All India Coordinated Research Project on Rapeseed-Mustard

Proceedings

29th Annual Group Meeting

held

At

RARI, Durgapura, Jaipur - (Raj.)

(August 01-03, 2022)

All India Coordinated Research Project on Rapeseed - Mustard
ICAR- Directorate of Rapeseed-Mustard Research
(Indian Council of Agricultural Research)
Sewar, Bharatpur-321 303 (Rajasthan), India

29th Annual Group Meeting
All India Coordinated Research Project on Rapeseed-Mustard
ICAR-Directorate of Rapeseed-Mustard Research, Sewar

(AUGUST 01-03, 2022)
Venue: RARI, DURGAPURA, JAIPUR

AGENDA

01st August 2022 (Monday)		
12.00-12.30hrs.	**REGISTRATION**	
12.30-13.30 hrs	**Lunch –RARI, Durgapura**	
13.30 hrs	**Departure to SKNAU, Jobner**	
14.30-17.00hrs.	**INAUGURAL SESSION**	
	Chairman	Prof. J.S. Sandhu, Vice-Chancellor, SKNAU, Jobner
	Chief Guest	Dr.Sanjeev Gupta, ADG (O&P),ICAR, NewDelhi
	Guest of honour	Dr. K.K.Singh, Vice-Chancellor, RPCAU, samastipur Dr. Sanjay Kumar, Director, ICAR-IISS, Mau
14.30-14.35 hrs.	Lighting of lamp	
14.35-14.50 hrs.	Welcome address, Presentation of Research highlights and Action Taken Report	Dr. P.K. Rai, Director, ICAR-DRMR, Bharatpur
14.50.15.00hrs.	Remarks (Guest of honour)	Dr. K.K.Singh, Vice-Chancellor, RPCAU, samastipur Dr. Sanjay Kumar, Director, ICAR-IISS, Mau
15.00-15.10 hrs.	Remarks (Chief Guest)	Dr.Sanjeev Gupta, ADG (O&P),ICAR, NewDelhi
15.10-15.20hrs.	Release of publications	
15.20- 15.30hrs.	Chairman'sRemarks	Prof. J.S. Sandhu, Vice-Chancellor, SKNAU, Jobner
15.30-15.35hrs.	Vote of thanks	Dr. Manohar Ram SKNCOA, Jobner
	Rapporteurs	Dr. H.K.Sharma, Sr. Scientist, ICAR-DRMR, Bharatpur Dr. Prashant Yadav, Scientist, ICAR-DRMR, Bharatpur
15.35-16.00hrs.	**Tea Break**	
16.00-17.00 hrs.	**Visit of university facilities**	
17.00 hrs	**Departure to Jaipur**	
02nd August 2022 (Tuesday) Venue: RARI, Durgapura, Jaipur		
10.00-13.15hrs.	**TECHNICAL SESSION I: Crop Improvement and Genetics Resources**	
	Chairman	Dr.Sanjeev Gupta, ADG (O&P),ICAR, NewDelhi
	Co- Chairman	Dr. Sanjay Kumar, Director, ICAR-IISS, Mau
	Subject Expert	Dr. S.S. Banga, Ramanna Fellow PAU, Ludhiana Dr. S.R.Bhatt, Former Prof. ICAR-NRCPB, New Delhi
	Rapporteurs	Dr. V.V. Singh, Principal Scientist, Plant Breeding, ICAR-DRMR, Bharatpur Dr. Kartikeya Srivastava, GPB, I.A.Sc., B.H.U.
10.00-10. 30 hrs.	Presentation of results of crop improvement trials conducted in AICRP-RM during 2021-22	Dr.K.H. Singh, PI Plant Breeding, ICAR-DRMR, Bharatpur
10.30-12.00 hrs.	Formulation of technical programme for 2022-23	
12.00hrs	**Tea Break**	
12.15-12.45hrs.	Session concluding remarks	Dr. Sanjeev Gupta/ Dr.S. S. Banga/ Dr. S.R.Bhatt
12.45-14.00hrs.	**Lunch Break**	
14.00-15.30hrs.	Varietal Identification Committee Meeting for Rapeseed-Mustard and Groundnut	
	Chairman: Dr.Sanjeev Gupta, ADG (O&P),ICAR, NewDelhi Members of VIC of Rapeseed-Mustard and Groundnut	
15.30-15. 45 hrs.	**Tea Break**	

15.45-17.30 hrs.	**TECHNICAL SESSION II: Plant Pathology and Entomology**	
	Chairman	Dr.Sanjeev Gupta, ADG (O&P),ICAR, NewDelhi
	Co-Chairman	Dr. P.K.Rai, Director, ICAR-DRMR, Bharatpur
	Subject Experts	1. Dr. H.C. Sharma, Former VC, UHF Solan (H.P.) 2. Dr. G.S. Saharan, Ex-Prof. & Head, Plant Pathology, CCSHAU, Hisar
	Rapporteurs	1. Dr. Pankaj Sharma, Principal Scientist, ICAR-DRMR, Bharatpur 2. Prof. S.S. Vaish, I.A.Sc.,BHU, Varanasi 3. Prof. M.S. Khan, Deptt. of Entomology, GBPUA&T, Pantnagar 4. Dr. Sarwan Kumar, Scientist, Entomology, PAU, Ludhiana
15.45-16.00hrs.	Presentation of results of Plant Pathological trials conducted in AICRP-RM during 2021-22	Dr. P.D. Meena PI, Plant Pathology, ICAR-DRMR, Bharatpur
16.00-16.30hrs.	Formulation of technical program for 2022-23	
16.30-16.45hrs.	Presentation of results of Entomological trials conducted in AICRP-RM during 2021-22	Dr. Sarwan Kumar, PI, Scientist, Entomology, PAU, Ludhiana
16.45-17.15hrs.	Formulation of technical program for 2022-23	
17.15-17.30hrs.	Session concluding remarks	Dr. Sanjeev Gupta / Dr. P.K.Rai / Dr. H.C. Sharma / Dr. G.S. Saharan

03 August 2022(Wednesday)		
09.30-10.30hrs	**Technical Session III: Breeder Seed Production**	
	Chairman	Dr.Sanjeev Gupta, ADG (O&P),ICAR, NewDelhi
	Co-Chairman	Dr. Sanjay Kumar, Director, ICAR-IISS, Mau
	Rapporteurs	Dr. H.S. Meena, Principal Scientist, Plant Breeding, ICAR-DRMR, Bharatpur Dr. Sunil Kumar Rai, Assoc. Prof. Plant Breeding, SKUAS&T, Jammu
9.30-10.00 hrs.	Scenario of Breeder seed production of Rapeseed-Mustard during 2021-22	Dr. Bhagirath Ram, Principal Scientist, ICAR-DRMR, Bharatpur
10.00-10.10 hrs.	Variety-wise breeder seed production program as per DAC indent	
10.10-10.30 hrs.	Session concluding remarks	Dr.Sanjeev Gupta/ Dr. sanjay kumar
10.30- 11.30 hrs.	**TECHNICAL SESSION IV: Crop Production**	
	Chairman	Dr.Sanjeev Gupta, ADG (O&P),ICAR, NewDelhi
	Co-Chairman	Dr. Sanjay Kumar, Director, ICAR-IISS, Mau
	Subject Expert	Dr. Virender Sardana, Prof. PAU, Ludhiana
	Rapporteurs	Dr. Rajiv Bharat, Sr. Scientist, Agronomy, SKUAS&T, Jammu
10.30 10.40 hrs.	Presentation of results of Crop Production trials conducted during 2021-22	Dr. R.S. Jat, PI, Agronomy, ICAR-DRMR, Bharatpur
10.40-11.00 hrs.	Formulation of technical program for 2022-23	
11.00-11.30 hrs.	Session concluding remarks	Dr. Sanjeev Gupta / Dr. Sanjay Kumar/ Dr. Virender sardana
11.30-11.40 hrs.	**Tea Break**	

11.40-12.15 hrs.	**Technical SessionV: Transfer of Technology**	
	Chairman	Dr.Sanjeev Gupta, ADG (O&P),ICAR, NewDelhi
	Co-Chairman	Dr. Sai Das, Ex- Director, DMR, New Delhi
	Rapporteurs	Dr. Ashok Kumar Sharma, PI, FLDs, ICAR, DRMR, Bharatpur
11.00-11.30 hrs.	Presentationof results of FLDs conducted during 2021-22	Dr. Ashok Kumar Sharma, PI, FLDs, ICAR, DRMR, Bharatpur
	Presentation on allocation of FLD for the year 2022-23	Allconcerned centres
11.30-11.45 hrs.	Activities of Outreach programs	Dr. A.K. Sharma, Principal Scientist, ICAR-DRMR, Bharatpur
11.45-12.15 hrs.	Session concluding remarks	Dr.Sanjeev Gupta/ Dr. Sai Das,
12.15-13.15 hrs.	**Technical Session VI: Biochemistry and Plant Physiology**	
	Chairman	Dr.Sanjeev Gupta, ADG (O&P),ICAR, NewDelhi
	Subject Experts	Dr. Maharaj Singh, Principal Scientist, ICAR-CAZRI, Jodhpur
	Rapporteurs	DrAnubhuti Sharma, PI, Biochemistry, ICAR-DRMR, Bharatpur Dr. Pushp Sharma, PI, Plant Physiology, PAU, Ludhiana
12.15-12.30 hrs.	Presentation of results of Biochemistry trials conducted in AICRP-RM durig 2021-22 and formulation of technical program for 2022-23	Dr. Anubhuti Sharma, PI, Biochemistry, ICAR-DRMR, Bharatpur
12.30-12.45 hrs.	Presentation of results of Plant Physiology trials conducted in AICRP-RM during 2021-22 and formulation of technical program for 2022-23	Dr. Pushp Sharma, PI, Plant Physiology, PAU, Ludhiana
12.45-13.15hrs.	Session concluding remarks	Dr.Sanjeev Gupta / Dr. Maharaj Singh
13.15-14.30 hrs.	**Lunch**	
14.30-17.00 hrs.	**PlenarySession**	
	Chairman	Prof. J.S. Sandhu, Vice-Chancellor, SKNAU, Jobner
	Co-Chairman	Dr.Sanjeev Gupta, ADG (O&P),ICAR, NewDelhi
	Convener	Director, ICAR-DRMR, Bharatpur
14.30-15.10 hrs.	Welcome and Remarks	Dr. P.K. Rai, Director, ICAR-DRMR, Bharatpur
15.10-15.30 hrs.	Presentation of summary recommendations and highlights of deliberations	Rapporteurs of different sessions.
15.30-16.00 hrs.	Farewell of Retiring Personnel	
16.00-16.15 hrs.	Remarks	Prof. J.S. Sandhu, Vice-Chancellor, SKNAU, Jobner
16.15-16.30 hrs.	Remarks	Dr.Sanjeev Gupta, ADG (O&P),ICAR, NewDelhi
16.30-17.00 hrs.	Vote of thanks	Dr. P.K. Rai, Director, ICAR-DRMR, Bharatpur
	Rapporteurs	Dr. H.K.Sharma, Sr. Scientist, ICAR-DRMR, Bharatpur Dr. Prashant Yadav, Scientist, ICAR-DRMR, Bharatpur

XXIX Annual Group Meeting of AICRP Rapeseed-Mustard
August 1-3, 2022 at RARI, Durgapura, Jaipur

Session I : Innagural

Chief Guest	**:**Prof. J.S. Sandhu, Vice-Chancellor, SKNAU, Jobner
Chairman	**:**Dr. Sanjeev Gupta, Assistant Director General (O&P), ICAR, New Delhi
Co-Chairman	**:**Dr. P.K. Rai, Director, ICAR-DRMR, Bharatpur
Guest of Honour	**:** Dr. K.K. Singh, Vice-Chancellor, Dr. RPCAU, Pusa Bihar
	: Dr. Sanjay Kumar, Director, IISS, MAU
Rapporteurs	**:** Dr. H.K. Sharma, Senior Scientist, ICAR-DRMR, Bharatpur
	: Dr. Prashant Yadav, Scientist, ICAR-DRMR, Bharatpur

The session started with welcome address by Dr. M.L. Jakhar, Director Research, SKNAU Jobner. He welcomed Prof. J.S. Sandhu, Vice-Chancellor, SKNAU, Jobner; Dr. Sanjeev Gupta, Assistant Director General (Oilseed &Pulses), ICAR, New Delhi; Dr. P.K. Rai, Director, ICAR-DRMR, Bharatpur; Dr. K.K. Singh, Vice-Chancellor, Dr. RPCAU, Pusa, Bihar; Dr. Sanjay Kumar, Director, IISS, Mau; Esteemed subject experts Prof. S.S. Banga, Dr. H.C. Sharma, Prof. G.S. Saharan, Progressive farmers and delegates from different AICRP-RM centres. Dr. Jhakhar briefed about the work of AICRP-RM centre, Jobner. He proposed to developJobneras Centre of Excellance for Orobanche. He requested for a new AICRP-RM centre at RARI, Durgapura, Jaipur.

Dr. P.K. Rai, Director, ICAR-DRMR, Bharatpur; presented the research highlights and action taken report of 28thAGM of AICRP-RM programme along with national and international scenario of rapeseed-mustard production. He threw light on the ongoing programmes and appraisedsummary of trials of different disciplines conducted under AICRP-RM across different centers. He was concerned about rejection of some of the AICRP-RM trials. Dr. Sanjay Kumar, Director; ICAR-IISS, Mau praised the increase in production of rapeseed-mustard during last decade. He showed his concern over low VRR of newly released varieties of mustard. He further opined to collaborate for development of standards for pest and diseasesof seed of mustard crop. Dr. K.K. Singh, Director; Vice-Chancellor, Dr. RPCAU, Pusa, Bihar, suggested to achieve self-sufficiency in edible oil production for meeting the demand of ever increasing population. Prof. J.S. Sandhu, Vice-Chancellor, SKNAU, Jobner briefed about the agriculture scenario and agro-ecological conditions of Jobner and Rajasthan. Keeping in view of climate change, he suggested to develop heat, frost, drought, salinity, aphid and Orobanche tolerant varieties of rapeseed-mustard for increasing production and reducing edible oil import. He suggested to work in mission mode for achieving self-sufficiency in oilseed production.

Dr. Sanjeev Gupta, Chief Guest of the session, told that extreme temperature of Jobner is unique for research work in mustard. He assured to increase more AICRP-RM centres in Rajasthan. Further, he told that self-sufficiency in oilseed is necessary to be achieved in next 5-7 years. He informed that Govt. of India has started Mustard Mission and Special programme on soybean to reduce edible oil import and increasing oilseed production. Dr. Gupta, told that rapeseed-mustard has scope for horizontal and vertical expansion. Furthermore, there is a need to increase the VRR for new rapeseed-mustard varieties. As area in Gujarat and Bihar is declining and increasing in West Bengal, Jharkhand, Assam, hence niche specific new varieties of rapeseed-mustard are required for such states. Yellow sarson and toria varieties with early maturity (<90 days) need to be developed. He emphasized that development of varieties with resistant to important diseases (WR, SR) is necessary. He cautioned that, new emerging threats like Orobanche needs to be addressed with greater efforts. He assured to develop Centre of Excellance for Orobanche at Jobercentre and suggested to submit proposal in consultation with ICAR-Directorate of Weed Research, Jabalpur. He advised that, QRT recommendations should be followed by all AICRP-RM centres. Further, he urged to import the diverse germplasm of rapeseed-mustard from International organisations across the world to further increase the genetic base of the crop. New Biochnological approaches like GWAS, Genomic selection and Genome editing techniques should be used to address the different issues of the crop. There is a need to increase the level of heterosis in Indian mustard for increasing production. He told that, for quality improvement in Indian mustard it is necessary to develop referral laboratories

atleast at two centres. Further he suggested to set up oilseed promotion fund for promotion and dissemination of mustard crop. Crop diversification in mustard based cropping system is required. He further told that, there is a greater scope for rapeseed-mustard cultivation in potato and sugarcane cropping system in Uttar Pradesh. He also suggested to set agenda/theme for promotion of mustard crop under AzadiKaAmritMahotsav campaign. The session ended with vote of thanks by Dr. Manohar Ram, Scientist, SKNAU, Jobner.

XXIX Annual Group Meeting of AICRP Rapeseed-Mustard
August 1-3, 2022 at RARI, Durgapura, Jaipur

Session I: Planning and Technical Programme Formulation: Genetics & Plant Breeding

Chairman	**:** Dr. Sanjeev Gupta, ADG (O&P), ICAR, New Delhi
Co-Chairman	**:** Dr. Sanjay Kumar, Director, ICAR-IISR, Mau
Subject Expert	**:** Dr. S.S. Banga, Ramanna Fellow PAU, Ludhiana
	: Dr. S. R. Bhat, Ex-Principal Scientist, NRCPB, New Delhi
Rapporteurs	**:** Dr. V.V. Singh, Principal Scientist, ICAR-DRMR, Bharatpur
	: Prof. Kartikeya Srivastava, I. A. Sc., BHU, Varanasi

Session started with the opening remarks of Dr Sanjeev Gupta, ADG (O&P), Chairman of the session. Dr K.H. Singh, PI (Plant Breeding) made a presentation on crop improvement programme. He informed the house that a total of 6966 accessions were maintained under AICRP-RM. 67 strains of toria were tested at Kanpur, Chattha-Jammu and Pantnagar for evaluation of advanced breeding lines. The yield superiority in Toria station trial was up to 24.3% over the check (PT-303) at Pantnagar. In yellow sarson, 67 strains were tested at Kanpur and Pantnagar. The yield superiority in station trial upto 25.8% over the check Pitambari was recorded at Pantnagar. In Indian mustard, 263 strains were evaluated at 09 centres; Chattha, Imphal, Hisar, Kanpur, Ludhiana, Pantanagar, Dholi, SK Nagar and Varanasi in 37 trials. Seed yield superiority upto 27.2% over the check NRCHB 101 was recorded at Pantnagar. Ten strains at Hisar, 177 strains at Ludhiana and 09 strains at Chattha of gobhi sarson were evaluated for seed yield and its component characters.

Performance of 178 strains including 02 of yellow sarson, 166 of Indian mustard and 10 of gobhi sarson was tested in nineteen performance evaluation trials consisting of yellow sarson (1), gobhi /sarson (1) and Indian mustard (17) at 46 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 42 strains including gobhi sarson (01) and Indian mustard (41) were promoted for advanced stage evaluation.

He raised certain issues for discussion in the house such as benchmark for early mustard trial, promotion criteria of quality mustard trial, use of check for comparison in combined trials at IVT, wide range of seed yield within the same zone, very high yield of the location of developing centres and wide range of seed yield of an entry within a zone. He also showed concerned on rejection of trials and reporting of data timely and properly. After presentation Chairman called upon the participants to give their suggestions on the various issues.

1. The early mustard trial should be discontinued till 100 – 105 days maturity material is developed at various centres.
2. It was decided that promotions of quality entries should be made at par in seed/oil yield with the best check.
3. House agreed that there shall be no separate trial on white rust resistance.
4. It was decided that seed yield data of developing centres will be discarded if found two times higher than any entry of particular trial.
5. AVT-1 and AVT-II trial in salinity shall be conducted separately and IVT trail shall be common with timely shown irrigated trial.
6. Each centre shall conduct a common station trialfor contribution of entries in IVT.
7. Rejection of trials shall be reported/ presented in the performa given below:

Name of the trial	Alloted	Reported	Accepted	Rejected	Remarks/ Reasons for rejection

8. Dr Rajendra Prasad, Director, IASRI, New Delhi shall be invited to suggest statistical analysis for minimizing variation in different trials.

9. Due to less number of entries, Taramira trial shall not be conducted this year.
10. A proposal of promising hybrids from IHT over varietal check shall be prepared alongwith test weight of each hybrid
11. Name of the centre whose performance is not satisfactory should be reflected in annual report/ presentation.

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

1. IVT Toria

SN	Entry	Pedigree	Method of breeding	Centre
1.	TKM 21-1	T-9 X PT- 507	Mass Selection	CSAUA&T, Kanpur
2.	TKM 21-2	ORT-11 X Anuradha	Mass Selection	CSAUA&T, Kanpur
3.	PT-2016-9	Composite Population	Composite breeding	GBPUAT, Pantnagar
4.	PT-2019-4	Re-current selection of PTC-2014-8	Recurrent Selection	GBPUAT, Pantnagar
5.	JT-14-9	Composite population	Toria Composite Population	SKUAST, Chatha, Jammu
6.	BAUT-08-09	BAUST-12 x TRCT-1-1-5-1	Pedigree method	BAU, Ranchi
7.	Zonal Check			
8.	PT-303 (NC)			
9.	LR			

Zonal check: Zone III - Bhawani Zone V - Bhawani

Latest Release: Zone III –Azad Chetna Zone V – TS 38

Locations:
Zone III: Kanpur, Pantnagar, Morena, Dholi
Zone V (RF): Kanke, Bhubaneswar, Shillongani, Jagdalpur, Imphal, Kalyani

2. IVT Yellow Sarson

SN	Entry	Pedigree	Method of breeding	Centre
1	YSKM 21-1	YSK-42 X YSK-2	Pedigree	CSAUA&T, Kanpur
2	YSKM 21-2	YSK-28 X YSK-42	Pedigree	CSAUA&T, Kanpur
3	DRMRYS 205	YSH 401 X *B. nigra*-2	Inter-specific Hybridization	DRMR, Bharatpur
4	DRMRYS 204	Ragini X *B. nigra*-2	Inter-specific Hybridization	DRMR, Bharatpur
5	DRMRYS-18-15	IC520765	Pureline Selection from Giridih, Jharkhand	DRMR, Bharatpur
6	PYS-2018-1	PYSC-21-6 X PYS-841	Pedigree	GBPUAT, Pantnagar
7	PYS-2018-4	PYSC-79-1 X PYSC-59-7	Pedigree	GBPUAT, Pantnagar
8	AAUJYS 14-2	(YSH 401 X B9) X B9	Pedigree	AAU, Jorhat
9	AAUJYS 15-2	YSH 401 X B9	Pedigree	AAU, Jorhat
10	RMYS 5	GP 77 X GP 48	Pedigree	ARS, Mandor
11	RMYS 4	GP 29 X GP 66	Pedigree	ARS, Mandor
12	YSH-0401 (NC)			
13	Zonal Check			
14	Pitambari (LR)			

Zonal check: Zone III - NRCYS-05-02 (Check) Zone V - Benoy

Locations

Zone-III: Kanpur, Pantnagar, Morena, Dholi
Zone-V: Shillongani, Imphal, Kanke, Kalyani, Bhubaneswar

3. Mustard

3.1. IVT Early Mustard

SN	Entry	Pedigree	Method of breeding	Centre
1	KMR(E) 22-1	Rohini X Mathura Rai	Pedigree	CSAUA&T, Kanpur
2	KMR(E) 22-2	Seeta X SEJ 2	Pedigree	CSAUA&T, Kanpur
3	DRMRCI- 156	DRMR 81 X DRMR 541-44	Pedigree	DRMR, Bharatpur
4	DRMRSJ 272	Jhumka x *B. nigra*	Inter-specific hybridization	DRMR, Bharatpur
5	DRMRIJ 20-117	DRMRIJ 31 X EC597313	Pedigree selection	DRMR, Bharatpur
6	DRMRHT-1712	BPR-549-9 X JBT-41/15	Pedigree selection	DRMR, Bharatpur
7	RH 1999-37	NPJ 227 X T 6342	Pedigree	CCS HAU, Hisar
8	RH 2199-11	RH 1370 X RH 1402A	Pedigree	CCS HAU, Hisar
9	PRE-2018-1	PRHC-13-1-2 X PR-19	Bulk	GBPUA&T, Pantnagar
10	PRE-2020-14	PRE-2008-5 X PRE-2007-6	Bulk	GBPUA&T, Pantnagar
11	NPJ 257	NRCHB- 101 X NPJ 173	Pedigree selection	IARI, New Delhi
12	NPJ 258	PM 25 X NPJ 176	Pedigree selection	IARI, New Delhi
13	Pusa MH 126 (Hybrid)	PUSA MH 2-3A X RP-8-1-2-1-2	Hybrid Breeding	IARI, New Delhi
14	ANDM 14-09	Pusa Jaikisan X GM 3	Pedigree	AAU, Anand
15	SVJH-72 (Hybrid)	SVJA-03 X SVJR-11	Heterosis Breeding	Shaktivardhak Hybrid Seeds, Pvt. Ltd.
16	TM 314-1	Rajendra suflam X TJD- 1	Pedigree	BARC, Mumbai
17	HUJMI 21-1	Ashirwad X Pusa Bold	Pedigree	BHU, Varanasi
18	ACN 247	ACN-9 X TM 101	Pedigree	CoA, Nagpur
19	SHIVANI PLUS	Mutant of Shivani	Mutation	Mali Agri Tech Pvt Ltd, Nadia
20	Q80623	6422 A/RF4493	Heterosis Breeding	Advanta Seeds Pvt Ltd
21	BAUM-2022-1	Mutant of Pusa Bold with 900Gy (PB1-14-7)	Mutation Breeding	BAU, Ranchi
22	Pusa Mustard 25 (NC)			
23	JD 6 (ZC)			
24	LR			
25	Pro 5111 (hybrid check)			

Zonal check/Latest Release: Zone IV : GDM 4 Zone V: NRCHB 101 Zone VI: NRCHB 101

Locations:

Zone IV : S. K. Nagar, Nagpur, Mandore, Junagarh
Zone V : Kanke, Shillongani, Bhubaneshwar, Jagdalpur, Imphal, Kalyani
Zone VI : Dharwad, Hyderabad (DOR), Raichur, Jagtial

3.2 AVT I Early Indian mustard

Zone II

Entries: DRMRHT 13-13-5-4, DRMRHT 13-13-5-5, KMR(E) 21-1, ORM 2019-25, PRE 2018-10#, RH 1999-42##, PM 25 (NC), PM 28 (LR), JD 6 (ZC), Filler

Locations: Chatha, Hisar, Ludhiana, New Delhi, Abohar

Repeat entry; ## second time repeat entry

3.3. 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	DRMRCI- 154	RH 819 X DRMRIJ 31	Pedigree	ICAR-DRMR, Bharatpur
2	DRMR 2020-8	DRMRIJ- 31 X NPJ 112	Pedigree	ICAR-DRMR, Bharatpur
3	DRMRIJ 21-37	DU38 X HB202	Pedigree selection	ICAR-DRMR, Bharatpur
4	SKM 1924	SKM 815 X RSK 29	Pedigree	SDAU, SK Nagar
5	SKM 2012	SKM 904 X RW 1-02	Pedigree	SDAU, SK Nagar
6	RH 2187	RH 1143 X DOMO-4	Pedigree	CCS HAU, Hisar
7	RH 2199	RH 1252 X RH 7846	Pedigree	CCS HAU, Hisar

8	KMR 22-3	Maya X RC-781	Pedigree	CSAUA&T, Kanpur
9	KMR 22-4	Varuna X KR 5610	Pedigree	CSAUA&T, Kanpur
10	NPJ 261	NPJ 102/ Laxmi//Pusa Jagannath	Pedigree selection	IARI, New Delhi
11	NPJ 262	Kranti//JM 2/BIOYSR///RH 749	Pedigree selection	IARI, New Delhi
12	PR-2019-1	Krishna X NRCHB-101	Bulk	GBPUA&T, Pantnagar
13	PR-2020-14	PR-2013-19 X Maya	Bulk	GBPUA&T, Pantnagar
14	HUJM-21-4	NDRE 4 X Pusa Bold	Pedigree	BHU, Varanasi
15	RMM-19-12	EJ-17 X Pusa Bold	Back Cross	ZARS,Morena
16	ACNMM-3	Mutant of BIO- 902	Mutation breeding	COA, Nagpur
17	TM316	TM 102 X RB9901	Pedigree	BARC, Mumbai
18	RB-110	RB-24 X RH-207	Pedigree	RRS, Bawal
19	DM 2020-3	DSC 48X DSC 24	Pedigree selection	Dayal Seeds (P) Ltd.
20	DRMRHT 18-141	MRNJ-05-2001 X BT-15	Pedigree	ICAR-DRMR, Bharatpur
21	RGN 528	RH 673 x RGN 48	Pedigree	SKRAU, Sriganganagar
22	PBR-813-2		Pedigree	PAU, Ludhiana
23	DTM- 341	DTM 134 X NRCDR 101	Pedigree	PAU Ludhiana
24	RAURD 18-1	Gamma ray mutant of Rajendra suflam	Mutation breeding	RAU, Dholi
25	Kranti (NC)			
26	Zonal Check			
27	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 – Giriraj; Zone- III: RGN 73; Zone- IV-GDM-4

Locations :

Zone I : Kangara, Dhaulakua, Bazaura, Una

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

Zone III : Kanpur, Pantnagar, Kota, Varanasi, Dholi, Jhansi, Tikamgarh, Banda, Bharatpur

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

3.4. AVT-I (Timely Sown, Irrigated/Quality/WRR)

Zone II

Entries: RH 1934*,SKM-1801*, NPJ 253*, DRMR 2018-25*** (WRR), DRMRCI(Q) 47**, IJ19R5004**, RH 1975#, RH 1974#, Giriraj (LR), RH 749(ZC), Kranti (NC), PM 32 (Quality LR),PM 30 (NC), PDZ 1(QC), Basanti (WRR C)

Locations : Abohar, Bawal, Chatha, Hisar, Ludhiana, Modipuram, New Delhi, Sriganganagar

*Timely sown irrigated, **quality strain, *** White Rust Resistant Strain, # AVT II strain

3.5. AVT-I+II (Timely Sown, Irrigated/Quality/WRR)

Zone III

Entries: NPJ 253*, PDZ 16**@, PDZ- 14**#@, PDZ 15**#@, IJ19R5004**, DRMR 2018-25***, DRMRIJ 20-157***, DRMR 2018-37***, RGN 73 (LR), Maya (ZC), Pusa Mustard 30 (quality LR), PDZ 1 (double low check), Kranti (NC), Basanti (WRR C)

Locations : Pantnagar, Kanpur, Morena, Bharatpur**,** Varanasi, Dholi, Jhansi

#AVT II strain, *timely sown strain, **quality strain, @double low strain, *** White Rust Resistant Strain,

3.6 AVT I (Timely sown irrigated)

Zone IV

Entries: PBR 939, NPJ 252, ACN 237, KMR 21-3, RGN 524, SKM 1801, NPJ 253, Kranti, BIO 902, GDM 4

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

3.7. IVT Mustard, Timely sown (Rainfed)

SN	Entry	Pedigree	Method of breeding	Centre
1	DRMRCI- 155	RH 819 X DRMRIJ 31	Pedigree	ICAR-DRMR, Bharatpur
2	DRMRRIL 21-1	Giriraj X Heera	SSD	ICAR-DRMR, Bharatpur
3	DRMR 2020-3	NRCHB 101 X NPJ 112	Pedigree	ICAR-DRMR, Bharatpur
4	DRMRHT-17-2	Urvashi X SEJ 2	Pedigree	ICAR-DRMR, Bharatpur
5	NPJ 263	Pusa Agrani X BCI 5	Pedigree	IARI, New Delhi
6	NPJ 264	DRMRIJ- 31 X BCI 4	Pedigree	IARI, New Delhi
7	RH 2148	RH 1402A X RH 0555	Pedigree	CCS HAU, Hisar
8	RH 2199-6	RH 8812 X JMMWR 9348	Pedigree	CCS HAU, Hisar

9	DTM- 341	DTM 134 X NRCDR 101	CMS based hybrid	PAU, Ludhiana
10	TM260	IC355399 X RB9901	Pedigree	BARC, Mumbai
11	JM-15-8	RSPR-69 X RB-50	Intraspecific hybridization	SKUAST, Chatha, Jammu
12	JKJH12	15A05 X RD07	Pedigree	J.K. Agri Gen. Ltd. Hyderabad
13	RB-113	RH-0749 X RH-0345	Pedigree	RRS, Bawal
14	RGN 526	RH 673 x RGN 48	Pedigree	SKRAU, Sriganganagar
15	BAUM-17	Shivani Mutant 900Gy+0.3% EMS	Mutation Breeding	BAU, Ranchi
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 : Sriganganagar, Hisar, Bawal, Ludhiana, Abohar
Zone V : Kanke, Jagdalpur, Shillongini, Bhubaneshwar, Imphal

3.8. AVT I Mustard, Timely sown (Rainfed)
Zone II
Entries: DRMRHJ 1117, RH 725 (ZC), RH 761 (LR), Kranti (NC), Filler
Locations: Abohar, Bawal, Hisar, Ludhiana, Sriganganagar

3.9. IVT- Mustard Late sown

SN	Entry	Pedigree	Method of breeding	Centre
1	DRMRCI- 160	DRMR 150-35 X BEC 144	MABB	ICAR-DRMR, Bharatpur
2	DRMRIJ 21-51	MJR 3 X Pusa Swarnim	Interspecific hybridization	DRMR, Bharatpur
3	DRMRSJ 294	Ragini X B. Nigra	Inter-specific hybridization	DRMR, Bharatpur
4	DRMRHT-13-28-13	BPR-543-2 X BPR-549-9	Pedigree	DRMR, Bharatpur
5	RH 1999-22	RH 1599-41 X RH 1402	Pedigree	CCS HAU, Hisar
6	RH 2199-11	RH 1370 X RH 1402A	Pedigree	CCS HAU, Hisar
7	KMR(L) 22-5	Ashirwad X Kanti	Pedigree	CSAUA&T, Kanpur
8	KMR(L) 22-6	Rohini X Vardan	Pedigree	CSAUA&T, Kanpur
9	NPJ 259	NPJ 138 X NPJ 116	Pedigree	IARI, New Delhi
10	NPJ 260	NRCH 101 X NPJ 173	Pedigree	IARI, New Delhi
11	NPJ 265	Pusa Mustard 25//DRMRIJ 31/BCI-4	Pedigree	IARI, New Delhi
12	TM258	IC355399 X RB9901	Pedigree	BARC, Mumbai
13	PRL-2020-5	NPJ-170 X RGN 73	Bulk	GBPUA&T, Pantnagar
14	PRL-2020-8	KMRL-12-1 X Ashirwad	Bulk	GBPUA&T, Pantnagar
15	HUJM-21-1	Oriental Rai X HUJM-9964	Pedigree	BHU, Varanasi
16	RGN 534	NPJ 190 x RGN 48	Pedigree	SKRAU, Sriganganagar
17	BAUM-2022-2	PB1-14-8(Mutant of Pusa Bold)	Mutation Breeding	BAU, Ranchi
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 : Sriganganagar, Hisar, New Delhi, Ludhiana, Abohar
Zone III: Kanpur, Pantnagar, Varanasi, Morena, Dholi, Sabour, Bharatpur, Banda

3.10. AVT-I Mustard, Late Sown (Irrigated)
Zone – II
Entries: NPJ 250**,** Kranti (NC), Radhika (LR), PM 26 (ZC), Filler

Locations: Sriganganagar, Hisar, New Delhi, Ludhiana, Abohar

3.11. AVT-I+IIMustard,Late Sown (Irrigated)
Zone – III
Entries: NPJ 251**,**DRMRHJ 430, DRMR 2018-19$,Kranti (NC), CS 56 (LR), NRCHB 101(ZC), Filler
Locations: Kanpur, Pantnagar, Varanasi, Morena, Dholi, Sabour, Bharatpur
$ AVT II strain

3.12. IHT,Hybrid Mustard (To be conducted in Lattice Design, layout is given in last section of plant breeding technical programme)

SN	Entry	Pedigree	CMS system used	Centre
1.	RHH 2201	Ogura based	F1 Hybrid breeding	CCS HAU, Hisar
2.	RHH 2202	Ogura based	F1 Hybrid breeding	CCS HAU, Hisar
3	RHH 2203	Ogura based	F1 Hybrid breeding	CCS HAU, Hisar
4	PHR 33281	IM64NA X MH	CMS based hybrid	PAU Ludhiana
5	PHR 4284	DJ116 X AJR 102B	CMS based hybrid	PAU Ludhiana
6	4205A252-01	4PDBN18A X 4PGQL32R	Ogura CMS based hybrid	Corteva Agriscience
7	DRMRHJ 310	OJA 3 X OJR 10	Ogura CMS	ICAR-DRMR, Bharatpur
8	DRMRHJ 223	OJA 2 X OJR23	Ogura CMS	ICAR-DRMR, Bharatpur
9	DRMRHJ 1419	MJA 14 X MJR 19	Moricandia CMS	ICAR-DRMR, Bharatpur
10	Pusa MH 103	NRCDR 02(mori) X RP 9-2-2-3	Hybrid Breeding	IARI, New Delhi
11	Pusa MH 111	RGN 48(mori) X RP 9-2-2-3	Hybrid Breeding	IARI, New Delhi
12	SKMH 1901	GMMo 2116A X GMMo 2105R	Heterosis Breeding	SKAU, S.K. Nagar
13	SVJH-73	SVJA-06 X SVJR-12	Heterosis Breeding	Shakti Vardhak Hybrid Seeds Pvt. Ltd.
14	JKJH11	15A01 X RD01	Heterosis Breeding	J.K. Agri Genetics Ltd. Hyderabad
15	NMH90M01	A line- (GRU283A/ GRU284B) BC1-BC2-BC3-BC4-BC5-BC-6-BC7-BC8 R line- (GRU509/ GRU476)- (X)-14-3-1-1-1-1-1	Heterosis Breeding	Nuziveedu Seeds Ltd.
16	KGMH-9783	KA- 108 X KR-76	Heterosis Breeding	Kamadgiri Crop Science Pvt. Ltd.
17	NAMJH21-04	NAMJA-2 X NAMJR-5	Heterosis Breeding	Namdhari Seeds Pvt. Ltd.
18	PMH90V02	A line- (GRU1269A/ GRU270B) BC1-BC2-BC3-BC4-BC5-BC-6-BC7-BC8 R line- (GRU509/ GRU483)- (X)-28-2-2-1-1-1-1	Heterosis Breeding	Prabhat Agri Biotech Ltd.
19	JH21002	SWJ01 X SWJ03R	Heterosis Breeding	SeedWorks International Pvt. Ltd. MRC, Jaipur
20	Q90007	G0023/ RFN9001	Heterosis Breeding	Advanta Seeds Pvt. Ltd.
21	KBH5207	KB20SA003 X KB20SR009	Ogura CMS Heterosis Breeding	Kaveri Seed Company Limited
22	BMH19011	PARENT 1 (BM0178M) PARENT 2 (BM704O)	Heterosis Breeding	Bioseed Research India (group DCMShriram Ltd.)
23	DRMRHJ-319	MJA 3X MJR 19	*Mori CMS*	ICAR-DRMR, Bharatpur
24	Kranti (NC)			
25	Zonal Check			
26	DMH-1 (Check)			
27	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(Advanta), Mahendragarh (Shaktivardhak)
Zone III : Kanpur, Morena, Kota, Bharatpur, Varanasi, Jhansi, Faizabad (Namdhari Seeds), Jaipur (Crystal)

Zone IV: SK Nagar, Mandore, Pali (CAZRI), Jalgaon, Nagpur

3.13. AHT-I Mustard
Zone – II
Entries: SVJH- 70, SVJH 71, 18J408C, NAMJH 21-01, RHH 2101, KGMH 9198, DRMRHJ 2518, IJ 16R1168, RMX 9922, Kranti (NC), DMH- 1 (Hybrid Check), RH 0749 (ZC), 45S46 (Hybrid Check)
Locations: Ludhiana, Hisar, New Delhi, Sriganganagar, Mahendragarh (Shaktivardhak), Alwar (Corteva),

3.14. AHT-I Mustard
Zone – IV
Entries: KGMH 9198, DRMRHJ 2518**,** IJ16R1168, NAMJH 21-01, 18 J408C, SVJH 71, Kranti (NC), DMH- 1 (Hybrid Check), GDM 4 (ZC), 45S46 (Hybrid Check)
Locations: SK Nagar, Mandore, Pali (CAZRI), Jalgaon, Nagpur

3.16. IVT, Quality Mustard

SN	Entry	Pedigree	Method of breeding	Centre
1.	Pusa QMH 1	PM 30(eru) X LES 1-27R	Hybrid Breeding	IARI, New Delhi
2.	LES 66	LES 1-27 X PDZ-3	Pedigree selection	IARI, New Delhi
3.	LES 67	LES 1-27 X PDZ-2	Pedigree selection	IARI, New Delhi
4.	PDZ 18	Agrani X Heera	Pedigree selection	IARI, New Delhi
5.	PDZ 19	PDZ-3 X RLC-3	Pedigree selection	IARI, New Delhi
6.	PMAS 7	Derived through MABC PBR 357/ RLC 3// PBR 357	Marker assisted back cross breeding	PAU Ludhiana
7.	PMAS 11	Derived through MABC PBR 357/ RLC 3// PBR 357	Marker assisted back cross breeding	PAU Ludhiana
8.	RH(OE) 1708	NOID X EC 597324	Pedigree (Zero Erucic Acid)	CCS, HAU, Hisar
9.	RH(OE) 1806	EC 597328 X RH(OE) 0502	Pedigree (Zero Erucic Acid)	CCS, HAU, Hisar
10.	DRMRCI(Q) 158	NRCHB- 101 X Heera	Pedigree	ICAR- DRMR, Bharatpur
11.	DRMRCI(Q) 172	NRCDR- 2 X RLC- 3	Pedigree	ICAR- DRMR, Bharatpur
12.	DRMRQ 29-20	EC5973 X PM 24	Pedigree method of breeding	ICAR- DRMR, Bharatpur
13	LR			
14.	Zonal Check			
15.	PM 30 (NC quality)			
16.	PDZ11 (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
Locations:
Zone II: Bawal, New Delhi, Hisar, Ludhiana, Sriganganagar,
Zone III: Pantnagar, Kanpur, Morena, Bharatpur, Dholi, Jhansi, Varanasi

3.17. AVT I Mustard Salinity
CS2020-10, CS 54 (Salinity check), CS 60 (LR), Kranti (NC)
Locations: Karnal, Lucknow, Agra, Hisar, Fatehpur, Bikaner

4. AVT-I Gobhi Sarson
Entries: GSH-2155, GSL-1 (NC), Kranti (NC), GSC 6 (QC), AKMS 8141 (LR), Filler
Locations : Kangra, Dhaulakuan, Bajaura, Chatha, Ludhiana, Abohar

LAYOUT OF EXPERIMENTS

Trials	IVT	AVT
Design	RBD/Alpha Lattice	RBD
Replication	Three (two blocks in each replication)	Four
Plot size Varieties- Zone II	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
Plot size Varieties-Zone I, III, IV & V	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
Plot size Hybrids	GrossAll Zones:2.7 X 5 m Net All Zones : 1.80 X 4.5 m	Gross All Zones:4.5 X 5 m Net All Zones : 3.6 X 4.5 m
No. of Rows Zone I, II, III, IV& V	Six, Data to be recorded from four rows	Ten, Data to be recorded from eight rows
No. of Rows NEH region	Seven of 4 m length	Twelve of 4 m length
Spacing varietal trials	45 X15 cm Zone II 30 X 10 cm Zone I, III, IV and V	45 X15 cm Zone II 30 X 10 cm Zone I, III, IV and V
Spacing hybrid trials	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_2O_5 : K_2O kg/ha
Yellow sarson	:	50 : 30: 30, N : P_2O_5 : K_2O g/ha
Mustard, Karan	:	Irrigated-80 : 40 : 40, N : P_2O_5 :K_2O kg/ha
Rai,Gobhi Sarson		Rainfed- 40 : 20 : 20, N : P_2O_5 :K_2O 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 20th August
- Seed material of rest of the trials should be sent latest by 30th 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 of IVT, AVT 1 and AVT 2 entries should be added for Entomological and Pathological experiments.
- 250 g seed / location of AVT-2 entries should be added for Agronomical experiments**.**
- 300 g seed of each quality strain should be added for biochemical analysis
- **Entire quantity of seed of each entry is to be sent in one lot in proper packing to avoid mixing of seed with other entry seed. Do not make separate packets and seed should be without any treatment or any other identification mark.**

Data reporting:-

- Data should be sent to Director, DRMR (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 10th July for inclusion in concerned IVT trial. In case of hybrid entry, mention the name of CMS system used for hybrid development.

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	30th September	10th October	10th October	31st October	15th November
2	Yellow sarson	31st October	31st October		31st October	15th November
3	Early mustard	30th September	10th October	10th October	15th November	30th November
4	Indian mustard, TS Irrigated/ Rainfed, (Hybrid, Quality, Salinity)	31st October	31st October	31st October	30th November	30th 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 averageyield 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.
- In toria/early mustard trial, promotion shall be based upon superiority over the earliest maturing check. A margin of 5 days over the best check's maturity duration shall be given in early maturity toria/mustard trial.
- 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.

Criteria for Promotion of Indian Mustard hybrids to higher order of testing and identification

- 10% higher seed yield over the best performing check variety / hybrid and numerically at par oil yield or 10% higher oil yield over the best performing check variety / hybrid and numerically at par seed yield.
- Numerically at par with best performing check variety/ hybrid for seed or oil yield for specialty types like low erucic acid (< 2%); glucosinolates (< 30 umole/g defatted seed meal) or any other character of Zonal/national importance.
- Moderately resistant or resistant reaction to major key diseases/ pest of the crop at several locations while comparing with check variety/ hybrid
- Stable performance in terms of consistency in yield and oil content across locations within a zone.
- Thermostability if indicated in physiological trials

Criteria for Promotion of Near Isogenic Lines (NILs) in AICRP- Rapeseed & Mustard

- Promotion of NILs shall be based on the consistency in the performance of target trait in the target environment and yield equivalence with recurrent parent.

Randomized Layout

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

v = 27, b = 9, r = 3, k = 9, AE = 0.9626, DE = 0.9832 α (0, 1, 2, 3)

Randomized Layout

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

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

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

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	

XXIX Annual Group Meeting of AICRP Rapeseed-Mustard
August 1-3, 2022 at RARI, Durgapura, Jaipur

Session II : Planning and Technical Programme Formulation: Plant Pathology and Entomology

Chairman : Dr. Sanjeev Gupta, Assistant Director General (O&P), ICAR, New Delhi
Co-Chairman : Dr. P. K. Rai, Director, ICAR-DRMR, Bharatpur
Subject Expert : Dr. H. C. Sharma, Former VC, UHF, Solan (HP)
Dr. G. S. Saharan,Ex-Prof. & Head, Dept. of Pl.Pathology, CCSHAU, Hisar
Rapporteurs : Dr. Pankaj Sharma, Principal Scientist, ICAR-DRMR, Bharatpur
: Dr. S. S. Vaish, Professor, I.A. Sc., BHU, Varanasi
: Prof. M. S. Khan, Dept. of Entomology, GBPUA&T, Pantnagar
: Dr. Sarwan Kumar, Sr. Entomologist, PAU, Ludhiana

The presentation of results, planning and technical programme formulation session of Plant Pathology started with introductory remark by the Chairman, Dr. Sanjeev Gupta, Assistant Director General (O&P), ICAR, New Delhi, and subject expert Prof. G. S. Saharan, Ex-Professor & Head, Dept. of Plant Pathology, CCSHAU, Hisar. Significant achievements of Plant Pathological trials conducted during the year 2021-22 at different locations presented by Dr. P.D. Meena, PI, Plant Pathology. The results of different trials conducted during 2021-22 were reviewed critically and the technical programme for the year 2022-23 was finalized after through discussion. He urged the entries will be included initially under UDN for screening against any disease under natural conditions followed by promotion in specific NDN. There is a requirement that the Director, ICAR-DRMR be consulted before publishing any experimental data, especially fungicide testing. Dr. Saharan appreciated the efforts made on preparation of the distribution map of different disease in India. Subject Expert Dr. G.S. Saharan, suggested that all coordinated centres should analyse the previeios years disease data and prepare distribution map of diseases for their states/agro-climatic regions. He also suggested that partially damage by insects in Brassica should be observed for induced resistance against diseases. Dr. Dhiraj Singh, Ex-Director ICAR-DRMR advised to exclude CV from data analysis for plant pathology trials and also take large sample size for WR observation. Dr. H.C. Sharma, Subject Expert, suggested that entries without WR resistance should not be included in different breeding trials.

Chairman, Dr. Sanjeev Gupta, focused to start breeding for disease resistance on WR and SR. He advised for conversion of already released high yielding 17 *Brassica juncea* varieties in seed chain with Marker Assisted Breeding. The centres for the programme were identified as BPR, HSR, IARI, BHU, PAU and NIPB. For SR crossing programme should be initiated with highly tolerant germplasm RH 1222-28 and *Brassica juncea* varieties namely, RH 749, RH 725, DRMR IJ-31, DRMR 150-35 and PM 28 at BPR, HSR, IARI and PAU.

- After regular testing for continuous three years under artificial/ natural conditions at different geographical locations, Indian mustard genotypes DRMR 2018-41, and RH 1400-1 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 **30th 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 2022**. (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 & II strains against major diseases under natural condition

S. No.	AVT-I+II (Entries)	S. No.	AVT-I+II (Entries)
Hybrid *Brassica juncea*		**White rust resistant mustard**	
1.	18J408C	25.	DRMR 2018-25
2.	SVJH- 70	26.	DRMRIJ 20-157
3.	NAMJH 21-01 WRR	27.	DRMR 2018-37
4.	SVJH-71	**LS mustard**	
5.	RHH 21-01	28.	NPJ 250 WRR
6.	KGMH 9198	29.	NPJ 251
7.	DRMRHJ 2518	30.	DRMRHJ 430
8.	IJ16R1168	31.	DRMR 2018-19 WRR
9.	RMX 9922	**TSI mustard Rainfed**	
TSI mustard		32.	DRMRHJ 1117
10.	RH- 1934	**Mustard salinity**	
11.	SKM- 1801	33.	CS 2020-10
12.	NPJ 253	**Early mustard**	
13	NPJ 252	34.	DRMRHT 13-13-5-5
14	PBR 939	35.	DRMRHT 13-13-5-4
15	ACN 237	36.	KMR(E) 21-1
16	KMR 21-3	37.	ORM 2019-25
17	RGN- 524	38.	PRE 2018-10
18	RH 1975	39.	RH 1999-42
19	RH 1974		**Gobhi Sarson**
Quality *Brassica juncea*		40.	GSH- 2155
20	PDZ-14 (Q) WRR		
21	PDZ-15 (Q) WRR		
22	PDZ-16 (Q) WRR		
23	DRMRCI (Q) 47 WRR		
24	IJ19R5004 WRR		
Checks: *B. juncea*: Rohini, NRCHB 101 (SC) & **Local Check**, BIOYSR, DRMRMJA-35 (RC-WR), PHR 2 (TC-AB); *B. napus*: GSL 1; *B. carinata*: DLSC 1, *B. rapa* ssp Yellow Sarson: NRCYS-5-2; *B. rapa* var Toria: PT 303; RTM 314, DMH 1			
Location:	**Dholi, Pantnagar, Hisar, Morena, Ludhiana, S.K. Nagar, Shillongani**		

Layout: i. Single row: two replications of 3 m row length
ii. Susceptible checks will be used after every two test rows

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

Disease	Location
Alternaria blight:	**Dholi, Pantnagar, Ludhiana, Shillongoni, Hisar**
White rust/ DM:	**Pantnagar, Morena, Hisar, Ludhiana, Bharatpur**
Sclerotinia rot:	**Dholi, Ludhiana, Pantnagar, Hisar, Bharatpur**

Methodology:

i. 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.
ii. 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 epiphytotic.

iv. The source of inoculum for creating epiphytotic conditions for PM screening needs to be implemented by collecting infected plant stubbles from previous crop season.

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 I = 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

C **(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

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

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

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

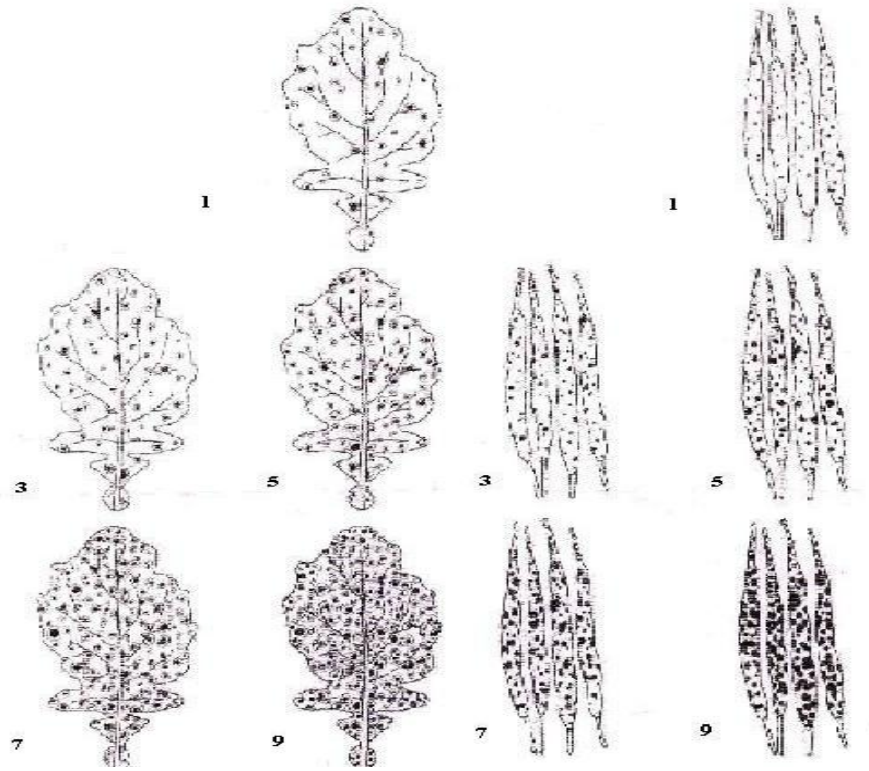
Note:

(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 17th 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 tolerant	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^{o}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/ A. brassicicola* 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 *Sclerotinia sclerotiorum* grown on thick layer of PDA at 20^{o}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

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	B*j*: DRMRDR 2116, DRMRDR 2119, DRMRDR 2133, DRMRDR 2135, DRMRDR 2140, DRMRDR 2141, DRMRDR 2151, DRMRDR 2152, DRMRDR 2155, DRMRDR 2156, DRMRDR 2195, DRMRDR 2196, DRMRDR 2201, DRMRDR 2202, DRMRDR 2203, DRMRDR 2206, DRMRDR 2227, DRMRDR 2235, DRMRDR 2236, DRMRDR 2241, DRMRDR 2242, DRMRDR 2203, DRMRCI 143, DRMRCI (Q) 57, DRMRCI 153, DRMRCI 168, DRMRCI 169, DRMRCI 170, DRMRCI 171, DRMRSJ 9, DRMRSJ 12, DRMRSJ 22, DRMRSJ 14, DRMR 2018-26, DRMR 2019-15, DRMR 2019-20, DRMR 2020-15
Pantnagar	*Bj:* PRD-2014-26, PRD-2014-21, PRD- 2014-7, PAB-2017-22, PAB-2017-25, PAB-2017-4, PAB-2017-1
Hisar	RH-1700-3
Check:	**Checks:** *Brassica juncea*: Rohini, NRCHB 101 (SC) & Local Check, BIOYSR, DRMRMJA 35 (RC-WR), PHR 2 (TC-AB); *B. napus*: GSL 1; *B. carinata*: DLSC 1, *B. rapa* ssp Yellow Sarson: NRCYS-5-2; *B. rapa* var *Toria*: PT 303
Locations:	**Dholi, Pantnagar, Morena, Hisar, S.K. Nagar, Ludhiana, Shillongoni, New Delhi, Varanasi, Jhansi, Jagdalpur, Nagpur, Mandor, Jammu**

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	B*j*: DRMRSJ-349, DRMR 2018-19, DRMR-PMJ-17, DRMRSJ 22, DRMRIJWR 20-11, DRMRIJWR 20-15, DRMRIJWR 20-16, DRMRIJWR 20-19, DRMRHJ 3130,
Pantnagar	*Bj:* PAB-2014-1, PAB-2014-4, PAB- 2014-7, PAB- 2014-8, PAB- 2014-18, PAB-2017-15, PAB-2017-18, PAB-2017-20
Hisar	RH-1700-3
Morena	*Bj*: RMM-10-1-1
Check:	*B. juncea*: Rohini, NRCHB 101 (SC) & Local Check, BIOYSR, DRMRMJA 35 (RC-WR), PHR 2 (TC-AB); *B. napus*: GSL 1; *B. carinata*: DLSC 1; *B. rapa* ssp Yellow *Sarson*: NRCYS-5-2; *B. rapa* var *Toria*: PT 303
Locations:	**Pantnagar, Dholi, Hisar, Ludhiana, Shillongani, Jagdalpur**

Layout: Replications: 02: Each entry should be sown in paired row of 3 m length between susceptible local check with 30 x 10 cm spacing.

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/ A. brassicicola* 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.** 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

Centre	**Entries to be sent**
Bharatpur	*Bj*: DRMRCI-125, DRMRCI-126, DRMRCI-131, DRMRCI-132, DRMRCI-139, DRMRQ 1-22, DRMRQ 202, DRMR 2018-1, DRMRSJ 22, DRMR 2018-25, DRMR 2018-37, DRMR 2018-19, DRMR 2018-41, DRMRIJWR-20-10, DRMRIJWR-20-13, DRMRIJWR-20-14, DRMRIJWR-20-15, DRMRIJWR-20-17, DRMRIJWR-20-19, DRMRIJWR-20-20, DRMRIJWR-20-21, DRMRIJWR-20-23, DRMRIJWR-20-24, DRMRIJWR-20-26, DRMRM 18-35-11, DRMRM 18-36-12, DRMRM 18-37-13, DRMRM-163, DRMRSJ-271, DRMRSJ-206, DRMRSJ-349, DRMRIJ-20-11, DRMRIJ-12-44, DRMRDR 2116, DRMRDR 2135, DRMRDR 2141, DRMRDR 2143, DRMRDR 2151, DRMRDR 2152, DRMRDR 2195, DRMRWR 153, DRMRDR 2155, DRMRDR 2156, DRMRDR 2196, DRMRDR 2227, DRMRDR 2235, DRMRDR 2242
New Delhi	*Bj*: PMW 18, PDZ 16, PDZ 17, NPJ 250
Hisar	*Bj*: RH 1400-1, RH- 1700, RH- 1700-1, RH- 1700-3, RH- 1700-4
Pantnagar	*Bj:* PAB 14-7, PAB 14-8, PAB 14-18
Ludhiana	*Bj:* JC 36, PMAS A 2010, PBR-813-2
Resistant / Susceptible check	*B. juncea*: Rohini, NRCHB 101 (SC) & Local Check, BIOYSR, DRMRMJA 35 (RC-WR), PHR 2 (TC-AB); *B. napus*: GSL 1; *B. carinata*: DLSC 1, *B. rapa* ssp Yellow *Sarson*: NRCYS-5-2; *B. rapa* var *Toria*: PT 303
Locations:	**Pantnagar, Morena, Hisar, Ludhiana, Dholi, 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.

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.

Layout: Replications: 02; each entry should be sown in paired row of 3 m length between susceptible check of *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 of *B. rapa* ssp. Yellow Sarson.

Centre	**Entries to be sent**
Materials:	*Bj:* DRMRSJ-25, DRMRSJ 361, DRMRIS 20-1, DRMRIS 20-4, DRMRIS 20-5, DRMRIS 20-11, DRMRDR 2119, DRMRDR 2156, DRMRDR 2220, DRMRDR 2237, DRMRDR 2238, DRMRDR 2239
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, Jhansi, Varanasi**
Layout:	i. Two rows each of 3 m row length, three replications ii. Susceptible check will be used after four test rows

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.**

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. Monitoring team must visit the trial to observe uniform disease appearance, if it is not so than trial may be rejected on spot to avoid inconsistent data.

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

Objective:	Disease response of accessions promoted to IVT under different geographical conditions in natural conditions
Location:	**Dholi, Pantnagar, Hisar, Ludhiana, SK Nagar, Shillongoni, Kanpur, Nagpur, Mandor**

Layout: i. Single row: two replications of 3 m row length
ii. 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	Organization	S. No.	Entries	Organization
***Brassica juncea* (Early)**			***B. juncea* (Timely sown, irrigated)**		
1.	KMR(E) 22-1	CSAUA&T, Kanpur	71	DRMRCI- 154	DRMR, Bharatpur
2.	KMR(E) 22-2	CSAUA&T, Kanpur	72	DRMR 2020-8	DRMR, Bharatpur
3.	DRMRCI- 156	DRMR, Bharatpur	73	DRMRIJ 21-37	DRMR, Bharatpur
4.	DRMRSJ 272	DRMR, Bharatpur	74	SKM 1924	SDAU, SK Nagar
5.	DRMRIJ 20-117	DRMR, Bharatpur	75	SKM 2012	SDAU, SK Nagar
6.	DRMRHT-1712	DRMR, Bharatpur	76	RH 2187	CCS HAU, Hisar
7.	RH 1999-37	CCS HAU, Hisar	77	RH 2199	CCS HAU, Hisar
8.	RH 2199-11	CCS HAU, Hisar	78	KMR 22-3	CSAUA&T, Kanpur
9.	PRE-2018-1	GBPUA&T, Pantnagar	79	KMR 22-4	CSAUA&T, Kanpur
10.	PRE-2020-14	GBPUA&T, Pantnagar	80	NPJ 261	IARI, New Delhi
11.	NPJ 257	IARI, New Delhi	81	NPJ 262	IARI, New Delhi
12.	NPJ 258	IARI, New Delhi	82	PR-2019-1	GBPUA&T, Pantnagar
13.	PusaMH126(Hybrid)	IARI, New Delhi	83	PR-2020-14	GBPUA&T, Pantnagar
14.	ANDM 14-09	AAU, Anand	84	HUJM-21-4	BHU, Varanasi
15.	SVJH-72 (Hybrid)	Shaktivardhak Hybrid Seeds, Pvt. Ltd.	85	RMM-19-12	ZARS,Morena
16.	TM 314-1	BARC, Mumbai	86	ACNMM-3	COA, Nagpur

17.	HUJMI 21-1	BHU, Varanasi	87	TM 316	BARC, Mumbai
18.	ACN 247	CoA, Nagpur	88	RB-110	RRS, Bawal
19.	SHIVANI PLUS	Mali Agri Tech Pvt Ltd, Nadia	89	DM 2020-3	Dayal Seeds (P) Ltd.
20.	Q80623	Advanta Seeds Pvt Ltd	90	DRMRHT 18-141	DRMR, Bharatpur
21.	BAUM-2022-1	BAU, Ranchi	91	RGN 528	SKRAU, Sriganganagar
	***B. juncea* (Timely Sown rainfed)**		92	PBR-813-2	PAU Ludhiana
22.	DRMRCI- 155	DRMR, Bharatpur	93	DTM-341	PAU Ludhiana
23.	DRMRRIL 21-1	DRMR, Bharatpur	94	RAURD 18-1	RAU, Dholi
24.	DRMR 2020-3	DRMR, Bharatpur		***B. juncea* (Late Sown)**	
25.	DRMRHT-17-2	DRMR, Bharatpur	95	DRMRCI- 160	DRMR, Bharatpur
26.	NPJ 263	IARI, New Delhi	96	DRMRIJ 21-51	DRMR, Bharatpur
27.	NPJ 264	IARI, New Delhi	97	DRMRSJ 294	DRMR, Bharatpur
28.	RH 2148	CCS HAU, Hisar	98	DRMRHT-13-28-13	DRMR, Bharatpur
29.	RH 2199-6	CCS HAU, Hisar	99	RH 1999-22	CCS HAU, Hisar
30.	DTM- 341	PAU, Ludhiana	100	RH 2199-11	CCS HAU, Hisar
31.	TM260	BARC, Mumbai	101	KMR(L) 22-5	CSAUA&T, Kanpur
32.	JM-15-8	SKUAST-Jammu	102	KMR(L) 22-6	CSAUA&T, Kanpur
33.	JKJH12	JK Agri Gen Ltd Hyderabad	103	NPJ 259	IARI, New Delhi
34.	RB-113	RRS, Bawal	104	NPJ 260	IARI, New Delhi
35.	RGN 526	SKRAU, Sriganganagar	105	NPJ 265	IARI, New Delhi
36	BAUM-2022-2	BAU, Ranchi	106	TM258	BARC, Mumbai
	***B. juncea* (Hybrid mustard)**		107	PRL-2020-5	GBPUA&T, Pantnagar
37	RHH 2201	CCS HAU, Hisar	108	PRL-2020-8	GBPUA&T, Pantnagar
38	RHH 2202	CCS HAU, Hisar	109	HUJM-21-1	BHU, Varanasi
39	RHH 2203	CCS HAU, Hisar	110	RGN 534	SKRAU, Sriganganagar
40	PHR 33281	PAU Ludhiana	111	BAUM-2022-2	BAU, Ranchi
41	PHR 4284	PAU Ludhiana		***B. juncea* (Quality)**	
42	4205A252-01	Corteva Agriscience	112	Pusa QMH 1	IARI, New Delhi
43	DRMRHJ 310	DRMR, Bharatpur	113	LES 66	IARI, New Delhi
44	DRMRHJ 223	DRMR, Bharatpur	114	LES 67	IARI, New Delhi
45	DRMRHJ 1419	DRMR, Bharatpur	115	PDZ 18	IARI, New Delhi
46	Pusa MH 103	IARI, New Delhi	116	PDZ 19	IARI, New Delhi
47	Pusa MH 111	IARI, New Delhi	117	PMAS 7	PAU Ludhiana
48	SKMH 1901	SKAU, S.K. Nagar	118	PMAS 11	PAU Ludhiana
49	SVJH-73	ShaktiVardhak Hybrid Seeds Pvt. Ltd.	119	RH(OE) 1708	CCS, HAU, Hisar
50	JKJH11	JK Agri Genetics Ltd. Hyderabad	120	RH(OE) 1806	CCS, HAU, Hisar
51	NMH90M01	Nuziveedu Seeds Ltd.	121	DRMRCI(Q) 158	DRMR, Bharatpur
52	KGMH-9783	Kamadgiri Crop Science Pvt. Ltd.	122	DRMRCI(Q) 172	DRMR, Bharatpur
53	NAMJH21-04	Namdhari Seeds Pvt. Ltd.	123	DRMRQ 29-20	DRMR, Bharatpur
54	PMH90V02	Prabhat Agri Biotech Ltd.		***B. rapa* var Toria**	
55	JH21002	SeedWorks International Pvt. Ltd. MRC, Jaipur	124	TKM 21-1	CSAUA&T, Kanpur
56	Q90007	Advanta Seeds Pvt. Ltd.	125	TKM 21-2	CSAUA&T, Kanpur
57	KBH5160	Kaveri Seed Company Limited	126	PT-2016-9	GBPUAT, Pantnagar
58	BMH19011	Bioseed Research India	127	PT-2019-4	GBPUAT, Pantnagar
59	DRMRHJ-319	DRMR, Bharatpur	128	JT-14-9	SKUAST-Jammu
	***B. rapa* ssp. Yellow Sarson**		129	BAUT-08-09	BAU, Ranchi
60	YSKM 21-1	CSAUA&T, Kanpur		**Checks:**	

61	YSKM 21-2	CSAUA&T, Kanpur		*B. juncea:* DMH-1, Rohini, NRCHB 101 (SC), BIOYSR, DRMRMJA 35 (RC-WR), PHR 2 (TC-AB);
62	DRMRYS 205	DRMR, Bharatpur		
63	DRMRYS 204	DRMR, Bharatpur		
64	DRMRYS-18-15	DRMR, Bharatpur		*B. rapa* var. *Toria:* PT 303; *B. napus:* GSL 1; *B. carinata:* DLSC 1; *Eruca sativa:* RTM 314; *B. rapa* var. YS: NRCYS-5-2
65	PYS-2018-1	GBPUAT, Pantnagar		
66	PYS-2018-4	GBPUAT, Pantnagar		
67	AAUJYS 14-2	AAU, Jorhat		
68	AAUJYS 15-2	AAU, Jorhat		
69	RMYS 5	ARS, Mandor		
70	RMYS 4	ARS, Mandor		

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

Objective: To asses yield losses caused by of the major diseases at different locations

Locations: Shillongani, Dholi, Jagdalpur, Varanasi

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* 10^6 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

Layout: The experiment shall be laid out in split-plot design with one replication with varieties Varuna & 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 & max. temp. (^{o}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

Objective:	To find out the efficacy of newer fungicides for disease management
Locations:	**Pantnagar, Morena, Hisar, Ludhiana, Dholi, Jhansi, Bharatpur, Shillongani**
Treatments: (Foliar spray at 45 and 70 DAS)	1. Tebuconazole 50% + trifloxostrobin 25% WG @ 0.1% 2. Propiconazole 25% EC @ 0.1% 3. Metalaxyl 4% + mancozeb 64% @ 0.25% 4. Hexaconazole 5% SC @ 0.1% 5. Tebuconazole 25.9% @ 0.1% 6. Azoxystrobin @ 0.1% 7. Trifloxystrobin 50% @ 0.1% 8. Check
Observations:	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
Layout:	Repln: 3; Plot size: 3x5m, Spacing: 30x10cm; D/S: 20-25 Oct; Var: DRMRIJ 31

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* 10^6 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

XXIX Annual Group Meeting of AICRP Rapeseed-Mustard
August 1-3, 2022, RARI Durgapura, Jaipur

Session II Planning & Technical Programme Formulation: Entomology

Chairman **:** Dr. Sanjeev Gupta, ADG (O &P), ICAR, New Delhi
Co-chairman **:** Dr. P.K. Rai, Director, ICAR-DRMR, Bharatpur
Subject Experts **:** Dr. H.C. Sharma, Ex Vice Chancellor, UHF, Solan (HP)
: Dr. G.S. Saharan, Ex-Professor & Head, Plant Pathology, CCS HAU, Hisar
Rapporteurs : Prof. M.S.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. He welcomed the Chairman, and the fellow entomologists. Dr. Sanjeev Gupta, suggested to evaluate some low glucosinolates lines for aphid infestation and induction of secondary metabolite activity particularly myrosinase enzyme. Dr. G.S.Saharan emphasized to analyze the long term data on mustard aphid and develop distribution map for mustard aphid. The map has been prepared and presented. Dr. H.C. Sharma expressed his concern about decreasing number of entomologists in entomology programme.

It was emphasized by Dr. Sarwan Kumar, PI of AICRP-RM Entomolgy that the experiments must be conducted as per technical programme with proper statistical analysis and the report should be submitted latest by May 15th 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. H.C.Sharma desired to add some resistant check along with susceptible check BSH 1 in screening trials. After discussions in the previous meeting, following checks were already included in screening trails: RH 725, PM 30, 45S46, PDZM 31, and *Brassica fruticulosa* introgressed *Brassica juncea* line. After thorough discussion following technical programme was finalized:

Technical Programme (2022-23)

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 table 1.

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

S. N	**1. IVT *Toria***		
1	TKM 21-1	T-9 X PT- 507	CSAUA&T, Kanpur
2	TKM 21-2	ORT-11 X Anuradha	CSAUA&T, Kanpur
3	PT-2016-9	Composite Population	GBPUAT, Pantnagar
4	PT-2019-4	Re-current selection of PTC-2014-8	GBPUAT, Pantnagar
5	JT-14-9	Composite population	SKUAST, Chatha, Jammu
6	BAUT-08-09	BAUST-12 x TRCT-1-1-5-1	BAU, Ranchi
	2. IVT Yellow *Sarson*		
1	YSKM 21-1	YSK-42 X YSK-2	CSAUA&T, Kanpur
2	YSKM 21-2	YSK-28 X YSK-42	CSAUA&T, Kanpur
3	DRMRYS 205	YSH 401 X *B. nigra*-2	DRMR, Bharatpur
4	DRMRYS 204	Ragini X *B. nigra*-2	DRMR, Bharatpur
5	DRMRYS-18-15	IC520765	DRMR, Bharatpur
6	PYS-2018-1	PYSC-21-6 X PYS-841	GBPUAT, Pantnagar
7	PYS-2018-4	PYSC-79-1 X PYSC-59-7	GBPUAT, Pantnagar
8	AAUJYS 14-2	(YSH 401 X B9) X B9	AAU, Jorhat
9	AAUJYS 15-2	YSH 401 X B9	AAU, Jorhat
10	RMYS 5	GP 77 X GP 48	ARS, Mandor
11	RMYS 4	GP 29 X GP 66	ARS, Mandor
	3. Mustard **3.1 IVT Early Mustard**		
1	KMR(E) 22-1	Rohini X Mathura Rai	CSAUA&T, Kanpur

2	KMR(E) 22-2	Seeta X SEJ 2	CSAUA&T, Kanpur
3	DRMRCI- 156	DRMR 81 X DRMR 541-44	DRMR, Bharatpur
4	DRMRSJ 272	Jhumka x *B. nigra*	DRMR, Bharatpur
5	DRMRIJ 20-117	DRMRIJ 31 X EC597313	DRMR, Bharatpur
6	DRMRHT-1712	BPR-549-9 X JBT-41/15	DRMR, Bharatpur
7	RH 1999-37	NPJ 227 X T 6342	CCS HAU, Hisar
8	RH 2199-11	RH 1370 X RH 1402A	CCS HAU, Hisar
9	PRE-2018-1	PRHC-13-1-2 X PR-19	GBPUA&T, Pantnagar
10	PRE-2020-14	PRE-2008-5 X PRE-2007-6	GBPUA&T, Pantnagar
11	NPJ 257	NRCHB- 101 X NPJ 173	IARI, New Delhi
12	NPJ 258	PM 25 X NPJ 176	IARI, New Delhi
13	Pusa MH 126 (Hybrid)	PUSA MH 2-3A X RP-8-1-2-1-2	IARI, New Delhi
14	ANDM 14-09	Pusa Jaikisan X GM 3	AAU, Anand
15	SVJH-72 (Hybrid)	SVJA-03 X SVJR-11	Shaktivardhak Hybrid Seeds, Pvt. Ltd.
16	TM 314-1	Rajendra suflam X TJD- 1	BARC, Mumbai
17	HUJMI 21-1	Ashirwad X Pusa Bold	BHU, Varanasi
18	ACN 247	ACN-9 X TM 101	CoA, Nagpur
19	SHIVANI PLUS	Mutant of Shivani	Mali Agri Tech Pvt Ltd, Nadia
20	Q80623	6422 A/RF4493	Advanta Seeds Pvt Ltd
21	BAUM-2022-1	Mutant of Pusa Bold with 900Gy (PB1-14-7)	BAU, Ranchi
	3.2 IVT Mustard Timely Sown, Irrigated		
1	DRMRCI- 154	RH 819 X DRMRIJ 31	ICAR-DRMR, Bharatpur
2	DRMR 2020-8	DRMRIJ- 31 X NPJ 112	ICAR-DRMR, Bharatpur
3	DRMRIJ 21-37	DU38 X HB202	ICAR-DRMR, Bharatpur
4	SKM 1924	SKM 815 X RSK 29	SDAU, SK Nagar
5	SKM 2012	SKM 904 X RW 1-02	SDAU, SK Nagar
6	RH 2187	RH 1143 X DOMO-4	CCS HAU, Hisar
7	RH 2199	RH 1252 X RH 7846	CCS HAU, Hisar
8	KMR 22-3	Maya X RC-781	CSAUA&T, Kanpur
9	KMR 22-4	Varuna X KR 5610	CSAUA&T, Kanpur
10	NPJ 261	NPJ 102/ Laxmi//Pusa Jagannath	IARI, New Delhi
11	NPJ 262	Kranti//JM 2/BIOYSR///RH 749	IARI, New Delhi
12	PR-2019-1	Krishna X NRCHB-101	GBPUA&T, Pantnagar
13	PR-2020-14	PR-2013-19 X Maya	GBPUA&T, Pantnagar
14	HUJM-21-4	NDRE 4 X Pusa Bold	BHU, Varanasi
15	RMM-19-12	EJ-17 X Pusa Bold	ZARS,Morena
16	ACNMM-3	Mutant of BIO- 902	COA, Nagpur
17	TM316	TM 102 X RB9901	BARC, Mumbai
18	RB-110	RB-24 X RH-207	RRS, Bawal
19	DM 2020-3	DSC 48X DSC 24	Dayal Seeds (P) Ltd.
20	NS-5507	RH-30 X NRCDR-2	Nath Bio-Genes(I) Ltd.
21	RGN 528	RH 673 x RGN 48	SKRAU, Sriganganagar
22	PBR-813-2		PAU, Ludhiana
23	DTM- 341	DTM 134 X NRCDR 101	PAU Ludhiana
24	RAURD 18-1	Gamma ray mutant of Rajendra Suflam	RAU, Dholi
	3.3 IVT Mustard Timely Sown (Rainfed)		
1	DRMRCI- 155	RH 819 X DRMRIJ 31	ICAR-DRMR, Bharatpur
2	DRMRRIL 21-1	Giriraj X Heera	ICAR-DRMR, Bharatpur
3	DRMR 2020-3	NRCHB 101 X NPJ 112	ICAR-DRMR, Bharatpur
4	DRMRHT-17-2	Urvashi X SEJ 2	ICAR-DRMR, Bharatpur
5	NPJ 263	Pusa Agrani X BCI 5	IARI, New Delhi
6	NPJ 264	DRMRIJ- 31 X BCI 4	IARI, New Delhi
7	RH 2148	RH 1402A X RH 0555	CCS HAU, Hisar
8	RH 2199-6	RH 8812 X JMMWR 9348	CCS HAU, Hisar
9	DTM- 341	DTM 134 X NRCDR 101	PAU, Ludhiana
10	TM260	IC355399 X RB9901	BARC, Mumbai
11	JM-15-8	RSPR-69 X RB-50	SKUAST, Chatha, Jammu
12	JKJH12	15A05 X RD07	J.K. Agri Gen. Ltd. Hyderabad
13	RB-113	RH-0749 X RH-0345	RRS, Bawal
14	RGN 526	RH 673 x RGN 48	SKRAU, Sriganganagar
15	BAUM-17	Shivani Mutant 900Gy+0.3% EMS	BAU, Ranchi

	3.4 IVT Mustard Late sown		
1	DRMRCI- 160	DRMR 150-35 X BEC 144	ICAR-DRMR, Bharatpur
2	DRMRIJ 21-51	MJR 3 X Pusa Swarnim	DRMR, Bharatpur
3	DRMRSJ 294	Ragini X B. Nigra	DRMR, Bharatpur
4	DRMRHT-13-28-13	BPR-543-2 X BPR-549-9	DRMR, Bharatpur
5	RH 1999-22	RH 1599-41 X RH 1402	CCS HAU, Hisar
6	RH 2199-11	RH 1370 X RH 1402A	CCS HAU, Hisar
7	KMR(L) 22-5	Ashirwad X Kanti	CSAUA&T, Kanpur
8	KMR(L) 22-6	Rohini X Vardan	CSAUA&T, Kanpur
9	NPJ 259	NPJ 138 X NPJ 116	IARI, New Delhi
10	NPJ 260	NRCH 101 X NPJ 173	IARI, New Delhi
11	NPJ 265	Pusa Mustard 25//DRMRIJ 31/BCI-4	IARI, New Delhi
12	TM258	IC355399 X RB9901	BARC, Mumbai
13	PRL-2020-5	NPJ-170 X RGN 73	GBPUA&T, Pantnagar
14	PRL-2020-8	KMRL-12-1 X Ashirwad	GBPUA&T, Pantnagar
15	HUJM-21-1	Oriental Rai X HUJM-9964	BHU, Varanasi
16	RGN 534	NPJ 190 x RGN 48	SKRAU, Sriganganagar
17	BAUM-2022-2	PB1-14-8(Mutant of Pusa Bold)	BAU, Ranchi
	3.5 Hybrid Mustard, IHT		
1.	RHH 2201	Ogura based	CCS HAU, Hisar
2.	RHH 2202	Ogura based	CCS HAU, Hisar
3	RHH 2203	Ogura based	CCS HAU, Hisar
4	PHR 33281	IM64NA X MH	PAU Ludhiana
5	PHR 4284	DJ116 X AJR 102B	PAU Ludhiana
6	4205A252-01	4PDBN18A X 4PGQL32L	Corteva Agriscience
7	DRMRHJ 310	OJA 3 X OJR 10	ICAR-DRMR, Bharatpur
8	DRMRHJ 223	OJA 2 X OJR23	ICAR-DRMR, Bharatpur
9	DRMRHJ 1419	MJA 14 X MJR 19	ICAR-DRMR, Bharatpur
10	Pusa MH 103	NRCDR 02(mori) X RP 9-2-2-3	IARI, New Delhi
11	Pusa MH 111	RGN 48(mori) X RP 9-2-2-3	IARI, New Delhi
12	SKMH 1901	GMMo 2116A X GMMo 2105R	SKAU, S.K. Nagar
13	SVJH-73	SVJA-06 X SVJR-12	Shakti Vardhak Hybrid Seeds Pvt. Ltd.
14	JKJH11	15A01 X RD01	J.K. Agri Genetics Ltd. Hyderabad
15	NMH90M01	A line- (GRU283A/ GRU284B) BC1-BC2-BC3-BC4-BC5-BC-6-BC7-BC8 R line- (GRU509/ GRU476)- (X)-14-3-1-1-1-1-1	Nuziveedu Seeds Ltd.
16	KGMH-9783	KA- 108 X KR-76	Kamadgiri Crop Science Pvt. Ltd.
17	NAMJH21-04	NAMJA-2 X NAMJR-5	Namdhari Seeds Pvt. Ltd.
18	PMH90V02	A line- (GRU1269A/ GRU270B) BC1-BC2-BC3-BC4-BC5-BC-6-BC7-BC8 R line- (GRU509/ GRU483)- (X)-28-2-2-1-1-1-1	Prabhat Agri Biotech Ltd.
19	JH21002	SWJ01 X SWJ03R	SeedWorks International Pvt. Ltd. MRC, Jaipur
20	Q90007	G0023/ RFN9001	Advanta Seeds Pvt. Ltd.
21	KBH5160		Kaveri Seed Company Limited
22	BMH19011	PARENT 1 (BM0178M) PARENT 2 (BM704O)	Bioseed Research India (group DCM Shriram Ltd.)
23	DRMRHJ-319	MJA3 X MJR 19	ICAR-DRMR, Bharatpur
	3.6 IVT Quality Mustard		

1.	Pusa QMH 1	PM 30(eru) X LES 1-27R	IARI, New Delhi
2.	LES 66	LES 1-27 X PDZ-3	IARI, New Delhi
3.	LES 67	LES 1-27 X PDZ-2	IARI, New Delhi
4.	PDZ 18	Agrani X Heera	IARI, New Delhi
5.	PDZ 19	PDZ-3 X RLC-3	IARI, New Delhi
6.	PMAS 7	Derived through MABC PBR 357/ RLC 3// PBR 357	PAU Ludhiana
7.	PMAS 11	Derived through MABC PBR 357/ RLC 3// PBR 357	PAU Ludhiana
8.	RH(OE) 1708	NOID X EC 597324	CCS, HAU, Hisar
9.	RH(OE) 1806	EC 597328 X RH(OE) 0502	CCS, HAU, Hisar
10.	DRMRCI(Q) 158	NRCHB- 101 X Heera	ICAR- DRMR, Bharatpur
11	DRMRCI(Q) 172	NRCDR- 2 X RLC- 3	ICAR- DRMR, Bharatpur
12	DRMRQ 29-20	EC5973 X PM 24	ICAR- DRMR, Bharatpur

Checks: RH-725 (Conventional check) BSH-1 (Susceptible check), 45-S-46 (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	**AVT-I Early Mustard** **Entries:** DRMRHT 13-13-5-4, DRMRHT 13-13-5-5, KMR(E) 21-1, ORM 2019-25, PRE 2018-10#, RH 1999-42##
2	**AVT-I Timely Sown, Irrigated/ Quality/ WRR** **Entries:** RH 1934*, SKM-1801*, NPJ 253*, DRMR 2018-25*** (WRR), DRMRCI(Q) 47**, IJ19R5004**, RH 1975#, RH 1974#, PDZ 16, PDZ 14, PDZ 15, DRMRIJ 20-157, DRMR 2018-37, PBR 939, NPJ 252, ACN 237, KMR 21-3, RGN 524,
3	**AVT I Mustard, Timely Sown, Rainfed** **Entries:** DRMRHJ 1117
4	**AVT- I Mustard (Late Sown, Irrigated)** **Entries:** NPJ 251, NPJ 250, DRMRHJ 430, DRMR 2018-19
5	**AHT-I Mustard** **Entries:** 18J408C**,** SVJH- 70, SVJH- 71 NAMJH 21-01,RHH 2101, KGMH 9198, DRMRHJ 2518, IJ16R1168,RMX 9922
6	**AVT-I Mustard Salinity** **Entries:** CS 2020-10, CS 54, CS 60
7	**AVT- I :** ***Gobhi Sarson*** **Entries: G**SH-2155, GSL 1 (C), GSC 6 (QC)

Checks: RH-725 (Conventional check) BSH-1 (Susceptible check), 45-S-46 (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. Data shuold be recorded separately for different *Brassica* sp.
2. Material for screening will be provided by the respective breeders and supplied by PI, Entomoly.

3. Maximum grading, either at full flowering stage or at pod formation stage, should be considered to classify the genotypes.
4. 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: Bharatpur, 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 percent 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 *Brassica* 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:	Bharatpur, 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 :

SMW	Weather Parameters							Aphids /10cm top twig			
	Temperature (^{0}C)		R.H. (%)		Sunshine (hrs)	Wind speed Kmph	Rainfall (mm)	*B. juncea*	*Eruca sativa*	*B. napus*	*B. rapa*
	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: Bharatpur, Ludhiana, Hisar, Morena, Kanpur, Pantnagar, S.K. Nagar, Dholi and Shillongani

Observatios 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:	Bharatpur, 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: Bharatpur, Ludhiana, Hisar, Pantnagar
Plot size: **4m x 3 m**
Replications : 3
Mustard variety: High glucosinolates: ***B. juncea*-**DRMR IJ 31, *B. napus*: GSL 1
Low glucosinolates: ***B. juncea*-**PM 30, *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, release aphids @ 20 aphids/ plant on 5 randomly selected plants in the infested plot. 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 in state pop.

Biochemical analysis:
1 Peroxidase
2 Myrosinase
3 Total glucosinolates
4 Total phenols
5 Ortho-dihydroxy phenols
6 Flavonols

Data recording and 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.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 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 by 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 that needful can be done.

XXIV Annual Group Meeting of AICRP Rapeseed-Mustard
August 1-3, 2022 at RARI, Durga pura, Jaipur

SESSION III: Breeder Seed Production

Chairman **:** Dr. Sanjeev Gupta, ADG (O& P), ICAR, New Delhi
Co- Chairman **:** Dr.Sanjay Kumar, Director, ICAR-IISS, Mau
Rapporteur **:** Dr. H S Meena, PS, ICAR-DRMR, Bharatpur
: Dr S K Rai, Assoc. Prof. SKUAST, Jammu

After brief introductory remarks from the Chairman, Dr.Bhagirath Ram, Pr Scientist, ICAR-DRMR presented the detailed report on breeder seed production of the year 2021-22. He informed that an indent of 84.38q of breederseed of 70 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 2021-22. Against the indent, 233.16 q breeder seed was produced, indicating a surplus availability of 160.16 q.Breeder seed of 03 varieties RH-819, RVM-3 and TBM-209 could notproduced. Further, he informed the shortage in breeder seed production of RVM-1 (-4.36 q), PM-26 (-2.25 q), RGN-298 (-0.28) of Indian mustard; RTM-1355 (-0.20 q) of Taramira; Pant Girija (-0.50 q) and Sachita (-0.015 q) of Yellow sarson;TS-38 (0.00 q) of Toria.In addition, 35.67 q breeder seed of 17 varieties of Indian mustard was also reported from nine centres. He gave an account of the percent contribution of recently notified (2011-2021) varieties in breeder seed production chain. He informed the house that breeder seed indent (BSP-1) for 2022-23 will be posted shortly by the DAC on its website and the same will be communicated to different co-operating centres once the indent is finalized. It can also be downloaded from the website of DAC www.seednet.com.

Dr Sanjeev Gupta, ADG (Oilseeds & Pulses), ICAR, New Delhi suggested that all recently released varieties of rapeseed-mustard should be included in state PoP/minikit for enhancing the breeder seed indent. He also suggested that meeting to decide BSP-I should be organized by DAC well in advance before AGM of AICRP-RM. He suggested to a write letter to all VCs/Directors who reported deficit breeder seed production. He also suggested to included seed hub project report while presenting scenario of breeder seed production and prepare seed rolling plan for rapeseed-mustard growing states.

During discussion, Dr. P K Rai, Director ICAR-DRMR emphasized on maintenance of nucleus seed plots of respective varieties for quality seed production. He also stressed upon increasing the varietal replacement rate through popularization of newly improved varieties.

The Chairman, in his concluding remarks, appreciated the status of breeder seed production in the country. The session ended with the vote of thanks to the Chair.

XXIX Annual Group Meeting of AICRP Rapeseed-Mustard
August 1-3, 2022 at RARI, Durgapura, Jaipur

Session IV: Formulation of technical programme 2022-23-Agronomy

Chairman	**:** Dr. Sanjeev Gupta, ADG (O&P), ICAR, New Delhi
Co-Chairman	**:** Dr. Sanjay Kumar, Director, ISSS, Mou, Uttar Pradesh
Subject Expert	**:** Dr. Virender Sardana, Prof. & I/C, AICRP (RM), PAU, Ludhiana
Rapporteurs	**:** Dr. Rajeev Bharat, Sr. Scientist-Agronomy, SKUAST- Jammu

The session was started with the opening remarks of the Chairman, Dr. Sanjeev Gupta, ADG (O&P), ICAR. Dr. R.S. Jat, PI and principal scientist, ICAR-DRMR, Bharatpur presented the results of the experiments conducted during 2021-22 by various centre's under AICRP (R&M) on soil, water, nutrient and weed related aspects. He also mentioned the non-compliance of the technical programme by the centres and precision of conducting and reporting the results.

1. The house decided to conclude the experiment on "***Long-term fertility experiment on cropping systems involving rapeseed-mustard***" next year at all AICRP centres and start it at ICAR-DRMR, Bharatpur with few voluntary centres who wants to continue it in the same fields.
2. Prof. S.S. Banga, Ramanna Fellow, PAU, Ludhiana suggested to study the nitrogen economy specially in the experiment on agronomic evaluation of new entries for better visualization of genotypesxnutrient responses.
3. Dr. Dhiraj Singh pointed out that the yield levels are poor than State average, and suggested to drop such reports in the future.
4. Dr. Sai Das suggested to strictly follow the site specific nutrient management and maintain optimum plant population to realize the genetic potential of the varieties.
5. Dr. Sanjeev Gupta, Chairman & ADG (O&P) suggested to precisely conduct and record the observation on weed dynamics, and plant and soil residues for label claim and recommendations of weed management experiment. He also suggested to calculate the nutrient economy (N, P, K, S & Zn) in microbial, biofertilizers and mineral nutrition experiments across the centres. The chairman directed to mention the name of the centre's who are not conducting the experiments and reporting the data properly along with the remarks in tabular form in the next meeting.
6. The PI made presentation to initiate research work in rice-fallow areas. The Chairman suggested to modify the experiment with all relevant information and technological intervention on residue management, crop establishment, nutrient management, water management and weed management, and present next year again.
7. The Chairman suggested to formulate and initiate the work on nano fertilizers for different nutrients to enhance the nutrient use efficiency.
8. The PI-Agronomy urged upon all centres to analyse the soil samples (N,P,K,S,Zn, & B) and economics of long term fertility experiment and submit final data for making a meaningful recommendations for various locations in the next meeting.

Suggestions for proper conduct of agronomical trials

1. The treatments of any experiment should not be modified at their end.
2. The results should be presented in the report as per format given in the technical programme including two-way tables in the split plot experiments.
3. Report all the important observations as per experimental requirement.

4. The trials should be sown on time so that treatment effects could be identified properly and yield levels are optimized.
5. The reports should be submitted by 31st May, 2022 positively. No report will be accepted after the due date.
6. The centres should send the information pertaining to field trials along with date of sowing to Director, DRMR latest by 25th November.
7. The centres accepting the trial (whose names are given in the technical programme) must positively report the data. In case of any difficulty centre should report immediately to Director/PI, DRMR.
8. The fertility/Biofertilizer experiments should be conducted at the same location in the same field over the years.
9. The economics of each experiment should be calculated on the basis of MSP and state recommended cost of cultivation for respective crops. The IBCR should be reported instead of B:C ratio.
10. Data without statistics will not be considered.
11. All the ancillary data of component crops should be recorded and reported.
12. The initial and final soil analysis data of all the experiments should be done and reported every year.
13. If the yield level of recommended fertiliser dose is less than the state average, the trial will be rejected.
14. If any centre needs oil and nutrient analysis, depute concerned scientist along with samples to DRMR, Bharatpur latest by 30th April for analysis.
15. The plot size should not be less than 21.6 m^2 in agronomic experiments and width of buffer channel should not be less than 1.5 m.
16. The final data must be submitted latest by 31st May, 2022. No data will be accepted after the due date.
17. 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.

Technical programme for 2022-23

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 $ZnSO_4$/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: Bharatpur (PM-Mustard), Ludhiana (Maize-Mustard), Hisar (PM-Mustard), Pantnagar (Maize-Mustard), Kota (Urdbean-Mustard)

Note: The discuntinued centers should submit the final pooled data on seed yield, system productivity, sustainability yield index, economics and Soil fertility status before and after 10 years (organic carbon, available N, P, K, S, Zn, B) before next Group Meeting.

Observations to be recorded in all the 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_2O/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. Fluazifop-p-butyl @ 0.125 kg a.i/ha at 25-30 DAS
4. Quizalofop @ 0.05 kg a.i./ha at 15-20 DAS
5. Weedy-check (No herbicide)
6. Weed free

Replication: 3
Design: RBD
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 dynamics, weed control efficiency and weed index should be reported at 45 and 80 DAS.
3. Information on plant and soil residue analysis should be reported or send the samples at ICAR-DRMR, Bharatpur.
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 **10th 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 (Irrigated)

Entries: RH 197, 4RH 1975 Giriraj (LR), RH 749 (ZC), Kranti (NC)
Locations: Bawal, Hisar, Ludhiana, Sriganganagar, New Delhi

Zone III: Quality mustard

Entries: PDZ 14, PDZ 15, PM 30 (LR), PDZ 1 (ZC), Kranti (NC), RGN 73
Locations: Kota, Kanpur, Pantnagar, Morena, Jhansi

Zone III: Mustard late sown

Entries: DRMR 2018-19, CS 56 (LR), NRCHB 101 (ZC), Kranti (NC)
Locations: Kota, Varanasi, Kanpur, Pantnagar, Jhansi

Fertility levels (for all the locations)

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

Replications: 3
Design: Split-plot (Entries in main plots and fertility levels in sub- plots)
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. Calculate N, P & K economy and use efficiency at different fertility levels.
6. 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^{+}
4. CRIDA MI-I
5. CRIDA MI-II
6. Control (No Culture)

Replications: 3

Design: Split plot

Location: Jobner, Nagpur, Jhansi, Banda, Dholi, Morena, Sriganganagar, 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. Calculate water and nutrient use efficiency precisely for all irrigation levels and microbes.
7. Analyse the microbial population at initial stage and at harvest stage.
8. Relative water content, membrane stability index, yield stability index, proline content, chlorophyll content at 80 DAS and water use efficiency.
9. 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, Bawal, Bharatpur

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 and their use efficiency should be given.
5. Analyse the microbial population at initial stage and at harvest stage.
6. 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: Split Plot Design

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

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 and their use efficiency.
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.

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August 1-3, 2022 at RARI, Durga pura, Jaipur

Technical Session V: Transfer of Technology

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

Co-Chairman : Dr. Sai Das, Ex- Director, DMR, New Delhi

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

After brief introductory remarks from chairman about the scenario of rapeseed-mustard production, constraints, yield gap and role of frontline demonstrations in technology dissemination, Dr. Ashok Kumar Sharma, Pr. Scientist, (Ag Extension), ICAR-DRMR, Bharatpur presented the annual report of frontline demonstrations (FLDs) on rapeseed-mustard conducted during 2021-22. He presented that 36 cooperating centres of AICRPRM/ ICAR institutes/ Ag. Universities/NGOs/FPOs conducted 2534 frontline demonstrations (FLDs) on rapeseed-mustard in 85 districts across 16 states during 2021-22. Rajasthan had maximum (835) followed by Uttar Pradesh (398), Assam (359) Manipur (150) and Madhya Pradesh (122) FLDs. The 629 FLDs on rapeseed and 1905 on mustard were conducted All the demonstrations were conducted in two different situations viz., irrigated (1785) and rainfed (604).

The maximum average yield of 2,462 kg/ha from the IP under irrigated conditions was in Haryana followed by 2,325 kg/ha in Gujarat; 2,228 kg/ha in Uttar Pradesh; 2,102 kg/ha in Madhya Pradesh and 2,001 kg/ha in Rajasthan. The maximum yield gap of 73.0% was recorded in Jammu & Kashmir followed by 66.7% in Assam; 56.6% in Odisha; 39.5% in Telangana and 35% in Himachal Pradesh. The maximum ANMR/ha were Rs 30,019; Rs 28,065; Rs. 26,461; Rs. 20,350 and Rs. 18,186 in Assam, Jammu & Kashmir, Uttar Pradesh, Telangana and Rajasthan, respectively. The cost of cultivation ranged from Rs. 19,250/ha in Jammu & Kashmir to Rs. 39697 /ha in Haryana in IP under irrigated Whole package demonstrations.

The maximum average yield of 1495 kg/ha from the IP of WP demonstrations under rainfed conditions was in Rajasthan followed by 1,166 kg/ha in Jammu & Kashmir. The maximum yield gap of 35.9% was recorded in Assam followed by 27.2% in Himachal Pradesh. The maximum ANMR/ha were Rs 15,712; and Rs 11,830 in Assam and Rajasthan, respectively. The cost of cultivation ranged from Rs. 12,690/ha in Himachal Pradesh to Rs 39,155/ha in Jammu & Kashmir in IP under rainfed Whole package demonstrations.

A total of 12 improved varieties of Indian mustard, 3 each of yellow sarson and toria and 4 of gobhi sarson were used in WP covering 15 states under irrigated condition. Under irrigated condition, improved variety RH 725 demonstrated in 96 FLDs in Uttar Pradesh, recorded highest average yield of 2,648 kg/ha with a yield improvement of 26.4% over local (FP) practice followed by Giriraj (131 FLDs) with average seed yield of 2,530 kg/ha with yield improvement 23.1%. The variety RH-725 in Jammu & Kashmir, under irrigated condition, recorded highest yield improvement of 74% with average seed yield of 1,203 kg/ha.

The maximum yield improvement of 20.4% from Pitambari variety of yellow sarson in Uttar Pradesh, 37 % from AKMS8141 variety of gobhi sarson in Himachal Pradesh, 66.6% from TS 38 variety of toria in Assam were recorded under irrigated condition.

Under rainfed condition, the demonstrations with RGN 298 recorded the highest average seed yield of 1,892 kg/ha with yield improvement of 9.4% in Rajasthan under rainfed situation. In Himachal Pradesh, 33 demonstrations with RCC4 recorded lowest average seed yield of 695 kg/ha with yield improvement of 32.4% over FP. However, the variety RCC-4 in Himachal Pradesh under rainfed condition recorded highest yield improvement of 32.4% with average seed yield of 695 kg/ha.

The maximum yield improvement of 40.4% from TS 36 variety of toria in Assam and 22.5% from RTM 1624 of taramira in Rajasthan were recorded under rainfed condition. The yield improvement of 23.8% from GSC 7 variety of gobhi sarson in Himachal Pradesh, 15% from Shalimar sarson 2 variety of brown sarson in Jammu & Kashmir were recorded under rainfed condition. A total of 145 FLDs with 5 component technologies for Indian mustard were carried out by different centres. Among all the components, sulphur and boron fertilization demonstrated by Bharatpur centre had maximum average yield of 2,052 kg/ha. However, maximum yield increase of 58.0% was recorded with seed and plant protection demonstrated by Bhubaneswar centre followed by 29.9% yield increase with Sclerotinia rot management demonstrated by Bansur resulting maximum ANMR of Rs 23,040/ha. Weeding and thinning component demonstrated by Bawal centre gave 19.0 and 15.0% yield enhancement over FP, respectively.

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

1. Quality mustard varieties should be included in FLDs.
2. Timely sown FLDs should be conducted and reported separately with potential yield of the varieties.

3. Regular communication by ICAR-DRMR and all AICRP-RM centres with Directors, States Department of Agriculture/ district extension personnel about the yield gap and technology intervention for respective states should be done.
4. Use all available digital platform for dissemination of R-M technologies.
5. Emphasis should be given on component technology FLDs which should be identified by respective centre based on technology gap in their state/district.
6. At least 10 FLDs should be conducted with each selected variety/ component.

The session ended with vote of thanks to chair.

Frontline Demonstrations on Rapeseed-Mustard 2022-23

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. Emphasis should be given to component technology demonstrations including INP and IPM. 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. One FLD is for one acre plot sixe only. Funds for conducting FLDs will be Rs. 2160.00 for an area of one acre (one FLD). No farmer should be allotted more than one FLD.
4. The binding of one acre area for one demonstration may not be observed, where holdings areas are too small. In these areas, one FLD (one acre area) can be divided in 2-3 farmers as per land holdings available.
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/ pesticides under FLDs should only be given by identifying the gaps in adoption. Growth promoters, Micro nutrients, etc can also 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 to the concerned centres/ 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 including all input, labour and miscellaneous cost 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/ICAR institutes/DAC&FW/ 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, 2023.
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 (2022-23)

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, 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, Bhubaneshwar 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 2022-23

S.No	Zone/Centre	Allotment
	Zone I	
1.	Khudwani	20
2.	Kangra	100
	Sub total	**120**
	Zone II	
3.	Jammu	100
4.	Hisar	100
5.	Bawal	30
6.	Sriganganagar	50
7.	Ludhiana	100
8.	Amity University	50
	Sub total	**430**
	Zone III	
9.	ICAR-DRMR	500
10.	Bansur	120
11.	RVSKVV, Gwalior/ Morena	200
12.	RLBCAU, Jhansi	200
13.	BUAT, Banda (Uttar Pradesh)	100
14.	Kota	100
15.	Pantnagar	100
16.	Kanpur	200
17.	Varanasi	200
18.	Dholi	100
	Sub total	**1820**
	Zone IV	
19.	Jobner	50
20.	Mandore	150
21.	Nagpur	100
22.	S.K. Nagar	100
	Sub total	**400**
	Zone V	
23.	Bhubaneshwar	100
24.	Shillongai	200
25.	Kalyani	50
26.	Kanke	100
27.	DEE, CAU, Imphal	200
28.	DR, AAU, Assam	300
	Sub total	**950**
	Zone VI	
29.	RARS, Jagtial, PJTSAU	30
30.	ICAR-IIOR	50
	Sub total	**80**
	Others	
31.	NGOs/ FPOs/University/KVKs	**2200**
	Grand total	**6000**

XXIXAnnual Group Meeting of AICRP Rapeseed-Mustard
August 1-3, 2022 at RARI, Durgapura, jaipur

Session VI : Planning and Technical Programme Formulation Biochemistry

Chairman : Dr. Sanjeev Gupta, ADG (O&P), New Delhi
Subject expert : Dr. Maharaj Singh, Principal Scientist, CAZRI, Jodhpur
Rapporteurs : Dr. Anubhuti Sharma, Principal Scientist, ICAR-DRMR, Bharatpur
: Dr. Pushp Sharma, Principal Physiologist, PAU, Ludhiana

The technical session on Plant Physiology and Biochemistry was chaired by Dr. Sanjeev Gupta, ADG (O&P) and Dr. Maharaj Singh, Principal Scientist, ICAR, CAZRI; Jodhpur was the subject matter expert. Dr. Pushp Sharma, PI (Plant Physiology), PAU Ludhiana and Dr. Anubhuti Sharma, PI (Biochemistry) presented the salient findings of experiments conducted by different centres during *rabi* 2021-22 of their respective disciplines.

The highlights of the programme of Biochemistry and Plant Physiology in 2021-22 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 ≤20% and ten seedlings dry weight ≥40 mg under controlled lab condition and seedling mortality ≤20% with dry matter ≥6.0g per ten seedlings under field condition. Results indicated only one genotype RMX9310 met the selection criteria at 3 locations under controlled conditions while RH1999-14, Kranti, ORM2019-25,PM25, RH1999-42, KMR(E)21-1, PHR8081,RMX9310, DRMRCI128 and Pro5111 under field condition with tolerance indices >0.62 over checks JD-6 and PM 25 to high temperature . Interestingly, JD6 recorded seedling mortality ≤30% at Bharatpur and Ludhiana under both the tested conditions. Conclusively, under controlled and field conditions, RMX9310 was found thermo tolerant
2. In the second experiment, germplam/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 related physiological along with yield contributing characters, only DRMRCI-96 showed better efficiency under low light with seed yield (≤30%) over the check and other entries tested.
3. Out of 34 breeding lines tested for drought tolerance along with check RH 0725 & RGN-229 only four entries viz.CAU-RMM3, NPJ210, DRMRCI-128 and Kranti at 3 locations (Bharatpur, Hisar and Ludhiana) DRMR118 and JC36 at 2 locations (Hisar and Ludhiana) were highly tolerant whereas NPJ214, DRMRSJ276 and RH1424 were moderately tolerant at Bharatpur, Hisar and Ludhiana. These entries maintained higher chlorophyll content, RWC, SPAD values and lesser decline in siliquae on main shoot, seeds per siliqua, seed weight and higher yield stability index under drought condition.
4. Only JC32 at 2 centres (Bharatpur and Ludhiana) along with Kranti and RH 2050 at 3 locations (Dholi, Hisar and Ludhiana) were identified as high temperature tolerant for terminal stage while PM26, HUJM20-6 and JC1 showed moderate tolerance at all the 4 locations . Out of 31 tested entries, these 3 identified entries showed thermo tolerance with high heat stability index (HSI≥0.5), YSI (≥0.55) and SY decline of ≤30%.
5. Only one entry CS2020-10 surpassed check CS-54 and Kranti for salinity tolerance at seedling stage.
6. Foliar application of trehalose @20mM, 2 % of urea and KNO_3 were identified to mitigate drought and improved mustard yield
7. Physiological traits and osmoprotectants enhanced with the microbial treatments under moisture stress at Dholi and Ludhiana. Maximum increase was with CRIDA MI II trailed by Biophos and Biophos$^+$ and MRD17 for RWC, SPAD with CRIDAMI II , total chlorophyll with both the CRIDA MI strains along with MRD17 and Biophos and Biophos $^+$ while proline and total sugars with CRIDA MI I at Ludhiana .
8. Variations existed for the physiological, yield attributes and seed yield in Giriraj, RH725 and PBR357 with microbial formulation (CSIR- Lucknow) and Pusa Sanjeevni (IARI-New Delhi) at Bharatpur, Dholi , Hisar and Ludhiana in normal and late plantings. Seed yield improved with both the inoculations in the NS and LS varieties at 4 locations except for RH725 inoculated with microbial formulation under LS condition at

Bharatpur, RH725 and Giriraj inoculated with Pusa Sanjeevani under normal and late sown conditions respectively at Hisar over un inoculated control.

After the presentation, the chairman suggested to revise the technical programme for physiological evaluation of AVT germplasm for marker traits. Professor S. S.Banga, Raja Ramanna Fellow offered to supply germplasm lines already characterized for transcriptomics for remobilization studies. The centres agreed to conduct the experiment.

The highlights of the programme of Biochemistry were:

1. IVT/AVT quality trials were evaluated at Bharatpur, Pantnagar, Hisar and Ludhiana. Among the 17 genotypes analyzed, Oil stability index which is the ratio of MUFA: PUFA, it ranged from 0.86 in DRMR Q143-9 to 1.70 in PDZM-31(CV ≤ 0.20). Entries were also analyzed for fatty acid profile and it has Palmitic acid ranged from 2.86% (DRMRQ 143-9) to 5.13 % (PDZ-16). (CV ≤ 0.17). **Stearic acid**: 1.26 % (DRMRQ 143-9) to 2.73% (LES-60). (CV ≤ 0.19). **Oleic acid:** 13.02 % (DRMRQ 143-9) to 50.66 % (PDZM-31). (CV ≤ 0.21). **Linoleic acid:** 15.13 % (DRMRQ 143-9) to 42.11 % (PDZ-16). (CV ≤ 0.20). **Linolenic acid:** 10.36 % (LES-65) to 21.16 % (DRMRQ 143-9). (CV ≤ 0.24). **Eicosanoic acid**: 0.56 % (RH (OE)-1807) to 1.31 % (DRMRQ 143-9). (CV ≤ 24). **Erucic acid**: 0.33 % (PM-32) to 46.18 % (DRMRQ 143-9). (CV ≤ 2.23). ω6: ω3 ratio ranged from 0.72 (DRMRQ 143-9) to 3.97 (PDZ-16). (CV ≤ 0.37). SFA: MUFA: PUFA ratio ranged between 1:05:07 to 1:19:11. Saturated and unsaturated ratio ranged between 41:12 to 1:30. (CV≤0.15). Nutritional Profiling of IVT/AVT entries of quality trials were observed.
2. Nutritional Profiling of entries of IVT/AVT quality trials observe total protein ranged from 29.61% (PM-32) to 33.88% (PM-29) (CV ≤ 0.05). Total antioxidant capacity ranged from 14.54 (PDZ-14) to 23.04 (LES-64) mg/g AAE (CV ≤ 0.15). **β-carotene** ranged from 2.99% (LES-65) to 5.01% (LES-60) (CV ≤ 0.13). **Total sinapic acid content** ranged from 1.25% (LES-60) to 2.23% (RH (OE)-1807) (CV ≤ 0.15). IVT/AVT quality trials were also analyzed for mineral composition through AAS**.** The promising genotypes having high copper content were PM-30 (0.89 ppm), DRMRQ 143-9 (0.86 ppm), LES-60 (0.82 ppm). The promising genotypes having high zinc content were PDZ-15 (0.957 ppm), RH (OE)-1808 (0.854 ppm), LES-60 (0.845 ppm), PM-30 (0.833 ppm). The promising genotypes having high iron content were PM-30 (16.58 ppm), RH (OE)-1808 (15.48 ppm), PDZ-15 (13.38 ppm). The promising genotypes having high Mn content were PM-30 (0.614 ppm), RH (OE)-1612 (0.518 ppm).
3. Estimation of anti-nutritional factors in quality breeding materials includes total glucosinolate content and phytic acid analysis. Total Glucosinolate mean values for four centres (Bharatpur, Pantnagar, Ludhiana, Hisar) were <30 µmol/g in PDZ-16, PDZ-17, PDZ-14, PDZ-15 and PDZM-31 genotypes. It ranged from 15.93 µmol/g (PDZ-16) to 62.02 µmol/g (LES-60) (CV ≤ 0.34). Phytic acid content mean values were < 2.25% in LES-64, LES-65, DRMR Q 143-9, PM-30, PM-32, PM-29, PDZ-15 and PDZM-31. Aliphatic glucosinolates were identified as sinigrin, tropeolin, gluconapin and few unknown peaks were unidentified using UPLC.Data was statistically analysed using SPSS version 22 software.

Technical Programme 2022-23
Plant Physiology

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

Entries of AVT (early/ germplasm) along with promising strains of 2021-22: RMX 9310, RH1999-42, DRMRCI133, DRMRCI125, KMR(E) 21-1, PHR-8081, Pro5111, Kranti, DRMR 2019-19, DRMRSJ 272, DRMRHT13-13-5-4, DRMRHT13-13-5-5, ORM2019-25, PRE2018-10, RH1999-42, DRMR20-33, DRMR19-5, DRMR 19-21, DRMR1167, DRMR-1188, DRMRCI128,DRMRCI145,DRMRCI165,DRMRCI166 ,DRMRCI 167,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 $25 \pm 1^{o}C$ for germination.
3. After 4-5 days (when the seedlings have about 2.5 cm height), the seedling should be exposed to high temperature ($45 \pm 1^{o}C$) with 30-40% relative humidity for 4 hours daily for 4 days.
4. Maintain uniform soil moisture level

Observations: Seedling mortality, dry weight (10 seedlings) and TTC test

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.

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), canopy temperature, membrane stability, seedling thermo tolerance index (STI) and seed to seedling thermotolerance index (SSTI).

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

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

6.2 Screening of genotypes for drought tolerance

Entries of AVT (rainfed/ germplasm) along with promising strains identified during 2021-22: DRMRSJ276, RH1424, DRMR1222, JC36, CAU- RMM 3, NPJ210, NPJ214 , DRMRCI 128 ,DRMR20-33, DRMR19-5, DRMR 19-21, DRMR1167, DRMR-1188, DRMRHJ 1117, DRMRCI128, DRMR CI146, DRMRCI 148, DRMRCI 161, DRMRCI 162 , DRMRCI 163 ,DRMR2019-7, DRMR2019-19 and Kranti Checks: RH 0725 & 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 2^{nd} 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: Dholi, Bharatpur, Hisar and Ludhiana.

6.3 Screening of genotypes for high temperature tolerance at terminal stage

Entries of AVT (late sown/ germplasm) along with promising strains from 2021-22: JC32, RH 2050, HUJM-20-6, JC1, NPJ 250, NPJ 251, DRMRHJ 430, DRMR 2018-19,CS56,NRCHB101,Radhika, Kranti,DRMR20-33, DRMR19-5, DRMR 19-21, DRMR1167, DRMR-1188, DRMRCI128, DRMRCI145 ,DRMRCI165,DRMRCI166,DRMRCI 167,DRMRHT-1712 , DRMR 2019-19, DRMR 2019-7 Check: PM-26 & BPR 543-2

Procedure: 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/siliqua, 1000 seed weight, seed yield (kg/ha) and heat stability index (HSI) and yield stability index (YSI).
Centers: Dholi, Bharatpur, Hisar and Ludhiana

6.4 Effect PGRs to mitigate drought stress
Latest released local variety for rain fed condition.
Methodology

1. Rainfed variety will be sown in 5 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 at Initiation of flowering and 50% flowering stage.
Design: RBD, **Replication**: 3
Observations: Photosynthetic pigments in 3rd or 4th 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) ,seed yield (kg/ha) and **B:C ratio**.
Centers: Dholi, Bharatpur**,** Hisar and Ludhiana

6.5 Enhancing productivity of rapeseed mustard through microbes under moisture stress
(Physiologists are associated with AGRONOMY trial for recording data*)
Treatments: A i) No culture
ii) Biophos
iii) Biophos and Biophos+
iv) CRIDA MI I
v) CRIDA MI II
vi) MRD17
vii) 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, Bharatpur**,** Hisar and Ludhiana

6.6 Microbes for mitigating temperature stress in mustard

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

Varieties: PBR357, RH725 and Giriraj
Microbial cultures will be applied as seed dressing before sowing
Design: SPD **Replication**: 3

Observations: Soil microbial counts before and after sowing, ambient temperature (from flowering to maturity), photosynthetic pigments (chla, chlb, 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: Dholi**,** Bharatpur, Hisar and Ludhiana

6.7: **Evaluation of germplasm /breeding lines for remobilization efficiency**
Methodology: About 140 lines will sown in paired rows each of 2m row length at optimum date of sowing. Protocol for recording wilting time by TWIG METHOD will be provided by Professor S.S Banga, Raja Ramanna Fellow, PAU, Ludhiana.
Observations: Wilting time, remobilization efficiency based on dry matter, main shoot length, siliquae on main shoot and seed yield
Centres: Dholi**,** Bharatpur, Hisar and Ludhiana

Technical Programme 2022-23
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. ω6/ω3 ratio
4. Oil stability index
5. SFA: MUFA: PUFA
6. Saturated and unsaturated fatty acid ratio

Centers: Bharatpur, Ludhiana, Hisar, Pantnagar

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

Parameters:

1. Total protein content
2. β-carotene content
3. Total Antioxidant content
4. Total sinapine content

Centers:Bharatpur, Pantnagar, Hisar, Ludhiana

5. Glucosinolate profiling (By HPLC/UPLC)

Centers: Bharatpur, Ludhiana

7.3. Screening of anti-nutritional factors in quality breeding material

Parameters:

1. Total Glucosinolates
2. Phytic acid

Centers: Bharatpur, Pantnagar, Hisar, Ludhiana

7.4. Biochemical basis of resistance to be evaluated for entomology trials.

Parameters:
Total Phenolic content

Total Enzyme activity (Myrosinase)
Centers: Bharatpur, Ludhiana, Hisar, Pantnagar

Entries for Biochemical analysis:

- **IVT, Quality Mustard**

SN	Entry	Pedigree	Method of breeding	Centre
1.	Pusa QMH 1	PM 30(eru) X LES 1-27R	Hybrid Breeding	IARI, New Delhi
2.	LES 66	LES 1-27 X PDZ-3	Pedigree selection	IARI, New Delhi
3.	LES 67	LES 1-27 X PDZ-2	Pedigree selection	IARI, New Delhi
4.	PDZ 18	Agrani X Heera	Pedigree selection	IARI, New Delhi
5.	PDZ 19	PDZ-3 X RLC-3	Pedigree selection	IARI, New Delhi
6.	PMAS 7	Derived through MABC PBR 357/ RLC 3// PBR 357	Marker assisted back cross breeding	PAU Ludhiana
7.	PMAS 11	Derived through MABC PBR 357/ RLC 3// PBR 357	Marker assisted back cross breeding	PAU Ludhiana
7	RH(OE) 1708	NOID X EC 597324	Pedigree (Zero Erucic Acid)	CCS, HAU, Hisar
8	RH(OE) 1806	EC 597328 X RH(OE) 0502	Pedigree (Zero Erucic Acid)	CCS, HAU, Hisar
9	DRMRCI(Q) 158	NRCHB- 101 X Heera	Pedigree	ICAR- DRMR, Bharatpur
10	DRMRCI(Q) 172	NRCDR- 2 X RLC- 3	Pedigree	ICAR- DRMR, Bharatpur
11	DRMRQ 29-20	EC5973 X PM 24	Pedigree method of breeding	ICAR- DRMR, Bharatpur
12	LR			
13	PM 30 (NC quality)			
14	PDZ11 (double low check)			

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

- Biochemical analysis of 17 varieties of Rapeseed Mustard which are still in seed chain.

Recommendations

1. For the promotion of variety oil content should be more than 38.5%. This recommendation has been placed in breeding trials.
2. Profiling of top varieties of RM which are still in seed chain should be analyzed biochemically.
3. Promising varieties with more than 45% oleic acid should be identified. And if there is no variety with >45% oleic acid then in the summary oleic acid should be written as "NIL".
4. Minimum of 250gm of samples should be send for analysis.
5. Experiment for mineral analysis by AAS should be removed due to lack of facilities.

XXIX Annual Group Meeting of AICRP Rapeseed-Mustard
August 01-03, 2022 at RARI, Durgapura, Jaipur

Session **: Plenary Session**
Chairman **:** Dr. Sanjeev Gupta, ADG (O&P), ICAR, New Delhi
Chief Guest **:** Dr. J.S. Sandhu, Vice Chancellor, SKNAU, Jobner
Convener **:** Dr. P.K. Rai, Director, ICAR-DRMR, Bharatpur
Rapporteurs **:** Dr. H.K. Sharma, Sr. Scientist, ICAR-DRMR, Bharatpur
: Dr. Prashant Yadav, Scientist, ICAR-DRMR, Bharatpur

The session started with presentation of recommendations of each technical session by Principal Investigators of each discipline. Dr. K. H. Singh, PI (Plant breeding) presented salient recommendations of plant breeding session. Chairman suggested to include the thousand seed weight of more than 4.5g for promotion of hybrids in hybrid evaluation trials.Dr. R.S. Jat presented the highlights of agronomy session. Dr. P. D. Meena presented the highlights of plant pathology session and Dr. Srawan Kumar presented highlights of entomology session. The highlights of plant biochemistry session were presentedby Dr. Anubhuti Sharma, followed by highlight of plant physiology session by Dr. Pushp Sharma.

Dr. P.K. Rai, Director, ICAR-DRMR presented the proceedings of VIC. He told that 8 varieties of rapeseed-mustard (07 Indian mustard, 01 Gobhi Sarson) were recommended by varietal identification committee. In his presidential address Chairman congratulated and appreciated the efforts of the centres and scientists whose varieties were identified during 29th AGM. He told that some trials were temporarily discontinued until the sufficient material for these trials are not available. Further, he informed the house that a new programme has been initiated for latest and mega varieties of Indian mustard for tolerance to white rust and stem rot diseases using marker assisted backcross breeding. He further suggested to include analysis of phyto-constituents and enzyme assays for screening for Aphid tolerance. He praised the efforts made for extension of rapeseed-mustard technologies through FLDs, SCSP, NEH and APART programme. He told that there is a need for further extension of mustard technologies in Bodo Land. Dr. J.S. Sandhu, Vice Chancellor, SKNAU, Jobner congratulated on identification of 08 varieties of rapeseed-mustard. He thanked ICAR and Dr. P.K. Rai, Director, DRMR for selecting the RARI, Durgapura for hosting the AGM.

Later on Dr. K.P. Prajapati, SKNAU, S.K. Nagar; Prof. S.J. Jambhulkar, BARC, Mumbai and Dr. Anil Pandey, Dr. RPCAU, Dholi were felicitated on the occasion of their superannuation. The session ended with the vote of thanks given by Dr. P.K. Rai, Director, ICAR-DRMR. He conveyed his regards to Dr. J.S. Sandhu, Vice Chancellor, SKNAU, Jobner and Dr. M.L. Jakhar, Director Research, SKNAU, Jobner for hosting the 29th AGM at RARI, Durgapura, Jaipur. He expressedhis 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. He also thanked all the esteemed subject experts and all the delegates.