Gram =51.00 Rs /Kg
Fennel =100.00 Rs /Kg, Coriander =65.00 Rs /Kg

Mustard equivalent yield = Mustard seed yield (kg/ha) + $\frac{\text{seed yield of intercrop (kg/ha)} \times \text{(Price of intercrop (Rs/kg))}}{\text{Price of Mustard (Rs/kg)}}$

Table 5.6.4(A): Effect of host plant diversity on abundance of mustard aphid and the associated specialist and generalist natural enemies at Ludhiana

Std. Week	Mustard aphid (no/plant)					Cabbage aphid (no/ plant)					Cabbage caterpillar (no of larvae/plant)				
	T1	T2	T3	T4	CD (p=0.05)	T1	T2	T3	T4	CD (p=0.05)	T1	T2	T3	T4	CD (p=0.05)
1	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-
2	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-
3	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-
4	1.5	0.0	0.0	0.0	**0.2**	1.1	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-
5	1.9	1.4	1.0	1.6	**NS**	2.1	1.3	0.7	0.9	**0.6**	0.0	0.0	0.0	0.0	-
6	3.4	1.8	2.1	1.3	**1.2**	3.2	1.7	3.2	0.9	**1.2**	0.0	0.0	0.0	0.0	-
7	25.4	13.0	14.8	1.0	**8.0**	3.5	2.3	2.0	0.9	**1.2**	30.2	8.0	18.7	4.9	**4.2**
8	44.4	18.6	19.7	9.7	**13.7**	41.5	38.9	16.1	6.3	**11.3**	53.0	36.3	23.7	4.6	**10.3**
9	133.3	66.3	53.7	21.2	**28.4**	155.0	75.2	45.7	22.0	**25.7**	50.0	35.9	29.1	12.9	**12.2**
10	101.0	58.4	48.2	25.9	**12.6**	84.0	46.7	49.7	21.3	**30.5**	49.1	43.0	22.3	13.9	**17.4**
11	73.7	32.9	27.2	10.5	**41.2**	103.0	31.3	28.7	5.7	**40.4**	15.8	13.6	11.1	0.0	**8.3**
12	36.1	14.5	22.9	2.8	**20.5**	52.3	16.2	15.9	9.9	**24.3**	0.0	0.0	0.0	0.0	-
13	2.8	1.7	10.3	0.0	**7.1**	18.9	3.7	5.3	0.0	**2.9**	0.0	0.0	0.0	0.0	-
Overall mean	46.9	23.2	22.2	8.2	**5.5**	51.5	24.2	18.6	7.5	**12.7**	39.6	27.3	21.0	7.3	**5.2**

T1: Mustard alone, T2: Mustard+fennel, T3: Mustard+chickpea, T4: Mustard+coriander

Table 5.6.4(B) Economics of effect of host plant diversity on abundance of mustard aphid and the associated specialist and generalist natural enemies at Ludhiana

Tr. No.	Treatments	Mustard equivalent yield (kg/ha)	Gross return (Rs/ha)	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	BCR
1	2	3	4	5	6	7
T_1	Mustard alone	1423.6	66197.9	30000	36197.9	2.2
T_2	Mustard + fennel	2984.3	138770.8	30500	108270.8	4.5
T_3	Mustard + chickpea	3442.4	160072.5	32000	128072.5	5.0
T_4	Mustard + coriander	2453.5	114087.5	31750	82337.5	3.6
	C.D. at 5%	**476.4**				

MSP: Mustard =46.50 Rs /Kg, Gram =51.00 Rs /Kg

Fennel =100.00 Rs /Kg, Coriander =65.00 Rs /Kg

$$\text{Mustard equivalent yield} = \text{Mustard seed yield (kg/ha)} + \frac{\text{seed yield of intercrop (kg/ha)} \times \text{(Price of intercrop (Rs/kg))}}{\text{Price of Mustard (Rs/kg)}}$$

Table 5.6.5 (A) Effect of host plant diversity on abundance of mustard aphid and the associated specialist and generalist natural enemies at SK Nagar

Std. Week	Aphids/10cm top twig of *Brassica*			
	Mustard alone	**Mustard+fennel**	**Mustard+chickpea**	**Mustard+coriander**
50	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0
2	5.6	5.4	5.3	5.2
3	12.7	13.6	12.5	12.8
4	58.9	59.5	61.9	60.3
5	144.0	145.0	139.5	143.7
6	215.8	207.0	211.1	218.6
7	331.5	330.0	333.0	336.4
8	161.9	164.3	161.5	171.9
9	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0

Table 5.6.5 (B) Economics of effect of host plant diversity on abundance of mustard aphid and the associated specialist and generalist natural enemies at SK Nagar

Tr. No.	**Treatments**	**Mustard equivalent yield (kg/ha)**	**Gross return (Rs/ha)**	**Cost of cultivation (Rs/ha)**	**Net return (Rs/ha)**	**BCR**
1	**2**	**3**	**4**	**5**	**6**	**7**
T_1	Mustard alone	1263	58745	29945	28800	1.96
T_2	Mustard + fennel	1139	52966	30187	22778	1.75
T_3	Mustard + chickpea	972	45195	31355	13839	1.44
T_4	Mustard + coriander	1185	55096	30855	24241	1.79
	C.D. at 5%					

MSP: Mustard =46.50 Rs /Kg, Gram =51.00 Rs /Kg
Fennel =100.00 Rs /Kg, Coriander =65.00 Rs /Kg

$$\text{Mustard equivalent yield} = \text{Mustard seed yield (kg/ha)} + \frac{\text{(seed yield of intercrop (kg/ha)} \times \text{(Price of intercrop (Rs/kg))}}{\text{Price of Mustard (Rs/kg)}}$$

Table 5.6.6 Effect of plant diversity on abundance of mustard aphid and the associated specialist and generalist natural enemies at Shillongani

Treatments	Mean aphid population (no/plant)		Mean no. of cocinella (G+A)/plant		Yield (kg/ha)
	Flowering Stage	Siliqua formation Stage	Flowering Stage	Siliqua formation Stage	
T1 (Mustard alone)	63.30	47.90	1.90	2.00	578
T2 (Mustard + fennel)	31.20	21.70	2.40	1.80	688 + 172 (fennel)
T3 (Mustard + chickpea)	47.30	33.60	2.00	1.80	654 + 161 (chickpea)
T4 (Mustard + Coriander)	28.60	20.80	2.10	1.90	721 + 179 (coriander)
Sem(+-)	1.64	1.24			19.54
CD (5%)	3.29	2.47	NS	NS	38.62

Table 5.6.7(A) Effect of host plant diversity on abundance of mustard aphid and the associated specialist and generalist natural enemies at Morena

Std. Week	No of aphids / plant				CD (p=0.05)
	Mustard alone	Mustard+fennel	Mustard+chickpea	Mustard+coriander	
50	0.0	0.0	0.0	0.0	-
51	0.0	0.0	0.0	0.0	-
52	0.0	0.0	0.0	0.0	-
1	24.4	9.6	12.8	9.2	**NS**
2	16.4	6.9	8.4	4.6	**0.93**
3	14.2	5.8	6.8	6.4	**0.99**
4	42.6	25.9	19.8	18.4	**3.19**
5	38.6	24.8	21.8	19.6	**4.03**
6	41.6	34.2	28.7	26.4	**4.67**
7	40.8	32.8	28.7	22.5	**3.05**
8	32.8	15.4	15.7	12.6	**2.83**
9	23.5	12.9	12.9	12.6	**2.63**
10	15.3	10.2	6.5	5.2	**0.56**
11	0.0	0.0	0.0	0.0	-
12	0.0	0.0	0.0	0.0	-
13	0.0	0.0	0.0	0.0	-

Table 5.6.7 (B) Economics of effect of host plant diversity on abundance of mustard aphid and the associated specialist and generalist natural enemies at Morena

Tr. No.	Treatments	Mustard equivalent yield (kg/ha)	Gross return (Rs/ha)	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	BCR
1	**2**	**3**	**4**	**5**	**6**	**7**
T_1	Mustard alone	1840	85560	31400	54160	2.7
T_2	Mustard + fennel	1372	63799	34725	29074	1.8
T_3	Mustard + chickpea	1585	73702	34500	39202	2.1
T_4	Mustard + coriander	1380	64170	34400	29777	1.9
	C.D. at 5%	**NS**	-	--	-	
	C.V.%	**11.6**	-	-	-	

MSP: Mustard =46.50 Rs /Kg, Gram =51.00 Rs /Kg

Fennel =100.00 Rs /Kg, Coriander =65.00 Rs /Kg

Mustard equivalent yield = Mustard seed yield (kg/ha) + $\frac{\text{seed yield of intercrop (kg/ha)} \times \text{(Price of intercrop (Rs/kg))}}{\text{Price of Mustard (Rs/kg)}}$

Plant Physiology

6.1 Screening of genotypes from different agroclimatic zones at seedling stage

Thirty three Indian mustard (*B. juncea*) genotypes procured, from different agro-climatic zones, were tested for high-temperature tolerance at seedling stage both under laboratory and field conditions. Test genotypes were evaluated in laboratory as per the standard protocol. For field planting, 100 seeds of each genotype were sown in 2 m row length at Bharatpur, Kanpur and Ludhiana with 3 replications. The field experiment was continued for 30 days. Seedling mortality and dry matter recorded varied significantly within the genotypes at the studied locations. Higher seedling mortality indicated more susceptibility of the genotypes to high temperature and *vice-versa* (Table 6.1.1 to 6.1.3)

Summarizing, seedling mortality ≤20% and DW/10 seedlings ≥ 30mg rated genotypes tolerant under controlled conditions. Three genotypes namely SVJH-056 RH1999-42 and DRMRCI133 at Kanpur and Ludhiana met the selection criteria except for dry matter in DRMRCI133 (25mg/10seedlings). In the field sown trial, RGN229, DRMRHT1712, NPJ-239, SVJH-006, ORM22019-01, TM188, BAUM09-12-2, DRMRCI133, RH1999-42 and DRMR1188 had seedling mortality ≤20% and DW≥3.0g at 3 locations except for DRMRCI133and NPJ-239 for dry matter at Bharatpur which was ≥2.5g. Both the checks PM25and JD-6 had seedling mortality ≤25% with dry matter ≥2.5g at Bharatpur, Kanpur and Ludhiana indicating moderate tolerance with STI and SSTI ≥60% under field condition only. Two genotypes RH1999-42 and DRMRCI133 were tolerant to high temperature at seedling stage both under laboratory and field conditions.

6.2 Evaluation of genotypes under low light stress condition

Six genotypes of Indian mustard were sown in paired rows at row spacing of 30 cm in the field with 3 replications under RBD. Treatments comprised i) shading with nets which cuts 30% natural light and ii) no shading (control). Shading was given for 30 days commencing from mid-December to mid-January following all the recommended practices for raising a healthy crop. Significant difference exists in the genotypes for studied traits and shading reduced physiological traits and seed yield significantly at two locations (Table 6.2.1 to 6.2.7)

Lesser reduction in the physiological traits and seed yield (≤20%) identified RH1676 at Hisar and Ludhiana as promising genotype under low light stress.

6.3 Screening of genotypes for drought tolerance

Thirty one genotypes of *B. juncea* were evaluated for drought tolerance under field conditions at Bharatpur, Hisar, Kanpur and Ludhiana. The test genotypes were sown in 5 rows with 2.5 m row length at 30 cm row spacing after pre-sowing irrigation. Treatments were replicated 3 times under RBD factorial design. Main treatment consisted of i) two post sowing irrigations at 35 and 65 DAS (IR) and ii) no post sowing irrigation (RF). Analysis of variance revealed significant genotypic differences for RWC, SPAD values, photosynthetic pigments, canopy temperature, yield components and seed yield (Table 6.3.1 to 6.3.12).

Overall, NPJ210 and DRMR1188 at Bharatpur, Hisar and Ludhiana were tolerant to moisture stress. Only one genotype DRMRSJ276 was rated highly tolerant at Bharatpur, Kanpur and Ludhiana whereas JC36 moderately tolerant at 3 locations (Bharatpur, Hisar and Ludhiana) to moisture stress. These genotypes maintained higher chlorophyll content, RWC, SPAD values and lesser decline in seeds per siliqua, seed weight with YSI≥0.5. RH0725 (check) suffered decline in seed yield ≤20 % and was rated drought tolerant at Bharatpur and Hisar only whereas RGN229 (check) was highly tolerant at Bharatpur, Hisar, Kanpur and Ludhiana.

6.4 Screening of genotypes for high-temperature tolerance at the terminal stage.

Thirty three mustard genotypes were sown in the field at two dates i.e. optimum/normal sowing (NS) in the third week of October and late sown in the last week of November (LS). Late sown (LS) crop faced high temperature (≥30^0C) at seed filling stage. Genotypes were sown in paired rows in RBD. The percent reduction was computed under late sown over normal sown. Environmental differences due to planting dates (NS and LS) significantly influenced canopy temperature, canopy temperature depression at studied locations except Bharatpur, membrane stability only at Ludhiana, yield attributes like number of seeds per siliqua, seed weight and seed yield. However, environment x genotypes (ExG) interaction effects were non-significant for CT, CTD and yield only at Bharatpur while MSI at Hisar (Table 6.4.1 to 6.4.6)

Raj Vijay Mustard and JC-32 were rated tolerant to terminal heat stress with seed yield reduction ≤30% and stability indices (HSI≥0.45 and YSI ≥0.7.0) at Hisar and Ludhiana with relatively lesser depression in membrane stability, seed weight, seeds per siliqua and cooler canopies. Only one genotype DRMR2017-27 at Bharatpur and Ludhiana showed thermo tolerance along with high heat stability index (HSI≥1.3), YSI (≥.0.75) and SY decline of ≤30%. BPR543-2 (check) suffered ≤20% yield loss at Bharatpur and Ludhiana with high indices (HSI ≥0.74 and YSI≥.0.8) and was considered highly tolerant.

6.5 Screening of genotypes for salinity tolerance at seedling stage

Counted seeds of six mustard genotypes were sown in the plastic tray using distilled water as control and 12dS/m saline solution to identify salinity tolerant genotypes. The experiment was conducted under ambient conditions and percent decrease in germination, seedling length, dry weight and seedling vigor II were used to assess salinity tolerance (Table 6.5.1 to 6.5.4)

Overall, Kranti and CS54 seems promising for salinity tolerance at Hisar and Ludhiana with lesser decline (≤20%) in germination percentage, seedling length, dry matter accumulation while SVII (≤30%) at Ludhiana only.

6.6 Effect of plant growth regulating substances on yield under rainfed conditions

Foliar application was given at initiation of flowering and at 50% flowering at 3 locations under rainfed conditions. Sequential foliar sprays of trehalose (Tre) @10and 20 mM, urea @1and 2% and potassium nitrate (KNO_3) @1 and 2% were tested to mitigate moisture stress in rainfed varieties. Local variety DRMR 1165-40 (Bharatpur**),** RH 725 (Hisar) and PBR97 (Ludhiana) were selected to test the efficacy of growth regulating substances. Non-significant differences were recorded for chla, chlb and HI at Bharatpur while for seeds per siliqua seed weight and biomass at Hisar (Table 6.6.1 to 6.6.5).
Overall, foliar application of trehalose @10mM, urea @2%, and both the concentrations of KNO_3 at Bharatpur, Hisar and Ludhiana improved seed yield under rainfed conditions.

6.7: Enhancing productivity of rapeseed mustard through microbes under moisture stress (Physiologists associated with AGRONOMY trail for recording data)

Physiological traits (chlorophyll, SPAD, RWC) and osmoprotectants (proline and total sugars) enhanced with the microbial treatments under moisture stress at Hisar and Ludhiana (Table 6.7.1 to 6.7.3).

Overall, maximum increase was with MKS6 for RWC and SPAD, total chlorophyll with CRIDAII and MRD17, proline with CRIDAI and MRD 17and total sugars with Biophos +Biophos and CRIDAI at both the locations.

6.8: Microbes for mitigating high temperature in mustard

The efficiency of stress adaptive consortium, Pusa Sanjeevni (IARI, New Delhi) and microbial formulation (CSIR-Lucknow) were tested under field conditions in three mustard varieties (RH725,Giriraj and PBR357) at Bharatpur, Hisar and Ludhiana (Table 6.8.1 to 6.8. 8).

Variations exist in the three varieties for the studied traits with microbial formulation and Pusa Sanjeevni under normal and late sown conditions. Microbial formulation enhanced seed yield in the late planted 3 varieties at Bharatpur and Pusa Sanjeevani only in PBR357. Seed yield improved with both the inoculations in the three varieties at Hisar and Ludhiana.

Table 6.1.1 Screening of genotypes from different agroclimatic zones for high temperature tolerance under controlled condition

Code	Entry	Laboratory condition									
		Seedling mortality (%)					DW of 10 seedlings (mg)				
		Bharatpur	Hisar	Kanpur	Ludhiana	Average	Bharatpur	Hisar	Kanpur	Ludhiana	Average
Phy20-1	DRMR2017-26	52.3	39.3	49.8	39.8	45.3	20.6	37.3	26.0	28.6	28.1
Phy20-2	DRMR-2018-27	55.4	23.9	41.0	31.0	37.8	22.3	45.3	27.8	26.9	30.6
Phy20-3	DRMR-2059	51.7	12.9	45.8	35.8	36.6	25.1	58.8	37.1	35.8	39.2
Phy20-4	DRMRHT13-22-10	47.9	24.3	44.1	34.1	37.6	30.2	49.3	30.1	35.8	36.4
Phy20-5	PM27	58.3	47.1	61.3	51.3	54.5	25.3	34.8	26.3	31.3	29.4
Phy20-6	RGN229	60.6	52.0	66.3	52.3	57.8	24.1	34.8	28.0	32.8	29.9
Phy20-7	KMR(E)-20-1	63.0	37.8	61.9	41.9	51.2	29.4	52.9	37.5	38.2	39.5
Phy20-8	KMR(E)-20-2	66.3	29.2	68.8	34.9	49.8	33.5	39.8	64.5	47.8	46.4
Phy20-9	DRMRCI129	68.7	41.4	65.2	55.2	57.6	30.1	43.8	40.0	42.5	39.1
Phy20-10	DRMRSJ112	70.2	19.9	68.1	58.1	54.1	29.5	57.8	34.5	32.4	38.6
Phy20-11	DRMRHT1712	60.3	35.3	62.3	52.3	52.6	20.5	52.9	24.4	39.4	34.3
Phy20-12	RH1999-12	65.0	49.3	60.2	50.2	56.2	30.0	41.4	45.1	42.9	39.9
Phy20-13	RH1999-21	52.7	34.7	38.5	38.5	41.1	31.7	42.0	32.8	40.5	36.8
Phy20-14	PRE-2018-8	65.4	34.8	68.5	58.5	56.8	25.9	41.6	26.5	28.2	30.6
Phy20-15	PRE-2018- 10	57.1	40.2	60.3	50.3	52.0	32.7	47.4	62.4	47.6	47.5
Phy20-16	NPJ-239	50.1	38.5	41.2	39.2	42.3	27.6	41.7	32.4	39.9	35.4
Phy20-17	NPJ-240	53.8	22.9	47.4	37.4	40.4	28.9	57.0	38.4	42.5	41.7
Phy20-18	SKM1746	50.0	51.8	50.0	49.2	50.3	26.4	45.7	42.2	40.0	38.6
Phy20-19	SVJH-006	45.7	60.3	14.8	16.8	34.4	25.0	43.1	34.0	35.1	34.3
Phy20-20	PHR8024	66.3	21.8	69.2	45.2	50.6	20.8	55.6	22.3	37.2	34.0
Phy20-21	PHR8031	68.2	37.1	69.8	48.8	56.0	22.5	36.8	32.7	35.8	32.0
Phy20-22	KGMH-3811	47.3	54.3	31.3	37.5	42.6	27.3	51.3	45.0	40.0	40.9
Phy20-23	RMM-19-06	55.0	46.8	64.3	44.3	52.6	26.1	43.4	25.4	36.1	32.8
Phy20-24	ORM 2019-01	40.4	54.3	23.6	33.6	38.0	18.1	35.6	24.9	28.5	26.8
Phy20-25	TM188	46.2	41.8	20.0	29.1	34.3	20.5	55.9	18.4	19.6	28.6
Phy20-26	BAUM09-12-2	48.5	58.8	14.3	34.9	39.1	22.3	49.9	27.2	25.3	31.2
Phy20-27	RH1999-42	40.3	61.5	12.5	18.5	33.2	26.6	38.8	35.4	32.7	33.4
Phy20-28	DRMRCI133	49.9	49.1	15.3	20.3	33.7	22.8	34.3	25.2	27.5	27.5
Phy20-29	DRMRCI134	70.1	22.6	68.9	48.9	52.6	21.4	57.8	27.8	31.7	34.7
Phy20-30	DRMR1167	55.6	24.2	43.8	33.8	39.4	15.0	61.5	16.3	17.9	27.7
Phy20-31	DRMR1188	50.2	23.9	30.0	35.0	34.8	18.5	45.3	29.7	28.6	30.5
Phy20-32	JD-6(check)	58.7	34.7	50.0	42.0	46.4	24.1	42.0	26.7	29.5	30.6
Phy20-33	PM25(check)	58.9	34.8	66.6	46.6	51.7	24.7	41.6	29.5	24.5	32.6
	Mean	**56.1**	**38.2**	**48.3**	**40.8**		**25.1**	**46.0**	**33.2**	**34.0**	
	CD (p=0.05)	4.5	12.8	2.8	10.2		NS	6.7	1.9	5.2	

Table 6.1.2 Screening of genotypes from different agroclimatic zones for high temeprature at seedling stage under field condition

Code	Entry	Field condition							
		Seedling mortality (%)				DW/10plants (g)			
		Bharatpur	Kanpur	Ludhiana	Average	Bharatpur	Kanpur	Ludhiana	Average
Phy20-1	DRMR2017-26	22.1	24.2	18.5	21.6	2.9	3.9	4.0	3.6
Phy20-2	DRMR-2018-27	20.1	23.5	20.9	21.5	3.0	3.7	4.3	3.7
Phy20-3	DRMR-2059	20.4	19.5	25.5	21.8	2.6	3.1	3.2	3.0
Phy20-4	DRMRHT13-22-10	19.6	18.2	22.2	20.0	2.6	2.8	4.3	3.2
Phy20-5	PM27	21.0	20.8	17.1	19.6	3.1	3.5	3.5	3.4
Phy20-6	RGN229	20.3	19.5	13.3	17.7	3.4	4.1	5.0	4.2
Phy20-7	KMR(E)-20-1	18.2	17.1	20.7	18.7	2.1	2.8	4.5	3.1
Phy20-8	KMR(E)-20-2	26.7	29.5	15.0	23.7	2.7	3.9	4.9	3.8
Phy20-9	DRMRCI129	26.4	25.2	11.9	21.2	3.4	3.3	3.2	3.3
Phy20-10	DRMRSJ112	25.9	24.7	18.3	23.0	3.0	3.8	4.4	3.7
Phy20-11	DRMRHT1712	20.5	20.0	7.9	16.1	3.2	4.5	3.7	3.8
Phy20-12	RH1999-12	25.3	24.2	11.0	20.2	3.6	3.8	4.9	4.1
Phy20-13	RH1999-21	22.5	20.1	3.3	15.3	4.0	4.2	4.7	4.3
Phy20-14	PRE-2018-8	20.0	22.2	11.8	18.0	3.3	3.9	4.0	3.7
Phy20-15	PRE-2018- 10	21.6	20.1	18.8	20.2	3.0	2.8	3.6	3.1
Phy20-16	NPJ-239	19.0	19.5	13.4	17.3	2.9	4.6	6.2	4.6
Phy20-17	NPJ-240	21.3	20.2	15.0	18.8	2.7	3.8	3.4	3.3
Phy20-18	SKM1746	25.7	24.2	35.3	28.4	2.1	2.9	4.5	3.2
Phy20-19	SVJH-006	18.2	12.1	14.8	15.0	3.2	4.5	4.5	4.1
Phy20-20	PHR8024	25.2	23.2	17.1	21.8	3.0	3.9	3.1	3.3
Phy20-21	PHR8031	22.6	21.0	22.1	21.9	2.7	2.4	4.8	3.3
Phy20-22	KGMH-3811	20.3	19.8	12.0	17.4	3.1	4.1	4.7	4.0
Phy20-23	RMM-19-06	18.7	20.5	13.7	17.6	2.6	4.4	3.7	3.6
Phy20-24	ORM2019-01	16.4	12.5	13.7	14.2	2.3	3.8	3.6	3.2
Phy20-25	TM188	19.6	11.8	13.3	14.9	3.2	4.6	4.1	4.0
Phy20-26	BAUM09-12-2	16.2	13.9	19.1	16.4	3.2	4.5	4.1	3.9
Phy20-27	RH1999-42	18.6	10.8	9.3	12.9	3.5	4.7	3.5	3.9
Phy20-28	DRMRCI133	18.4	14.3	8.6	13.8	2.6	4.6	3.8	3.7
Phy20-29	DRMRCI134	22.1	21.5	3.5	15.7	3.2	2.9	2.7	2.9
Phy20-30	DRMR1167	20.1	20.2	15.9	18.7	2.3	3.9	3.1	3.1
Phy20-31	DRMR1188	18.7	16.8	17.0	17.5	2.7	3.8	3.7	3.4
Phy20-32	JD-6(check)	21.6	20.9	19.2	20.6	3.0	4.3	2.8	3.4
Phy20-33	PM25(check)	25.5	22.8	17.2	21.8	2.8	3.5	3.9	3.4
	Mean	**21.2**	**19.8**	**15.7**		**2.9**	**3.7**	**4.0**	
	CD (p=0.05)	9.9	1.1	1.7		7.5	0.3	1.8	

Table 6.1.3 Effect of high temparature at seedling stage on SPAD and RWC under field condition

Code	Entry	SPAD			RWC (%)				Ludhiana	
		Bharatpur	Ludhiana	Average	Bharatpur	Kanpur	Ludhiana	Average	STI	SSTI
Phy20-1	DRMR2017-26	49.2	45.6	47.4	81.1	73.5	55.5	70.0	81.5	64.5
Phy20-2	DRMR-2018-27	47.5	46.9	47.2	84.5	73.1	58.8	72.1	82.7	68.0
Phy20-3	DRMR-2059	48.6	41.3	45.0	86.2	73.2	37.1	65.5	74.5	54.9
Phy20-4	DRMRHT13-22-10	46.7	45.6	46.2	83.8	74.0	54.1	70.6	77.8	63.4
Phy20-5	PM27	48.1	41.0	44.6	85.7	66.8	76.0	76.2	81.9	60.4
Phy20-6	RGN229	50.7	43.0	46.9	76.0	80.2	74.8	77.0	90.5	72.1
Phy20-7	KMR(E)-20-1	48.3	49.2	48.8	80.4	70.5	59.0	70.0	79.3	60.2
Phy20-8	KMR(E)-20-2	48.8	42.8	45.8	79.5	78.0	34.2	63.9	86.3	74.5
Phy20-9	DRMRCI129	49.1	37.1	43.1	84.2	69.5	51.4	68.4	87.0	63.7
Phy20-10	DRMRSJ112	47.2	43.3	45.3	83.6	68.3	49.5	67.1	81.0	60.7
Phy20-11	DRMRHT1712	47.7	37.2	42.4	84.3	76.5	63.4	74.7	90.5	69.7
Phy20-12	RH1999-12	47.9	38.1	43.0	83.2	77.1	54.8	71.7	87.9	67.0
Phy20-13	RH1999-21	46.0	50.6	48.3	79.0	77.6	46.5	67.7	95.0	73.7
Phy20-14	PRE-2018-8	52.3	44.2	48.2	80.1	73.2	52.6	68.6	76.2	71.9
Phy20-15	PRE-2018- 10	50.6	44.6	47.6	72.4	65.8	58.7	65.6	81.2	60.0
Phy20-16	NPJ-239	49.0	40.6	44.8	87.1	76.5	57.8	73.8	83.8	65.8
Phy20-17	NPJ-240	51.3	41.9	46.6	90.2	72.1	41.3	67.9	94.1	74.1
Phy20-18	SKM1746	51.4	45.7	48.6	89.0	67.9	50.8	69.2	84.0	66.4
Phy20-19	SVJH-006	48.8	43.4	46.1	87.8	75.2	63.9	75.6	78.8	62.5
Phy20-20	PHR8024	45.7	45.9	45.8	83.8	73.8	57.9	71.8	80.6	60.4
Phy20-21	PHR8031	45.5	46.9	46.2	84.1	75.2	43.8	67.7	84.7	63.0
Phy20-22	KGMH-3811	48.8	37.9	43.3	90.6	74.7	64.5	76.6	87.8	66.5
Phy20-23	RMM-19-06	46.9	45.1	46.0	86.5	69.5	53.0	69.7	84.9	65.8
Phy20-24	ORM2019-01	49.2	47.4	48.3	87.8	71.3	50.1	69.7	79.8	74.8
Phy20-25	TM188	47.0	47.3	47.1	82.6	70.1	42.2	65.0	86.0	71.0
Phy20-26	BAUM09-12-2	47.4	45.7	46.5	87.1	69.5	50.3	69.0	78.3	62.5
Phy20-27	RH1999-42	45.9	42.7	44.3	84.5	70.5	47.3	67.4	88.8	72.2
Phy20-28	DRMRCI133	31.0	50.0	40.5	87.5	69.8	63.5	73.6	85.6	66.6
Phy20-29	DRMRCI134	45.4	43.0	44.2	86.7	70.1	42.6	66.5	95.2	73.0
Phy20-30	DRMR1167	48.2	45.9	47.1	88.7	71.1	51.1	70.3	83.9	70.0
Phy20-31	DRMR1188	51.3	42.1	46.7	88.1	69.5	30.9	62.8	83.1	82.2
Phy20-32	JD-6(check)	49.2	50.4	49.8	80.6	67.9	46.3	64.9	78.6	59.9
Phy20-33	PM25(check)	48.8	41.6	45.2	86.5	70.3	48.6	68.5	81.3	60.2
	Mean	**47.9**	**44.1**		**83.5**	**70.0**	**52.5**		**84.0**	**66.7**
	CD (p=0.05)	NS	2.8		NS	2.8	7.3	5.1	5.6	1.3

Table 6.2.1 Effect of low light stress on photosynthesis at two stages of crop growth

Code	Entry	Photosynthesis (µmol /m²/s)								
		15 days of shading			10 days after removal of nets					
		Ludhiana			Hisar			Ludhiana		
		C	S	Red (%)	C	S	Red (%)	C	S	Red (%)
Phy34	DRMRCI96	21.3	16.2	23.9	6.5	4.4	32.1	24.5	22.7	7.3
Phy35	RMM10-1-1	20.5	18.3	10.7	7.7	5.5	28.4	22.8	20.3	11.0
Phy36	RH-1676	24.7	22.1	10.5	7.0	4.9	30.2	25.3	24	5.1
Phy37	PBR385	22.4	19.2	14.3	7.2	5.2	27.4	24.8	21.6	12.9
Phy38	NRCHB101	21.8	17.8	18.3	7.6	5.5	28.2	23.4	19.7	15.8
Phy39	RH-749(Check)	20.7	18.3	11.6	7.1	5.5	22.1	24.4	22.4	8.2
	Mean	**21.9**	**18.65**		**7.2**	**5.2**		**24.2**	**21.8**	
CD (p=0.05)		S=0.223			S=NS			S=0.612		
		G=0.134			G=1.21			G=1.43		
		SxG=NS			SxG=NS			SxG=NS		

Table 6.2.2 Effect of low light stress on chlorophyll content and chlorophyll stability index 10 days after removal of nets at Hisar

Code	Entry	Photosynthetic pigments (mg/g FW)									CSI
		Chl a			Chl b			Total Chl			
		C	S	Red(%)	C	S	Red (%)	C	S	Red (%)	
Phy34	DRMRCI96	1.63	1.51	7.2	1.68	1.50	10.8	3.31	3.01	9.0	0.91
Phy35	RMM10-1-1	1.75	1.64	6.5	0.27	0.23	15.0	2.02	1.86	7.6	0.92
Phy36	RH-1676	1.95	1.58	18.6	0.36	0.24	34.3	2.31	1.82	21.1	0.79
Phy37	PBR385	1.38	1.07	22.5	0.39	0.34	12.6	1.77	1.41	20.3	0.80
Phy38	NRCHB101	1.77	1.61	9.4	0.36	0.25	29.4	2.13	1.86	12.7	0.87
Phy39	RH-749(Check)	1.49	1.33	10.9	0.36	0.27	24.9	1.85	1.60	13.6	0.86
	Mean	**1.66**	**1.46**		**0.57**	**0.47**		**2.23**	**1.93**		**0.86**
CD (p=0.05)		S=NS			S=0.039			S=0.159			
		G=0.367			G=0.070			G=0.330			
		SxG=NS			SxG=NS			SxG=NS			

Table 6.2.3 Effect of low light stress on photosynthetic pigments (mg/gFW) and chlorophyll stability index 10 days after removal of nets at Ludhiana

Code	Entry	Chl a			Chl b			Total Chl			Carotenoids			CSI
		C	S	Red (%)	C	S	Red (%)	C	S	Red (%)	C	S	Red (%)	
Phy34	DRMRCI96	0.686	0.685	0.1	0.811	0.524	35.4	1.46	1.21	17.3	0.464	0.336	27.5	0.83
Phy35	RMM10-1-1	1.584	1.568	1.0	0.482	0.337	30.0	2.07	1.95	5.8	0.454	0.294	35.3	0.94
Phy36	RH-1676	1.312	0.861	34.3	0.776	0.494	36.3	1.70	1.64	3.7	0.451	0.411	9.0	0.96
Phy37	PBR385	0.889	0.672	24.4	0.667	0.660	1.0	1.55	1.39	10.3	0.444	0.405	8.9	0.90
Phy38	NRCHB101	1.027	0.874	14.9	0.773	0.579	25.1	1.65	1.63	1.2	0.482	0.359	25.4	0.99
Phy39	RH-749(Check)	0.753	0.659	12.5	0.725	0.711	1.9	1.46	1.37	6.2	0.424	0.415	2.2	0.94
	Mean	**1.042**	**0.887**		**0.706**	**0.551**		**1.65**	**1.53**		**0.453**	**0.370**		
CD (p=0.05)		S=0.085			S=.022			S=0.080			S=0.014			
		G=0.209			G=0.055			G=0.195			G=0.035			
		SxG=0.296			SxG=.077			SxG=0.277			SxG=0.050			

C=Control S= 30% shading

Table 6. 2.4 Effect of low light stress 10 days after removal of nets on physiological traits

Code	Entry	Ludhiana									Hisar		
		LWR (%)			SLW(mg/cm2)			SPAD			SPAD		
		C	S	Red (%)	C	S	Red (%)	C	S	Red (%)	C	S	Red (%)
Phy34	DRMRCI96	78.5	78.1	0.5	3.6	3.1	14.4	47.5	47.0	1.2	45.3	35.0	22.7
Phy35	RMM10-1-1	83.1	78.2	5.9	2.8	2.6	6.4	45.5	43.6	4.0	45.5	34.9	23.3
Phy36	RH-1676	81.1	80.6	0.6	2.5	1.8	28.0	46.8	42.1	10.0	46.3	36.3	21.6
Phy37	PBR385	79.8	79.1	0.8	3.5	2.0	42.9	42.2	40.7	3.4	45.8	36.9	19.4
Phy38	NRCHB101	79.8	79.1	0.8	2.8	1.5	44.5	46.7	44.6	4.5	50	43.7	12.6
Phy39	RH-749(Check)	85.5	80.8	5.5	3.5	1.6	53.5	50.0	42.4	15.2	45.3	37.2	17.9
	Mean	**81.3**	**79.3**		**3.1**	**2.1**		**46.5**	**43.4**		**42.4**	**34.0**	
CD (p=0.05)		S=0.33			S=0.194			S=1.96			S= 1.31		
		G=0.99			G=0.476			G=1.83			G= 3.33		
		SxG=0.82			SxG=0.673			SxG=1.62			SxG=NS		

C=Control S= 30% shading

Table 6.2.5 Effect of low light stress on siliquae on main shoot and total siliquae per plant at Hisar and Ludhiana

Code	Entry	Siliquae on main shoot						Total siliquae per plant					
		Hisar			Ludhiana			Hisar			Ludhiana		
		C	S	Red (%)	C	S	Red (%)	C	S	Red (%)	C	S	Red (%)
Phy34	DRMRCI96	48.0	45.0	6.3	38.8	30.9	20.3	318.2	275	13.6	197.6	192.3	2.7
Phy35	RMM10-1-1	50.9	41.5	18.5	40.3	32.5	19.5	242.1	199	17.8	220.7	156.1	29.2
Phy36	RH-1676	49.0	47.5	3.1	35.3	26.2	25.7	183.3	149.2	18.6	203.5	157.0	22.8
Phy37	PBR385	56.3	39.0	30.7	38.2	38.1	0.3	357.3	228.8	36.0	212.9	188.2	11.6
Phy38	NRCHB101	56.0	43.5	22.3	35.9	22.5	37.3	221.8	160.9	27.5	141.2	123.1	12.8
Phy39	RH-749(Check)	58.8	46.4	21.1	37.8	34.3	9.3	236.1	190.3	19.4	175.2	148.0	15.5
	Mean	**53.2**	**43.8**		**37.7**	**30.8**		**259.8**	**200.5**		**191.8**	**160.8**	
CD (p=0.05)		S=NS			S=3.21			S=36.14				S=18.2	
		G=1.8			G=1.95			G=56.1				G=11.1	
		SxG=NS			SxG=1.52			SxG=NS				SxG=30.3	

C=Control S= 30% shading

Table 6.2.6 Effect of low light stress on seeds per siliqua and 1000 seed weight at Hisar and Ludhiana

Code	Entry	Seeds/Siliqua						1000 seed weight (g)					
		Hisar			Ludhiana			Hisar			Ludhiana		
		C	S	Red (%)	C	S	Red (%)	C	S	Red (%)	C	S	Red (%)
Phy34	DRMRCI96	14.3	12.5	12.6	11.4	10.4	8.7	5.2	4.6	11.5	4.52	4.3	5.2
Phy35	RMM10-1-1	11.3	9.6	15.0	11.9	11.3	4.8	5.6	4.7	16.1	4.87	3.5	28.1
Phy36	RH-1676	12.8	11.9	7.0	11.4	10.7	6.1	6.2	5.0	19.4	5.60	4.7	16.8
Phy37	PBR385	12.7	12.3	3.1	12.2	11.1	8.8	5.7	4.3	24.6	4.26	4.0	5.2
Phy38	NRCHB101	14.2	11.9	16.2	11.3	10.6	6.2	6.1	4.3	29.5	4.69	4.2	9.8
Phy39	RH-749(Check)	10.8	10.7	0.9	9.6	9.1	5.5	7.1	5.8	18.3	5.80	5.4	7.4
	Mean	**12.5**	**11.8**		**11.3**	**10.5**		**6.0**	**4.8**		**4.96**	**4.3**	
CD (p=0.05)		S=NS			S=1.98			S=0.254			S=0.84		
		G=1.378			G=0.97			G=0.538			G=0.928		
		SxG=NS			SxG=0.36			SxG=NS			SxG=0.86		

C=Control S= 30% shading

Table 6.2.7 Effect of low light stress on biological yield and seed yield at two locations

Code	Entry	Biological yield						Seed yield					
		Hisar (g/plant)			Ludhiana (kg/ha)			Hisar (g/plant)			Ludhiana (kg/ha)		
		C	S	Red (%)	C	S	Red (%)	C	S	Red (%)	C	S	Red (%)
Phy34	DRMRCI96	84.0	77.2	8.1	5444	4444	18.4	18.8	15.9	15.4	1222.2	742.2	39.3
Phy35	RMM10-1-1	65.4	61.4	6.1	4222	2338	44.6	15.4	12.8	16.9	684.4	364.4	46.8
Phy36	RH-1676	51.2	45.7	10.7	6511	6422	1.4	12.3	9.9	19.5	943.2	880.0	6.7
Phy37	PBR385	67.5	57.1	15.4	5222	4889	6.4	16.0	11.9	25.6	1040.0	860.0	17.3
Phy38	NRCHB101	50.5	44.4	12.1	3333	2000	40.0	12.4	8.9	28.2	400.0	344.0	14.0
Phy39	RH-749(Check)	66.9	59.5	11.1	4111	3667	10.8	15.8	12.7	19.6	1104.4	622.2	43.7
	Mean	**64.2**	**57.6**		**4807**	**3960**		**15.1**	**12.0**		**899.1**	**635.5**	
CD (p=0.05)		S=4.309			S=70.8			S=1.39			S=23.2		
		G=9.141			G=418.4			G=2.95			G=56.8		
		SxG=12.9			SxG=491.7			SxG=NS			SxG=80.4		

C=Control S= 30% shading

Table 6.3.1 Effect of moisture stress on SPAD at 3 locations

Code	Entry	SPAD								
		Bharatpur			Hisar			Ludhiana		
		IR	RF	Red (%)	IR	RF	Red (%)	IR	RF	Red (%)
Phy-20-40	NPJ-225	35.5	36.2	1.9	38.6	34.0	11.9	51.4	43.2	16.1
Phy-20-41	DRMR2017-8	33.4	38.5	13.2	29.4	21.8	25.9	49.8	42.2	15.4
Phy-20-42	DRMR2018-27	36.0	46.7	22.9	37.0	31.5	14.9	50.5	46.1	8.6
Phy-20-43	DRMR-1222	38.5	46.7	17.6	32.8	28.2	14.0	48.2	44.8	7.0
Phy-20-44	DRMRCI136	37.5	48.7	23.0	35.4	26.8	24.3	48.4	43.6	9.9
Phy-20-45	DRMRCI137	36.8	47.4	22.4	49.3	35.7	27.6	48.5	44.7	7.8
Phy-20-46	DRMR1167	38.0	47.1	19.3	36.3	22.9	36.9	50.7	46.8	7.6
Phy-20-47	DRMR1188	36.7	50.2	26.9	42.8	39.3	8.2	53.0	42.1	20.5
Phy-20-48	NPJ214	37.5	48.3	22.4	47.6	38.4	19.3	46.4	46.1	0.7
Phy-20-49	LES54	38.5	49.6	22.4	34.7	26.9	22.5	53.1	43.2	18.5
Phy-20-50	NPJ210	40.0	50.1	20.2	29.3	23.3	20.5	54.0	50.3	6.9
Phy-20-51	DRMTCI14	35.5	47.4	25.1	39.5	35.9	9.1	50.8	42.6	16.1
Phy-20-52	RH1424	38.6	48.8	20.9	35.0	27.7	20.9	49.4	45.9	7.0
Phy-20-53	DRMRCI-128	34.8	47.5	26.7	37.2	31.5	15.3	50.1	44.3	11.6
Phy-20-54	DRMRSJ276	39.4	49.6	20.6	47.8	30.8	35.6	48.1	40.5	15.8
Phy-20-55	DRMRHJ908	37.9	46.8	19.0	39.8	36.2	9.0	49.2	46.2	6.1
Phy-20-56	DRMRHT1913	33.9	47.3	28.3	43.9	40.0	8.9	51.1	43.3	15.2
Phy-20-57	NPJ-243	33.7	48.4	30.4	37.2	25.3	32.0	52.4	40.9	22.0
Phy-20-58	NPJ-244	37.4	48.0	22.1	47.8	33.3	30.3	52.8	41.4	21.7
Phy-20-59	RGN-500	33.3	35.3	5.7	40.7	36.4	10.6	43.2	41.9	3.1
Phy-20-60	RGN-486	36.2	49.2	26.4	42.5	36.5	14.1	49.6	42.8	13.6
Phy-20-61	RH1920	38.6	49.3	21.7	38.7	27.8	28.2	53.5	39.5	26.2
Phy-20-62	RH1921	38.3	48.0	20.2	41.2	34.5	16.3	50.6	49.8	1.5
Phy-20-63	TM264	35.6	47.4	24.9	40.7	27.4	32.7	48.3	38.7	19.9
Phy-20-64	JM-13-3	34.2	38.4	11.1	26.5	24.1	9.1	52.8	48.2	8.7
Phy-20-65	CAU-RM-4-1-1	38.6	47.5	18.7	43.1	37.8	12.3	52.0	44.7	14.0
Phy-20-66	JC32	30.1	44.0	31.5	33.1	22.8	31.1	49.6	39.8	19.7
Phy-20-67	JC36	33.6	40.1	16.2	44.6	40.9	8.3	48.2	39.3	18.4
Phy-20-68	PBR-450	39.7	46.0	13.7	32.8	22.1	32.6	50.8	42.0	17.4
Phy-20-69	RH-0725(check)	36.6	47.1	22.3	33.8	27.8	17.8	51.8	43.8	15.4
Phy-20-70	RGN-229(check)	36.6	47.5	22.9	36.3	34.5	5.0	47.7	44.5	6.6
	Mean	**36.5**	**46.2**		**38.6**	**31.0**		**50.2**	**43.7**	
CD (p=0.05)		I=1.14			I=0.894			I=1.25		
		G=4.50			G=3.014			G=1.29		
		IxG=6.36			IxG=NS			IxG=2.54		

IR=Irrigated RF= Rainfed

Table 6.3.2 Effect of moisture stress on relative water content (RWC) at 3 locations

Code	Entry	RWC (%)								
		Bharatpur			Hisar			Ludhiana		
		IR	RF	Red (%)	IR	RF	Red (%)	IR	RF	Red (%)
Phy-20-40	NPJ-225	94.1	87.8	6.7	71.7	45.8	36.1	84.8	79.1	6.8
Phy-20-41	DRMR2017-8	92.8	88.2	5.0	75.0	51.4	31.4	84.0	83.0	1.2
Phy-20-42	DRMR2018-27	92.3	87.3	5.4	72.9	44.3	39.2	82.4	81.4	1.2
Phy-20-43	DRMR-1222	94.6	87	8.0	63.7	37.1	41.8	82.7	78.9	4.5
Phy-20-44	DRMRCI136	95.9	83.9	12.5	76.2	46.7	38.7	83.2	82.1	1.4
Phy-20-45	DRMRCI137	93.8	86.2	8.1	72.9	47.9	34.2	87.7	84.2	4.0
Phy-20-46	DRMR1167	94.5	86.2	8.8	75.9	53.9	29.0	83.7	82.7	1.2
Phy-20-47	DRMR1188	96.5	91.2	5.5	64.2	35.7	44.4	84.0	82.8	1.4
Phy-20-48	NPJ214	96.2	84.3	12.4	61.5	38.1	38.0	83.5	83.2	0.4
Phy-20-49	LES54	94.5	85.9	9.1	72.4	44.7	38.2	86.4	82.1	5.1
Phy-20-50	NPJ210	93.6	83.6	10.7	65.5	41.3	37.0	96.4	84.8	12.0
Phy-20-51	DRMTCI14	94.0	85.7	8.8	61.9	33.4	46.1	84.7	83.1	1.9
Phy-20-52	RH1424	92.2	88	4.6	80.6	54.7	32.1	84.7	80.5	5.0
Phy-20-53	DRMRCI-128	92.9	86.3	7.1	69.5	43.5	37.4	85.9	75.2	12.4
Phy-20-54	DRMRSJ276	96.5	85.3	11.6	69.8	48.2	30.8	79.9	77.1	3.5
Phy-20-55	DRMRHJ908	95.3	86.7	9.0	68.0	46.0	32.4	85.7	84.9	0.9
Phy-20-56	DRMRHT1913	94.7	87.5	7.6	71.6	46.9	34.6	88.4	85.6	3.2
Phy-20-57	NPJ-243	95.5	85.2	10.8	75.6	51.5	31.8	90.2	84.8	6.0
Phy-20-58	NPJ-244	93.9	84.3	10.2	73.8	48.8	33.8	86.3	83.8	2.9
Phy-20-59	RGN-500	95.5	83.6	12.5	76.5	46.4	39.4	84.1	83.4	0.8
Phy-20-60	RGN-486	93.8	85.5	8.8	75.0	49.9	33.4	84.5	79.3	6.1
Phy-20-61	RH1920	94.6	87.7	7.3	75.0	50.4	32.8	85.8	81.1	5.5
Phy-20-62	RH1921	95.4	86.2	9.6	78.7	50.3	36.1	82.9	76.3	8.0
Phy-20-63	TM264	95.5	86.9	9.0	74.8	43.2	42.2	86.7	83.4	3.8
Phy-20-64	JM-13-3	93.9	82.7	11.9	72.7	47.2	35.0	83.1	76.3	8.2
Phy-20-65	CAU-RM-4-1-1	95.1	86.2	9.4	73.8	46.3	37.3	85.1	80.3	5.6
Phy-20-66	JC32	95.1	85.9	9.7	77.8	53.9	30.7	83.5	79.7	4.5
Phy-20-67	JC36	95.1	94.9	0.2	65.1	36.1	44.6	85.5	75.9	11.3
Phy-20-68	PBR-450	91.8	79.8	13.1	75.6	53.8	28.9	88.0	86.8	1.3
Phy-20-69	RH-0725(check)	98.7	93.5	5.3	81.6	52.1	36.2	84.9	80.5	5.2
Phy-20-70	RGN-229(check)	91.2	84.3	7.6	71.0	46.5	34.5	88.0	82.4	6.3
	Mean	**94.5**	**86.4**		**72.3**	**46.3**		**85.4**	**81.4**	
CD (p=0.05)		I=1.17			I=1.640			I=1.21		
		G=4.61			G=5.616			G=2.79		
		IxG=6.51			IxG=NS			IxG=3.94		

IR=Irrigated RF= Rainfed

Table 6.3.3 Effect of moisture stress on canopy temperature

Code	Entry	Canopy temperature (˚C)					
		Bharatpur		Hisar		Ludhiana	
		IR	RF	IR	RF	IR	RF
Phy-20-40	NPJ-225	11.4	13.1	28.2	29.0	18.6	24.7
Phy-20-41	DRMR2017-8	10.6	10.8	27.3	28.2	18.5	22.7
Phy-20-42	DRMR2018-27	10.1	12.5	26.1	29.0	21.5	23.5
Phy-20-43	DRMR-1222	10.4	10.6	26.7	30.0	20.0	22.1
Phy-20-44	DRMRCI136	10.5	11.4	27.2	28.7	18.2	23.5
Phy-20-45	DRMRCI137	9.6	11.2	25.6	29.7	19.5	23.2
Phy-20-46	DRMR1167	10.1	11.1	26.7	30.1	20.8	19.5
Phy-20-47	DRMR1188	9.0	11.3	26.7	27.2	21.4	20.6
Phy-20-48	NPJ214	8.6	10.5	26.1	29.6	20.9	19.6
Phy-20-49	LES54	8.7	10.8	27.4	28.0	20.3	19.5
Phy-20-50	NPJ210	8.6	10.1	27.6	28.3	18.8	20.2
Phy-20-51	DRMTCI14	9.3	10.7	26.2	29.4	19.4	21.6
Phy-20-52	RH1424	9.5	11	26.7	27.7	19.0	19.4
Phy-20-53	DRMRCI-128	9.5	11.6	26.7	29.8	18.8	19.7
Phy-20-54	DRMRSJ276	9.2	12.8	26.1	30.1	21.1	20.6
Phy-20-55	DRMRHJ908	10.6	11.1	27.2	30.6	17.6	19.3
Phy-20-56	DRMRHT1913	9.7	11.2	26.3	28.5	19.3	21.8
Phy-20-57	NPJ-243	9.9	10.5	26.1	29.7	19.4	20.1
Phy-20-58	NPJ-244	10.3	10.6	25.9	29.4	20.6	22.5
Phy-20-59	RGN-500	9.7	11.3	26.8	28.9	18.0	22.1
Phy-20-60	RGN-486	10.8	11.1	26.3	29.1	19.4	21.0
Phy-20-61	RH1920	9.4	10	25.7	28.4	18.9	19.6
Phy-20-62	RH1921	10.5	11.2	26.7	29.0	17.9	23.2
Phy-20-63	TM264	10.3	10.8	25.2	27.8	18.4	22.9
Phy-20-64	JM-13-3	10.2	13.2	26.8	29.7	19.8	22.9
Phy-20-65	CAU-RM-4-1-1	10.7	10.9	25.7	30.0	21.0	21.2
Phy-20-66	JC32	6.1	11.8	27.0	28.0	18.6	22.2
Phy-20-67	JC36	10.4	12.3	26.6	27.0	19.6	21.9
Phy-20-68	PBR-450	9.9	14.3	26.7	30.7	18.8	21.1
Phy-20-69	RH-0725(check)	10.0	13.7	27.3	28.4	19.9	21.0
Phy-20-70	RGN-229(check)	10.1	13.1	26.6	29.7	20.2	21.9
	Mean	**9.8**	**11.5**	**26.6**	**29.0**	**19.5**	**21.4**
CD (p=0.05)		I=0.48		I= 1.217		I=0.398	
		G=NS		G= 0.384		G=1.56	
		IxG=NS		IxG= 1.480		IxG=2.21	

IR=Irrigated RF= Rainfed

Table 6.3.4 Effect of moisture stress on photosynthetic pigments (mg/gF.W.) at Ludhiana

Code	Entry	Ludhiana											
		Photosynthetic Pigments (mg/gFW)											
		Chl a			Chl b			Total Chl			Carotenoids		
		IR	RF	Red (%)	IR	RF	Red (%)	IR	RF	Red (%)	IR	RF	Red (%)
Phy-20-40	NPJ-225	1.59	1.11	30.3	0.245	0.236	3.7	1.74	1.35	22.5	0.325	0.282	13.0
Phy-20-41	DRMR2017-8	1.45	1.38	5.0	0.306	0.273	11.0	1.72	1.68	2.3	0.436	0.402	7.8
Phy-20-42	DRMR2018-27	1.99	1.41	29.1	0.464	0.246	47.0	2.12	1.88	11.4	0.413	0.408	1.0
Phy-20-43	DRMR-1222	2.02	1.84	8.7	0.219	0.183	16.3	2.24	2.03	9.4	0.442	0.434	1.8
Phy-20-44	DRMRCI136	1.79	1.43	20.2	0.404	0.128	68.3	1.92	1.84	4.5	0.426	0.309	27.6
Phy-20-45	DRMRCI137	1.88	1.57	16.3	0.131	0.105	19.9	1.98	1.70	14.1	0.393	0.299	24.0
Phy-20-46	DRMR1167	2.03	1.28	36.8	0.341	0.104	69.5	2.08	1.52	27.1	0.424	0.370	12.7
Phy-20-47	DRMR1188	1.78	1.62	9.1	0.599	0.176	70.6	2.22	1.96	11.7	0.503	0.453	10.0
Phy-20-48	NPJ214	1.63	1.61	0.9	0.301	0.148	50.8	1.91	1.73	9.9	0.391	0.387	1.0
Phy-20-49	LES54	1.43	1.17	18.4	0.289	0.123	57.3	1.55	1.45	6.3	0.384	0.351	8.7
Phy-20-50	NPJ210	1.53	1.33	12.9	0.263	0.106	59.6	1.62	1.59	1.6	0.378	0.370	2.2
Phy-20-51	DRMTCI14	1.63	1.49	8.6	0.303	0.180	40.7	2.19	1.80	17.5	0.556	0.367	34.1
Phy-20-52	RH1424	1.98	1.35	31.7	0.221	0.179	19.1	2.20	1.53	30.4	0.393	0.368	6.3
Phy-20-53	DRMRCI-128	2.01	1.43	28.9	0.206	0.119	42.2	2.12	1.54	27.4	0.542	0.358	33.9
Phy-20-54	DRMRSJ276	1.70	1.63	4.1	0.318	0.114	64.2	2.01	1.74	13.6	0.412	0.361	12.4
Phy-20-55	DRMRHJ908	1.51	1.22	19.2	0.502	0.317	37.0	2.02	1.53	23.9	0.444	0.363	18.1
Phy-20-56	DRMRHT1913	1.82	1.58	13.1	0.525	0.319	39.3	2.10	2.03	3.2	0.471	0.387	17.8
Phy-20-57	NPJ-243	1.71	1.49	12.8	0.670	0.395	41.1	2.38	1.88	20.7	0.527	0.386	26.8
Phy-20-58	NPJ-244	1.49	1.25	15.9	0.565	0.355	37.2	2.06	1.61	21.7	0.471	0.394	16.4
Phy-20-59	RGN-500	1.56	1.23	21.1	0.515	0.320	38.0	2.08	1.55	25.3	0.446	0.366	18.1
Phy-20-60	RGN-486	1.41	1.27	9.9	0.472	0.455	3.6	1.88	1.72	8.3	0.450	0.389	13.6
Phy-20-61	RH1920	1.35	1.30	4.3	0.420	0.323	23.3	1.72	1.68	2.3	0.400	0.399	0.4
Phy-20-62	RH1921	2.89	1.05	63.5	0.542	0.125	77.0	3.01	1.59	47.0	0.533	0.348	34.8
Phy-20-63	TM264	1.45	1.11	23.4	0.728	0.390	46.5	2.18	1.50	31.2	0.471	0.338	28.3
Phy-20-64	JM-13-3	1.73	1.37	21.0	0.524	0.257	50.9	1.99	1.89	4.9	0.466	0.393	15.6
Phy-20-65	CAU-RM-4-1-1	1.79	1.46	18.7	0.470	0.100	78.8	1.93	1.89	2.1	0.421	0.353	16.3
Phy-20-66	JC32	2.14	1.05	51.2	0.507	0.275	45.8	2.42	1.55	35.8	0.465	0.322	30.7
Phy-20-67	JC36	2.40	1.40	41.7	0.498	0.241	51.6	2.01	1.90	5.5	0.399	0.384	3.9
Phy-20-68	PBR-450	1.38	1.20	13.0	0.558	0.322	42.2	1.94	1.54	20.6	0.446	0.355	20.4
Phy-20-69	RH-0725(check)	2.16	1.40	35.2	0.501	0.348	30.7	2.51	1.90	24.2	0.506	0.407	19.6
Phy-20-70	RGN-229(check)	1.48	1.11	24.8	0.427	0.387	9.4	1.87	1.54	17.5	0.452	0.394	12.8
	Mean	**1.76**	**1.36**		**0.421**	**0.237**		**2.05**	**1.70**		**0.445**	**0.371**	
CD (p=0.05)		I=NS			I=0.0168			I=0.123			I=0.021		
		G=0.183			G=0.066			G=0.183			G=0.045		
		IxG=0.259			IxG=0.097			IxG=0.260			IxG=0.064		

IR=Irrigated RF= Rainfed

Table 6.3.5 Effect of moisture stress on siliquae on main shoot (SMS) at 3 locations

Code	Entry	Siliquae on main shoot								
		Hisar			Kanpur			Ludhiana		
		IR	RF	Red (%)	IR	RF	Red (%)	IR	RF	Red (%)
Phy-20-40	NPJ-225	51.1	46.2	9.6	59.5	44.8	25.2	51.9	48.3	6.9
Phy-20-41	DRMR2017-8	51.1	41.6	18.6	53.2	42.9	19.4	49.5	45.3	8.4
Phy-20-42	DRMR2018-27	59.5	47	21.0	53.5	34.6	35.3	45.1	40.0	11.4
Phy-20-43	DRMR-1222	50.1	48.2	3.8	58.0	48.2	16.9	44.9	43.8	2.4
Phy-20-44	DRMRCI136	42.8	41	4.2	53.5	47.3	11.5	37.5	32.9	12.3
Phy-20-45	DRMRCI137	57.3	42.2	26.4	51.2	42.5	17.0	45.9	39.1	14.7
Phy-20-46	DRMR1167	63.3	49.7	21.5	49.1	44.4	9.5	43.5	39.4	9.4
Phy-20-47	DRMR1188	48.7	47.3	2.9	48.0	39.6	17.5	43.7	41.9	4.1
Phy-20-48	NPJ214	53.3	44.7	16.1	58.4	54.2	7.2	40.6	33.6	17.2
Phy-20-49	LES54	51.6	48	7.0	49.5	41.3	16.6	51.3	45.5	11.3
Phy-20-50	NPJ210	57.9	43.9	24.2	59.3	50.5	14.8	45.8	42.2	7.9
Phy-20-51	DRMTCI14	47.6	45.5	4.4	50.2	47.3	5.7	44.7	39.1	12.4
Phy-20-52	RH1424	55.7	44.8	19.6	54.3	44.5	18.0	45.2	39.9	11.8
Phy-20-53	DRMRCI-128	47.7	39.8	16.6	53.1	39.8	13.3	49.3	46.6	5.5
Phy-20-54	DRMRSJ276	59.5	41.8	29.7	49.7	46.2	7.0	50.1	41.3	17.7
Phy-20-55	DRMRHJ908	49.6	44.4	10.5	57.4	50.1	12.7	51.7	33.0	36.2
Phy-20-56	DRMRHT1913	56	54.5	2.7	56.3	50.7	9.9	48.0	44.5	7.2
Phy-20-57	NPJ-243	46.9	43.2	7.9	43.5	38.3	11.9	39.7	34.9	12.1
Phy-20-58	NPJ-244	56.5	45.7	19.1	56.8	45.8	19.4	45.8	43.5	5.1
Phy-20-59	RGN-500	55.1	45.8	16.9	51.6	43.5	15.7	55.6	46.1	17.1
Phy-20-60	RGN-486	53.4	51.6	3.4	53.5	45.7	14.6	51.3	46.9	8.5
Phy-20-61	RH1920	53.3	46.4	12.9	46.8	41.4	12.2	42.6	40.8	4.2
Phy-20-62	RH1921	52.5	51.3	2.3	44.8	40.2	10.3	45.9	44.2	3.8
Phy-20-63	TM264	54	53.4	1.1	61.5	44.3	28.0	47.7	39.8	16.6
Phy-20-64	JM-13-3	48.4	46.5	3.9	55.1	41.8	24.1	43.3	36.4	15.9
Phy-20-65	CAU-RM-4-1-1	49.4	47.4	4.0	54.3	44.5	18.0	39.0	38.5	1.3
Phy-20-66	JC32	50.3	48.8	3.0	57.1	46.2	19.1	39.8	37.5	5.8
Phy-20-67	JC36	46.8	46.1	1.5	43.5	35.3	18.8	43.5	43.1	1.0
Phy-20-68	PBR-450	59.1	40.9	30.8	51.4	34.3	33.3	43.3	38.3	11.4
Phy-20-69	RH-0725(check)	51.6	49.4	4.3	43.2	37.1	24.1	48.7	46.3	4.9
Phy-20-70	RGN-229(check)	55.9	50.3	10.0	51.5	48.0	6.8	48.9	44.7	8.7
	Mean	**52.8**	**46.4**		**52.9**	**48.7**		**45.9**	**41.2**	
CD (p=0.05)		I=1.469			I=2.1			I=3.76		
		G=5.783			G=0.5			G=8.15		
		IxG=NS			IxG=2.9			IxG=ns		

IR=Irrigated RF= Rainfed

Table 6.3.6 Effect of moisture stress on seeds per siliqua at 3 locations in Indian mustard

Code	Entry	Seeds/siliqua								
		Hisar			Kanpur			Ludhiana		
		IR	RF	Red (%)	IR	RF	Red (%)	IR	RF	Red (%)
Phy-20-40	NPJ-225	13.7	13.2	3.6	13.9	13.1	5.7	12.3	11.8	4.1
Phy-20-41	DRMR2017-8	13.9	12.3	11.8	14.2	12.3	13.4	14.5	12.2	16.1
Phy-20-42	DRMR2018-27	14.2	12.3	12.9	14.2	10.8	23.9	12.8	11.8	7.8
Phy-20-43	DRMR-1222	13.5	12.0	10.7	16.0	14.3	10.6	12.6	11.0	13.2
Phy-20-44	DRMRCI136	13.1	12.8	2.3	14.5	13.5	6.9	11.2	10.7	4.6
Phy-20-45	DRMRCI137	12.4	11.3	9.3	14.8	14.1	4.7	11.1	10.2	8.1
Phy-20-46	DRMR1167	13.5	10.8	20.1	13.3	12.5	6.0	12.3	10.7	13.0
Phy-20-47	DRMR1188	12.0	11.8	2.0	15.8	14.8	6.3	12.6	12.1	4.0
Phy-20-48	NPJ214	13.6	13.0	4.3	14.8	14.2	4.1	12.4	10.9	12.1
Phy-20-49	LES54	14.0	12.7	9.0	14.0	13.5	3.6	11.7	9.4	19.4
Phy-20-50	NPJ210	13.8	12.1	12.4	14.5	13.3	8.3	11.8	10.8	8.5
Phy-20-51	DRMTCI14	13.5	11.2	16.9	14.8	14.4	2.7	12.1	11.6	4.1
Phy-20-52	RH1424	13.4	12.9	3.7	13.5	13.2	2.2	12.2	11.5	5.5
Phy-20-53	DRMRCI-128	13.6	13.1	3.7	12.5	12.1	3.2	12.1	9.5	20.9
Phy-20-54	DRMRSJ276	12.4	10.9	12.3	14.2	13.7	3.5	12.0	11.4	5.0
Phy-20-55	DRMRHJ908	13.0	11.7	10.3	14.2	13.8	2.8	13.0	12.5	3.6
Phy-20-56	DRMRHT1913	13.5	12.5	7.3	12.0	9.7	19.2	13.1	12.4	5.3
Phy-20-57	NPJ-243	13.8	13.2	4.5	14.1	13.3	5.7	12.2	10.9	10.9
Phy-20-58	NPJ-244	13.8	12.8	7.3	14.2	13.5	4.9	11.8	11.5	2.5
Phy-20-59	RGN-500	13.2	10.9	17.7	12.1	11.3	6.6	12.9	11.6	10.1
Phy-20-60	RGN-486	11.7	11.7	0.4	12.0	10.8	10.0	12.4	10.6	14.5
Phy-20-61	RH1920	12.7	12.3	3.3	14.1	13.2	6.4	11.9	11.1	7.1
Phy-20-62	RH1921	12.6	12.3	2.1	14.0	13.5	3.6	12.6	12.1	4.5
Phy-20-63	TM264	12.3	11.7	4.7	14.0	13.0	7.1	11.1	10.6	4.5
Phy-20-64	JM-13-3	12.1	11.5	5.1	13.5	12.2	9.6	13.5	13.1	3.0
Phy-20-65	CAU-RM-4-1-1	12.9	12.4	3.9	14.1	11.0	22.0	12.7	11.0	13.4
Phy-20-66	JC32	13.7	13.0	5.2	15.2	14.1	7.2	13.9	10.9	21.6
Phy-20-67	JC36	12.8	12.6	1.5	15.1	13.5	10.6	9.5	8.6	9.2
Phy-20-68	PBR-450	12.7	9.8	22.9	16.1	13.3	17.4	12.2	10.9	10.7
Phy-20-69	RH-0725(check)	13.8	13.1	5.0	11.8	11.0	6.8	13.0	11.2	14.1
Phy-20-70	RGN-229(check)	12.9	11.9	7.4	15.2	12.8	15.8	13.1	11.1	15.3
	Mean	**13.2**	**12.1**		**14.1**	**12.9**		**12.3**	**11.1**	
CD (p=0.05)		I=0.297			I=0.6			I=0.21		
		G=1.168			G=0.1			G=1.49		
		IxG=NS			IxG=0.9			IxG=2.1		

IR=Irrigated RF= Rainfed

Table 6.3. 7: Effect of moisture stress on 1000 seed weight at 3 locations in Indian mustard

Code	Entry	1000 seed weight (g)								
		Hisar			Kanpur			Ludhiana		
		IR	RF	Red (%)	IR	RF	Red (%)	IR	RF	Red (%)
Phy-20-40	NPJ-225	5.7	5.5	2.3	6.0	5.6	6.7	5.5	4.6	16.6
Phy-20-41	DRMR2017-8	4.7	4.4	7.4	6.1	4.5	26.2	6.0	5.5	9.8
Phy-20-42	DRMR2018-27	6.5	6.3	3.4	5.8	5.4	6.9	6.5	4.5	31.2
Phy-20-43	DRMR-1222	5.4	5.4	0.9	6.6	6.2	6.1	6.4	4.9	22.9
Phy-20-44	DRMRCI136	4.8	4.3	10.5	6.6	3.5	47.0	7.9	4.8	39.4
Phy-20-45	DRMRCI137	5.8	4.7	18.8	6.1	5.4	11.5	6.1	4.5	26.0
Phy-20-46	DRMR1167	6.3	4.9	22.0	5.8	5.6	3.4	6.2	6.0	3.6
Phy-20-47	DRMR1188	5.5	5.4	2.2	6.0	5.5	8.3	5.6	5.4	3.6
Phy-20-48	NPJ214	5.8	5.2	10.4	5.1	5.0	2.0	7.7	5.4	30.2
Phy-20-49	LES54	5.5	5.0	9.3	4.5	4.0	1.1	5.9	5.4	8.5
Phy-20-50	NPJ210	4.7	4.5	5.5	5.6	5.5	1.8	5.2	4.5	13.5
Phy-20-51	DRMTCI14	5.3	5.0	4.7	5.1	5.0	2.0	9.3	5.2	44.7
Phy-20-52	RH1424	5.8	5.5	5.5	6.1	6.0	4.9	7.2	5.9	18.7
Phy-20-53	DRMRCI-128	6.0	5.0	16.8	6.1	4.8	21.3	6.4	5.0	22.3
Phy-20-54	DRMRSJ276	5.7	5.4	6.1	5.3	5.2	1.9	6.0	4.3	28.6
Phy-20-55	DRMRHJ908	5.8	5.0	14.2	5.6	5.1	9.0	5.5	5.1	5.6
Phy-20-56	DRMRHT1913	6.6	6.6	0.8	5.7	5.5	3.5	5.1	4.7	6.2
Phy-20-57	NPJ-243	4.1	3.9	5.6	6.6	6.3	4.5	6.7	4.6	30.9
Phy-20-58	NPJ-244	4.9	3.9	18.9	6.6	5.6	15.2	6.8	5.2	22.8
Phy-20-59	RGN-500	5.3	5.1	3.8	6.0	4.3	28.3	5.0	4.3	14.0
Phy-20-60	RGN-486	6.2	4.8	23.5	5.1	5.0	2.0	6.1	4.9	19.8
Phy-20-61	RH1920	3.9	3.6	9.2	7.5	6.3	16.0	6.3	5.8	8.5
Phy-20-62	RH1921	4.7	4.5	5.6	7.3	6.9	5.5	5.9	5.4	8.5
Phy-20-63	TM264	4.5	4.3	4.7	7.0	6.3	10.0	6.6	6.1	8.0
Phy-20-64	JM-13-3	6.5	5.7	12.7	5.9	5.8	1.7	5.1	4.7	7.7
Phy-20-65	CAU-RM-4-1-1	4.3	4.0	6.7	5.0	4.9	2.0	5.4	4.8	11.2
Phy-20-66	JC32	4.9	4.8	2.9	3.3	3.0	9.0	6.1	4.6	25.7
Phy-20-67	JC36	5.2	5.1	1.6	3.5	3.3	5.7	6.0	4.6	24.6
Phy-20-68	PBR-450	5.6	4.6	17.9	5.6	5.4	3.6	6.0	5.8	3.8
Phy-20-69	RH-0725(check)	4.5	4.3	5.6	4.7	4.5	4.3	7.0	5.8	17.1
Phy-20-70	RGN-229(check)	4.4	4.3	2.3	5.4	5.2	3.7	5.4	4.9	10.6
	Mean	**5.3**	**4.9**		**5.7**	**5.2**		**6.2**	**5.1**	
CD (p=0.05)		I=0.140			I=0.3			I=2.93		
		G=0.530			G=0.1			G=1.95		
		IxG=NS			IxG=0.4			IxG=3.96		

IR=Irrigated RF= Rainfed

Table 6.3.8 Effect of moisture stress on biological yield at 4 locations

Code	Entry	Biological yield											
		Bharatpur (kg/ha)			Hisar (g/plant)			Kanpur (g/plant)			Ludhiana (kg/ha)		
		IR	RF	Red (%)	IR	RF	Red (%)	IR	RF	Red (%)	IR	RF	Red (%)
Phy-20-40	NPJ-225	1578	903	42.8	92.7	82.1	11.4	120.1	65.8	45.2	9156	5511	39.8
Phy-20-41	DRMR2017-8	1311	1043	20.5	70	58.3	16.7	160.5	100.7	37.3	7563	6133	18.9
Phy-20-42	DRMR2018-27	933	797	14.6	57.2	45.7	20.1	220.1	101.5	53.9	8089	5422	33
Phy-20-43	DRMR-1222	1089	966	11.3	63.6	51.9	18.4	120.2	105.3	12.4	8533	5467	35.9
Phy-20-44	DRMRCI136	1044	947.0	9.4	57.2	48.1	16	220	95.8	56.5	7244	4667	35.6
Phy-20-45	DRMRCI137	1800	1136.0	36.9	77.2	51.5	33	240	170.7	29	8222	6444	21.6
Phy-20-46	DRMR1167	1311	895.0	31.7	91.4	42.7	53	191	130.3	31.8	5111	4889	4.3
Phy-20-47	DRMR1188	1289	907.0	29.7	62.9	55.3	12	281	120.9	56.9	7511	5600	25.4
Phy-20-48	NPJ214	907	728.0	19.7	89.1	60.6	32	211	110.5	47.5	5333	4489	15.8
Phy-20-49	LES54	1289	887.0	31.2	99.1	65.7	34	170	95.9	43.7	7511	4400	41.4
Phy-20-50	NPJ210	733	739.0	0.7	63.1	48.3	24	201	110.8	44.8	4178	2889	30.9
Phy-20-51	DRMTCI14	1311	1260.0	3.9	48.1	42.0	13	211	118.6	43.7	8178	5778	29.3
Phy-20-52	RH1424	1400	907.0	35.2	64.0	50.8	21	80	40.5	49.6	7289	5333	26.8
Phy-20-53	DRMRCI-128	1267	1102.0	13.0	75.4	49.8	34	110	45.8	58.4	7244	5644	22.1
Phy-20-54	DRMRSJ276	1089	855.0	21.5	75.4	58.7	22	140	135.7	3.3	7111	5244	26.3
Phy-20-55	DRMRHJ908	1756	938.0	46.6	83.6	59.7	29	105	95.9	8.7	7911	4356	44.9
Phy-20-56	DRMRHT1913	1222	992.0	18.8	66.3	60.2	9	111	102.3	7.7	8933	5734	35.8
Phy-20-57	NPJ-243	1244	862.0	30.7	64.0	45.3	29	121	80.5	33.2	8000	3556	55.6
Phy-20-58	NPJ-244	1133	854.0	24.6	86.8	68.7	21	161	90.3	43.8	7467	5422	27.4
Phy-20-59	RGN-500	1133	1169.0	3.1	71.8	52.3	27	180	90.1	50.1	7911	5333	32.6
Phy-20-60	RGN-486	1311	807.0	38.4	100.9	79.0	22	121	95.8	20.6	9511	5156	45.8
Phy-20-61	RH1920	1311	974.0	25.7	90.9	70.1	23	140	100.9	27.9	7644	5644	26.2
Phy-20-62	RH1921	1311	1243.0	5.2	80.0	62.6	22	240	140.5	41.5	7778	5333	31.4
Phy-20-63	TM264	1000	907.0	9.3	83.6	56.7	32	121	100.8	16.6	7289	4489	38.4
Phy-20-64	JM-13-3	1267	1156.0	8.7	82.3	73.5	11	131	70.7	45.8	5644	4667	17.3
Phy-20-65	CAU-RM-4-1-1	1644	853.0	48.1	95.9	79.0	18	210	75.3	64.2	7467	5111	31.5
Phy-20-66	JC32	504	482.0	4.5	84.5	64.3	24	201	100.9	49.8	7689	3556	53.8
Phy-20-67	JC36	1067	828.0	22.4	56.0	51.7	8	156	105.5	32.2	8000	3644	54.4
Phy-20-68	PBR-450	1111	799.0	28.1	91.4	51.3	44	121	90.3	25.1	6756	2089	69.1
Phy-20-69	RH-0725(check)	1311.0	1049.0	20.0	70.9	57.7	19	181	80.5	55.5	7449	4667	37.4
Phy-20-70	RGN-229(check)	2311	1252.0	45.8	89.1	69.3	22	160	125.4	21.8	8889	6889	22.5
	Mean	**1225**	**943.0**	**33.1**	**76.9**	**58.5**		**167**	**100.1**		**7504**	**4953**	
CD (p=0.05)		I=117.4			I=2.795			I=5.1			I=93.9		
		G=462.2			G=9.116			G=1.3			G=369.8		
		IxG=NS			IxG=NS			IxG=7.2			IxG=523.0		

IR= Irrigated RF= Rainfed

Table 6.3.9 Effect of moisture stress on seed yield at 4 locations

Code	Entry	Seed yield											
		Bharatpur (kg/ha)			Hisar (g/plant)			Kanpur (g/plant)			Ludhiana (kg/ha)		
		IR	RF	Red (%)	IR	RF	Red (%)	IR	RF	Red (%)	IR	RF	Red (%)
Phy-20-40	NPJ-225	468.7	212.1	54.7	21.0	17.9	14.8	26.3	12.5	52.5	2073	1340	35.4
Phy-20-41	DRMR2017-8	395.8	293.4	25.9	13.8	11.9	13.8	28.4	15.8	44.4	1475	1172	20.6
Phy-20-42	DRMR2018-27	268.7	252.1	6.2	15.1	9.5	37.1	54.3	14.8	72.7	1650	1191	27.8
Phy-20-43	DRMR-1222	301.6	290	3.8	19.8	15.7	20.7	24.8	23.2	6.5	1867	1286	31.1
Phy-20-44	DRMRCI136	294.9	281.1	4.7	16.9	10.7	36.7	56.2	22.2	60.5	1773	1277	28
Phy-20-45	DRMRCI137	303.6	341.7	12.5	22.4	12.1	46.0	52.5	28.3	46.1	1532	1264	17.5
Phy-20-46	DRMR1167	262.2	262.1	0.0	22.6	11.8	47.8	35.7	8.4	76.5	1047	1004	4.2
Phy-20-47	DRMR1188	260.7	284.5	9.1	15.9	14.2	10.7	64.2	20.9	67.4	1774	1306	26.4
Phy-20-48	NPJ214	289.8	243.8	15.9	19.6	14.5	26.0	62.7	19.4	69.1	1172	1068	8.9
Phy-20-49	LES54	357.3	309.5	13.4	19.4	15.5	20.1	39.1	22.0	43.7	1640	1104	32.7
Phy-20-50	NPJ210	237.1	244.1	3.0	16.7	13.7	18.0	38.9	13.6	65.0	1109	869	21.6
Phy-20-51	DRMTCI14	313.8	365.7	16.5	12.2	9.4	23.0	37.3	18.1	51.5	1615	1199	25.8
Phy-20-52	RH1424	338.2	306.3	9.4	15.9	12.8	19.5	18.1	9.0	48.6	1743	1224	29.8
Phy-20-53	DRMRCI-128	324.0	340.2	5.0	19.2	12.3	35.9	26.3	11.9	54.7	1810	1237	31.6
Phy-20-54	DRMRSJ276	295.6	256.2	13.3	19.7	10.7	45.7	35.3	29.6	16.1	1258	1054	16.2
Phy-20-55	DRMRHJ908	524.2	302.1	42.4	16.4	13.2	19.5	35.8	31.7	11.5	1874	1176	37.2
Phy-20-56	DRMRHT1913	318.2	299.2	6.0	15.8	14.6	7.6	43.0	15.9	63.0	1975	1351	31.6
Phy-20-57	NPJ-243	314.4	277.7	11.7	14.7	9.7	34.0	30.6	10.3	66.3	1605	1387	13.6
Phy-20-58	NPJ-244	325.8	290.0	11.0	16.2	11.2	30.9	47.8	19.1	60.0	1744	1298	25.6
Phy-20-59	RGN-500	281.1	364.2	29.6	17.2	11.6	32.6	41.2	17.9	56.6	1786	1267	29.1
Phy-20-60	RGN-486	328.4	257.2	21.7	19.4	12.1	37.6	30.3	25.7	15.2	1913	1207	36.9
Phy-20-61	RH1920	314.0	315.2	0.4	19.8	12.0	39.4	26.5	15.3	42.3	1689	1183	29.9
Phy-20-62	RH1921	311.3	365.2	17.3	18.1	14.3	21.0	43.3	24.7	45.0	1604	1310	18.3
Phy-20-63	TM264	288.9	295.6	2.3	19.4	11.8	39.2	28.7	12.5	56.4	1480	1135	23.3
Phy-20-64	JM-13-3	239.3	359.1	50.1	17.9	14.8	17.3	27.5	14.5	47.3	1073	1011	5.8
Phy-20-65	CAU-RM-4-1-1	410.0	269.6	34.2	21.3	17.4	18.3	55.2	15.5	71.9	1340	1001	25.3
Phy-20-66	JC32	130.0	159.5	22.7	22.4	13.9	37.9	50.9	16.5	67.6	1656	1032	37.7
Phy-20-67	JC36	273.8	247.7	9.5	12.9	12.0	7.0	23.5	17.5	25.5	1887	1235	34.6
Phy-20-68	PBR-450	292.4	232.5	20.5	19.4	10.7	44.8	20.5	15.6	23.9	1414	1042	26.3
Phy-20-69	RH-0725(check)	354.0	339.7	4.0	18.6	15.3	17.7	37.7	16.1	57.3	1971	1188	39.7
Phy-20-70	RGN-229(check)	357.1	342.6	4.1	21.7	15.5	28.6	23.8	18.8	21.0	1647	1186	28
	Mean	**315.3**	**290.3**		**18.1**	**13**		**38**	**18.0**		**1619**	**1181**	
CD (p=0.05)		I=NS			I=0.638			I=1.5			I=43.4		
		G=NS			G=2.513			G=0.4			G=171.2		
		IxG=NS			IxG=NS			IxG=2.1			IxG=242.1		

IR= Irrigated RF= Rainfed

Table 6.3.10 Effect of moisture stress on harvest index at 4 locations

Code	Entry	HI (%)							
		Bharatpur		Hisar		Kanpur		Ludhiana	
		IR	RF	IR	RF	RF	IR	RF	IR
Phy-20-40	NPJ-225	28.9	24.4	22.7	21.8	21.9	19.0	24.3	22.6
Phy-20-41	DRMR2017-8	29.9	28.2	20.4	19.7	17.7	15.7	19.5	19.1
Phy-20-42	DRMR2018-27	28.8	31.8	26.5	20.9	24.7	14.6	22.0	20.4
Phy-20-43	DRMR-1222	27.3	29.9	31.1	30.3	20.6	22.6	23.5	21.9
Phy-20-44	DRMRCI136	28.3	31.2	29.5	22.4	25.5	23.2	27.4	24.5
Phy-20-45	DRMRCI137	20.2	30.1	32.8	20.0	21.8	16.6	19.6	18.6
Phy-20-46	DRMR1167	22.1	29.3	26.9	22.7	18.7	6.4	20.5	20.5
Phy-20-47	DRMR1188	22.5	31.4	25.6	25.4	22.9	17.3	23.6	23.3
Phy-20-48	NPJ214	32.0	34.1	22.0	23.9	29.8	17.6	23.8	22.0
Phy-20-49	LES54	27.8	34.9	19.6	23.6	23.0	22.9	25.1	21.8
Phy-20-50	NPJ210	32.6	34.8	26.4	28.4	19.4	12.3	30.1	26.5
Phy-20-51	DRMTCI14	24.1	29.2	25.5	22.4	17.7	15.3	20.8	19.8
Phy-20-52	RH1424	25.1	33.8	24.8	25.1	22.5	22.9	23.9	23.0
Phy-20-53	DRMRCI-128	25.5	31.1	25.4	24.6	23.9	25.9	25.0	21.9
Phy-20-54	DRMRSJ276	27.2	29.9	28.1	15.9	18.5	21.8	20.1	17.7
Phy-20-55	DRMRHJ908	28.8	32.2	19.6	22.1	34.1	33.0	27.0	23.7
Phy-20-56	DRMRHT1913	25.7	30.1	23.9	24.3	22.5	14.4	23.6	22.1
Phy-20-57	NPJ-243	25.0	32.1	22.9	21.5	25.4	12.8	29.0	21.1
Phy-20-58	NPJ-244	28.5	33.9	18.7	16.3	29.8	21.2	23.9	23.4
Phy-20-59	RGN-500	24.9	31.2	24.0	22.2	27.8	19.7	23.8	22.6
Phy-20-60	RGN-486	25.1	33.3	19.2	15.3	25.1	24.8	23.4	20.1
Phy-20-61	RH1920	24.0	32.4	21.8	16.4	18.9	15.2	22.1	21.0
Phy-20-62	RH1921	23.7	29.5	22.6	22.9	18.0	17.8	24.6	20.6
Phy-20-63	TM264	28.8	32.4	23.3	20.9	23.8	12.4	25.3	20.3
Phy-20-64	JM-13-3	21.3	31.0	21.7	20.2	21.1	20.5	21.7	19.0
Phy-20-65	CAU-RM-4-1-1	25.2	31.2	22.2	22.1	26.3	20.6	19.6	18.0
Phy-20-66	JC32	26.1	34.0	26.5	21.6	25.3	16.4	29.0	21.5
Phy-20-67	JC36	24.7	29.8	23.0	23.3	15.1	16.5	33.9	23.6
Phy-20-68	PBR-450	26.3	28.6	25.0	19.9	17.0	17.2	29.9	20.9
Phy-20-69	RH-0725(check)	26.9	32.3	26.3	26.5	20.9	20.0	26.5	25.5
Phy-20-70	RGN-229(check)	19.3	27.7	24.3	22.4	14.8	15.0	18.5	17.2
	Mean	**28.9**	**31.2**	**24.2**	**22.1**	**22.7**	**18.5**	**24.2**	**21.4**
CD (p=0.05)		I=NS		I=NS		I=0.3		I=0.587	
		G=NS		G=2.201		G=0.1		G=2.31	
		IxG=NS		IxG=NS		IxG=0.4		IxG=3.27	

IR= Irrigated RF= Rainfed

Table 6.3.11 Effect of moisture stress on oil content at Hisar and Ludhiana

Code	Entry	Oil content (%)					
		Hisar			Ludhiana		
		IR	RF	Red (%)	IR	RF	Red (%)
Phy-20-40	NPJ-225	39.8	39.8	0.4	41.0	40.9	0.2
Phy-20-41	DRMR2017-8	39.7	38.8	2.3	40.6	38.7	4.6
Phy-20-42	DRMR2018-27	39.5	38.8	1.9	40.2	40.2	0.1
Phy-20-43	DRMR-1222	38.7	39.7	1.0	40.1	39.9	0.6
Phy-20-44	DRMRCI136	39.4	39.6	0.6	41.4	40.6	1.8
Phy-20-45	DRMRCI137	39.6	38.9	2.7	40.9	40.7	0.5
Phy-20-46	DRMR1167	39.7	38.8	2.5	42.1	42.0	0.4
Phy-20-47	DRMR1188	40.1	39.3	1.0	41.2	39.9	3.2
Phy-20-48	NPJ214	40.0	39.4	1.6	41.9	39.5	5.6
Phy-20-49	LES54	40.0	39.1	2.4	41.2	39.7	3.8
Phy-20-50	NPJ210	39.8	39.6	0.6	42.7	38.8	9.1
Phy-20-51	DRMTCI14	40.0	38.9	2.1	41.4	39.5	4.6
Phy-20-52	RH1424	39.8	38.8	2.5	43.1	41.1	4.6
Phy-20-53	DRMRCI-128	39.7	38.9	2.0	42.1	41.3	2.0
Phy-20-54	DRMRSJ276	39.8	38.9	2.3	42.1	40.8	2.9
Phy-20-55	DRMRHJ908	39.7	39.1	1.5	40.8	40.7	0.2
Phy-20-56	DRMRHT1913	39.5	39.4	0.4	41.8	41.5	0.7
Phy-20-57	NPJ-243	38.8	38.5	0.9	41.3	39.9	3.4
Phy-20-58	NPJ-244	38.7	38.6	0.8	42.1	41.0	2.6
Phy-20-59	RGN-500	39.6	39.5	0.4	41.7	41.1	1.5
Phy-20-60	RGN-486	39.5	38.7	1.9	41.2	40.0	2.7
Phy-20-61	RH1920	39.7	38.6	2.6	42.2	41.2	2.3
Phy-20-62	RH1921	39.8	38.8	2.5	41.8	40.6	2.9
Phy-20-63	TM264	39.5	39.5	0.8	41.3	40.1	2.9
Phy-20-64	JM-13-3	39.9	39.2	1.9	41.3	41.0	0.8
Phy-20-65	CAU-RM-4-1-1	40.0	39.7	0.9	40.6	40.2	1.0
Phy-20-66	JC32	39.4	38.8	1.6	39.7	38.3	3.6
Phy-20-67	JC36	39.6	38.9	0.5	41.4	40.5	2.2
Phy-20-68	PBR-450	39.7	39.7	2.8	42.0	39.9	5.0
Phy-20-69	RH-0725(check)	39.7	39.8	1.5	42.0	41.1	2.2
Phy-20-70	RGN-229(check)	40.1	38.9	1.7	42.5	41.6	2.2
	Mean	**39.6**	**39.1**		**41.5**	**40.4**	
CD (p=0.05)		I=0.205			I=0.476		
		G=NS			G=1.13		
		IxG=NS			IxG=1.58		

IR= Irrigated RF= Rainfed

Table 6.3.12 Effect of moisture stress on drought susceptibility and yield stability indices

Code	Entry	Drought susceptibility index (DSI)			Yield stability index (YSI)			
		Hisar	Kanpur	Ludhiana	Bharatpur	Hisar	Kanpur	Ludhiana
Phy-20-40	NPJ-225	0.49	1.00	1.31	0.45	0.865	0.475	0.646
Phy-20-41	DRMR2017-8	0.45	0.85	0.76	0.74	0.860	0.556	0.794
Phy-20-42	DRMR2018-27	1.21	1.39	1.03	0.94	0.637	0.273	0.722
Phy-20-43	DRMR-1222	0.67	0.12	1.15	0.96	0.796	0.935	0.689
Phy-20-44	DRMRCI136	1.19	1.16	1.03	0.95	0.627	0.395	0.720
Phy-20-45	DRMRCI137	1.76	0.88	0.65	1.13	0.403	0.539	0.825
Phy-20-46	DRMR1167	1.99	1.46	0.15	1.00	0.388	0.235	0.958
Phy-20-47	DRMR1188	0.36	1.29	0.97	1.09	0.884	0.326	0.736
Phy-20-48	NPJ214	0.85	1.32	0.33	0.84	0.744	0.309	0.911
Phy-20-49	LES54	0.66	0.84	1.21	0.87	0.791	0.563	0.673
Phy-20-50	NPJ210	0.58	1.25	0.80	1.03	0.828	0.350	0.784
Phy-20-51	DRMTCI14	0.76	0.99	0.95	1.17	0.768	0.485	0.742
Phy-20-52	RH1424	0.65	0.96	1.10	0.91	0.802	0.499	0.702
Phy-20-53	DRMRCI-128	1.18	1.05	1.17	1.05	0.648	0.452	0.684
Phy-20-54	DRMRSJ276	1.53	0.31	0.60	0.87	0.474	0.839	0.838
Phy-20-55	DRMRHJ908	0.64	0.22	1.38	0.58	0.806	0.885	0.628
Phy-20-56	DRMRHT1913	0.26	1.21	1.17	0.94	0.909	0.370	0.684
Phy-20-57	NPJ-243	1.11	1.27	0.50	0.88	0.661	0.337	0.864
Phy-20-58	NPJ-244	1.01	1.15	0.94	0.89	0.697	0.400	0.744
Phy-20-59	RGN-500	1.07	1.08	1.07	1.30	0.683	0.434	0.709
Phy-20-60	RGN-486	1.23	0.29	1.36	0.78	0.625	0.848	0.631
Phy-20-61	RH1920	1.37	0.81	1.11	1.00	0.579	0.577	0.701
Phy-20-62	RH1921	0.67	0.82	0.68	1.17	0.798	0.570	0.817
Phy-20-63	TM264	1.28	1.08	0.86	1.02	0.606	0.436	0.767
Phy-20-64	JM-13-3	0.56	0.91	0.21	1.50	0.830	0.527	0.942
Phy-20-65	CAU-RM-4-1-1	0.59	1.38	0.94	0.66	0.815	0.281	0.747
Phy-20-66	JC32	1.24	1.29	1.39	1.23	0.620	0.324	0.623
Phy-20-67	JC36	0.23	0.49	1.28	0.90	0.930	0.745	0.654
Phy-20-68	PBR-450	1.81	0.46	0.97	0.80	0.449	0.761	0.737
Phy-20-69	RH-0725(check)	0.59	1.10	1.47	0.96	0.826	0.427	0.603
Phy-20-70	RGN-229(check)	0.93	0.40	1.03	0.96	0.713	0.790	0.720
	Mean	**0.93**	**0.93**	**0.95**		**0.715**	**0.514**	**0.742**

IR= Irrigated RF= Rainfed

Table 6.4.1 Effect of terminal heat stress on canopy tempearture (CT) and canopy temperature depression (CTD) in Indian mustard

Code	Enty	Canopy temperatire (^{0}C)						Canopy temperature depression (^{o}C)					
		Bhartpur		Hisar		Ludhiana		Bhartpur		Hisar		Ludhiana	
		NS	LS	NS	LS	NS	LS	NS	LS	NS	LS	NS	LS
Phy71	PDZ-14	11	21.3	25.6	27.0	21.4	20.4	-7.0	-6.7	-5.6	-3.0	-1.5	-2.15
Phy72	DRMR 2017-27	10.2	22.2	29.2	29.3	21.1	21.6	-7.8	-5.8	-4.6	-2.5	-2.3	-2.15
Phy73	DRMR2018-27	11.4	21.7	28.2	28.1	20.3	21.2	-6.6	-6.3	-5.8	-3.5	-2.4	-1.05
Phy74	DRMR1167	10.7	21.1	27.2	27.9	20.5	19.4	-7.3	-6.9	-3.9	-3.6	-2.1	-1.10
Phy75	DRMR1188	10.6	21	30.0	30.1	20.9	20.8	-7.4	-7.0	-3.4	-2.3	-1.9	-0.80
Phy76	DRMRCI133	10.3	21.6	28.5	28.1	21.2	19.8	-7.7	-6.4	-4.3	-4.2	-1.3	-0.45
Phy77	DRMRCI134	11.3	21.6	28.3	28.1	21.2	19.5	-6.7	-6.4	-4.2	-4.0	-1.4	-0.90
Phy78	DRMRCI130	11.1	21.5	27.1	27.9	20.1	18.6	-6.9	-6.5	-3.9	-3.5	-1.3	-0.70
Phy79	DRMR2018-19	11.2	23.5	30.1	30.3	20.5	19.7	-6.8	-4.5	-3.6	-1.9	-2.1	-0.20
Phy80	DRMRHJ2520	10.6	20.9	29.2	29.4	19.7	19.7	-7.4	-7.1	-4.1	-3.5	-2.9	-0.05
Phy81	DRMR2059	12	23.7	29.8	29.6	21.8	19.2	-6.0	-4.3	-3.7	-1.8	-3.0	-0.30
Phy82	Raj Vijay mustard -2(LR)	12.2	22.5	29.8	30.8	20.8	19.8	-5.8	-5.5	-4.3	-2.3	-1.9	-0.25
Phy83	DRMRHT13-28-8	12.0	22.4	29.2	30.0	20.6	19.4	-6.0	-5.6	-5.1	-3.0	-2.8	-0.55
Phy84	RH1999-19	11.8	22.2	29.0	29.2	20.5	19.5	-6.2	-5.8	-4.7	-4.0	-2.3	-0.65
Phy85	RH1999-22	11.8	22.2	28.0	28.3	20.8	20.1	-6.2	-5.8	-4.7	-4.8	-2.1	-0.20
Phy86	KMR(L)-20-5	12.8	22.8	28.4	28.7	21.2	19.6	-5.2	-5.2	-4.6	-4.3	-2.5	-0.85
Phy87	KMR(L)-20-6	13.4	23.7	28.9	29.1	19.2	18.5	-4.6	-4.3	-4.9	-2.9	-3.7	-1.00
Phy88	NPJ-245	12.5	22.2	26.7	27.8	19.3	20.2	-5.5	-5.8	-4.3	-3.9	-3.9	-0.50
Phy89	NPJ-246	12.4	21.8	27.8	27.7	20.0	19.9	-5.6	-6.2	-4.1	-3.3	-1.9	-0.85
Phy90	PAB-2014-4	12.1	22.4	29.6	29.6	20.1	18.7	-5.9	-5.6	-4.5	-3.6	-4.3	-1.10
Phy91	PRL-2017-2	12.6	22.9	27.8	28.2	19.7	18.1	-5.4	-5.1	-3.1	-1.9	-3.4	-0.30
Phy92	RGN-494	12.9	22.9	29.7	29.8	19.1	19.5	-5.1	-5.1	-4.0	-3.5	-3.9	-0.95
Phy93	RGN488	12.2	22.5	29.2	28.9	19.9	19.4	-5.8	-5.5	-3.3	-3.4	-3.7	-0.25
Phy94	TM179-2	11.8	22.1	26.6	26.7	19.8	19.1	-6.2	-5.9	-3.6	-3.5	-3.3	-0.20
Phy95	HUJM-19-18	12.6	22.9	30.3	31.2	19.3	19.8	-5.4	-5.1	-4.3	-2.2	-3.8	-0.15
Phy96	DRMRIC18-1-1	12.9	23.2	26.2	26.2	19.4	19.6	-5.1	-4.8	-5.2	-5.2	-3.4	-1.35
Phy97	DRMRIC18-4-1	14.1	24.5	28.5	28.6	21.1	19.2	-3.9	-3.5	-4.5	-4.3	-2.6	-0.20
Phy98	DRMRIC18-7-2	15.1	24.4	30.5	30.8	19.6	18.7	-2.9	-3.6	-2.4	-1.8	-3.1	0.50
Phy99	JC32	11.1	21.5	29.4	29.8	19.8	17.8	-6.9	-6.5	-4.9	-3.5	-2.6	-1.35
Phy100	JC36	11.5	21.9	30.1	30.1	22.0	20.6	-6.5	-6.1	-3.2	-2.5	-1.1	-0.75
Phy101	PM-26(check)	9.6	21.6	27.5	27.2	21.7	20.4	-8.4	-6.4	-4.0	-4.3	-0.6	-0.62
Phy102	NRCHB101	9.9	22.6	27.0	28.9	20.4	19.1	-8.1	-5.4	-4.8	-4.0	-2.8	-0.25
Phy103	BPR543-2	11.8	23.8	31.0	31.3	20.6	19.8	-6.2	-4.2	**-3.1**	-2.9	-1.9	-0.15
	Mean	**11.8**	**22.4**	**28.6**	**28.9**	**20.4**	**19.6**	**-6.2**	**-5.6**	**-4.2**	**-3.3**	**-5.0**	**-1.32**
CD (p=0.05)		E=0.66		E=0.231		E=0.210		E=NS		E=0.195		E=0.459	
		G=NS		G=0.951		G=0.867		G=NS		G=0.79		G=0.69	
		ExG=NS		ExG=1.345		ExG=1.22		ExG=NS		ExG=1.119		ExG=1.05	

NS=Normal sown LS =Late sown

Table 6.4.2 Effect of terminal heat stress on membrane stability index at Hisar and Ludhiana

Code	Entry	Membrane stability index					
		Hisar			Ludhiana		
		NS	LS	Red (%)	NS	LS	Red (%)
Phy71	PDZ-14	0.69	0.64	7.3	0.95	0.67	29.3
Phy72	DRMR 2017-27	0.48	0.35	27.1	0.92	0.82	11.0
Phy73	DRMR2018-27	0.58	0.55	5.2	0.94	0.52	44.2
Phy74	DRMR1167	0.58	0.54	6.9	0.94	0.83	11.2
Phy75	DRMR1188	0.53	0.43	18.9	0.95	0.79	17.0
Phy76	DRMRCI133	0.55	0.52	5.5	0.96	0.83	13.5
Phy77	DRMRCI134	0.64	0.60	6.3	0.96	0.90	5.6
Phy78	DRMRCI130	0.61	0.53	13.1	0.94	0.88	6.9
Phy79	DRMR2018-19	0.71	0.60	15.5	0.93	0.84	9.2
Phy80	DRMRHJ2520	0.50	0.47	6.0	0.95	0.84	11.2
Phy81	DRMR2059	0.55	0.51	7.3	0.96	0.81	14.8
Phy82	Raj Vijay mustard -2(LR)	0.49	0.36	26.5	0.93	0.69	25.2
Phy83	DRMRHT13-28-8	0.57	0.52	8.8	0.93	0.79	14.8
Phy84	RH1999-19	0.65	0.51	21.5	0.89	0.88	1.6
Phy85	RH1999-22	0.55	0.50	9.1	0.90	0.78	14.0
Phy86	KMR(L)-20-5	0.65	0.56	13.9	0.89	0.85	4.1
Phy87	KMR(L)-20-6	0.69	0.67	2.9	0.87	0.66	23.4
Phy88	NPJ-245	0.56	0.50	10.7	0.89	0.88	1.0
Phy89	NPJ-246	0.54	0.34	37.0	0.93	0.83	11.4
Phy90	PAB-2014-4	0.58	0.34	41.4	0.86	0.73	14.6
Phy91	PRL-2017-2	0.36	0.27	25.0	0.86	0.82	4.2
Phy92	RGN-494	0.56	0.39	30.4	0.93	0.75	18.9
Phy93	RGN488	0.62	0.60	3.2	0.92	0.85	7.4
Phy94	TM179-2	0.70	0.50	28.6	0.93	0.85	9.4
Phy95	HUJM-19-18	0.69	0.50	27.5	0.93	0.82	11.7
Phy96	DRMRIC18-1-1	0.60	0.56	6.7	0.93	0.63	31.8
Phy97	DRMRIC18-4-1	0.58	0.54	6.9	0.92	0.70	23.8
Phy98	DRMRIC18-7-2	0.62	0.43	30.7	0.92	0.89	3.3
Phy99	JC32	0.65	0.34	47.7	0.93	0.86	7.5
Phy100	JC36	0.58	0.57	1.7	0.85	0.82	3.0
Phy101	PM-26(check)	0.62	0.59	4.8	0.87	0.87	0.4
Phy102	NRCHB101	0.58	0.53	8.6	0.88	0.81	8.5
Phy103	BPR543-2	0.60	0.50	16.7	0.93	0.87	6.5
	Mean	**0.59**	**0.50**		**0.92**	**0.80**	
CD (p=0.05)		E=0.109			E=0.922		
		G=0.028			G=0.374		
		ExG=NS			ExG=1.5		

NS=Normal sown LS =Late sown

Table 6.4.3 Effect of terminal heat stress on seeds per siliqua at Hisar and Ludhiana

Code	Entry	Seeds/siliqua					
		Hisar			Ludhiana		
		NS	LS	Red (%)	NS	LS	Red (%)
Phy71	PDZ-14	13.7	10.6	22.8	11.9	11.6	3.1
Phy72	DRMR 2017-27	14.1	10.6	25.0	12.8	11.7	8.8
Phy73	DRMR2018-27	13.4	12.3	8.2	14.6	9.1	37.4
Phy74	DRMR1167	13.9	12.1	13.0	11.4	11.3	0.9
Phy75	DRMR1188	13.5	12.6	6.9	12.8	11.7	8.6
Phy76	DRMRCI133	13.0	12.7	2.1	13.2	11.0	16.2
Phy77	DRMRCI134	14.1	13.4	5.2	12.1	10.4	14.0
Phy78	DRMRCI130	13.0	10.6	18.2	12.5	11.2	10.6
Phy79	DRMR2018-19	13.5	12.9	4.2	12.5	11.8	5.7
Phy80	DRMRHJ2520	13.6	12.3	9.4	11.5	11.5	0.3
Phy81	DRMR2059	13.0	11.7	10.2	12.3	10.8	11.9
Phy82	Raj Vijay mustard -2(LR)	12.0	9.1	24.4	12.9	12.3	4.4
Phy83	DRMRHT13-28-8	12.4	11.8	5.1	12.2	11.2	8.2
Phy84	RH1999-19	12.9	11.6	10.3	12.8	12.1	5.8
Phy85	RH1999-22	14.1	12.0	14.7	11.6	10.1	12.8
Phy86	KMR(L)-20-5	12.3	10.6	14.1	12.0	11.2	6.7
Phy87	KMR(L)-20-6	13.3	12.3	7.3	14.3	10.0	30.1
Phy88	NPJ-245	14.3	12.3	14.2	12.3	10.1	17.4
Phy89	NPJ-246	13.0	12.7	2.5	13.6	10.0	26.0
Phy90	PAB-2014-4	12.2	10.4	14.8	11.4	9.7	14.6
Phy91	PRL-2017-2	12.8	11.5	10.1	14.1	11.6	17.7
Phy92	RGN-494	12.9	10.7	17.1	11.5	10.2	11.3
Phy93	RGN488	13.4	13.2	1.5	14.5	8.9	38.6
Phy94	TM179-2	12.0	11.1	7.7	13.2	10.8	18.2
Phy95	HUJM-19-18	12.8	11.4	11.2	11.2	11.1	0.6
Phy96	DRMRIC18-1-1	14.0	11.6	17.4	10.9	10.1	7.3
Phy97	DRMRIC18-4-1	12.4	9.0	27.2	13.2	10.7	18.5
Phy98	DRMRIC18-7-2	12.6	11.7	7.1	12.6	10.6	16.1
Phy99	JC32	13.6	11.3	16.9	12.3	12.1	1.6
Phy100	JC36	13.2	13.0	1.5	13.4	13.0	2.5
Phy101	PM-26(check)	13.1	12.8	2.1	12.4	10.7	13.4
Phy102	NRCHB101	14.1	10.1	28.2	13.3	12.8	3.7
Phy103	BPR543-2	13.3	10.9	18.5	11.8	9.6	18.6
	Mean	**13.2**	**11.6**		**12.6**	**10.9**	
CD (p=0.05)		E=0.764			E=0.533		
		G=0.188			G=0.744		
		ExG=1.081			ExG=1.31		

NS=Normal sown LS =Late sown

Table 6.4.4 Effect of terminal heat stress on 1000 seed weight (g) at Hisar and Ludhiana

Code	Entry	1000 seed weight (g)					
		Hisar			Ludhiana		
		NS	LS	Red (%)	NS	LS	Red (%)
Phy71	PDZ-14	4.7	3.2	31.9	4.1	3.9	4.9
Phy72	DRMR 2017-27	3.9	2.8	28.9	5.3	4.6	13.2
Phy73	DRMR2018-27	5.5	4.4	20.2	6.3	4.7	25.5
Phy74	DRMR1167	5.6	4.7	16.0	5.7	5.5	2.4
Phy75	DRMR1188	6.0	5.0	16.3	5.4	5.2	3.3
Phy76	DRMRCI133	5.7	4.6	18.5	6.2	5.7	8.1
Phy77	DRMRCI134	5.8	4.9	15.9	6.6	6.1	6.8
Phy78	DRMRCI130	5.4	4.7	12.6	6.3	6.2	1.7
Phy79	DRMR2018-19	6.1	4.8	22.2	6.1	5.2	14.3
Phy80	DRMRHJ2520	3.4	3.0	12.9	4.6	3.4	25.5
Phy81	DRMR2059	6.1	4.6	24.3	5.7	4.9	13.7
Phy82	Raj Vijay mustard -2(LR)	4.5	3.8	15.0	5.3	4.2	21.9
Phy83	DRMRHT13-28-8	3.9	2.8	27.4	5.8	5.3	8.4
Phy84	RH1999-19	5.0	4.0	20.2	5.8	4.4	24.9
Phy85	RH1999-22	5.7	4.7	18.7	4.7	3.8	19.9
Phy86	KMR(L)-20-5	5.1	4.1	18.7	5.9	5.1	13.9
Phy87	KMR(L)-20-6	4.8	4.5	6.2	5.9	5.3	10.8
Phy88	NPJ-245	5.2	4.3	18.1	6.6	5.9	11.0
Phy89	NPJ-246	4.8	4.3	11.0	4.9	4.5	8.0
Phy90	PAB-2014-4	4.1	3.4	15.5	5.5	4.8	12.7
Phy91	PRL-2017-2	4.5	3.7	17.6	5.7	5.0	12.0
Phy92	RGN-494	4.7	4.2	10.9	5.1	4.4	13.7
Phy93	RGN488	4.9	4.6	5.9	6.2	4.8	22.6
Phy94	TM179-2	5.9	5.3	10.2	6.2	4.3	29.9
Phy95	HUJM-19-18	6.0	4.8	20.4	6.7	5.8	14.1
Phy96	DRMRIC18-1-1	5.5	4.3	21.3	5.3	4.0	23.4
Phy97	DRMRIC18-4-1	6.0	5.1	15.2	5.4	4.0	26.5
Phy98	DRMRIC18-7-2	3.7	3.5	3.6	5.1	5.0	2.2
Phy99	JC32	5.0	4.5	9.2	4.4	4.3	3.5
Phy100	JC36	4.2	3.9	6.9	5.4	4.8	12.5
Phy101	PM-26(check)	4.1	3.6	11.9	5.8	5.0	13.5
Phy102	NRCHB101	4.8	3.6	24.0	6.2	5.6	9.0
Phy103	BPR543-2	4.6	3.9	15.2	5.1	4.6	9.3
	Mean	**5.0**	**4.2**		**5.6**	**4.9**	
CD (p=0.05)		E=0.313			E=3.41		
		G=0.077			G=1.11		
		ExG=0.443			ExG=4.98		

NS=Normal sown LS =Late sown

Table 6.4.5 Effect of terminal heat stress on seed yield at Bharatpur,Hisar and Ludhiana

Code	Entry	Seed yield								
		Bharatpur (kg/ha)			Hisar (g/plant)			Ludhiana (kg/ha)		
		NS	LS	Red (%)	NS	LS	Red (%)	NS	LS	Red (%)
Phy71	PDZ-14	144.4	99.1	31.4	23.6	15.7	33.3	1477	1186	19.7
Phy72	DRMR 2017-27	184.6	139.2	24.6	20.9	9.6	54.1	2218	1819	18.0
Phy73	DRMR2018-27	139.7	94.4	32.4	21.7	12.1	44.1	2213	1479	33.2
Phy74	DRMR1167	137.0	88.4	35.5	20.3	12.4	38.9	1299	1028	20.9
Phy75	DRMR1188	136.6	91.2	33.2	20.0	11.9	40.5	1396	1027	26.4
Phy76	DRMRCI133	143.8	98.4	31.5	18.3	9.0	51.0	1638	1483	9.4
Phy77	DRMRCI134	128.6	76.6	40.4	15.7	10.8	31.2	1504	1214	19.3
Phy78	DRMRCI130	148.8	103.4	30.5	17.7	10.8	39.0	1981	1734	12.5
Phy79	DRMR2018-19	131.7	73.1	44.5	19.7	12.7	35.8	1436	1261	12.2
Phy80	DRMRHJ2520	133.4	84.1	37.0	19.5	9.5	51.1	1767	1531	13.3
Phy81	DRMR2059	134.5	89.2	33.7	19.2	10.6	44.9	1791	1369	23.6
Phy82	Raj Vijay mustard -2(LR)	121.4	72.7	40.1	13.7	9.8	28.9	1443	1270	12.0
Phy83	DRMRHT13-28-8	142.9	97.6	31.7	17.1	7.8	54.3	1577	1357	14.0
Phy84	RH1999-19	146.9	101.6	30.9	17.1	9.8	42.8	1514	1346	11.2
Phy85	RH1999-22	141.4	96.1	32.1	16.3	10.9	33.1	1684	1448	14.1
Phy86	KMR(L)-20-5	156.8	111.5	28.9	15.4	10.6	31.6	1386	1030	25.7
Phy87	KMR(L)-20-6	135.5	90.2	33.5	14.0	10.0	28.4	1748	1504	13.9
Phy88	NPJ-245	122.0	73.3	39.9	22.2	10.7	51.8	1229	1142	7.1
Phy89	NPJ-246	123.7	71.7	42.0	16.0	13.5	15.9	1556	1076	30.9
Phy90	PAB-2014-4	137.1	91.7	33.1	16.6	8.8	47.2	1740	1032	40.7
Phy91	PRL-2017-2	119.4	74.1	38.0	18.6	10.6	42.8	1584	1570	0.9
Phy92	RGN-494	131.5	86.2	34.5	14.3	12.2	14.8	2293	1493	34.9
Phy93	RGN488	141.0	95.7	32.2	14.6	13.3	8.7	2100	1422	32.3
Phy94	TM179-2	127.6	53.2	58.3	14.9	7.7	48.4	1163	1071	7.9
Phy95	HUJM-19-18	129.8	81.2	37.5	18.3	13.2	27.9	1739	989	43.1
Phy96	DRMRIC18-1-1	122.4	53.8	56.1	16.3	8.2	49.7	1442	1392	3.5
Phy97	DRMRIC18-4-1	115.5	30.2	73.9	13.1	10.4	20.8	1226	840	31.5
Phy98	DRMRIC18-7-2	121.8	56.5	53.6	16.8	13.2	21.6	1421	730	48.6
Phy99	JC32	128.0	76.0	40.6	16.7	14.4	13.8	1174	881	25.0
Phy100	JC36	132.5	87.2	34.2	7.8	7.0	9.9	1579	1072	32.1
Phy101	PM-26(check)	132.3	86.9	34.3	17.2	11.6	32.3	1540	1148	25.5
Phy102	NRCHB101	152.4	87.4	42.6	22.9	10.5	54.2	1496	1389	7.1
Phy103	BPR543-2	185.6	148.2	20.1	21.7	11.1	48.8	1428	1323	7.4
	Mean	**137.3**	**86.7**		**17.5**	**10.9**		**1599**	**1262**	
CD (p=0.05)		E=6.23			E=3.089			E=46.9		
		G=25.2			G=0.760			G=193.5		
		ExG=NS			ExG=4.368			ExG=273.8		

NS=Normal sown LS =Late sown

Table 6.4.6 Effect of terminal heat stress on heat and yield stability indices

Code	Entry	Heat stability index (HSI)			Yield stability index (YSI)		
		Bharatpur	Hisar	Ludhiana	Bharatpur	Hisar	Ludhiana
Phy71	PDZ-14	0.76	1.21	0.68	0.69	0.667	0.803
Phy72	DRMR 2017-27	1.36	0.65	1.58	0.75	0.459	0.820
Phy73	DRMR2018-27	0.70	0.86	1.28	0.68	0.559	0.668
Phy74	DRMR1167	0.64	0.82	0.52	0.65	0.611	0.791
Phy75	DRMR1188	0.66	0.77	0.56	0.67	0.595	0.736
Phy76	DRMRCI133	0.75	0.54	0.95	0.68	0.490	0.906
Phy77	DRMRCI134	0.52	0.56	0.71	0.60	0.688	0.807
Phy78	DRMRCI130	0.82	0.63	1.34	0.69	0.610	0.875
Phy79	DRMR2018-19	0.51	0.82	0.71	0.56	0.642	0.878
Phy80	DRMRHJ2520	0.60	0.60	1.06	0.63	0.489	0.867
Phy81	DRMR2059	0.64	0.66	0.96	0.66	0.551	0.764
Phy82	Raj Vijay mustard -2(LR)	0.47	0.44	0.72	0.60	0.712	0.880
Phy83	DRMRHT13-28-8	0.74	0.43	0.84	0.68	0.457	0.860
Phy84	RH1999-19	0.79	0.54	0.80	0.69	0.572	0.888
Phy85	RH1999-22	0.72	0.58	0.95	0.68	0.669	0.859
Phy86	KMR(L)-20-5	0.93	0.53	0.56	0.71	0.684	0.743
Phy87	KMR(L)-20-6	0.65	0.46	1.03	0.67	0.716	0.861
Phy88	NPJ-245	0.47	0.78	0.55	0.60	0.482	0.929
Phy89	NPJ-246	0.47	0.70	0.65	0.58	0.841	0.691
Phy90	PAB-2014-4	0.67	0.48	0.70	0.67	0.529	0.593
Phy91	PRL-2017-2	0.47	0.65	0.97	0.62	0.572	0.991
Phy92	RGN-494	0.60	0.57	1.34	0.66	0.852	0.651
Phy93	RGN488	0.72	0.63	1.17	0.68	0.913	0.677
Phy94	TM179-2	0.36	0.37	0.49	0.42	0.516	0.921
Phy95	HUJM-19-18	0.56	0.79	0.57	0.63	0.721	0.569
Phy96	DRMRIC18-1-1	0.35	0.44	0.78	0.44	0.503	0.965
Phy97	DRMRIC18-4-1	0.19	0.44	0.40	0.26	0.792	0.685
Phy98	DRMRIC18-7-2	0.37	0.73	0.41	0.46	0.784	0.514
Phy99	JC32	0.52	0.78	0.40	0.59	0.859	0.750
Phy100	JC36	0.61	0.18	0.66	0.66	0.901	0.679
Phy101	PM-26(check)	0.61	0.65	0.69	0.66	0.677	0.745
Phy102	NRCHB101	0.71	0.78	0.81	0.57	0.458	0.929
Phy103	BPR543-2	1.46	0.78	0.74	0.80	0.512	0.926
	Mean	**0.65**	**0.63**	**0.805**	**0.623**	**0.639**	**0.795**

NS=Normal sown LS =Late sown

Table 6.5.1 Effect of salinity on germination in Indian mustard genotypes

Code	Entry	Germination (%)											
		Bharatpur			Hisar			Kanpur			Ludhiana		
		Control	Saline	Red (%)	Control	Saline	Red (%)	Control	Saline	Red (%)	Control	Saline	Red (%)
Phy-20-104	PDZ-4	91.3	51.7	43.4	94.4	88.9	5.9	96.8	64.5	33.3	96.2	74.9	22.1
Phy-20-105	CS2005-143	93.7	55.0	41.3	88.9	80.6	9.4	90.4	70.3	22.2	80.1	66.8	16.6
Phy-20-106	Kranti(NC)	94.3	68.3	27.6	94.4	86.1	8.8	94.2	60.7	35.6	83.2	70.3	15.5
Phy-20-107	CS-54(check)	96.0	20.0	79.2	91.7	77.8	15.2	91.8	65.4	28.7	90.2	75.4	16.4
Phy-20-108	CS-60 (LR)	94.3	53.3	43.5	97.2	86.1	11.4	95.2	75.4	20.7	82.4	75.4	8.5
Phy-20-109	Giriraj	95.0	85.0	10.5	94.4	86.1	8.8	96.5	80.6	15.4	85.6	70.6	17.5
	Mean	**94.1**	**55.6**		**93.5**	**84.3**		**94.1**	**69.5**		**86.3**	**72.2**	
		T=4.67			T=1.60			T=3.4			T=1.01		
		G=8.08			G=3.4			G=1.9			G=1.89		
CD (p=0.05)		TxG=11.4			TxG=3.95			TxG=4.9			TxG=2.78		

Table 6.5.2 Seedling length as influenced by salinity at 4 locations

Code	Entry	Seedling length(cm)											
		Bharatpur			Hisar			Kanpur			Ludhiana		
		Control	Saline	Red (%)	Control	Saline	Red (%)	Control	Saline	Red (%)	Control	Saline	Red (%)
Phy-20-104	PDZ-4	10.4	3.0	71.6	7.43	6.18	16.8	10.9	7.9	27.5	12.6	8.5	32.5
Phy-20-105	CS2005-143	10.3	3.8	63.6	7.85	6.28	20.0	10.5	8.1	22.8	11.2	9.4	16.1
Phy-20-106	Kranti(NC)	11.1	3.9	65.2	5.87	4.63	21.1	11.3	7.8	30.9	10.4	8.4	19.2
Phy-20-107	CS-54(check)	10.6	2.0	80.8	5.40	5.01	7.2	11.8	8.0	32.2	10.8	7.9	26.9
Phy-20-108	CS-60 (LR)	11.6	4.3	62.9	7.18	5.83	18.8	12.2	10.3	15.6	13.6	9.4	30.9
Phy-20-109	Giriraj	12.8	4.9	62.0	7.65	6.35	17.0	12.5	10.6	15.2	12.5	9.7	22.4
	Mean	**11.1**	**3.6**		**6.89**	**5.71**		**11.5**	**8.7**		**11.9**	**8.9**	
		T=1.16			T=0.584			T=0.03			T=0.35		
		G=NS			G=NS			G=0.02			G=0.62		
CD (p=0.05)		TxG=NS			TxG=NS			TxG=NS			TxG=0.97		

Table 6.5.3 Dry matter as influenced by salinity at Bharatpur, Hisar, Kanpur and Ludhiana

Code	Entry	Dry matter /10 seedlings											
		Bharatpur			Hisar			Kanpur			Ludhiana		
		Control	Saline	Red (%)	Control	Saline	Red (%)	Control	Saline	Red (%)	Control	Saline	Red (%)
Phy-20-104	PDZ-4	0.061	0.032	47.5	0.115	0.089	22.6	0.528	0.386	26.9	0.324	0.232	28.4
Phy-20-105	CS2005-143	0.059	0.035	40.7	0.131	0.089	32.1	0.632	0.49	22.5	0.345	0.256	25.8
Phy-20-106	Kranti(NC)	0.058	0.035	39.7	0.093	0.065	30.1	0.588	0.405	31.2	0.162	0.152	6.2
Phy-20-107	CS-54(check)	0.058	0.029	50.0	0.110	0.085	22.7	0.559	0.383	31.3	0.162	0.134	17.3
Phy-20-108	CS-60 (LR)	0.058	0.036	37.9	0.112	0.079	29.5	0.604	0.508	16.0	0.221	0.191	13.6
Phy-20-109	Giriraj	0.059	0.038	35.6	0.101	0.076	24.8	0.618	0.52	15.9	0.359	0.289	19.5
	Mean	**0.059**	**0.034**		**0.110**	**0.080**		**0.588**	**0.499**		**0.262**	**0.209**	
		T=0.002			T=0.001			T=0.3			T=0.013		
		G=NS			G=0.003			G=0.1			G=0.024		
CD (p=0.05)		TxG=NS			TxG=0.002			TxG=0.4			TxG=0.037		

Salinity@12ds/m

Table 6.5.4 Seedling vigour index II as influenced by salinity at Bharatpur, Hisar, Kanpur and Ludhiana

Code	Entry	Seedling vigour index II (SVII)											
		Bharatpur			Hisar			Kanpur			Ludhiana		
		Control	Saline	Red (%)	Control	Saline	Red (%)	Control	Saline	Red (%)	Control	Saline	Red (%)
Phy-20-104	PDZ-4	5.60	1.60	71.0	1.02	0.72	29.4	5.1	2.5	51.3	3.1	1.7	45.5
Phy-20-105	CS2005-143	5.50	1.90	64.9	1.23	0.77	37.4	5.7	3.4	39.7	2.8	1.7	38.1
Phy-20-106	Kranti(NC)	5.60	2.40	56.8	0.86	0.50	41.9	5.5	2.5	55.5	1.3	1.1	20.7
Phy-20-107	CS-54(check)	5.60	0.60	89.6	1.07	0.73	31.8	5.1	2.5	51.3	1.5	1.0	30.9
Phy-20-108	CS-60 (LR)	5.50	1.90	65.1	1.06	0.68	35.8	5.8	3.8	33.4	1.8	1.4	20.9
Phy-20-109	Giriraj	5.70	3.30	42.6	0.95	0.65	31.6	6.0	4.2	29.7	3.1	2.0	33.6
	Mean	**5.60**	**2.00**		**1.03**	**0.68**		**5.5**	**3.1**		**2.3**	**1.5**	
CD (p=0.05)		T=0.289			T=0.21			T=0.7			T=0.25		
		G=0.501			G=0.033			G=0.4			G=0.21		
		TxG=0.708			TxG=0.051			TxG=1.0			TxG=0.46		

Salinity@12ds/m

Table 6.6.1 Effect of PGRs to mitigate moisture stress in Indian mustard at Bharatpur

Treatments	Chl a	Chl b	Seed yeild (kg/ha)	Biomass (kg/ha)	HI
Control	19.1	5.7	218.6	854	25.1
Waterspray	16.6	3.6	313.7	1294	24.3
Urea @1%	27.7	3.9	328.9	1362	24.2
Urea @2%	29.1	3.7	350.0	1456	24.0
Trehalose @10mM	24.3	4.8	326.3	1350	24.2
Trehalose@20mM	26.2	4.4	340.4	1413	24.1
KNO3@1%	23.8	5.2	338.9	1407	24.1
KNO3@2%	30.6	3.2	361.9	1510	24.0
CD (p=0.05)	NS	NS	70.4	257.4	NS

Table 6.6.2 Effect of PGRs on RWC, yield components and seed yield at Hisar

Treatments	RWC (%)	Siliquae on main shoot	Total siliquae/plant	Seeds/siliqua	1000 seed weight (g)	Seed yield (g/plant)	Biomass (g/plant)	HI (%)
Control	59.7	61.7	89.2	15.4	5.36	42.9	59.7	22.3
Waterspray	66.3	61.0	132.8	15.7	5.5	53.7	55.0	26.9
Urea @1%	69.0	81.3	231.3	15.4	5.64	83.4	58.0	26.3
Urea @2%	76.3	83.3	334.8	16.3	5.02	109.9	111.0	22.3
Trehalose @10mM	65.3	83.3	175.8	14.9	5.36	69.8	62.7	23.9
Trehalose@20mM	55.0	71.3	97.6	14.2	5.18	47.1	56.7	21.3
KNO3@1%	73.0	68.0	425.0	13.6	5.14	127.9	96.0	22.9
KNO3@2%	72.7	63.7	362.9	13	4.96	111.1	87.0	23.4
CD (p=0.05)	7.5	3.47	40.74	NS	NS	2.25	NS	

Table 6.6.3 Effect of PGRs on physiological traits at Ludhiana

Treatments	RWC (%)	LWR (%)	Photosynthetic pigments (mg/gFW)			
			Chl a	Chl b	Total Chl	Carotrnoids
Control	71.7	48.2	1.40	0.43	1.83	0.326
Waterspray	72.3	54.6	1.43	0.50	1.93	0.356
Urea @1%	79.8	55.4	1.60	0.53	2.13	0.371
Urea @2%	78.3	55.5	1.48	0.67	2.15	0.391
Trehalose @10mM	74.8	71.2	1.51	0.65	2.15	0.373
Trehalose@20mM	78.1	61.6	1.54	0.55	2.09	0.387
KNO3@1%	78.6	62.5	1.44	0.63	2.07	0.399
KNO3@2%	72.9	64.8	1.45	0.70	2.15	0.394
CD (p=0.05)	3.1	1.3	1.24	0.42	1.17	0.246

Table 6.6.4 Effect of PGRs on yield attributes and seed yield at Ludhiana

Treatments	Siliquae on main shoot	Total siliquae/plant	Seeds/siliqua	1000 seed weight (g)	Biological yield (kg/ha)	Seed Yield (kg/ha)	HI (%)
Control	45.1	210.0	9.5	5.1	4089	902	22.1
Waterspray	46.6	215.0	9.7	5.4	4138	995	24.0
Urea @1%	40.2	297.6	10.4	5.7	4778	1011	21.2
Urea @2%	45.9	312.0	10.9	5.9	5244	1188	22.7
Trehalose @10mM	43.8	249.0	10.9	6.0	4556	1092	24.0
Trehalose@20mM	45.2	287.0	10.5	5.6	4535	1010	22.3
KNO3@1%	44.0	236.9	11.2	6.2	4444	1092	24.6
KNO3@2%	41.2	328.6	10.4	6.0	4667	1036	22.2
CD (p=0.05)	3.27	33.40	NS	0.43	41.90	36.90	0.50

Table 6.7.1 Influence of microbes on physiological traits under moisture stress at Hisar

Parameters	RWC (%)			SPAD			Proline content (µmol/g FW)			Total Chl (mg/g FW)			Total soluble sugars (mg/gFW)		
Treatments	**I0**	**I1**	**I2**	**I0**	**I1**	**I2**	**I0**	**I1**	**I2**	**I0**	**I1**	**I2**	**I0**	**I1**	**I2**
Control (No Culture)	27.8	42.7	56.3	16.5	32.7	53.3	1.60	3.52	4.51	8.8	8.1	6.4	5.4	6.7	7.3
Biophos and BioPhos	55.1	68.7	74.3	34.8	50.3	63.1	2.15	2.54	2.66	8.9	8.2	6.5	6.4	8.0	8.7
CRIDA -I	44.9	59.3	70.9	33.8	48.2	61.4	1.88	3.06	3.71	9.6	8.9	7.1	5.9	7.4	8.0
CRIDA -II	42.6	56.0	65.3	31.5	45.6	59.1	2.01	2.60	2.92	10.0	9.2	7.4	6.2	7.8	8.5
MKS 6	47.9	62.7	71.2	40.9	54.3	64.8	1.59	2.78	3.87	10.1	9.3	7.4	6.2	7.8	8.5
MRD 17	53.0	67.0	73.5	27.2	39.0	58.0	2.09	2.69	2.80	11.1	10.2	8.2	6.7	8.4	9.2
Mean	**45.2**	**59.4**	**68.6**	**30.8**	**45.0**	**60.0**	**1.89**	**2.86**	**3.41**	**9.7**	**9.0**	**7.2**	**6.1**	**7.7**	**8.4**
CD (p=0.05)	T= 4.848			T= 4.470			T= 0.513			T= 0.856			T= 0.516		
	I= 3.428			I= 3.161			I= 0.362			I= 0.494			I= 0.621		
	TXI= NS			TXI= NS			TXI= 0.888			TXI= NS			TXI= NS		

I0=No irrigation; I1=One irrigation; I2=Two irrigations

Table 6.7.2 Influence of microbes on photosynthetic pigments under moisture stress at Ludhiana

	Photosynthetic pigments (mg/gFW)															
	Chl a				Chl b				Total Chl				Carotenoids			
Treatment	**I0**	**I1**	**I2**	**Average**	**I0**	**I1**	**I2**	**Average**	**I0**	**I1**	**I2**	**Average**	**I0**	**I1**	**I2**	**Average**
Control	1.34	1.68	1.80	1.61	0.248	0.384	0.514	0.382	1.89	2.11	2.48	2.16	0.401	0.420	0.477	0.433
Biophos	2.00	2.14	2.15	2.10	0.529	0.555	0.617	0.567	2.55	2.67	2.77	2.66	0.469	0.515	0.534	0.506
Biophos+Biophas	1.62	1.75	1.86	1.74	0.422	0.486	0.544	0.484	2.09	2.11	2.24	2.15	0.411	0.513	0.528	0.484
CRIDAI	1.67	2.26	2.37	2.10	0.308	0.456	0.626	0.463	2.18	2.52	2.72	2.47	0.451	0.495	0.575	0.507
CRIDAII	2.13	2.38	2.40	2.30	0.40	0.402	0.540	0.447	2.59	2.67	2.8	2.69	0.445	0.496	0.527	0.489
MKS6	1.73	1.96	2.04	1.91	0.415	0.470	0.681	0.522	2.09	2.44	2.64	2.39	0.424	0.487	0.535	0.482
MRD17	1.65	1.93	2.26	1.95	0.370	0.44	0.579	0.462	2.22	2.31	2.63	2.39	0.458	0.503	0.580	0.514
Mean	**1.73**	**2.01**	**2.13**		**0.385**	**0.456**	**0.586**		**2.23**	**2.40**	**2.61**		**0.437**	**0.490**	**0.537**	
	I=0.132				I=0.55				I=0.115				I=.0201			
	T=0.296				T=0.99				T=0.264				T=.0145			
CD (p=0.05)	IxT=0.325				IxT=1.52				IxT=0.331				IxT=0.0928			

I0=No irrigation; I1=One irrigation; I2=Two irrigations

Table 6.7.3 Influence of microbes on physiological traits under moisture stress at Ludhiana

	SPAD				RWC(%)				Proline(mg/gDW)				Total sugars(mg/gDW)			
Treatment	**I0**	**I1**	**I2**	**Average**	**I0**	**I1**	**I2**	**Average**	**I0**	**I1**	**I2**	**Average**	**I0**	**I1**	**I2**	**Average**
Control	39.0	42.0	43.0	41.3	70.4	78.0	81.6	76.6	28.1	17.6	8.9	18.2	20.3	21.3	63.6	35.1
Biophos	42.0	45.0	50.0	45.7	78.3	79.3	83.8	80.5	53.5	48.3	28.6	43.5	21.1	29.2	82.5	44.3
Biophos+Biophas	41.0	43.0	45.0	43.0	73.1	82.9	85.4	80.5	59.5	50.1	45.8	51.8	75.2	77.2	92.5	81.6
CRIDAI	42.0	50.0	53.0	48.3	74.0	82.4	84.1	80.2	90.4	82.8	19.2	64.1	28.5	30.3	86.7	48.5
CRIDAII	41.0	42.5	47.0	43.5	80.3	82.5	83.7	82.2	50.5	39.6	29.1	39.7	21.0	30.9	92.7	48.2
MKS6	43.0	45.0	48.0	45.3	77.3	81.3	82.5	80.4	75.4	23.9	18.9	39.4	21.3	26.4	64.4	37.4
MRD17	42.0	44.0	52.0	46.0	76.4	80.2	87.1	81.2	78.5	46.8	16.4	47.2	20.9	70.9	90.2	60.7
Mean	**41.4**	**44.5**	**48.3**		**75.7**	**80.9**	**84.0**		**62.3**	**44.2**	**23.8**		**29.8**	**40.9**	**81.8**	
	I=1.11				I=2.68				I=1.01				I=1.27			
	T=2.59				T=5.69				T=2.04				T=1.41			
CD (p=0.05)	IxT=4.49				IxT=8.72				IxT=4.91				IxT=2.59			

I0=No irrigation; I1=One irrigation; I2=Two irrigations

Table 6.8.1 Photosynthetic pigments as influenced by microbes for temperature stress at Hisar

Culture	Varieties	Chl a (mg/g FW)			Chl b (mg/g FW			Total Chl (mg/g FW		RWC (%)		
		NS	LS	% Change	NS	LS	% Change	NS	LS	NS	LS	% Change
No culture	RH725	1.86	1.46	21.8	0.553	0.433	21.7	2.41	1.89	59.0	38.5	34.8
	Giriraj	1.66	1.22	26.2	0.586	0.432	26.2	2.25	1.66	77.0	49.2	36.2
	PBR357	0.77	0.59	23.9	0.590	0.448	24.0	1.36	1.04	76.7	51.3	33.0
Microbial formulation	RH725	1.91	1.48	22.6	0.555	0.431	22.4	2.47	1.91	70.3	47.2	32.9
	Giriraj	1.87	1.48	20.8	0.630	0.499	20.9	2.50	1.98	63.7	40.5	36.4
	PBR357	1.93	1.46	24.0	0.665	0.506	23.9	2.59	1.97	63.7	41.7	34.6
Pusa Sanjeevani	RH725	0.62	0.56	9.4	0.454	0.394	13.2	1.07	0.95	73.0	48.3	33.8
	Giriraj	0.62	0.55	11.1	0.523	0.468	10.5	1.14	1.02	80.3	57.2	28.8
	PBR357	0.66	0.57	12.4	0.453	0.401	11.4	1.11	0.98	69.3	47.0	32.2
	Mean	**1.32**	**1.04**		**0.556**	**0.446**		**1.88**	**1.49**	**70.3**	**46.8**	**33.6**
CD(p=0.05)		E= 0.040			E= 0.028			E= 0.055		E= 2.819		
		V= 0.049			V= 0.034			V= 0.068		V= 3.453		
		C= 0.049			C= 0.034			C= 0.068		C= 3.453		
		ExC= NS			ExC= NS			ExC= NS		ExC= NS		
		CxV= 0.086			CxV= NS			CxV= 0.117		CxV= 5.98		
		ExVxC= NS			ExVxC= NS			ExVxC= NS		ExVxC= NS		

NS= Normal Sown; LS= Late Sown

Table 6.8.2 Total siliquae per plant, seed weight and seed yield as influenced by microbes at Hisar for temperature stress

Culture	Varieties	Total siliqua/plant		1000 Seed weight(g)		Seed Yield/plant(g)			Biological Yield/plant(g)		
		NS	LS	NS	LS	NS	LS	% Change	NS	LS	% Change
No culture	RH725	278.0	217.5	5.1	4.3	15.9	10.2	35.6	71.7	27.0	0.6
	Giriraj	212.1	155.3	5.0	3.8	14.9	9.3	37.9	56.3	20.7	0.6
	PBR357	256.5	207.3	5.3	4.4	16.4	10.7	34.6	77.9	32.1	0.6
Microbial formulation	RH725	317.3	243.3	5.2	4.3	19.2	14.6	24.3	67.8	42.0	0.4
	Giriraj	206.9	169.4	5.0	3.9	14.9	10.0	33.2	53.3	26.5	0.5
	PBR357	255.8	211.3	4.9	4.0	17.5	12.3	29.7	87.0	39.3	0.6
Pusa Sanjeevani	RH725	268.5	211.1	4.8	4.0	20.1	16.1	19.9	78.7	45.2	0.4
	Giriraj	171.0	131.3	5.1	4.1	15.6	11.6	25.6	48.4	30.0	0.4
	PBR357	276.3	216.7	4.9	4.1	17.3	13.3	23.1	87.3	49.3	0.4
	Mean	**249.1**	**195.9**	**5.0**	**4.1**	**16.9**	**12.0**	**29.3**	**69.83**	**34.68**	**0.5**
CD=(p=0.05)		E= 33.93		E= 12.30		E= 1.158			E=7.193		
		V= NS		V= 0.219		V= 1.418			V= NS		
		C= 41.55		C= 0.210		C= 1.418			C= 8.810		
		ExC= NS		ExC= 0.147		ExC= NS			ExC= NS		
		CxV=NS		CxV=0.863		CxV= NS			CxV= NS		
		ExVxC=NS		ExVxC=0.017		ExVxC= NS			ExVxC= NS		

NS= Normal Sown; LS= Late Sown

Table 6.8.3 Photosynthetic pigments as influenced by microbes for temperature stress at Ludhiana

Culture	Varieties	Photosynthetic pigments (mg/gFW)											
		Chl a			Chl b			Total Chl			Carotenoids		
		NS	LS	Average	NS	LS	Average	NS	LS	Average	NS	LS	Average
No culture	RH725	1.60	1.46	1.53	0.380	0.363	0.372	1.98	1.82	1.90	0.464	0.455	0.460
	Giriraj	1.38	1.16	1.27	0.331	0.213	0.272	1.71	1.38	1.54	0.425	0.363	0.394
	PBR357	1.35	1.52	1.44	0.645	0.241	0.443	2.00	1.76	1.88	0.481	0.455	0.468
	Mean	**1.44**	**1.38**		**0.452**	**0.273**		**1.89**	**1.65**		**0.456**	**0.424**	
Microbial formulation	RH725	1.62	1.33	1.47	0.617	0.289	0.453	1.95	1.90	1.93	0.465	0.442	0.454
	Giriraj	1.51	1.38	1.45	0.650	0.278	0.464	2.16	1.66	1.91	0.504	0.413	0.459
	PBR357	1.44	1.22	1.33	0.661	0.259	0.460	2.10	1.48	1.79	0.508	0.397	0.452
	Mean	**1.52**	**1.31**		**0.643**	**0.275**		**2.07**	**1.68**		**0.493**	**0.417**	
Pusa Sanjeevani	RH725	1.71	1.67	1.69	0.708	0.702	0.705	2.41	2.38	2.39	0.586	0.578	0.582
	Giriraj	1.41	1.35	1.38	0.788	0.601	0.695	2.19	1.95	2.07	0.546	0.494	0.520
	PBR357	1.58	1.39	1.48	0.720	0.299	0.509	2.30	1.68	1.99	0.572	0.430	0.501
	Mean	**1.57**	**1.47**		**0.739**	**0.534**		**2.3**	**2.00**		**0.57**	**0.501**	
	Overall mean	**1.48**	**1.43**		**0.611**	**0.361**		**2.1**	**1.78**		**0.51**	**0.447**	
CD (p=0.05)		E=2.11			E=0.0655			E=0.019			E=ns		
		C=3.39			C=0.207			C=.113			C=0.286		
		ExC=1.6			ExC=0.293			ExC=.392			ExC=ns		
		V=.101			V=0.327			V=0.114			V=0.0296		
		ExV=ns			ExV=0.462			ExV=0.162			ExV=0.0419		
		CxV=ns			CxV=0.566			CxV=0.198			CxV=0.513		
		ExCxV=0.248			ExCxV=0.801			ExCxV=0.281			ExCxV=0.726		

Table 6.8.4 Physiological traits as influenced by microbes for temperature stress at Ludhiana

		RWC (%)			Membrane stability index (%)			CTD(°C)	
Culture	**Varieties**	**NS**	**LS**	**Average**	**NS**	**LS**	**Average**	**NS**	**LS**
No culture	RH725	85.0	76.7	80.9	76.7	68.6	72.7	-6.3	-8.2
	Giriraj	81.2	78.9	80.0	73.5	72.6	73.1	-5.8	-7.8
	PBR357	78.4	77.8	78.1	73.9	65.8	69.9	-5.5	-6.6
	Mean	**81.5**	**77.8**		**74.7**	**69.0**		**-5.9**	**-7.5**
Microbial formulation	RH725	80.4	73.8	77.1	68.0	64.6	66.3	-6.3	-8.7
	Giriraj	80.8	74.8	77.8	69.6	66.0	67.8	-5.7	-8.3
	PBR357	82.7	78.0	80.4	74.4	72.1	73.3	-7.5	-8.1
	Mean	**81.3**	**75.5**		**70.7**	**67.6**		**-6.5**	**-8.4**
Pusa Sanjeevani	RH725	84.9	79.5	82.2	74.4	72.2	73.3	-5.7	-7.3
	Giriraj	79.0	77.6	78.3	73.7	66.1	69.9	-6.4	-6.6
	PBR357	82.9	79.1	81.0	80.9	78.5	79.7	-4.0	-5.5
	Mean	**82.3**	**78.7**		**76.3**	**72.3**		**-5.4**	**-6.5**
	Overall mean	**82.0**	**77.3**		**73.9**	**69.6**		**-5.9**	**-7.5**
CD(p=0.05)		E=3.93			E=0.05			E=0.12	
		C=3.7			C=0.98			C=0.378	
		ExC=4.22			ExC=1.22			ExC=0.534	
		V=0.35			V=2.4			V=0.402	
		ExV=1.92			ExV=1.5			ExV=0.569	
		CxV=0.79			CxV=1.7			CxV=0.696	
		ExCxV=1.13			ExCxV=0.36			ExCxV=0.985	

NS= Normal Sown; LS= Late Sown

Table 6.8.5 Yield attributes as influenced by microbes for temperature stress at Ludhiana

Culture	Varieties	Siliquae on main shoot			Total siliquae/plant			Seeds/siliqua			1000 seed weight(g)		
		NS	LS	Average	NS	LS	Average	NS	LS	Average	NS	LS	Average
No culture	RH725	44.1	40.7	42.4	253.7	161.1	207.4	10.2	9.8	10.0	6.2	5.1	5.7
	Giriraj	40.1	38.4	39.3	238.5	199.5	219.0	12.0	11.9	11.9	6.3	5.4	5.8
	PBR357	46.0	41.6	43.8	282.3	221.9	252.1	10.3	8.9	9.6	7.5	6.4	6.9
	Mean	**43.4**	**40.2**		**258.1**	**194.2**		**10.8**	**10.2**		**6.7**	**5.6**	
Microbial formulation	RH725	42.8	32.7	37.8	206.9	189.5	198.2	11.6	8.8	10.2	6.6	4.5	5.5
	Giriraj	45.3	43.5	44.4	192.3	186.7	189.5	12.9	12.7	12.8	6.5	6.0	6.3
	PBR357	42.5	36.3	39.4	242.1	225.4	233.8	11.0	10.5	10.7	6.6	5.4	6.0
	Mean	**43.5**	**37.5**		**213.8**	**200.5**		**11.8**	**10.6**		**6.6**	**5.3**	
Pusa Sanjeevani	RH725	41.9	40.0	41.0	249.1	198.9	224.0	11.9	10.1	11.0	6.8	5.7	6.3
	Giriraj	44.1	41.3	42.7	237.8	180.5	209.1	12.3	11.0	11.6	7.4	6.6	7.0
	PBR357	45.3	43.1	44.2	257.1	238.6	247.9	11.1	9.9	10.5	7.5	5.3	6.4
	Mean	**43.8**	**41.5**		**248.0**	**206.0**		**11.7**	**10.3**		**7.2**	**5.9**	
	Overall mean	**43.6**	**39.7**		**240.0**	**200.2**		**11.5**	**10.4**		**6.8**	**5.6**	
		E=4.73			E=12.4			E=0.05			E=0.280		
		C=0.90			C=2.21			C=0.472			C=0.275		
		ExC=1.10			ExC=4.2			ExC=0.419			ExC=0.389		
		V=0.046			V=18.4			V=0.449			V=0.267		
		ExV=2.17			ExV=1.48			ExV=0.636			ExV=0.378		
		CxV=2.66			CxV=0.051			CxV=0.779			CxV=0.463		
CD(p=0.05)		ExCxV=3.77			ExCxV=0.067			ExCxV=ns			ExCxV=0.655		

Table 6.8.6 Seed yield as influenced by microbes for temperature stress at Ludhiana

		Bilogical yield (kg/ha)			Seed yield (kg/ha)			HI(%)		
Culture	Varieties	NS	LS	Average	NS	LS	Average	NS	LS	Average
No culture	RH725	6519	4815	5667	1156	763.7	960	20.7	18.0	19.4
	Giriraj	5444	4370	4907	1050	740.0	895	20.6	16.6	18.6
	PBR357	5852	4630	5241	1130	933.0	1032	17.6	19.3	18.4
	Mean	**5938**	**4605**		**1112**	**812.2**		**19.7**	**18.0**	
Microbial formulation	RH725	6222	4259	5241	1205	860.7	1033	18.8	17.1	18.0
	Giriraj	6111	5333	5722	1357	985.9	1171	22.2	18.8	20.5
	PBR357	5556	3630	4593	1142	1007.0	1075	20.5	18.7	19.6
	Mean	**5963**	**4407**		**1235**	**951.2**		**20.5**	**18.2**	
Pusa Sanjeevani	RH725	5667	4963	5315	1107	1070.0	1089	20.9	19.2	20.0
	Giriraj	5222	5000	5111	1194	950.4	1072	22.4	18.8	20.6
	PBR357	5074	4444	4759	1140	1033.0	1086	22.5	18.2	20.4
	Mean	**5321**	**4802**		**1147**	**1017.8**		**22.0**	**18.7**	
	Overall mean	**5741**	**4605**		**1165**	**927.1**		**20.7**	**18.3**	
		E=45.3			E=162.2			E=1.92		
		C=35.9			C=80.3			C=0.720		
		ExC=305.7			ExC=ns			ExC=ns		
		V=240.5			V=78.5			V=ns		
		ExV=ns			ExV=ns			ExV=1.15		
		CxV=416.5			CxV=136.0			CxV=1.41		
CD(p=0.05)		ExCxV=589.1			ExCxV=192.3			ExCxV=2.007		

NS= Normal Sown; LS= Late Sown

Table 6.8.7 Photosynthetic pigments (mg/gFW) as influenced by microbes for temperature stress

Culture	Varieties	Bharatpur											
		Chl a			Chl b			Total Chl			Carotenoids		
		NS	LS	Average	NS	LS	Average	NS	LS	Average	NS	LS	Average
No culture 110	RH725	1.802	1.488	1.645	0.626	0.262	0.444	2.417	1.750	2.083	0.597	0.372	0.485
	Giriraj	1.522	0.941	1.231	0.228	0.266	0.247	1.270	1.206	1.238	0.481	0.247	0.364
	PBR357	1.805	1.414	1.610	0.215	0.372	0.293	2.054	1.786	1.920	0.621	0.390	0.505
	Mean	**1.709**	**1.281**		**0.356**	**0.300**		**1.914**	**1.581**		**0.566**	**0.336**	
Microbial formulation	RH725	1.846	1.600	1.723	0.151	0.242	0.197	1.997	1.841	1.919	0.602	0.370	0.486
	Giriraj	1.318	0.815	1.067	0.381	0.457	0.419	1.698	1.271	1.485	0.591	0.363	0.477
	PBR357	1.632	1.527	1.580	0.585	0.347	0.466	2.217	1.873	2.045	0.599	0.370	0.485
	Mean	**1.599**	**1.314**		**0.372**	**0.348**		**1.971**	**1.662**		**0.598**	**0.367**	
Pusa Sanjeevani	RH725	1.792	1.582	1.687	0.529	0.392	0.460	2.330	1.974	2.152	0.598	0.368	0.483
	Giriraj	1.042	0.941	0.992	0.445	0.221	0.333	1.966	1.161	1.564	0.574	0.350	0.462
	PBR357	1.840	1.613	1.726	0.503	0.130	0.316	2.307	1.742	2.025	0.598	0.371	0.485
	Mean	**1.558**	**1.379**		**0.492**	**0.247**		**2.201**	**1.626**		**0.590**	**0.363**	
CD(p=0.05)		E=0.225			E=0.046			E=0.198			E=NS		
		V=NS			V=NS			V=0.106			V=0.018		
		ExV=NS			ExV=0.065			ExV=0.15			ExV=NS		
		C=0.107			C=NS			C=0.125			C=0.044		
		ExC=0.152			ExC=0.069			ExC=0.176			ExC=NS		
		VxC=0.186			VxC=0.084			VxC=0.216			VxC=NS		
		ExVxC=0.263			ExVxC=0.119			ExVxC+NS			ExVXc=NS		

Table 6.8.8 Biomass, seed yield and harvest index as influenced by microbes for temperature stress at Bharatpur

Culture	Varieties	Biological yield (kg/ha)			Seed yield (kg/ha)			HI (%)		
		NS	LS	Average	NS	LS	Average	NS	LS	Average
No culture 110	RH725	2067	1289	1678	452.4	342.2	397.3	21.9	26.6	24.3
	Giriraj	1889	1044	1467	275.6	233.3	254.5	14.6	22.3	18.5
	PBR357	1933	1016	1474	286.7	248.7	267.7	14.8	24.5	19.7
	Mean	**1963**	**1116**		**338.2**	**274.7**		**17.1**	**24.5**	
Microbial formulation	RH725	1889	1378	1633	438.9	388.9	413.9	23.2	28.2	25.7
	Giriraj	1867	1200	1533	439.3	283.8	361.6	23.5	23.6	23.6
	PBR357	2178	960	1569	452.0	297.8	374.9	20.8	31	25.9
	Mean	**1978**	**1179**		**443.4**	**323.5**		**22.5**	**27.6**	
Pusa Sanjeevani	RH725	2222	1222	1722	555.6	335.6	445.6	25	27.5	26.3
	Giriraj	1844	1069	1457	315.6	228.9	272.3	17.1	21.4	19.3
	PBR357	1911	1113	1512	411.1	337.8	374.5	21.5	30.3	25.9
	Mean	**1993**	**1135**		**427.4**	**300.7**		**21.2**	**26.4**	
CD(p=0.05)		E=190.3			E=8.62					
		V=552.4			V=2.48					
		ExV=701.2			ExV=3.51					
		C=1069.8			C=4.81					
		ExV=1513.0			ExV=6.808					
		GxC=1853.0			GxC=8.338					
		ExCxV=2630.7			ExCxV=11.79					

NS= Normal Sown; LS= Late Sown

Biochemistry

7.1 Evaluation of important breeding materials for nutritional quality index (NQI) of oil.

Parameters: Fatty acid profiling, ω6/ω3, Oil stability index, SFA: MUFA: PUFA, Saturated and unsaturated ratio.

Centres: Bharatpur, Ludhiana, Kangra, Pantnagar, Hisar and Kanpur

KRANTI (National Check), RH-749 (Zonal Check) and PDZ-1(Quality check)

Results:

7.1.1 Oil Stability Index of Quality

Oil stability index which is the ratio of MUFA: PUFA was analyzed at six centres (Bharatpur, Pantnagar, Hisar, Kangra, Ludhiana and Kanpur). On the basis of mean estimates, it ranged from 0.60 in RH-749 to 2.97 in GSH-2196(CV ≤ 0.28). (Table 1).

7.1.2 Fatty Acid Profiling

Entries of IVT/AVT quality trials were analysed for fatty acid profile at Bharatpur, Kanpur, Kangra, Pantnagar, Hisar and Ludhiana. Major fatty acids studied are given below:

Palmitic acid: 1.87% (RGN-73) to 4.6% (PDZ-12) (CV ≤ 0.32).

Stearic acid: 0.60 % (RH-749) to 2.05% (LES-63). (CV ≤ 0.69).

Oleic acid: 10.58 % (RH-749) to 59.55 % (GSH-2196). (CV ≤ 0.22).

Linoleic acid: 17.20 % (KRANTI) to 43.57 % (PDZ-15). (CV ≤ 0.15).

Linolenic acid: 9.04 % (PDZ-1) to 20.69 % (LES-62). (CV ≤ 0.25).

Eicosanoic acid: 0.36 % (PDZ-15) to 7.19 % (OIJ5001). (CV ≤ 1.0).

Erucic acid: 0.03% (PDZ-1) to 2.10 % (GSH-2196). (CV ≤ 1.20).

ω6: ω3 ratio ranged from 1.15 (RH-749) to 4.11 (LES-58). (CV ≤ 0.33).

SFA: MUFA: PUFA ratio ranged between 1:06:09 (PDZ-15) to 1:29:15 (RGN-73).

Saturated and unsaturated ratio ranged between 1:06 to 1:13. **(Table 1-11)**

7.2. Nutritional Profiling of important quality breeding materials

Parameters: Seed meal-protein content, methionine, tryptophan, total antioxidant activity, β-carotene content.

Centres: Bharatpur, Kanpur, Kangra, Pantnagar, Hisar, Ludhiana

KRANTI (National Check), RH-749 (Zonal Check) and PDZ-1(Quality check)

Results:

Entries of IVT/AVT quality trials were evaluated for Nutritional Profiling of important quality breeding materials at six centres.

Total Protein: 30.18% (JC-36) to 35.21% (PDZ-14) (CV ≤ 0.08).

Methionine: 1.55 (Kranti) to 2.10 (RH-749) g/100g protein (CV ≤ 0.40).

Tryptophan: 0.95 (PDZ-14) to 1.37 (PDZ-11) g/100g protein (CV ≤ 0.38).

Total antioxidant capacity ranged from 16.15 (PDZ-1) to 23.31 (PM-29) mg/g AAE (CV ≤ 0.27).

β-carotene ranged from 2.50% (PDZ-15) to 4.83% (kranti) (CV ≤ 0.36).

(β-carotene and Total antioxidant activity were analyzed at five centers excluding Kanpur)

(Table 12-16)

7.3. Estimation of anti-nutritional factors in quality breeding materials

Parameters: Total Glucosinolates and Phytic acid

Centres: Bharatpur, Kangra, Pantnagar, Hisar, Ludhiana

KRANTI (National Check), RH-749 (Zonal Check) and PDZ-1(Quality check)

Entries of IVT/AVT quality trials were evaluated at five centres.

Results:

Total Glucosinolate mean values for five centres (Bharatpur, Pantnagar, Ludhiana, Kangra, Hisar) were <30 µmol/g in PDZ-15, PDZ-12, PDZ-1, PDZ-11, PDZ-14, OIJ5001, 91J5001, GSH-1699, JC-32, GSH-2196, JC-36, RCH-1, GSH-2180 genotypes.

Glucosinolate ranged from 75.36% (RH(OE)-706) to 13.71% (GSH-2196) (CV ≤ 0.34).

Phytic acid content mean values were < 2.25% in PDZ-15, PDZ-12, PDZ-11, RH(OE)-706 (Table 17-18(CV ≤ 0.25).

(Total glucosinolate content and phytic acid content were analyzed at five centers excluding Kanpur (Tables 17-18).

Table 1: Oil Stability Index (OSI)

S.NO.	Code	Genotype	BPR	PNT	HSR	KNG	LDH	KNP	Mean
1.	Biochem-20-1	RH (OE)-1804	1.06	1.14	1.03	1.15	1.14	1.04	1.09
2.	Biochem-20-2	LES-62	1.67	1.21	1.13	1.63	1.33	1.07	1.34
3.	Biochem-20-3	PDZ-15	0.90	0.81	0.91	0.92	0.81	0.84	0.86
4.	Biochem-20-4	RH-749	0.55	0.69	0.57	0.53	0.69	0.59	0.60
5.	Biochem-20-5	PDZ-12	0.95	0.85	0.95	0.95	0.85	0.99	0.92
6.	Biochem-20-6	RGN-73	0.72	0.56	0.75	0.70	0.59	0.75	0.68
7.	Biochem-20-7	LES-60	1.24	1.04	1.14	1.29	1.01	1.10	1.14
8.	Biochem-20-8	KRANTI	0.80	0.83	0.84	0.75	0.83	0.82	0.81
9.	Biochem-20-10	PDZ-1	1.36	1.40	1.30	1.35	1.55	1.35	1.39
10.	Biochem-20-11	RH (OE)-1807	1.12	0.98	1.05	1.10	1.02	0.99	1.05
11.	Biochem-20-12	PDZ-11	0.95	0.87	0.93	0.97	0.94	0.95	0.93
12.	Biochem-20-13	RH(OE)-706	1.12	1.37	1.13	1.11	1.37	1.06	1.19
13.	Biochem-20-14	PM 29	1.18	1.13	1.19	1.17	0.96	1.04	1.11
14.	Biochem-20-15	PDZ-14	1.07	0.92	0.99	1.09	1.00	0.90	1.00
15.	Biochem-20-16	LES-63	1.23	1.13	1.21	1.25	1.22	1.11	1.19
16.	Biochem-20-17	O I J 5001	1.40	1.51	1.51	1.50	1.56	1.62	1.52
17.	Biochem-20-18	9IJ 5001	1.58	1.34	1.41	1.76	1.46	1.36	1.49
18.	Biochem-20-19	GSH-1699	3.43	1.82	3.55	3.67	1.98	2.90	2.89
19.	Biochem-20-20	JC-32	1.13	1.18	1.17	1.10	1.14	1.14	1.14
20.	Biochem-20-21	GSH-2196	2.89	3.14	2.94	2.88	2.99	3.00	2.97
21.	Biochem-20-22	JC-36	1.32	1.25	1.19	1.43	1.22	1.07	1.25
22.	Biochem-20-23	RCH-1	1.19	1.15	1.20	1.21	1.15	1.16	1.18
23.	Biochem-20-24	GSH-2180	2.49	2.41	2.35	2.65	2.18	2.05	2.35

Table 2: Palmitic acid (%)

S.No	Palmitic acid	Genotype	BPR	PNT	HSR	KNG	LDH	KNP	Mean
1.	Biochem-20-1	RH (OE)-1804	3.35	2.84	3.11	3.29	3.59	3.51	3.28
2.	Biochem-20-2	LES-62	3.31	1.41	3.28	3.41	3.35	2.64	2.90
3.	Biochem-20-3	PDZ-15	4.80	3.56	4.72	3.56	4.88	3.08	4.10
4.	Biochem-20-4	RH-749	2.50	3.29	2.99	2.43	2.02	3.39	2.77
5.	Biochem-20-5	PDZ-12	4.71	4.18	4.27	5.04	5.14	4.24	4.60
6.	Biochem-20-6	RGN-73	1.87	1.33	1.74	2.95	2.01	1.33	1.87
7.	Biochem-20-7	LES-60	3.78	3.98	3.72	3.98	3.84	3.57	3.81
8.	Biochem-20-8	KRANTI	2.27	2.12	2.29	2.91	2.26	2.12	2.33
9.	Biochem-20-10	PDZ-1	4.03	3.93	3.90	3.93	4.17	3.66	3.94
10.	Biochem-20-11	RH (OE)-1807	3.82	4.74	3.75	3.74	3.90	3.31	3.88
11.	Biochem-20-12	PDZ-11	4.45	4.22	4.23	4.22	4.67	4.51	4.38
12.	Biochem-20-13	RH(OE)-706	3.68	3.30	3.35	3.30	4.02	3.25	3.48
13.	Biochem-20-14	PM 29	4.57	4.23	4.50	4.23	4.63	4.22	4.40
14.	Biochem-20-15	PDZ-14	3.19	3.82	2.42	3.82	3.96	2.99	3.36
15.	Biochem-20-16	LES-63	4.15	4.44	3.45	4.44	4.86	3.94	4.21
16.	Biochem-20-17	O I J 5001	3.77	3.72	3.60	3.72	3.93	3.70	3.74
17.	Biochem-20-18	9IJ 5001	4.68	4.46	4.46	4.46	4.90	4.23	4.53
18.	Biochem-20-19	GSH-1699	3.78	4.81	3.58	4.81	3.99	3.48	4.07
19.	Biochem-20-20	JC-32	3.84	3.92	2.94	3.92	4.73	3.86	3.87
20.	Biochem-20-21	GSH-2196	3.92	3.41	3.66	3.41	4.19	3.49	3.68
21.	Biochem-20-22	JC-36	3.74	2.87	3.18	4.13	4.29	2.88	3.51
22.	Biochem-20-23	RCH-1	4.07	3.75	3.75	3.16	4.40	3.71	3.81
23.	Biochem-20-24	GSH-2180	3.75	4.22	3.21	4.22	4.29	3.85	3.92

Table 3: Stearic acid (%)

S.NO.	Code	Genotype	BPR	PNT	HSR	KNG	LDH	KNP	Mean
1.	Biochem-20-1	RH (OE)-1804	1.39	1.40	0.19	0.33	1.59	1.20	1.02
2.	Biochem-20-2	LES-62	1.55	1.20	1.32	1.20	1.78	1.13	1.36
3.	Biochem-20-3	PDZ-15	1.35	1.57	1.22	1.57	1.48	1.29	1.41
4.	Biochem-20-4	RH-749	0.83	0.21	0.99	0.59	0.66	0.35	0.60
5.	Biochem-20-5	PDZ-12	1.15	0.54	1.08	1.48	1.21	0.99	1.07
6.	Biochem-20-6	RGN-73	0.71	0.95	0.51	0.89	0.91	0.87	0.81
7.	Biochem-20-7	LES-60	1.73	0.71	1.58	0.71	1.87	1.15	1.29
8.	Biochem-20-8	KRANTI	0.83	0.77	0.84	1.41	0.82	0.78	0.91
9.	Biochem-20-10	PDZ-1	1.43	0.91	0.84	0.20	2.02	1.45	1.14
10.	Biochem-20-11	RH (OE)-1807	1.40	1.94	1.23	1.94	1.57	1.51	1.60
11.	Biochem-20-12	PDZ-11	1.49	1.96	1.69	1.96	1.28	1.68	1.68
12.	Biochem-20-13	RH(OE)-706	1.46	1.82	1.38	1.82	1.54	1.40	1.57
13.	Biochem-20-14	PM 29	1.54	2.36	1.36	2.36	1.71	2.40	1.95
14.	Biochem-20-15	PDZ-14	1.68	1.22	1.62	1.23	1.74	1.11	1.43
15.	Biochem-20-16	LES-63	1.71	2.67	1.43	2.67	1.98	1.85	2.05
16.	Biochem-20-17	O I J 5001	1.68	2.37	1.63	2.37	1.73	1.79	1.93
17.	Biochem-20-18	9IJ 5001	1.91	2.35	1.91	2.35	1.91	1.62	2.01
18.	Biochem-20-19	GSH-1699	1.72	2.44	1.92	2.44	1.52	1.57	1.93
19.	Biochem-20-20	JC-32	1.38	1.44	1.30	0.44	1.45	1.21	1.20
20.	Biochem-20-21	GSH-2196	1.24	1.21	1.28	1.49	1.19	1.08	1.25
21.	Biochem-20-22	JC-36	1.60	1.19	1.39	1.34	1.81	1.11	1.41
22.	Biochem-20-23	RCH-1	1.07	0.48	0.48	0.30	1.65	0.47	0.74
23.	Biochem-20-24	GSH-2180	1.31	1.78	1.41	1.78	1.20	1.17	1.44

Table 4: Oleic acid (%)

S.NO.	Code	Genotype	BPR	PNT	HSR	KNG	LDH	KNP	Mean
1.	Biochem-20-1	RH (OE)-1804	34.65	33.69	35.04	39.54	36.06	35.73	35.79
2.	Biochem-20-2	LES-62	43.48	36.01	34.97	45.67	45.99	34.75	40.15
3.	Biochem-20-3	PDZ-15	39.30	35.83	39.12	35.02	39.47	36.53	37.54
4.	Biochem-20-4	RH-749	9.02	14.71	9.21	9.52	8.83	12.21	10.58
5.	Biochem-20-5	PDZ-12	38.64	31.31	38.11	38.07	39.17	36.15	36.91
6.	Biochem-20-6	RGN-73	12.41	11.90	12.92	12.92	11.89	13.79	12.64
7.	Biochem-20-7	LES-60	44.71	40.11	41.89	45.01	47.53	41.57	43.47
8.	Biochem-20-8	KRANTI	13.98	14.15	15.41	11.11	12.55	14.15	13.56
9.	Biochem-20-10	PDZ-1	48.81	49.93	47.14	49.24	50.48	46.05	48.61
10.	Biochem-20-11	RH (OE)-1807	38.10	39.01	38.13	38.03	38.06	35.92	37.87
11.	Biochem-20-12	PDZ-11	37.93	38.23	36.33	36.23	39.52	37.52	37.63
12.	Biochem-20-13	RH(OE)-706	40.45	44.99	39.19	38.99	41.71	38.56	40.65
13.	Biochem-20-14	PM 29	43.78	36.48	42.61	42.00	44.94	38.56	41.39
14.	Biochem-20-15	PDZ-14	40.75	38.50	38.88	40.85	42.61	35.08	39.44
15.	Biochem-20-16	LES-63	41.85	41.92	40.01	39.91	43.68	39.74	41.18
16.	Biochem-20-17	O I J 5001	38.03	36.42	37.84	34.28	39.22	37.17	37.16
17.	Biochem-20-18	9IJ 5001	49.79	48.82	45.84	44.87	53.73	44.82	47.98
18.	Biochem-20-19	GSH-1699	62.65	49.46	60.46	59.46	64.83	56.32	58.86
19.	Biochem-20-20	JC-32	32.72	31.42	32.96	33.96	32.48	32.51	32.68
20.	Biochem-20-21	GSH-2196	58.98	61.02	58.40	58.10	59.55	61.26	59.55
21.	Biochem-20-22	JC-36	39.89	39.04	37.66	43.66	44.11	35.98	40.06
22.	Biochem-20-23	RCH-1	43.43	41.56	42.43	45.67	44.43	42.06	43.26
23.	Biochem-20-24	GSH-2180	51.09	54.20	50.02	50.20	52.15	49.13	51.13

Table 5: Linoleic acid (%)

S.NO.	Code	Genotype	BPR	PNT	HSR	KNG	LDH	KNP	Mean
1.	Biochem-20-1	RH (OE)-1804	32.75	29.57	34.14	33.68	31.35	34.33	32.64
2.	Biochem-20-2	LES-62	25.96	27.04	30.82	20.67	28.15	32.52	27.53
3.	Biochem-20-3	PDZ-15	43.61	44.15	43.15	44.15	43.07	43.29	43.57
4.	Biochem-20-4	RH-749	16.29	21.34	16.04	16.04	16.54	20.84	17.85
5.	Biochem-20-5	PDZ-12	40.47	36.68	39.99	39.64	41.30	36.68	39.13
6.	Biochem-20-6	RGN-73	17.16	20.32	17.27	20.17	17.04	18.33	18.38
7.	Biochem-20-7	LES-60	36.17	39.55	36.61	35.61	36.73	37.69	37.06
8.	Biochem-20-8	KRANTI	17.58	17.00	18.34	16.09	16.82	17.35	17.20
9.	Biochem-20-10	PDZ-1	35.81	32.30	36.25	34.35	37.36	34.10	35.03
10.	Biochem-20-11	RH (OE)-1807	33.89	38.16	36.27	33.71	34.50	36.16	35.45
11.	Biochem-20-12	PDZ-11	39.94	40.61	39.17	39.06	40.71	39.59	39.85
12.	Biochem-20-13	RH(OE)-706	36.24	32.74	34.77	34.74	37.71	36.29	35.42
13.	Biochem-20-14	PM 29	37.05	37.97	35.80	35.82	38.30	37.12	37.01
14.	Biochem-20-15	PDZ-14	38.18	38.40	39.28	37.28	39.08	38.82	38.51
15.	Biochem-20-16	LES-63	34.01	34.50	33.20	33.23	34.82	35.87	34.27
16.	Biochem-20-17	O I J 5001	27.07	23.41	25.01	24.42	26.31	22.94	24.86
17.	Biochem-20-18	9IJ 5001	31.48	33.46	32.46	33.45	30.50	32.96	32.38
18.	Biochem-20-19	GSH-1699	18.28	24.93	17.04	18.99	17.66	19.43	19.39
19.	Biochem-20-20	JC-32	28.90	27.50	28.16	29.49	29.63	28.56	28.71
20.	Biochem-20-21	GSH-2196	20.44	20.42	19.89	20.11	20.69	20.42	20.33
21.	Biochem-20-22	JC-36	30.24	31.83	31.72	26.72	30.75	33.50	30.79
22.	Biochem-20-23	RCH-1	36.52	36.14	35.28	35.94	36.75	36.19	36.14
23.	Biochem-20-24	GSH-2180	20.51	24.82	21.32	21.82	19.70	24.01	22.03

Table 6: Linolenic acid (%)

S.NO.	Code	Genotype	BPR	PNT	HSR	KNG	LDH	KNP	Mean
1.	Biochem-20-1	RH (OE)-1804	20.61	20.68	19.77	14.77	21.44	15.85	18.85
2.	Biochem-20-2	LES-62	19.76	25.70	18.77	18.77	20.75	20.41	20.69
3.	Biochem-20-3	PDZ-15	11.24	14.15	11.43	14.15	11.05	13.73	12.62
4.	Biochem-20-4	RH-749	15.22	16.54	14.02	14.05	16.41	16.55	15.46
5.	Biochem-20-5	PDZ-12	13.87	21.90	14.54	14.59	13.19	19.90	16.33
6.	Biochem-20-6	RGN-73	14.32	14.76	12.71	12.72	15.93	15.56	14.33
7.	Biochem-20-7	LES-60	11.69	14.02	13.33	13.35	10.04	13.74	12.69
8.	Biochem-20-8	KRANTI	14.09	11.59	12.08	18.09	16.09	11.59	13.92
9.	Biochem-20-10	PDZ-1	7.56	10.13	9.13	9.13	5.98	12.32	9.04
10.	Biochem-20-11	RH (OE)-1807	16.12	11.67	16.67	16.67	15.56	18.28	15.83
11.	Biochem-20-12	PDZ-11	14.48	12.50	15.81	15.81	13.14	14.10	14.31
12.	Biochem-20-13	RH(OE)-706	15.97	15.51	17.52	17.52	14.41	17.24	16.36
13.	Biochem-20-14	PM 29	11.62	16.51	13.25	13.25	9.98	12.88	12.91
14.	Biochem-20-15	PDZ-14	12.72	11.53	13.53	13.53	11.90	18.54	13.62
15.	Biochem-20-16	LES-63	15.64	15.12	17.13	17.13	14.15	16.13	15.88
16.	Biochem-20-17	O I J 5001	16.05	11.50	17.37	12.15	15.93	11.98	14.16
17.	Biochem-20-18	9IJ 5001	9.08	9.48	10.00	10.00	8.16	9.98	9.45
18.	Biochem-20-19	GSH-1699	10.95	14.96	11.42	9.31	10.48	13.46	11.76
19.	Biochem-20-20	JC-32	14.54	15.40	12.35	12.35	16.72	14.09	14.24
20.	Biochem-20-21	GSH-2196	10.89	8.69	9.88	9.88	11.90	8.69	9.99
21.	Biochem-20-22	JC-36	12.83	13.04	12.16	12.16	13.49	15.57	13.21
22.	Biochem-20-23	RCH-1	12.84	14.30	14.30	11.50	11.38	12.80	12.85
23.	Biochem-20-24	GSH-2180	14.65	8.51	14.30	8.51	14.99	11.15	12.02

Table 7: Eicosanoic acid (%)

S.NO.	Code	Genotype	BPR	PNT	HSR	KNG	LDH	KNP	Mean
1.	Biochem-20-1	RH (OE)-1804	1.01	3.70	1.08	1.08	0.93	2.54	1.72
2.	Biochem-20-2	LES-62	4.69	8.00	9.38	9.38	0.00	7.84	6.55
3.	Biochem-20-3	PDZ-15	0.11	0.00	0.21	0.41	0.00	1.19	0.32
4.	Biochem-20-4	RH-749	4.31	9.86	6.21	6.45	2.42	7.35	6.10
5.	Biochem-20-5	PDZ-12	0.11	3.93	0.22	0.22	0.00	0.93	0.90
6.	Biochem-20-6	RGN-73	4.70	5.92	7.36	7.36	2.04	5.83	5.53
7.	Biochem-20-7	LES-60	0.51	1.00	1.01	1.01	0.00	1.07	0.77
8.	Biochem-20-8	KRANTI	3.98	6.54	6.55	6.82	1.42	6.59	5.32
9.	Biochem-20-10	PDZ-1	0.94	1.97	1.87	1.97	0.00	1.89	1.44
10.	Biochem-20-11	RH (OE)-1807	0.98	1.56	1.21	1.21	0.76	1.59	1.22
11.	Biochem-20-12	PDZ-11	0.71	1.97	1.41	1.39	0.00	1.77	1.21
12.	Biochem-20-13	RH(OE)-706	0.99	0.97	1.97	1.97	0.00	1.97	1.31
13.	Biochem-20-14	PM 29	0.76	1.58	1.52	1.57	0.00	3.58	1.50
14.	Biochem-20-15	PDZ-14	1.14	4.83	1.86	1.83	0.41	2.21	2.05
15.	Biochem-20-16	LES-63	0.58	1.20	1.16	1.16	0.00	1.40	0.92
16.	Biochem-20-17	O I J 5001	3.90	10.11	6.65	8.11	1.14	9.95	6.64
17.	Biochem-20-18	9IJ 5001	1.89	1.18	3.77	3.71	0.00	3.67	2.37
18.	Biochem-20-19	GSH-1699	1.67	2.33	3.33	3.33	0.00	3.30	2.33
19.	Biochem-20-20	JC-32	4.05	6.65	6.68	7.68	1.41	6.65	5.52
20.	Biochem-20-21	GSH-2196	2.45	2.57	4.89	4.88	0.00	2.53	2.89
21.	Biochem-20-22	JC-36	3.94	5.32	6.52	8.10	1.37	6.18	5.24
22.	Biochem-20-23	RCH-1	1.31	2.52	2.61	1.72	0.00	2.54	1.78
23.	Biochem-20-24	GSH-2180	2.34	1.28	4.67	7.67	0.00	5.64	3.60

Table 8: Erucic acid (%)

S.NO.	Code	Genotype	BPR	PNT	HSR	KNG	LDH	KNP	Mean
1.	Biochem-20-1	RH (OE)-1804	5.60	8.01	6.24	5.01	4.96	6.67	6.08
2.	Biochem-20-2	LES-62	0.33	0.00	0.65	1.13	0.00	0.69	0.47
3.	Biochem-20-3	PDZ-15	0.17	0.00	0.00	0.50	0.33	0.14	0.19
4.	Biochem-20-4	RH-749	52.04	33.91	40.93	49.61	53.09	38.95	44.76
5.	Biochem-20-5	PDZ-12	0.46	0.73	0.91	0.93	0.00	0.46	0.58
6.	Biochem-20-6	RGN-73	47.58	44.64	42.96	42.09	50.20	44.29	45.29
7.	Biochem-20-7	LES-60	0.08	0.19	0.16	0.16	0.00	0.18	0.13
8.	Biochem-20-8	KRANTI	46.43	47.62	40.80	42.38	50.06	46.98	45.71
9.	Biochem-20-10	PDZ-1	0.01	0.02	0.02	0.02	0.00	0.09	0.03
10.	Biochem-20-11	RH (OE)-1807	2.98	1.11	1.12	2.92	4.84	1.78	2.46
11.	Biochem-20-12	PDZ-11	0.35	0.20	0.00	0.00	0.69	0.51	0.29
12.	Biochem-20-13	RH(OE)-706	0.35	0.00	0.07	0.07	0.63	0.52	0.27
13.	Biochem-20-14	PM 29	0.43	0.50	0.41	0.47	0.45	0.49	0.46
14.	Biochem-20-15	PDZ-14	0.61	0.82	0.95	0.86	0.26	1.02	0.75
15.	Biochem-20-16	LES-63	0.34	0.12	0.15	0.13	0.53	0.27	0.26
16.	Biochem-20-17	O I J 5001	10.00	10.48	8.24	12.01	11.76	12.62	10.85
17.	Biochem-20-18	9IJ 5001	0.46	0.00	0.09	0.07	0.82	0.19	0.27
18.	Biochem-20-19	GSH-1699	1.76	2.62	1.98	1.63	1.54	1.92	1.91
19.	Biochem-20-20	JC-32	13.09	12.98	12.57	11.81	13.60	11.93	12.66
20.	Biochem-20-21	GSH-2196	2.15	2.09	1.89	2.09	2.41	1.96	2.10
21.	Biochem-20-22	JC-36	4.97	5.98	5.98	3.51	3.96	3.79	4.70
22.	Biochem-20-23	RCH-1	1.01	1.02	1.08	0.91	0.94	0.99	0.99
23.	Biochem-20-24	GSH-2180	6.28	4.89	4.88	4.80	7.67	4.95	5.58

Table 9: ω6 and ω3 ratio

S.NO.	Code	Genotype	BPR	PNT	HSR	KNG	LDH	KNP	Mean
1.	Biochem-20-1	RH (OE)-1804	1.59	1.40	1.73	2.31	1.46	2.17	1.78
2.	Biochem-20-2	LES-62	1.31	1.00	1.64	0.95	1.36	1.59	1.31
3.	Biochem-20-3	PDZ-15	3.88	3.10	3.78	3.12	3.90	3.15	3.49
4.	Biochem-20-4	RH-749	1.07	1.30	1.14	1.14	1.01	1.26	1.15
5.	Biochem-20-5	PDZ-12	2.92	1.70	2.75	2.72	3.13	1.84	2.51
6.	Biochem-20-6	RGN-73	1.20	1.40	1.36	1.35	1.07	1.18	1.26
7.	Biochem-20-7	LES-60	3.10	2.80	2.75	2.67	3.66	2.74	2.95
8.	Biochem-20-8	KRANTI	1.25	1.50	1.52	1.33	1.04	1.50	1.36
9.	Biochem-20-10	PDZ-1	4.74	3.20	3.97	3.76	6.25	2.77	4.11
10.	Biochem-20-11	RH (OE)-1807	2.10	3.30	2.18	2.02	2.22	1.98	2.30
11.	Biochem-20-12	PDZ-11	2.76	3.20	2.48	2.47	3.10	2.81	2.80
12.	Biochem-20-13	RH(OE)-706	2.27	2.10	1.98	1.98	2.63	2.11	2.18
13.	Biochem-20-14	PM 29	3.19	2.30	2.70	2.70	3.84	2.88	2.94
14.	Biochem-20-15	PDZ-14	3.00	3.30	2.90	2.76	3.29	2.09	2.89
15.	Biochem-20-16	LES-63	2.17	2.30	1.94	1.94	2.46	2.22	2.17
16.	Biochem-20-17	O I J 5001	1.69	2.00	1.44	2.01	1.66	1.92	1.79
17.	Biochem-20-18	9IJ 5001	3.47	3.50	3.25	3.25	3.74	3.30	3.42
18.	Biochem-20-19	GSH-1699	1.67	1.70	1.49	2.04	1.69	1.44	1.67
19.	Biochem-20-20	JC-32	1.99	1.80	2.28	2.32	1.78	2.03	2.03
20.	Biochem-20-21	GSH-2196	1.88	2.30	2.01	2.04	1.78	2.35	2.06
21.	Biochem-20-22	JC-36	2.36	2.40	2.61	2.20	2.28	2.15	2.33
22.	Biochem-20-23	RCH-1	2.84	2.50	2.47	2.09	3.23	2.83	2.66
23.	Biochem-20-24	GSH-2180	1.40	2.90	1.49	2.45	1.32	2.15	1.95

Table 10: SFA: MUFA: PUFA ratio

S.NO.	Code	Genotype	BPR	PNT	HSR	KNG	LDH	KNP
1.	Biochem-20-1	RH (OE)-1804	1:09:11	1:11:12	1:13:16	1:13:13	1:08:10	1:10:11
2.	Biochem-20-2	LES-62	1:10:09	1:17:20	1:10:11	1:12:09	1:08:09	1:12:14
3.	Biochem-20-3	PDZ-15	1:06:09	1:07:11	1:07:09	1:07:11	1:06:09	1:09:13
4.	Biochem-20-4	RH-749	1:19:09	1:17:11	1:16:08	1:22:10	1:24:12	1:16:10
5.	Biochem-20-5	PDZ-12	1:07:09	1:08:12	1:07:10	1:06:08	1:06:09	1:07:11
6.	Biochem-20-6	RGN-73	1:25:12	1:27:15	1:29:13	1:16:09	1:22:11	1:29:15
7.	Biochem-20-7	LES-60	1:08:09	1:09:11	1:08:09	1:10:10	1:08:08	1:09:11
8.	Biochem-20-8	KRANTI	1:21:10	1:24:10	1:21:10	1:14:08	1:20:10	1:23:10
9.	Biochem-20-10	PDZ-1	1:09:08	1:11:09	1:10:10	1:12:11	1:08:07	1:09:09
10.	Biochem-20-11	RH (OE)-1807	1:08:10	1:06:08	1:08:11	1:07:09	1:08:09	1:08:11
11.	Biochem-20-12	PDZ-11	1:07:09	1:07:09	1:06:09	1:06:09	1:07:09	1:06:09
12.	Biochem-20-13	RH(OE)-706	1:08:10	1:09:09	1:09:11	1:08:10	1:08:08	1:09:12
13.	Biochem-20-14	PM 29	1:07:08	1:06:08	1:08:08	1:07:07	1:07:08	1:06:08
14.	Biochem-20-15	PDZ-14	1:09:10	1:09:10	1:10:13	1:09:10	1:08:09	1:09:14
15.	Biochem-20-16	LES-63	1:07:08	1:06:07	1:09:10	1:06:07	1:06:07	1:07:09
16.	Biochem-20-17	O I J 5001	1:10:08	1:09:06	1:10:08	1:09:06	1:09:07	1:11:06
17.	Biochem-20-18	9IJ 5001	1:08:06	1:07:06	1:08:07	1:07:06	1:08:06	1:08:07
18.	Biochem-20-19	GSH-1699	1:12:05	1:08:06	1:12:05	1:09:04	1:12:05	1:12:07
19.	Biochem-20-20	JC-32	1:10:08	1:10:08	1:12:10	1:12:10	1:08:07	1:10:08
20.	Biochem-20-21	GSH-2196	1:12:06	1:14:06	1:13:06	1:13:06	1:12:06	1:14:06
21.	Biochem-20-22	JC-36	1:09:08	1:12:11	1:11:10	1:10:07	1:08:07	1:12:12
22.	Biochem-20-23	RCH-1	1:09:10	1:11:12	1:11:12	1:14:14	1:08:08	1:11:12
23.	Biochem-20-24	GSH-2180	1:12:07	1:10:06	1:13:08	1:10:05	1:11:06	1:12:07

Table 11: Saturated: Unsaturated fatty acid ratio

S.NO.	Code	Genotype	BPR	PNT	HSR	KNG	LDH	KNP
1.	Biochem-20-1	RH (OE)-1804	1:11	1:11	1:12	1:13	1:10	1:10
2.	Biochem-20-2	LES-62	1:09	1:11	1:10	1:08	1:09	1:12
3.	Biochem-20-3	PDZ-15	1:08	1:10	1:09	1:11	1:08	1:13
4.	Biochem-20-4	RH-749	1:09	1:10	1:07	1:09	1:12	1:10
5.	Biochem-20-5	PDZ-12	1:09	1:12	1:10	1:08	1:08	1:10
6.	Biochem-20-6	RGN-73	1:12	1:11	1:13	1:08	1:11	1:12
7.	Biochem-20-7	LES-60	1:08	1:11	1:09	1:10	1:08	1:10
8.	Biochem-20-8	KRANTI	1:10	1:09	1:09	1:07	1:10	1:09
9.	Biochem-20-10	PDZ-1	1:07	1:08	1:09	1:10	1:07	1:09
10.	Biochem-20-11	RH (OE)-1807	1:09	1:07	1:10	1:08	1:09	1:11
11.	Biochem-20-12	PDZ-11	1:09	1:08	1:09	1:08	1:09	1:08
12.	Biochem-20-13	RH(OE)-706	1:10	1:09	1:11	1:10	1:09	1:11
13.	Biochem-20-14	PM 29	1:07	1:08	1:08	1:07	1:07	1:07
14.	Biochem-20-15	PDZ-14	1:10	1:09	1:13	1:10	1:08	1:12
15.	Biochem-20-16	LES-63	1:08	1:06	1:10	1:07	1:07	1:08
16.	Biochem-20-17	O I J 5001	1:07	1:05	1:08	1:06	1:07	1:06
17.	Biochem-20-18	9IJ 5001	1:06	1:06	1:06	1:06	1:05	1:07
18.	Biochem-20-19	GSH-1699	1:05	1:05	1:05	1:03	1:05	1:06
19.	Biochem-20-20	JC-32	1:08	1:08	1:09	1:09	1:07	1:08
20.	Biochem-20-21	GSH-2196	1:06	1:06	1:06	1:06	1:06	1:06
21.	Biochem-20-22	JC-36	1:08	1:11	1:09	1:07	1:07	1:12
22.	Biochem-20-23	RCH-1	1:09	1:11	1:11	1:13	1:07	1:11
23.	Biochem-20-24	GSH-2180	1:06	1:05	1:07	1:05	1:06	1:07

Table 12: Protein content (%)

S.NO.	Code	Genotype	BPR	PNT	HSR	KNG	LDH	KNP	mean
1.	Biochem-20-1	RH (OE)-1804	33.64	32.80	33.79	33.32	34.64	32.69	33.48
2.	Biochem-20-2	LES-62	33.99	33.29	34.30	35.21	33.18	30.83	33.99
3.	Biochem-20-3	PDZ-15	34.91	34.77	36.49	35.95	32.45	29.54	34.91
4.	Biochem-20-4	RH-749	33.88	34.23	34.26	33.84	33.18	31.56	33.88
5.	Biochem-20-5	PDZ-12	34.89	34.43	35.76	35.46	33.91	30.32	34.89
6.	Biochem-20-6	RGN-73	33.09	32.01	33.88	34.02	32.45	32.17	33.09
7.	Biochem-20-7	LES-60	31.72	31.73	32.36	32.53	30.26	34.05	31.72
8.	Biochem-20-8	KRANTI	33.70	34.32	33.35	33.24	33.91	31.16	33.70
9.	Biochem-20-10	PDZ-1	31.60	32.06	31.85	31.51	30.99	30.94	31.60
10.	Biochem-20-11	RH (OE)-1807	33.33	33.28	33.69	33.89	32.45	32.83	33.33
11.	Biochem-20-12	PDZ-11	33.59	32.94	34.08	34.90	32.45	31.56	33.59
12.	Biochem-20-13	RH(OE)-706	33.04	32.57	33.52	34.34	31.72	32.46	33.04
13.	Biochem-20-14	PM 29	31.80	32.19	31.82	32.19	30.99	33.71	31.80
14.	Biochem-20-15	PDZ-14	35.21	34.16	35.92	35.40	35.36	30.52	35.21
15.	Biochem-20-16	LES-63	34.41	33.61	35.93	35.64	32.45	31.08	34.41
16.	Biochem-20-17	O I J 5001	34.69	34.16	35.31	34.65	34.64	30.52	34.69
17.	Biochem-20-18	9IJ 5001	34.96	33.83	35.53	35.14	35.36	31.00	34.96
18.	Biochem-20-19	GSH-1699	34.57	34.74	35.40	34.96	33.18	29.26	34.57
19.	Biochem-20-20	JC-32	32.76	32.51	32.17	31.73	34.64	30.80	32.76
20.	Biochem-20-21	GSH-2196	35.04	35.12	36.77	36.55	31.72	29.72	35.04
21.	Biochem-20-22	JC-36	30.12	30.31	29.49	30.43	30.26	30.47	30.12
22.	Biochem-20-23	RCH-1	31.55	30.48	31.66	31.62	32.45	32.24	31.55
23.	Biochem-20-24	GSH-2180	32.43	32.02	31.67	31.39	34.64	31.30	32.43

Table 13: Methionine content (g/100g protein)

S.NO.	Code	Genotype	BPR	PNT	HSR	KNG	LDH	KNP	MEAN
1.	Biochem-20-1	RH (OE)-1804	1.83	2.00	1.92	2.00	1.40	1.96	1.85
2.	Biochem-20-2	LES-62	1.91	2.02	1.97	2.02	1.65	1.48	1.84
3.	Biochem-20-3	PDZ-15	1.90	1.85	1.77	1.85	2.13	1.45	1.83
4.	Biochem-20-4	RH-749	2.18	2.17	2.60	2.17	1.79	1.69	2.10
5.	Biochem-20-5	PDZ-12	2.09	2.01	2.02	2.01	2.35	1.55	2.00
6.	Biochem-20-6	RGN-73	2.00	2.14	1.98	2.14	1.76	1.35	1.90
7.	Biochem-20-7	LES-60	2.12	2.13	2.10	2.13	2.13	1.71	2.05
8.	Biochem-20-8	KRANTI	1.80	1.86	1.73	1.86	1.76	0.28	1.55
9.	Biochem-20-10	PDZ-1	2.18	2.18	1.96	2.18	2.40	1.21	2.02
10.	Biochem-20-11	RH (OE)-1807	1.98	2.02	1.96	2.02	1.94	1.75	1.94
11.	Biochem-20-12	PDZ-11	1.85	2.02	2.08	2.02	1.30	1.59	1.81
12.	Biochem-20-13	RH(OE)-706	2.12	2.01	2.20	2.01	2.25	1.83	2.07
13.	Biochem-20-14	PM 29	2.00	2.04	2.11	2.04	1.80	2.16	2.02
14.	Biochem-20-15	PDZ-14	1.78	1.89	1.75	1.89	1.61	1.90	1.80
15.	Biochem-20-16	LES-63	1.98	2.17	1.88	2.17	1.71	0.92	1.81
16.	Biochem-20-17	O I J 5001	1.86	1.97	1.97	1.97	1.53	0.98	1.71
17.	Biochem-20-18	9IJ 5001	1.95	2.13	2.18	2.13	1.36	1.21	1.83
18.	Biochem-20-19	GSH-1699	1.71	1.90	1.69	1.90	1.38	1.19	1.63
19.	Biochem-20-20	JC-32	1.91	2.11	2.09	2.11	1.34	1.44	1.83
20.	Biochem-20-21	GSH-2196	1.89	2.07	2.04	2.07	1.39	1.33	1.80
21.	Biochem-20-22	JC-36	2.12	2.26	2.26	2.26	1.71	1.29	1.98
22.	Biochem-20-23	RCH-1	2.04	2.19	2.18	2.19	1.61	1.83	2.01
23.	Biochem-20-24	GSH-2180	1.97	2.16	2.15	2.16	1.42	1.53	1.90

Table 14: Tryptophan content (g/100g protein)

S.NO.	Code	Genotype	BPR	PNT	HSR	KNG	LDH	KNP	Mean
1.	Biochem-20-1	RH (OE)-1804	1.13	1.09	1.08	1.01	1.16	1.78	1.21
2.	Biochem-20-2	LES-62	0.83	0.82	0.78	1.07	0.85	1.78	1.02
3.	Biochem-20-3	PDZ-15	0.80	0.75	1.00	1.03	0.85	1.79	1.04
4.	Biochem-20-4	RH-749	1.16	1.00	0.91	1.21	1.32	1.86	1.24
5.	Biochem-20-5	PDZ-12	1.19	0.80	0.83	1.01	1.59	1.70	1.19
6.	Biochem-20-6	RGN-73	1.10	1.18	1.10	1.22	1.01	1.66	1.21
7.	Biochem-20-7	LES-60	1.15	1.20	1.19	0.99	1.10	1.82	1.24
8.	Biochem-20-8	KRANTI	0.95	0.87	0.80	1.19	1.03	0.91	0.96
9.	Biochem-20-10	PDZ-1	1.21	1.23	1.16	0.95	1.18	1.79	1.25
10.	Biochem-20-11	RH (OE)-1807	0.96	0.80	0.78	1.03	1.11	1.83	1.08
11.	Biochem-20-12	PDZ-11	1.43	1.13	1.11	1.00	1.72	1.81	1.37
12.	Biochem-20-13	RH(OE)-706	1.16	1.20	1.50	1.04	1.13	1.88	1.32
13.	Biochem-20-14	PM 29	1.47	1.21	0.97	0.98	1.74	0.92	1.21
14.	Biochem-20-15	PDZ-14	0.99	0.72	0.76	1.01	1.27	0.95	0.95
15.	Biochem-20-16	LES-63	1.16	0.72	0.72	1.02	1.61	1.64	1.15
16.	Biochem-20-17	O I J 5001	1.26	0.93	1.31	0.99	1.60	1.04	1.19
17.	Biochem-20-18	9IJ 5001	0.98	0.81	0.87	1.00	1.15	1.69	1.08
18.	Biochem-20-19	GSH-1699	1.11	0.98	1.09	1.06	1.23	0.91	1.06
19.	Biochem-20-20	JC-32	1.05	1.15	1.35	0.96	0.95	1.73	1.20
20.	Biochem-20-21	GSH-2196	0.92	0.83	1.20	1.11	1.01	1.31	1.06
21.	Biochem-20-22	JC-36	1.09	1.28	1.38	0.92	0.89	1.72	1.21
22.	Biochem-20-23	RCH-1	1.18	1.29	1.81	0.96	1.07	0.79	1.18
23.	Biochem-20-24	GSH-2180	1.09	1.14	1.51	0.95	1.05	1.67	1.23

Table 15: Total antioxidant capacity (mg/g AAE)

S.NO.	Code	Genotype	BPR	PNT	HSR	KNG	LDH	Mean
1.	Biochem-20-1	RH (OE)-1804	19.86	19.59	18.45	22.16	20.12	20.04
2.	Biochem-20-2	LES-62	16.57	15.38	23.06	18.36	17.76	18.23
3.	Biochem-20-3	PDZ-15	15.48	15.03	18.05	16.79	15.94	16.26
4.	Biochem-20-4	RH-749	17.99	18.49	20.50	24.32	17.50	19.76
5.	Biochem-20-5	PDZ-12	17.67	21.37	20.20	15.03	13.98	17.65
6.	Biochem-20-6	RGN-73	18.76	20.11	23.01	24.57	17.41	20.77
7.	Biochem-20-7	LES-60	19.45	21.58	23.98	17.84	17.32	20.03
8.	Biochem-20-8	KRANTI	21.90	22.09	24.00	24.09	21.72	22.76
9.	Biochem-20-10	PDZ-1	15.65	17.09	15.93	17.88	14.20	16.15
10.	Biochem-20-11	RH (OE)-1807	17.83	15.63	26.16	21.12	20.03	20.15
11.	Biochem-20-12	PDZ-11	19.73	18.11	16.16	16.17	21.34	18.30
12.	Biochem-20-13	RH(OE)-706	19.53	21.81	23.80	21.44	17.25	20.76
13.	Biochem-20-14	PM 29	24.41	20.87	24.05	19.24	27.96	23.31
14.	Biochem-20-15	PDZ-14	17.55	17.88	21.37	17.01	17.22	18.20
15.	Biochem-20-16	LES-63	19.32	15.44	28.16	15.12	23.19	20.24
16.	Biochem-20-17	O I J 5001	17.22	15.24	17.60	19.92	19.21	17.84
17.	Biochem-20-18	9IJ 5001	18.46	19.53	23.18	18.99	17.40	19.51
18.	Biochem-20-19	GSH-1699	16.96	16.79	26.79	20.63	17.14	19.66
19.	Biochem-20-20	JC-32	18.25	20.22	21.42	24.40	16.27	20.11
20.	Biochem-20-21	GSH-2196	19.80	21.10	23.50	23.04	18.50	21.19
21.	Biochem-20-22	JC-36	17.15	20.22	20.70	23.44	14.08	19.12
22.	Biochem-20-23	RCH-1	19.15	19.89	25.71	23.76	18.40	21.38
23.	Biochem-20-24	GSH-2180	19.06	19.63	21.10	25.80	18.50	20.82

Table 16: β-carotene (ppm)

S.NO.	Code	Genotype	BPR	PNT	HSR	KNG	LDH	Mean
1.	Biochem-20-1	RH (OE)-1804	3.12	2.78	2.89	3.47	2.77	3.01
2.	Biochem-20-2	LES-62	2.99	3.36	3.38	2.61	2.35	2.94
3.	Biochem-20-3	PDZ-15	2.49	2.72	2.99	2.25	2.06	2.50
4.	Biochem-20-4	RH-749	4.08	3.89	3.07	4.27	3.49	3.76
5.	Biochem-20-5	PDZ-12	3.62	5.00	2.80	2.23	2.29	3.19
6.	Biochem-20-6	RGN-73	5.06	5.06	3.89	5.07	2.36	4.29
7.	Biochem-20-7	LES-60	4.32	5.31	3.56	3.34	3.04	3.91
8.	Biochem-20-8	KRANTI	5.39	5.58	4.00	5.20	3.97	4.83
9.	Biochem-20-10	PDZ-1	3.90	4.50	4.42	3.29	3.66	3.95
10.	Biochem-20-11	RH (OE)-1807	4.44	5.39	4.90	3.50	4.04	4.45
11.	Biochem-20-12	PDZ-11	3.03	3.86	3.43	2.19	3.98	3.30
12.	Biochem-20-13	RH(OE)-706	4.46	5.61	5.48	3.31	5.13	4.80
13.	Biochem-20-14	PM 29	3.19	3.72	5.04	2.65	3.61	3.64
14.	Biochem-20-15	PDZ-14	3.09	3.61	3.80	2.57	3.71	3.36
15.	Biochem-20-16	LES-63	2.76	3.44	4.40	2.08	4.64	3.46
16.	Biochem-20-17	O I J 5001	3.05	3.14	4.08	2.97	4.13	3.47
17.	Biochem-20-18	9IJ 5001	3.39	4.19	4.69	2.59	5.05	3.98
18.	Biochem-20-19	GSH-1699	5.09	5.64	4.56	4.55	3.13	4.59
19.	Biochem-20-20	JC-32	4.53	4.58	5.19	4.49	4.41	4.64
20.	Biochem-20-21	GSH-2196	4.54	3.75	4.48	5.32	3.60	4.34
21.	Biochem-20-22	JC-36	4.62	4.63	5.60	4.60	4.21	4.73
22.	Biochem-20-23	RCH-1	4.39	5.11	3.09	3.67	2.87	3.82
23.	Biochem-20-24	GSH-2180	4.88	5.00	3.76	4.75	3.84	4.45

Table 17: Total glucosinolate (µmole/g)

S.NO.	Code	Genotype	BPR	PNT	HSR	KNG	LDH	Mean
1.	Biochem-20-1	RH (OE)-1804	59.78	78.87	44.28	89.06	71.08	68.61
2.	Biochem-20-2	LES-62	58.14	54.29	44.53	76.24	64.78	59.60
3.	Biochem-20-3	PDZ-15	15.99	14.08	21.65	20.85	15.44	17.60
4.	Biochem-20-4	RH-749	61.66	80.78	52.32	88.00	76.79	71.91
5.	Biochem-20-5	PDZ-12	24.35	19.36	40.59	22.89	20.40	25.52
6.	Biochem-20-6	RGN-73	59.70	78.16	57.65	82.00	72.21	69.94
7.	Biochem-20-7	LES-60	60.43	89.62	58.96	96.80	75.69	76.30
8.	Biochem-20-8	KRANTI	58.88	66.25	47.89	80.60	68.98	64.52
9.	Biochem-20-10	PDZ-1	18.78	21.94	30.11	19.18	22.92	22.59
10.	Biochem-20-11	RH (OE)-1807	71.50	67.69	52.81	72.82	86.83	70.33
11.	Biochem-20-12	PDZ-11	15.42	14.16	30.26	13.04	14.88	17.55
12.	Biochem-20-13	RH(OE)-706	70.68	84.99	60.84	84.32	73.55	74.88
13.	Biochem-20-14	PM 29	60.93	89.73	48.79	99.68	87.33	77.29
14.	Biochem-20-15	PDZ-14	15.25	17.21	24.93	16.14	17.85	18.28
15.	Biochem-20-16	LES-63	65.19	66.00	76.42	68.55	59.57	67.15
16.	Biochem-20-17	O I J 5001	18.94	25.50	31.90	19.94	21.84	23.62
17.	Biochem-20-18	9IJ 5001	13.69	0.00	15.09	14.25	16.94	12.00
18.	Biochem-20-19	GSH-1699	14.92	0.00	17.71	12.02	20.86	13.10
19.	Biochem-20-20	JC-32	17.96	21.56	27.96	15.95	18.54	20.39
20.	Biochem-20-21	GSH-2196	11.07	13.05	15.01	14.60	15.11	13.77
21.	Biochem-20-22	JC-36	17.63	17.96	30.91	19.62	24.16	22.06
22.	Biochem-20-23	RCH-1	17.47	21.32	32.64	18.02	16.30	21.15
23.	Biochem-20-24	GSH-2180	19.76	16.58	25.34	16.46	21.26	19.88

Table 18: Phytic acid (%)

S.NO.	Code	Genotype	BPR	PNT	HSR	KNG	LDH	Mean
1.	Biochem-20-1	RH (OE)-1804	2.56	2.00	2.75	2.45	3.13	2.58
2.	Biochem-20-2	LES-62	2.49	1.91	2.68	2.01	3.06	2.43
3.	Biochem-20-3	PDZ-15	2.20	1.79	2.34	1.99	2.60	2.18
4.	Biochem-20-4	RH-749	2.30	1.85	1.90	2.58	2.75	2.28
5.	Biochem-20-5	PDZ-12	1.98	1.67	2.21	2.45	2.29	2.12
6.	Biochem-20-6	RGN-73	2.17	1.66	2.59	2.59	2.67	2.34
7.	Biochem-20-7	LES-60	2.17	1.86	2.39	2.57	2.48	2.29
8.	Biochem-20-8	KRANTI	2.14	1.84	2.35	2.66	2.43	2.28
9.	Biochem-20-10	PDZ-1	2.42	2.41	2.08	2.51	2.44	2.37
10.	Biochem-20-11	RH (OE)-1807	2.54	1.94	2.02	2.52	3.14	2.43
11.	Biochem-20-12	PDZ-11	2.29	2.01	2.20	2.11	2.57	2.24
12.	Biochem-20-13	RH(OE)-706	2.30	1.97	1.91	1.99	2.64	2.16
13.	Biochem-20-14	PM 29	2.68	2.37	2.30	2.50	3.00	2.57
14.	Biochem-20-15	PDZ-14	2.55	2.36	1.99	2.34	2.74	2.40
15.	Biochem-20-16	LES-63	2.28	2.06	2.73	2.24	2.51	2.36
16.	Biochem-20-17	O I J 5001	2.34	2.04	2.26	2.18	2.63	2.29
17.	Biochem-20-18	9IJ 5001	2.55	2.07	2.00	2.17	3.04	2.37
18.	Biochem-20-19	GSH-1699	2.83	2.09	1.93	2.57	3.56	2.60
19.	Biochem-20-20	JC-32	2.47	2.09	2.00	2.63	2.85	2.40
20.	Biochem-20-21	GSH-2196	2.52	1.93	2.49	2.61	3.11	2.53
21.	Biochem-20-22	JC-36	2.53	2.01	2.44	2.58	3.05	2.52
22.	Biochem-20-23	RCH-1	2.40	1.91	1.90	2.58	2.88	2.33
23.	Biochem-20-24	GSH-2180	2.57	2.05	1.92	2.67	3.09	2.46

Table 19: Special entries fatty acid analysis (Mean values): (Evaluated at Six centers (Bharatpur, Pantnagar, Hisar, Kangra, Ludhiana and Kanpur).

Code	Genotype	PA	SA	OA	LA	LiA	EiA	EA	ω6/ ω3	OSI	S:M:P	S:U
Biochem-20-1	DRMR-Q-202	3.90	1.46	36.17	25.89	17.75	3.35	0.27	1.46	1.40	1:07:08	1:09
Biochem-20-2	DRMR-Q-1-2-37	3.95	1.13	28.22	25.74	20.03	1.37	0.93	1.29	1.10	1:06:09	1:08
Biochem-20-3	DRMR-Q-204	4.04	1.07	38.93	28.99	12.08	0.57	0.00	2.40	1.34	1:08:08	1:08
Biochem-20-4	DRMR-Q-1-22	4.01	0.56	35.31	30.84	12.57	1.20	0.27	2.45	1.14	1:08:10	1:08

(**PA**: Palmitic acid; **SA**: Stearic acid; **OA**: Oleic acid; **LA**: Linoleic acid; **LiA**: Linolenic acid; **EiA**: Eicosenoic acid; **EA**: Erucic acid; **ω6 and ω3 ratio; OSI**: Oil stability index; **SFA: MUFA: PUFA** ratio; **Saturated: unsaturated** fatty acid ratio)

Table 20: Special entries value addition analysis (Mean values):

Code	Genotype	protein	Met	Trp	PA	GLS	β-carotene	TAA
Biochem-20-1	DRMR-Q-202	32.77	1.74	1.14	2.49	18.07	2.83	15.95
Biochem-20-2	DRMR-Q-1-2-37	32.62	1.8	1.09	2.45	22.09	3.33	16.28
Biochem-20-3	DRMR-Q-204	32.12	1.66	1.12	2.30	18.65	3.11	14.57
Biochem-20-4	DRMR-Q-1-22	33.16	1.75	0.93	2.55	16.05	3.24	16.82

(**Met:** Methionine; **Trp:** Tryptophan; **PA**: Phytic acid; **GLS:** Glucosinolate; **TAA:** Total antioxidant activity)

Frontline demonstrations on Rapeseed-Mustard 2020-21

8.1 Distribution of frontline demonstrations

Under the scheme "Frontline demonstrations and other related activities of Oilseeds" funded under the NFSM-Oilseed by DAC&FW, Ministry of Agriculture and Farmers' Welfare, Govt. of India, 33 cooperating centres of AICRPRM/ ICAR institutes/ Ag. Universities/NGOs/FPOs conducted 2517 frontline demonstrations (FLDs) against the allocation of 2400 FLDs under irrigated as well as rainfed conditions on rapeseed (toria, yellow sarson, brown sarson gobhi sarson and taramira) and mustard (Indian mustard) in 80 districts across 15 states during 2020-21. Rajasthan had maximum (839) followed by Uttar Pradesh (340), Manipur (300), Assam (231) and Madhya Pradesh (170) FLDs. Out of 33 FLDs conducting centres, 9 were in Rajasthan, 6 in Uttar Pradesh, 2 each in Assam, Haryana, Jammu & Kashmir and Maharashtra and one each in rest of the 9 states. Maximum districts (16) were covered in Uttar Pradesh followed by 13 in Rajasthan, 8 in Maharashtra, 7 each in Haryana and Madhya Pradesh, 6 in Assam, 5 in Jammu & Kashmir, 4 each in Manipur and Punjab, 3 in Odisha and 2 each in Gujarat and Uttarakhand and one each in Himachal Pradesh, Telangana and West Bengal (Table 8.1). The sowing time spread from Sept. 9, 2020 (Uttarakhand) for toria to Dec 22, 2020 (Telangana) for Indian mustard.

8.2 Types of demonstrations

The 449 FLDs on rapeseed and 2068 on mustard were conducted. Maximum 2068 FLDs were conducted on Indian mustard followed by toria (254), gobhi sarson (114), yellow sarson (36), brown sarson (30) and taramira (15). All the demonstrations were conducted under whole package demonstrations in two different situations viz., irrigated (1879) and rainfed (638). Variety-wise analysis was also done to see the performance of demonstrated improved varieties. There were 13 varieties of Indian mustard followed by 3 each of toria and yellow sarson and 2 of of gobhi sarson under irrigated condition. The 4 varieties of toria, 3 of Indian mustard, 2 of taramira and one each of gobhi sarson and brown sarson were demonstrated under rainfed condition (Table 8.2). The results included the mean seed yield (kg/ha) for both the improved plot (IP) with improved technology and the farmers' plot (FP) with farmers' practice, besides yield superiority of improved technology (%), cost of cultivation (CoC), gross monetary return (GMR) and additional net monetary return (ANMR) in Rs/ha from the IP and benefit: cost (B:C) ratio for both the IP and FP.

8.3 Whole package FLDs of rapeseed-mustard under rainfed condition

Sriganganagar and Jobner centres (Rajasthan); Jhansi (Uttar Pradesh); AAU, Jorhat & Shillongani (Assam); Pantnagar (Uttarakhand); Khudwani (J&K); CAU, Imphal (Manipur); Kangra (Himachal Pradesh) and Bhubaneswar (Odisha) conducted 638 FLDs on WP of rapeseed-mustard under rainfed condition (Table 8.3). The maximum demonstrations (300) were conducted in Manipur on toria (183) and Indian mustard (117) under rainfed condition with mean seed yield of 1,014 kg/ha in IP and 805 kg/ha in FP. IP had a yield advantage of 26.0% and ANMR of Rs 7,398/ha under rainfed condition in Manipur. 210 demonstrations were conducted in Assam on Indian mustard (201) and toria (9) which recorded maximum yield advantage of 56.6% and maximum ANMR of Rs. 17,662/ha, followed by Odisha that recorded 45.9 % yield improvement in 20 FLDs on toria with 693 kg/ha average seed yield in IP and ANMR of Rs. 6,990/ha under rainfed condition**.** Rajasthan with 45 FLDs observed maximum mean seed yield of 1,544 kg/ha in IP and 1,378 kg/ha in FP with lowest yield advantage of 12.0% from IP over the FP under rainfed condition. J&K with average mean seed yield of 1,063 kg/ha in 30 FLDs on brown sarson observed yield advantage of 19.2% from IP with ANMR of Rs. 5,943/ha. Himachal Pradesh with average mean seed yield of 1,012 kg/ha in 27 FLDs observed yield advantage of 33.9% from IP. Uttarakhand conducted 6 FLDs on toria that gave mean seed yield of 1,125 kg/ha in IP and 960 kg/ha in FP. IP had a yield advantage of 17.2% and ANMR of Rs 7,036/ha under rainfed condition in Uttarakhand.

The maximum (1,544 kg/ha) and minimum (693 kg/ha) mean seed yield from IP were observed in Rajasthan and Odisha, respectively. The cost of cultivation of IP ranged from Rs. 14,393 /ha in Rajasthan to Rs 31,322 /ha in J&K under rainfed condition. The IP also had higher

B:C ratio in all states than that of FP in rainfed condition. The highest B:C ratio for IP (6.68) in Rajasthan and lowest (1.34) in Odisha were recorded.

8.4 Whole package FLDs of rapeseed-mustard under irrigated condition

The whole package technology demonstration included use of improved variety, balanced use of fertilizers, proper spacing, use of micronutrients and need based plant protection and scientific cultural practices in comparison to farmers' practices of crop cultivation. Bharatpur, KVK (Bansur), Jodhpur, Kota, Lupin, Solidaridad and VMFPCL centres/NGOs in Rajasthan; Varanasi, Kanpur, Ag. University (Banda), Jhansi, Agrimitta , Amity University (Noida) in Uttar Pradesh; Hisar and Bawal in Haryana; Morena and Jhansi in Madhya Pradesh; S K Nagar in Gujarat; Shillongani in Assam; Ludhiana in Punjab; Kangra in Himachal Pradesh; Chatha in J&K; Pantnagar in Uttarakhand; KVK, Kaneri (Kholapur) and Nagpur in Maharashtra; Kalyani in West Bengal; Bhubaneswar in Odisha and Jagtial in Telengana conducted 1879 FLDs on whole package of rapeseed-mustard under irrigated condition (Table 8.4).

The maximum FLDs (794) were conducted in Rajasthan where improved plot recorded average yield of 2,372 kg/ha with yield superiority of 13.8% and ANMR of Rs 17,758/ha.

Under irrigated condition, mean seed yield from IP ranged from 957 in Odisha to 2,606 kg/ha in Haryana, whereas from FP ranged from 614 in Odisha to 2,204 kg/ha in Haryana. The yield increase due to IP ranged from 7.14% in Punjab to 95.9% in J&K.

For IP, Haryana had the highest cost of cultivation (Rs 41,672/ha), while Jammu & Kashmir had the lowest cost of cultivation (Rs 19,200/ha).

The maximum ANMR (Rs 36,132 /ha) was reported due to the improved WP of Indian mustard in Uttar Pradesh, while minimum was in West Bengal (Rs 6,085 /ha). All IP had positive ANMR. The higher B:C ratio for the improved WP under irrigated condition in all the states. The highest B:C ratio of IP (4.72) was realized in Rajasthan (Table 8.4).

8.5 Varietal performance in Whole package FLDs of rapeseed-mustard under irrigated condition

An effort was also made to see the performance of demonstrated varieties in whole package demonstrations in different states under irrigated and rainfed condition.

8.5.1 Indian mustard

A total of 13 improved varieties of Indian mustard namely Giriraj, RH 725, NRCHB101, RH 749, CS 60, Azad Mahak, RB 50, GDM 4, RH-406, TAM 108-1, RCH 1, PHR 126 and PR 20 were used in WP covering 12 states under irrigated condition (Table 8.5). Improved variety RH 725 demonstrated in 45 FLDs in Uttar Pradesh recorded highest average yield of 2,906 kg/ha with a yield improvement of 45.4% over local (FP) practice and ANMR of Rs 50,218 /ha followed by CS 60 demonstrated in 11 FLDs in Uttar Pradesh with average seed yield of 2,856 kg/ha. The maximum yield improvement 109.6% was recorded in Jammu & Kashmir with Giriraj variety. The minimum yield improvement of 4.3% was reported from PHR-126 variety in Punjab, while minimum average seed yield of 957 kg/ha was reported from NRCHB-101 variety in Odisha.

The Giriraj variety was demonstrated in 4 states which recorded highest mean seed yield of 2,443 kg/ha with 14.3% yield improvement in Rajasthan (522 FLDs) followed by 2,286 kg/ha with 36.6% yield improvement in Uttar Pradesh (103 FLDs), 1,982 with 13.9% yield improvement in Madhya Pradesh (85 FLDs) and 1,488 kg/ha with maximum yield improvement of 109.6% in Jammu and Kashmir (60 FLDs) over FP.

The RH 725 variety was also demonstrated in 4 states which recorded highest yield improvement of 45.4% with mean seed yield of 2,906 kg/ha in Uttar Pradesh (45 FLDs) followed by 18.0% with mean seed yield of 2,667 kg/ha in Haryana (63 FLDs), 18.0% with mean seed yield of 2,180 kg/ha in Madhya Pradesh (20 FLDs) and 11.8% with mean seed yield of 2,347 in Rajasthan (176 FLDs) over FP.

The improved variety RH 749 was demonstrated in 3 states which recorded highest yield improvement of 48.0% with mean seed yield of 1,989 kg/ha in Uttar Pradesh (85 FLDs) followed by 22.0% with mean seed yield of 2,150 kg/ha in Haryana (4 FLDs) and 12.3% with mean seed yield of 1,757 kg/ha in Madhya Pradesh over FP.

The improved variety NRCHB 101 was demonstrated in 6 states which recorded highest mean seed yield of 2,033 kg/ha with yield improvement of 15.3% in Rajasthan (96 FLDs), followed by 1,389 kg/ha mean seed yield with 85.7% yield improvement in Jammu & Kashmir (37 FLDs), 1,334 kg/ha mean seed yield with 18.5% yield improvement in Mahashtra (50 FLDs), 1,192 kg/ha

mean seed yield with 31.6% yield improvement in Telangana (20 FLDs), 1,183 kg/ha mean seed yield with 22.7% yield improvement in West Bengal (40 FLDs) and 957 kg/ha mean seed yield with 55.9% yield improvement in Odisha (30 FLDs) over FP

In Uttar Pradesh, six improved varieties viz. RH 749, Giriraj, NRCHB 101, RH 725, CS 60, and Azad Mahak were demonstrated in 330 FLDs by 6 centres under irrigated condition. Out of which, improved variety RH 725 demonstrated in 45 FLDs in Uttar Pradesh recorded highest yield of 2,906 kg/ha with yield improvement of 45.5% over FP. In Uttar Pradesh, the improved variety Giriraj was used in maximum demonstrations (103 FLDs), which recorded average seed yield of 2,286 kg/ha with yield improvement of 36.6%. The improved variety RH 749 was demonstrated in 85 FLDs, which recorded average seed yield of 1,989 kg/ha with yield improvement of 48.0%. The improved variety NRCHB 101 was demonstrated in 75 FLDs, which recorded average seed yield of 1,786 kg/ha with yield improvement of 49.3%. The improved varieties Azad Mahak (11 FLDs) and CS 60 (11 FLDs) recorded a yield improvement of 53.4 and 43.0%, respectively in Uttar Pradesh.

The three improved varieties viz. Giriraj, RH 725 and NRCHB 101 were demonstrated in 794 FLDs by seven centres/FPOs in Rajasthan under irrigated condition. Out of which, improved variety Giriraj was demonstrated in maximum demonstrations (522 FLDs) conducted by Bharatpur, Lupin, Solidaridad, VMFPCL and Kota centres in Rajasthan recorded highest average yield of 2,443 kg/ha with yield improvement of 14.3% followed by RH 725 (176 FLDs), which recorded average seed yield of 2,347 kg/ha with yield improvement of 11.8% over FP. The improved variety NRCHB 101 demonstrated in 96 FLDs, recorded 2,033 kg/ha average seed yield under IP with yield improvement of 15.3%.

In Haryana, the improved variety RH 725 demonstrated in 63 FLDs by two centres recorded highest mean seed yield of 2,667 kg/ha with yield improvement of 18.0%, while RH 749 demonstrated in 4 FLDs by Bawal centre recorded mean seed yield of 2,150 kg/ha with yield improvement of 22.0%. The other improved variety RB 50 (4 FLDs) recorded 2,100 kg/ha average seed yield under IP with yield improvement of 20.8%.

The yield improvement of 12.7% with mean seed yield of 2,312 kg/ha from GDM 4 (50 FLDs) was recorded in Gujarat. In Maharashtra, the improved varieties TAM 108-1 (50 FLDs) recorded 1,084 kg/ha average seed yield with 22.2% yield improvement, over FP. The RH 406 variety demonstrated in 35 FLDs in Madhya Pradesh recorded 1,109 kg/ha average seed yield under IP with yield improvement of 23.0% while PR-20 variety demonstrated in 3 FLDs in Uttarakhand recorded 1,743 kg/ha average seed yield under IP with yield improvement of 19.4%

The maximum ANMR (Rs 50,218 /ha) was reported from RH 725 variety in Uttar Pradesh, while minimum (Rs. 5,406/ha) was from PHR 126 variety in Punjab. All IP had positive ANMR. The higher B:C ratio for all improved varieties under irrigated condition in all the states except PHR 126 due to relatively higher additional cost was realized. However, highest B:C ratio of IP (5.69) was realized from PHR 126 variety in Punjab. (Table 8.5).

8.5.2 Yellow sarson

Pantnagar conducted 20 FLDs with PPS 1 and 6 FLDs with Pant Sweta varieties of yellow sarson. The IP with Pant Sweta and PPS 1 had the average yield of 1,459 kg/ha and 1,361 kg/ha, respectively with yield improvement of 15.0% and 17.1%, respectively. Kanpur centre conducted 10 FLDs with Pitambari variety which recorded average yield of 1,705 kg/ha with maximum yield improvement of 35.6% and maximum ANMR of Rs. 21,815/ha from IP in Uttar Pradesh (Table 8.5).

8.5.3 Gobhi sarson

Kangra and Ludhiana centres conducted 56 FLDs each using GSC 7 variety of gobhi sarson (Table 8.5). The IP recorded maximum average yield of 2,125 kg/ha with a yield improvement of 11.2% and an ANMR of Rs 11,362 /ha in Punjab, while average seed yield of 1,255 kg/ha with a yield improvement of 41.0% and an ANMR of Rs 15,600 /ha was recorded from IP in Himachal Pradesh. Ludhiana centre also conducted 31 FLDs with PGSH-1707 variety which recorded average yield of 2,142 kg/ha with yield improvement of 4.5% and ANMR of Rs. 4,183/ha from IP in Punjab.

8.5.4 Toria

Pantnagar conducted 12 FLDs with Uttara and 3 FLDs with PT 508 varieties of toria. The IP with Uttara and PT 508 had the average yield of 1,351 kg/ha and 1,338 kg/ha, respectively with

yield improvement of 16.8% and 16.0%, respectively. Shillongani centre conducted 21 FLDs with TS-38 variety which recorded average yield of 1,252 kg/ha with yield improvement of 58.3% and ANMR of Rs. 17,241/ha from IP in Assam. All demonstrated varieties had higher B:C ratio than that of FP (Table 8.5).

8.6 Varietal performance in Whole package FLDs of rapeseed-mustard under rainfed condition

8.6.1 Indian mustard

A total of 3 improved varieties of Indian mustard namely RGN 298, NRCHB 101 and DRMR 150-35 were used in WP covering 3 states under rainfed condition (Table 8.6).

Sriganganagar in Rajasthan conducted 30 FLDs with RGN 298 variety of Indian mustard under rainfed condition which showed highest average seed yield of 1,747 kg/ha with yield improvement of 9.4% in Rajasthan.

The improved variety NRCHB 101 was demonstrated (228 FLDs) in 2 states under rainfed situations, which recorded highest mean seed yield of 1,213 kg/ha with highest yield improvement of 64.6% in Assam (116 FLDs) followed by 1,012 kg/ha mean seed yield with yield improvement of 26.8% in Manipur (112 FLDs) over FP. The DRMR 150-35 variety demonstrated (90 FLDs) in 2 states, which recorded maximum average seed yield of 1,232 kg/ha with maximum yield improvement of 46.5% in Assam, while the same variety in 5 FLDs recorded average seed yield of 1,032 kg/ha with yield improvement of 34.2% in Manipur over FP.

The maximum ANMR (Rs 19,088 /ha) was reported in Assam, while minimum (Rs. 7,658 /ha) was in Manipur from NRCHB 101 variety. All IP had positive ANMR. The higher B:C ratio for all improved varieties under rainfed condition in all the states under IP was realized. The highest B:C ratio of IP (6.88) was realized from RGN 298 variety in Rajasthan. (Table 8.6).

8.6.2 Toria

The improved variety TS 38 of toria was demonstrated (192 FLDs) in 2 states under rainfed situations, which recorded highest mean seed yield of 1,221 kg/ha with highest yield improvement of 58.6% in Assam (9 FLDs) followed by 1,015 kg/ha mean seed yield with yield improvement of 25.3% in Manipur (183 FLDs) over FP. Pantnagar conducted 4 FLDs with Uttara and 2 FLDs with PT 508 varieties of toria in Uttarakhand. The IP with Uttara and PT 508 had the average yield of 1,133 kg/ha and 1,110 kg/ha, respectively with yield improvement of 17.4% and 16.8%, respectively. Bhubaneswar centre conducted 20 FLDs with Sushree variety, which recorded seed yield of 693 kg/ha with yield improvement of 45.9%. The maximum ANMR (Rs 16,715 /ha) from TS 38 variety was reported in Assam, while minimum (Rs. 6,690 /ha) from PT 508 variety was in Uttarakhand. All IP had positive ANMR. (Table 8.6).

8.6.3 Gobhi sarson

Kangra centre used GSC 7 variety of gobhi sarson in 27 demonstrations conducted in Himachal Pradesh under rainfed condition (Table 8.6). The IP demonstrations with GSC 7 had an average seed yield of 1,012 kg/ha against 756 kg/ha in FP with a yield improvement of 33.9% and ANMR of Rs.10,485 /ha.

8.6.4 Brown sarson

Khudwani conducted 30 FLDs with Shalimar sarson 2 variety of brown sarson in rainfed situation of Jammu & Kashmir which recorded an average seed yield of 1,063 kg/ha with 19.20% yield improvement in IP. The demonstrated variety had higher B:C ratio than that of FP. (Table 8.6).

8.6.5 Taramira

Jobner centre conducted 15 FLDs using RTM 1355 and RTM 1351 varieties of taramira under rainfed situation of Rajasthan (Table 8.6). The demonstrations with RTM 1355 (7 FLDs) recorded an average seed yield of 1,165 kg/ha with a yield improvement of 19.9% and an ANMR of Rs 9,122 /ha, while demonstrations with RTM 1351 (8 FLDs) recorded an average seed yield of 1,114 kg/ha with a yield improvement of 21.6% and an ANMR of Rs 9,392 /ha.

8.7 Exploitable yield reservoir in rapeseed-mustard

It is evident from the productivity potentials and profitability of improved rapeseed-mustard production technologies that there exists vast potential to improve the rapeseed-mustard productivity under real farm situations. An attempt was made to estimate the extent of such yield reservoir available for exploitation (Table 8.7). Yield gap-I as a result of demonstration of improved technology over farmers practices was ranging from 7.1% in Punjab to 77.0% in Jammu & Kashmir, whereas, the yield gap-II (between IP and three year from 2017-18 to 2019-20 state average productivity) was ranging from 0.7% in West Bengal to as high as 269.4% in Maharashtra.

Exploitable production-1 (EP-I is the sum of 3 year State average production and production increased over State average production by bridging yield gap-I) and exploitable production-II (EP-II is the sum of 3 year State average production and production increased over State average production by bridging gap-II) were also worked out as indicated in Table 8.7.

It can be understood from the Table 8.7 that rapeseed-mustard productivity at national level could be improved by 23.0 and 29.1% by bridging the yield gaps-I and II, respectively. Similarly, the national rapeseed-mustard production could be increased from 8.93 to 10.99 and 11.53 mt by bridging yield gaps I and II, respectively. This indicates the presence of significant yield reservoir which can be exploited through spread of appropriate technology among the farmers. Therefore, there is an urgent need for effective transfer of improved rapeseed-mustard production technologies to the rapeseed-mustard growers in order to convince them to adopt such technologies so that yield gaps can be bridged and rapeseed-mustard production in the country can be stepped up.

8.8 Training of field level extension workers under the programme of FLDs and other related activities

For upgrading the knowledge and skills of grass root extension workers of States Department of Agriculture about research developments in the field of rapeseed-mustard, 14 training programmes for extension workers of two days each were organized by ICAR-DRMR and AICRPRM centres during 2020-21 under this scheme.

In these training programmes, a total of 336 extension personnel from State Department of Agriculture of Rajasthan, Uttar Pradesh, Madhya Pradesh, Gujarat, Jammu & Kashmir and Uttarakhand participated and they were made aware of the new technologies advances in rapeseed-mustard cultivation so that they communicate the same to the farmers in the field.

State of participants	Organizing AICRPRM Centre	Place of training	Dates	No. of participants
Uttar Pradesh	Varanasi	KVK, Mirzapur	6-7 Feb. 2021	20
	Varanasi	BHU, Varanasi	26-27 Feb. 2021	20
	Jhansi	RLBCAU, Jhansi	5-6 March 20021	20
	Kanpur	CSAUA&T	6-7 March 20021	20
Madhya Pradesh	Morena	ZARS Morena	06-07 Jan. 2021	24
		KVK, Datia	13-14 Jan. 2021	30
		KVK, Shivpuri	02-03 March 2021	34
		KVK, Ashok Nagar	05-06 March 2021	39
Gujarat	SK Nagar	CMRS, SDAU	21-22 Jan. 2021	24
J & K	Chatha	Chatha, Jammu	18-19 Feb. 2021	23
Uttarakhand	Pantnagar	GBPUAT, Pantnagar	13-14 March 2021	22
Rajasthan	Kota	ARS, Kota	22-23 Feb. 2020	20
Rajasthan (2 programme	Bansur	KVK, Bansur, Alwar	18-19 Feb. 2021	40

simultaneously)				
	Total			**336**

Table 8.1 State wise FLDs on rapeseed-mustard conducted during 2020-21

State	Centre(s)	Total FLDs	Districts covered	Crops	Period of Sowing 2020
Assam (ASM)	DoR, (AAU)	201	Majuli, Tinsukia, Dhemaji, Karbi Anglong, Nalbari	Indian mustard	Nov 05-20
	Shillongani (SHL)	30	Nagaon	Toria	Oct 25-Dec 20
Odisha	Bhubaneswar (BHU)	50	Keonjhar, Mayurbhanj, Bhadrak	Indian mustard Toria	Oct 14-Dec 16
Gujarat (GUJ)	S K Nagar (SKN)	50	Banaskantha, Patan	Indian mustard	Oct 10-Nov 8
Haryana (HAR)	Hisar (HSR)	51	Rewari, Bhiwani, Hisar, Fatehabad, Mahendragarh	Indian mustard	Sept 20-Oct.21
	Bawal (BAW)	20	Rewari, Mohindergarh	Indian mustard	Oct 19-30
Himachal Pradesh (HP)	Kangra (KNG)	54	Kangra	Gobhi sarson	Oct 10- 26
Jammu & Kashmir (J&K)	Chatha (CHT)	97	Jammu, Samba	Indian Mustard	Oct 25-Nov 20
	Khudwani (KHD)	30	Anantnag, Kulgam, Pulwama	Brown sarson	Oct 10-25
Madhya Pradesh (MP)	Morena (MOR)	100	Morena, Bhind, Datia, Ashok Nagar, Guna	Indian mustard	Oct 15-Nov 24
	Jhansi (JHI)	70	Niwari, Datia	Indian mustard	Oct 16-Nov 15
Maharashtra (MH)	Nagpur (NGP)	50	Akola, Amravati, Nagpur Chandrapur, Gondia Bhandara, Wardha,	Indian mustard	Oct 25-Nov 15
	KLP (50)	50	Kolhapur	Indian mustard	Nov 05-15
Manipur (MAN)	CAU (IMP)	300	Imphal West, Imphal East, Ukhrul, Bishnupur	Indian mustard Toria	Nov 11-Dec 8
Punjab (PUN)	Ludhiana (LDH)	75	Fazilka, Pathankot, Ludhiana Fatehgarh Sahib	Gobhi sarson Indian mustard	Oct 7-Nov 10
Rajasthan (RAJ)	Bharatpur (BPR)	400	Bharatpur	Indian mustard	Oct 8-Nov 2
	Bansur (BAN)	74	Alwar	Indian mustard	Oct 12-27
	Jodhpur (JDH)	70	Jodhpur, Nagaur, Pali	Indian mustard	Oct 25-Nov 8
	Kota (KOT)	50	Kota, Baran	Indian mustard	Oct 10-28
	Jobner (JOB)	15	Jaipur	Taramira	Oct 16-29
	Sriganganagar (SGN)	30	Sriganganagar	Indian mustard	Oct 15-25
	Lupin	100	Karoli, Dholpur	Indian mustard	Oct 12-Nov 3
	Solidaridad	50	Baran, Kota, Tonk, Bundi	Indian mustard	Oct 15-30
	VMFPCL	50	Bharatpur	Indian mustard	Oct 10-28
Telangana State (TS)	Jagtial (JGT)	20	Jagtial	Indian mustard	Nov 1-Dec 22
Uttar Pradesh (UP)	Banda (BND)	50	Banda	Indian mustard	Oct 28-Nov 15
	Jhansi (JHI)	30	Jhansi	Indian mustard	Oct 16-Nov 15
	Kanpur (KPR)	50	Unnao, Fatehpur, Kanpur Dehat, Kanpur Nagar, Kannuj, Firojabad.	Indian mustard,	Sept 22-Oct 29
	Varanasi (VAR)	120	Mirzapur, Chandauli, Bhadoi, Varanasi, Azamgarh	Indian mustard	Oct 15-Nov 10
	Amity University (AMT)	40	Gautam Budh Nagar Bulandshahar	Indian mustard	Oct 12-18
	Agrimitra	50	Mirzapur	Indian mustard	Nov 11-15
Uttarakhand (UK)	Pantnagar (PNT)	50	U.S. Nagar, Nainital	Indian mustard Toria, Yellow sarson	Sept 9-Oct.10
West Bengal (WB)	Kalyani (KLN)	40	Purulia	Indian mustard	Nov 5-12
15	**33***	**2517**	**80**	**6**	**Sept 9-Dec 20**

***Jhansi centre conducted FLDs in two states, viz. Uttar Pradesh and Madhya Pradesh**

Table 8.2 Frontline demonstrations conducted on rapeseed-mustard during 2020-21

Crop	FLDs (No)	Distribution of FLDs			
		Whole package		Varietal distribution (total No. of Varieties)	
		Irrigated	Rainfed	Irrigated	Rainfed
Toria	254	36	218	03	04
Gobhi sarson	114	87	27	02	01
Yellow sarson	36	36	00	03	00
Brown sarson	30	00	30	00	01
Taramira	15	00	15	00	02
Indian mustard	2068	1720	348	13	03
Total	**2517**	**1879**	**638**	**21**	**11**

Abbreviations used in the text and table: WP: whole package; IR: Irrigated; RF: Rainfed; YIOFP: Yield increase over farmer's practice; CoC: Cost of cultivation; GMR: Gross monetary return; ANMR: Additional Net Monetary Return; IP: Improved practices; FP: Farmers' Practices; B:C : Benefit : Cost;

Table 8.3 Performance of whole package FLDs on rapeseed-mustard under rainfed condition during 2020-21

State	Centre	Crops	FLDs	Mean yield (kg /ha)		YIOFP (%)	COC (Rs/ha)		GMR (Rs/ha)		ANMR (Rs/ha)	B: C Ratio	
				IP	FP		IP	FP	IP	FP		IP	FP
RAJ	SGN (30) JOB (15)	Indian mustard (30) Taramira (15)	45	1544 (1056-2400)	1378 (875-2100)	12.0	14393	13915	96169	86141	9550	6.68	6.19
ASM	DoR, AAU (201) SHL (9)	Indian mustard (201) Toria (9)	210	1227 (900-1550)	784 (630-1125)	56.6	24970	20482	61350	39200	17662	2.45	1.91
UK	PNT (6)	Toria (6)	6	1125 (1100-1180)	960 (950-990)	17.2	19865	19228	52313	44640	7036	2.63	2.32
J&K	KHD (30)	Brown sarson (30)	30	1063 (951-1179)	892 (785-971)	19.2	31322	27860	58465	49060	5943	1.86	1.76
MAN	CAU (300)	Indian mustard (117) Toria (183)	300	1014 (900-1120)	805 (670-950)	26.0	13146	11139	45630	36225	7398	3.47	3.25
HP	KNG (27)	Gobhi sarson (27)	27	1012 (775-1350)	756 (570-875)	33.9	21100	18465	51865	38745	10485	2.45	2.09
ODH	BHU (20)	Toria (20)	20	693 (623-741)	475 (416-518)	45.9	28275	23275	38115	26125	6990	1.34	1.12

Figure in parenthesis is the number of FLDs conducted by the centre

Table 8.4 Performance of whole package FLDs on rapeseed-mustard under irrigated condition during 2020-21

State	Centre	Crops	FLDs	Mean yield (kg /ha)		YIOFP (%)	COC (Rs/ha)		GMR (Rs/ha)		ANMR (Rs/ha)	B: C Ratio	
				IP	FP		IP	FP	IP	FP		IP	FP
RAJ	BPR (400) BAN (74) JDH (70) KOT (50) Lupin (100) Solidaridad (50) VMFPCL (50)	Indian mustard (794)	794	2372 (1600-3500	2084 (1400-2900)	13.8	32632	31670	154180	135460	17758	4.72	4.27
UP	VAR (120) KPR (50) BND (50) Agrimitra (50) AMTI (40) JHI (30)	Indian mustard (330) Yellow sarson (10)	340	2185 (950-3250)	1520 (890-2360)	43.8	30701	26933	131100	91200	36132	4.27	3.38
MP	MOR (100) JHI (70)	Indian mustard (170)	170	1786 (900-2640)	1548 (820-1950)	15.0	27298	25775	112518	97524	13471	4.12	3.78
HAR	Hisar (51) Bawal (20)	Indian mustard (71)	71	2606 (2000-3200)	2204 (1550-2700)	18.2	41672	38089	156360	132240	20537	3.75	3.47
GUJ	SKN (50)	Indian mustard (50)	50	2312 (1940-2903)	2052 (1656-2619)	12.7	29118	27058	107508	95418	10030	3.69	3.52
ASM	SHL (21)	Toria (21)	21	1252 (1110-1650)	791 (740-900)	58.3	27770	19656	68860	43505	17241	2.47	2.21
PUN	LDH (75)	Gobhi Sarson (60) Indian mustard (15)	75	2203 (1750-3090)	2056 (1600-2950)	7.1	29457	28147	127774	119248	7216	4.33	4.23
HP	KNG (27)	Gobhi sarson (27)	27	1255 (1015-1475)	889 (710-985)	41.0	25521	22363	64319	45561	15600	2.52	2.03
J&K	CHT (97)	Indian mustard (97)	97	1450 (1000-2000)	740 (600-850)	95.9	19200	14040	79750	40700	33890	4.15	2.89
UK	PNT (44)	Indian mustard (3) Yellow Sarson (26) Toria (15)	44	1396 (1250-1800)	1195 (1050-1510)	16.8	25847	24414	64914	55568	7913	2.51	2.27
MH	NGP (50) KLP (50)	Indian mustard (100)	100	1208 (700-1586)	1005 (575-1304)	20.2	22577	20503	56172	46733	7365	2.48	2.27
WB	KLN (40)	Indian mustard (40)	40	1193 (980-1375)	972 (700-1150)	22.7	31750	27900	53685	43750	6085	1.69	1.56
ODH	BHU (30)	Indian mustard (30)	30	957 (785-1056)	614 (535-671)	55.9	32275	25275	52635	33770	11865	1.63	1.33

TS	JGT (20)	Indian mustard (20)	20	1192 (900-1475)	906 (750-990)	31.6	20500	24250	55428	42129	17049	2.70	1.73

Table 8.5 Variety-wise performance in whole package FLDs on rapeseed-mustard under Irrigated conditions during 2020-21

State	Centre	Varieties	FLDs	Mean yield (kg /ha)		YIOFP (%)	COC (Rs/ha)		GMR (Rs/ha)		ANMR (Rs/ha)	B: C Ratio	
				IP	FP		IP	FP	IP	FP		IP	FP
Indian mustard													
RAJ	BPR (294) Lupin (100) Solidaridad (50) VMFPCL (50) KOT (28)	Giriraj	522	2443 (1600-3500)	2137 (1400-2900)	14.3	33668	32704	159445	138905	19576	4.73	4.24
RAJ	BPR (80) BAN (74) KOT (22)	RH-725	176	2347 (1600-3200)	2100 (1550-2500)	11.8	32470	31847	152555	136500	15432	4.69	4.28
RAJ	JDH (70) BPR (26)	NRCHB-101	96	2033 (2250-3000)	1763 (2000-2500)	15.3	27294	25729	132145	114595	15985	4.84	4.45
UP	VAR (50) JHI (30)	RH-749	85	1989 (950-3104)	1344 (1050-1861)	48.0	28131	23633	119340	80640	34202	4.24	3.41
UP	Agrimitra (50) VAR (40) KPR (13)	Giriraj	103	2286 (1750-3036)	1673 (1286-2100)	36.6	31818	29736	137160	100380	34698	4.31	3.37
UP	BND (50) VAR (25)	NRCHB-101	75	1786 (1325-1500)	1196 (890-1025)	49.3	27193	20932	107160	71760	29139	3.94	3.42
UP	AMT (29) KPR (16)	RH-725	45	2906 (2400-3250)	1998 (1400-2360)	45.4	34828	30566	174360	119880	50218	5.00	3.92
UP	AMT (11)	CS-60	11	2856 (2780-2900)	1997 (1830-2140)	43.0	32000	26400	171360	119820	45940	5.35	4.53
UP	KPR (11)	Azad Mahak	11	2259 (2100-2400)	1473 (1300-1700)	53.4	39765	34516	135540	88380	41911	3.40	2.56
HAR	HSR (51) BAW (12)	RH-725	63	2667 (2000-3200)	2261 (1700-2700)	18.0	41903	38472	160020	135660	20929	3.81	3.52
HAR	BAW (4)	RH-749	4	2150 (2000-2300)	1763 (1550-2000)	22.0	39850	35369	129000	105780	18739	3.23	2.99
HAR	BAW (4)	RB-50	4	2100 (2000-2200)	1738 (1600-1800)	20.8	39850	34778	126000	104280	16648	3.16	2.99
GUJ	SKN (50)	GDM-4	50	2312 (1940-2903)	2052 (1656-2619)	12.7	29118	27058	107508	95418	10030	3.69	3.52
MP	MOR (50) JHI (35)	Giriraj	85	1982 (1520-2640)	1740 (1500-1950)	13.9	27657	26254	124866	109620	13843	4.51	4.17
MP	MOR (30)	RH-749	30	1757 (1620-1890)	1564 (1460-1750)	12.3	24967	23234	114205	101660	10812	4.57	4.37
MP	MOR (20)	RH-725	20	2180 (2100-2315)	1835 (1750-1950)	18.0	31400	29500	141700	119275	20525	4.51	4.04

MP	JHI (35)	RH-406	35	1109 (900-1550)	900 (820-980)	23.0	26084	24662	66540	54000	11118	2.55	2.18
J&K	CHT (60)	Giriraj	60	1488 (1100-2000)	710 (600-840)	109.6	19200	14040	81840	39050	37630	4.26	2.78
J&K	CHT (37)	NRCHB-101	37	1389 (1000-2000)	748 (640-850)	85.7	19200	14040	76395	41140	30095	3.97	2.93
MS	NAG (50)	TAM-108-1	50	1084 (700-1529)	887 (575-1215)	22.2	17155	15807	50406	41246	7812	2.93	2.61
MS	KLP (50)	NRCHB-101	50	1334 (1124-1586)	1126 (922-1304)	18.5	28000	25200	62031	52359	6872	2.21	2.07
ODH	BHU (30)	NRCHB 101	30	957 (785-1056)	614 (535-671)	55.9	32275	25275	52635	33770	11865	1.63	1.33
WB	KLN (40)	NRCHB-101	40	1193 (980-1375)	972 (700-1150)	22.7	31750	27900	53685	43750	6085	1.69	1.56
TS	JGT (20)	NRCHB 101	20	1192 (900-1475)	906 (750-990)	31.6	20500	24250	55428	42129	17049	2.70	1.73
PUN	LDH (10)	RCH-1	10	2306 (1750-2765)	2170 (1575-2600)	6.3	29525	28250	133748	125860	6613	4.52	4.45
PUN	LDH (5)	PHR-126	5	2827 (2730-2955)	2710 (2650-2850)	4.3	28800	27420	163966	157180	5406	5.69	5.73
UK	PNT (3)	PR-20	3	1743 (1630-1800)	1460 (1370-1510)	19.4	29763	28780	81050	67890	12177	2.72	2.35
Yellow sarson													
UK	PNT (20)	PPS-1	20	1361 (1250-1500)	1162 (1080-1310)	17.1	25571	24116	63287	54033	7799	2.47	2.24
UK	PNT (6)	Pant Sweta	6	1459 (1380-1500)	1269 (1170-1325)	15.0	27608	26418	67844	59009	7645	2.45	2.23
UP	KPR (10)	Pitambari	10	1705 (1650-1800)	1260 (1200-1400)	35.3	37389	32504	102300	75600	21815	2.73	2.32
Gobhi sarson													
PUN	LDH (31)	PGSH-1707	31	2142 (1750-3090)	2050 (1600-2950)	4.5	29176	28023	124236	118900	4183	4.25	4.24
PUN	LDH (29)	GSC-7	29	2125 (1750-2750)	1911 (1625-2400)	11.2	29847	28369	127500	114660	11362	4.27	4.04
HP	KNG (27)	GSC-7	27	1255 (1015-1475)	889 (710-985)	41.0	25521	22363	64319	45561	15600	2.52	2.03
Toria													
UK	PNT (3)	PT-508	3	1338 (1290-1375)	1153 (1120-1190)	16.0	24873	23520	62217	53615	7249	2.50	2.27
UK	PNT (12)	Uttara	12	1351 (1200-1500)	1157 (1050-1280)	16.8	24691	23040	62822	53801	7370	2.54	2.33

ASM	SHL (21)	TS-38	21	1252 (1110-1650)	791 (740-900)	58.3	27770	19656	68860	43505	17241	2.47	2.21

Table 8.6 Varietal performance in Whole package FLDs of rapeseed-mustard under rainfed condition during 2020-21

State	Centre	Varieties	FLDs	Mean yield (kg /ha)		YIOFP (%)	COC (Rs/ha)		GMR (Rs/ha)		ANMR (Rs/ha)	B: C Ratio	
				IP	FP		IP	FP	IP	FP		IP	FP
Indian mustard													
RAJ	SGN (30)	RGN 298	30	1747 (1200-2400)	1597 (1100-2100)	9.4	16500	16500	113555	103805	9750	6.88	6.29
ASM	DoR, AAU (116)	NRCHB 101	116	1213 (980-1500)	737 (630-1125)	64.6	25332	20620	60650	36850	19088	2.39	1.78
ASM	DoR, AAU (85)	DRMR-150-35	85	1232 (900-1550)	841 (715-1008)	46.5	23993	20246	61600	42050	15803	2.56	2.07
MAN	CAU (112)	NRCHB 101	112	1012 (900-1110)	798 (675-900)	26.8	13070	11098	45540	35910	7658	3.48	3.23
MAN	CAU (5)	DRMR-150-35	5	1032 (970-1120)	769 (720-820)	34.2	13331	11200	46440	34605	9704	3.48	3.08
Toria													
ASM	SHL (9)	TS 38	9	1221 (1105-1385)	770 (690-800)	58.6	26721	18631	67155	42350	16715	2.51	2.27
MAN	CAU (183)	TS 38	183	1015 (900-1205)	810 (690-950)	25.3	13188	11162	50750	36450	12274	3.84	3.22
UK	PNT (4)	Uttara	4	1133 (1100-1180)	965 (950-990)	17.4	19700	19120	52685	44873	7232	2.67	2.34
UK	PNT (2)	PT-508	2	1110 (1100-1120)	950 (940-960)	16.8	20195	19445	51615	44175	6690	2.55	2.27
ODH	BHU (20)	Sushree	20	693 (623-741)	475 (416-518)	45.9	28275	23275	38115	26125	6990	1.34	1.12
Gobhi sarson													
HP	KNG (27)	GSC 7	27	1012 (775-1350)	756 (570-875)	33.9	21100	18465	51865	38745	10485	2.45	2.09
Brown sarson													
J&K	KHD (30)	Shalimar sarson -2	30	1063 (951-1179)	892 (785-971)	19.2	31322	27860	58465	49060	5943	1.86	1.76
Taramira													
RAJ	JOB (7)	RTM 1355	7	1165 (1078-1222)	972 (875-1022)	19.9	10200	8900	62910	52488	9122	6.16	5.89

RAJ	JOB (8)	RTM 1351	8	1114 (1056-1211)	916 (850-1014)	21.6	10162	8862	60156	49464	9392	5.91	5.58

Table 8.7 Exploitable yield reservoir of rapeseed-mustard in major states during 2020-21

State	No. of FLDs	FLDs Mean yield (kg /ha)		Yield gap- I (%)	Three year State average yield (Kg/ha) (2017-18 to 2019-20)	Yield gap- II (%)	Three year State average production (000 tonnes) (2017-18 to 2019-20)	Expected production (000 tonnes)	
		IP	FP					EP-I	EP-II
RAJ	839	2328	2046	13.8	1559	49.3	3932.2	4474.8	5870.8
HAR	71	2606	2204	18.2	1956	33.2	1170.5	1383.5	1559.1
MP	170	1786	1548	15.0	1438	24.2	1018.1	1170.8	1417.2
UP	340	2185	1520	43.8	1378	58.6	1006.2	1446.9	1595.8
WB	40	1193	972	21.7	1185	0.7	723.1	879.9	728.1
GUJ	50	2312	2052	12.7	1841	25.6	360.5	406.3	452.8
ASM	231	1229	785	56.6	633	94.2	182.2	285.3	353.9
PUN	75	2203	2056	7.1	1501	46.8	46.0	49.3	67.52
J&K	127	1359	764	77.0	947	43.5	44.2	78.2	63.4
MAN	300	1014	805	26.0	845	20.0	23.8	30.0	28.6
UK	50	1364	1167	16.8	900	51.6	14.4	16.8	21.8
HP	54	1133	823	37.7	555	104.1	4.7	6.5	9.6
MS	100	1208	1005	20.2	327	269.4	2.7	3.3	10.0
ODH	50	852	558	52.7	298	185.9	2.2	3.4	6.3
All India	**2497**	**1828.9**	**1481.7**	**23.0**	**1417**	**29.1**	**8936.4**	**10997.8**	**11536.9**

New Abbreviations used in FLDs report_2020-21

- **AMT:** Amity University, Noida
- **KLP:** Kolhapur KVK, Kaneri
- **VMFPCL:** Veeresh Multipurpose Farmers Producer Company Limited, Bharatpur
- **Lupin:** Lupin Human Welfare & Research Foundation, Bharatpur
- **Solidaridad :** Solidaridad Regional Expertise Centre, New Delhi
- **Agrimitra :** Agrimitra, Farmers Producer Company Limited, Mirzapur, Uttar Pradesh

Achievements of AICRP-RM coordinating centers

Varieties notified by SVRC of respective states:

Centre	Crop	Variety	Year of notification	State	Condition
Pantnagar	Yellow Sarson	Pant Girija	2020	Uttarakhand	Suitable for plains of Uttarakhand
Kangra	Gobhi Sarson	Him Palam Gobhi Sarson 1	2020	Himachal Pradesh	-
Ludhiana	Canola quality gobhi sarson hybrid	PGSH 1707	2020	Punjab	Timely sown and irrigated
Chatha	Toria	RSPT 6	2019	J&K	-
	Mustard	RSPR- 69	2019	J&K	-
Morena	Mustard	RVM-3	-	M.P., U.P., and Rajasthan	-
Varanasi	Mustard	HUJM 10-6	-	Uttar Pradesh	
Kanpur	Rai	Azad Mahak (KMR (E)15-2) Surekha (KMR 16-2)	2021 2021	Uttar Pradesh Uttar Pradesh	Early sown Timely sown
	Toria	Azad Chetna (TKM 14-2)	2021	Uttar Pradesh	Early sown
S.K. Nagar	Mustard	Gujarat Mustard 6	-	Gujarat	-

Publications of AICRP-RM coordinating centers:

Research paper published

Chatha

Bharat, Rajeev, Rai S. K. Vinod Gupta and Rahul Gupta (2020) Performance of Frontline Demonstrations for Increasing the Productivity of Rapeseed Mustard in Jammu Region, International journal of current microbiology and applied sciences. 9(7): 3285-3291.

Hisar

Mohan, N., Kumari , Nisha, Jattan, Minakshi, Avtar, R. and Rathore, Vineeta (2020) Aftermath of terminal heat stress on Indian mustard (*Brassica juncea* L.) : A brief review, *J. Oilseed Brassica*, (11)1:1-8.

Choudhary, R.R., Sheoran, R.K., Avtar, R., Kumar, D. and Samita (2020) Heterosis studies based upon *Mori* CMS system in *Brassica juncea* L., *Journal of Oilseed Brassica,* 11(2): 116-120. Monika, Yadav, R.C., Yadav, N.R., Avtar, R. and Singh, D. (2020) Correlation studies for drought tolerance in Indian mustard (*Brassica juncea*) under different water regimes, *Indian Journal of Agricultural Sciences*, 90(4):49-54.

Singh, Manjeet, Avtar, R., Pal, Ajay, Punia, Rakesh, Singh, Vivek K., Bishnoi, Mahavir, Singh, Anoop, Choudhary, Raju Ram and Mandhania, Siwani (2020) Genotype-specific antioxidant responses and assessment of resistance against *Sclerotinia sclerotiorum* causing Sclerotinia rot in Indian mustard. *Pathogens*, *9*(11), 892; https://doi.org/10.3390/pathogens9110892.

Singh, V.K., Avtar, R., Mahavir, Kumari, N., Manjeet and Kumar, R. (2020) Assessment of genetic diversity among Indian and exotic genotypes of *Brassica juncea* using phenotypic evaluation. *Indian Journal of Agricultural Research*, https://doi.org/10.18805/IJARe.A-5502.

Mohan, N., Kumari, Nisha, Jattan, M., Avtar, R., Rani, Babita and Sushil (2020) Response of antioxidative system of *Brassica juncea* (L.) Czern & Coss. to terminal heat stress. *Bangladesh J. Botany*, 49(4): 1185-1188.

Singh, V.K., Avtar, R., Mahavir, Kumari, N., Manjeet and Kumar, R. (2021) Assessment of genetic diversity and population structure in Indian mustard (*Brassica juncea*) using SSR markers. *Indian Journal Environmental Biology*, 42: 396-405. DOI: http: //doi.org/ 10.22438/jeb/42/2(SI)/SI-241.

Punia, Rakesh, Pavitra Kumari, Anil Kumar, A. S. Rathi, and Ram Avtar (2021) "Impact of weather parameters on alternaria blight of Indian mustard [(*Brassica juncea* (L.) Czern. & Coss.)]." *Bangladesh Journal of Botany*, 50(1): 15-19.

Jagdalpur

Mahendra; J. L. Salam (2020). Genetic Diversity Estimation in Toria [*Brassica rapa* (L.) Genotypes Collected from Baster platue. International journal of current microbiology and applied sciences 9(3): 2577-2584.

Ashish Sahu, J.L.Salam, Surbhi Verma and Stanley Samuel (2020) Combining ability and Heterosis for Seed Yield and its Attributes Traits in Indian Mustarda (Brassica juncea L. Czern and Coss). International journal of current microbiology and applied sciences 9(7): 720-727.

Vandana Chadar, R. R. Bhanwar, Y.P.S. Nirala and Luchika Rana (2020). Screening of Rapeseed and Mustard (Brassica) germplasm and breeding material against eryihphe cruciferarum causing powdery mildew under Bastar Plateau of Chhattishgarh. International journal of current microbiology and applied sciences. 9(5): 180-185.

Kanpur

Singh, M. and Tomar, A. Combining ability (gca and sca) and heterotic response analysis in Indian Mustard (Brassica juncea L. Czern and Coss) under Bundelkhand region. International Journal of Agricultural Invention, 5(1): 57-63.

Ram Avtar, Mahak Singh and Amit Tomar (2020). Genetic components analysis in Indian Mustard (*Brassica juncea* L. Czern & Coss). *Internationa Journal of Agricultural Invention*. 4(2): 175-181.

Manish Srivastava, Mahak Singh and Amit Tomar (2020). Selection parameter analysis in Indian mustard (Brassica juncea L. Czern & Coss). International Journal of Agricultural Invention. 4(2): 222-228.

Deepak Singh, D.K.Singh, Arun Kumar and Sucharu Singh (2020) Seasonal incidence of insect pests on Rapeseed-mustard, Int.J. Curr-microbial App. Sci. 9(4): 2525-2531.

Deepak Singh Pal, D.K.. Singh, Sindhe Pravin Gautam and Arun Kumar (2020). Bio-rational management of mustard aphid, (Lipaphis erysimi Kalt). International Journal of Chemical Studies:8(2)2554-2557.

Deepak Singh Pal, D.K. Singh, Arun Kumar and Sindhe Praveen Gautama (2020). Effect of Bio-rational approaches for management of mustard aphid, (Lipaphis erysimi Kalt) on seed yield and its economics. International entomology and Zoology Studies 8(3): 255-258.

Praveen G Shinde, Pratap A Divekar, D.K. Singh, Deepak Singh Pal, and Ansar Nadaf (2021). Bio pesticide management strategy for mustard aphid, Lipaphis erysimi (Homoptera: Aphididae). The Pharma Innovation Journal; 10(7):397-400.

Kota

Meena, B.S., Patidar, B.K., Meena, L.K., Meena, S.N. and Meena,K.C. 2020.Yield, quality and economics of Indian mustard (Brassica juncea) under different nutrient supply in clay loam soils of Rajasthan. Journal of Pharmacognosy and Phytochemistry; 9(4): 656-659.

Meena, B.S., Narolia, R. S., Meena, L. K., Meena, K.C. and Meena, S. N. 2020. Evaluation of hydrogel and salicylic acid application effect on yield, quality, economics and water-use efficiency of Indian mustard (*Brassica juncea*) in restricted irrigation condition of S-E Rajasthan. Int.J.Curr.Microbiol. App.Sci, 9(5): 3274-3283.

Sharma, A., Meena, B.S., Meena, R.K., Yadav, R.K., Patidar, B.K., Dhayal, S. and Kumar, R. 2020. Response of nitrogen, phosphorus and potassium on quality parameters and economics analysis of Indian mustard (*Brassica juncea* (L.) Czern and Coss). *Journal of Pharmacognosy and Phytochemistry* 9(5): 911-913.

Sharma, A., Meena, B.S., Meena, R.K., Yadav, R.K., Patidar, B.K., Dhayal, S. and Kumar, R. 2020. Effect of different levels of nitrogen, phosphorus and potassium on growth, yield attributes and yield of Indian mustard (*Brassica juncea* (L.) Czern and Coss) in S-E Rajasthan. *International Journal of Current Microbiology and Applied Sciences* 9 (09) :2216-2221.

Meena, J.K., Khajan Singh, Meena, P.K.P., R.K. and Meena, D. 2020. Studies on Genetic Variability, Correlation and Path Analysis in Lentil (*Lens culinaris*Medik.) Genotypes. *Int.J.Curr.Microbiol.App.Sci.* 9 (9):2078-2087.

Meena, H.O., Meena, P.K.P., Khajan Singh, Meena ,H.P. and Meena, D.2020. Genetic Divergence Analysis in Indian Mustard [*Brassica juncea* (L.) Czern&Coss.]. *Int. J. Curr. Microbiol. App. Sci.* 9 (10):2185-2192

Ludhiana

Agrawal, N., Gupta, M., Atri, C., Akhatar, J., Kuma,r S., Heselop-Harrison, J. S. and Banga, S. S. (2021) Anchoring alien chromosome segment substitutions bearing gene(s) for resistance to mustard aphid in *Brassica juncea-B. fruticulosa* introgression lines and their possible disruption through gamma irradiation. *Theoretical and Applied Genetics*, doi: 10.1007/s00122-021-03886-z.

Akhatar J., Goyal, A., Kaur, N., Atri, C., Mittal, M., Singh, M. P., Kaur, R., Rialch, I. and Banga, S S. (2021) Genome wide association analyses to understand genetic basis of flowering and plant height under three levels of nitrogen application in *Brassica juncea* (L.) Czern & Coss. *Scientific Reports* 11, 4278.

Akhatar, J., Singh, M.P., Sharma, A., Kaur, H., Kaur, N., Sharma, S., Bharti, B., Sardana V.K. and Banga, S. (2020) Association mapping of seed quality traits under varying conditions of nitrogen application in *Brassica juncea* L. Czern & Coss. *Frontiers in Genetics*, 11: 744.

Chugh, P. and Sharma, P. (2020) Evaluation of physiological and biochemical traits as screening technique for heat stress tolerance in Indian mustard [*Brassica juncea* (L.) Czern and Coss.] genotypes. *Plant Cell Biotechnology and Molecular Biology* 21: 64-81.

Chugh, P. and Sharma, P. (2021) Effect of heat stress on the relationship between SPAD and cholorophyll content in Indian mustard genotypes. *Current Journal of Applied Science and Technology* 40(15): 38-47.

Gudi, S., Atri, C., Goyal, A., Kaur, N., Akhatar, J., Mittal, M., Kaur, K., Kaur, G. and Banga, S. S. (2020) Physical mapping of introgressed chromosome fragment carrying the fertility restorer *(Rfo)* gene for Ogura CMS in *Brassica juncea* L. Czern&Coss. Theoretical and Applied Genetics, 133: 2949-2959.

Gupta, N., Gupta, M., Akhatar, J., Goyal, A., Kaur, R., Sharma, S., Goyal, P., Mukta, A., Kaur, N., Mittal, M., Prabha, S. M., Bharti, B., Sardana, V. K., Banga, S. S. (2020) Association genetics of the parameters related to nitrogen use efficiency in *Brassica juncea* L. *Plant Molecular Biology* 105:161-175.

Kaur, K., Sharma, P., Kaur, I. and Sardana, V. (2021) Nitrogen impact on morpho-physiological traits and yield of Indian mustard (*Brassica juncea*) genotypes. *Journal of Agricultural Science and Technology* 11: 1-14.

Priya, K., Sharma, P., Choudhary, O.P. and Sardana, V. (2021) Regulation of salinity tolerance in *Brassica juncea* (L.) introgression lines: Osmoprotectants, antioxidative molecules and ionic content. GSC Advanced Research and Reviews 06 (03): 116–131.

Morena

Jagendra Singh. 2020. Correlation and Path Studies for Seed Yield and Its Attributing Traits in Indian Mustard [*Brassica juncea* (L.) Czern & Coss.]. *Int.J.Curr.Microbiol.App.Sci.* 9(09): 620-626.

Nagpur

Parikshit D. Raut, Sandeep R. Kamdi, Beena Nair, Rajesh D. Deotale, Ankush D. Sapkal, Sharad S. Bhure, Jagdish M. Parbat and Nitin D. Dadas (2021). Heterosis for seed yield and yield contributing

characters in Indian mustard [*Brassica juncea* (L.). Journal of Soils and Crops; 31(1):105-109. NAAS rating – 4.50

Ankush D. Sapkal, Sandeep R. Kamdi, Beena Nair, Rajesh D. Deotale, Parikshit D. Raut, S. S. Bhure and J.M. Parbat (2021). Heterosis for seed yield and yield contributing characters in Indian mustard [*Brassica juncea* (L.)]. J. of Soils and Crops; 31(1):152-157.

Sandeep Kamdi, Sharad Bhure, Prakash Kadu Kshama Mehboob Shah, Jagdish Parbat and Suraj Kumre (2020). Genetic variability and correlation studies for yield and yield contributing characters in dvance lines of Indian mustard (*Brassica juncea*). Frontiers in Crop Improvement; 8 (2): 125-127.

Pantnagar

Pooja Upadhyay, AK Tewari, Devanshu Dev and GR Daniel (2021). Evaluation of different Brassica genotypes under field conditions against white rust disease (Albugo candida) of rapeseed-mustard for resistant. International Journal of Chemical Studies. 9 (1): 2694-2699.

Devanshu Dev; A. K. Tewari; Pooja Upadhyay and G. R. Daniel (2020). Identification and nomenclature of Albugo candida pathotypes of Indian origin causing white rust disease of rapeseed-mustard. European Journal of Plant Pathology. 1-17.

Kiran Goswami, AK Tewari and Pooja Upadhyay (2020). In vitro evaluation of fungicides against mycelial growth and sclerotial viability of Sclerotinia sclerotiorum (Lib.) de Bary, the cause of Sclerotinia rot of Rapeseed-mustard. Journal of Pharmacognosy and Phytochemistry. SP6: 285-290.

H Punetha, A. Adhikari (2020). Phenolic acid content and antioxidative capacity of methanolic extracts from quality Indian mustard genotypes. Journal of Oilseed Brassica. 11(2):110-115.

Rajeev Kumar, H Punetha, Dinesh Pandey (2020). Polymerase Chain Reaction (PCR) based cloning of Mitogen Activated Protein Kinase (MAPK3) in expression vector for isolation and purification of MAPK3 protein. Biotech Today: An International Journal of Biological Sciences. 10(1): 7-11.

Usha Pant, Ram Bhajan, Anita Singh, Kalpana Kulshesthra, AK Singh, Himanshu Punetha (2020). Green leafy mustard: A healthy alternative. Electronic Journal of Plant Breeding. 11 (1): 267-270.

Sanchika Snehi, Usha Pant, Ram Bhajan A.K. Singh and N.K. Singh (2020). Variability trait association and path analysis studies in local germplasm of yellow sarson (Brassica rapa var. Yellow sarson prain). Plant Archives. 20 (2): 4747-4752.

Ardeep, Negi M.S., Mahapatra B.S., Pandey S.T. and Jai Paul (2020). Effect of residual fertility on oil quality of Indian mustard (Brassica juncea L. Czern & Coss). International Journal of Chemical Studies. 8(5): 644-646.

Ardeep, Negi M.S., Mahapatra B.S., Pandey S.T., Jai Paul and Anupama Rawat (2020). Effect of residual fertility on yield of Indian mustard (Brassica juncea L. Czern & Coss). Journal of Pharmacognosy and Phytochemistry. 9(5): 2721-2727.

Ranital (Earlier Bhubaneswar)

Das, C.K., Nayak,U., and Pati, P. (2021).Elucidating the molecular anatomy of acetyl-CoA carboxylase in Brassica rapa for evolving climate-resilient interventions to minimize carbon footprints. Sustainable Chemical Engineering.2 :21-39

Shillongani

Chakrabarty, R. and Kalita, H. 2020. Study of disease complex in rabi oilseeds grown in *kharif* rice (*Oryza sativa* L.) – lands under agro-climatic condition of Central Brahmaputra Valley Zone of Assam. *Journal of Crop and weed.* 16(1): 186-191.

Kalita, B., Hazarika, D., Rahman, N. and Sarmah, P.C. 2021. Study on crop losses due to covid-19 lockdown period in Nagaon district of Assam. *Journal of Agri Search*.8(2):167-172.

S K Nagar

Jat, A. L., Prajapati, K. P., Patel, J. R. and Desai, A. G. (2020). Impact assessment of frontline demostrations on mustard [*Brassica juncea* L.) under North Gujarat agro-climatic region. *Journal of Oilseeds Research*, 37(4): 309-311.

Patel, P. B., Patel, P. J., Patel J. R. and Patel P. C. (2021). Elucidation of genetic variability and inter-relationship studies for seed yield and quality traits in Indian mustard [*Brassica juncea* (L.) Czern and Coss]. *Electronic Journal of Plant Breeding*, 12(2): 589-596.

Varanasi

Rana, Kiran, Parihar, Manoj, Singh, J.P. and Singh, Rajesh Kumar. 2020. Effect of sulfur fertilization, varieties and irrigation scheduling on growth, yield, and heat utilization efficiency of Indian mustard (Brassica juncea L.). Communications in Soil Science and Plant Analysis 51(2):265-275.

Singh, Sonam, Behera, Tusarkanta, Singh, Rajesh Kumar and Rakshit, Amitava. 2020. Impact of improved forms of sulphur on NPK status of soil under mustard (Brassica juncea L.) cultivation. International Journal of Chemical Studies 8(2): 645-648.

Rana, Kiran, Singh, J.P. Singh, Rajesh Kumar and Parihar, Manoj. 2020. Variation in dry matter accumulation and growth indices of different mustard (Brassica juncea L.) hybrids as influenced by irrigation scheduling and sulphur fertilization. Journal of Oilseed Brassica 11(2): 103-109.

LIST OF RAPESEED-MUSTARD RESEARCH SCIENTISTS

ASOM AGRICULTURAL UNIVERSITY (ASOM)

1. Dr. P.K. Dev Chaudhry, Pr. Scientist (Pl. Breeding), RARS, AAU, Shilongani, Nagaon, Asom-782001
2. Dr. P.C. Sarma, Agronomist, RARS, Shillongani, Nagaon 782 001
3. Dr. E. Phukan, Principal Scientist Entomology, RARS, Shillongani, Nagaon 782 001
4. Dr. (Ms.) R. Chakrabarty, Scientist (Pl. Pathology), RARS, Shillongani, Nagaon 782 001

BANARAS HINDU UNIVERSITY, VARANASI (U.P.)

5. Dr. Kartikeya Srivastava, Professor, Department of Genetics & Plant Breeding, Institute of Agricultural Sciences, BHU, Varanasi-221005
6. Dr. Rajesh Kumar Singh, Lecture-cum-Jr. Agronomist (OS), Institute of Agricultural Sciences, BHU Varanasi 221 005
7. Prof. S.S. Vaish, Deptt. of Plant Pathology, BHU, Varanasi-221005

BIRSA ARGICULTURAL UNIVERSITY, KANKE, RANCHI (JHARKHAND)

8. Dr. Arun Kumar, Jr. Breeder, BAU, Kanke, Ranchi 834 006
9. Dr. (Ms) Rajani Kiran Lakra, Jr. Agronomist, BAU, Kanke, Ranchi 834 006

CENTRAL AGRICULTURAL UNIVERSITY, IMPHAL (MANIPUR)

10. Dr. Pushparani Senjam, Pr. Pl. Breeder (Pl. Breeding), CAU, P.O. Box 23, Imphal- 795 004
11. Dr. Diana Shampurailapam, (Agronomist), CAU, P.O. Box 23, Imphal- 795 004

C.S.A. UNIVERSITY OF AGRICULTURE & TECHNOLOGY, KANPUR (U.P.)

12. Dr. Mahak Singh, Breeder (R&M), CSAUA&T, Kanpur 208 002
13. Dr. Rajbir Singh, Agronomist, (OS), CSAUA&T, Kanpur 208 002
14. Dr. D.K. Singh, Asstt. Prof. (Entomology), CSAUA&T, Kanpur 208 002

C.S.K. HIMACHAL PRADESH KRISHI VISHWA VIDYALAYA, PALAMPUR (H.P.)

15. Dr. (Mrs) Adarsh Bala, Pl. Breeder, SAREC, CSKHPKVV, Kangra 176 001
16. Dr. S.K.Gautam, Scientist (Agronomy), SAREC, CSKHPKV, Kangra 176 001
17. Dr. A.K.Manchanda, Agronomist, RRS, CSKHPKV, Dhaula Kuan 176 001

C.C.S. HARYANA AGRICULTURAL UNIVERSITY, HISAR (HARYANA)

18. Dr. Ram Avtar, Plant Breeder, CCS HAU, Hisar 125 004
19. Dr. Rakesh, Jr.Plant Pathologist, CCS HAU, Hisar 125 004
20. Dr. Sunita Yadav Asstt. Entomologist, CCS HAU, Hisar 125 004
21. Dr. Nisha Kumari, Biochemist,CCS HAU, Hisar 125 004
22. Dr. Vinod Goyal Jr. Plant Physiologist,CCS HAU, Hisar 125 004
23. Dr. Vineeta Rathore, Jr. Agronomist, CCS HAU, Hisar 125 004
24. Dr. Ashok Kumar Dehinwal, PI & Asst.Scientist (PB) CCS HAU, RRS, Bawal, Rewari 123 501
25. Dr. Bikram Singh, Agronomist, CCS HAU, RRS, Bawal, Rewari 123 501

DR. PANJABRAO DESHMUKH KRISHI VIDYAPEETH, AKOLA (MAHARASHTRA)

26. Dr.(Mrs.) Beena Nair, Breeder ,Genetics & Pl. Breeding, College of Agriculture, Nagpur 440 0001
27. Dr. Vishakha B. Pohare, Jr. Agronomist, College of Agriculture, Nagpur 440 001
28. Dr. Sandeep R.Kamdi, Jr. Breeder ,ARS , Washim, College of Agriculture, Nagpur 440 001

G.B. PANT UNIVERSITY OF AGRICULTURE & TECHNOLOGY, PANTNAGAR (UK)

29. Dr. A.K. Tiwari, Prof. & Programme coordinator,AICRP-RM , GBPUA&T, Pantnagar 263 145
30. Prof. M.S.Negi, Prof. & PI of AICRP-RM-Agronomy, GBPUA&T, Pantnagar 263 145
31. Dr. Himanshu Punetha, Biochemist, GBPUA&T, Pantnagar 263 145
32. Dr. Usha Bhatt, Jr. Breeder, GBPUA&T, Pantnagar 263 145
33. Dr. A.K. Pandey, SRO Entomology, GBPUA&T, Pantnagar 263 145

INDIRA GANDHI AGRICULTURAL UNIVERSITY, RAIPUR (CHATTISGARH)

34. Dr. J.L. Salam, Oilseeds Breeder, RRS, IGKV, Jagdalpur, Bastar 494 005
35. Dr. Raja Ram Bhanwar , Plant Pathologist, RRS, IGKV, Jagdalpur, Bastar 494 005

MAHATMA PHULE KRISHI VIDYAPEETH, RAHURI (MAHARASHTRA)

36. Dr. S.C. Patil, Principal Scientist & I/c Oilseeds, Res. Station, MPKVV, Jalgaon 425 001
37. Dr. Girish B. Chaudhary, Oilseeds Research Station, MPKVV, Jalgaon 425 001

ORISSA UNIVERSITY OF AGRICULTURE & TECHNOLOGY, RRTTS, Ranital (ODISHA)

38. Dr. Chinmay Kumar Dash, Plant breeder, College of Agri. OUA&T, Bhubaneswar
39. Dr. (Mrs.) Preeti Nanda Pati, Agronomist, College of Agri. OUA&T, Bhubaneswar

PUNJAB AGRICULTURAL UNIVERSITY, LUDHIANA (PUNJAB)

40. Dr. Virender Sardana, Pr. Agronomist (Incharge Oilseeds Station), PAU, Ludhiana 141 004
41. Dr. P.S. Sandhu, Principal Plant Pathologist, PAU, Ludhiana 141 004
42. Dr. Pushp Sharma, Principal Physiologist (Oilseeds) PAU, Ludhiana 141 004
43. Dr. (Ms.) Gurpreet Kaur, Sr. Breeder (Oilseeds), PAU, Ludhiana 141 004
44. Dr. Sarwan Kumar, Sr. Entomologist, PAU, Ludhiana 141 004
45. Dr. Chhaya Atri, Sr. Breeder, PAU, Ludhiana 141 004
46. Dr. Indu Bala Dehal, sBreeder, PAU, Ludhiana 141 004
47. Dr. Sanjula Sharma, Biochemist, Ludhiana 141 004
48. Dr Sunayana,Plant Breeder, Abohar 152 116

RAJMATA VIJAYA RAJE SCINDIA AGRICULTURAL UNIVERSITY, GWALIOR (M.P.)

49. Dr. Jogendra Singh, Scientist Plant Breeding, ZARS, Morena 476 001
50. Dr. Swati Singh Tomar, Entomologist, ZARS, Morena 476 001
51. Mr. N.K.Sharma, Senior Technical Officer, ZARS, Morena 476 001

Dr.RAJENDRA PRASAD CENTRAL AGRICULTURAL UNIVERSITY (PUSA), DHOLI (BIHAR)

52. Dr. Anil Pandey, Prof. Chief Scientist, Deptt. of Pl. Breeding (R&M), TCA,RPCAU, Dholi 843 121
53. Dr.Vikram Bharat, Jr. Agronomist, TCA,RPCAU, Dholi 843 121
54. Dr. C.S. Chaudhary, Jr., Pathologist, TCA,RPCAU, Dholi 843 121
55. Dr. Udayan Mukherjee, Prof. Chief Scientist (Ento), TCA,RPCAU, Dholi 843 121

RANI LAXMI BAI CENTRAL AGRICULTURAL UNIVERSITY, JHANSI, (U.P.)-284003

56. Dr. Rakesh Chaudhary, Scientist (Pl. Breedeing), RLBCAU, University, Jhansi, (U.P.) 284003
57. Dr. Artika Singh, Scientist (Agronomy), RLBCAU, University, Jhansi, (U.P.) 284003
58. Dr. Shubha Trivedi, Scientist (Plant Pathology), RLBCAU, University, Jhansi, (U.P.) 284003

S.K. RAJASTHAN AGRICULTURAL UNIVERSITY, BIKANER (RAJASTHAN)

59. Dr. Vijay Prakash, Prof. (Plant Breeding), ARS, (RAU), Sriganganagar 335 001
60. Dr. S.K. Bairwa, (Pathologist), ARS, (RAU), Sriganganagar 335 001
61. Dr.Dashrath Prasad, Jr. Agronomist, ARS, (RAU), Sriganganagar 335 001

SRI KARAN NARENDRA AGRICULTURAL UNIVERSITY, JOBNER (RAJASTHAN)

62. Dr.Manohar Ram, Asstt.Professor, (Pl. Breeding), SKN College of Agriculture, Jobner. 303329
63. Dr. Priyanka Kumawat, Agronomist, SKN College of Agriculture, Jobner, Jaipur 303 329

AGRICULTURE UNIVERSITY KOTA, BORKHERA, KOTA (RAJASTHAN)

64. Dr. B.S. Meena, Agronomist, ARS, Ummedganj, Nayapura, Kota – 324001
65. Dr. P.K. Prem Meena, Asstt. Prof., Plant Breeding, ARS, Ummedganj, Nayapura, Kota – 324 001

SARDAR KRUSHINAGAR DANTIWADA AGRICULTURAL UNIVERSITY, S.K. NAGAR (GUJARAT)

66 Dr. A.G. Desai, I/c, Center-Mustard Scheme, SKDAU, SK Nagar 385506
65 Prof. K.P.Prajapati, Breeder Mustard Scheme, SKDAU, SK Nagar 385506
66 Dr. J.R. Patel, Assistant Research Scientist (Plant Breeding), SKDAU, SK Nagar 385506
67 Dr. A.L. Jat, Assistant Research Scientist (Agronomy), SKDAU, S.K. Nagar 385 506
68 Dr. G.P. Gangwar , Assistant Research Scientist (Plant Pathology), S.K.D.A.U., S.K. Nagar 385 506
69 Prof. D.N. Tejani, Assistant Research Scientist (Entomology), S.K.D.A.U., S.K. Nagar 385 506

SHERE-E-KASHMIR UNIVERSITY OF AGRICULTURAL SCIENCES & TECHNOLOGY, CHATHA (Jammu & Kashmir)

70 Dr.Sunil Kumar Rai,Asst. Professor, Genetics & Plant Breeding, SKUAST-Jammu, FOA, Main Campus, Chatha,Jammu 180 002
71 Dr. Rajeev Bharat, Jr.Scientist (Agronomy), SKUAST-Jammu, FOA, Main Campus, Chatha, Jammu 180 002

UNIVERSITY OF AGRICULTURE SCIENCES, DHARWAD

72 Dr. B. R. Patil, Professor, Deptt. of Plant Breeding & Genetics, COA, Dharwad 580 005

BANDA UNIVERSITYOF AGRICULTUREL & TECHNOLOGY, BANDA (U.P)

73 Dr. N.K. Bajpai, Director Research, BUAT , Banda- 210 001
74 Dr. Hitesh Kumar, Pl. Breeder, BUAT, Banda- 210 001
75 Dr. Amit Singh, Associate Professor, (Agronomy), BUAT, Banda- 210 001

BHABHA ATOMIC RESEARCH CENTER, MUMBAI

76 Dr. Sanjay J. Jambhulkar, Scientific Officer 'G', Head EGFFS, NA&BTD, BARC, Mumbai 400 085
77 Dr. Archana N.Rai, scientist Officer,F, BARC, Mumbai 400 085

ICAR INSTITUTES

ICAR-DIRECTORATE OF RAPESEED-MUSTARD RESEARCH, BHARATPUR (RAJASTHAN)

78 Dr. P.K. Rai, Pr. Scientist, (Pl. Pathology & Acting Director), DRMR, Bharatpur 321 303
79 Dr. V.V. Singh, Pr. Scientist, (Genetics & Pl. Breeding), DRMR, Bharatpur 321 303
80 Dr. K. H. Singh, Pr. Scientist, (Genetics & Pl. Breeding), DRMR, Bharatpur 321 303
81 Dr. P.D. Meena, Pr. Scientist, (Pl. Pathology), DRMR, Bharatpur 321 303
82 Dr. Pankaj Kumar Sharma, Pr. Scientist (Pl. Pathology), DRMR, Bharatpur 321 303
83 Dr. A.K. Sharma, Pr. Scientist, (Ag. Extension), DRMR, Bharatpur 321 303
84 Dr. Bhagirath Ram, Pr. Scientist, (Genetics & Pl. Breeding), DRMR, Bharatpur 321303
85 Dr. Vinod Kumar, Pr. Scientist, Computer Application in Agri., DRMR, Bharatpur 321 303
86 Dr. R.S.Jat, Pr. Scientist, (Agronomy), DRMR, Bharatpur, 321303
87 Dr. Arun Kumar, Pr. Scientist, (Genetics), DRMR, Bharatpur 321 303
88 Dr. H.S. Meena, Senior Scientist, (Genetics & Pl. Breeding), DRMR, Bharatpur 321 303
89 Dr.Anubhuti Sharma, Pr. Scientist, Biochemistry, DRMR, Bharatpur 321 303
90 Dr. Ajay Kumar, Scientist, Sr.scale (Pl. Biotechnology), DRMR, Bharatpur 321 303
91 Dr.Mukesh Kumar Meena, Scientist, (Soil Science) , DRMR, Bharatpur 321 303
92 Dr.Mrs. Priyamedha, Scientist(SS), (Genetics & Pl. Breeding), DRMR, Bharatpur 321 303
93 Dr.Ibandalin Mawlong, Scientist, Biochemistry, DRMR, Bharatpur 321 303
94 Dr.Sujith Kumar, Scientist, Biochemistry, DRMR, Bharatpur 321 303
95 Mrs. Reema Rani Sherwal, Scientist, Biotechnology, DRMR, Bharatpur 321 303
96 Mr. Prashant Kumar, Scientist, Biotechnology, DRMR, Bharatpur 321 303
97 Dr. Harveer Singh, Scientist, Agronomy, DRMR, Bharatpur 321 303
98 Dr. Bhiru Lal Meena, Scientist, (Genetics & Plant Breeding), DRMR, Bharatpur 321 303
99 Dr. Murlidhar Meena, Scientist,(Soil Science), DRMR, Bharatpur 321 303
100 Dr. M.L.Dotania, Scientist,(Soil Science), DRMR, Bharatpur 321 303
101 Dr. Vasudev Meena, Scientist,Weed Science, DRMR, Bharatpur 321 303

ICAR-INDIAN AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI

102 Dr. D.K.Yadava, Pr. Scientist, Head, Seed Science & Technology, IARI, New Delhi 110 012
103 Dr.S.S Rathore, Pr. Scientist, Division of Agronomy, IARI, New Delhi 110 012
104 Dr. (Mrs.) Sujata Vasudev, Pr. Scientist (Genetics & Plant Breeding.), IARI, New Delhi 110 012
105 Dr. Naveen Singh, Pr. Scientist (Genetics & Plant Breeding.), IARI, New Delhi 110 012
106 Dr. Rajendra Singh, Pr. Scientist, (Genetics & Plant Breeding.), IARI, New Delhi 110 012
107 Dr.Yash Pal, Scientst, Division of Genetics, IARI, New Delhi 110 012
108 Dr. Navinder Saini, Pr. Scientst, Division of Genetics, IARI, New Delhi 110 012
109 Dr. M.K. Dhillon, Pr. Scientst, Division of Entomology, IARI, New Delhi 110 012

ICAR- NATIONAL BUREAU OF PLANT GENETIC RESOURCES, NEW DELHI

110 Dr. Rashmi yadav, Sr. Scientist, NBPGR, New Delhi 110 012
111 Dr. Jameel Akhtar, Pr. Scientist, NBPGR, New Delhi 110 012

ICAR-NATIONAL RESEARCH CENTRE ON PLANT BIOTECHNOLOGY, NEW DELHI

112 Dr. S.R. Bhat, Emeritus Scientist, NRCPB, New Delhi 110 012

ICAR - NATIONAL CENTRE FOR INTEGRATED PEST MANAGEMENT, NEW DELHI

113 Dr. M.S. Yadav, Pr. Scientist (Plant. Pathology.), NCIPM, New Delhi 110 012

ICAR- CENTRAL SOIL SALINITY RESEARCH INSTITUTE, KARNAL (HARYANA)

114 Dr. Joginder Singh, Scientist, CSSRI, Karnal 132 001

ICAR- INDIAN AGRICULTURAL STATISTICS RESEARCH INSTITUTE, NEW DELHI

115 Dr. Rajendera Prasad, Head, Division of Design of Experiments, IASRI, Library Avenue, Pusa, New Delhi-110 012

ICAR-VIVEKANANDA PARVATIYA KRISHI ANUSANDHAN SANSTHAN, ALMORA (UTTARAKHAND)

116 Dr. Lakshmi Kant, Head, Crop Improvement Division, VPKAS, Almora 263 601

PRIVATE ORGANISATIONS

117 Dr. Bhupesh Vaid, Pioneer Hi-Breed, Pioneer Hybrid Pvt. Ltd. Company, Gahlot Farm, Adjoining Sector-47, Opp. House No. 525, Gurugram (Haryana)
118 Dr.Nilasis Ghosh Dastidar,Namdhari Seed Pvt. Ltd.,104, Ist Floor , Block 5, Erose Garden, Faridabad (Haryana) Dr.

119 Dr. M.C. Gupta, Sr. Breeder (Mustard), Rasi Seeds (P) Ltd., Plot No. 126, Sector-8, IMT Manesar, Dist. Gurgaon-122 051 Haryana
120 Dr. R.K. Arora, Director, Mustard & Millet Research, Tierra Agrotech.Pvt. Ltd, Gurugram
121 Mr. S.U. Baig, Breeder, M/s. Nath Seeds Ltd., P B No.318, Nath House, Nath Road, Aurangabad
122 Mr. C.H.Mruthunjaya, Pr. Scientist, Mustard Crop, Hytech Seed India Pvt. Ltd. Alwar (Raj.)
123 Dr. Vijay P. Hande, Plant Breeder, Nirmal Seeds Pvt. Ltd,Pachora, Dist. Jalgaon 424201 (MS)
124 Dr. E. Selvarani, Research Scientist, Corteva Agriscience (Pioneer), MRRC, Jaipur (Raj.)
125 Mr. Saurabh Goel, Kamadgiri Seeds, Agra 282 004
126 Dr. Ved Prakash, M.D.,Shakti Vardhak Hybrid Seeds Pvt. Ltd. Tilak Bazar,Hisar
127 Dr. Bhojraj Singh, Breeder,-Mustard, Metahelix, Alwar, Rajasthan
128 Dr. R.S.Mahala, Director, Mustard & Millet Research,Seed Works Pvt. Ltd. Shri Krishana house,3 rd Floor, Banjara Hills, Hyderabad -500 034 (Telangana)
129 Dr. Kalyan Singh Shekhawat, Sentil Seeds Pvt. Ltd. IDAR, Near Surpur Viiage IDA, Gujrat 383430
130 Dr. Shankar Yadav,Sr. Breeder(Mustard) Seed Works International Pvt. Ltd.8-2-626/2,Road No 10 Shri Krishana house,3 rd Floor, Banjara Hills, Hyderabad -500 034 (Telangana)
131 Mr. Sushil Goenka, President, The Solvent Extractors' Association of India, 142, Jolly Maker Chambers No. 2, 14th Floor, 225, Nariman Point, Mumbai 400 021
132 Dr. Rajarshi Kundu, Managing Director, Mali Agri Tech Pvt Ltd, Subhas Avenue, Ranaghat-741201, Dist. Nadia, West Bengal
133 Dr. Shailash Kumar Breeder, UPL Ltd., Krishnama House, 8-2-418, 4th floor, Rd. No.-7, Banjara Hill, Hyderabad. Dr. Rajarshi Kundu, Managing Director, Mali Agri Tech Pvt Ltd, Subhas Avenue, Ranaghat-741201, Dist. Nadia, West Bengal
134 Dr. U.S. Singh, Breeder (Wheat & Mustard), Nuziveedu Seeds Limited, 905, 9th Floor, Kanchan Junga Bulding, Barakhambha Road, Connaught Place, New Delhi
135 Mr. Sushil Karwa, Managing Director, Krishdhan Seeds Pvt. Ltd., "Krishidhan Bhavan" D3 to D6, Addln. MIDC, Aurangabad Road, JALNA 431 213 Maharashtra

Appendix-III

Zone-wise research centres for multi-location testing

Zone I		
Jammu & Kashmir	**:**	**Khudwani*, Srinagar***
Himachal Pradesh	**:**	**Kangra, Dhaula Kuan*, Bajaura*, Una***
Zone II		
Jammu & Kashmir	**:**	**Chatha**
Punjab	**:**	**Ludhiana**
Haryana	**:**	**Hisar, Bawal, Karnal*, Palwal (Sohna)*, Panipat***
Rajasthan	**:**	**Navgaon, Sriganganagar**
Delhi	**:**	**IARI New Delhi***
Zone III		
Uttar Pradesh	**:**	**Kanpur, Varanasi, Lucknow*, Agra*, Banda*, Jhanshi, Modipuram***
Uttarakhand	**:**	**Pantnagar**
Madhya Pradesh	**:**	**Morena**
Rajasthan	**:**	**Kota, Bharatpur**
Bihar	**:**	**Dholi (on the basis of proceeding 2016)**
Zone IV		
Rajasthan	**:**	**Jobner, Mandor***
Gujarat	**:**	**S.K. Nagar, Junagarh***
Maharashtra	**:**	**Nagpur, Washim***
Zone V		
Chhattisgarh	**:**	**Jagdalpur**
Jharkhand	**:**	**Kanke**
West Bengal	**:**	**Kalyani**
Odisha	**:**	**Bhubaneswar**
Asom	**:**	**Shillongani**
Manipur	**:**	**Imphal**
Zone VI		
Karnataka	**:**	**Raichur*, Dharwad***
Telangana	**:**	**Hyderabad* Jagtial***

*** Voluntary Centre :**

Abbreviations used in the report

Zone I		**Zone III**		**Zone IV**	
SRN	**Srinagar**	**BPR**	**Bharatpur**	**WSM**	**Washim**
KHD	**Khudwani**	**KOT**	**Kota**	**SKN**	**S.K. Nagar**
KNG	**Kangra**	**DOL**	**Dholi**	**NGP**	**Nagpur**
DLK	**Dhaula Kuan**			**MDR**	**Mandore**
UNA	**Una**	**VAR**	**Varanasi**		
BJR	**Bajaura**	**LKW**	**Lucknow**		
		BND	**Banda**		
		PNT	**Pantnagar**		
Zone II					
CHT	**Chatha**	**MOR**	**Morena**	**Zone V**	
MOD	**Modipuram**				
MDG	**Mahendragarh**	**SBR**	**Sabour**	**KLN**	**Kalyani**
LDH	**Ludhiana**	**AGR**	**Agra**		
ABR	**Abohar**	**KPR**	**Kanpur**	**BHU**	**Bhubaneswar**
HSR	**Hisar**	**JHS**	**Jhanshi**	**JAG**	**Jagdalpur**
BAW	**Bawal**			**SHL**	**Shillongani**
KAR	**Karnal**				
NAV	**Navgaon**			**Zone VI**	
NDH	**New Delhi**			**RAI**	**Raichur**
PAL	**Palwal**			**DWD**	**Dharwad**
SGN	**Sriganganagar**			**HYD**	**Hyderabad**
GUG	**Gurugram**			**JGT**	**Jagtial**

Appendix-IV

Zone wise FLD's Centres

1. JHD : Jharkhand
2. CAU : Central Agriculture University, Imphal
3. RLBCAU : Rani Laxmi Bai Central Agriculture University, Jhanshi
4. AMT : Amity University, Noida
5. JGT : Jagtial Centre
6. AMT : Amity University, Noida
7. KLP : Kolhapur KVK, Kaneri
8. VMFPCL : Veeresh Multipurpose Farmers Producer Company Limited, Bharatpur
9. Lupin : Lupin Human Welfare & Research Foundation, Bharatpur
10. Solidaridad : Solidaridad Regional Expertise Centre, New Delhi
11. Agrimitra : Agrimitra, Farmers Producer Company Limited, Mirzapur, Uttar Pradesh