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भाकृ अनुप
ICAR

Project Coordinator's Report
(2020-21)

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Through Video- Conference
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ICAR-Directorate of Rapeseed-Mustard Research
(Indian Council of Agricultural Research)
Sewar, Bharatpur 321 303 (Rajasthan), India
(*An ISO 9001:2008 Certified Organization*)

All India Coordinated Research Project on Rapeseed-Mustard: Research Highlights (2020-21)

P.K. Rai

ICAR-Directorate of Rapeseed-Mustard Research, Bharatpur 321 303, Rajasthan

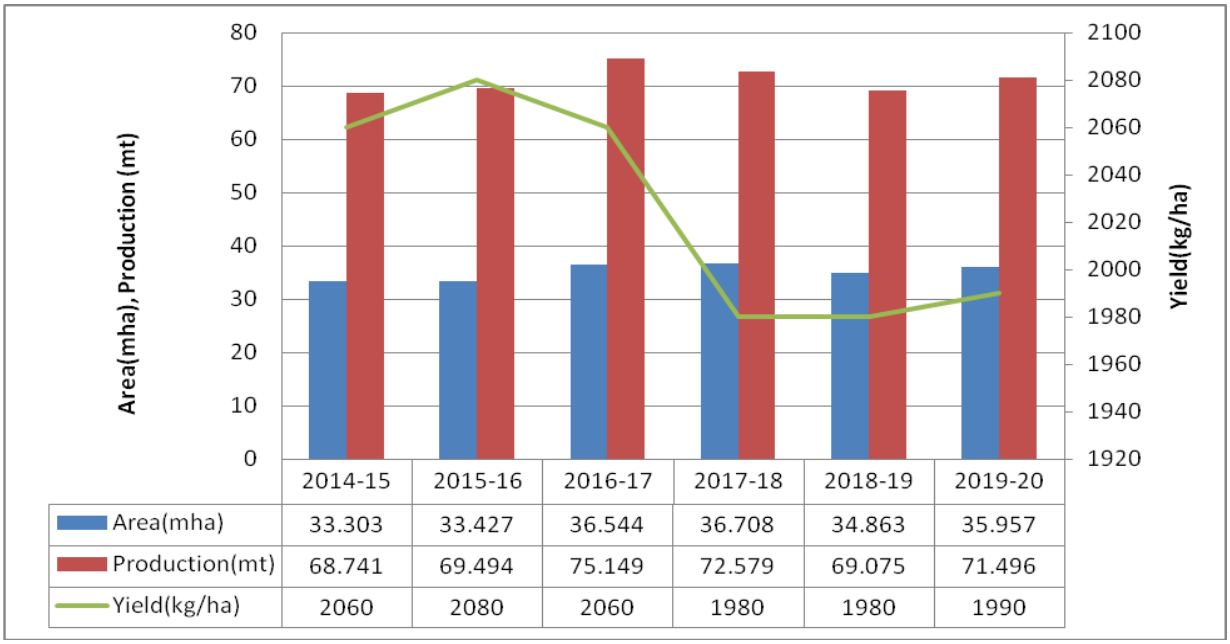
Hon'ble Deputy Director General (CS), ICAR, esteemed subject experts Dr H C Sharma, Prof. S. S. Banga, Dr K R Kaundal, Dr A. K. Gupta, Prof. G S Saharan, my colleagues from Council Dr Sanjeev Gupta, ADG (O & P), Dr D. K. Yadava, ADG (Seed), Dr. S.K. Jha, Oilseed & pulse sectionesteemed distinguished scientist from this Directorate and from AICRP-RM coordinating centres, representatives from private seed companies, ladies and gentlemen!

I take this opportunity to express my sincere gratitude to Dr. T. Mohapatra, Secretary, DARE, Government of India and Director General, ICAR for his constant encouragement, guidance and help to improve rapeseed-mustard research and development programme in the country. I am thankful to Deputy Director General (Crop Science) Dr T R Sharma for according permission to hold this Group meeting in virtual mode and also for accepting our request to chairing the inaugural session of this 28th AICRP-RM Group meeting. I am also thankful to Assistant Director General (O & P) Dr. Sanjeev Gupta, Assistant Director General (Seeds) Dr. D.K. Yadava and other ADGs of the Council for their guidance and support extended for the planning and implementation of All India Coordinated Research Project on Rapeseed-Mustard. With the permission of chair, I would like to present the crop status and research highlights of the programme during 2020-21 and ATR for discussion of the esteemed subject experts, colleagues in the rapeseed-mustard fraternity, policy planners and administrators and look forward for their critical comments and suggestions for further strengthening and revitalizing the programe.

Crop scenario

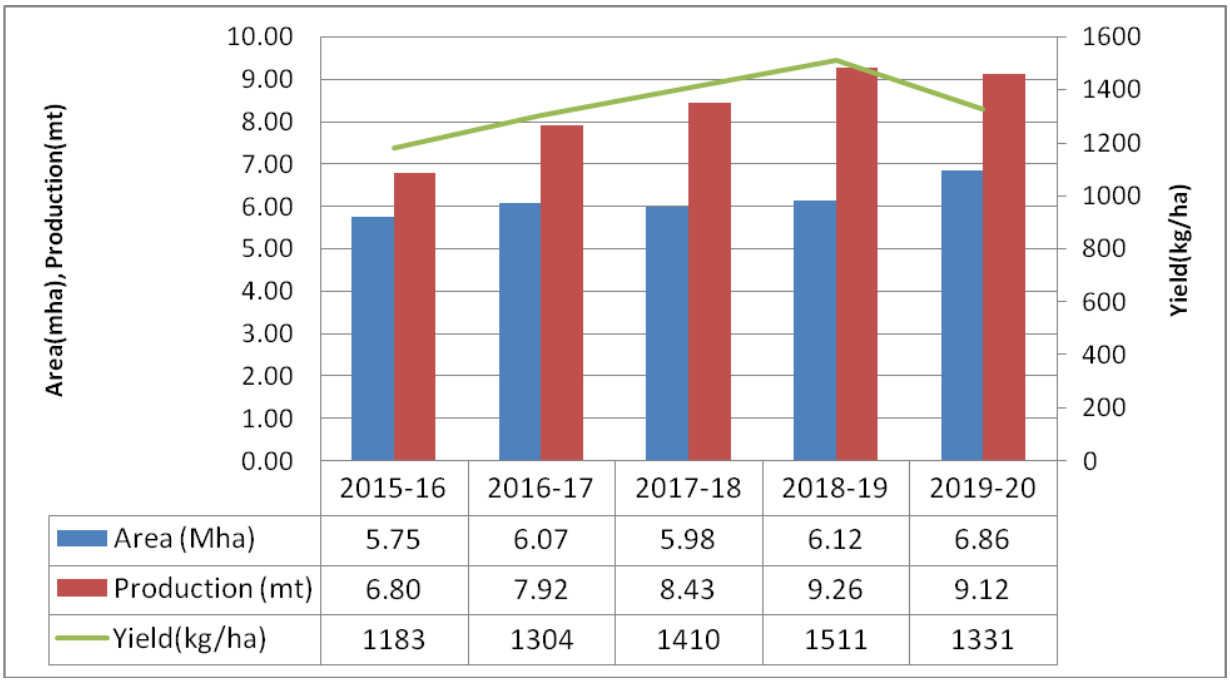
Total area, production and yield of rapeseed-mustard in world during 2019-20 was 35.95 million hectares (mha), 71.49 million tonnes (mt) and 1990 kg/ha, respectively (Fig. 1). There has been a considerable increase in production and productivity from 2013-14 to 2019-20. There was slight decrease in production and productivity from 2017-18 to 2018-19. However, There was slight increase in area, production and productivity in 2019-20.

Backed by good monsoon, India has attained a record food grain production of 305.44 million tonnes during 2020-21. The total oilseeds production is expected to be 36.57 million tonnes during 2020-21. The rapeseed-mustard acreage increased from 6.12 m ha (2018-19) to 6.86 m ha (2019-20). However, production got slightly decreased from 9.26 mt (2018-19) to 9.12 mt (2019-20). The rapeseed-mustard yield slightly decreased during 2019-20 as compared to the previous years (Fig. 2). The inconsistency in the rapeseed-mustard production system over the years is a cause of concern for all of us.



	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Area(mha)	33.303	33.427	36.544	36.708	34.863	35.957
Production(mt)	68.741	69.494	75.149	72.579	69.075	71.496
Yield(kg/ha)	2060	2080	2060	1980	1980	1990

Fig. 1 Global trend of area, production and productivity of rapeseed-mustard

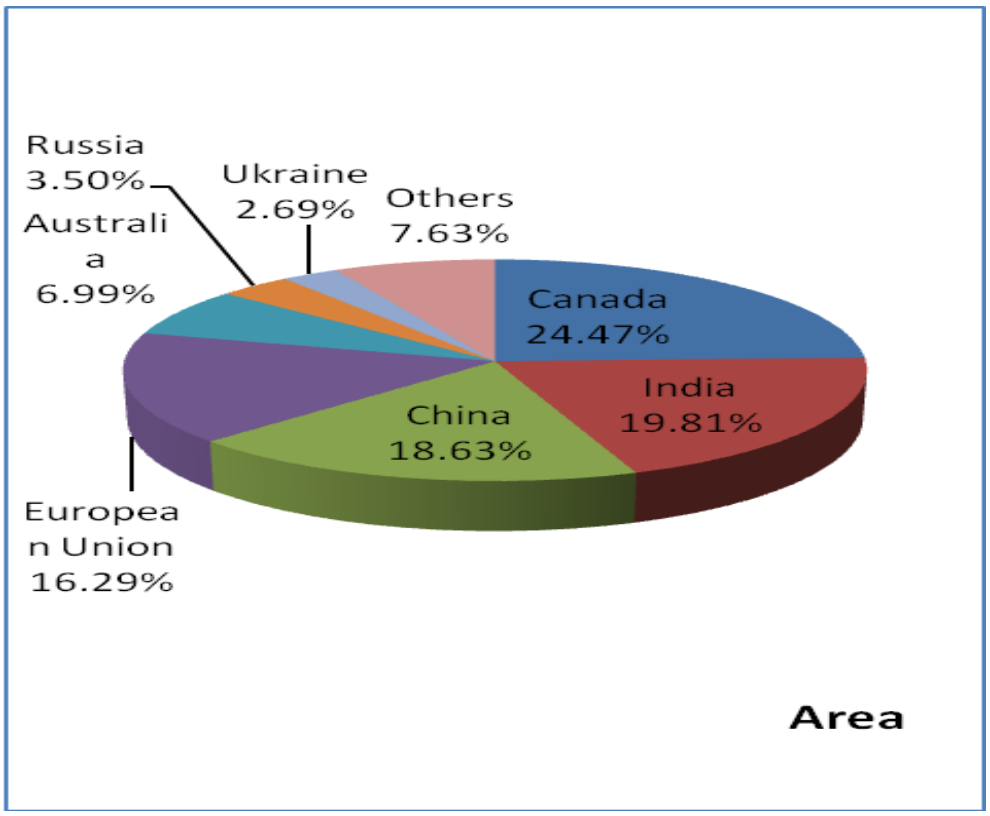


	2015-16	2016-17	2017-18	2018-19	2019-20
Area (Mha)	5.75	6.07	5.98	6.12	6.86
Production (mt)	6.80	7.92	8.43	9.26	9.12
Yield(kg/ha)	1183	1304	1410	1511	1331

Fig. 2 Trends in area, production and yield of rapeseed-mustard in India

Globally, India continues to be rank 2nd after Canada in acreage (19.81%) (Fig. 3a) and rank 4th after Canada, European Union and China in production (10.37%) (Fig. 3b).

(a)


Russia
3.50%
Ukraine
2.69%
Others
7.63%
Australi
a
6.99%
Canada
24.47%
India
19.81%
China
18.63%
Europea
n Union
16.29%
Area

(b)

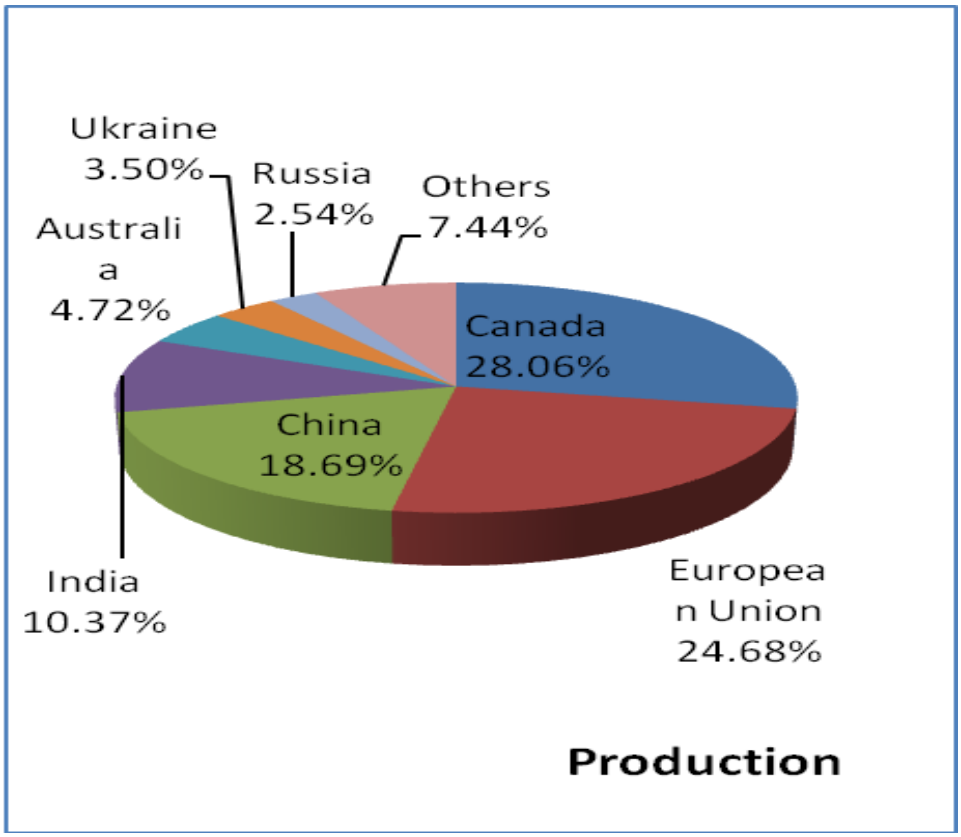

Ukraine
3.50%
Russia
2.54%
Others
7.44%
Australi
a
4.72%
Canada
28.06%
China
18.69%
India
10.37%
Europea
n Union
24.68%
Production

Fig. 3 Contribution of major rapeseed-mustard producing countries in a) Area and b) Production (Average of 2015-16 to 2019-20)

Rapeseed-Mustard crops in India are grown in diverse agro climatic conditions. If we see the trends from 2015-16 to 2019-20, their contribution to the total acreage was 23.91% (Fig. 4a) and oilseed production was 27.19%, (Fig. 4b).

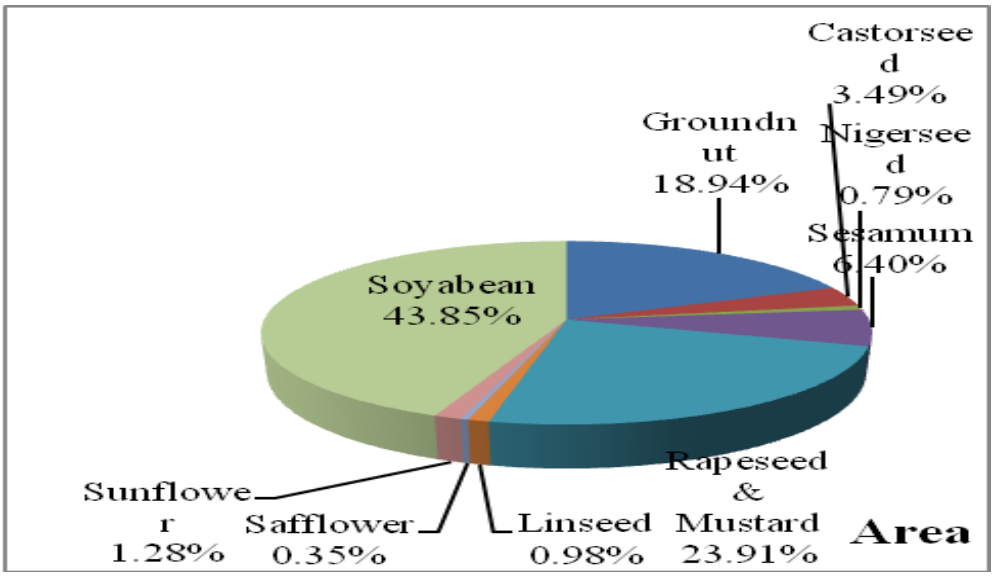


Fig. 4a Contribution of major oilseed crops in total oilseed acreage (Average of 2014-15 to 2019-20)

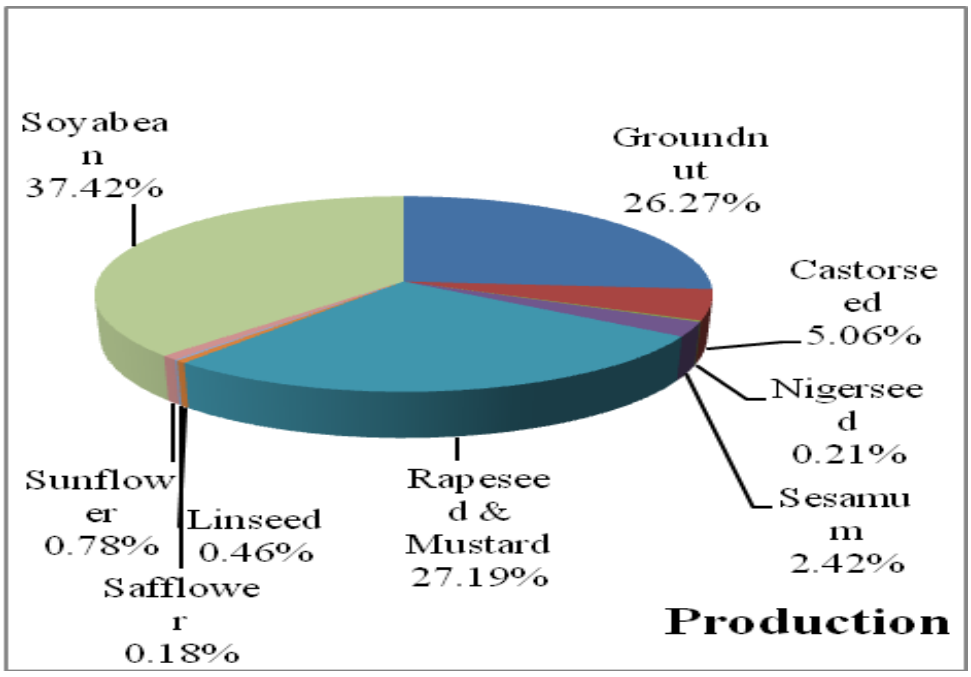


Fig. 4b Contribution of major oilseed crops in total oilseed production (Average of 2014-15 to 2019-20)

Rajasthan, Madhya Pradesh, Uttar Pradesh, Haryana, West Bengal, and Assam states accounted for 86.72% of area and 89.53% of production in the country. Rajasthan alone contributed 41.44% to the total area (Fig. 5a) and 45.03% to the production (Fig. 5b).

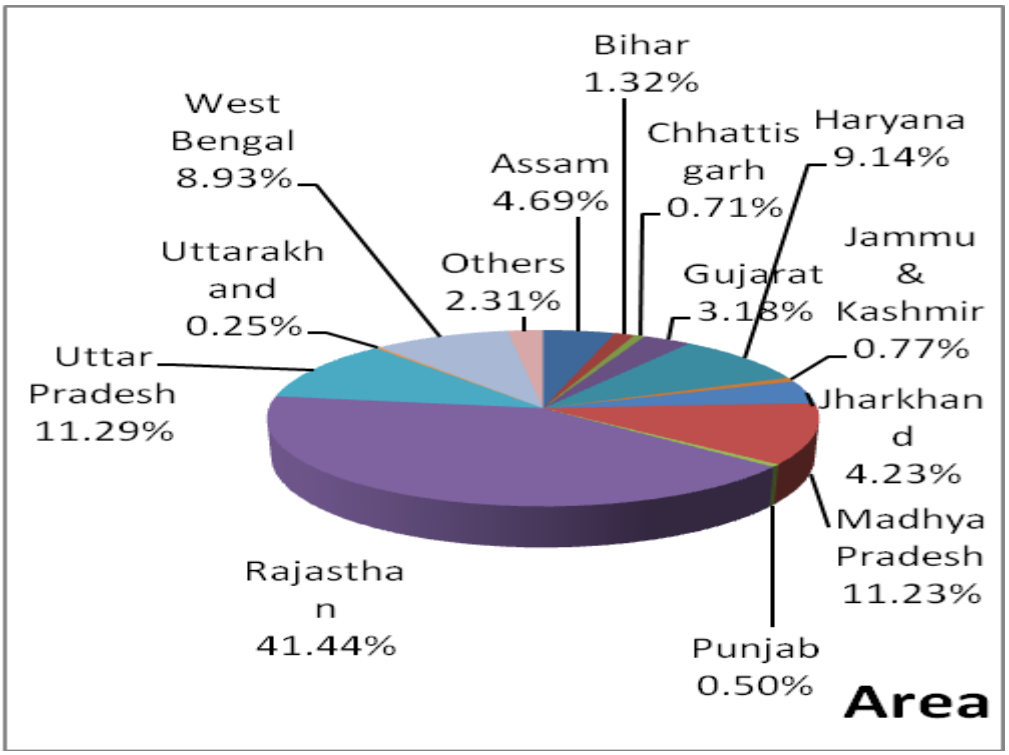


Fig. 5a Contribution of major states to acreage (Average of 2015-16 to 2019-20)

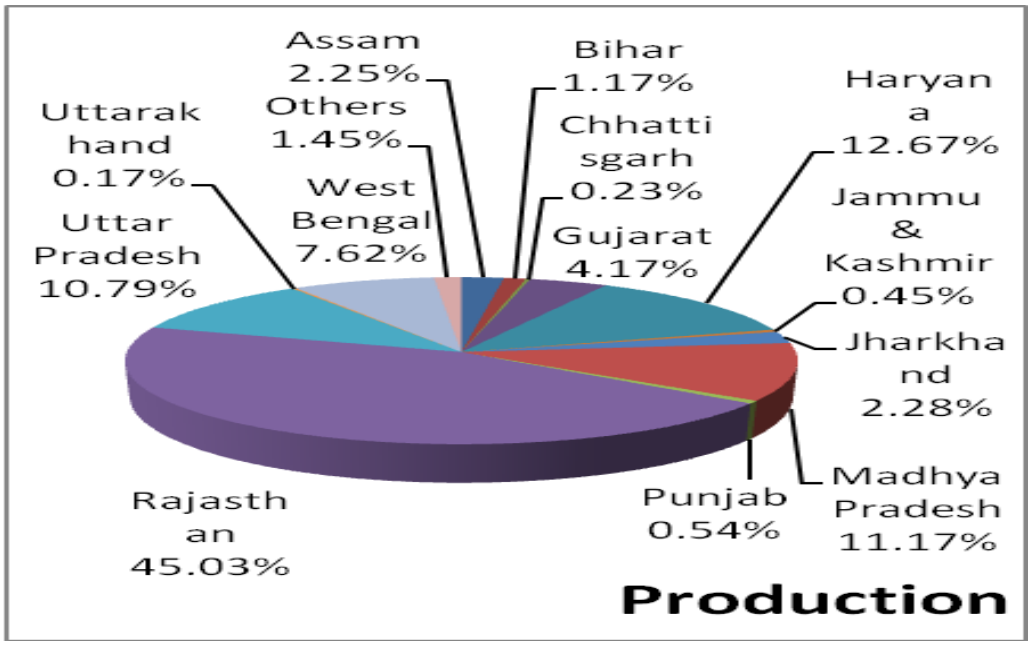


Fig. 5b Contribution of major states to production (Average of 2015-16 to 2019-20)

It has been observed that during last 10 years (2010-11 to 2019-20), at country level, the acreage of rapeseed-mustard slightly decreased by -0.64. However, increase in yield by 11.0% and production by 10.36% (Fig. 6). Some of the RM cultivating states including Rajasthan, Madhya Pradesh, Gujarat and Bihar showed decrease in RM acreage, which is a growing concern.

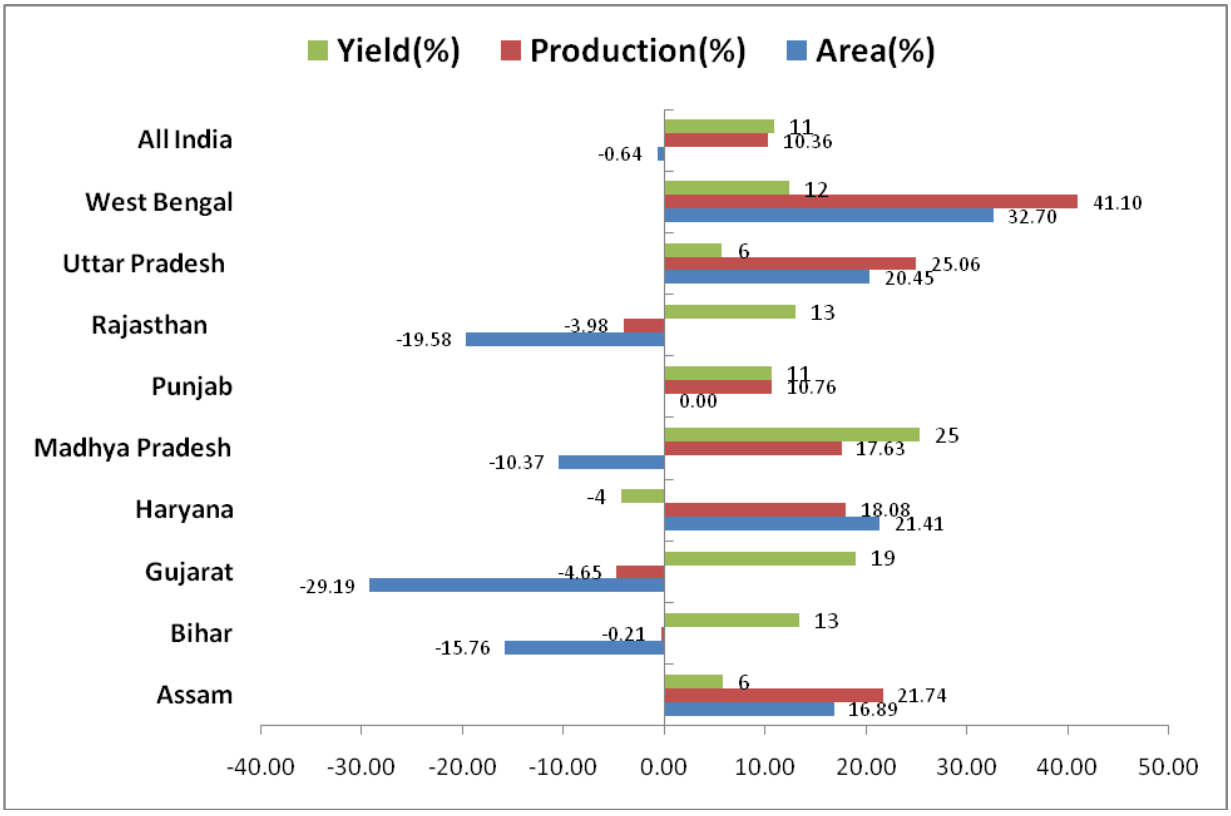


Fig. 6 Per cent change in area, production and productivity in Rapeseed - mustard in 2019-20 (base year: 2010-11)

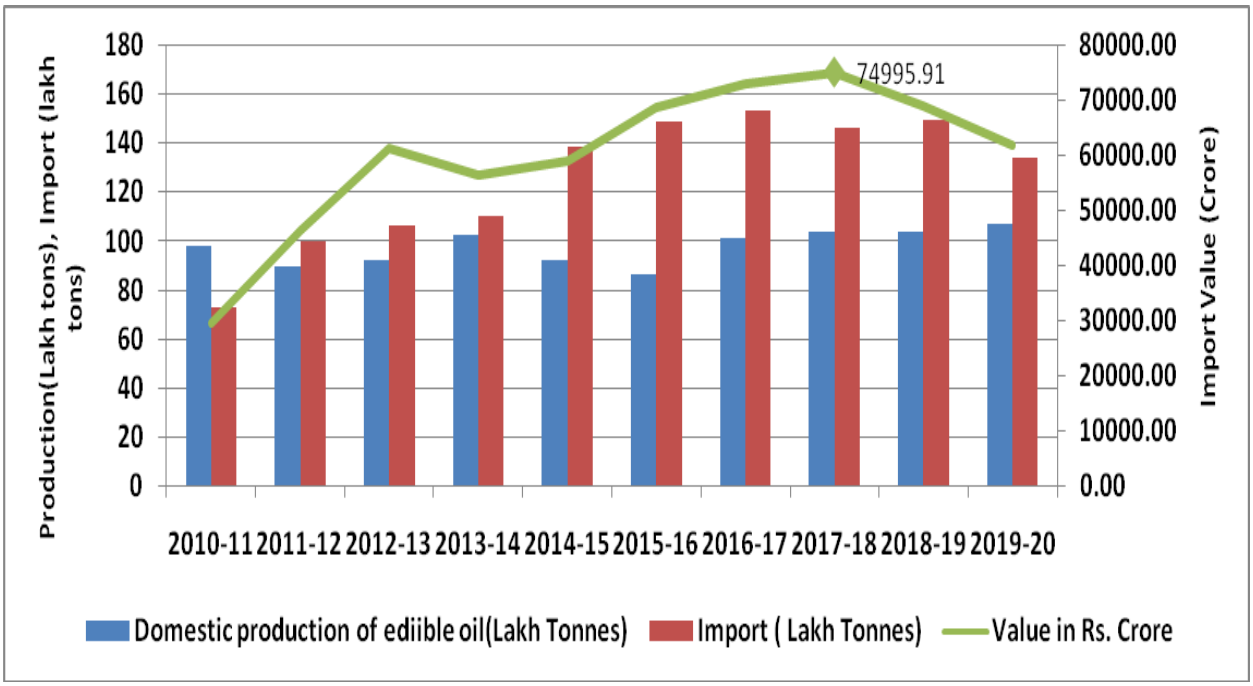


Fig. 7 Edible oil production and import trends in India

Despite all efforts, the import of edible oil has increased up to 136.00 lakh ton during 2019-20. The total availability of edible oil has also increased from 88.00 lakh ton (2015-16) to 113.50 lakh ton (2019-20) (Fig. 7).

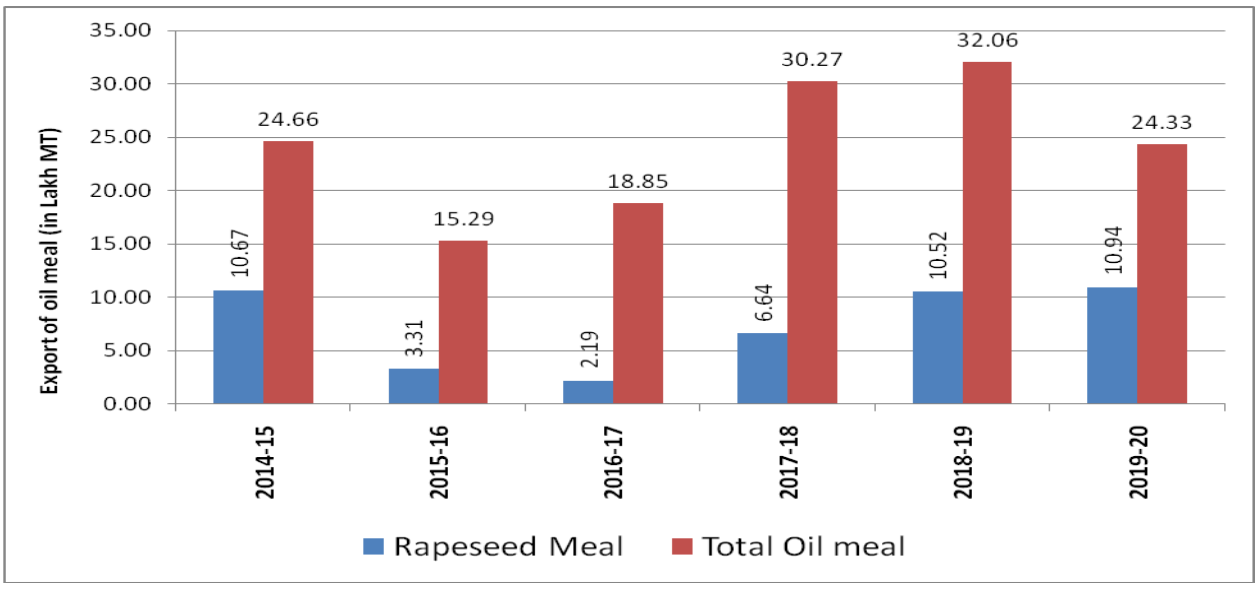


Fig. 8 Status of export of Rapeseed-mustard seed meal

The export of rapeseed-mustard seed meal during 2019-20 has slightly decreased to 24.33 lakh tons as compared to that of 2014-15 (24.66 lakh tons) (Fig. 8).

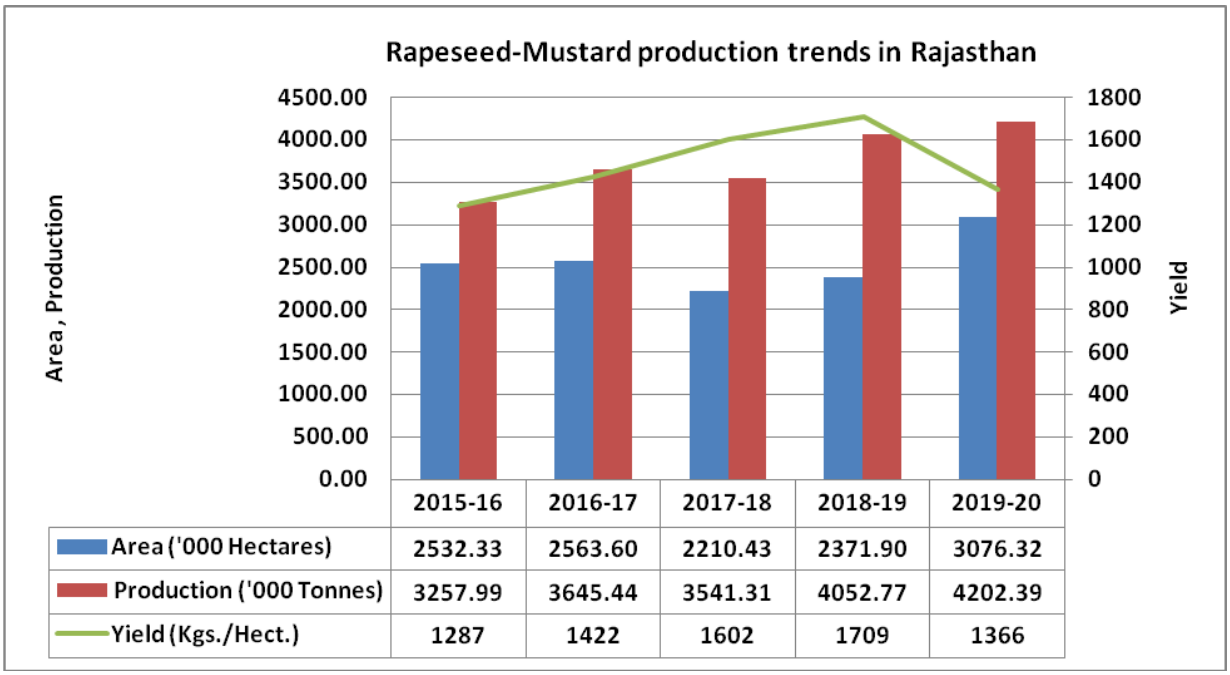


Fig. 9 Rapeseed-mustard production trends in Rajasthan

Among various states cultivating RM crops, Rajasthan has shown an increment in area and production in the year 2019-20 as compared to the previous crop season. However, productivity slightly decreased in as compared to the previous crop season. Production of the RM crops in Rajasthan has showed perpendicular increment from 2015-16 to 2019-20 (Fig. 9).

Seasonal Conditions

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

Genetics and Plant Breeding

Varietal Improvement

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

Genetic Resource Management

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

Creation of genetic variability through hybridization/ mutagenesis and selection

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

Evaluation of advanced breeding lines

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

Hybrid development

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

Breeder seed production

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

Coordinated Trials

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

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

Zone I	Zone II	Zone III	Zone IV	Zone V
Yellow Sarson, IVT				

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

Figures in parenthesis indicate seed yield (Kg/ha), percent superiority over best check
** promoted on the basis of White rust resistance; # double low strain

Crop Production

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

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

Application of 150% NPK recorded markedly higher seed yield of mustard at KHD, LDH, HSR, SGN, DOL, KOT, MOR, SKN, BHU and SHL which was 99.7, 307, 67, 33, 380, 64,

148, 72, 83 and 330% higher over the control, respectively. Whereas, at KNG 100% NPK + 40 kg S/ha and at PNT 100% NPK + FYM @ 2.5 t/ha recorded significantly higher seed yield of mustard which was 209.7 and 184% higher over the control.

3.2 Evaluation of herbicides for weed management in rapeseed – mustard

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

3.3 Agronomic evaluation of promising rapeseed-mustard entries

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

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

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

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

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

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

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

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

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

Application of 100% RDF significantly recorded higher mustard seed yield at all the locations. The combination of biofertilizers; PSMO + Azotobacter+ KMB + ZSB recorded significantly higher seed yield at Chatha, Sriganganagar, Pantnagar, Morena, Kota, Varanasi, SK Nagar,

Bhubneswar, Bawal, Bharatpur, Khudwani and Shillongani. Whereas, ZSB at Kangra, Hisar and Dholi, and KMB at Imphal recorded markedly higher seed yield over the rest of the biofertilizers. Net returns were also increased with the use of biofertilizers at all the locations.

Plant Pathology

Disease Scenario

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

Screening of *Brassica* germplasm and breeding materials

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

Uniform Disease Nursery for major diseases

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

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

National Disease Nursery (NDN) for Alternaria blight

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

National Disease Nursery (NDN) for white rust

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

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

National Disease Nursery (NDN) for Sclerotinia rot

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

Screening of IVT entries of Brassica against different diseases

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

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

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

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

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

PNT

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

SHL

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

SKN

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

MOR

Experiment was laid out with cvs. Varuna and Rohini with eight dates of sowing at weekly intervals. AB on leaf first appeared 47 DAS in Nov 19 sown Varuna and Rohini. Whereas, AB on silique appeared at 90 DAS on same plots. PM was appeared first at 80 DAS which was maximum 51.8 % reported on cv. Rohini at 130 DAS in Nov 19 sown crop. WR appeared first 40 DAS in Nov 19 sown Rohini and progressed till 120 DAS in Nov 05 and Nov 12 sown crop. WR disease severity was maximum upto 44.9% in Nov 05 sown crop on both cultivars. While,

maximum staghead incidence (40.2%) was observed in Nov 12 sown Rohini. The maximum yield (34.0 q/ha) was recorded in Oct 15 sown Rohini and 32.9 q/ha in Varuna.

JAG

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

DOL

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

HSR

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

JHS

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

Efficacy of fungicides against major rapeseed-mustard diseases

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

Entomology

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

The highest yield losses were observed in PM 31 at SK Nagar (42.7%), while at NDH RH 725 suffered 38.5% yield loss due to insect-pests. At LDH, PM 31 suffered 28.6% loss followed by

22.9% in RH 725 at DHO, 21.5% in PM 31 at HSR, 15.0% in PM 31 at PTN and 9.3% in RH 725 at MOR.

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

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

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

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

Plant Physiology

Five experiments were conducted to evaluate mustard genotypes from different agro-climatic zones to abiotic stresses while sixth experiment was conducted at three locations to test the efficacy of PGR's under rainfed conditions. Two experiments were formulated to test the efficacy of microbes to mitigate drought and temperature stress. Seedling mortality ≤20% and DW/10 seedlings ≥ 30mg rated genotypes tolerant under controlled conditions. Three genotypes namely SVJH-056 RH1999-42 and DRMRCI133 at Kanpur and Ludhiana met the selection criteria except for dry matter in DRMRCI133 (25mg/10seedlings). In the field sown trial, RGN229, DRMRHT1712, NPJ-239, SVJH-006, ORM 2019-01, TM188, BAUM09-12-2 , DRMRCI133, RH1999-42 and DRMR1188 had seedling mortality ≤20% and DW≥3.0g at 3 locations except for DRMRCI133 and NPJ-239 for dry matter at Bharatpur which was ≥2.5g. Both the checks PM 25 and JD-6 had seedling mortality ≤25% with dry matter ≥2.5g at Bharatpur, Kanpur and Ludhiana indicating moderate tolerance with STI and SSTI ≥60% under field condition only. Two genotypes RH1999-42 and DRMRCI133 were tolerant to high temperature at seedling stage both under laboratory and field conditions. Light stress due to shading for 30 days impaired physiological and yield traits to variable extent within the genotypes and also at two locations. Lesser reduction in the physiological traits and seed yield (≤20%) identified RH1676 at Hisar and Ludhiana as promising genotypes under low light stress. Moisture stress imposed by withholding irrigations at 35 and 65 DAS significantly affected the performance of thirty-one genotypes tested at 4 locations. Overall, NPJ210 and DRMR1188 at Bharatpur, Hisar and Ludhiana were tolerant to moisture stress. Only one genotype DRMRSJ276 was rated highly tolerant at Bharatpur, Kanpur and Ludhiana whereas JC36 moderately tolerant at 3 locations (Bharatpur, Hisar and Ludhiana) to moisture stress.

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

Biochemistry

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

Frontline demonstrations 2020-21

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

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

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

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

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

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

under rainfed condition recorded highest yield improvement of 64.6% with average seed yield of 1,213 kg/ha.

The maximum yield improvement of 58.6% from TS 38 variety of toria in Assam and 21.6 % from RTM 1351 of taramira in Rajasthan were recorded under rainfed condition.
The yield improvement of 33.9% from GSC 7 variety of gobhi sarson in Himachal Pradesh, 19.2 % from Shalimar sarson 2 variety of brown sarson in Jammu & Kashmir were recorded under rainfed condition.

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Thank You!

ACTION TAKEN REPORT 2021

Genetics and Plant Breeding	
Promotion of hybrids at par with hybrid entry as best check was discussed. Chairman decided to constitute a committee on this aspect.	Committee has been constituted
Re-zonalization of AICRP-RM centres was discussed and it was felt that a committee should be constituted to give recommendation on this issue.	Committee has been constituted
Induction of zone wise entries was also discussed at length and it was agreed by all. However, mechanism needs to be devised for implementing this issue.	Committee has been constituted
It was emphasized to evaluate pre-breeding material at different places to identify diverse material for biotic and abiotic stress and component traits.	Provisions of evaluating prebreeding / promising material already exist in Plant Pathology for biotic stresses and in Plant Physiology for abiotic stresses under AICRPRM.
Crossing of resistant material (biotic and abiotic stresses) with high yield bases should be taken up at main centres.	Available donors for disease resistance against white rust and for thermo-tolerance and drought tolerance are being used in the crossing programme.
Distribution of segregating/ Pre-breeding material to all centres was discussed. Chairman opined to have a field day at pre-maturity stage at ICAR-DRMR, Bharatpur and call all breeders so that they can select material of their own interest.	Segregating material is continuously being provided to interested centres. During 2020-21, seed of 10 F_2 crosses was sent to BHU Varanasi, Modipuram and CAU Jhansi.
Abohar be added as testing centre in zone- II for rainfed, irrigated and late sown trials	Abohar centre has been added for the conduct of trials under rainfed, irrigated and late sown conditions.
Jhansi be added as centre in zone- III for IHT/ AHT trial and Diggi be added as centre for Taramira trial.	Both Jhansi and Diggi centres were added to respective trials as suggested.
It was decided to formulate centre- wise hybridization programme.	Centre-wise hybridization programme was formulated and is given in annual progress report of AICRPRM 2021.
In technical programme, method of developing an entry should also be included along with pedigree.	Recommendation has been implemented from 2021-22 technical programme.
Agronomy	
Recommendation	Action
Efforts are needed for management of Orobanche parasite under collaborative work with other organization including NRCPB, Delhi University and PAU, Ludhiana etc	Collaborated with IPFT, Gurugram for the developed of innovative herbicide formulations (nano/encapsulated/slow release and chemical/bio). Screened the formulations under field conditions in hotspot areas and found some of the formulations quite effective

	against Orobanche as well as other annual weeds. There is need to further evaluate the formulations for better bio-efficacy and safety. Collaboration with Delhi University, South Campus is under process for testing of herbicide resistant lines against Orobanche.
Use microbial consortia for improving the fertility of soil for rapeseed-mustard crops	Initiated the work and evaluated drought alleviating microbes as well as biofertilizers to enhance the soil fertility and yield.
Supplementary field observations with laboratory analysis in long term as well as other agronomic experiments for better reasoning	Started taking supplementary observations in all the experiments
Review the herbicides recommended in other similar crops for different weeds in India and abroad which can also be tried under Indian conditions	Reviewed the literature and formulated a new experiment on herbicide use for weed management in rapeseed-mustard.
Plant Pathology	
Online proof of conducting trials, videos should be submitted at date of sowing, disease appearance, peak of the disease and at harvesting	Online monitoring was done using whatsapp mobile group
Develop Near Isogenic Lines (NIL's) to identify the *Albugo candida* races with wider virulence in the host differential	Development of NIL's started
NRCDR 513, GSL 1, PBC 9221 and DRMRIJ 12-28 showed differential reactions to the isolates may be crossed with universal susceptible genotypes and number of R-genes should be observed using pure single sporangium isolate	Crosses of four genotypes were attempted with NRCHB 101, DRMRIJ 31, NRCDR 2
If the disease severity/ incidence on susceptible check is less than resistant/tolerant check will not be considered for publication in the report	Action taken accordingly
Entomology	
Add some resistant check along with susceptible check BSH 1 in screening trials	After thorough discussions, it was decided to incorporate separate checks for mustard aphid in IVT and AVT trials as checks RH 725, PM 30, 45S46, PDZM 31 and introgressed material were used in these trials.
Biochemistry	
A new experiment on saturated and unsaturated ratio was suggested to be technical programme.	Experiment was included in the program. Only ICAR-DRMR submitted report whereas other centers have not sent the report.
It was suggested that all the centers must follow the same protocols with similar standards for all the experiments.	All the centers followed the same protocol with similar standards for all the experiments.
It was suggested that each center should send statistically (CV/SD/SE) analysed report and the data in triplicate.	Only Bharatpur, Kangra, Pantnagar centers sent statistically analysed report.

Annexure 1

Rapeseed – Mustard hybrids/varieties released during 2011-2020

Year of notification	Number	Variety/Hybrid
Brassica juncea		
2011	02	Pusa Mustard 26 (NPJ 113), Pusa Mustard 27,
2012	04	Pusa Mustard 28 (NPJ 118), ELM 123 (RLC 2), Coral PAC 437, and PR 2006-1,
2013	09	Giriraj (DRMRIJ 31), RH 0749, Divya 33, Pusa Mustard 29, RH 0406, Pusa Mustard 30, RajVijay Mustard 2, RGN-229, RGN 236
2015	07	Albeli 1, RGN 298, GDM-4*, PBR 357, Pant Rai 20* DRMR-150-35**, SKM 518**
2016	05	Gujarat Mustard 5*, JK Pukhraj*, JK Samridhi Gold*, RLC 2*, RVM 1*
2017	04	PRB-2008-5*, CS 58**, NRCHB 101**, RH 749**
2018	05	CS 2800-1-2-3-5-1**, RH 0725**, PDZ-1**, DRMR 1165-40**, Hybrid (PRO5111) Keshri**
2019	03	RSPR-69*, TAM 108-1*, Azad Mahak (KMR (E)-15-2)*
2020	01	Gujarat Mustard 6 (Banas Sona)*
Toria (*Brassica rapa*)		
2016	01	TL 17*
2019	02	RSPT-6*, Azad Chetan (TKM 14-2)*
2020	01	Pant Girja*
Yellow sarson (*Brassica rapa*)		
2016	01	JK Pukhraj (JKYS 2)*
Taramira (*Eruca sativa*)		
2011	02	Vallabh, Taramira 1* and VallabhTaramira 2*
2014	01	RTM 1355**
2017	01	RTM-1351**
Brown Sarson		
2012	01	Shalimar Sarson-1*
Gobhi Sarson		
2015	02	RSPN-25, GSC-7
Karan rai (*Brassica carinata*)		
2016	01	BJC 1 (PC6)*
Grand Total	**53**	

** State release (21)*
** Identified (12)

ICAR-DRMR, Bharatpur

List of Varieties/Hybrids (Indian mustard) [Last 10 years]

Name of the Variety / Hybrid		Year of notification/Release	Pedigree	Maturity (days)	Yield (kg/ha)	Oil Content (%)	Salient features	Area of Adaptability
1.	Pusa Mustard 25 (NPJ 112)	2010	SEJ 8 x Pusa Jagannath	94-120	1324-1654	35.5-41.2	Suitable for early sown irrigated conditions, high temperature tolerance at juvenile stage	Zone-II (Delhi, Haryana ,Punjab, J&K and part of Rajasthan), Zone-III (MP, UP, Eastern Raj)
2.	Coral 434 (PAC 432) (Hybrid)	2010	PAC 432A(ogu CMS) x PAC 432R	121-132	1831-2581	40-42	Hybrid	Zone III (MP, Uttar Pradesh, Uttarakhand and Rajasthan)
3.	NRCDR 601	2010	NBPGR 272 x RK 9903	137-151	1939-2626	38.7-41.6	Tolerant to salinity and high temperature at sowing time	Zone-II (Delhi, Haryana ,Punjab, J&K and part of Rajasthan)
4.	RH 0119	2010	Pusa Bold x Rajat (PCR7)	145-150	1047-2156	38.5-39.8	thermo-tolerance	Haryana
5.	NRC HB 101	2009/2017	BL 4 x Pusa Bold	105-135	1382-1491	35- 42	Suitable for late sown irrigated conditions	Zone-III (Eastern Rajasthan, MP, UP, UK), Zone-V (Jharkhand, Bihar, Odisha, Assom, WB)
6.	Pusa Mustard -26 (NPJ-113)	2011	VEJ Open x Pusa Agrani	115-137	1481-1895	30-41	Suitable for late sown (November sowing) irrigated conditions,moderately tolerant to high temperature at seedling and maturity stage	Zone-II (Delhi, Haryana ,Punjab, J&K and part of Rajasthan)
7.	Pusa Mustard -27 (EJ-17)	2011	[Divya x Pusa Bold) x PR 666 EPS] x [(PR 704 EPS 2 x B85)]	108-135	1437-1659	39.6-45.4	Suitable for early sown (September sowing) irrigated conditions , tolerant to high temperature at seedling and maturity stage	Zone III (MP, Uttar Pradesh, Uttarakhand and Rajasthan)
8.	RLC 2	2011	QM 4 x Pusa Bold	132-155	2039-2342	35.2-40.2	Low (less than 2%) erucic acid (‘0’) variety of raya	Punjab, Haryana, NCR, parts of Rajasthan

9.	Coral 437 (PAC 437) (Hybrid)	2012	PAC 432A(ogu CMS) x PAC 437R	140-150	2032-2772	39.4-41.2	Hybrid, tolerant to white rust	Zone-II (Delhi ,Haryana,Punjab, Jammu and parts of Rajasthan)
10.	Pant Rai 18 (PR 2006-1)	2012		99-133	1831-3511	39.4-42.4	Tolerant to high temperature, for late sown irrigated condition	Delhi ,Haryana,
11.	Giriraj (DRMRIJ 31)	2013	HB9908 x HB9916	137-153	2246-2767	38.7-42.5	Large seed, seed yield	Delhi, Haryana, Jammu, Punjab and northern Rajasthan
12.	RH 0406	2013	RH 9608 x RH 30	145-150	2200-2300	38-40	Suitable for timely sown rainfed conditions, lodging resistant; bold seeded	Delhi, Haryana, Jammu and Kashmir, Punjab and parts of Rajasthan
13.	Divya-33	2013	RH-30 x Luxmi	136-161	1699-3560	36-40.7	Suitable for timely sown irrigated conditions	Rajasthan, Punjab, Haryana and Jammu & Kashmir
14.	Raj Vijay Mustard 2 (JMWR 08-3) (RMV 2)	2013	Selection from Chambal region	120-141	1674	37.1-41.2	Moderately resistant to white rust	Delhi, Haryana, Jammu and Kashmir, Punjab and parts of Rajasthan
15.	RH 0749	2013	RH 781 x RH 9617	124-142	2600-2800	39-39.8	Suitable for timely sown irrigated condition; large seed, long siliqua; dominance of primary branches	Delhi, Haryana, Jammu and Kashmir, Punjab and parts of Rajasthan
16.	Pusa Mustard 29 (f)	2013	(ZEM-2 x Pusa Barani) x EC-287711	131-155	1927-2568	30.0-39.8	Low erucic acid; timely sown irrigated, condition	Delhi, Haryana, Jammu and Kashmir, Punjab and Rajasthan
17.	Pusa Mustard 30 (LES 43)	2013	Bio 902 x ZEM-1	137	1564-2238	36-39.4	Low erucic acid; timely sown irrigated condition	Uttar Pradesh, Uttarakhand, Madhya Pradesh. Rajasthan
18.	RRN 573	2013		137	2072	41.58	Irrigated, normal sown condition	Rajasthan
19.	RGN 229	2013	Heb-3 x Laxmi	146	2162-2568	40.7	Tolerant to high temperature and salinity during seedling stage	Delhi, Haryana, Punjab, Jammu and parts of Rajasthan

20.	RGN 236	2013	SBG-00-01 x laxmi	127	1636	39.1	Tolerant to high temperature and salinity during seedling stage	Delhi, Haryana, Punjab, Jammu and parts of Rajasthan
21.	Gujarat Mustard-3 (GM-3)	2015	RSK 78 x Varuna	103-112	1661-2811	38-40.06	Irrigated conditions, Early, Bold seeded (6.02 g/1000 seed wt.), Tolerant to high temperature	Gujarat
22.	Gujarat Dantiwada Mustard-4 (GDM-4)	2015	SKM 9433 x GM 2	104-115	1850-3031	38.40-39.02	Irrigated conditions, High Yield, Bold seeded, High oil content, tolerant to powdery mildew and aphids	Gujarat
23.	Albeli-1	2015	SVM-19 x SVM9102	140-145	2133	40.8	Irrigated conditions; tolerant to Alternaria blight, white rust and powdery mildew	Eastern Rajasthan, Madhya Pradesh, Uttar Pradesh, Uttarakhand
24.	Pant Rai-20	2012/2015	Pure line selection from Kranti'	122-128	2500-3000	40	High yielding, medium maturity, bold seeded, suitable for irrigated/rainfed timely sown conditions. High temperature tolerance at maturity.	Rajasthan, Punjab, Haryana, Delhi, Jammu and Kashmir and
25.	PBR-357	2015	(PBR 91 x RLM 514) x Bio 902	132-155	2039-2342	35.2-40.2	Bold seeded	Punjab, Haryana, NCR, parts of Rajasthan
26.	RGN-298	2015		143	2172	40	Suitable for rainfed conditions	Rajasthan, Punjab, Haryana, Delhi, Jammu and Kashmir and Uttar Pradesh
27.	Pusa Mustard 28	2016	SEJ 8 x Pusa Jagannath	107	933-3003	40-42.8	Suitable for early (September) sown irrigated conditions and a good substitute to *B. rapa* cv. Toria	J & K (Plains), Punjab, Haryana, Rajasthan, Delhi and Western UP.
28.	Pusa Double Zero Mustard- 31 (PDZ 1)	2016	LES 1-27 x NUDHYJ-3	142	2234	40.7	Low erucic acid and low glucosinolate	NCR region of Delhi
29.	RLC 2 (IC 5 1 1 6 1 5)	2016		142-150	2039-2342	36.3-38.9	Low erucic acid	Punjab
30.	PBR 378	2016	(PBR 91 x RLM 514) x RLM 619	134-156	1228-3484	37.7-41.9	Timely sown rainfed conditions	Punjab, Haryana, parts of Rajasthan

31.	Gujarat Dantiwada Mustard 5 (GDM 5)	2016	BIO 129-97 x NDR 9503	134-155	2081-2360	38.0-41.4	High Yield, High oil content (40.50%), Tolerant to lodging and shattering, Suitable for timely sown rainfed conditions	Punjab, Haryana, Jammu, Northern Rajasthan and Delhi
32.	Raj Vijay Mustard 1	2016	Selection from Bastar (CG) region	98-121	1389-2019	40.2-43.1	Suitable for rainfed conditions	Madhya Pradesh
33.	RLC-3	2016	JM06003 x JM06020	138 -150	2175 -2435	41.5	Double low, yellow seeded, white rust immune variety	Irrigated conditions of Punjab
34.	CS-58 (CS 1100 - 1-2-2-3)	2017	CS52 x CS609-B10	128-142	1734-2168	38.5-39.5	Salinity tolerant	Haryana, Punjab and Uttar Pradesh
35.	Pant Rai-21	2015/2017	(Varuna x Pusa Bold) x BSIPS-23	122-125	2500-3000	40	High yielding, medium maturity, bold seeded, long siliqua, long main raceme	Suitable for irrigated timely sown conditions of Uttarakhand plains
36.	RH-725	2018	RH 781 x RH-9617	136-143	2500-2600	40.2	Suitable for timely sowing and rainfed conditions, moderately resistant to Alternaria leaf blight, white rust and aphid Infestation	Jammu, Punjab, Haryana, Delhi and Northern Rajasthan
37.	CS-60 (CS2800-1-2-3-5-1)	2018	CS330-1-1 x CS609-B10	125-132	1900-2200 Under saline and alkali soil conditions	40-41	Highly suitable for timely sown, salt-affected soil and water conditions with salinity level (ECe) up to 12.0 dS /m, water salinity up to 15 dS/m and alkali soils up to pH 9.5, resistant to Alternaria blight, WR, PM, DM, stag head and SR, tolerant to aphid	Haryana, Punjab, Uttar Pradesh and Rajasthan
38.	Pusa Double Zero Mustard- 31 (PDZ-1)	2018	LES-1 x NUDHYJ-3	141-152	2234	40.7	Suitable for timely sowing under rainfed conditions	Rajasthan, Punjab, Haryana, U.P., Delhi & Jammu and H.P.

39.	RSPR-69 (MCN-04-35)	2019	RLM 198 x Varuna	135-145	1990	39.4	Suitable for irrigated and rainfed areas, timely sown, resistant to white rust and moderately resistant to Alternaria blight and major pests	Jammu region
40.	TBM-204 (TrobayBidhan Mustard- 204) TM-204	2019	TM102 x TM28	110-115	1500-1800	41	Timely sown irrigated condition, resistant to white rust and Alternaria blight and negligible to moderate to aphid infestation	West Bengal, Jharkhand, Odisha
41.	RH 761	2019	JMR 9738 x RH 30	137-143	2500-2600	40.4	Suitable for timely sowing and rainfed conditions, long siliqua with bold seeds	Jammu, Punjab, Haryana, Delhi and Rajasthan (Northern Region)
42.	Azad Mahak KMR(E) 15-2	2020	Mathura Rai x JD-6	120-125	2047	41.60	Tolerant to high temperature, it escapes from diseases ,*Alternaria blight*, *white rust* and fog.	Uttar Pradesh
43.	Pusa Mustard 32 (LES 54)	2020	Pusa Mustard 21 X EC 597325	143-147	2067	37.5-39.0	Timely sown irrigated conditions, Low erucic acid variety	Zone – II, Rajasthan (Northern and Western parts), Punjab, Haryana, Delhi, Western Uttar Pradesh, Plains of Jammu & Kashmir and Himachal Pradesh
44.	DRMR 2017-15 (Radhika)	2020	Ashirwad x DRMR 2486	131	1686-1847	40.7	Suitable for late sowing under irrigated conditions, high seed and oil yield	Zone – II, Rajasthan (Northern and Western parts), Punjab, Haryana, Delhi, Western Uttar Pradesh, Plains of Jammu & Kashmir and Himachal Pradesh
45.	DRMRIC 16-38 (Brijraj)	2020	NRCHB 101 X Pusa Swarnim	120-149	1733	37.6-40.9	Suitable for late sowing under irrigated conditions high seed and oil yield	Zone – II, Rajasthan (Northern and Western parts), Punjab, Haryana, Delhi, Western Uttar Pradesh, Plains of Jammu & Kashmir and Himachal Pradesh

46.	DRMR 1165-40	2020	EC552583 x BPR-897-4-3	142	2200-2600	41.2	Rainfed, timely sown	Jammu, Punjab, Haryana, Delhi and Rajasthan (Northern Region)
47.	DRMR 150-35	2020	RH819 x Pusa bold	114	1200-1800	36.7-42.8	Rainfed condition	Zone-V (Orissa, WB, Bihar, Jharkhand, Chhattisgarh and Assam)
48.	KMR-16-2 (Surekha)	2020	-	125-130	3200-3400	40.3-42.4	High yield and resistant to Alternaria blight and white rust, tolerance to high temperature	Uttar Pradesh

List of Varieties/Hybrids (Yellow Sarson)

S.No	Name of the Variety / Hybrid	Year of notification	Notification No.	Pedigree	Maturity (days)	Yield (kg/ha)	Oil Content (%)	Salient features	Area of Adaptability
1.	Pant Sweta	2015/2017	SO.1007(E) Dt: 30.03.17	PYS-841 x PYS-7	105-110	1600-2000	45	High yielding, suitable for sowing in October under irrigated conditions, tetralocular upright bearing and cream colour flowers	Uttarakhand plains
2.	Pant Girija	2018/2020	SO.99(A) Dt: 6.01.20	NDYS-123 x Ragini	92-128	1400-1700	45.30	Medium maturity, yellow flowered upright, bilocularsiliqua bearing.	Plains of Uttarakhand
3.	Sanchita (YSWB 2014/2)	2020	S.O.3482 (E), Dt.07.10.20		95-97	1400-1600	44-45	-	West Bengal
4.	Anushka (YSWB 2011-10-1)	2020	S.O.3482 (E), Dt.07.10.20	-	85	1400-1600	44-45	-	West Bengal

List of Varieties/Hybrids (Toria)

S. No	Name of the Variety / Hybrid	Year of notification	Notification No.	Pedigree	Maturity (days)	Yield (kg/ha)	Oil Content (%)	Salient features	Area of Adaptability
1.	Sushree	2015		Mutant of TS-29	75-83	1381	42.15	Suitable for late sown condition and nonlodging type	Odisha
2.	TWC2 (Composite 2)	-		Composite from double cross (ITSA x B54) x (T9 x Karmaha)	75-80	1000-1200	42		Eastern India
3.	TL 17	2016	3540(E), 22.11.16	Selection from TLC1	90	1300	42	Suitable for multiple cropping systems. Escapes major diseases and pests	Toria growing districts of Punjab
4.	Sushree	2015	3-48/2015.SD-IV, dated 23.11.2015	Mutant of TS-29	75 -83	1381 kg/ha (Average yield)	42.15%	Suitable for late sown condition and non-lodging type	Odisha
5.	Pant Hill Toria-1	2015/2017	SO.1007(E) Dt: 30.03.17	PT-9719 x TS-50	122-134	900-1200	42	High yielding, suitable for sowing under rainfed conditions.	Uttarakhand hills.
6.	Pant Toria-508	2015/2017	SO.1007(E) Dt: 30.03.17	(PT 507 x Bhawani) x PT 303	91-96	1600-1900	42	High yielding, suitable for sowing in September under irrigated conditions.	Uttarakhand plains

7.	Raj Vijay Toria 1	2017	2805(E), 25.8.17	JT 1 x T9	98-105	1276-1874	41.2	Tolerant to drought, suitable for rainfed and irrigated condition, tolerant to shattering, sowing lime - first to second week of September	Madhya Pradesh
8.	Tapeshwari (TK 06-1)	2018	6318, 26.12.18	Mass selection from population (ORT-5,JMT-298,PT-303,T9 and Bhawani)	90-95	1350-1400	41.96	Suitable for rainfed, irrigated areas and recommended for extra early sowing, i.e. midSeptember, tolerant to drought and fog, being extra early maturity, it escapes diseases especially Alternaria blight, aphid and white rust.	Uttar Pradesh
9.	Tripura Toria 1 (TRC T-1-1-5-1/ IC 615573)	2018			86	800-900		Suitable for rainfed upland and lowland after kharif, perform well under residual moisture after kharif rice, also as utera crop, maturity: resistant to lodging, exhibits very low incidence of white rust, Sclerotinia rot, bacterial stem rot and aphid.	Tripura
10.	RSPT-6 (TCN 13-9)	2019	1326,02.4.2019	RSPT-1 x RSPT-2	85-90	1130	42.6	Moderately resistant to white rust, downy mildew, Alternaria blight, aphid and major pests	Jammu Region

11.	Azad Chetna (TKM 14-2)	2020		Mass selection from population (TK01-1,TK01-2,PT-303,TK02-1, TK02-2, TK 9901,PT-507,T9 and Bhawahi)	90-95	1440	42.2	Being early in maturity it escapes from Alternaria blight, aphid and fog	Uttar Pradesh
12.	TS-38	2020		Simple Recurrent Selection from Popular *Toria* var. 'M 27'.	85-95	1689	42-44	Suitable for timely sowing, rainfed condition	Zone-V, Assam, Arunachal Pradesh, Nagaland, Manipur, Mizoram, West Bengal and Odisha

List of Varieties/Hybrids (Brown Sarson)

S.No	Name of the Variety / Hybrid	Year of notification	Notification No.	Pedigree	Maturity (days)	Yield (kg/ha)	Oil Content (%)	Salient features	Area of Adaptability
1.	HPBS-1	2018			147	1000-1200		Suitable for rainfed farming in late September– October in low and mid hills of Himachal Pradesh	Himachal Pradesh
2.	Shalimar Sarsaon-2 (KBS-49)	2019	3220(E), 5.9.19						Jammu and Kashmir
3.	Shalimar Sarsaon-3 (KBS-3)	2019	3220(E), 5.9.19	Pusa Kalyani x Yukina	150-155	900-1200	40-45	Resistant to white rust and cold tolerant	Himachal Pradesh

List of Varieties/Hybrids (Taramira)

S.No	Name of the Variety / Hybrid	Year of notification	Notification No.	Pedigree	Maturity (days)	Yield (kg/ha)	Oil Content (%)	Salient features	Area of Adaptability
1.	Vallabh Taramira 1(PUT93-11)	2011		PUT 23 x T 27	130-135	616-1133	38-40	Suitable for rainfed conditions, moderately resistant to AB and Aphid	Uttar Pradesh
2.	Jobner Tara (RTM-1351)	2017	1007(E), 30.3.17	T-27 x RTM-2002	137-142	1300-1500	39.70	Suitable for rainfed situation	Rajasthan, Haryana, Punjab, UP, Gujarat, Delhi, Uttarakhand and Maharashtra
3.	Jwala Tara (RTM-1355)	2017	2805(E), 25.8.17	RTM-910 x T-27	133-145	1300-1400	38.90	Suitable for rainfed situation	Rajasthan, Haryana, Punjab, UP, Madhya Pradesh, Gujarat and Delhi

List of Varieties/Hybrids (African Sarson / Ethiopian Mustard)

S.No	Name of the Variety / Hybrid	Year of notification	Notification No.	Pedigree	Maturity (days)	Yield (kg/ha)	Oil Content (%)	Salient features	Area of Adaptability
1.	BJC 1 (PC 6)	2016	3540(E), 22.11.16	(*B.juncea* x *B.carinata* cv PC 5) x *B.napus* cv GSC5	157	1930	40	Determinate plant canopy with every shoot terminating into a pod. Free of white rust.	Punjab

List of Varieties/Hybrids (Gobhi Sarson)

S.No	Name of the Variety / Hybrid	Year of notification	Notification No.	Pedigree	Maturity (days)	Yield (kg/ha)	Oil Content (%)	Salient features	Area of Adaptability
1.	RSPN-25 (NCN-15)	2015	1936/196,28.1.2015	*B. napus* x *B. hirta*	145-155	1595	39.0	Variety has broad leaves; basal branching, resistance to lodging, responsive to fertilizers, suitable for timely sown conditions	Jammu region
2.	GSC 7 (GSC lol)	2015	1228(E), 7.5.15	Rivette x RR001	144-163	1911-2190	8.6-42.0	'00' canola quality variety	Punjab, Haryana, Himachal Pradesh, Jammu and Kashimir and Rajasthan
3.	ONK 1	2019	212, 24.6.19	Single plant selection from a local variety Sheetal which was developed as a single plant selection from Exotic line EC-129127	146-172	693-1789	37.9-42.2	Low incidence of Alternaria leaf blight and Sclerotinia stem rot, resistance to white rust and moderate resistance to downy and powdery mildew, wider adaptability	Zone-I(Himachal Pradesh, Jammu &Kashmir)
4.	Him Palam Gobhi Sarson I (AKMS 8141)	2020		GSL 1 X HYOLA 401	166	1915	37.5-42.8	Suitable for timely sowing under irrigated, high fertility	Himachal Pradesh, Srinagar, Jammu, Punjab

Rapeseed-Mustard varieties found place in seed chain from 20210 -2020.

S. No.	Rapeseed-Mustard varieties in breeder seed chain (Breeder seed indent) 2010 to 2020	BS Indent
1.	M-27 (Toria), GM-2, Geeta, Swarna Jyoti, Vasundra, RH-30, CS-56, CS-54, CS-52, Jagnnath, Pusa Agrani, Pusa Jaikisan, Pusa Bold, Pusa Bahar, GSL-1, RLM-619, PBR-210,TL-15, NRCDR-02, NRCHB-101, RN-393 (Aravali), Navgold, RGN-73, RGN-145, RGN-48, Karan Tara, Ashirwad, Maya, Rohini, Varuna (T-59), T-9, Kranti, Kiran, PT-507, PT-303, Jhumka, B-9, GM-3, Laxmi, Pusa Mahak, Pusa EJ-9912-13, Pusa Mustard-21, Pusa Mustard-22 (LET-17), Pusa Aditya, KBS-3, RCC-4, Sheetal, Jawarhar Mustard-2, JMT-689, (Jawahar Toria-1), Shatabdi, Anuradha (ORT-6-2), Parbati (ORT-2-4), GSC-5, GSC-6, ELM-079, PBR-91, PBT-37, RN-37, RN-505, Narendra Tara, Kranti (RK-9807), Urvashi (RK-9501), Basanti (RK-8501), Bhawani, Narendra Ageti Rai-4, VLT-3, Agrani (B-54)	2010-11
2.	M-27 (Toria), GM-2, GM-1, GM-3, Geeta,RB-50, Vasundra, RH-30, CS-56, CS-54, Jagnnath, Pusa Agrani, Pusa Jaikisan, Pusa Bold, Pusa Bahar, Pusa Mahak, Pusa EJ-9912-13, Pusa Mustard-21, Pusa Mustard-22 (LET-17), PM-24, PM-25, PM-27,Ragini, Pusa EJ-9912-13, Pusa Vijay, Pusa Aditya, PBR-210, ELM-079, PBR-91, NRCHB-506 (F), NRCHB-506 (M), NRCDR-02, NRCHB-101, DRMR 601 (NRCDR-601), NRCYS-05,02, RN-393 (Aravali), Navgold, RGN-73, RGN-145, RGN-48, Karan Tara, Ashirwad, Maya, Rohini, Varuna (T-59), T-9, Pitambari (RYSK-05-02), Pua Kayani, Kranti, PT-303, Jhumka, B-9, Laxmi, Sheetal (CAN-9), Shatabdi, Kranti (RK-9807), Basanti (RK-8501), Bhawani, Narendra Ageti , Rai-4, VLT-3, Agrani (B-54)	2011-12
3.	M-27 (Toria), GM-2, GM-1, GM-3, Geeta, Him Sarson-1, Neelam, Sheetal, RCC-4, RB-50, Geeta, RB-50, Vasundhra, RH-30, CS-56, CS-54, CS-52, Swarna Jyoti, Jagnnath, Pusa Agrani, Pusa Jaikisan, Pusa Bold, Pusa Bahar, Pusa Mahak, Pusa EJ-9912-13, Pusa Mustard-21, Pusa Mustard-22 (LET-17), PM-24, PM-25, PM-27, Ragini, Pusa EJ-9912-13, Pusa Vijay, Pusa Aditya, PBR-210, RLC-1, RLM-619, TBT-37, TL-15, PBR-91, GSC-5, GSL-1,NRCHB-506 (F), NRCHB-506 (M), NRCDR-02, NRCHB-101, DRMR 601 (NRCDR-601), NRCYS-05,02, RRN-505,RN-393 (Aravali), Navgold, RGN-73, RGN-145, RGN-48, Karan Tara, Ashirwad, Maya, Rohini, Varuna (T-59), Urvashi, T-9, Bhawani, Pitambari (RYSK-05-02), Kranti, PT-507, PT-303, Pant Pili Sarson-1, Jhumka, B-9, Sheetal (CAN-9), Shatabdi, Basanti (RK-8501), Bhawani, Narendra Ageti Ageti-4, Uttara, VLT-3, Agrani (B-54)	2012-13
4.	M-27 (Toria), TS-36, Chhatisgarh Sarson, Pusa Kalyani, GM-2, GM-3, Him Sarson-1, Neelam, Sheetal, RCC-4, RB-50, RH-30, Swarna Jyoti, Vasundhra, Laxmi, RH-0406, RH-0749, CS-56, CS-54, Pusa Agrani, Pusa Jaikisan, Pusa Bold, Pusa Bahar, Pusa Mahak, PM-24, PM-25, PM-27,PM-28, PM-29, PM-30, Pusa Vijay, PusaSwarnim (IGC-01), Raj	2013-14

	Vijay Mustard-2, JMT-689, Shatabdi, Anuradha, Parvati (QRT-2-4), GSL-1, PBR-91, RLC-1, RLM-619, PBT-37, TL-15, DRMRIJ-31, NRCHB-506 (F), NRCHB-506 (M), NRCDR-02, NRCHB-101, DRMR 601 (NRCDR-601), NRCYS-05,02, , Karan Tara, Narendra Tara, Navgold, RGN-73, RGN-145, RGN-48,RGN-229, RGN-238, Divya-33, Ashirwad, Maya, Rohini, Varuna (T-59), Urvashi, T-9, Bhawani, Pitambari (RYSK-05-02), Kranti, PT-507, PT-303, Pant Pili Sarson-1, Jhumka, B-9, Sheetal (CAN-9), Shatabdi, Basanti (RK-8501), Bhawani, Narendra Ageti -4, Narendra Rai, (NDR-8501), Uttara, Panchali (TWC-3), Benoy (B-9)	
5.	M-27 (Toria), TS-36, Chhatisgarh Sarson, Pusa Kalyani, GM-2, GM-3, Him Sarson-1, Neelam, Sheetal, RCC-4, RB-50, RH-30, Vasundhra, Laxmi, RH-0406, RH-0749, RH-119, YSH-0401, CS-56, Pusa Agrani, Pusa Jaikisan, Pusa Bold, Pusa Bahar, Pusa Mahak, Jagannath, PM-24, PM-25, PM-27,PM-28, PM-29, PM-30, Pusa Vijay, Pusa tarak, JM-3 (JMM-915), Anuradha, Parvati (QRT-2-4), GSC-5, GCS-6, GSC-7, PBR-91, RLC-1, RLM-619, PBT-357, TL-15, TL-17, DRMRIJ-31, NRCDR-02, NRCHB-101, DRMR 601 (NRCDR-601), NRCYS-05,02, , Karan Tara, Narendra Tara, Navgold, RGN-73, RGN-145, RGN-48, RGN-229, RGN-236, Divya-33, Maya, Rohini, basanti (RK-8501), Varuna (T-59), T-9, Bhawani, Pitambari (RYSK-05-02), Narendra rai (NDR-8501), Kranti, PT-507, PT-303, Pant Pili Sarson-1, Uttara, VL-Torai-3,Agrani, Jhumka, Benoy (B-9)	2014-15
6.	M -27, Chhattisgarh Sarson, Gujarat Mustard 2,Gujarat Mustard 3,Him Sarson-1, RCC – 4, RB-50, RH 30, Vasundhra , Laxmi , RH 406, RH 0749, RH 0119,Swarn Jyoti (RH 9801), YSH 0401, Pusa Bold, Pusa Jaikisan, Pusa Mustard-24 , Pusa Mustard-25 , Pusa Mustard-26 , Pusa Mustard-27 , Pusa Mustard 28, Pusa Mustard-29 ,Pusa Mustard-30, Pusa Mahak, Jagannath (VSL-5), Pusa Vijay, Pusa Tarak, Pusa Swarnim (IGC-01), Jawahar Mustard-3 (JMM-915), RVM-2, JMT-689, Anuradha ,Parvati (QRT-2-4), PBR- 357, PBR-91, RLC-1, RLM-619, TL-15, TL-17, GSC-6, GSC-7, Hyola , PAC-401, Giriraj (DRMRIJ 31) , NRCDR 2, NRCHB 101, DRMR 601, NRCYS 05-02, Narendra Tara , RRN-573, RGN 145, RGN 48, RGN 73, RGN-229, RGN-236, RGN-298, RGN-303, Maya, Basanti (RK 8501), Rohini, Varuna , Kanti , Urvashi, Ashirwad (RK-01-3), Bhawani, Tapeswari, Pitambari, PT-303 ,Pant Pili Sarson -1, Uttara , VL Toria-3, Agrani , humka ,Benoy (B 9),Chini Sarson.	2015-16
7.	M -27, TS-36, TS-38, TS-46, Chhattisgarh Sarson, Gujarat Mustard 2 , Gujarat Mustard 3, Him Sarson-1 (ONK-1), Neelam, RCC – 4, RB-50, RH 30, Vasundhra (RH 9304), Laxmi (RH 8812), RH 406, RH 0749, BSH-1,YSH 0401, Pusa Bold, Pusa Jaikisan, Pusa Mustard-24, Pusa Mustard-25, Pusa Mustard-26, Pusa Mustard-27 , Pusa Mustard 28, Pusa Mustard-29, Pusa Mustard-30, Pusa Mahak, Jaganath (VSL-5), Pusa	2016-17

	Vijay, Pusa Mustard-22 (LET-17), Pusa Agrani (SEJ-2), KBS-3,Jawahar Mustard-3 (JMM-915), Jawahar Mustard-1, Anuradha, Parvati (QRT-2-4), PBR- 357,PBR-91, RLM-619, TL-15, GSC-7,Giriraj (DRMRIJ 31) ,NRCDR 2,NRCHB 101, DRMR 601, NRCYS 05-02,Narendra Tara , RTM-1355, RRN-573, RGN 145, RGN 48, RGN 73, RGN-229, RGN-236,RGN-298, RGN-303, Rohini, Varuna , Bhawani, TYPE-9,Pitambari, Pant Rai-19, PT-303 ,Pant Pili Sarson -1, Uttara , VL Toria-3, Agrani (B-54), Jhumka , Benoy (B 9), BAUR 9502 (SHIVAN), Chini Sarson, Kalyapur yellow sarson, Kalyani	
8.	M -27, TS-36, Chhattisgarh Sarson, Gujarat Mustard 2 ,Gujarat Mustard 3,Him Sarson-1 (ONK-1), RCC – 4, RB-50,RH 30, Laxmi (RH-8812),RH 406,RH 0749,YSH 0401, CS-58,Pusa Double Zero Mustard-31 (PDZ-1), Pusa Bold, Pusa Jaikisan (Bio-902),Pusa Mustard-24 (LET-18),Pusa Mustard-25 (NPJ112), Pusa Mustard-26 (NPJ113), Pusa Mustard-27 (EJ17),Pusa Mustard 28 (NPJ124), Pusa Mustard-30 (LES-43), Pusa Mahak (JD-6),Pusa Vijay (NPJ 93),Pusa Mustard-22 (LET-17),Pusa Agrani (SEJ-2),Jawahar Mustard-3 (JMM-915), Raj Vijay Mustard-2 (JMWR08-3) (RVM2),Anuradha (ORT-M6-2),PBR-357,RLC-3,PBR-91,RLM-619,TL-17, TL-15,GSC-6,GSC-7,Giriraj (DRMRIJ 31) ,NRCDR 2,NRCHB 101,NRCYS 05-02, RGN 48,RGN 73,RGN-229,RGN-236,RGN-298,RGN-303,Rohini,Varuna ,Bhawani, TYPE-9, Pitambari (RYSK-05-02), Kranti (PR-15),Pant Rai-21, PT-303, Pant Pili Sarson -1, Uttara (PT-2002-25),Pant Hill Toria-1(PT-2006-4) ,Pant Toria-508(PTE-2008-2) ,Agrani (B-54), Panchali (TWC-3), Jhumka (YSBNC-1), Benoy (B 9),BAUR 9502 (SHIVANI),Chini Sarson	2017-18
9.	M -27 ,TS-36, Chhattisgarh Sarson, HPN-1 (Sheetal), RCC – 4, RB-50,RH 30, Laxmi (RH-8812),RH 406, RH 0749, YSH 0401, Pusa Double Zero Mustard-31 (PDZ-1),Pusa Bold, Pusa Jaikisan (Bio-902), Pusa Mustard-24 (LET-18), Pusa Mustard-25 (NPJ112), Pusa Mustard-26 (NPJ113), Pusa Mustard-27 (EJ17), Pusa Mustard 28 (NPJ124), Pusa Mustard-30 (LES-43),Pusa Mahak (JD-6), Pusa Vijay (NPJ 93), Pusa Agrani (SEJ-2), Jawahar Mustard-3 (JMM-915),Raj Vijay Mustard-2 (JMWR08-3) (RVM2), Anuradha (ORT-M6-2),Sushree, PBR- 357, RLC-3, PBR-91 ,RLM-619, TL-17,TL-15,GSC-6, GSC-7, Giriraj (DRMRIJ 31) ,NRCDR 2, NRCHB 101, NRCYS 05-02, RGN 48,RGN-229, RGN-298, RTM-1351, RTM-1355 (Jwala Tara), Rohini, Varuna , Bhawani, TYPE-9, Tapeshvari TK 06-1, Pitambari (RYSK-05-02), Kranti (PR-15),Pant Rai-19, PT-303, Pant Pili Sarson -1, Pant Sweta (PYS 2007-10), Uttara (PT-2002-25), Agrani (B-54), Panchali (TWC-3),Jhumka (YSBNC-1), Benoy (B 9),BAUR 9502 (SHIVANI)	2018-19
10.	M -27, TS-36, TS-38, Rajendra Sublam, Chhattisgarh Sarson, Gujarat Mustard -3, Gujarat Dantiwada Mustard -4, ONK-1 (Him Sarson), RH-725, RH 406, RH 0749, RH-761, YSH 0401, CS-58, CS-60 ,Pusa Double Zero Mustard-31 (PDZ-1), Pusa Mustard-25 (NPJ112), Pusa	2019-20

	Mustard-26 (NPJ113), Pusa Mustard-27 (EJ17), Pusa Mustard 28 (NPJ124), Pusa Mustard-30 (LES-43), Pusa Tarak, Pusa Mahak (JD-6), Pusa Vijay (NPJ 93), RVM-1, Raj Vijay Toria-1, Sushree, PBR- 357, RLC-3,TL-17,TL-15, GSC-7, Giriraj (DRMRIJ 31) ,DRMR 601 (NRCDR 601),NRCHB-506, NRCDR 2,NRCHB 101, NRCYS 05-02, RGN-229,RGN-298	
11.	Chhattisgarh Sarson, Gujarat Mustard -3, ONK-1 (Him Sarson),RH-725, RH 406, RH 0749, RH-761, Laxmi (RH-8812), RH-30, YSH 0401,CS-58,CS-60, RSPT-06, BAUR9502- (Shivani), RVM-1, RVM-2, Raj Vijay Toria-1,Pusa Mustard-32 , Pusa Double Zero Mustard-31 (PDZ-1),Pusa Mustard-25 (NPJ112),Pusa Mustard-26 (NPJ113), Pusa Mustard-27 (EJ17),Pusa Mustard 28 (NPJ124), Pusa Mustard-30 (LES-43),PusaTarak, PusaMahak (JD-6), Pusa Vijay (NPJ 93,) Pusa Jaikisan (Bio-902), Pusa Bold, Sushree, PBR- 357,RLC-3, TL-17, GSC-7, GSC-6, BJC-1 (PC-6), Giriraj (DRMRIJ 31) , DRMR 601 (NRCDR 601), NRCHB-506, NRCDR 2, NRCHB 101, DRMR 150-35, NRCYS 05-02, RGN-298, RGN-236, RTM-1351, RTM-1355 (Jwala Tara), Rohini, Varuna (T-59), Tapeshvari TK 06-1, T-9 Pitambari (RYSK-05-02), Pant Rai-21, Pant Hill Toria-1, Pant Toria-508 (PTE-2008-2), PT-507, PT-303, Pant Pili Sarson -1, Pant Sweta (PYS 2007-10), Uttara (PT-2002-25), Benoy (B 9), TBM-209 (TrombayBidhan Mustard-204) TM-204, Agrani (B-54), humka (YSBNC-1). RGN-236, RTM-1351,RTM-1355 (Jwala Tara),JK Pukhraj (JKYS-2), Tripura Toria-1, Bhawani, Tapeshvari TK 06-1,Pitambari (RYSK-05-02),Pant Rai-21, PT-508, Pant Pili Sarson -1, Pant Sweta (PYS 2007-10),Uttara (PT-2002-25), Benoy (B 9).	2020-21

Annexure-IV

ICAR-DRMR, Bharatpur

Date: 02.08.2021

VARIETIES IDENTIFIED UNDER AICRP-RM DURING YEAR- 2010-2020

Year	Name variety	Identified for Situation
2010	NPJ-113 (Pusa Mustard 26)	Indentified for Late sown irrigated conditions of Zone II.
	EJ 17 (Pusa Mustard 27)	Indentified for Early sown irrigated conditions of Zone III.
2011	Coral 437 (PAC437) Hybrid	Identified for : Punjab, Haryana, New Delhi, Jammu and Parts of Rajasthan under timely sown irrigated conditions.
	ELM 123 (RLC 2)	Indentified for Punjab, Haryana, New Delhi, Jammu and Parts of Rajasthan
	NPJ-124 (Pusa Mustard 28)	Indentified for: Punjab, Haryana, New Delhi, Jammu and Parts of Rajasthan under early sown irrigated conditions
	PBR-357	Indentified for: Punjab, Haryana, New Delhi, Jammu and Parts of Rajasthan under timely sown irrigated conditions
	PR 2006-1 (Pant Rai 19)	Indentified for: Punjab, Haryana, New Delhi, Jammu and Parts of Rajasthan under early sown irrigated conditions
	RGN 229	Indentified for: Punjab, Haryana, New Delhi, Jammu and Parts of Rajasthan under rainfed conditions
	RGN-236	Indentified for: Punjab, Haryana, New Delhi, Jammu and Parts of Rajasthan under late sown conditions
	RH0406	Indentified for: Punjab, Haryana, New Delhi, Jammu and Parts of Rajasthan under rainfed conditions
2012	Divya 33	Identified for Haryana, Jammu, Punjab and Northern Rajasthan under timely sown irrigated conditions
	JMWR 08-3	Identified for Haryana, Jammu, Punjab and Northern Rajasthan under late sown irrigated conditions
	PBR-378	Identified for Haryana, Jammu, Punjab and Northern Rajasthan under rainfed conditions.
	RH 0749	Identified for Haryana, Jammu, Punjab and Northern Rajasthan under timely sown irrigated conditions
	44S01 (Hybrid)	Identified for Asom, Bihar, Chhatishgarh, Jharkhand, Odisha and Manipur under rainfed conditions.
2013	DRMR IJ 31	Identified for Delhi, Haryana, Jammu, Punjab and northern Rajasthan.
	LET 36	Identified for Delhi, Haryana, Jammu, Punjab and northern Rajasthan
	LES 43	Identified for Uttar Pradesh, Uttarakhand,

		Madhya Pradesh and eastern Rajasthan.
	GSC 101 (Gobhi Sarson)	Identified for Delhi, Haryana, Himachal Pradesh, Jammu& Kashmir, Punjab and northern Rajasthan.
2014	ALBELI-1	Identified for Zone III(Irrigated Conditions) : MP, UP, Uttarakhand and Eastern Rajasthan.
	RGN-298	Identified for Zone II (Rainfed Conditions) : Northern Rajasthan, Punjab, Haryana and Jammu.
	RTM-1355 (Taramira)	Identified for Taramira growing regions of country.
2015	DRMR 150-35	Identified for Assam, Bihar, Odisha, West Bengal, Tripura, Meghalaya under rainfed conditions.
	SKM-518	Identified for Punjab, Haryana, Jammu, Northern Rajasthan, Delhi under rainfed condition.
	RTM- 1351 (Taramira)	Identified for Taramira growing regions of country.
2016	CS 1100-1-2-2-3 (CS 58)	Identified for Salinity/ alkalinity conditions of mustard growing regions
	RH 0749	Identified for Zone III (Timely sown Irrigated conditions of U.P., M.P., Eastern Rajasthan and Uttarakhand)
	NRCHB-101	Identified for Rainfed condition of Zone V (Bihar, Odisha, Chhattishgarh, Jharkhand, West Bengal, Manipur, Meghalaya, Tripura)
2017	CS 2800-1-2-3-5-1	Identified for Salinity/ Alkalinity conditions of mustard growing regions
	RH 0725	Identified for Zone II Timely sown and Rainfed Conditions of Jammu, Punjab, Haryana, Delhi, Northern Rajasthan
	PDZ-1	Identified for Double low quality (low erucic acid content in oil and low glucosinalate content in seed meal) Zone II Northern Rajasthan, Punjab, Haryana, Delhi, Jammu & Kashmir).
	DRMR 1165-40	Identified for Zone II Timely sown and rainfed conditions of Jammu, Punjab, Haryana, Delhi and northern Rajasthan.
	Hybrid (PRO 5111) Keshri	Identified for Early Sown conditions of Zone-II (UP., MP., Uttarakhand and Part of Eastern Rajasthan)
2018	RH-761	Identified for Timely sown rainfed conditions of zone-II (Jammu, Punjab, Haryana, Delhi, and Northern Rajasthan)
2020	Brijraj (DRMR IC-1638)	Identified for Zone-II (Punjab, Haryana, Jammu & Kashmir, Northern Rajasthan)
	Radhika (DRMR 2017-15)	Identified for Zone-II (Punjab, Haryana, Jammu

		& Kashmir, Northern Rajasthan)
	AKMS 8141 (Gobhi Sarson)	Identified for Himachal Pradesh, Punjab, Jammu & Kashmir.
	TS-38 (Toria)	Identified for Zone –IV (Assam, Orissa, West Bengal)
	LES-54 (PM-32)	Identified for Zone –II (Punjab, Haryana, Jammu & Kashmir,).

Annexure-V

Address of Project Coordination & Programme Leaders of All India Coordinated Research Project on Rapeseed-Mustard

Dr. Pramod Kumar Rai
Project Coordinator
AICRP on Rapeseed-Mustard
ICAR-Directorate of Rapeseed-Mustard Research
Sewar, Bharatpur- 321303

Phone: (Off.): 05644-260419, Mobile: 9549810486
Fax: 05644-260565, E-mail: director.drmr@gmail.com

Principal Investigator/Resource Person

S.No.	DISCIPLINE	NAME & ADDRESS	PHONE & e-mail
1.	Plant Breeding	Dr. K.H. Singh, Principal Scientist, (GPB), ICAR-DRMR, Bharatpur	Mobile: 9413835118 e-mail: kharendrasingh@gmail.com
2.	Agronomy	Dr. R.S. Jat, Principal Scientist (Agronomy), ICAR-DRMR, Bharatpur	Mobile: 9610567700 e-mail: rs.jat@icar.gov.in
3.	Plant Pathology	Dr. Prabhu Dayal Meena Principal Scientist (Plant Pathology), ICAR-DRMR, Bharatpur	Mobile: 9549158009 e-mail: Prabhu.Meena5@icar.gov.in
4.	Entomology	Dr. Sarwan Kumar, Senior Entomologist (Oilseeds)/ Associate Professor Department of Plant Breeding and Genetics Punjab Agricultural University Ludhiana	Mobile: 9988151555 e-mail: sarwanent@pau.edu
5.	Plant Physiology	Dr.Pushp Sharma Principal Physiologist (Oilseeds) Oilseeds Section Department of Plant Breeding and Genetics Punjab Agricultural university,Ludhiana	Mobile: 9915044881 e-mail:pushp20@yahoo.com ; pushp20@pau.edu
6.	Bio-Chemistry	Dr. Anubhuti Sharma, Principal Scientist, (Biochemistry), ICAR-DRMR, Bharatpur	Mobile: 9772429768 e-mail: sharmaanubhuti98@gmail.com
7.	FLD	Dr. Ashok Kumar Sharma, Principal Scientist (Agriculture Extension), ICAR-DRMR, Bharatpur	Mobile: 9549157392 e-mail: ashok.drmr@gmail.com
8.	Breeder Seed Production	Dr. Bhagirath Ram, Principal Scientist, (GPB), ICAR-DRMR, Bharatpur	Mobile: 9660114965 e-mail: bhagirathram_icar@yahoo.com

Annexure-VI

Budget

Head- wise break-up of Plan Budget in respect of AICRP on R-M under DARE/ICAR during 2020-21.

(Rs. in lakh)

Head	Expenditure
Grants in Aid-salaries	1050.00
Grants in Aid-salaries	174.10
TSP	21.73
NEH	61.20
Total	1307.03

Zone-wise research centre's for multi-location testing

Zone I

Jammu & Kashmir	:	Khudwani, Srinagar*
Himachal Pradesh	:	Kangra, DhaulaKuan*, Bajaura*, Una*

Zone II

Jammu &Kashmir	:	Chatha
Punjab	:	Ludhiana, Bathinda*
Haryana	:	Hisar, Bawal, Karnal*, Gurgaon*, Panipat*
Rajasthan	:	Navgaon, Sriganganagar, Alwar*
Delhi	:	IARI*, Jaunti*, Modipuram*

Zone III

Uttar Pradesh	:	Kanpur, Faizabad /(Jhansi), Varanasi, Lucknow*, Agra*, Mauranipur*, CSSRI* (Agra)
Uttarakhand	:	Pantnagar
Madhya Pradesh	:	Morena, Tikamgarh*
Rajasthan	:	Kota*, Bharatpur

Zone IV

Rajasthan	:	Jobner
Gujarat	:	Junagadh*, S.K. Nagar, Anand*
Maharashtra	:	Jalgaon*, Nagpur

Zone V

Chhattisgarh	:	Jagdalpur
Bihar	:	Dholi
Jharkhand	:	Kanke
West Bengal	:	Berhampore /(Kalyani)
Orissa	:	Bhubaneswar
Assam	:	Shillongani
N.E.Hill State	:	Imphal, Shillong*

*Voluntary Centre

Abbreviations used in the report

Zone I		**Zone III**		**Zone V**	
KHD	Khudwani	AG	Agra	BE	Berhampor
KNG	Kangra	BPR	Bharatpu	BH	Bhubanes
DLK	Dhaula Kuan	KO	Kota	DO	Dholi
UNA	Una	KP	Kanpur	JA	Jagdalpur
SRN	Srinagar	FZB	Faizabad	KN	Kanke
Zo		VA	Varanasi	IMP	Imphal
CHT	Chatha	LK	Lucknow	SH	Shillong
LDH	Ludhiana	MR	Mauranip	SH	Shillongan
BTH	Bathinda	PNT	Pantnaga		
HSR	Hisar	MO R	Morena		
BAW	Bawal	TK	Tikamgar		
KAR	Karnal				
NAV	Navgaon	**Zon**			
PNP	Panipat	AN	Anand		
SGN	Sriganganagar	JUG	Junagadh		
MOD	Modipuram	SK N	S.K. Nagar		
NDH	New Delhi	BK	Bikaner		
JNT	Jaunti	JAL	Jalgaon		
ALW	Alwar	NGP	Nagpur		
GUR	Gurgaon				

27th Annual Group Meeting

All India Coordinated Research Project on Rapeseed-Mustard

Group Meeting

Video- Conference

at

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

(August 03-04, 2020)