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# Proceedings

## 28<sup>th</sup> ANNUAL GROUP MEETING OF RAPESEED-MUSTARD RESEARCH WORKERS

**AUGUST 06-07, 2021**

**(USING VIRTUAL PLATFORM)**



**All India Coordinated Research Project on Rapeseed-Mustard  
(Indian Council of Agricultural Research)**

**ICAR-Directorate of Rapeseed-Mustard Research,  
Bharatpur, Rajasthan-321303**

**ICAR-DIRECTORATE OF RAPESEED-MUSTARD RESEARCH**  
**(ALL INDIA COORDINATED RESEARCH PROJECT ON RAPESEED-MUSTARD)**  
**28<sup>th</sup> ANNUAL GROUP MEETING OF**  
**RAPESEED-MUSTARD RESEARCH WORKERS ONLINE**  
**(August -6-7, 2021)**

<b>06.08.20201 (Friday)</b>	
<b>10.00-11.00</b>	<b>Welcome and Presentation of overall achievements of AICRP on Rapeseed-Mustard</b>
<b>Chairman</b>	Dr. T.R. Sharma, Deputy Director General (CS), ICAR, New Delhi
<b>Co-Chairman</b>	Dr. Sanjeev Gupta, Assistant Director General (O&P), ICAR, New Delhi
Welcome	Dr. P.K. Rai, Director, ICAR-DRMR, Bharatpur
Release of Publication	Dr. T.R. Sharma, Deputy Director General (CS), ICAR, New Delhi
Presentation of Research Highlights of AICRP-RM (2020-21) and ATR	Dr. P.K. Rai, Director, ICAR-DRMR, Bharatpur
Chairman's Remarks	Dr. T.R. Sharma, Deputy Director General (CS), ICAR, New Delhi
<b>11.00-13.30</b>	<b>TECHNICAL SESSION-I: Crop Improvement and Genetics Resources</b>
<b>Chairman &amp; Subject Expert</b>	Dr. S.S. Banga, National Professor, PAU, Ludhiana
<b>Co-Chairman</b>	Dr. Sanjeev Gupta, ADG (O&P), ICAR, New Delhi
<b>Convener</b>	Dr. P.K. Rai, Director, ICAR-DRMR, Bharatpur
<b>Rapporteurs</b>	Dr. V.V. Singh, Principal Scientist, Plant Breeding, ICAR-DRMR, Bharatpur Prof. Kartikeya Srivastava, GPB, I.A.Sc., B.H.U.
1. Presentation of results of crop improvement trials conducted in AICRP-RM during 2020-21	Dr. K.H. Singh, PI Pl. Breeding, ICAR-DRMR, Bharatpur
2. Formulation of technical programme for 2021-22	
<b>13.30-14.00</b>	<b>Lunch</b>
<b>14.00-14.30</b>	<b>TECHNICAL SESSION-II :Breeder Seed Production</b>
<b>Chairman</b>	Dr. D.K. Yadava, ADG (Seeds), ICAR, KrishiBhavan, New Delhi
<b>Co-Chairman</b>	Dr. Sanjay Singh, Director ICAR-IISS, Mau
<b>Rapporteurs</b>	Dr. H.S. Meena, Senior Scientist, Plant Breeding, ICAR-DRMR, Bharatpur Dr. Sunil Kumar Rai, Junior Scientist, Plant Breeding, SKUAS&T, Jammu
1. Scenario of Breeder seed production of Rapeseed-Mustard during 2020-21	Dr. Bhagirath Ram, PI, Seed Project, ICAR-DRMR, Bharatpur
2. Targets and allocation of Breeder seed production- 2021-22	
<b>14.30-15.30</b>	<b>TECHNICAL SESSION-III: Crop Production</b>
<b>Chairman &amp; Subject Expert</b>	Dr. A.K. Gupta, Dean, College of Agriculture, Jobner (SKNAU)
<b>Rapporteurs</b>	Dr. R.L. Chaudhary, Scientist, Agronomy, ICAR-DRMR, Bharatpur Dr. Rajiv Bharat, Jr. Scientist, Agronomy, SKUAS&T, Jammu
1. Presentation of results of Crop Production trials conducted in AICRP-RM during 2020-21	Dr. R.S. Jat, PI, Agronomy, ICAR-DRMR, Bharatpur
2. Formulation of technical programme for 2021-22	
<b>15.30-16.00</b>	<b>TECHNICAL SESSION-IV: Front Line Demonstration</b>
<b>Chairman</b>	Dr. S.K. Jha., Principal Scientist (O&P), ICAR, New Delhi
<b>Rapporteurs</b>	Dr. Ashok Kumar Sharma, PI, FLDs, ICAR-DRMR, Bharatpur

1. Presentation of results of FLDs conducted during 2020-21	Dr. Ashok Kumar Sharma, PI,	
2. Presentation on allocation of FLD for the year 2021-22	FLDs, ICAR-DRMR, Bharatpur	
<b>16.00-17.00</b>	<b>TECHNICAL SESSION-V: Crop Protection</b>	
<b>Chairman</b>	Dr. H.C. Sharma, Former VC, UHFSolan (H.P.)	
<b>Subject Expert</b>	Dr. H.C. Sharma, Former VC, UHF, Solan (H.P.)	
<b>Subject Expert</b>	Dr. G.S. Saharan, Ex-Prof. & Head, Plant Pathology, CCSHAU, Hisar	
<b>Rapporteurs</b>	Dr. Pankaj Sharma, Principal Scientist, ICAR-DRMR, Bharatpur Prof. S.S. Vaish, I.A.Sc., BHU, Varanasi Prof. M.S. Khan, Deptt. of Entomology, GBPUA&T, Pantnagar Dr. Sarwan Kumar, Scientist, Entomology, PAU, Ludhiana	
1. Presentation of results of Plant Pathological trials conducted in AICRP-RM during 2020-21	Dr. P.D. Meena PI, Plant Pathology, ICAR-DRMR, Bharatpur	
2. Formulation of technical programme for 2021-22		
1. Presentation of results of Entomological trials conducted in AICRP-RM during 2020-21	Dr. Sarwan Kumar, PI, Scientist, Entomology, PAU, Ludhiana	
2. Formulation of technical programme for 2021-22		
<b>August 7, 2021 (Saturday)</b>		
<b>9.30-10.30 h</b>	<b>TECHNICAL SESSION-VI: Biochemistry &amp; Plant Physiology</b>	
<b>Chairman</b>	Dr. K.R. Koundal, Former Joint Director Research, ICAR-IARI, New Delhi	
<b>Co-Chairman</b>	Dr. Maharaj Singh, Principal Scientist, ICAR- IISR, Indore	
<b>Rapporteurs</b>	Dr. Anubhuti Sharma, PI, Biochemistry, ICAR-DRMR, Bharatpur Dr. Pushp Sharma, PI, Plant Physiology, PAU, Ludhiana	
1. Presentation of results of Biochemistry trials conducted in AICRP-RM during 2020-21	Dr. Anubhuti Sharma, PI, Biochemistry, ICAR-DRMR, Bharatpur	
2. Formulation of technical programme for 2021-22		
1. Presentation of results of Plant Physiological trials conducted in AICRP-RM during 2020-21	Dr. Pushp Sharma, PI, Plant Physiology, PAU, Ludhiana	
2. Formulation of technical programme for 2021-22		
<b>10.30-11.30</b>	<b>TECHNICAL SESSION-VII: Varietal Identification Committee</b>	
<b>11.30-13.30</b>	<b>PLENARY SESSION</b>	
<b>Chairman</b>	Dr. T.R. Sharma, Deputy Director General (CS), ICAR, New Delhi	
<b>Co-Chairman</b>	Dr. Sanjeev Gupta, Assistant Director General (O&P), ICAR, New Delhi	
<b>Summary Recommendation</b>		
<b>11.30-12.30</b>	Highlights of deliberations of different sessions Dr. K.H. Singh, PI, Plant Breeding Dr. R.S. Jat, PI, Agronomy Dr. P.D. Meena PI, PI. Pathology Dr. Sarwan Kumar, PI, Entomology Dr. Anubhuti Sharma, PI, Biochemistry Dr. PushpAharma, PI, PI. Physiology Dr. Ashok Kumar Sharma, PI, FLDs	
<b>12.30-12.40</b>	Felicitation of Retiring Scientists of AICRP-Rapeseed-Mustard	
<b>12.40-13.15</b>	Presidential Address	Dr. T.R. Sharma, Deputy Director General (CS), ICAR, New Delhi
<b>13.15-13.30</b>	Vote of thanks	Dr. Sanjeev Gupta, ADG (O&P), ICAR, New Delhi

**XXVIII Annual Group Meeting of AICRP Rapeseed-Mustard  
August 06-07, 2021 at Online**

<b>Session I</b>	<b>: Inaugural</b>
<b>Chairman</b>	: Dr. T.R. Sharma, Deputy Director General (CS), ICAR, New Delhi
<b>Co-chairman</b>	: Dr. Sanjeev Gupta, Assistant Director General (O&P), ICAR, New Delhi
<b>Convener</b>	: Dr. P.K. RAI, Director, ICAR-DRMR, Bharatpur
<b>Rapporteur</b>	: Dr. H.K. Sharma, Sr. Scientist, ICAR-DRMR, Bharatpur

The inaugural session started with the welcome address and presentation by Dr. P.K. Rai, Director, ICAR-DRMR, Bharatpur. He welcomed Dr. T. R. Sharma, DDG (Crop Science), ICAR, New Delhi, Dr. Sanjeev Gupta, ADG (Oilseeds & Pulses), Dr. D. K. Yadava, ADG (Seed), ICAR, New Delhi, esteemed subject experts Prof. S.S. Banga, Dr. H.C. Sharma, Dr. K.R. Kaundal, Prof. G.S. Saharan, Dr. A.K. Gupta, Dr. Sanjay Singh, Dr. S.K. Singh, Dr. S.K. Jha, Dr. Maharaj Singh and all the delegates from different AICRP-RM centres. Dr. Rai presented the research highlights of AICRP-RM programme along with national and international scenario of area, production and productivity of rapeseed-mustard. He also presented the action taken report of recommendations of 27<sup>th</sup> AGM. He threw light on the ongoing programmes and apprised that during 2020-21, 177 trials of different disciplines were conducted under AICRP-RM at different centres across all zones.

Dr. T. R. Sharma, DDG (CS), ICAR, New Delhi and chairman of the inaugural session of Annual Group Meeting of AICRP-RM, praised the presentation of AICRP-RM programme by Dr. P.K. Rai, Director, ICAR-DRMR. On this occasion, Dr. T.R. Sharma, released five publications developed by ICAR-DRMR. In his inaugural address, he suggested to strengthen the basic studies including pre-breeding, marker assisted selection, genome editing etc. at ICAR-DRMR and other centres. He further suggested to use Brassica coenospecies (*Diplotaxis*, *Camelina sativa*, *Capsella*, *Arabidopsis*, *Erucastrum*) related to Brassica and allied genera in prebreeding programme to transfer resistance to biotic stresses (*Alternaria*, stem rot, aphid, orobanche) and abiotic stresses (drought, heat, cold). He further stressed upon the development of double zero varieties with differential expression of erucic acid and glucosinolate genes in plants and seeds which can be possible through use of biotechnological interventions. Further, he stressed upon identification of differentials for pathogens of white rust, *Alternaria* blight and stem rot. He emphasized that extensive efforts are needed for management of *Orobanche* parasite, which has become a major threat to the rapeseed-mustard crops. He said that there is need of collaborative work with other organizations including NIPB, Delhi University and PAU, Ludhiana etc.

He was happy that rapeseed-mustard area during 2019-20 increased to 6.86 mha with production of 9.12 mt. He congratulated all mustard fraternity including farmers, scientist and other stakeholders for their contribution in increasing the area and production of rapeseed-mustard. Furthermore, he urged the scientist of AICRP-RM to bridge the yield gap by development of improved production, protection technologies and high yielding varieties. He suggested to develop the segregating material using trait specific donors at some of lead centres and distributing them to other centres for selection of promising lines suitable to different mustard growing regions. He stressed to take up hybridization programme and distribution of segregating material in a big way.

He said that scientist should develop the improved package of practices relevant to present scenario and get them released in AICRP-RM just like release of varieties. He further stressed to disseminate these technologies to farmers.

The session ended with the vote of thanks given by Dr. P. K. Rai, Director, ICAR-DRMR. He expressed his sincere gratitude to Dr. T. Mohapatra, Secretary, DARE, GoI & DG, ICAR, New Delhi, Dr. T. R. Sharma, DDG (CS), ICAR, New Delhi, Dr. Sanjeev Gupta, ADG (Oilseeds & Pulses), Dr. D. K. Yadava, ADG (Seed), ICAR, New Delhi, for their constant encouragement, guidance and help to improve rapeseed-mustard research and development programme in the country. He also thanked all the esteemed subject experts and all the delegates.

## **XXVIII Annual Group Meeting of AICRP Rapeseed-Mustard August 6-7, 2021 at Online**

### **Session III: Planning and Technical Programme Formulation: Genetics & Plant Breeding**

**Chairman & Subject Expert** : Dr. S.S. Banga, National Professor, PAU, Ludhiana  
**Co-Chairman** : Dr. Sanjeev Gupta, ADG (O&P), ICAR, New Delhi  
**Convener** : Dr. P. K. Rai, Director, ICAR- DRMR, Bharatpur  
**Rapporteurs** : Dr. V.V. Singh, Principal Scientist, ICAR-DRMR, Bharatpur  
: Prof. Kartikeya Srivastava, I. A. Sc., BHU, Varanasi

At the outset, Chairman congratulated the scientists on the record production of rapeseed-mustard crops expected during crop season 2020-21. He also complemented the scientists for successful conduct of research experiments in spite of the unprecedented conditions due to ongoing pandemic. Chairman stressed upon the necessity of improving the precision of varietal trials. He later requested the Co-Chairman to conduct proceedings of the session. Dr. K. H. Singh, PI, Plant Breeding appraised the house about the entries tested and promoted and also raise the issues for discussion. Co-chairman in his remarks felt the necessity of a relook at the criteria being followed for promoting test genotypes. He also pointed out that some actions mentioned in ATR were not completed, even after one year. Therefore, ATR should be taken seriously and Director, DRMR should provide complete support to the committees constituted for the purpose. Co-chairman also helmed long deliberations with the rapeseed-mustard scientists and finalized following recommendations with inputs from the participants and Chairman.

1. Single low/double low entries and WR-resistant varieties may continue to be evaluated in separate trials. However, these may be tested along with conventional varieties in AVT-1 after ascertaining their single/double low-quality characteristics.
2. The matter of salinity trial was discussed in length and it was decided that entries inducted for salinity tolerance shall be evaluated for salinity tolerance first and promising salinity-tolerant strains shall be evaluated under targeted conditions in IVT. High performing genotypes will then be tested in AVT-1 under high fertility conditions along with other promotions in respective zones.
3. Proper weightage should be given to insect and disease resistance along with salinity tolerance and seed quality traits while promoting strains. Council may also consider defining acceptable level of yield penalties for special purpose genotypes required by farmers and industry.
4. Concentrated efforts are required for recommending more varieties in the areas with high scope of mustard cultivation and only a few recommended varieties.
5. More trials may be allocated to Banda (UP) centre as their entries performed very well in the trials.
6. A varietal trial of mustard may be allocated to Jagtial (Telangana)
7. Development of short duration, high yielding toria and mustard varieties should be taken up on a priority basis.

8. White rust-resistant varieties are in demand by farmers; therefore, efforts should be accelerated breeding of WR-resistant varieties.
9. Efforts may be made to immediately restore and further improve the facilities for estimating oil content and fatty acid profile available at ICAR-DRMR, Bharatpur.
10. It was stressed that sharing of segregating material is very important among AICRP partners. There should be a well-structured programme for sharing of breeding material among AICRP centres.
11. The germination issue of certain genotypes in IVT Timely sown irrigated and rainfed trials was discussed at length, the house decided that the breeders should check germination before submitting the entry for trials. The same lot of seeds should be used for all trials.
12. Dayal Seeds (PVT) LTD., Meerut offered to share 90–95 days maturing breeding lines with AICRP programme.
13. Recommendations of the Re-zonalization committee should be made available before the current sowing season. Director DRMR should provide long sought data support to the committee.
14. Promotion criteria of hybrid entries and near isogenics lines should be decided within a week so the promotion of promising hybrids and isogenics lines is decided for evaluation during ensuing crop season.

In his concluding remarks, Chairman emphasized the importance of conducting a strong pre-breeding programme with well-defined species/genera for important traits. Pre-breeding is a difficult and long-term activity with uncertain outcomes coupled and then there is a challenge linkage drag. He emphasized the necessity of conducting one-week orientation course for AICRP scientists interested in undertaking pre-breeding activities, before the ensuing crop season. He also advised DRMR to multiply the seeds from entries of large diversity panel made available to them and distribute to all interested partners. This NASF supported panel includes more than 70 alien introgression lines with variation for key defensive traits and plant architecture. He also proposed the necessity of using newly developed field plot techniques and statistical analysis methods to handle multilocation datasets to improve decision making by reducing the biased caused by high G x E interactions. He believed that the time has come to think of genomic prediction aided partial phenotyping to take care of unbalanced data sets resulting from erroneous or missing information from one or other location. The meeting ended with a vote of thanks to the chair, co-chair and the participating scientists.

Later on after in-depth deliberations, different crop wise trials were constituted and presented by Dr. K.H. Singh, PI, Plant Breeding.

## 1. AVT I YELLOW SARSON

### Zone V (Rainfed)

**Entries:** RMYS 2, PYS 2018-02, NRCYS 05-2 (ZC), YSH 401 (NC), Pitambari (LR), Filler

**Locations:** Shillongani, Imphal, Kanke, Kalyani, Bhubaneswar

## 2. Mustard

**2.1. IVT Early Mustard** (To be conducted in Lattice Design, layout is given in last section of plant breeding technical programme)

S N	Entry	Pedigree	Method of breeding	Centre
1	KMR(E) 21-1	Maya X RK 9807	Pedigree	CSAUA&T, Kanpur
2	KMR(E) 21-2	Varuna X RK 9803	Pedigree	CSAUA&T, Kanpur
3	DRMRHT 13-13-5-5	GM 2 X BPR 549-9	Pedigree	DRMR, Bharatpur
4	DRMRHT 13-13-5-4	GM 2 X BPR 549-9	Pedigree	DRMR, Bharatpur
5	DRMRIJ 16-9-7	NRCHB 101 X Pusa Swarnim	Inter-specific hybridization	DRMR, Bharatpur
6	DRMRCI-141	NPJ 112 X BPR 560-68	Pedigree	DRMR, Bharatpur
7	DRMRSJ 364	<i>B. rapa</i> var. <i>KOS-1</i> X <i>B. nigra</i>	Inter-specific hybridization	DRMR, Bharatpur
8	RH 1999-14	RH 1402 A x RH 1401	Pedigree	CCS HAU, Hisar
9	RH 1999-18	RH 1402A X RH 1007	Pedigree	CCS HAU, Hisar
10	PRE-2018-7	PR-2006-1xNDRE-4	Bulk	GBPUA&T, Pantnagar
11	PRE-2018-9	PR-2009-9xPR-20	Bulk	GBPUA&T, Pantnagar
12	NPJ 248	NRCHB-101/ NPJ 173	Pedigree selection	IARI, New Delhi
13	NPJ 249	NRCHB-101/ NPJ 173	Pedigree selection	IARI, New Delhi
14	SVJH- 69(Hybrid)	SVJA- 05 X SVJR- 10	Heterosis breeding	Shaktivardhak Hybrid Seeds, Pvt. Ltd.
15	PHR-8081 (Hybrid)	DTM 217 X DTMR	Hybrid breeding	PAU, Ludhiana
16	PHR-8425 (Hybrid)	DTM 269 X DTMR	Hybrid breeding	PAU, Ludhiana
17	BAUM-21-3	Mutant of P.Bold	Mutation breeding	BAU, Kanke, Ranchi
18	ORM 2019-25	ORM 3-2-1 x PM 25	Pedigree	OUAT, Bhubaneswar
19	TM 311	TJD1XPM25	Mutation breeding	BARC, Mumbai
20	HUJM (E) 20-4	MCN 10-11 x ASHIRWAD	Pedigree	BHU, Varanasi
21	RMX 9310 (Hybrid))	RSA 0122 X RSR 0032	CGMS based	Rasi Seeds, Pvt. Ltd.
22	ACN 226	ACN-9 x GM-2	Pedigree	CoA, Nagpur
23	Mali MS 90	Shivani/Bankura Local//Bankura Local	Pedigree	Mali Agri Tech Pvt Ltd, Nadia
24	Pusa Mustard 25 (NC)			
25	JD 6 (ZC)			
26	LR			
27	Pro 5111 (hybrid check)			

**Zonal check/Latest Release:** Zone II: Pusa Mustard 28 (NPJ 124); Zone III : Pusa Mustard 27 (EJ 17), Zone IV: GDM- 4, Zone V: NRCHB 101; Zone VI: NRCHB 101

**Locations:**

- Zone II** : Hisar, Ludhiana, Chatha, IARI New Delhi  
**Zone III** : Kanpur, Pantnagar, Morena, Bharatpur, Dholi, CAU Jhansi  
**Zone IV** : S. K. Nagar, Nagpur, Mandore, Junagarh  
**Zone V** : Kanke, Shillongani, Bhubaneshwar, Jagdalpur, Imphal, Kalyani  
**Zone VI** : Dharwad, Hyderabad (DOR), Raichur, Jagtial

**2.2 AVT I Early Indian mustard**

**Zone II**

Entries : PRE 2018-10, RH 1999-42#, PM 25 (NC), PM 28 (LR), JD 6 (ZC), Filler  
 Locations:Chatha, Hisar, Ludhiana, New Delhi  
 #Repeat entry

**2.3 AHT I Early Indian mustard**

**Zone III**

Entries : DRMRHJ 2403#, JD 6 (ZC), PM 28 (LR), PRO 5111 (Hybrid check), PM 25 (NC), Filler  
 Locations: Kanpur, Pantnagar, Morena, Bharatpur, Dholi, CAU Jhansi  
 #Repeat entry

**2.4. IVT Timely Sown, Irrigated**

(To be conducted in Lattice Design, layout is given in last section of plant breeding technical programme)

SN	Entry	Pedigree	Method of breeding	Centre
1	DRMRIJ 18-62	IJ- 31 X LET- 36	Pedigree	ICAR-DRMR, Bharatpur
2	DRMR 2019-19	DRMR 2035 X NRCHB-101	Pedigree	ICAR-DRMR, Bharatpur
3	DRMRCI- 147	DRMR 10-40 X DRMR 541-44	Pedigree	ICAR-DRMR, Bharatpur
4	SKM 1744	EC 287711 X RSK 28	Pedigree	SDAU, SK Nagar
5	SKM 1801	GM 3 X GDM 4	Pedigree	SDAU, SK Nagar
6	RGN-507	RGN 348 x RGN 229	Pedigree	ARS, Sriganaganagar
7	RGN-524	RL 1359 x Pusa Bold	Pedigree	ARS, Sriganaganagar
8	PBR 939	PBR 357 X Giriraj	Pedigree	PAU Ludhiana
9	RH 1934	JM 6011 X RH 1365	Pedigree	CCS HAU, Hisar
10	RH 2049	RH 1203 X RH 7846	Pedigree	CCS HAU, Hisar
11	KMR 21-3	Rusa Bold X Maya	Pedigree	CSAUA&T, Kanpur
12	KMR 21-4	Varuna X PR- 15	Pedigree	CSAUA&T, Kanpur
13	NPJ-252	NPJ 156/EJ 17	Pedigree selection	IARI, New Delhi
14	NPJ-253	KMR-12-1/NPJ 156	Pedigree selection	IARI, New Delhi
15	PRB-2016-1	PR-2006-1× PRB-2006-5	Bulk	GBPUA&T, Pantnagar
16	PR-2019-3	Krishna× NRCHB 101	Bulk	GBPUA&T, Pantnagar
17	HUJM-20-9	MCN 10-11 × HUJM 05-03	Pedigree	BHU, Varanasi
18	HUJM -10-6	HUJM-007 × Induced Mutant of Local collection	Pedigree	BHU, Varanasi



19	RMM 19-18	JM-4 x B-85		ZARS,Morena
20	ACN 237	Urvashi x BIOYSR	Pedigree	COA, Nagpur
21	ORM 18-29-5	ORM 8-5-11 x Pusa Bold	Pedigree	OUAT, Bhubaneshwar
22	DM- 1521	Laxmi X DSC 48		Dayal Seeds Pvt. Ltd. Meerut
23	BAUM-21-1	Mutant of Shivani with 900Gy+ 0.3 EMS (S4-15-1)	Mutation breeding	BAU, Kanke, Ranchi
24	JM-16-5	RSPR-01x RH 749	Pedigree	SKUAST, Chatha, Jammu
25	RB- 109	RH-846 X RH- 940	Pedigree	RRS, Bawal
26	Kranti (NC)			
27	Zonal Check			
28	Latest Release			

**Zonal Checks:** Zone I: RCC 4; Zone- II- RH 749; Zone- III - Maya; Zone- IV – Bio 902

**Latest Release:** Zone I- Giriraj; Zone- II (Irrigated) - Giriraj; Zone- III: RGN 73; Zone- IV-GDM-4

**Locations :**

**Zone I :** Kangara, Dhaulakua, Bazaura, Una

**Zone II:** Abohar, Bawal, Ludhiana, Hisar, Sriganaganar, New Delhi, Chatha, Modipuram

**Zone III:** Kanpur, Pantnagar, Morena, Kota, Varanasi, Dholi, Jhansi

**Zone IV:** S.K. Nagar, Nagpur, Jalgaon, Mandore, Pali (CAZRI), ARS Washim(COA, Nagpur)

**2.5. AVT-I (Timely Sown, Irrigated),**

**Zone I, Repeat**

**Entries:** AKMS 19-2, RGN 443, SKM 1626, PBR 385, PR 2016-4, PR 2016-8, DRMR 2017-16, RH 1676, Giriraj (LR), RCC 4 (ZC), Kranti (NC), RH 749 (ZC)

**Locations :** Kangara, Dhaulakua, Bazaura, Una

**2.6. AVT-I +II (Timely Sown, Irrigated/Quality/salinity)**

**Zone II**

**Entries:** RH 1975, RH 1974, RH(OE)-1807, JC 36#, PDZ-15#, PDZ-14#, LES 60\$, RH (OE) 1706\$, CS 2005-143\$, Giriraj (LR), RH 749(ZC), Kranti (NC), PM 29 (Quality LR), PDZ 1 (Double low check), CS- 54 (salinity ZC), CS 60 (salinity LR)

**Locations :** Abohar, Bawal, Chatha, Hisar, Ludhiana, Modipuram, New Delhi, Sriganaganar  
\$ AVT II Strain, # double low strain

**2.7. AVT-I +II (Timely Sown, Irrigated/Quality/salinity)**

**Zone III**

**Entries:** JC 36#, PDZ-15#, PDZ-14#, OIJ5001#, CS 2005-143\$, RGN 73 (ZC), Pusa Mustard 30 (quality LR), PDZ 1 (double low check), Kranti (NC), CS- 54 (salinity ZC), CS 60 (salinity LR), Filler

**Locations :** Pantnagar, Kanpur, Morena, Bharatpur, Varanasi, Dholi, Jhansi  
\$ AVT II strain (salinity), # double low strain

## 2.8. IVT Mustard, Timely sown (Rainfed)

SN	Entry	Pedigree	Method of breeding	Centre
1	DRMRCI-148	RH-819 X NRCDR-02	Pedigree	ICAR-DRMR, Bharatpur
2	DRMRHJ 1117	MJA 11 X MJR 17	Heterosis breeding	ICAR-DRMR, Bharatpur
3	DRMR 2019-7	RH 749 X NRCHB- 101	Pedigree	ICAR-DRMR, Bharatpur
4	DRMRHT 13-22-2	JN032 X BPR 549-9	Pedigree	ICAR-DRMR, Bharatpur
5	NPJ-254	NPJ 112 / BCEF 17-20-1	Pedigree	IARI, New Delhi
6	NPJ-255	KMR-12-1/NPJ 156	Pedigree	IARI, New Delhi
7	RGN-510	NPJ 182 x RH 406	Pedigree	ARS, Sriganaganagar
8	RGN-519	RGN 332 x RH 749	Pedigree	ARS, Sriganaganagar
9	RH 1928	RH 0749 X Phy 13-8	Pedigree	CCS HAU, Hisar
10	RH 1930	RH 0749 X DRMRIJ 11-275	Pedigree	CCS HAU, Hisar
11	PBR 552	RL 1359 X RGN 181	Pedigree	PAU, Ludhiana
12	PBR 357	(PBR-91 x RLM 514) x Bio-902	Pedigree	PAU, Ludhiana
13	BAUM-21-2	Mutant of Shivani	Mutation breeding	BAU, Kanke, Ranchi
14	CAU- RMM 3	Mutant of PM 25	Mutation breeding	DoR, CAU, Imphal
15	RB- 110	RH- 24 X RH-207	Pedigree	RRS, Bawal
16	Kranti (NC)			
17	Zonal Check			
18	Latest Release			

**Check : Zonal Check - Zone II :** RH 725 ; Zone V: NRCHB 101

**Latest Release –** Zone II : RH 761, Zone V : DRMR 150-35

**Locations:**

**Zone II :** Sriganaganagar, Hisar, Bawal, Ludhiana, Abohar

**Zone V :** Kanke, Jagdalpur, Shillongini, Bhubaneshwar, Imphal

## 2.9. AVT I+II Mustard, Timely sown (Rainfed)

**Zone II**

**Entries:** DRMRCI 128, RH 1424#, RGN 229 (ZC), RH 761 (LR for AVT I), RH 725 (LR for AVT II), Kranti (NC), Filler

**Locations:** Abohar, Bawal, Hisar, Ludhiana, Sriganaganagar

# AVT II Entry

## 2.10. IVT- Mustard Late sown

SN	Entry	Pedigree	Method of breeding	Centre
1	DRMRHT-13-7-113	NRCHB- 101 X BPR 549-9	Pedigree	DRMR, Bharatpur
2	DRMRHJ 430	OJA 4 X OJR 1	Heterosis breeding	DRMR, Bharatpur
3	DRMRSJ 272	<i>B. rapa</i> var. Jhumka X <i>B. nigra</i>	Inter-specific hybridization	DRMR, Bharatpur
4	DRMRCI 140	RH 819 X DRMR 270	Pedigree	DRMR, Bharatpur
5	RH 1939	RH 1130 X T 6342	Pedigree	CCS HAU, Hisar
6	RH 2050	RH 1203 X RH 7846	Pedigree	CCS HAU, Hisar
7	KMR(L) 21-5	Ashirwad X Urvashi	Pedigree	CSAUA&T, Kanpur
8	KMR(L) 21-6	Ashirwad X Krishna	Pedigree	CSAUA&T, Kanpur
9	NPJ 250	P Vijay/BioYSR//P Vijay	Pedigree	IARI, New Delhi
10	NPJ 251	PBR 357//NPJ 102/RGN 48//NPJ 174/PBR 2008-5	Pedigree	IARI, New Delhi
11	PAB-2014-7	Vardan × PAB 2002	Bulk	GBPUA&T, Pantnagar
12	PRB-2014-17	Varuna × PAB 9511	Bulk	GBPUA&T, Pantnagar
13	RGN-520	MOP 12-211 x RH 749	Pedigree	ARS, Sriganaganagar
14	RGN-522	PBR 423 x PBR 357	Pedigree	ARS, Sriganaganagar
15	BAUM-08-15	Bio-133-04 X BBM-07-1	Pedigree	BAU, Kanke, Ranchi
16	HUJM-20-6	MCN 10-11 × HUJM 9903	Pedigree	BHU, Varanasi
17	ACN 237	Urvashi x BIOYSR	Pedigree	CoA, Nagpur
18	Kranti (NC)			
19	Zonal Check			
20	Latest Release			

**Zonal check:** Zone-II - Pusa Mustard 26 (NPJ 113); Zone-III- NRCHB-101

**Latest Release :** Zone-II – Radhika (DRMR 2017-15); Zone-III- CS 56

### Locations:

**Zone II :** Sriganaganagar, Hisar, New Delhi, Ludhiana, Abohar

**Zone III:** Kanpur, Pantnagar, Varanasi, Morena, Dholi, Sabour

## 2.11. AVT-I Mustard, Late Sown (Irrigated)

### Zone – III

**Entries:** DRMR 2018-19, Kranti (NC), CS 56 (LR), NRCHB 101(ZC), Filler

**Locations:** Kanpur, Pantnagar, Varanasi, Morena, Dholi, Sabour

## 2.12. IHT, Hybrid Mustard

SN	Entry	Pedigree	CMS system used	Centre
1.	RHH 2101	RH 8812 X OR 31	Ogura CMS	CCS HAU, Hisar
2.	RHH 2102	<i>RH 0630 X OR 506</i>	Ogura CMS	CCS HAU, Hisar
3	RH 2103	RH 8812 X OR 506	Ogura CMS	CCS HAU, Hisar
4	PHR3281	IM60NA X MH-13	Ogura CMS	PAU Ludhiana
5	PHR4457	DTM32NA X AJR102B	Ogura CMS	PAU Ludhiana
6	PHR5175	DTM218NA X TCN	Ogura CMS	PAU Ludhiana

7	DRMRHJ 2518	MJA 25 X MJR 18	Moricandia CMS	ICAR-DRMR, Bharatpur
8	DRMRJH 3717	MJA 37 X MJR 17	Moricandia CMS	ICAR-DRMR, Bharatpur
9	DRMRHJ 3130	OJA 31 X OJR 1	Ogura CMS	ICAR-DRMR, Bharatpur
10	DRMRHJ 3720	MJA 37 X MJR 20	Moricandia CMS	ICAR-DRMR, Bharatpur
11	Pusa MH 62	Pusa MS 2-3A/RP 9-2-2	<i>ber</i> cytoplasm	IARI, New Delhi
12	Pusa MH 65	Pusa MS 2-3A/RP 2-3-3	<i>ber</i> cytoplasm	IARI, New Delhi
13	SVJH- 70	SVJA- 05 X SVJR- 13	Ogura CMS	Shakti Vardhak Hybrid Seeds Pvt. Ltd.
14	SVJH- 71	SVJA- 09 X SVJR- 10	Ogura CMS	Shakti Vardhak Hybrid Seeds Pvt. Ltd.
15	RMX9922	RSA 0039 X RSR 0002	Ogura CMS	Rasi Seeds, Pvt. Ltd.
16	NMH90M01	GRU 283A X GRU 509	Ogura CMS based	Nuziveedu Seeds Ltd.
17	KGMH 9198	27 A X 63 R	Hybridization	Kamadgiri Seeds
18	18J408C	4PHHW64A X 4PRTK05R	Ogura CMS based	Corteva Agriscience
19	NAMJH21-01	NAMJA1 X NAMJR6	Ogura CMS based	Namdhari Seeds Pvt. Ltd.
20	PMH90V02	GRU269A/GRU270B X	Selection & Hybridization	Prabhat Agri Biotech Ltd.
21	KMH 8765	SWJ03A X SWJ02R	Pedigree method with ogura CMS system	SeedWorks International Pvt Ltd Mustard Research Centre Jaipur
22	IJ16R1168	PA1IJ104 X PR10IJ055	Ogura CMS	Bayer Bioscience,Pvt. Ltd, Faridabad
23	Kranti (NC)			
24	Zonal Check			
25	DMH-1 (Check)			
26	45S46 (Check)			

**Observations on number of sterile/fertile plants are to be recorded on 20 plants per replication on boarder rows by covering main raceme at bud stage and recoding observation on seed set at maturity in hybrid trial.**

**Plant height(cm) data on 5 plants from each entry in each replication are also to be recorded in hybrid trial.**

Zonal check: Zone-II : RH 749    Zone-III : RGN 73    Zone IV : GDM 4

**Locations:**

**Zone II :** Hisar, Ludhiana, New Delhi, Palwal(Bayer), Mahendragarh (Shaktivardhak), Alwar (Corteva)

**Zone III :** Kanpur, Pantnagar, Morena, Kota, Bharatpur, Varanasi, Dholi, Jhansi, Faizabad (Namdhari Seeds)

**Zone IV:** SK Nagar, Mandore, ARS,Wasim(COA,Nagpur), Pali (CAZRI), Jalgaon

**2.13. IVT, Quality Mustard**

SN	Entry	Pedigree	Method of breeding	Centre
1.	LES- 64	LES 45 X NPJ 171	Pedigree selection	IARI, New Delhi
2.	LES- 65	Pusa Mustard 21 X PDZ-2	Pedigree selection	IARI, New Delhi
3.	PDZ-16#	Pusa Agrani X Heera	Pedigree selection	IARI, New Delhi

4.	PDZ-17#	Pusa Mustard 21 X PDZ-2	Pedigree selection	IARI, New Delhi
5.	JC-1	(PBR 210 X JM 06003) X NUDH YJ4	Pedigree	PAU Ludhiana
6.	JC-16	CJRB 1579-5-11 X JM06003	Pedigree	PAU Ludhiana
7	RH (OE)-1612	EC 552573 X RH 0305	Back Cross	CCS, HAU, Hisar
8	RH (OE)-1808	EC 552529 X AJ 3	Back Cross	CCS, HAU, Hisar
9	DRMRQ 143-9	NRCHB- 101 X PM- 21	Pedigree	ICAR- DRMR, Bharatpur
10	DRMRQ 4-3	NRCDR 02 X PM- 22	Pedigree	ICAR- DRMR, Bharatpur
11	DRMRCI(Q) 47	NRCHB- 101 X Heera	Pedigree	ICAR- DRMR, Bharatpur
12	DRMRCI(Q) 57	NRCHB- 101 X Heera	Pedigree	ICAR- DRMR, Bharatpur
13	IJ19R5004	PA7IJ136 X PR9IJ403	Heterosis breeding	Bayer Bioscience Pvt Ltd, Faridabad
14	LR			
15	Zonal Check			
16	PM 30 (NC quality)			
17	PDZ1 (double low check)			
18	Filler			

# - double low strains

**Zonal check :- Zone II –RH 749; Zone III – RGN 73**

**Latest Release (Quality Check):** Zone II- Pusa Mustard 32 (LES 54); Zone III- Pusa Mustard 30

**Locations:**

**Zone II :** Bawal, New Delhi, Hisar, Ludhiana, Sriganaganagar,

**Zone III :** Pantnagar, Kanpur, Morena, Bharatpur, Dholi, Jhansi, Varanasi

#### 2.14. IVT Mustard, Saline/alkaline conditions

SN	Entry	Pedigree	Method of breeding	Centre
1	CS 2020-10	RH 781 x CS 56	Bulk-Pedigree selction	ICAR- CSSRI, Karnal
2	CS 2009-234	CS 54 x Krishna	Bulk-Pedigree selction	ICAR- CSSRI, Karnal
3	CS 2013-64	CS 56 x Pusa Jagannath	Bulk-Pedigree selction	ICAR- CSSRI, Karnal
4	CS 2020-4	Rohini x CS 54	Bulk-Pedigree selction	ICAR- CSSRI, Karnal
5	NPJ 256	NPJ 124/NPJ 116	Pedigree	IARI, New Delhi
6	NPJ 231	Varuna/ NPJ 93	Pedigree	IARI, New Delhi
7	RH 1927	RH0749 x PHY 13-8	Pedigree	CCS HAU, Hisar
8	RH 1928	RH0749 x PHY 13-8	Pedigree	CCS HAU, Hisar
9	Kranti (NC)			
10	CS- 54 (check)			
11	CS 60 (LR)			

**Locations:** Agra, Hisar, Karnal, Nain (Panipat), Lucknow, Bikaner

Note: Trial is to be conducted in the soil having minimum of E<sub>Ce</sub> 10.0/pH > 9.0

### 2.15. Mustard: IVT White Rust Resistance\*

SN	Entry	Pedigree	Method of breeding	Centre
1	DRMRCI(W)- 125	Derived through MABC (NRCDR 02 X DONSKAJA)	Marker assisted back cross	ICAR-DRMR, Bharatpur
2	DRMRIJ 20-157	OJA 1 X OJR 4	Pedigree	ICAR-DRMR, Bharatpur
3	DRMRHJ 317	MJA 3 X MJR 17	Heterosis breeding	ICAR-DRMR, Bharatpur
4	DRMR 2018-25	NRCHB- 101 X DRMR 2398	Pedigree	ICAR-DRMR, Bharatpur
5	DRMR 2018-37	DRMR- 2019 X NRCDR 02	Pedigree	ICAR-DRMR, Bharatpur
6	RH 2007	TM 215 X RH 0401	Pedigree	CCS, HAU, Hisar
7	RH 2070	TPM 1 X RH 0401	Pedigree	CCS, HAU, Hisar
8	Basanti (WRR Check)			
9	Zonal Check			
10	LR			

**\*Observations are to be recorded in collaboration with plant pathologist on white rust reaction at 75, 100 days after sowing**

**Zonal Checks:** Zone- II- RH 749; Zone- III –Maya

**Latest Release:** Zone- II (Irrigated) - Giriraj; Zone- III: RGN 73

**Locations :**

**Zone II:** Ludhiana, Hisar, Sriganagar, New Delhi, Chatha

**Zone III:** Kanpur, Pantnagar, Morena, Dholi, Bharatpur

### 2.16. Mustard: White Rust Resistance AVT II-NIL

SN	Entry	Pedigree	Centre
1	Rohini (A4A5)-491	WRR Introgressed Rohini	CGMCP, UDSC, New Delhi
2	PB (A4A5)-842	WRR Introgressed Pusa Bold	CGMCP, UDSC, New Delhi
3	PJK (A4A5)-21	WRR Introgressed Pusa Jaikisan	CGMCP, UDSC, New Delhi
4	Varuna (A4A5)-936-279	WRR Introgressed Varuna	CGMCP, UDSC, New Delhi
5	Rohini (Parent)		
6	Pusa Bold (Parent)		
7	Pusa Jaikisan (Parent)		
8	Varuna (Parent)		
9	Zonal Check		
10	LR		

**Zonal Checks:** Zone- II- RH 749; Zone- III –Maya

**Latest Release:** Zone- II (Irrigated) - Giriraj; Zone- III: RGN 73

**Locations :**

**Zone II:** Ludhiana, Sriganagar, New Delhi, Chatha

**Zone III:** Kanpur, Pantnagar, Morena, Dholi, Bharatpur

### 3. Gobhi Sarson:

#### 3.1. IVT + AVT II Gobhi sarson (Trial is to be conducted in AVT II format)

SN	Entry	Pedigree	Method of breeding	Centre
1	GSH-2155	LG-5 X ZY005	Hybrid breeding	PAU, Ludhiana
2	GSH-1723	IG-1BC X ZY005	Hybrid breeding	PAU, Ludhiana
3	GSH-1703	AG28BC X ZY005	Hybrid breeding	PAU, Ludhiana
4	HNS 1102	HNS 0901 X EC552600	Pedigree	CCS, HAU, Hisar
5	HNS 1206	HNS 9516 X EC552600	Pedigree	CCS, HAU, Hisar
6	DRMRIN 20-23	GSC 6 X Pusa Swarnim	Interspecific hybridization	ICAR-DRMR Bharatpur
7	DRMRIN 20-3	GSC 6 X Pusa Swarnim	Interspecific hybridization	ICAR-DRMR Bharatpur
8	JGS-15-6	RSPN-25 x GSL-1	Pedigree	SKUAST, Chatha, Jammu
9	AKGS 8060	Sheetal x NUDH 86	Pedigree	SKRE, Kangra
10	<b>AKGS 19-8 (AVT II Strain)</b>			
11	GSL-1 (NC)			
12	Kranti (NC)			
13	GSC 6 (Quality check)			
14	AKMS 8141 (HPGS 1), LR			

**Locations:** Kangra, Dhaula Kuan, Bajaura, Chatha, Ludhiana, Abohar

## LAYOUT OF EXPERIMENTS

<b>Trials</b>	<b>IVT</b>	<b>AVT</b>
<b>Design</b>	RBD/Alpha Lattice	RBD
<b>Replication</b>	Three (two blocks in each replication)	Four
<b>Plot size Varieties- Zone II</b>	Gross: 2.7 X 5 m; Net: 1.8 X 4.5 m	Gross: 4.5 X 5 m; Net: 3.6 X 4.5 m
<b>Plot size Varieties-Zone I, III, IV &amp; V</b>	Gross: 1.8 X 5 m; Net: 1.2 X 4.5 m	Gross: 3.0 X 5 m; Net: 2.4 X 4.5 m
<b>Plot size Hybrids</b>	Gross Zone II; 2.70 X 5 m; Net: 1.80 X 4.5 m Gross Zone I, III, IV and V 2.25 X 5 m; Net: 1.35 X 4.5 m	Gross Zone I, III, IV and V Net: 4.5 X 5 m; Net: 3.6 X 4.5 m
<b>No. of Rows Zone I, II, III, IV &amp; V</b>	Six, Data to be recorded from four rows	Ten, Data to be recorded from eight rows
<b>No. of Rows NEH region</b>	Seven of 4 m length	Twelve of 4 m length
<b>Spacing varietal trials</b>	45 X 15 cm Zone II 30 X 10 cm Zone I, III, IV and V	45 X 15 cm Zone II 30 X 10 cm Zone I, III, IV and V
<b>Spacing hybrid trials</b>	45 X 15 cm	45 X 15 cm

**Note : In case of combined IVT + AVT 1 Trial, layout of AVT I Trial shall be followed**

### Fertilizer doses :

Toria	:	50 : 25 : 25 , N: P <sub>2</sub> O <sub>5</sub> : K <sub>2</sub> O kg/ha
Yellow sarson	:	50 : 30: 30, N : P <sub>2</sub> O <sub>5</sub> : K <sub>2</sub> O g/ha
Mustard, Karan	:	Irrigated-80 : 40 : 40, N : P <sub>2</sub> O <sub>5</sub> : K <sub>2</sub> O kg/ha
Rai, Gobhi Sarson	:	Rainfed- 40 : 20 : 20, N : P <sub>2</sub> O <sub>5</sub> : K <sub>2</sub> O kg/ha
Taramira	:	30 N kg/ha
Hybrids	:	125 % of RDF for the respective states

### Seed Supply:

- Seed material of Toria and Mustard (Early sown) trials should be sent latest by 20<sup>th</sup> August
- Seed material of rest of the trials should be sent latest by 30<sup>th</sup> August
- In case of late receipt of seed material, it will not be included in the trials.
- 50 g seed for IVT and 100 g seed for AVT for each location should be sent.
- 200 g seed packet of IVT, AVT 1 and AVT 2 entries should be sent separately for Entomological and Pathological experiments.
- 250 g seed / location of AVT-2 entries should be sent separately for Agronomical experiments.
- **300 g seed of each quality strain should be sent separately for biochemical analysis**

### Data reporting:-

- Data should be sent to Director, DRMR ( [director.drmr@gmail.com](mailto:director.drmr@gmail.com)) on the prescribed data sheets latest by May 15, otherwise it will not be possible to include in the report



- Weather data with brief weather report should be supplied along with trial data.
- Yield data (kg/ha) should be sent after analysis. Unanalyzed data will not be included in Annual Report.
- Entries along with pedigree and method of breeding should be sent in the prescribed proforma available at DRMR website latest by 10<sup>th</sup> July for inclusion in concerned IVT trial.

**Note:**

- In each case, preceding crop may be reported.
- Soil test for NPK may be got done and reported along with the results.
- No irrigation is to be given for rainfed experiments and 5m buffer spacing in all sides should be kept.
- If there is no rain before the sowing, pre-sowing irrigation is to be given.
- The centres, which have accepted the trials, must report data otherwise their test entries will not be included in trials if the data are not supplied without any valid reason.

**Cut off sowing dates for different trials**

S.N.	Trial	Zone				
		I & II	III	IV	V	VI
1	Toria	30 <sup>th</sup> September	10 <sup>th</sup> October	10 <sup>th</sup> October	31 <sup>st</sup> October	15 <sup>th</sup> November
2	Yellow sarson	31 <sup>st</sup> October	31 <sup>st</sup> October		31 <sup>st</sup> October	15 <sup>th</sup> November
3	Early mustard	30 <sup>th</sup> September	10 <sup>th</sup> October	10 <sup>th</sup> October	15 <sup>th</sup> November	30 <sup>th</sup> November
4	Indian mustard, TS Irrigated/ Rainfed, (Hybrid, Quality, Salinity)	31 <sup>st</sup> October	31 <sup>st</sup> October	31 <sup>st</sup> October	30 <sup>th</sup> November	30 <sup>th</sup> November
5	Indian mustard Late Sown	November 15-30	November 15-30	November 15-30		

**Criteria for promoting the strains**

- The strain (variety/hybrid) out yielding the best check by margin of at least 10 percent either for seed yield or for oil yield shall be promoted for advanced stage of testing, however an exemption upto 10 kg for seed yield may be considered.
- The qualifying strains for possessing any specific trait like quality, drought, and disease and pest resistance will be promoted even if its yield is at par with the best check.
- In single zero lines, promotion shall be on the basis of 10 % superiority for seed/oil yield over quality check as well as seed/oil yield at par/ better than the best non quality check
- In double zero lines, promotion shall be on the basis of 10% superiority for seed/oil yield over quality check as well as at least -10% seed/oil yield of the best non quality check

- The qualifying trials for computing the mean seed yield should have CV less than 15% for trials conducted under irrigated and less than 20% for trials conducted under rainfed and alkaline and saline conditions.
- If the differences in seed yield of same genotype being used as filler/check are equal or greater than CD value, the data of the centre shall not be considered.
- If the variation for seed yield among the strains of a trial is more than four times at one centre and not supported by similar trend at other centres of the zone, such data of that centre shall not be considered.
- The plant population should be at least 80% of the expected plant population.

Plant Population -Minimum Criteria

IVT	110
AVT	260

- The experimental mean seed yield should be equal to or greater than the state mean for the seed yield.
- 75% of state average yield during last 3 years shall be the criteria for inclusion of data on the basis of General Mean for late sown, Rainfed, Salinity. In taramira 50% of state average yield shall be the criteria for inclusion of data on the basis of grand mean of trial
- In Salinity trials EC levels should be 10 or >10 dS/m for inclusion of the data.
- A margin of 5 days over the best check's maturity duration shall be given in early maturity toria/mustard trial.
- In toria/early mustard trial, promotion shall be based upon superiority over the earliest maturing check
- Non significant data shall not be considered for computation of mean.
- Expts with <5% C.V. shall not be considered for computation of mean
- Entries developed through pure line selection from germplasm/variety shall not be evaluated.

#### Randomized Layout

Field Plan for **Indian mustard IVT Early and IVT Timely Sown (Irrigated)** Expt. under Alpha Lattice Design, are given below:

**Proposed Alpha Lattice Design for IVT Early Mustard**  
 $v = 27, b = 9, r = 3, k = 9, AE = 0.9626, DE = 0.9832 \quad \alpha(0,1,2,3)$

#### Randomized Layout

REPLICATION 1									
<b>Block 1</b>	19	9	4	15	2	27	10	22	18
<b>Block 2</b>	23	20	7	16	25	3	5	13	11
<b>Block 3</b>	14	21	1	12	26	17	24	8	6

REPLICATION 2									
<b>Block 1</b>	20	17	8	10	4	14	3	22	27
<b>Block 2</b>	16	19	24	7	26	6	12	13	2
<b>Block 3</b>	23	11	25	18	5	9	1	21	15

REPLICATION 3									
<b>Block 1</b>	9	6	21	15	3	27	18	24	12
<b>Block 2</b>	14	17	20	23	26	5	11	8	2
<b>Block 3</b>	1	7	19	25	10	4	13	22	16

**Proposed Alpha Lattice Design for IVT Timely Sown (Irrigated)**  
 $v = 28, b = 12, r = 3, k = 7, AE = 0.9603, DE = 0.9812 \quad \alpha(0,1,2)$

REPLICATION 1							
<b>Block 1</b>	20	16	8	12	28	4	24
<b>Block 2</b>	25	5	9	13	17	21	1
<b>Block 3</b>	7	15	19	11	23	3	27
<b>Block 4</b>	6	26	2	18	22	10	14

REPLICATION 2							
<b>Block 1</b>	13	22	7	26	4	17	11
<b>Block 2</b>	9	5	2	24	15	28	19
<b>Block 3</b>	18	8	12	14	1	23	27
<b>Block 4</b>	25	10	21	3	20	16	6

REPLICATION 3							
<b>Block 1</b>	25	7	23	13	2	12	20
<b>Block 2</b>	16	1	11	6	22	19	28
<b>Block 3</b>	17	24	26	14	9	3	8
<b>Block 4</b>	18	5	15	4	10	21	27

**Datasheet for recording the observations Early Mustard**

rep	block	treatment	Seed yield	rep	block	treatment	Seed yield	rep	block	treatment	Seed yield
1	1	19		2	1	20		3	1	9	
1	1	9		2	1	17		3	1	6	
1	1	4		2	1	8		3	1	21	
1	1	15		2	1	10		3	1	15	
1	1	2		2	1	4		3	1	3	
1	1	27		2	1	14		3	1	27	
1	1	10		2	1	3		3	1	18	
1	1	22		2	1	22		3	1	24	
1	1	18		2	1	27		3	1	12	
1	2	23		2	2	16		3	2	14	
1	2	20		2	2	19		3	2	17	
1	2	7		2	2	24		3	2	20	
1	2	16		2	2	7		3	2	23	
1	2	25		2	2	26		3	2	26	
1	2	3		2	2	6		3	2	5	
1	2	5		2	2	12		3	2	11	
1	2	13		2	2	13		3	2	8	
1	2	11		2	2	2		3	2	2	
1	3	14		2	3	23		3	3	1	
1	3	21		2	3	11		3	3	7	
1	3	1		2	3	25		3	3	19	
1	3	12		2	3	18		3	3	25	
1	3	26		2	3	5		3	3	10	
1	3	17		2	3	9		3	3	4	
1	3	24		2	3	1		3	3	13	
1	3	8		2	3	21		3	3	22	
1	3	6		2	3	15		3	3	16	

**Datasheet for recording the observations Timely Sown Irrigated**

rep	block	treatment	Seed yield	rep	block	treatment	Seed yield	rep	block	treatment	Seed yield
1	1	20		2	1	13		3	1	25	
1	1	16		2	1	22		3	1	7	
1	1	8		2	1	7		3	1	23	
1	1	12		2	1	26		3	1	13	
1	1	28		2	1	4		3	1	2	
1	1	4		2	1	17		3	1	12	
1	1	24		2	1	11		3	1	20	
1	2	25		2	2	9		3	2	16	
1	2	5		2	2	5		3	2	1	
1	2	9		2	2	2		3	2	11	
1	2	13		2	2	24		3	2	6	
1	2	17		2	2	15		3	2	22	
1	2	21		2	2	28		3	2	19	
1	2	1		2	2	19		3	2	28	
1	3	7		2	3	18		3	3	17	
1	3	15		2	3	8		3	3	24	
1	3	19		2	3	12		3	3	26	
1	3	11		2	3	14		3	3	14	
1	3	23		2	3	1		3	3	9	
1	3	3		2	3	23		3	3	3	
1	3	27		2	3	27		3	3	8	
1	4	6		2	4	25		3	4	18	
1	4	26		2	4	10		3	4	5	
1	4	2		2	4	21		3	4	15	
1	4	18		2	4	3		3	4	4	
1	4	22		2	4	20		3	4	10	
1	4	10		2	4	16		3	4	21	
1	4	14		2	4	6		3	4	27	

## XXVIII Annual Group Meeting of AICRP Rapeseed-Mustard

August 6-7, 2021 at Online

### SESSION II: Breeder Seed Production

<b>Chairman</b>	: Dr D K Yadava, ADG (Seed), ICAR, New Delhi
<b>Co- Chairman</b>	: Dr Sanjay Singh, Director, ICAR-IISS, Mau (UP)
<b>Rapporteur</b>	: Dr H S Meena, Sr Scientist, ICAR-DRMR, Bharatpur, Rajasthan
	: Dr Sunil Kumar Rai, Junior Scientist, Plant Breeding, SKUAS&T, Jammu

After brief introductory remarks by the Chairman Dr D.K.Yadava, ADG (Seed), ICAR, New Delhi, Dr.Bhagirath Ram, Pr.Scientist, ICAR-DRMR presented the detailed report on breeder seed production of the year 2020-21. He informed the house that an indent of 82.93 q of breeder seed of 64 varieties of Rapeseed-Mustard was received from Department of Agriculture and Cooperation (DAC), Ministry of Agriculture and Farmers Welfare, Govt of India for the year 2020-21. He informed to the house that against the indent of 82.93 q. 194.35 q breeder seed was produced, indicating a surplus availability of 116.44 q. Breeder seed of 03 varieties *i.e.* RVM-1 and TBM-204 of Indian mustard and Jhumka (YSNNC-1) of yellow sarson could not be produced. Further, he informed that less quantity of ONK-1(-0.48q) of Gobhi Sarson; Uttara (-0.05) of toria (-0.35); RGN-298 (-0.37) and RVM-2 (-0.04) of Indian mustard. In addition, an additional quantity of 15.29 q breeder seed of 10 varieties was also reported from five centres. Subsequently, he gave an account of the percent contribution of recently notified (2011-2020) varieties in breeder seed production chain. He informed the house that a tentative breeder seed indent for Rabi 2021-22 is to be communicated shortly. The breeder seed indent (BSP-1) for 2021-22 be posted shortly by the DAC on its website. The final version of the same will be communicated to different co-operating centres once the indent is finalized by DAC and it can be downloaded from the website of DAC [www.seednet.com](http://www.seednet.com). Chairman stressed upon the maintenance of high quality of nucleus/breeder seed of the varieties. Dr. Sanjay Singh, Director, ICAR-IISS, Mau (UP) suggested that the share of recently released varieties should be enhanced and newly released varieties should be included in seed chain.

The Chairman, in his concluding remarks, appreciated the status of breeder seed production in country. He said that the SRR is appreciable in Rapeseed- Mustard but there is need to further replace the older varieties with recently released varieties. The session ended with the vote of thanks.

## XXVIII Annual Group Meeting of AICRP Rapeseed-Mustard

August 6-7, 2021 Online

### Session III: Planning and Technical Programme Formulation: Agronomy

**Chairman:** Dr. A.K. Gupta, Dean, College of Agriculture, Jobner (SKNAU)

**Rapporteurs:** Dr. R.L. Choudhary, Scientist-Agronomy, DRMR, Bharatpur  
Dr. Rajeev Bharat, Jr. Scientist-Agronomy, SKUAST-Jammu

The session was started with the opening remarks of the Chairman, Dr. A.K. Gupta on various aspects of the agronomic research including soil, water, nutrient and weed related issues, particularly for Orobanche management in the rapeseed-mustard. He further stressed upon the supplementary field observations with laboratory analysis in long term as well as other agronomic experiments for better reasoning. Deliberations were also made to initiate research work in rice-fallow system. However, it needs proper mechanization for crop establishment, hence possible options should be explored by having collaborations with other ICAR institute/ Universities, said by the Chairman.

Dr. R.S. Jat, Principal Scientist-Agronomy, ICAR-DRMR presented the findings of the experiments conducted during 2020-21. The technical programme for the year 2021-22 was critically discussed and finalised. It was decided to conclude the experiment on “*Developing resource efficient and resilient rapeseed-mustard based cropping systems under changing climate scenario*”. However, supplementary data on system-based yield, productivity, sustainability and soil fertility along with detailed materials and methods should be provided by the respective centres. A new experiment on “*Optimization of mineral nutrient management for higher productivity*” was formulated. The PI urged upon the scientists of various coordinating centres of AICRP (R&M) to conduct the experiments strictly as per the technical program and also report the data accordingly. Soil samples of long-term fertility (before & after 10-years) are to be sent to the ICAR-DRMR latest by 30 September 2021. The session ended with the vote of thanks to the Chairman.

### Recommendation:

1. Raised bed planting of green gram-mustard cropping system at recommended levels of nutrients is recommended for higher yield and system productivity at Chatha, Kanpur, Pantnagar and Morena.

### Technical programme for 2021-22

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

Treatment	Season	
	Rabi (Rapeseed-mustard)	Kharif
T1	Control	Control
T2	100% PK	100% PK
T3	100% NPK	100% NPK
T4	150% NPK	150% NPK
T5	100% NPK + S (recommended as per zone)	100% NPK

T6	100% NPK + Zn @ 25 kg ZnSO <sub>4</sub> /ha	100% NPK
T7	100% NPK + B @ 1 kg B/ha	100% NPK
T8	100% NPK + FYM @ 2.5t/ha (dry weight basis)	100% NPK
T9	100% NP	100% NP
T10	100% NK	100% NK

**Replication: 3**

**Design: RBD**

**Locations:** Khudwani (Rice-Mustard), Kangra (Maize-Mustard), Ludhiana (Maize-Mustard), Hisar (PM-Mustard), Pantnagar (Maize-Mustard), Morena (PM- Mustard), SK Nagar (GG-Mustard), Dholi (Rice-Mustard), Shillongani (Rice-Toria), Bhubhaneshwar (Rice-Mustard), Kota (Urdbean-Mustard), Sriganaganagar (Pearlmillet/ cluster bean-Mustard).

**Observations to be recorded in all crops every year**

1. Growth, yield attributes, yield, system productivity, oil content and economics is to be reported every year.
2. Disease and pest incidence, if any, is to be reported by the pathologist.
3. Soil samples every year from 0-15 cm and 15-30 cm depth to be taken after mustard harvest to assess build up/ depletion of soil fertility (Organic carbon, pH, N, P, K, S, Zn, B).
4. The experiment should be conducted on fixed plots and cannot be changed.
5. Potassium is to be applied @ 20 kg K<sub>2</sub>O/ha in case of no recommendation for potassium application.
6. Observations on weed infestation needs to be recorded treatment wise.

### 3.2 Evaluation of herbicides for weed management in rapeseed - mustard.

**Treatment**

1. Pendimethalin @ 1.0 kg a.i /ha (PE)
2. Pendimethalin @ 0.5 kg a.i /ha (PE)
3. Oxadiargyl @ 0.09 kg a.i g/ha (PE)
4. Oxadiargyl @ 0.045 kg a.i/ha (PE)
5. Fluazifop-p-butyl @ 0.125 kg a.i/ha at 25-30 DAS
6. Quizalofop @ 0.05 kg a.i./ha at 15-20 DAS
7. Weedy-check (No herbicide)
8. Weed free

**Design: RBD**

**Replication: 3**

**Locations:** Ludhiana, Hisar, Pantnagar, SK Nagar, Bhubhaneshwar, Imphal

**Observations:**

1. Data on growth, yield attributes, yield, oil content and economics is to be reported every year.

2. Data on weed control efficiency should be calculated based on either weed dry weight or weed count data should be reported at 45 and 80 DAS.
3. Information on weed index should be reported.
4. Phytotoxicity effects if observed should be reported with photographs.

### 3.3 Agronomic evaluation of promising rapeseed-mustard entries

#### Objectives:

1. Identified advanced strains promoted to AVT-II of rapeseed-mustard will be taken along with check varieties of national/zonal importance.
2. The zone wise entries seeds should be supplied to the Director, DRMR, Bharatpur latest by **10<sup>th</sup> August 2021** by the concerned breeder.
3. The recommended fertility level be mentioned.
4. Economics be worked out giving cost of cultivation and net returns.

#### Zone-II Mustard timely sown (Rainfed)

Entries: **RH 1424**, RGN 229 (ZC), RH 725, Kranti (NC), Filler (RGN 229)  
 Locations: Abohar, Bawal, Hisar, Ludhiana, Sriganaganagar

#### Zone II: Quality mustard

Entries: **LES 60**, **RH (OE) 1706**, Kranti (NC), PM 29 (LR), RH 749 (ZC), Filler (PM 29),  
 Locations: New Delhi, Hisar, Ludhiana, Sriganaganagar, Bawal

#### Mustard: White Rust Resistance: AVT II-NIL

Zone- II: **Rohini (A4A5)-491**, **PB (A4A5)-842**, **PJK (A4A5)-21**, **Varuna (A4A5)-936-279**, Rohini (parent), PB (parent), PJK (parent), Varuna (parent), RH 749, Giriraj  
 Locations: Ludhiana, Hisar, Sriganaganagar, Delhi, Chatha

Zone- III: **Rohini (A4A5)-491**, **PB (A4A5)-842**, **PJK (A4A5)-21**, **Varuna (A4A5)-936-279**, Rohini (parent), PB (parent), PJK (parent), Varuna (parent), Maya, RGN 73

Locations: Kanpur, Pantnagar, Morena, Dholi, Bharatpur

#### Mustard, Saline/alkaline conditions

Entries: **CS 2005-143**, Kranti (NC), CS- 54 (ZC), CS 60 (LR), Filler (CS- 54)

Locations: Agra, Hisar, Karnal, Nain (Panipat), Lucknow, Bikaner

Note: Trial is to be conducted in the soil having minimum of ECe 10.0/pH > 9.0

#### Gobhi sarson

Entries: **AKGS 19-8**, GSL 1(ZC), Kranti (NC), GSC 6 (QC), Filler (GSL 1)

Location : Ludhiana, Kangra, Doula Kuan, Bajaura, Chatha

#### Fertility levels (for all the locations)

1. Recommended fertility level
2. 125% of the recommended fertility level
3. 150% of the recommended fertility level



**Design:** Split-plot (Entries in main plots and fertility levels in sub- plots)

**Replications:** 3

**Observations:**

1. Yield and yield attributes (branches/plant, siliquae/plant, seeds/siliqua, 1000 seed weight and seed weight/plant and seed yield).
2. Oil content.
3. Initial fertility status of soil.
4. Uptake of nitrogen, phosphorus and potassium at pre-flowering and harvest stage.
5. Always report the data in two-way table with entries and fertility levels as given in the report.

### **3.4 Enhancing drought and heat tolerance in rapeseed-mustard through microbes**

**Main plot treatments:**

1. No irrigation
2. 50% deficit irrigation
3. Normal level of irrigation

**Sub plots treatments:**

1. MRD 17
2. MKS 6
3. Biophos and BioPhos<sup>+</sup>
4. CRIDA MI-I
5. CRIDA MI-II
6. Control (No Culture)

**Design:** Split plot

**Replications:** 3

**Location:** Jobner, Nagpur, Jhansi, Banda, Dholi, Morena, Sriganaganar, Ludhiana, SK Nagar, Varanasi, Chatha, Imphal, Bawal

**Observations:**

1. Growth parameters.
2. Yield and yield attributes (branches/plant, siliquae/plant, seeds/siliqua, 1000 seed weight and seed weight/plant) and seed yield.
3. Oil content, oil yield and economics.
4. Soil moisture at sowing, before and after each irrigation and at harvest.
5. Nutrient (N, P, K) status before sowing and at harvest.
6. Relative water content, membrane stability index, yield stability index, proline content, chlorophyll content at 80 DAS and water use efficiency.
7. Always report the data in two-way table with LSD values ( $p = 0.05$ ) and CV (%) of main-plot, sub-plot and interactions as given in the report.

### **3.5 Response of macro and micro nutrient bio-fertilizers in enhancing rapeseed-mustard productivity and soil health.**

#### **Treatment details:**

##### **Main plot treatments: Fertility level**

1. 100% RDF
2. 75% RDF
3. Control

##### **Sub plot: Microbial consortia**

1. Azotobactor
2. Phosphate Solubilising Micro Organism (PSMO)
3. Potassium Mobilizing Biofertiliser (KMB)
4. Zinc Solubilizing Biofertiliser (ZSB)
5. NPK consortia + ZSB
6. Control (No biofertilizer)

#### **Replication: 3**

#### **Design: Split plot design**

**Locations:** Kangra, Ludhiana, Pantnagar, Morena, SK Nagar, Dholi, Kanke, Shillongani, Bhubhaneshwar, Kota, Varanasi, Chatha, Imphal

#### **Observations:**

1. Growth parameters.
2. Yield and yield attributes (branches/plant, siliquae/plant, seeds/siliqua, 1000 seed weight and seed weight/plant and seed yield).
3. Oil content, oil yield and economics.
4. Availability of N, P, K, S and Zn before sowing and at harvest.
5. Always report the data in two-way table with CV (%), LSD values ( $p = 0.05$ ) of main-plot, sub-plot and interactions as given in the report.

**Note:** All the biofertilizers are in liquid form and are manufactured and supplied from IFFCO.

### **3.6 Optimization of mineral nutrient management for higher productivity**

#### **Treatment details:**

##### **Main plot treatments: Major nutrients (NPK)**

1. Control
2. 100% NPK
3. 125% NPK
4. 150% NPK

##### **Sub plot: Secondary & micro nutrients**

1. 20 kg S + 2.5 kg Zn + 0.5 kg B/ha
2. 40 kg S + 5 kg Zn + 1 kg B/ha
3. 20 kg S + 2.5 kg Zn + 0.5 kg B/ha enriched with 500 kg FYM/ha
4. 40 kg S + 5 kg Zn + 1 kg B/ha enriched with 500 kg FYM/ha

**Replication: 3**

**Design: SPD**

**Locations:** Banda, Bhubhaneshwar, Chatha, Dholi, Imphal, Jhansi, Jobner, Kangra, Kanke, Kanpur, Kota, Ludhiana, Morena, Nagpur, Pantnagar, SK Nagar, Shillongani, Sriganganagar

**Observations:**

1. Growth and yield attributes, yield, oil content is to be reported every year.
2. System productivity, profitability and sustainability to be reported every year.
3. Initially measure soil physical and chemical properties from 0-15 cm and 15-30 cm depth.
4. Soil analysis (Organic carbon, pH, N, P, K, S, Zn, B) before and at harvest. Accordingly prepare balance sheet of all the nutrients in soil.
5. Always report the data in two-way table with CV (%), LSD values ( $p = 0.05$ ) of main-plot, sub-plot and interactions as given in the report.

**Total Agronomic trials to be conducted during the year 2021-22**

- 3.1 Long-term fertility experiment on cropping systems involving rapeseed-mustard.
- 3.2 Evaluation of herbicides for weed management in rapeseed – mustard.
- 3.3 Agronomic evaluation of promising rapeseed-mustard entries.
- 3.4 Enhancing drought and heat tolerance in rapeseed-mustard through microbes.
- 3.5 Response of macro and micro nutrient bio-fertilizers in enhancing rapeseed mustard productivity and soil health.
- 3.6 Optimization of mineral nutrient management for higher productivity.

**Suggestions for proper conduct of agronomical trials**

1. The field layout of all the agronomy trials should be provided to the Plant Pathologist/Entomologist of the AICRP-RM centres for recording of insect and disease infestation if any, and due credit will be shared with the agronomist.
2. The treatments of any experiment should not be modified by the centres.
3. The trials should be laid out on time so that treatment effects could be identified properly and yield levels are optimized.
4. The centres should send the information pertaining to field trials along with date of sowing to Director, DRMR latest by **25<sup>th</sup> November**.
5. The centres accepting the trial (whose names are given in the technical programme) must positively report the data. In case of any difficulty individual centre should write immediately to PI/Director, DRMR.
6. The cropping sequence and long-term trials be conducted at the same location in the same field over years.
7. The plot size should not be less than 21.6 m<sup>2</sup> and width of buffer channel should not be less than 1.5m.
8. The economics of production must be given in each experiment; calculate on the basis of MSP and state recommended cost of cultivation for respective crops. The IBCR should be reported instead of B:C ratio.
9. If the yield level of recommended fertiliser dose is less than the state average, the trial will be rejected.
10. If any centre needs oil and nutrient analysis, please depute concern scientist along with samples to DRMR, Bharatpur latest by 30<sup>th</sup> April for timely report compilation.
11. Data do not follow the statistical standards will be rejected.

12. All the ancillary data of component crops should be recorded and reported.
13. The centres concluding a particular trial/experiment should compile the results and submit the comprehensive report to PI/Director for inclusion in a review of agronomic aspects.
14. The initial and final soil analysis should be done and reported every year. If facility is not available, can send the samples at ICAR-DRMR for analysis.
15. The final data must be submitted latest by 31<sup>st</sup> May, 2022. No data will be accepted after the due date.

**XXVIII Annual Group Meeting of AICRP Rapeseed- Mustard  
August 6-7, 2021 at Online**

**SESSION X: Frontline Demonstrations on Rapeseed-Mustard**

**Chairman** : Dr. S. K. Jha, ADG (OP), ICAR, New Delhi

**Rapporteur** : Dr. Ashok Kumar Sharma, Pr. Scientist, ICAR-DRMR, Bharatpur

After brief introductory remarks of chairman about the importance of frontline demonstrations in technology dissemination of rapeseed-mustard production, present status of edible oilseed production and efforts of Government of India and ICAR in increasing production and productivity of oilseed crops, awareness of the farmers about recommended technology of rapeseed mustard, linkages with stakeholders, concern of DAC&FW, New Delhi, etc. Dr. Ashok Kumar Sharma, Pr. Scientist, (Ag Extension), ICAR-DRMR, Bharatpur presented the results of 2517 frontline demonstrations (FLDs) conducted on rapeseed-mustard in 80 districts across 15 states during 2020-21. He reported that 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.

The chairman said that govt. has launched mustard mission for increasing production and productivity of oilseeds especially, rapeseed-mustard. There is a need to conduct FLDs effectively to show the production potential of new recommended varieties and technologies to the framers at their own field. It will develop confidence of the farmers for adoption of recommended technologies.

The chairman complimented the work done and presentation of FLDs. After in depth discussion in the session, the following recommendations emerged.

#### Recommendations

1. Besides trainings for extension personnel of State Department of Agriculture, trainings may be organized for input dealers also.
2. Some demonstrations should also be conducted on other component technology based on the identified critical gaps in the state/districts.
3. Monitoring of FLDs should be more focused by including personnel from State Departments of Agriculture, KVKs, Universities, NGOs, progressive farmers, etc.
4. A technical bulletin including all recommended technologies of rapeseed mustard along with critical gaps in different states can be published for benefit of all the stakeholders.
5. DAC&FW should be requested for allocating more number of FLDs so that other potential areas/districts can be covered

The session ended with vote of thanks to chair.

## **Frontline Demonstrations on Rapeseed-Mustard 2021-22**

### **Guidelines for conducting frontline demonstrations**

1. Each implementing centre will conduct the FLDs as per the allotment list given along with the technical programme.
2. As per new guideline, all the demonstrations will be conducted in cluster approach. Only whole package demonstrations including INP and IPM should be conducted. For organizing FLDs, adopt adjoining villages of a panchayat (Cluster approach) preferably 2-3 village in one district only to show the impact and carry out PRA for identifying the critical factor for low productivity. A group of multidisciplinary scientists, instead of one scientist should be involved in FLDs programme
3. Funds for conducting FLDs will be Rs. 2160.00 for an area of one acre.
4. The binding of one acre area for one demonstration may not be observed, as the holdings in some areas are too small.
5. Unspent balance of previous years may be utilized but subject to revalidation by ICAR-DRMR.
6. In the report, specifically mention the rainfed and irrigated situation and also the normal and late sown conditions under which FLDs are actually conducted.
7. Farmers having soil health card issued by Department of Agriculture/KVKs should only be selected for conducting FLDs in Oilseeds. Fertilizer inputs will be provided to farmers under FLDs on the basis of Soil health card. The chemical fertilizers under FLDs should only be given by identifying the gaps in adoption. Growth promoters, Micro nutrients, etc can be given.
8. New varieties less than 5 year old may be preferred under FLDs and ensure that in any circumstances, varieties more than 10 years old shall not be allowed.
9. The improved varieties recommended for a particular zone should also be tested against the local variety. At least 50 per cent of recently released varieties of the zone must be included in FLDs by each centre other than its own centers.
10. The in-charge of the implementing centre should indent the requisite quantity of the varieties from the concerned breeders well before the start of the season.
11. The total cost of cultivation for improved plot (IP) and farmers' plot (FP) per ha should be reported separately and ensure that they vary from each other only on the technology being tested (whole package, component, cropping system as the case may be).
12. The package of practices should be improved / recommended for the concerned zone. Technology used in FLDs should be clear and thoroughly described along with complete package in the report
13. Each centre must work out the economics of the FLDs and report the B:C ratio for the improved plot (IP) and farmer's plot (FP) for each demonstration instead of IBCR value.
14. Document farmers' practices and the prevailing ITK during PRA and send the same along with the preliminary report to the Director, DRMR within one month after the sowing.
15. The impact of new technology should be discussed during scientist-farmer interaction, training and field visit / kisan diwas / kisan mela, etc in the village. Photography of the FLD activities must be done and send good photographs to DRMR, Bharatpur for record.
16. The centres should send the preliminary report pertaining to the name of farmer, location along with date of sowing and technology demonstrated to the Director, ICAR-DRMR, Director Agriculture of the respective state/ the district level extension agency and NGOs, for proper monitoring, strengthening the linkages and also extending learning experiences to relatively large population of farmers.
17. The final data book for individual farmer, as supplied by the ICAR-DRMR, must be sent to ICAR-DRMR, Bharatpur along with the summary sheet of results latest by April 30, 2022.
18. Every center should send the list of selected farmers for the FLDs for the release of 50% budget as an advance. After receiving the audit utilization certificate of the previous season, rest 50% budget would be released.
19. Reservation for SC and ST community must be followed in selecting beneficiary farmers for conducting FLDs as per norms.
20. Every centre will do the geo tagging of all FLDs as per the guideline of DAC&FW, Govt. of India

**Zone wise improved varieties recommended for FLDs on rapeseed-mustard (2021-22)**

**Zone-I: Kangra and Khudwani**

**Brown sarson:** Shalimar Sarson-1

**Ghobhi Sarson:** GSC-7, AKMS 8141, GSH 1699 (hybrid)

**Zone -II: Chata, Hisar, Bewal, Ludhiana, Navgaon and Sriganganagar**

**Indian Mustard:**

**Irrigated Timely Sown** RH 749, DRMRIJ 31, NRCDR 601, PBR 357

**Rainfed:** RH 406, RGN 298, GDM 5, PBR 378, RH 725, RH 761, DRMR 1165-40.

**Late Sown irrigated:** Brajraj, Radhika, RVM 2 (Raj Vijay Mustard 2), RGN 236.

**Quality:** Pusa mustard 30, RLC 3, Pusa mustard 31 (Double zero), PM 32, PM 33, RCH 1 (hybrid)

**Early Sown:** Pusa mustard 28, pant Rai 19 (PR 2006-1)

**Salinity/Alkalinity:** CS 58, CS 60

**Gobhi Sarson:** GSC 7, RSPN 25, AKMS 8141, GSH 1699

**Zone-III: Morena, Bharatpur, Kota, Faizabad, Banda, Jhansi, Agra, Varanasi, Kanpur Pantnagar and Dholi,**

**Indian Mustard:**

**Irrigated Timely Sown:** RH 749, Griraj (DMRIJ 31), NRCHB 101, RGN 73

**Late Sown Irrigated:** NRCHB 101

**Early Sown:** Pusa Mustard 27

**Quality:** Pusa mustard 30

**Yellow Sarson:** Pitambari, YSH 401, Pant Pilli Sarson 1, NRCYS 05-02, Pant Sweta,

**Toria:** Uttara, Tapeswari

**Taramira:** RTM 1351, RTM 1355, RTM 1624

**Zone-IV: Junagarh, S.K. Nagar, Jobner, Mandore and Nagpur**

**Indian Mustard:** GDM 4, NRCHB 101

**Taramira:** RTM 1351, RTM 1355, RTM 1624

**Zone-V: Shillongani, Kanke, Jagdalpur, Imphal, Tripura, Bhubaneswar and Berhempore**

**Indian Mustard:** NRCHB 101, DRMR 150-35, Pusa Mustard 25, Pusa Mustard 27

**Yellow Sarson:** Pitambari, YSH 401, NRCYS 05-2, Pant Sweta,

**Toria:** TS 38



**Centre wise allotment of FLDs on rapeseed-mustard for 2021-22**

<b>S.No</b>	<b>Zone/Centre</b>	<b>Allotment</b>
<b>Zone I</b>		
1.	Khudwani	20
2.	Kangra	30
	<b>Sub total</b>	<b>50</b>
<b>Zone II</b>		
3.	Jammu	40
4.	Hisar	40
5.	Bawal	20
6.	Sriganganagar	30
7.	Ludhiana	40
8.	Amity University	40
9.	<b>Sub total</b>	<b>210</b>
<b>Zone III</b>		
10.	ICAR-DRMR	400
11.	Bansur	100
12.	RVSKVV, Morena	100
13.	RLBCAU, Jhansi	50
14.	BUAT, Banda (Uttar Pradesh)	50
15.	Kota	30
16.	Pantnagar	30
17.	Kanpur	70
18.	Varanasi	100
19.	Dholi	50
20.	<b>Sub total</b>	<b>980</b>
<b>Zone IV</b>		
21.	Jobner	20
22.	Mandore	50
23.	Nagpur	50
24.	S.K. Nagar	50
25.	<b>Sub total</b>	<b>170</b>
<b>Zone V</b>		
26.	Bhubaneshwar	30
27.	Shillongai	30
28.	Kalyani	30
29.	Kanke	30
30.	DEE, CAU, Imphal	100
31.	DR, AAU, Assam	200
32.	<b>Sub total</b>	<b>420</b>
<b>Zone VI</b>		
34.	RARS, Jagtial, PJTSAU	20
<b>Others</b>		
35.	NGOs/ FPOs/University/KVKs	350
<b>Grand total</b>		<b>2200</b>

## XXVIII Annual Group Meeting of AICRP Rapeseed-Mustard August 6-7, 2021 Online

### Session IV : Planning & Technical Programme Formulation: Plant Pathology

**Chairman** : Dr. H.C. Sharma, Former VC, UHF, Solan (H.P.)

**Subject Expert** : Dr. G. S. Saharan, Ex-Prof. & Head, Dept. of Plant Pathology, CCSHAU, Hisar

**Rapporteurs** : Dr. Pankaj Sharma, Principal Scientist, ICAR-DRMR, Bharatpur

: Dr. S.S. Vaish, Professor, I.A. Sc., BHU, Varanasi

The planning and technical programme formulation session of Plant Pathology started with introductory remark by the Chairman Dr. H.C. Sharma, Former VC, UHF, Solan (H.P.) and subject expert Dr. G. S. Saharan, Ex-Professor & Head, Dept. of Plant Pathology, CCSHAU, Hisar. Dr. P.D. Meena, PI, Plant Pathology presented significant achievements during the year 2020-21. He insisted the scientist to take up the observations as per technical program for all experiments and submit in excel format after statistical analysis. Chairman, emphasized to ensure that if the disease severity/ incidence on susceptible check are less than resistant/ tolerant check will not be considered for publication in the report.

The list of new entries for inclusion under different Plant Pathological trials in coming season should be provided ten days before AICRP- RM workshop to PI, Plant Pathology. The results of different trials conducted during 2020-21 were reviewed critically and the technical programme for the year 2021-22 was finalized after through discussion.

- ✓ After consistent testing under artificial/ natural conditions at different geographical locations, DRMRSJ- 25, and RH 1400 genotypes are recommended as white rust resistant sources for use in the breeding programme.

### Technical Programme

All centres should report observations on percent disease severity (AB, WR, PM) following 0-9 rating scale. Date of sowing and date of observation(s) should be indicated in data sheet itself. Data for disease severity/ incidence to be reported replication-wise as also after proper statistical analysis (angular transformation) in the same format as in the AICRP-RM Annual Progress Report 2013 with CD ( $P < 0.05$ ) and CV (%) values for comparison of treatments. Transformed value should be indicated in parenthesis. Soft copy of data should be prepared only in **MS Excel sheets**. **Text of report should be in MS Word**. Both **soft (by email file attachment only)** and hard copy of data should reach the PI (Plant Pathology), ICAR-DRMR, Bharatpur latest by **30<sup>th</sup> April, 2022**. No hand written or unanalyzed data will be accepted.

**Attention:** (i) Seeds from different trials labelled suitably and in separate packets should reach the PI, Plant Pathology, ICAR-DRMR, Bharatpur **latest by 20 August 2021**. (ii) Pathologist from respective centre should take action for supply of seed well in time. The national disease nursery (NDN) for different diseases should be conducted with artificial inoculation. Data for all other major diseases occurring on the test entries needs to be recorded and reported. Respective centres should take up detail work on sources of resistance, epidemiology, losses and control of diseases of local importance.

**4.1 Screening of Brassica germplasm and breeding material against major diseases**  
**Objective:** Disease response of elite accessions under different geographical conditions

**4.1.1 Screening of Brassica AVT-I & AVT-II strains against different diseases under natural condition**

S. No.	AVT-I+II (Entries)	S. No.	AVT-I+II (Entries)
	<i>Brassica juncea</i>	21.	CS 2005-143
1.	RGN 443	22.	Rohini (A4A5)-491
2.	SKM 1626	23.	PB (A4A5)-842
3.	PBR 385	24.	Varuna (A4A5)-936-279
4.	PR 2016-4	25.	PJK (A4A5)-21
5.	PR 2016-8	26.	DRMR 2017-16
6.	PRE-2018-10 (Early)	27.	DRMRCI 128
7.	RH 1676		<i>Brassica napus</i>
8.	RH 1424	28.	GSH-2155
9.	RH 1999-42 (Early)	29.	GSH-1723
10.	DRMRHJ 2403 (Hybrid)	30.	GSH-1703
11.	RH 1975	31.	HNS 1102
12.	RH 1974	32.	HNS 1206
13.	RH(OE)-1807	33.	DRMRIN 20-23
14.	RH (OE) 1706	34.	DRMRIN 20-3
15.	JC 36	35.	JGS-15-6
16.	PDZ-14	36.	AKGS 8060
17.	PDZ-15	37.	AKGS 19-8 (AVT II)
18.	DRMR 2018-19		<i>B. rapa</i> ssp. <b>Yellow Sarson</b>
19.	LES 60	38.	RMYS 2
20.	0IJ5001	39.	PYS-2018-12
<b>Checks:</b> <i>B. juncea</i> : Rohini, NRCHB 101 (SC) & Local Check, BIOYSR, DRMRMJA-35 (RC-WR), PHR 2 (TC-AB); <i>B. napus</i> : GSL 1; <i>B. carinata</i> : DLSC 1, <i>B. rapa</i> ssp Yellow Sarson: NRCYS-5-2; <i>B. rapa</i> var <i>Toria</i> : PT 303; RTM 314			

- Location:** Dholi, Pantnagar, Hisar, Morena, Jagdalpur, Ludhiana, S.K. Nagar, Shillongani, New Delhi, Banda, Sriganaganagar, and Kanpur
- Layout:**
- Single row: two replications of 3 m row length
  - Susceptible checks will be used after every two test rows

**4.1.2 Screening of Brassica AVT-I and AVT-II strains against different diseases using artificially inoculated infector–row under field condition**

Disease	Location
Alternaria blight:	Dholi, Pantnagar, Ludhiana, Shillongani, New Delhi
White rust/ DM:	Pantnagar, Morena, Hisar, Ludhiana, Bharatpur
Sclerotinia rot:	Dholi, Ludhiana, Pantnagar, Hisar, Bharatpur

**Methodology:**

- Add oosporic material of local isolate only after grinding hypertrophied plant material collected from the previous year crop along with seed for white rust and downy mildew.
- For secondary spread of the disease make repeated inoculations after collecting

inoculum from the naturally infected plants for all the major diseases (AB, WR, DM, PM, SR).

- iii. Give frequent irrigation and higher doses of nitrogenous fertilizer to create epiphytic.

### Observations to be recorded

- i. Date of first appearance of each disease including bacterial rot
- ii. Data as percent disease severity / percent disease incidence for WR (75 DAS/ at maximum disease pressure), AB / PM/ BR (90 DAS/ at maximum disease pressure) on leaves and pods and number of staghead (15 days before harvest) should be recorded on 10 randomly selected plants from each plot using 0-9 scale. Date of observation and date of sowing should be indicated in data sheet itself.
- iii. Cotyledonary infection due to downy mildew and pod infection due to Alternaria blight should be recorded separately.

Staghead formation should be recorded as percent incidence and percent twigs infected.

Staghead (% twigs affected) = (number of twigs infected/ total number of twigs) x 100.

- iv. Data for all major diseases may be recorded as percent disease severity (AB, WR and PM) on leaves/ pods or as percent disease incidence (SR, DM, CR, BR).
- v. Date of each observation should be provided in the data sheet.
- vi. Data should be statistically analysed as per the design using ANOVA after arc sin transformation. Actual and transformed (in parenthesis) values along with mean, CD ( $P < 0.05$ ) and CV (%) are to be submitted for report preparation.

**Scale (0-9) for rating of entries for reaction to Alternaria blight, white rust and powdery mildew should be used**

**0 (Immune for WR)** = No lesion

**1 (HR)** = Non-sporulating pinpoint size or small brown necrotic spots, less than 5% leaf area covered by lesion

**3 (R)** = Small roundish slightly sporulating larger brown necrotic spots, about 1-2 mm in diameter with a distinct margin or yellow halo, 5-10% leaf area covered by lesions

**5 (MR)** = Moderately sporulating, non-coalescing larger brown spots, about 2-4 mm in diam with a distinct margin or yellow halo, 11-25% leaf area covered by the spots

**7 (S)** = Moderately sporulating, coalescing larger brown spots about 4-5 mm in diam, 26-50% leaf area covered by the lesions

**9 (HS)** = Profusely sporulating, rapidly coalescing brown to black spots measuring more than 6mm diam without margins covering more than 50% leaf area

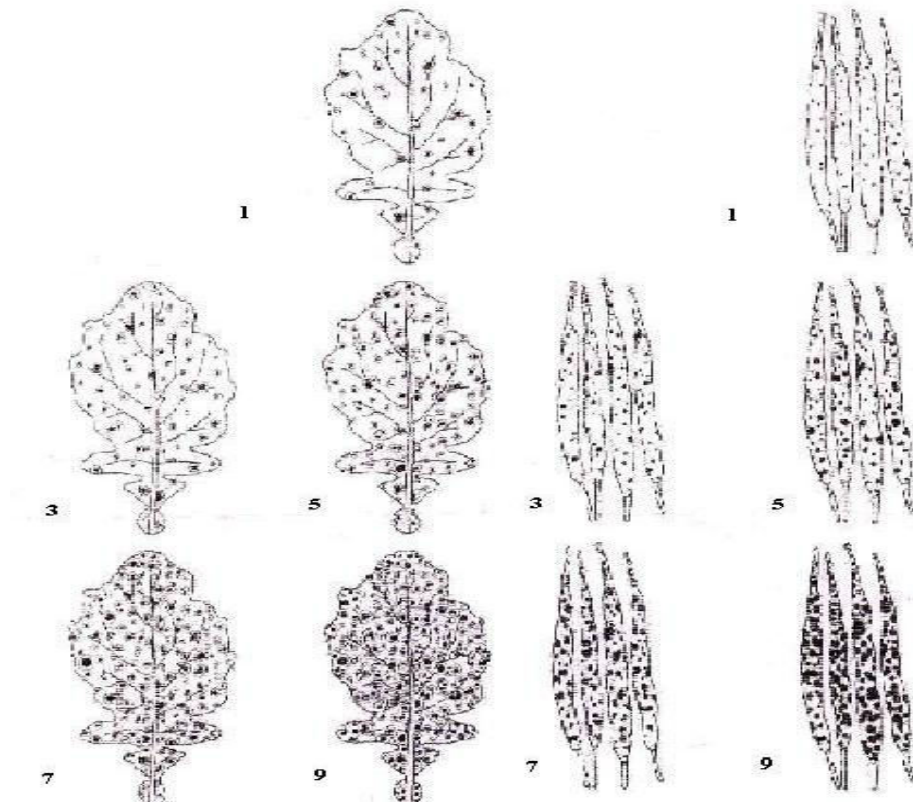
$$\text{Average severity score} = \frac{(N-1 \times 0) + (N-2 \times 1) + (N-3 \times 3) + ((N-4 \times 5) + (N-5 \times 7) + (N-6 \times 9))}{\text{Number of leaf samples}}$$

$$\text{Percent Disease Intensity (PDI)} = \frac{(N-1 \times 0) + (N-2 \times 1) + (N-3 \times 3) + ((N-4 \times 5) + (N-5 \times 7) + (N-6 \times 9)) \times 100}{\text{No. of leaf samples} \times 9}$$

Where N-1 to N-6 represents frequency of leaves in the respective score

#### Note:

- (1) The word spots can be read as pustules if the same scale is used for white rust rating
- (2) In case of white rust, brown spot can be read as creamy white pustule
- (3) This scale can also be used in management trials
- (4) For PM, the same rating scale will be followed ignoring the lesion/ pustule characteristics



**Diseased leaf and pod area assesment key for for Alternaria blight of rapeseed-mustard (Conn et al. 1990) modified and adopted by AICRP-RM Plant Pathologist during 17<sup>th</sup> AICRP-RM Group meeting -2010 at Gwalior**

**Scale (0-4) for rating of entries for reaction to Sclerotinia rot**

Reaction	Rating	Lesion (cm)
Resistant	0	< 3
Moderately resistant	1	3-5
Moderately susceptible	2	5-10
Susceptible	3	10-15
Highly susceptible	4	>15

\*Stem diameter and % incidence must also be recorded

**Method of artificial inoculation for white rust:**

Test plants (including checks) should be inoculated twice i.e. at initiation of flowering and pod formation stage. Inoculum may be prepared by collecting fresh zoosporangia from naturally infected leaves with *Albugo candida*. Petri plates containing zoosporangia suspended in distilled water be kept at 4°C for 2 h to facilitate germination of zoosporangia. To assure germination of the sporangia, the plates may be examined under the low power microscope. Germinating zoosporangia would be emptied and zoospores will be visible in the suspension. Suspension containing zoospores be filtered through double layered muslin cloth and further diluted with distilled water for spraying on leaves of test plants. This may be done with the help of atomizer / small sprayer in the afternoon (after 1500 hrs). Data for disease severity may be recorded 75 DAS/ at maximum disease pressure on leaves and 15 days before harvest for staghead.

**Method of artificial inoculation for Alternaria blight**

Test plants (including checks) should be inoculated twice i.e. at initiation of flowering and pod

formation in the afternoon (after 1500 hrs) with conidial suspension ( $10^5$  cfu / ml) of pure culture of *Alternaria brassicae* using distilled water. Disease severity should be recorded 90 DAS/ at maximum disease pressure on leaves and 15 days before harvest on pods.

#### Method of artificial inoculation for Sclerotinia rot

Cut 5 mm discs of fungal mycelium along with medium from 7-days old pure culture *S. sclerotiorum* grown on thick layer of PDA at 20°C. Place one disc on third internode of plant at flowering stage. Wrap the stem along with the fungal agar disc with a swab of cotton dipped in sterile distilled water. Record observation 3-weeks after inoculation for lesion size and per cent disease incidence.

#### Method of artificial inoculation for downy mildew

Freshly harvested conidia in distilled water from naturally/ artificially infected cotyledonary leaves of susceptible variety should be used for preparation of conidial suspension. Inoculum concentration should be adjusted to  $10^4$  conidia/ ml using distilled water. Prepared conidial suspension of *Hyaloperonospora parasitica* should be inoculated directly to test plants at 2/3 leaf stage in the afternoon (after 1500 hrs). Observations should be recorded after 7-10 days of inoculation.

### 4.2 Uniform disease nursery (UDN) trial for major diseases of rapeseed-mustard

**Objective:** Disease reaction of accessions under different geographical conditions (under natural conditions) for identification of lines for respective national disease nursery trials

**Locations:** Dholi, Pantnagar, Morena, Hisar, S.K. Nagar, Ludhiana, Shillongoni, New Delhi, Sriganaganagar, Jhansi, Jagdalpur, Kanpur, Jammu, Berhampore

**Materials:** Concerned breeders/ scientists will supply the seed material to Director, DRMR indicating 'for Pathology 4.2 UDN trial'. PI, Plant Pathology, DRMR will in turn send the material to different centres. Pathologist of each centre, with the help of plant breeder, should be responsible for sending the seed of each entry (minimum 100 g) under proper cover labelling species and accession details. Entries must be arranged species-wise.

**Observations:** Should be recorded and reported as percent disease severity (AB, WR, PM) or percent disease incidence (Sclerotinia rot, Club root as per trial 4.1.

Centre	Entries to be sent
Bharatpur	Bj: DRMRSJ-4, DRMRSJ-7, DRMR 2018-1, DRMR 2018-19, DRMR 2018-25, DRMR 2018-37, DRMR 2018-41, DRMRSJ-206, DRMRSJ-271, DRMRSJ-349, DRMRDR 2116, DRMRDR 2119, DRMRDR 2119, DRMRDR 2133, DRMRDR 2135, DRMRDR 2140, DRMRDR 2141, DRMRDR 2156, DRMRDR 2195, DRMRDR 2196, DRMRQ 202, DRMRQ -1-22, DRMRIJWR 20-10, DRMRIJWR 20-11, DRMRIJWR 20-12, DRMRIJWR 20-13, DRMRIJWR 20-14, DRMRIJWR 20-15, DRMRIJWR 20-16, DRMRIJWR 20-17, DRMRIJWR 20-18, DRMRIJWR 20-19, DRMRIJWR 20-20, DRMRIJWR 20-21, DRMRIJWR 20-23, DRMRIJWR 20-24, DRMRIJWR 20-26, DRMRIJWR 20-28, DRMRIJ 12-21, DRMRIJ 12-26, DRMRIJ 12-37, DRMRIJ 12-44, DRMRIJ 12-46
Pantnagar	Bj: PAB-14-1, PAB-14-4, PAB-14-7, PAB-14-8, PAB-14-18, PAB-2017-17, PAB-2017-18, PAB-2017-22, PRD-19-6
Morena	Bj: RMM-19-18
New Delhi	Bj: PMW 18
Check:	<i>B. juncea</i> : Rohini, NRCHB 101 (SC) & Local Check, BIOYSR, DRMRMJA 35 (RC-WR), PHR 2 (TC-AB); <i>B. napus</i> : GSL 1; <i>B. carinata</i> : DLSC 1, <i>B. rapa</i> ssp Yellow Sarson: NRCYS-5-2; <i>B. rapa</i> var <i>Toria</i> : PT 303

**NOTE:** All concerned scientists should mention the name of the species of the entry while sending seeds.

### 4.3 National disease nursery (NDN) for Alternaria blight

**Objective:** To identify potential donors against Alternaria blight after screening under different geographical locations

Centre	Entries to be sent
Bharatpur	Bj: DRMRSJ-4, DRMRSJ-7, DRMRSJ-206, DRMRSJ-271, DRMRSJ-349, DRMR 2018-1, DRMR 2018-19, DRMRSJ-22, DRMR-PMJ 17, DRMR 2018-25, DRMR 2018-37, DRMR 2018-41, DRMRDR 2116, DRMRDR 2119, DRMRDR 2133, DRMRDR 2135, DRMRDR 2140, DRMRDR 2141, DRMRDR 2156, DRMRDR 2195, DRMRDR 2196, DRMRM-163, DRMRM-177
Pantnagar	Bj: PAB-2014-4, PAB-2014-8, PAB-17-15, PAB-17-18, PAB-2017-20, PAB-2017-21, PRD-17-20, PRD-17-22, PRD-17-23
Morena	Bj: RMM-19-06, RMM-19-18, RMM-10-1-1
New Delhi	Bj: PMW 18, NPJ 247
Check:	<i>B. juncea</i> : Rohini, NRCHB 101 (SC) & Local Check, BIOYSR, DRMRMJA 35 (RC-WR), PHR 2 (TC-AB); <i>B. napus</i> : GSL 1; <i>B. carinata</i> : DLSC 1; <i>B. rapa</i> ssp Yellow Sarson: NRCYS-5-2; <i>B. rapa</i> var Toria: PT 303
Locations:	Pantnagar, Dholi, Morena, Hisar, Ludhiana, Shillongani, Kanpur, Jagdalpur

**Layout:** Replications: 02: Each entry should be sown in paired row of 3 m length between susceptible check *B. rapa* var Yellow Sarson (local check)

**Method of inoculation:** Test plants (including checks) should be inoculated at initiation of flowering and initiation of pod formation during afternoon (after 1500 hrs) with pure culture of *Alternaria brassicae* using  $10^5$  conidial suspensions/ ml in distilled water. Data for disease severity may be recorded at 90 DAS/ at maximum disease pressure on leaves and 15 days before harvest on pods. Screening is to be done strictly under artificial inoculation condition.

**Scale to be used:** Data should be reported as percent disease severity as per 4.1.

**Observations:** Date of sowing, date of first appearance of Alternaria blight, its intensity on leaf and pod in each entry should be reported as per trial 4.1. In addition, seed infection should also be detected following standard procedure.

**Note:** Concerned breeder/ scientist will supply the seed material of each entry (minimum 50 g) to Director, DRMR indicating 'for Pathology 4.3 NDN / AB trial'. Director, ICAR-DRMR will in turn send the material to different centres. Pathologist of each centre should be responsible for sending the seed of his centre with help of concern breeder. No responsibility shall be taken in the absence of seed not reaching to the Incharge, Plant Pathology, ICAR-DRMR, Bharatpur.

### 4.4 National disease nursery (NDN) for white rust under artificial conditions

**Objective:** To identify potential donors against white rust under different geographical locations

**Observations:** Date of sowing, date of first appearance of white rust on each entry, its intensity should be reported as per trial 4.1. Screening is to be done under artificial inoculation condition.

Centre	Entries to be sent
Bharatpur	Bj: DRMRSJ-4, DRMRSJ-7, DRMRSJ-206, DRMRSJ-271, DRMRSJ-349, DRMR 2018-1, DRMR 2018-19, DRMR 2018-25, DRMR 2018-37, DRMR 2018-41, DRMRCI 125, DRMRCI 126, DRMRCI 131, DRMRCI 132, DRMRCI 139, DRMRWR 143, DRMRWR 153, DRMRDR 2140, DRMRDR 2141, DRMRDR 2156, DRMRDR 2195, DRMRDR 2196, DRMRM 18- 35-11,

	DRMRM 18-36-12, DRMRM 18-37-13, DRMRIJ 12-40, DRMRIJ 12-48, DRMRMJA 35, DRMRIJ 12-26
New Delhi	Bj: PMW 18, NPJ 248, NPJ 249, NPJ 250, NPJ 251, NPJ 252, NPJ 253, NPJ 254, NPJ 255, NPJ 256, LES 64, LES 65, PDZ-16, PDZ-17
Hisar	Bj: RH 1400, RH 1400-1, RH- 1700, RH- 1700-1, RH- 1700-2, RH- 1700-3, RH- 1700-4
Pantnagar	Bj: PWR-13-8, PRD-14-6, PRD-14-21, PRD-2019-16, PAB 14-1, PAB 14-18, PRD-14-1, PRD-1204-4, PRD-2014-23, PRD-2014-27
Morena	Bj: RMM-19-06, RMM-19-18
Resistant / Susceptible check	<i>B. juncea</i> : Rohini, NRCHB 101 (SC) & Local Check, BIOYSR, DRMRMJA 35 (RC-WR), PHR 2 (TC-AB); <i>B. napus</i> : GSL 1; <i>B. carinata</i> : DLSC 1, <i>B. rapa</i> ssp Yellow Sarson: NRCYS-5-2; <i>B. rapa</i> var <i>Toria</i> : PT 303
<b>Locations:</b>	Pantnagar, Morena, Hisar, Ludhiana, Bharatpur

**Note:** Concerned breeders/ scientists will supply the seed material of each entry (minimum 100 g) to PI, Plant Pathology, DRMR indicating ‘for Pathology 4.4 NDN / WR trial’. PI, Plant Pathology, ICAR-DRMR will in turn send the material to different centres. Pathologist of each centre should be responsible for sending the seed of his centre with the help of breeder.

**Layout:** Replications: 02; each entry should be sown in paired row of 3 m length between susceptible check *B. juncea* (local check).

**Method of artificial inoculation against white rust:** Test plants (including checks) should be inoculated at initiation of flowering and initiation of pod formation. Inoculum may be prepared and inoculated as per method described in 4.1. Data for disease severity may be recorded at 75 DAS/ at maximum disease pressure on leaves and 15 days before harvest for stagheads.

#### 4.5 National disease nursery (NDN) for Sclerotinia rot

**Objective:** To identify potential donors against Sclerotinia rot after screening under different geographical locations

**Layout:** Repln: 2; each entry should be sown in paired row of 3 m length between susceptible checks

**Method of artificial inoculation for Sclerotinia rot:** As described 4.1.

**Observations:** Date of sowing, date of first appearance of disease on each entry, percent disease incidence/ intensity of different diseases should be reported at 20 days before harvest as per trial 4.1. In addition, data on lesion length stem diameter and 1000-seed weight should also be recorded. Screening is to be done strictly under artificial inoculation condition.

Centre	Entries to be sent
Materials:	Bj: DRMRSJ-25, DRMRSJ 361, DRMRIS 20-1, DRMRIS 20-4, DRMRIS 20-5
Susceptible check:	Bj: Rohini, NRCHB 101, BIOYSR, DRMRMJA 35, Br: NRCYS-5-2
Tolerant check:	Bc: NPC 16
Locations:	Dholi, Pantnagar, Hisar, Ludhiana, Bharatpur, Shillongani, Sriganganagar, Jhansi, NBPGR, New Delhi
Layout:	i. Two rows each of 3 m row length, three replications ii. Susceptible check will be used after four test rows

**Note:** Concerned breeders/ scientists will supply the seed material of each entry (minimum 100 g) to Director, DRMR indicating ‘for Pathology 4.5 NDN / SR trial’. Director, DRMR will in turn send the material to different centres. Pathologist of each centre should be responsible for



sending the seed of his centre with help of concern breeder(s). All centres must sow zonal check. Artificial inoculation should be done by stem inoculation.

#### 4.6 Screening of IVT entries of *Brassica* against different diseases

<b>Objective:</b>	Disease response of accessions promoted to IVT under different geographical conditions in natural conditions
<b>Location:</b>	Dholi, Pantnagar, Hisar, Ludhiana, Morena, Jagdalpur, SK Nagar, Shillongoni, Kanpur, Jhansi

- Layout:**
- Single row: two replications of 3 m row length
  - Susceptible checks will be used after every two test rows

**Observations:** Should be recorded and reported as percent disease severity (AB, WR, PM) or percent disease incidence (SR, DM, CR) as per trial 4.1.

S. No.	Entries	S. No.	Entries
<b><i>Brassica juncea</i> (Early)</b>		<b><i>B. juncea</i> (Timely sown, Rainfed)</b>	
1.	KMR(E) 21-1	82.	DRMRCI-148
2.	KMR(E) 21-2	83.	DRMRHJ 1117
3.	DRMRHT 13-13-5-5	84.	DRMR 2019-7
4.	DRMRHT 13-13-5-4	85.	DRMRHT 13-22-2
5.	DRMRIJ 16-9-7	86.	NPJ-254
6.	DRMRCI-141	87.	NPJ-255
7.	DRMRSJ 364	88.	RGN-510
8.	RH 1999-14	89.	RGN-519
9.	RH 1999-18	90.	RH 1928
10.	PRE-2018-7	91.	RH 1930
11.	PRE-2018-9	92.	PBR 552
12.	NPJ 248	93.	PBR 357
13.	NPJ 249	94.	BAUM-21-2
14.	SVJH- 69(Hybrid)	95.	DM- 1521
15.	PHR-8081 (Hybrid)	96.	ORM 26-37-2
16.	PHR-8425 (Hybrid)	97.	CAU- RMM 3
17.	BAUM-21-3	98.	RB- 110
18.	ORM 2019-25	<b><i>B. juncea</i> (Hybrid mustard)</b>	
19.	TM 311	99.	RHH 2101
20.	HUJM (E) 20-4	100.	RHH 2102
21.	RMX 9310 (Hybrid))	101.	RH 2103
22.	ACN 226	102.	PHR3281
23.	Mali MS 90	103.	PHR4457
	<b><i>B. juncea</i> (Timely Sown Irrigated)</b>	104.	PHR5175
24.	DRMRIJ 18-62	105.	DRMRHJ 2518
25.	DRMR 2019-19	106.	DRMRJH 3717
26.	DRMRCI- 147	107.	DRMRHJ 3130
27.	SKM 1744	108.	DRMRHJ 3720
31.	SKM 1801	109.	Pusa MH 62
32.	RGN-507	110.	Pusa MH 65
33.	RGN-524	111.	SVJH- 70
34.	PBR 939	112.	SVJH- 71
35.	RH 1934	113.	RMX9922
36.	RH 2049	114.	NMH90M01
37.	KMR 21-3	115.	KGSH-9198

38.	KMR 21-4	116.	18J408C
39.	NPJ-252	<b>117.</b>	NAMJH21-01
40.	NPJ-253	118.	PMH90V02
41.	PRB-2016-1	119.	KMH 8765
42.	PR-2019-3	120.	IJ16R1168
43.	HUJM-20-9		<b><i>B. juncea</i> (Saline/ alkaline)</b>
44.	HUJM -10-6	121.	CS 2020-10
45.	RMM 19-18	122.	CS 2009-234
46.	ACN 237	123.	CS 2013-64
47.	ORM 18-29-5	124.	CS 2020-4
48.	DM- 1521	125.	NPJ 256
49.	BAUM-21-1	126.	NPJ 231
50.	JM-16-5	127.	RH 1927
51.	RB- 109	128.	RH 1928
	<b><i>B. juncea</i> (Quality)</b>		<b><i>B. juncea</i> (White Rust Resistance)</b>
52.	LES- 64	129	DRMRCI(W)- 125
<b>53.</b>	LES- 65	130.	DRMRIJ 20-157
54.	PDZ-16#	131.	DRMRHJ 317
55.	PDZ-17#	132.	DRMR 2018-25
56.	JC-1	133.	DRMR 2018-37
57.	JC-16	134.	RH 2007
58.	RH (OE)-1612	135.	RH 2070
59.	RH (OE)-1808		
60.	DRMRQ 143-9		<b>Checks: <i>B. juncea</i></b>
61.	DRMRQ 4-3		Rohini (SC)
62.	DRMRCI(Q) 47		NRCHB 101 (SC)
63.	DRMRCI(Q) 57		BIOYSR (RC-WR)
64.	IJ19R5004		DRMRMJA 35 (RC-WR)
	<b><i>B. juncea</i> (Late Sown)</b>		Basanti (RC-WR)
65.	DRMRHT-13-7-113		RH 749
66.	DRMRHJ 430		Maya
67.	DRMRSJ 272		RGN 73
68.	DRMRCI 140		Girraj
69.	RH 1939		PHR 2 (TC-AB)
70.	RH 2050		<i>B. carinata</i> : DLSC 1
<b>71.</b>	KMR(L) 21-5		<i>B. napus</i> : GSL 1
72.	KMR(L) 21-6		<i>B. rapa</i> var. <i>Toria</i> : PT 303
73.	NPJ 250		<i>B. rapa</i> var. YS: NRCYS-5-2
74.	NPJ 251		<i>Eruca sativa</i> : RTM 314
75.	PAB-2014-7		
76.	PAB-2014-17		
77.	RGN-520		
78.	RGN-522		
7.	BAUM-08-15		
80.	HUJM-20-6		
81.	ACN 237		

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

**Objective:** To assess yield losses caused by the major diseases at different locations

**Locations:** Shillongani, Dholi, Jagdalpur, Berhampore

**Layout:** The experiment shall be laid out in randomized block design with three replications with variety Varuna with different treatments. Each plot shall be of 1.5 m x 5 m size with a spacing of 30 cm x 10 cm (the plot may have 5 rows at 30 cm spacing). Recommended doses of N and P fertilizers shall be applied; insect-pest protection practices to be undertaken (it is suggested to apply seed treatment and spray with suitable insecticides as per requirement. No protection to be taken against any disease.

**Treatments:**

1. Iprodione 50WP -FS @ 0.2%
2. Tebuconazole 50%+trifloxistrobin 25% WG-FS @ 0.5g/l
3. Soil application of Potash 40 kg/ h
4. ST+FS with *Trichoderma harzianum* @ 10g/ kg seed
5. Lower three leaf removal at 45 DAS
6. Garlic bulb extract @ 1% w/v (ST+FS)
7. *Pseudomonas florescence* 10<sup>6</sup> c.f.u.
8. Check

**Observations:**

Data for initial date of appearance of disease in each plot shall be recorded for per cent Alternaria blight disease severity (PDS) on leaf for and pods in each treatment/ plot –following new rating scale adopted by the group (2010). Data may be recorded from 10-tagged plants randomly in experimental plot. Seed yield per plot be recorded and provided in kg/ ha. Data should be reported after statistical analysis along with IBCR.

#### **4.8 Epidemiology of Alternaria blight, white rust, powdery and downy mildew Objective:**

**Objective:** To develop models for forecasting of the major diseases at different locations

**Locations:** Pantnagar, Hisar, Shillongani, SK Nagar, Dholi, Jhansi, Morena, Jagdalpur, Kanpur

**Layout:** The experiment shall be laid out in split-plot design with one replication with varieties Varuna and Local (important variety of the locality) as main-plot treatments and dates of sowing

(08) at weekly interval (01, 08, 15, 22, 29 Oct, 05, 12 and 19 Nov) as sub-plot treatments. Each plot shall be of 1.5 m x 5 m size with a spacing of 30 cm x 10 cm (the plot may have 5 rows at 30 cm spacing). Recommended doses of N and P fertilizers shall be applied with no application of K fertilizer; insect-pest protection practices to be undertaken (apply seed treatment with appropriate insecticide and spray 1 ml/ l at 15-day interval). No protection to be taken against any disease.

**Observations:**

Data for initial date of appearance of disease in each plot shall be recorded on copies of data sheet with data for percent disease severity (PDS) in each treatment/ plot twice-a-week (on Tuesday morning and Friday evening) till harvest on leaf for Alternaria blight (powdery mildew in SK Nagar) and white rust and Alternaria blight PDS on pods – all following new rating scale adopted by the group (2010). Plot-wise observation for staghead percent and percent incidence of Sclerotinia rot shall also be recorded. Data may be recorded from 10-tagged plants randomly in experimental plot (tagged by stacking with stick). Seed yield per plot be recorded and provided in kg/ ha.

Maximum possible details of daily weather data for crop period (September to day of harvest of the last plot) for different parameters [Min and max. temp. (°C), rainfall (mm), max and min RH

(%), solar intensity/ sunshine hours] may also be recorded and submitted to PI, Plant pathology, ICAR- DRMR, Bharatpur at end of every month. Wherever possible, data for leaf wetness and wind velocity (km/ h) may also be recorded and submitted. Data should be reported after correlation regression analysis along with disease severity of different diseases during the year accompanied by weather data for its finalization

Data for disease severity/ incidence may be recorded in excel of prescribed data sheets and they may be sent along with daily weather data to PI (Plant Pathology), ICAR-DRMR, Bharatpur at the end of every month for necessary analysis.

#### 4.9 Efficacy of fungicides against major diseases of rapeseed-mustard

<b>Objective:</b>	To find out the efficacy of newer fungicides for disease management
<b>Locations:</b>	Pantnagar, Morena, Hisar, Ludhiana, Dholi, Jhansi, Bharatpur, Sriganaganagar, Shillongani
<b>Treatments:</b> (Foliar spray at 45 and 70 DAS)	<ol style="list-style-type: none"> <li>1. Tebuconazole 50% + trifloxostrobin 25% WG @ 0.1%</li> <li>2. Propiconazole 25% EC @ 0.1%</li> <li>3. Metalaxyl 4% + mancozeb 64% @ 0.25%</li> <li>4. Hexaconazole 5% SC @ 0.1%</li> <li>5. Tebuconazole 25.9% @ 0.1%</li> <li>6. Azoxystrobin @ 0.1%</li> <li>7. Trifloxystrobin 50% @ 0.1%</li> <li>8. Check</li> </ol>
<b>Observations:</b>	Disease occurrence, severity/ incidence for major diseases including Alternaria blight and AB on pods, white rust, % stag head, powdery mildew—following new rating scale adopted by the group (2010), Sclerotinia rot incidence should be recorded as per trial 4.5. Data may be recorded from 10-tagged plants randomly in experimental plot. Seed yield per plot be recorded and provided in kg/ha. Data should be reported after statistical analysis along with IBCR
<b>Layout:</b>	Repln: 3; Plot size: 3x5m, Spacing: 30x10cm; D/S: 20-25 Oct; Variety: Girraj

#### 4.10 Bio-management of rapeseed-mustard diseases

**Objective:** To assess effective bio-management of major diseases at different locations

**Location:** PNT, HSR, LDH, BPR, JHS, SKN, SHL

**Layout:** Variety: **DRMRIJ 31**; Plot size: 3x5 m, Repln: 3; Spacing: 30x10 cm; D/s: 20-25 Oct

**Treatments:**

T1= ST with *T. harzianum* @ 10g / kg

T2= Soil incorporation of *Th* with mustard straw @ 2.5t / h

T3= T1+ FS of *Th* at 60 and 75 d.a.s. @ 6gm/ ha

T4= Soil incorporation with FYM of *Th* @ 1 kg/ q FYM

T5= *Bacillus subtilis* 10<sup>6</sup> c.f.u.

T6= Control

**Observations:** ABL, ABP, WR, SH, PM severity and SR incidence as above

#### 4.11 Farmers' field for disease outbreak

**Objective:** Survey of farmers' fields for occurrence of major/minor diseases

**Observations at all centre:**

- i. Initial appearance of the disease with intensity and cultivars affected
- ii. Fortnightly observations on the same field
- iii. Fortnightly weather parameters

# XXVIII Annual Group Meeting of AICRP Rapeseed-Mustard

August 6-7, 2021 Online

## Session VI Planning & Technical Programme Formulation: Entomology

**Chairman** : Dr. H C Sharma, Former Vice Chancellor, UHF, Solan (HP)  
**Rapporteurs** : Prof. MS Khan, Deptt. of Entomology, GBPUA&T, Pantnagar  
: Dr. Sarwan Kumar, Sr Entomologist, PAU, Ludhiana

The planning and technical programme formulation session of Entomology started with welcome address by Dr. PK Rai, Director, DRMR. He welcomed the Chairman, and the fellow entomologists. Dr H C Sharma, Ex-Professor & Vice Chancellor, UHF, Solan (HP) in his introductory remarks mentioned that entomologists should identify lines with at least partial resistance to mustard aphid along with superior agronomic base that can be incorporated in mustard aphid IPM module(s). He also emphasized to study the bio-control agents of mustard aphid including *Verticillium lecanii*. Dr GS Saharan, Ex-Professor and Head, Plant Pathology, CCS HAU, Hisar emphasized to analyze the long term data on mustard aphid and develop some distribution map for mustard aphid. It was decided that Dr Mukesh Dhillon from IARI will analyze the long term population data of mustard aphid. Dr HC Sharma emphasized that if there is any source of resistance to mustard aphid, it should be used in breeding programme aimed at development of aphid resistance against rapeseed-mustard.

It was emphasized by Dr Sarwan Kumar, PI of AICRP-RM that the experiments must be conducted as per technical programme with proper statistical analysis and the report should be submitted latest by May 31<sup>st</sup> of the year. For data recording, a uniform format will be circulated to all the centers. Data should be submitted in the same format as circulated by PI. All entomologists should follow technical programme strictly. Dr HC Sharma desired to add some resistant check along with susceptible check BSH 1 in screening trials. After thorough discussions on the same point in last years meeting, the house agreed to incorporate separate checks for mustard aphid in IVT and AVT trials and five new checks *i.e* RH 725, PM 30, 45S46, PDZM 31, and *Brassica fruticulosa* introgressed *Brassica juncea* line were decided to use in these trials. After three years of experimentation two trials on (i) Bio-intensive IPM module for management of mustard aphid and (ii) Bioefficacy of newer insecticides against mustard aphid were concluded and the following recommendations emerged:

### Recommendations:

1. Bio-intensive IPM module is recommended for the management of mustard aphid:
  - Sow the crop at recommended time and avoid late sowing.
  - Avoid excessive use of nitrogenous fertilizers (urea) and apply only recommended dose.
  - At flowering, monitor the crop regularly at weekly intervals.
  - Apply control interventions only if aphid population increases economic threshold level.
  - Whenever, aphid population crosses economic threshold, first spray should be done with azadirachtin 3000 ppm @ 5 ml/ l water followed by second spray after 10 days.
2. For the chemical control of mustard aphid, spray the crop with thiamethoxam 25 WG @ 0.1 g/l water (CIB recommended dose) when the aphid population reaches economic threshold level.

Precaution: Spray should be done in the afternoon when pollinators including honeybees are less active.

### Technical Programme (2020-21)

#### Project 5.1 A): Screening of germplasm and advanced genotypes for resistance against mustard aphid

**Locations:** Bharatpur, Ludhiana, Hisar, New Delhi, Morena, Kanpur, Pantnagar, S.K. Nagar, Dholi, Shillongani

**Methodology:** Grow entries in 3 m long paired rows in 3 replications. Delay the sowing by 20 to 25 days than the normal to ensure heavy aphid pressure under natural conditions.

**Observations:** Record observations on number of aphids per plant (10 cm top twig), per cent plants with aphids on 10 randomly selected plants per entry, and derive aphid population index (API), aphid damage index (ADI), and aphid resistance index (ARI) as described in the below given table.

**Time of observation:** 1. At full flowering stage 2. At full siliqua formation stage.

**Note:** The material will be supplied by the PI, Entomology.

Record data separately for different *Brassica* spp.  
 Material for screening will be provided by the respective breeders.  
 Maximum grading either at full flowering stage or at pod formation stage should be considered to classify the genotypes.  
 Self at least two plants per entry for genetically pure seed.

Aphid infestation index can be calculated as per the following table:

Table 1: Aphid population, damage and resistance indices to categorize rapeseed-mustard for resistance to *Lipaphis erysimi*

S.N	Aphid population index (API)	Aphid damage index (ADI)	Aphid resistance index (ARI)	Resistance category
1	1 = No or less than 20 aphids on the inflorescences of test plants	1 = Normal plant growth, no symptoms of injury, no curling or yellowing of leaves	0.1-1.0 (API+ADI/2)	0.0-1.0 = Resistant
2	2 = upto 25% inflorescences have 21-100 aphids on the test plants	2 = Average plant growth, curling and yellowing of few leaves, flowering and fruiting	1.1-2.0 (API+ADI/2)	1.1-2.0 = Moderately resistant
3	3 = upto 50% of inflorescences have 101-250 aphids across test plants	3 = Poor plant growth, curling and yellowing of leaves on some branches, drying of few flowers and poor pod setting	2.1-3.0 (API+ADI/2)	2.1-2.5 = Tolerant
4	4 = upto 75% inflorescences have 251-500 aphids across test plants	4 = Stunted plant growth, heavy curling and yellowing of leaves all through the plant, drying and curling of almost half the inflorescence with poor flowering and rare pod setting	3.1-4.0 (API+ADI/2)	2.6-3.5 = Susceptible
5	5 = 100% of inflorescences have more than 500 aphids across test plants	5 = Severe stunting and ragged plant appearance, yellowing and curling of almost all the leaves, complete drying of inflorescence without any flower and immature drying of pods if any	4.1-5.0 (API+ADI/2)	3.6-5.0 = Highly susceptible

(Ref. Dhillon, 2018)

## Project 5.1: Screening of germplasm and advanced genotypes for resistance against mustard aphid

Sr No	1. IVT Mustard (1.1 IVT Early Mustard)		
1	KMR(E) 21-1	Maya X RK 9807	CSAUA&T, Kanpur
2	KMR(E) 21-2	Varuna X RK 9803	CSAUA&T, Kanpur
3	DRMRHT 13-13-5-5	GM 2 X BPR 549-9	DRMR, Bharatpur
4	DRMRHT 13-13-5-4	GM 2 X BPR 549-9	DRMR, Bharatpur
5	DRMRIJ 16-9-7	NRCHB 101 X Pusa Swarnim	DRMR, Bharatpur
6	DRMRCI-141	NPJ 112 X BPR 560-68	DRMR, Bharatpur
7	DRMRSJ 364	<i>B. rapa</i> var. <i>KOS-1</i> X <i>B. nigra</i>	DRMR, Bharatpur
8	RH 1999-14	RH 1402 A x RH 1401	CCS HAU, Hisar
9	RH 1999-18	RH 1402A X RH 1007	CCS HAU, Hisar
10	PRE-2018-7	PR-2006-1xNDRE-4	GBPUA&T, Pantnagar
11	PRE-2018-9	PR-2009-9xPR-20	GBPUA&T, Pantnagar
12	NPJ 248	NRCHB-101/ NPJ 173	IARI, New Delhi
13	NPJ 249	NRCHB-101/ NPJ 173	IARI, New Delhi
14	SVJH- 69(Hybrid)	SVJA- 05 X SVJR- 10	Shaktivardhak Hybrid Seeds, Pvt. Ltd.
15	PHR-8081 (Hybrid)	DTM 217 X DTMR	PAU, Ludhiana
16	PHR-8425 (Hybrid)	DTM 269 X DTMR	PAU, Ludhiana
17	BAUM-21-3	Mutant of P.Bold	BAU, Kanke, Ranchi
18	ORM 2019-25	ORM 3-2-1 x PM 25	OUAT, Bhubaneshwar
19	TM 311	TJD1XPM25	BARC, Mumbai
20	HUJM (E) 20-4	MCN 10-11 x ASHIRWAD	BHU, Varanasi
21	RMX 9310 (Hybrid))	RSA 0122 X RSR 0032	Rasi Seeds, Pvt. Ltd.
22	ACN 226	ACN-9 x GM-2	CoA, Nagpur
23	Mali MS 90	Shivani/Bankura Local//Bankura Local	Mali Agri Tech Pvt Ltd, Nadia
	<b>1.2 IVT Timely Sown, Irrigated</b>		
1	DRMRIJ 18-62	IJ- 31 X LET- 36	DRMR, Bharatpur
2	DRMR 2019-19	DRMR 2035 X NRCHB-101	DRMR, Bharatpur
3	DRMRCI- 147	DRMR 10-40 X DRMR 541-44	DRMR, Bharatpur
4	SKM 1744	EC 287711 X RSK 28	SDAU, SK Nagar
5	SKM 1801	GM 3 X GDM 4	SDAU, SK Nagar
6	RGN-507	RGN 348 x RGN 229	ARS, Sriganganagar
7	RGN-524	RL 1359 x Pusa Bold	ARS, Sriganganagar
8	PBR 939	PBR 357 X Giriraj	PAU Ludhiana
9	RH 1934	JM 6011 X RH 1365	CCS HAU, Hisar
10	RH 2049	RH 1203 X RH 7846	CCS HAU, Hisar
11	KMR 21-3	Rusa Bold X Maya	CSAUA&T, Kanpur
12	KMR 21-4	Varuna X PR- 15	CSAUA&T, Kanpur
13	NPJ-252	NPJ 156/EJ 17	IARI, New Delhi
14	NPJ-253	KMR-12-1/NPJ 156	IARI, New Delhi
15	PRB-2016-1	PR-2006-1x PRB-2006-5	GBPUA&T, Pantnagar
16	PR-2019-3	Krishna x NRCHB 101	GBPUA&T, Pantnagar
17	HUJM-20-9	MCN 10-11 x HUJM 05-03	BHU, Varanasi
18	HUJM -10-6	HUJM-007 x Induced Mutant of Local collection	BHU, Varanasi
19	RMM 19-18	JM-4 x B-85	ZARS,Morena
20	ACN 237	Urvashi x BIOYSR	COA, Nagpur
21	ORM 18-29-5	ORM 8-5-11 x Pusa Bold	OUAT, Bhubaneshwar
22	DM- 1521	Laxmi X DSC 48	Dayal Seeds Pvt. Ltd. Meerut
23	BAUM-21-1	Mutant of Shivani with 900Gy+ 0.3 EMS (S4-15-1)	BAU, Kanke, Ranchi
24	JM-16-5	RSPR-01x RH 749	SKUAST, Chatha, Jammu
25	RB- 109	RH-846 X RH- 940	RRS, Bawal
	<b>1.3 IVT Mustard (Rainfed)</b>		
1	DRMRCI-148	RH-819 X NRCDR-02	ICAR-DRMR, Bharatpur
2	DRMRHJ 1117	MJA 11 X MJR 17	ICAR-DRMR, Bharatpur

3	DRMR 2019-7	RH 749 X NRCHB- 101	ICAR-DRMR, Bharatpur
4	DRMRHT 13-22-2	JN032 X BPR 549-9	ICAR-DRMR, Bharatpur
5	NPJ-254	NPJ 112 / BCEF 17-20-1	IARI, New Delhi
6	NPJ-255	KMR-12-1/NPJ 156	IARI, New Delhi
7	RGN-510	NPJ 182 x RH 406	ARS, Sriganganagar
8	RGN-519	RGN 332 x RH 749	ARS, Sriganganagar
9	RH 1928	RH 0749 X Phy 13-8	CCS HAU, Hisar
10	RH 1930	RH 0749 X DRMRIJ 11-275	CCS HAU, Hisar
11	PBR 552	RL 1359 X RGN 181	PAU, Ludhiana
12	PBR 357	(PBR-91 x RLM 514) x Bio-902	PAU, Ludhiana
13	BAUM-21-2	Mutant of Shivani	BAU, Kanke, Ranchi
14	DM- 1521	Laxmi X DSC 48	Dayal Seeds Pvt. Ltd. Meerut
15	ORM 26-37-2	ORM 53-7-3 x NRCHB101	OUAT, Bhubaneshwar
16	CAU- RMM 3	Mutant of PM 25	DoR, CAU, Imphal
17	RB- 110	RH- 24 X RH-207	RRS, Bawal
<b>1.4 IVT- Mustard Late sown</b>			
1	DRMRHT-13-7-113	NRCHB- 101 X BPR 549-9	DRMR, Bharatpur
2	DRMRHJ 430	OJA 4 X OJR 1	DRMR, Bharatpur
3	DRMRSJ 272	<i>B. rapa var. Jhumka X B. nigra</i>	DRMR, Bharatpur
4	DRMRCI 140	RH 819 X DRMR 270	DRMR, Bharatpur
5	RH 1939	RH 1130 X T 6342	CCS HAU, Hisar
6	RH 2050	RH 1203 X RH 7846	CCS HAU, Hisar
7	KMR(L) 21-5	Ashirwad X Urvashi	CSAUA&T, Kanpur
8	KMR(L) 21-6	Ashirwad X Krishna	CSAUA&T, Kanpur
9	NPJ 250	P Vijay/BioYSR/P Vijay	IARI, New Delhi
10	NPJ 251	PBR 357//NPJ 102/RGN 48//NPJ 174/PBR 2008-5	IARI, New Delhi
11	PAB-2014-7	Vardan x PAB 2002	GBPUA&T, Pantnagar
12	PAB-2014-17	Varuna x PAB 9511	GBPUA&T, Pantnagar
13	RGN-520	MOP 12-211 x RH 749	ARS, Sriganganagar
14	RGN-522	PBR 423 x PBR 357	ARS, Sriganganagar
15	BAUM-08-15	Bio-133-04 X BBM-07-1	BAU, Kanke, Ranchi
16	HUJM-20-6	MCN 10-11 x HUJM 9903	BHU, Varanasi
17	ACN 237	Urvashi x BIOYSR	CoA, Nagpur
<b>1.5 Hybrid Mustard, IHT</b>			
1.	RHH 2101	RH 8812 X OR 31	CCS HAU, Hisar
2.	RHH 2102	<i>RH 0630 X OR 506</i>	CCS HAU, Hisar
3	RH 2103	RH 8812 X OR 506	CCS HAU, Hisar
4	PHR3281	IM60NA X MH-13	PAU Ludhiana
5	PHR4457	DTM32NA X AJR102B	PAU Ludhiana
6	PHR5175	DTM218NA X TCN	PAU Ludhiana
7	DRMRHJ 2518	MJA 25 X MJR 18	ICAR-DRMR, Bharatpur
8	DRMRJH 3717	MJA 37 X MJR 17	ICAR-DRMR, Bharatpur
9	DRMRHJ 3130	OJA 31 X OJR 1	ICAR-DRMR, Bharatpur
10	DRMRHJ 3720	MJA 37 X MJR 20	ICAR-DRMR, Bharatpur
11	Pusa MH 62	Pusa MS 2-3A/RP 9-2-2	IARI, New Delhi
12	Pusa MH 65	Pusa MS 2-3A/RP 2-3-3	IARI, New Delhi
13	SVJH- 70	SVJA- 05 X SVJR- 13	Shakti Vardhak Hybrid Seeds Pvt. Ltd.
14	SVJH- 71	SVJA- 09 X SVJR- 10	Shakti Vardhak Hybrid Seeds Pvt. Ltd.
15	RMX9922	RSA 0039 X RSR 0002	Rasi Seeds, Pvt. Ltd.
16	NMH90M01	GRU 283A X GRU 509	Nuziveedu Seeds Ltd.
17	KGSH-9198	27 A X 63 R	Kamadgiri Seeds
18	18J408C	4PHHW64A X 4PRTK05R	Corteva Agriscience
19	NAMJH21-01	NAMJA1 X NAMJR6	Namdhari Seeds Pvt. Ltd.



20	PMH90V02	GRU269A/GRU270B X	Prabhat Agri Biotech Ltd.
21	KMH 8765	SWJ03A X SWJ02R	SeedWorks International Pvt Ltd Mustard Research Centre Jaipur
22	IJ16R1168	PA1IJ104 X PR10IJ055	Bayer Bioscience, Pvt. Ltd, Faridabad
<b>1.6 Quality Mustard : IVT</b>			
1.	LES- 64	LES 45 X NPJ 171	IARI, New Delhi
2.	LES- 65	Pusa Mustard 21 X PDZ-2	IARI, New Delhi
3.	PDZ-16#	Pusa Agrani X Heera	IARI, New Delhi
4.	PDZ-17#	Pusa Mustard 21 X PDZ-2	IARI, New Delhi
5.	JC-1	(PBR 210 X JM 06003) X NUDH YJ4	PAU Ludhiana
6.	JC-16	CJRB 1579-5-11 X JM06003	PAU Ludhiana
7.	RH (OE)-1612	EC 552573 X RH 0305	CCS, HAU, Hisar
8.	RH (OE)-1808	EC 552529 X AJ 3	CCS, HAU, Hisar
9.	DRMRQ 143-9	NRCHB- 101 X PM- 21	ICAR- DRMR, Bharatpur
10.	DRMRQ 4-3	NRCDR 02 X PM- 22	ICAR- DRMR, Bharatpur
11	DRMRCI(Q) 47	NRCHB- 101 X Heera	ICAR- DRMR, Bharatpur
12	DRMRCI(Q) 57	NRCHB- 101 X Heera	ICAR- DRMR, Bharatpur
13	IJ19R5004	PA7IJ136 X PR9IJ403	Bayer Bioscience Pvt Ltd, Faridabad
<b>1.7 IVT Mustard: Saline/alkaline conditions</b>			
1	CS 2020-10	RH 781 x CS 56	ICAR- CSSRI, Karnal
2	CS 2009-234	CS 54 x Krishna	ICAR- CSSRI, Karnal
3	CS 2013-64	CS 56 x Pusa Jagannath	ICAR- CSSRI, Karnal
4	CS 2020-4	Rohini x CS 54	ICAR- CSSRI, Karnal
5	NPJ 256	NPJ 124/NPJ 116	IARI, New Delhi
6	NPJ 231	Varuna/ NPJ 93	IARI, New Delhi
7	RH 1927	RH0749 x PHY 13-8	CCS HAU, Hisar
8	RH 1928	RH0749 x PHY 13-8	CCS HAU, Hisar
<b>1.8 IVT Mustard: White Rust Resistance</b>			
1	DRMRCI(W)- 125	Derived through MABC (NRCDR02 X DONSKAJA)	ICAR-DRMR, Bharatpur
2	DRMRIJ 20-157	OJA 1 X OJR 4	ICAR-DRMR, Bharatpur
3	DRMRHJ 317	MJA 3 X MJR 17	ICAR-DRMR, Bharatpur
4	DRMR 2018-25	NRCHB- 101 X DRMR 2398	ICAR-DRMR, Bharatpur
5	DRMR 2018-37	DRMR- 2019 X NRCDR 02	ICAR-DRMR, Bharatpur
6	RH 2007	TM 215 X RH 0401	CCS, HAU, Hisar
7	RH 2070	TPM 1 X RH 0401	CCS, HAU, Hisar
<b>2. IVT Gobhi Sarson</b>			
1	GSH-2155	LG-5 X ZY005	PAU, Ludhiana
2	GSH-1723	IG-1BC X ZY005	PAU, Ludhiana
3	GSH-1703	AG28BC X ZY005	PAU, Ludhiana
4	HNS 1102	HNS 0901 X EC552600	CCS, HAU, Hisar
5	HNS 1206	HNS 9516 X EC552600	CCS, HAU, Hisar
6	DRMRIN 20-23	GSC 6 X Pusa Swarnim	ICAR-DRMR Bharatpur
7	DRMRIN 20-3	GSC 6 X Pusa Swarnim	ICAR-DRMR Bharatpur
8	JGS-15-6	RSPN-25 x GSL-1	SKUAST, Chatha, Jammu
9	AKGS 8060	Sheetal x NUDH 86	SKRE, Kangra

**Checks:** RH-725 (Conventional check) BSH-1 (Susceptible check), DMH-1 (Hybrid check), LR-PDZM-31 (Quality check), Kranti (NC) and PM30 (LR) and *Brassica fruticulosa* introgressed *Brassica juncea* line (resistant check) will be the check entries for all screening programme.

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

Following are the AVT-I + II entries of *Brassica* to be screened for their reaction to mustard aphid

SN	Entry
1	<b>AVT I Yellow Sarson</b> <b>Entries:</b> RMYS 2, PYS 2018-02
2	<b>AVT-I Early Mustard</b> <b>Entries:</b> PRE 2018-10, RH 1999-42
3	<b>AHT-I Early Indian Mustard</b> <b>Entries:</b> DRMRHJ 2403
4	<b>AVT- I Mustard (Time Sown, Irrigated )</b> <b>Entries:</b> RGN 443, SKM 1626, PBR 385, PR 2016-4, PR 2016-8, DRMR 2017-16, RH 1676, RH 1975, RH 1974
5	<b>AVT-I + II Quality Mustard</b> <b>Entries:</b> RH(OE)-1807, JC 36, PDZ-15, PDZ-14, LES 60\$, RH (OE) 1706\$, 0IJ5001
6	<b>AVT- I : Mustard: Saline/alkaline conditions Entries:</b> CS 2005-143
7	<b>AVT-I+II Mustard, Timely sown (Rainfed)</b> <b>Entries:</b> DRMRCI 128, RH 1424
8	<b>AVT-I: Mustard, Late Sown (Irrigated)</b> <b>Entries:</b> DRMR 2018-19
9	<b>AVT-I White Rust Resistance</b> Rohini (A4A5)-491, Rohini (Parent), PB (A4A5)-842, Pusa Bold (Parent), PJK (A4A5)-21, Pusa Jai Kisan (Parent), Varuna (A4A5)-936-279 and Varuna (Parent)
10	<b>AVT -I Gobhi Sarson</b> AKGS 19-8

**Checks:** RH-725 (Conventional check) BSH-1 (Susceptible check), DMH-1 (Hybrid check), LR-PDZM-31 (Quality check), Kranti (NC) and PM30 (LR) and *Brassica fruticulosa* introgressed *Brassica juncea* line (resistant check) will be the check entries for all screening programme.

**Observations:** Record aphid infestations index (AII) on 0-5 scale, average aphid population per plant (10 cm top twig) and per cent plant infestation on the basis of 10 randomly selected plants per entry [Calculated as per the given methods in table:1, (Ref. Dhillon, 2018)]

**Time of observation:**

- 1. At full flowering stage**
- 2. At full siliqua formation stage.**

**Note :**

1. The material will be supplied by the PI, Entomology.
2. Record data separately for different *Brassica* sp.
3. Material for screening will be provided by the respective breeders.
4. Maximum grading either at full flowering stage or at pod formation stage should be considered to classify the genotypes.
5. Self at least two plants per entry for genetically pure seed.

**Project 5.2: Assessment of yield losses due to aphid in *Brassica* crops**

Objective: To find out yield losses caused by various insect-pests

Locations: Ludhiana, Hisar, New Delhi, Morena, Kanpur, Pantnagar, S.K. Nagar, Dholi and Shillongani

**Treatments** (2) (i) Protected (ii) Unprotected

The protected set to be sprayed with locally recommended insecticide against insect-pests. Spray should be done when the pest population reaches economic threshold level.

**Entries: The recent released/identified varieties for *Brassica juncea* were taken for yield losses trial: Radhika and Brijraj and locally high performing variety**

**Design - RBD, Plot size: 4.2 m x 3m, Replications 4**

**Sowing time:** Second fortnight of November

- Observations:**
1. Observations of different insect pests to be recorded on randomly selected 10 tagged plants per plot as per standard methodology given in 5.3. However, before every spray data on insect-pests population will be recorded and per cent reduction in pest population will be worked out.
  2. Percent reduction in insect pest population in protected set over unprotected one of the same variety.
  3. Yield data at harvest.
  4. Yield loss to be worked out.

**Format for data recording of project 5.2**

Project 5.2: Assessment of yield losses due to insect pests in <i>Brassica</i> crops								
Date of Sowing: ----- Date of Harvesting: -----								
Entries	Aphid population before treatment		Aphid population after treatment		% reduction in aphid population in protected set over unprotected	Yield kg/ha		Avoidable yield loss (%)
	Protected	Unprotected	Protected	Unprotected		Protected	Unprotected	
PM 31								
RH 725								
Local high yielding Variety								

**Project 5.3(A): Agro-ecological analysis of various insect-pests on *Brassica* crops**

Locations: Ludhiana, Hisar, Morena, Kanpur, Pantnagar, S.K. Nagar, Dholi and Shillongani  
 Crops/Entries (i) *Brassica juncea* (DRMRIJ 31) (ii) *Eruca sativa* (T 27) (iii) *B. napus* GSC 6 (iv) *B. rapa* BSH 1  
 Plot size: 4.2 m x 3 m  
 Replications : 3

Crop sowing (i) Timely sown (ii) Late sown

Observations: (Recorded at weekly intervals)

1. Mustard aphid : Number of aphids/10 cm twig on 10 plants per genotype (See Project No. 5.1)
2. Mustard sawfly : Number of larvae/10 plants (sawfly larval population to be recorded at 3 days interval)
3. Painted bug : Number of bugs (adult + nymph)/10 plants
4. Flea beetle : Number of beetles/10 plants
5. Cabbage caterpillar : Number of larvae/10 plants
6. Others : a) Number of insects/10 plants  
 b) Pollinator diversity should be recorded (Species diversity can be recorded through taxonomic identification as well as image varification from the experts)  
 c) Natural enemies (*i.e.* parasitoids, predators and entomogenous pathogens diversity etc) diversity should be recorded (Species diversity can be recorded through taxonomic identification as well as image varification from the experts)

**Format for data recording for Project 5.3(A): Agro-ecological analysis of various insect-pests**

Date of Harvesting :      Date of sowing :										
SM	Weather Parameters						Aphids /10cm top twig			
	Temperature (°C)		R.H. (%)		Sunshine (hrs)	Wind speed Kmph	Rainfall (mm)	<i>B. juncea</i>	<i>Eruca sativa</i>	<i>B. napus</i>
W	Max	Min.	Max	Min.						

Note- The same format can be used for other pests as well.

### Project 5.3 (B): Monitoring of alate aphids on yellow sticky traps

**Objective:** All the centres will install yellow (chrome) painted smeared with transparent greasy material on 1 kg oil tin box (round) at 5 locations in the experimental farm at 1.5 m above ground from first week of October onwards. The height of trap should be adjusted so that it remains 1 foot above the crop canopy. The data on the winged trapped mustard aphid is to be recorded daily by taking care of cardinal directions throughout the year

**Locations:** Ludhiana, Hisar, Morena, Kanpur, Pantnagar, S.K. Nagar, Dholi and Shillongani

**Observations:** i) Temperature, (maximum and minimum), RH (morning and evening), sunshine hours, rainfall and rainy days

**Analysis:** Data on the insect-pests infestation from different centres will be analyzed with respect to meteorological parameter

### 5.4 Effect of host plant diversity on abundance of mustard aphid and the associated specialist and generalist natural enemies

**Locations:** Ludhiana, Hisar, Morena, Kanpur, Pantnagar, S.K. Nagar, Dholi and Shillongani

**Plot size:** 8m x 3 m

**Replications :** 3

**Mustard variety:** *Brassica juncea*

**Sowing time** Sowing time: Mustard: **second/third week of November**

**Treatments:** T1 Mustard alone

T2 Mustard + Linseed

T3 Mustard + Chickpea

T4 Mustard+ coriander

**Note: Inter-cropping is done in 16 (Mustard) : 4 (Other combination of crop)**

**Note: Seed rate for Coriander (10kg/acre), Linseed (15 /acre), Chickpea (18kg/acre). Spacing should be followed as like mustard (45\*15 cm with in row)**

**Observations:**

1. Weekly data on the population development of mustard aphid/ 10 plants selected at random
2. Number of mummified aphids (Parasitized by specialist parasitoid: *Diaeretiella rapae*) and number of generalist predators such as lady bird beetles, syrphid fly larvae, *Chrysoperla* sp. etc.
3. Yield data at harvest (Mustard + intercrop).

Economics may be calculated per unit of area for each crop

### 5.5 Effect of aphid herbivory on changes in biochemical parameters of Brassica plants

**Locations:** Ludhiana, Hisar, Pantnagar

**Plot size:** 4m x 3 m

**Replications :** 3

**Mustard variety:** *Brassica juncea*: DRMR IJ 31, *B. napus*: GSC 6

**Design:** RBD

**Sowing time** Sowing time: Mustard: **second/third week of November**

**Treatments:** T1 Aphid infested

T2 Uninfested

**Methodology:** At flowering, in the infested plot release aphids @ 20 aphids/ plant on 5 randomly selected plants. After 48 hours, collect the top 10 cm twig of plants from both infested and uninfested plots for biochemical analysis. To avoid

natural aphid infestation in uninfested plots spray the plots with recommended insecticide of the state.

**Biochemical analysis:**

- 1 Peroxidase
- 2 Phenylalanine ammonia lyase
- 3 Total glucosinolates
- 4 Total phenols
- 5 Ortho-dihydroxy phenols
- 6 Flavonols

**Data and Recording Analysis:**

All centres will also record aphid population data at weekly interval to find out the correlation of aphid population with biochemical constituents.

- 1 Analyze the data w.r.t. increase/decrease in biochemical constituent in infested treatment over uninfested.
2. Record the yield data at harvest.

**Data reporting:**

- Data should be sent to Director, DRMR ( [director.drmmr@gmail.com](mailto:director.drmmr@gmail.com)) on the prescribed data sheets latest by May 15, otherwise it will not be possible to include in the report
- Weather data with brief weather report should be supplied along with trial data.
- Yield data (kg/ha) should be sent after analysis. Unanalyzed data will not be included in the report

**Note:**

- 1 Report should be submitted on time
- 2 As suggested by DG, ICAR, Pictures of different stages of the crop, trial conducted, insect damage and operation performed to be submitted from all the centers.

Problem faced by center PI with respect to conducting the AICRP-RM trials can be communicated to DRMR through official mail as and when they come across so needful can be done.

**XXVIII Annual Group Meeting of AICRP Rapeseed-Mustard**  
**August 6-7, 2021 Online**  
**Planning and Technical Programme Formulation: Plant Physiology & Biochemistry**

<b>Chairman</b>	: Dr. K.R. Koundal, Former Joint Director Research, ICAR-IARI, New Delhi
<b>Subject expert</b>	: Dr. Maharaj Singh, Principal Scientist, IISR, Indore
<b>Rapporteurs</b>	: Dr. Anubhuti Sharma, Principal Scientist, ICAR-DRMR, Bharatpur : Dr. Pushp Sharma, Principal Physiologist, PAU, Ludhiana

The session started with the formal introduction of the chairman Dr. K.R. Koundal, subject expert Dr. Maharaj Singh and scientists from different coordinating centers participated in the formulation of the programme. The highlights of the programme of Biochemistry and Plant Physiology were

1. Entries of IVT/AVT (early/ rainfed) along with promising strains of 2020-21 and check JD-6 and PM 25 were screened for high temperature tolerance at seedling stage for the trait's seedling mortality  $\leq 20\%$  and 10 seedlings dry weight  $\geq 30$  mg under controlled lab condition and seedling mortality  $\leq 20\%$  with dry matter  $\geq 3.0$ g per ten seedlings under field condition. The results indicated 3 entries SVJH-056, RH1999-42 and DRMRCI133 at Kanpur and Ludhiana under controlled condition while RGN229, DRMRHT1712, SVJH-006, ORM2019-01, TM188, BAUM09-12-2, RH1999-42, DRMRCI133 and DRMR1188 in the field condition at 3 locations met the selection criteria and showed tolerance over the checks JD-6 and PM 25 to high temperature. Conclusively, under both controlled and field conditions, RH1999-42 and DRMRCI133 were found thermo tolerant.
2. In the second experiment, germplasm/breeding lines were tested for their efficiency to low light intensity on the basis of photosynthesis, chlorophyll content, specific leaf weight, leaf water retention and other physiological characters, only RH 1676 showed better efficiency under low light with seed yield ( $\leq 20\%$ ) over the check and other entries tested.
3. Out of 31 breeding lines tested for drought tolerance along with check RH 0725 & RGN-229 only one entry DRMRSJ276 was rated highly tolerant at Bharatpur, Kanpur and Ludhiana centers whereas JC36 showed moderate tolerance at 3 locations (Bharatpur, Hisar and Ludhiana). These entries maintained higher chlorophyll content, RWC, SPAD values and lesser decline in seeds per siliqua, seed weight and higher yield stability index under drought condition.
4. Genotype DRMR2017-27 along with Raj Vijay Mustard 2 and JC-32 were identified as high temperature tolerant for terminal stage at Bharatpur, Hisar and Ludhiana centers. Out of 33 tested entries these 3 genotypes showed thermo tolerance along with high heat stability index ( $HSI \geq 1.3$ ), YSI ( $\geq 0.75$ ) and SY decline of  $\leq 30\%$ .
5. None of the tested entries surpassed check CS-54 and Kranti for salinity tolerance at seedling stage.
6. Foliar application of trehalose @10mM, urea @2%, and  $KNO_3$  were identified to mitigate drought and improved mustard yield.
7. New experiment on enhancing productivity of rapeseed mustard through microbes under moisture stress showed enhanced chlorophyll content, relative water content proline and sugar content with microbial treatments under moisture stress at Hisar and Ludhiana centers. Maximum increase was with MKS6 for RWC and SPAD, total chlorophyll with CRIDAI and MRD17, proline with CRIDAI and MRD 17 and total sugars with Biophos +Biophos and CRIDAI at both the locations.
8. Variations existed for the physiological, yield attributes and seed yield in Giriraj, RH725 and PBR357 with microbial formulation (CSIR- Luck now) and Pusa Sanjeevni (IARI-New Delhi) at Bharatpur, Hisar and Ludhiana in normal and late plantings. However, under late sown condition both the microbial inoculations improved seed yield at 3 locations while abiotic stress consortium (Pusa Sanjeevni) only in PBR357 at Bharatpur.

10. IVT/AVT entries in quality trials were evaluated for biochemistry analysis 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  $\leq$  0.28). Palmitic acid ranged from 1.87% (RGN-73) to 4.6% (PDZ-12) (CV  $\leq$  0.32); Stearic acid: 0.60 % (RH-749) to 2.05% (LES-63). (CV  $\leq$  0.69). Oleic acid: 10.58 % (RH-749) to 59.55 % (GSH-2196). (CV  $\leq$  0.22); Linoleic acid: 17.20 % (Kranti) to 43.57 % (PDZ-15) (CV  $\leq$  0.15); Linolenic acid: 9.04 % (PDZ-1) to 20.69 % (LES-62) (CV  $\leq$  0.25); Eicosanoic acid: 0.36 % (PDZ-15) to 7.19 % (OIJ5001) (CV  $\leq$  1.0); Erucic acid: 0.03% (PDZ-1) to 2.10 % (GSH-2196) (CV  $\leq$  1.20);  $\omega$ 6:  $\omega$ 3 ratio ranged from 1.15 (RH-749) to 4.11 (LES-58) (CV  $\leq$  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.
11. Total protein ranged from 30.18% (JC-36) to 35.21% (PDZ-14) (CV  $\leq$  0.08); Methionine: 1.55 (Kranti) to 2.10 (RH-749) g/100g protein (CV  $\leq$  0.40); Tryptophan: 0.95 (PDZ-14) to 1.37 (PDZ-11) g/100g protein (CV  $\leq$  0.38);
12. Total antioxidant capacity ranged from 16.15 (PDZ-1) to 23.31 (PM-29) mg/g AAE (CV  $\leq$  0.27);  $\beta$ -carotene ranged from 2.50% (PDZ-15) to 4.83% (Kranti) (CV  $\leq$  0.36).
13. 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  $<30 \mu\text{mol/g}$  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  $\leq$  0.34). Phytic acid content mean values were  $< 2.25\%$  in PDZ-15, PDZ-12, PDZ-11, RH (OE)-1706 (CV  $\leq$  0.25).

## Technical Programme 2021-22

### Plant Physiology

#### 6.1 Screening of genotypes from different agro climatic zones for high temperature tolerance at seedling stage.

Entries of IVT/AVT (early/rainfed) along with promising strains of 2020-21: RH1999-42, DRMRCI133, KMR(E) 21-1, KMR(E) 21-2, DRMRHT13-13-5-5, DRMRHT13-13-5-4, DRMRIJ16-9-7, DRMRCI-141, DRMRSJ 364, NPJ 248, NPJ 249, SVJH- 69, PHR-8081, PHR-8425, BAUM-21-3, ORM 2019-25, TM 311, HUJM (E) 20-4, RMX 9310, ACN226, Pro5111, DRMR1188, DRMR1167, DRMR1372, DRMRCI145, RH1999-14, RH1999-18, PRE-2018-,9, PRE-2018-10, Kranti, DRMRCI128, RH1424, DRMRHT-1712 checks JD-6 & PM25

#### Methodology:

Controlled condition (Laboratory)

1. Take 5 kg soil in plastic trays and add water to bring it to field capacity.
2. Sow the seeds in rows and place the tray in seed germinator at  $25 \pm 1^\circ\text{C}$  for germination.
3. After 4-5 days (when the seedlings have about 2.5 cm height), the seedling should be exposed to high temperature ( $45 \pm 1^\circ\text{C}$ ) with 30-40% relative humidity for 4 hours daily for 4 days.

Field condition

1. Sowing should be done around 20-25 September.
2. Plot will be irrigated prior to the sowing (Only pre-sowing irrigation).
3. 100 count seeds will be sown in 2 m row length.
4. Experiment will be continued for 30 days.

**Design :** CRD (Lab.)/ RCBD (Field), Replication: 3



**Observations** : Soil moisture at depth of 0-15cm (at the time of seeding, 10, 20 and 30 DAS), ambient temperature, daily soil temperature, seedling mortality, dry weight (10seedlings), RWC, SPAD values, seedling thermotolerance index (STI) and seed to seedling thermotolerance index (SSTI).

**Centers** : Bharatpur, Dholi, Hisar, Kanpur and Ludhiana.

## 6.2 Evaluation of genotypes under low light stress condition

**Entries** : RH-1676, DRMRCI 96, PBR385 and NRCHB101 check RH-749

**Methodology** :

1. Sowing will be done in the field from 20-25 Oct. in RBD with 3 replications.
2. There will be two treatments, shading of natural light with the nets that cuts 25-30% natural sunlight and no shading (control). The shading will be given for 30 days during Dec15- Jan15.

**Observations** : Photosynthesis of 3rd /4th physiologically matured leaf from the top of each genotype will be measured before shading, 15 days of shading and 10 days after termination of the shading treatment. Time for photosynthesis measurement will be taken during the time from 11.30 AM-2.30 PM, light intensity, transpiration, SLW, SPAD, chlorophyll (a, b, total & carotenoids) content, chlorophyll stability index (CSI), siliquae on main shoot (SMS), total siliquae per plant, seed number per siliqua, seed weight , biological yield (kg/ha) and seed yield (kg/ha) will be recorded.

**Centers** : Bharatpur, Hisar, Kanpur and Ludhiana

## 6.3 Screening of genotypes for drought tolerance

Entries of IVT/AVT (rainfed/quality) along with promising strains identified during 2020-21: DRMRSJ276, NPJ210, NPJ214, RH1424, DRMR1222, JC36, DRMRCI-144, DRMRCI-146, DRMRCI-148, DRMRHJ1117, DRMR 2019-7, DRMR1188, DRMR 1176, DRMRHT 13-22-2, NPJ-254, NPJ-255, RGN-510, RGN-519, RH 1928, RH 1930, PBR 552, PBR 357, BAUM-21-2, DM-1521, CAU- RMM 3, RB-110, DRMRCI 128, RH 761, PDZ15, LES60, RH(OE)1807 and Kranti(NC) Checks: RH 725 & RGN-229

**Methodology** :

1. Sowing will be done in 5 rows each of 2.5 m row length.
2. Surface irrigation (5-6 cm) will be done prior to the sowing.
3. In irrigated condition, two irrigations will be given, first at 35 and second at 65 DAS while rainfed set be grown without irrigation.

**Design** : RBD, Replication: 3

**Observations** : Soil moisture (0-30, 30-60 cm) at the time of seeding, before 2nd irrigation and maturity, field capacity, rainfall, SPAD value, chlorophyll content, RWC, CT, seed weight, siliquae on main shoot (SMS), seeds/siliqua, biological yield (kg/ha), seed yield (kg/ha), harvest index, yield stability index (YSI), drought susceptibility index (DSI) and oil content.

**Centers** : Bharatpur, Hisar, Kanpur and Ludhiana.

#### **6.4 Screening of genotypes for high temperature tolerance at terminal stage**

Entries of IVT/AVT (late sown/quality) along with promising strains from 2020-21: DRMR 2017-27, DRMR 2018-19, JC32, DRMR1176, DRMR1372, DRMR 2546, DRMRHT-13-7-113, DRMRSJ 272, DRMRCI 140, RH 1939, RH 2050, ACN 237, KMR(L)21-5, KMR(L) 21-6, NPJ 250, NPJ 251, PAB-2014-7, PAB-2014-17, RGN-520, RGN-522, BAUM-08-15, HUJM-20-6, Kranti(NC), RH(OE)-1807, JC 36, JC1, JC16, PDZ-15, LES 60 and RH (OE) 1706 Check: PM-26.

**Methodology:** Two rows of each genotype will be sown at optimum date of sowing and one month thereafter as late sown.

**Plot Size:** 5.0 x 0.6m, Spacing: 30 x 10 cm

**Design:** RBD Replication: 3

**Observations:** Ambient temperature (from flowering to maturity), canopy temperature, canopy temperature depression (CTD), membrane stability index, number of seeds/silique, 1000 seed weight, seed yield (kg/ha) and heat stability index (HSI) and yield stability index (YSI).

**Centers:** Bharatpur, Dholi, Hisar, Kanpur and Ludhiana

#### **6.5 Screening of genotypes for salinity tolerance at seedling stage**

Entries of IVT/AVT II (saline/alkaline) along with promising strains identified during 2020-21: Kranti (NC), CS-54 (ZC), CS-60 (LR), CS 2005-143, CS 2020-10, CS 2009-234, CS 2013-64, CS 2020-4, NPJ256, NPJ231, RH 1927 and RH1928

##### **Methodology**

1. Plastic tray should be used that can accommodate about 5-6 kg soil.
2. Soil salinity of 12dS/m should be created using saline solution as per the guideline given by CSSRI, Karnal.
3. Counted seeds (20) should be sown (25-30 Oct.) at uniform depth of about 1.5-2.0 cm in rows. About 2.5 cm distance should be maintained between two seedlings. The trays will be kept in open field under natural condition.
4. The experiment should be conducted during 25-30 Oct. at all the locations. Electrical conductivity and soil moisture should be monitored at the time of sowing and at regular intervals of 5 days.
5. 15 days old should be used for recording shoot length and dry weight.

**Design:** CRD, Replication: 3

**Observation:** Germination (%), seedling length and seedling dry weight (10 seedlings) and seedling vigour II.

**Centers:** Bharatpur, Hisar, Kanpur, Karnal and Ludhiana.

## 6.6 Effect PGRs to mitigate drought stress

Latest released local variety for rain fed condition

### Methodology

1. Rainfed variety will be sown in 9 rows each of 5 m row length.
2. Treatments: Urea -1 and 2%  
Trehalose -10 and 20mM  
Potassium nitrate – 1 and 2 %  
Water spray  
Control

**Foliar sprays:** Initiation of flowering and 50% flowering stage.

**Design:** RBD, Replication: 3

**Observation:** Photosynthetic pigments in 3<sup>rd</sup> or 4<sup>th</sup> leaf on main shoot (chla, chlb, total chl and carotenoids), CSI, RWC, LWR, siliquae on main shoot (SMS), total siliquae/plant, number of seeds/siliqua, seed weight, biomass (kg/ha) and seed yield (kg/ha).

**Centers:** Bharatpur, Dholi, Hisar, Kanpur and Ludhiana

## 6.7 Enhancing productivity of rapeseed mustard through microbes under moisture stress

(Physiologists are associated with AGRONOMY trail for recording data)

Treatments: A i) No culture

ii) Biophos

iii) Biophos+ Biophos

iv) CRIDAI

v) CRIDAII

vi) MRD17

viii) MKS 6

B i) No irrigation

ii) 50% deficit irrigation

iii) Normal level of irrigation

**Observations:** RWC, SPAD values, Chlorophyll (chla, chlb. total chl. and carotenoids), proline and total sugars (DW basis)

**Centers:** Dholi, Hisar, Kanpur and Ludhiana

## 6.8: Microbes for mitigating temperature stress in mustard

**Varieties:** PBR357, RH725 and Giriraj

**Methodology:** Sowing will be done in 5 rows each of 3m row length at optimum date of sowing and one month thereafter as late sown

Microbial cultures will be applied as seed dressing before sowing

**Cultures:** without culture, microbial formulation as bio stimulant (MFs) and stress adaptive consortium (Pusa Sanjeevni)

**Design:** SPD Replication: 3

**Observation:** Soil microbial counts before and after sowing, ambient temperature (from flowering to maturity), photosynthetic pigments (chl<sub>a</sub>, chl<sub>b</sub>, total chl and carotenoids), canopy temperature, canopy temperature depression, membrane stability, RWC, total siliquae/plant, seed weight, biomass(kg/ha) and seed yield (kg/ha)

**Centres:** Bharatpur, Dholi, Hisar, Kanpur and Ludhiana

#### **Technical Programme**

#### **Biochemistry**

### **7.1 Evaluation of important breeding materials for Nutritional Quality Index (NQI) of oil.**

#### **Parameters:**

1. Oil content analysis
2. Fatty acid profiling (Palmitic acid, stearic acid, Oleic acid, Linoleic acid, Linolenic acid, Eicosenoic acid, erucic acid)
3.  $\omega 6/\omega 3$ ,
4. Oil stability index,
5. SFA: MUFA: PUFA
6. Saturated and unsaturated fatty acid ratio

**Centres: Bharatpur, Ludhiana, Hisar, Kanpur**

KRANTI (National Check) and PDZ-1(Quality check)

### **7.2. Value addition screening in seed meal of promising breeding materials**

#### **Parameters:**

1. Protein content
2.  $\beta$ -carotene
3. Total Antioxidant content
4. Total Brassicasterol content
5. Total sinapic acid content

**Centres: Bharatpur, Kanpur, Pantnagar, Hisar, Ludhiana**

6. Mineral Composition analysis (By AAS)

**Centres: Pantnagar, Hisar**

Glucosinolate profiling (By HPLC)

**Centres: Bharatpur, Ludhiana, Kanpur**

KRANTI (National Check) and PDZ-1(Quality check)

### **7.3. Screening of anti-nutritional factors in quality breeding materials**

Number of Parameters:

1. Total Glucosinolates
2. Phytic acid

**Centres: Bharatpur, Kanpur, Pantnagar, Hisar, Ludhiana**

KRANTI (National Check) and PDZ-1(Quality check)

## Entries for Biochemical analysis:

### IVT, Quality Mustard

SN	Entry	Pedigree	Method of breeding	Centre
1.	LES- 64	LES 45 X NPJ 171	Pedigree selection	IARI, New Delhi
2.	LES- 65	Pusa Mustard 21 X PDZ-2	Pedigree selection	IARI, New Delhi
3.	PDZ-16#	Pusa Agrani X Heera	Pedigree selection	IARI, New Delhi
4.	PDZ-17#	Pusa Mustard 21 X PDZ-2	Pedigree selection	IARI, New Delhi
5.	JC-1	(PBR 210 X JM 06003) X NUDH YJ4	Pedigree	PAU Ludhiana
6.	JC-16	CJRB 1579-5-11 X JM06003	Pedigree	PAU Ludhiana
7	RH (OE)-1612	EC 552573 X RH 0305	Back Cross	CCS, HAU, Hisar
8	RH (OE)-1808	EC 552529 X AJ 3	Back Cross	CCS, HAU, Hisar
9	DRMRQ 143-9	NRCHB- 101 X PM- 21	Pedigree	ICAR- DRMR, Bharatpur
10	DRMRQ 4-3	NRCDR 02 X PM- 22	Pedigree	ICAR- DRMR, Bharatpur
11	DRMRCI(Q) 47	NRCHB- 101 X Heera	Pedigree	ICAR- DRMR, Bharatpur
12	DRMRCI(Q) 57	NRCHB- 101 X Heera	Pedigree	ICAR- DRMR, Bharatpur
13	LR			
14	Zonal Check			
15	PM 30 (NC quality)			
16	PDZ1 (double low check)			

# - double low strains

**Zonal check :- Zone II –RH 749; Zone III – RGN 73**

**Latest Release (Quality Check):** Zone II- Pusa Mustard 32 (LES 54); Zone III- Pusa Mustard 30

### 2.11. AVT-I+II Quality Mustard

#### Zone II

**Entries:** RH(OE)-1807, JC 36#, PDZ-15#, PDZ-14#, LES 60\$, RH (OE) 1706\$, Kranti (NC), PM 29 (LR), RH 749 (ZC), Filler (PM 29),

\$ AVT II Strain, # double low strain

### 2.12. AVT-I Quality Mustard, Zone III

**Entries:** JC 36#, PDZ-15#, PDZ-14#, 0IJ5001#, RGN 73 (ZC), Pusa Mustard 30 (LR), Kranti (NC), Filler (RGN 73)

# double low strain

## Recommendations

### Physiology

All the experiments in Plant Physiology and Biochemistry were critically discussed and following recommendations were made:

1. Promising entries identified in the different experiments on abiotic stresses are being tested for three consecutive years. Based on their performance for physiological traits and yield criteria, the identified entries are registered with NBPGR and are being used in the breeding programmes. Some entries were identified in 2019 and compilation of elite entries for ten years has also been submitted to directorate. Based on 4 years data along

with B:C ratio sequential foliar application of salicylic acid and brassinolide improved yield under rainfed condition (2020) which will be published.

2. Tensiometer, IRGA/photosynthesis system, pyranometer with line sensor, lux meter/canopy imager and growth chamber/ BOD incubator are essentially required for physiological experiments for Hisar and Ludhiana and at those centers which do not have this facility.

### **Biochemistry**

1. Each center should send statistically (CV/SD/SE) analyzed data well in time.
2. Add oil content analysis in experiment-7.1 as important parameter.
3. Genotypes need to be analyzed for three consecutive years.
4. Genotype behavior for last three consecutive years should be studied to identify genotypes for commercial production by breeders.
5. Mineral analysis should be done for Zinc, Iron, Calcium, Magnesium, Copper and Sulphur.

It was emphasized to conduct the experiment strictly as per technical program and record the observations at specified stage/duration. All the centers should submit data for all the attributes so that definite conclusion can be made. The session ended with vote of thanks to the chairperson and participants.

**XXVIII Annual Group Meeting of AICRP Rapeseed-Mustard  
August 6-7, 2021 at Online**

**Session VII: Plenary Session**

**Chairman** : Dr. T. R. Sharma, DDG (Crop Science), ICAR, New Delhi

**Co-Chairman** : Dr. Sanjeev Gupta, ADG (O&P), ICAR, New Delhi

At the outset chairman congratulated the efforts of rapeseed-mustard researchers for record production of rapeseed mustard to the tune of 9.99 mt during 2020-21. Principal Investigators of each discipline presented the highlights of their respective sessions. Dr. K. H. Singh, PI (Plant breeding) presented salient recommendations of plant breeding session. Chairman appreciated on initiation of national crossing programme. He stressed upon sharing of segregating material to different centres and also to strength in the pre-breeding activities. Dr. R.L. Choudhary presented the highlights of agronomy session. It was suggested to initiate work on nano-fertilizer to enhance the input use efficiency. Chairman emphasised to develop prototype of different tools for their use in enhancing mechanisation in this crop. Dr. P. D. Meena presented the highlights of plant pathology session. Dr. H. C. Sharma advised to establish susceptible and resistant checks for each disease as well as for insect pests on the basis of long term screening against different biotic stresses. Dr. G. S. Saharan suggested initiation research on resistance against powdery mildew. Chairman Dr. T. R. Sharma, DDG (CS) also stressed upon initiating research on powdery mildew resistant and suggested to formulate a breeding program for combining resistance against powdery mildew with resistance against white rust. Dr. Srawan Kumar presented highlights of entomology. Dr. H. C. Sharma suggested publishing a brochure with recommendation on the basis of results of completed experiments. Chairman desired that research against mustard aphid resistance/ tolerance should be collaborated with NCIPM. Similarly for AB and stem rot also, institutes working on these diseases should be collaborated with DRMR. Dr. Pushp Sharma presented highlights of plant physiology session, followed by biochemistry by Dr. Anubhuti Sharma and FLD's by Dr. A. K. Sharma. Following recommendations emerged through discussions:

- Breeding programme on resistance against powdery mildew should be initiated.
- Looking to the role of mechanization in mustard cultivation, the chairman suggested to develop different prototypes & made available for mechanization in the crop.
- It was suggested to initiate the work on nano-fertilizers to enhance the input use efficiency.
- Distinct checks for susceptibility and resistance/ tolerance should be established against each disease and insect- pests.
- A brochure on recommendations emerged from completed experiments of plant protection should be published.
- Experiment on resistance against mustard aphid should be collaborated with NCIPM.

In his presidential address Chairman highlighted the need for identifying whole profile of all possible traits of promising genotypes expressing resistance/ tolerance against different abiotic/ biotic stresses. He also expressed concern over low variability in these crops and suggested to strengthen pre-breeding program for broadening the genetic base. Important traits should be mapped by centres including IARI, PAU and DRMR. Later on Dr. Y. P. Singh, acting ADG (Food Crops) ICAR, New Delhi and Dr. P. C. Sharma, AAU, Shillongni were felicitated on the occasion of their superannuation. Session ended with Vote of Thanks, to Chair extended by Dr. Sanjeev Gupta, ADG (O&P).