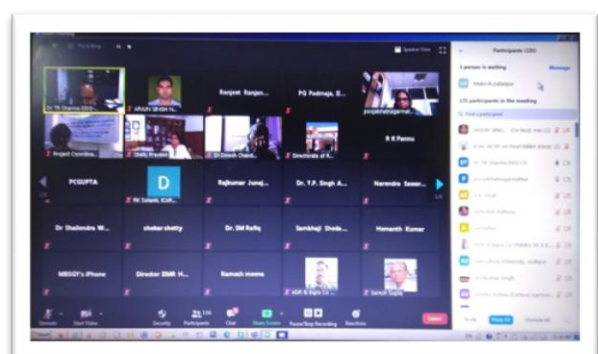
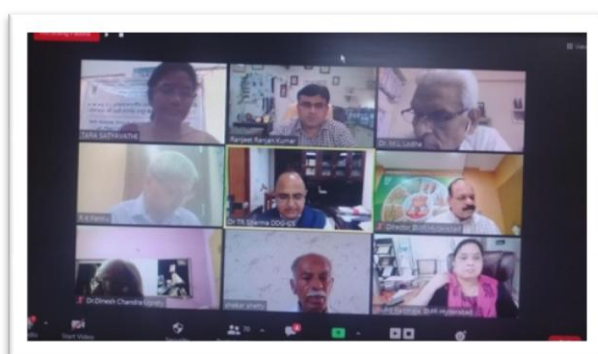
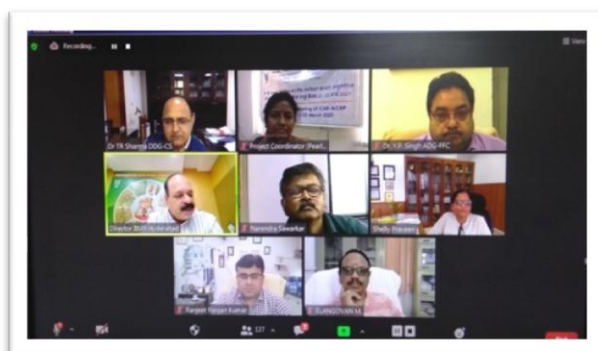


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**Proceedings of 56th Online Annual Group Meeting
of
ICAR-All India Coordinated Research Project on Pearl Millet
(March 22-23, 2021)**



**ICAR-All India Coordinated Research Project on Pearl Millet
Mandor, Jodhpur 342 304**

<https://aicrp.icar.gov.in/pearl/>

www.aicpmip.res.in



AGENDA

19th March, 2021

09:00-16:30	Review of Research Results of AICRP-PM Centres 2020-2021 (Centre-wise presentation of significant results and progress report)
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Day 1: March 22, 2021 (Monday)

Time	10:00 – 11:30 AM	Session I: Review of Research Results and Progress report 2020-21
	Chairman	Dr. T.R. Sharma, DDG (CS) ICAR, New Delhi
	Co-chairs	Dr. Y.P. Singh, ADG(FFC), ICAR Dr. Vilas A Tonapi, Director, ICAR-IIMR, Hyderabad
	PAMC Experts	Dr. P. Raghava Reddy, Ex VC, ANGRAU, Hyderabad Dr. R.K. Pannu, Ex. Dean, CS HAU, Hisar Dr. H.S. Sekhar Shetty, Ex Professor, Downy Mildew Research Lab, Univ. of Mysore Dr. M.L. Lodha, Division of Bio-Chemistry, IARI, New Delhi Dr. DC Uprety, Ex Principal Scientist, Division of Plant Physiology, IARI
	Rapporteurs	Dr. P.S. Shekhawat, SKRAU, Bikaner Dr. Sanjana Reddy, ICAR-IIMR, Hyderabad
10:05-10:25	Presentation of Research Highlights in Pearl Millet 2020-21	Dr. C. Tara Satyavathi, PC, ICAR-AICRP on Pearl millet, Jodhpur
Discipline-wise Presentation		(PI Presentation- 10 minutes for each presentation)
10:25-10:35	Plant Breeding	Dr. Vikas Khandelwal, ICAR-AICRP on Pearl millet, Jodhpur
10:35-10:45	Agronomy	Dr. Anil Kumar, CCS HAU, Hisar
10:45-10:55	Plant Pathology	Dr. Chandra Nayak, UoM, Mysore
10:55-11:05	Entomology	Dr. R.K. Juneja, JAU, Jamnagar
11:05-11:15	Plant Physiology	Dr. R.C. Meena, ICAR-AICRP on Pearl millet, Jodhpur
11:15-11:25	Plant Biotechnology	Dr. Supriya, ICAR-AICRP on Pearl millet, Jodhpur

11:30 – 13.30	Session II: Discipline-wise planning and finalization of technical programmes	
Discipline	Co-chairs	Rapporteurs
Crop Improvement (11:30-12:15)	Dr. P. Raghava Reddy, Chairman, PAMC Dr. C. Tara Satyavathi, PC, ICAR-AICRP on Pearl Millet, Jodhpur	Dr. Vikas Khandelwal/ Dr. Supriya ICAR-AICRP on Pearl millet Dr. L.D. Sharma, RARI, Durgapura
Crop Production (12:15-12:45)	Dr. R.K. Pannu, Ex. Dean CCS HAU, Hisar Dr. D.C. Uprety, Ex Principal Scientist, Division of Plant Physiology, IARI	Dr. Anil Kumar, CCS HAU Hisar Dr. Meenakshi Grover, ICAR-IARI
Crop Protection (12:45-13:30)	Dr. H.S. Sekhar Shetty, Ex Professor, Downy Mildew Research Lab, Univ. of Mysore	Dr. Chandra Nayak, UOM, Mysore Dr. Raj Kumar Juneja, ICAR-AICRP-PM, Junagarh

13:30-14:30	Lunch
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14:30 – 16:00	Session III: Review of Research Results of ICAR-ICRISAT Collaborative Projects 2020-21 and Plan of Work 2021-22; Review of Frontline Demonstrations for 2020-21 and Action Plan 2021-22	
	Chairman	Dr. S.K. Malhotra, Agri. Commissioner, DAC, New Delhi
	Co-Chairs	Dr. Vilas A. Tonapi, Director, IIMR, Hyderabad; Dr. C. Tara Satyavathi, PC, ICAR-AICRP on Pearl millet, Jodhpur
	Rapporteur	Dr. K.D. Mungra, JAU, Jamnagar
14:30-14:50	Progress report of ICAR-ICRISAT Partnership trials 2020-21	Dr. B.R. Beniwal, ICAR-AICRP on Pearl millet, Jodhpur
14:50-15:00 15:00-15:10	Partnership trials for 2021-22 - Breeding - Marker assisted breeding trials	Dr. S.K. Gupta, Principal Scientist (Pearl millet breeding), ICRISAT Dr. Rakesh Srivastava, Principal Scientist (Pearl millet Molecular breeding), ICRISAT
15:10-15:25	Progress reports on FLDs	Sh. Manoj Kumar, ICAR-AICRP on Pearl millet, Jodhpur

16:00– 17:30	Session IV: Varietal Identification Committee Meeting	
Chairman	Dr. T.R. Sharma, DDG (Crop Science), ICAR, New Delhi	
	All the members of the VIC	
Member Secretary	Dr. C. Tara Satyavathi, PC, ICAR-AICRP on Pearl millet, Jodhpur	

Day 2: March 23, 2021 (Tuesday)

10:00 – 12:30	Session V: New initiatives for pearl millet research	
	Chairman	Dr. T.R. Sharma, DDG (CS), ICAR, New Delhi
	Co-chairs	Dr. Y. P. Singh, ADG(FFC), ICAR, New Delhi Dr. Vilas A Tonapi, Director, ICAR-IIMR, Hyderabad
	Rapporteurs	Dr. R.K. Kakani, ICAR-CAZRI, Jodhpur Dr. Supriya, ICAR-AICRP on Pearl Millet, Jodhpur
10:05-10:30	Genetic gain in pearl millet, development of material & technologies for A ₁ zone	Dr. C. Tara Satyavathi, PC, ICAR-AICRP on Pearl millet, Jodhpur
Addressing rancidity and improving shelf-life in pearl millet		
10:30-10:50	ICAR-IARI, New Delhi	Dr. Shelly Praveen, Head, Division of Biochemistry, ICAR-IARI, New Delhi
10:50-11:10	ICAR-IIMR, Hyderabad	Dr. P.G. Padmaja, Principal Scientist, IIMR, Hyderabad
11:10-11:30	ICRISAT	Dr. Pooja Bhatnagar, Principal Scientist, ICRISAT
11:30-11:50	Information system on Pearl millet	Dr. Rajendra Prasad, Director, ICAR-IASRI, New Delhi

11:50-12:10	ICAR - BMGF Project: Pearl millet BMS	Dr. Abishek Rathore, Principal Scientist, ICRISAT
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12:30 – 13:30	Session VI: Review of DUS Testing Project, Progress Report 2020 -21 and Review of BSP 2020-21 and Action Plan 2021-22	
	Chairman	Dr. O.P. Yadav, Director, ICAR-CAZRI, Jodhpur
	Co-chair	Dr. T.K. Nagarathna, Registrar, PPV&FRA, New Delhi
	Rapporteur	Dr. Dev Vart Yadav, CCS HAU, Hisar Dr. Arun Kumar MB, ICAR-IARI, New Delhi
12:35-12:50	Presentation	Progress Report of DUS testing in pearl millet - Dr. Vikas Khandelwal, ICAR-AICRP on Pearl millet, Jodhpur
12:50-13:10		Breeder Seed Production- Dr. Vikas Khandelwal, Sr. Scientist (GPB), ICAR-AICRP on Pearl Millet

13.30 – 14.30	Lunch Break
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14:30 – 16:30	Session VII: Plenary Session/ Session-wise Presentation & Recommendations	
	Chairman	Dr. T.R. Sharma, DDG (CS), ICAR, New Delhi
	Guest of Honour	Dr. Y.P. Singh, ADG (FFC) , ICAR, New Delhi
		Dr. Vilas A. Tonapi, Director, ICAR-IIMR, Hyderabad
	Rapporteur	Dr. R.K. Solanki, ICAR-CAZRI, Jodhpur
14:30-14:35	Welcome and initial remarks	Dr. C. Tara Satyavathi, Project Coordinator, ICAR-AICRP on Pearl millet, Jodhpur
14:35-15:05	Technical Sessions	Respective Rapporteurs of technical sessions (05 minute each)
15:05-15:45	Remarks by PAMC experts	All experts
15:45-15:50	Remarks by Guest of Honours	Dr. Y.P. Singh, ADG(FFC) , ICAR
15:50-15:55		Dr. Vilas A. Tonapi, Director, ICAR-IIMR, Hyderabad
15:55-16:05	Release of Publications, Felicitation of retiring employees, Awards	
16:05-16:35	Plenary Address	Dr. T.R. Sharma, DDG (CS), ICAR, New Delhi
16:35-16:40	Vote of thanks	Dr. Vikas Khandelwal, Senior Scientist, ICAR-AICRP on Pearl millet, Jodhpur

12th April, 2021

10:30-13:00	ICAR-AICRP on Pearl Millet Centers Breeders Meeting
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Review of Research Results of ICAR-AICRP on Pearl millet funded centres (2020-21)

An online meeting was held via zoom platform on 19th March, 2021 to evaluate the performance of different centers of ICAR-AICRP on Pearl millet. The evaluation was done by the PAMC. At the outset of the meeting, Project Coordinator welcomed the Chairman and all PAMC experts. The session was chaired by Dr. Vilas A Tonapi, Director, ICAR-Indian Institute of Millets Research and Co-chaired by Dr. C Tara Satyavathi, Project Coordinator, ICAR-AICRP on Pearl millet, Jodhpur. PAMC experts, Dr. P. Raghava Reddy, Ex VC, ANGRAU, Hyderabad; Dr. R.K. Pannu, Ex Dean CCS HAU, Hisar; Dr. H.S. Shekhar Shetty, Ex Professor, Downy Mildew Research Lab, Univ. of Mysore; Dr. M.L. Lodha, Ex-Head Division of Biochemistry, IARI, New Delhi; Dr. DC Upreti, Ex Principal Scientist, Division of Plant Physiology, IARI comprised the evaluation committee for the meeting.

The progress made during 2020-21 was presented by respective centre PIs of different ICAR-AICRP on Pearl millet centre. In depth, discussions were held after each centre presentation and the following observations and suggestion were made:

SKRAU, Bikaner- Dr. PS Shekhawat presented the progress report and following suggestions were made:

- Soil analysis should be carried out before and after sowing.
- Work on development of mapping population should be initiated.
- Effective mechanism of soil moisture conservation should be followed.

RARI, Durgapura- Dr. L.D. Sharma presented the progress of the centre and following suggestions were given:

- Seed of parental lines should be sent to the PC Unit, Jodhpur as per last year's recommendation to form a National Repository of pearl millet parental lines.
- A mapping population should be developed by the centre for downy mildew and details of parental lines involved should be shared with PC-Unit, Jodhpur.
- Parental lines and hybrid seed production of recently released biofortified hybrids namely RHB 233 and RHB 234 should be taken up intensively for making them popular among the farmers in similar lines as made by Aurangabad centre.
- As the centre has good physiological facilities, more field experiments should be taken up and pot culture experiments should be avoided.
- Post of plant physiologist should be filled up.
- NAAS rating in publications should be indicated.

CCSHAU, Hisar- Dr. Dev Vrat Yadav presented the progress report. The following suggestions were given by the Project Coordinator and PAMC expert members:

- As per previous year's recommendation, few grams of seed of parental lines should be sent to the PC Unit, Jodhpur to form a National Repository of pearl millet parental lines.

- The activity on characterization and cataloguing of germplasm available at centre should be completed.
- Documentation of various technologies developed by the centre should be completed.
- Details on the parental lines involved in development of mapping population for blast should be shared with PC-unit.
- Blast isolates should be collected from all representative locations and sent to Dr. Chandra Nayaka, PI, Plant Pathology, University of Mysore.
- Efforts in lines similar to Aurangabad centre should be made to popularize recently released biofortified hybrids namely HHB 299 and HHB 311.
- 1-2 slides on pre breeding activities should be shared with PC-Unit.
- Centre wise presentation is made only by the centre incharge and not discipline wise from the centre.
- Publications should be listed instead of numbers.

RVSKVV, Gwalior- Dr. R.K. Pandya presented the progress of the centre and the following observations were made:

- Breeder should focus on development of hybrids/varieties as per the preference of farmers (tall hybrids with long panicles)
- Results involving cow urine may be standardized at the location before discussion at national level. Quantification of performance of cow urine should also be looked into.
- Pre-breeding activities and mapping population development should be initiated.
- Seed replacement rate is very high (about 80%) and need to be checked.
- As Mysore centre has also developed diagnostic markers for blast, the centre has to discuss with Dr. Chandra Nayaka, PI, Plant Pathology regarding SSR markers.
- Pearl millet publications with NAAS rating should be sent to PC-Unit, Jodhpur and also included in the presentation.

PAU, Ludhiana- Dr. Ruchika Bhardwaj presented the progress report. The presentation was appreciated and the following suggestions were given:

- Resistance and susceptible lines based on disease scores taken under natural condition should be confirmed under artificial inoculation before using them in breeding program.
- Blast should be inoculated in seedling as well as adult plant stage.
- Resistance sources of blast can be obtained in collaboration with Dr. Chandra Nayaka for the development of mapping population.

JAU, Jamnagar- Dr. K.D. Mungra presented the progress report. Project Coordinator appreciated the efforts made for collecting Jafrabadi landrace. The following suggestions were given by the Project Coordinator and the expert members:

- Since plant pathologist is retiring, alternate arrangements for recruitment should be made.
- Data in pathological trials that were abandoned due to rains should be shared.

- Though downy mildew is less during 2020-21, downy mildew should be strictly monitored in farmer's fields and economics should be worked out.
- Entries should be rechecked for resistance and escape mechanism.
- Work should be taken up for value addition of biofortified hybrids developed by the centre.
- Number of slides should be minimized.
- Plant physiologists should be involved in the summer work also.
- Popularization of technologies should be given due emphasis.

ANGRAU, Ananthapuramu- The progress report was presented by Dr. R. Narasimuhulu. The work on extension and breeding was appreciated. The suggestions given are as follows:

- Hybrids with significantly superior performance need to be promoted and entered in AICRP trials.
- Work related to pearl millet only should be presented.
- Efforts should be made to publish more scientific papers.

NARP, Aurangabad- Dr. SB Pawar presented the progress report and the centre was appreciated for the extension work and popularization of biofortified hybrids which were reflected in breeders' seed indent. The centre was suggested that efforts should be made for bringing in more scientific publications.

TNAU, Coimbatore- Dr. K. Iyanaar presented the progress report and the following suggestions were given for the centre:

- Quality of publications should be improved.
- Characterization of germplasm lines should be completed and a small quantity of seed should be shared with ICAR-IIMR gene bank to be maintained as a duplicate set.
- Downy mildew incidence in indicator row should be mentioned since all lines are resistant in the pathology experiment, the scoring should be doubly checked.
- Value addition and product development work should be given priority.

MPKV, Dhule- Dr. Vikas Pawar presented the progress report and the centre was appreciated for the progress and following suggestions were given:

- Seed of parental lines should be sent to the PC Unit, Jodhpur as per last year's recommendation to form a National Repository of pearl millet parental lines.
- Work on pre-breeding should be started.
- Materials developed by Dr. Patil (Retired Pearl millet breeder) should be maintained.
- Characterization and documentation of germplasm should be done.
- Seed indent for released hybrids and MoU with private sector should be pursued so that hybrids developed by centre are popularized among farmers.
- Newly developed hybrids should be monitored for blast.

UOM, Mysore- Dr. Chandra Nayaka presented the progress report. The work done at the center was appreciated by Project Coordinator and the PAMC expert members. Only one suggestion was made:

- Additional studies on elicitors in case of downy mildew need to be taken up.

UAS, Vijayapur- Dr. B.K. Athoni presented the progress report and the following suggestions were given for the centre:

- The hybrids and varieties released from the station should be popularized among farmers through FLDs and bring them in seed production chain.
- Mapping population for blast and rust should be developed.
- Soil analysis before sowing and after harvesting should be taken up in farmer's field.
- Work on blast pathogen should be carried forward.

General observations made by Project coordinator and PAMC experts-

- Popularization of hybrids and varieties developed by the respective centres in the targeted areas.
- All centers should set goal for productivity enhancement.
- Promotion of pearl millet in tribal areas to be taken up wherever possible by the centers.
- Pre-breeding work should be strengthened.
- Focus should be given on quality of publications and publish in high impact factor journals.
- Budget given should be utilized in the financial year itself.

Overall, Dr. Pannu (PAMC expert member & Ex-QRT member) appreciated that the quality of work and presentation has improved significantly and is reflected in yield increases of pearl millet. Dr P. Raghava Reddy also mentioned that the centers have improved with respect to material generation and quality of presentations. They have to popularize their products through their seed production programs and FLDs. Technologies identified should be included in package of practices and implemented through Department of Agriculture. Good work on biofortification has been reported by all the centers and from here on the product development has to be concentrated. Crop management practices should focus on obtaining more yield improvement. Targets have to be set by breeders of all centers on achievable yield levels. Project Coordinator, Pearl millet informed the centers that all steps are being taken up regarding budget in pursuing with ICAR headquarters and ICAR-IIMR. No shortage is expected regarding pay and allowances. However, everyone should take necessary steps to spend the amount given towards contingencies. Promotion of millet in tribal areas under TSP should be targeted by all centers especially those centers located in Rajasthan should gear up.

The meeting ended with the vote of thanks.

SESSION I**Review of Research Results and Progress Report 2020-21**

Chairman	Dr. T.R. Sharma, DDG (CS) ICAR, New Delhi
Co-chairs	Dr. Y.P. Singh, ADG(FFC), ICAR Dr. Vilas A Tonapi, Director, ICAR-IIMR, Hyderabad
PAMC Experts	Dr. P. Raghava Reddy, Ex VC, ANGRAU, Hyderabad Dr. R.K. Pannu, Ex Dean, CCS HAU, Hisar Dr. H. Shekhar Shetty, Ex Professor, Downy Mildew Research Lab, Univ. of Mysore Dr. M.L. Lodha, Division of Bio-Chemistry, IARI, New Delhi Dr. DC Uprety, Ex Principal Scientist, Division of Plant Physiology, IARI
Rapporteurs	Dr. P.S. Shekhawat, SKRAU, Bikaner Dr. Sanjana Reddy, ICAR-IIMR, Hyderabad
Date	22 nd March, 2021

The 56th Annual Group Meeting of ICAR-AICRP on Pearl millet was held online via Zoom on 22nd-23rd March, 2021. Dr. T. R. Sharma, DDG (Crop Science), ICAR, New Delhi chaired the session while Dr. Y.P. Singh, ADG (FFC), ICAR, New Delhi and Dr. Vilas A Tonapi, Director, ICAR- Indian Institute of Millets Research, Hyderabad co-chaired the session. Around 150 participants including PAMC Chairman, Dr. P. Raghava Reddy and members Dr. M.L. Lodha (Biochemistry), Dr. R.K. Pannu (Agronomy), Prof. H. Shekhar Shetty (Plant Pathology) and Dr. D.C. Uprety (Plant Physiology), Directors from various ICAR institutes and scientists from public sector, private sector and ICRISAT attended this online meeting.

Research Highlights in Pearl millet 2020-21

Dr. C. Tara Satyavathi, Project Coordinator, ICAR-AICRP on Pearl millet, Jodhpur welcomed all the guests and participants and presented research highlights of various experiments in Pearl millet conducted during 2020-21. She briefed about the availability of MS lines, restorers and germplasm lines with all the AICRP centers. She also informed that about 77 new hybrids, 39 released hybrids were evaluated in 14 trials across 57 test locations during 2020-21, 12-18q of breeder seed of 31 parental lines and 5 OPVs was produced. Two recommendations were generated from agronomy discipline which can be popularized among farmers. Out of 324 ha under FLDs, around 60.4 ha was covered with biofortified hybrids. Further, she added that more incidences of rust and blast were observed during 2020-21. 13 candidate varieties were characterized for DUS traits. Three MoUs were signed with private seed companies by different AICRP on Pearl millet centers.

Presentations were made by Principal Investigators of different disciplines on progress made during 2020-21 in this session:

Plant Breeding: The presentation was done by PI, Plant Breeding, Dr. Vikas Khandelwal, ICAR-AICRP on Pearl Millet, Jodhpur. He stated that 176 trials were allotted to different centers. Out of which, 166 trials were successfully conducted by different centers in all zones. A total of 24 entries were promoted in different trials while 3 entries completed three years of testing. DDG, Dr. T.R. Sharma asked the breeders to broaden the genetic base as genetic variability is the major problem in the program. He also suggested to prepare a crossing plan in coordination with Director, IIMR and the responsibility of the same should be given to the respective centre.

Agronomy: PI, Agronomy, Dr. Anil Kumar, CCSHAU, Hisar presented the progress report of Agronomy discipline. He informed that 43 of 45 trials under five experiments were successfully conducted during 2020-21. Two recommendations based on weed control studies and application of nutrients through organic source of FYM or Vermicompost along with biofertilizer Biomix (*Azospirillum* + PSB), respectively emerging from previous years experiments were also presented.

DDG, Dr. T.R. Sharma asked the presenters to follow a format showing targets, achievements and recommendations. The available recommendations should be put in VIC meeting. Initial levels of soil nutrients and residual moisture should be also added in presentation. Dr. Lodha asked all the centers to take up soil analysis before sowing and after harvesting as taken up by Hisar centre. Dr. Pannu also stressed upon that such soil analysis should be made mandatory. If facilities are unavailable at locations, samples can be collected and sent to university for analysis. Dr. D.C. Uprety suggested that data on temperature, soil moisture, NPK, physiochemical structure of soil should be recorded by all centers.

Pathology: PI, Pathology, Dr. Chandra Nayaka, UoM, Mysore presented the report on trials taken up during *kharif* 2020. He informed that a total of 252 entries were screened in multiple trials during 2020-21. Higher incidence of rust and blast was observed. Positive effect of elicitors in controlling DM was also recorded. DDG suggested to identify any entry that is resistant to all five diseases and it should be used as donor line and shared with breeders for use in crossing program. Dr. Shetty mentioned that except DM, all other diseases are screened under natural infection. Artificial inoculation should be taken up and experiments need to be re-organized to accommodate the same. There should be creation of nurseries taking landraces, wild types, elite lines etc to identify the donors. Dr. Rajan Sharma, ICRISAT suggested to screen germplasm at specific locations and under controlled conditions and showed willingness to share mini core set available with ICRISAT to PC Unit.

Entomology: PI, Entomology, Dr. R.K. Juneja, JAU, Jamnagar presented the progress report. He reported the increased incidence of shoot fly in the trials especially at Jaipur. DDG suggested that one recommendation on white grubs is available and further experiments should be closed. DDG (CS) suggested to have trial on germplasm screening at broader level for disease and pest in collaboration with AICRP on Pearl millet centres, NBPGR and ICRISAT so that breeder can select the desired source of resistance.

Plant Physiology: The presentation was done by PI, Plant Physiology, Dr. R.C. Meena, ICAR-AICRP on Pearl Millet, Jodhpur. DDG mentioned that there is no need for physiological trial for the entries that are under advanced testing as there is no use for the information generated.

Work should be taken up for screening and identification of abiotic stress resistant lines for use by breeders. Dr. Upreti, Member of PAMC urged the physiologists to focus on physiological studies. He suggested that the physiological work should be done in collaboration with breeders. Dr. Lodha suggested that soil moisture and temperature data must be presented. DDG asked for re-designing the experiments with the help of experts and physiologists must plan their experiments in collaboration with plant breeders and agronomists.

Plant Biotechnology: The presentation was done by Dr. Supriya, PI, Plant Biotechnology, ICAR- AICRP on Pearl Millet, Jodhpur. She presented the work done on Plant Biotechnology at PC unit during 2020-21. She presented the work on genetic diversity analysis of pearl millet hybrids/varieties and DNA finger printing using SSR markers. Dr. Rakesh Srivastava informed about 30 QC SNPs which are more reliable in genetic diversity analysis and DNA finger printing available with ICRIAT. DDG (CS) suggested that ICRISAT may be collaborated for genotyping and more focus should be laid on material and interpretation. He also suggested to plan the biotechnology work under two main themes- characterization of germplasm and validation of markers.

DDG (CS) stressed upon that there is a need to frame a strong technical program and finalize the trials for 2021-22 in the scientific group with the help of discipline PAMC experts. Genetic and genomic resources should be used and more number of diverse parents should be involved in hybridization program. Number of experiments should be reduced; have more precision and more information should be derived.

SESSION II**PLAN OF WORK 2021-22****A. CROP IMPROVEMENT (PLANT BREEDING)**

Chairman	Dr. P Raghava Reddy, Chairman, PAMC
Co-chair	Dr. C. Tara Satyavathi, PC, ICAR-AICRP on Pearl Millet
Rapporteurs	Dr. Vikas Khandelwal/Dr. Supriya/Dr. L. D. Sharma
Date	22 nd March, 2021

FORMULATION OF TECHNICAL PROGRAMME FOR 2021-22 PLANT BREEDING**Organization of trials****Criteria for promotion of entries**

- Grain yield = higher than best check or 10% higher over relevant check in early and Medium group and 5% over relevant check in Late group.
- Downy mildew (60 DAS) under sick plot equal to or less than 5% in hybrids and populations across all Zones.
- Blast (Score) equal to or less than 3 (by using 0-9 scale) in hybrids and populations across all Zones.
- Ergot (% severity) under artificial inoculation conditions equal or less than 20% across all Zones in hybrids and populations.
- Smut (% severity) under artificial inoculation conditions equal or less than 20% across all Zones in hybrids and populations.
- Rust (% leaf area) equal to or less than 20% in hybrids and populations across all Zones.
- Days to 50% flowering in IHT (Early) and AHPT (Early) equal to or less than 45 Days, in IHT (Medium) and AHT (Medium) equal to or less than 50 Days.
- A grace period of one day in days to 50% flowering may be given to hybrids yielding grains 15% higher over HHB 67 Improved in early group hybrids and yielding grains 15% higher over relevant check in medium group hybrids.
- The total promoted entries should not be more than 33% of total test entries in medium and late maturity hybrid trials.
- Iron content ≥ 42 ppm and Zinc content ≥ 32 ppm in all the trials.

Promotion Criteria for Summer Hybrid Trial: (From 2019 onward)

- Grain yield = higher than best check or 5% higher over relevant check.
- Downy mildew (60 DAS) under sick plot equal to or less than 5% in hybrids.
- Blast (Score) equal to or less than 3 (by using 0-9 scale) in hybrids.
- Ergot (% severity) under artificial inoculation conditions equal or less than 20% in hybrids.
- Smut (% severity) under artificial inoculation conditions equal or less than 20% in hybrids.
- Rust (% leaf area) equal to or less than 20% in hybrids.

- The total promoted entries should not be more than 33% of total test entries.
- Iron content ≥ 42 ppm and Zinc content ≥ 32 ppm.

Testing fees is increased to Rs. 75,000 + GST 18% per entry

The following entries were promoted to next higher stage in various trials on the basis of performance in trials for the characters:

Hybrid and Population Trials

Entries promoted to next higher stage of testing in kharif/summer 2021 Zone A₁ and A

S. No.	Advanced Hybrid & Population Trial (E) Zone A ₁	S. No.	Advanced Hybrid Trial (L) Zone A [AHT(L) A]
	IHT (E) to AHPT I (E)		IHT (L) A to AHT I (L) A
1	MH 2553	1	MH 2573
2	MH 2555	2	MH 2575
	PT A to AHPT I (E)	3	MH 2577
	Nil	4	MH 2580
	AHPT I (E) to AHPT II (E)		AHT I (L) A to AHT II (L) A
1	MH 2474		Nil
	Checks		
4	HHB 67 (Imp.)		Checks
5	RHB 177	1	86M86
6	HH B 272	2	KBH 108
7	MPMH 21	3	MP-7792
8	RHB 223		
S. No.	Advanced Hybrid Trial (M) Zone A [AHT (M) A]	S. No.	Population Trial Zone A (PT A)
	IHT (M) A to AHT I (M) A		PT A to PT I A
1	MH 2559		Nil
2	MH 2562		PT I A to PT II A
			Nil
	AHT I (M) A to AHT II (M) A		+ New entries of PT
	MH 2480		Checks
	Checks	1	Raj 171
1	MPMH 17	2	Pusa Comp. 383
2	86M01	3	JBV 2
3	PB 1705	4	Pusa Comp. 701
4	GHB 905	5	Dhanshakti
		6	ICMV 221
S. No.	Essentially Derived Varietal Trial (EDV) A ₁ & A		
	EDV to EDV I		
	Nil		
	+ New entries of EDV		
	Checks		

Entries promoted to next higher stage of testing in kharif/ summer 2021 Zone B

S. No.	Advanced Hybrid Trial (M) Zone B [AHT (M) B]	S. No.	Advanced Hybrid Trial (L) Zone B [AHT (L) B]
	IHT (M) B to AHT I (M) B		IHT (L) B to AHT I (L) B
1	MH 2559	1	MH 2574
2	MH 2562	2	MH 2581
3	MH 2564	3	MH 2582
	AHT I (M) B to AHT II (M) B		AHT I (L) B to AHT II (L) B
	Nil		Nil
	Checks		Checks
1	Pratap	1	86M86
2	NBH 5767	2	Kaveri Super Boss
3	86M01	3	NBH 4903
4	AHB 1269		
S. No.	Summer Hybrid Trial (SHT)	S. No.	Population Trial Zone B (PT B)
	SHT to SHT I		PT B to I PT B
1	MSH 371	1	MP 609
2	MSH 372		PT I B to PT II B
3	MSH 374		Nil
4	MSH 377		
	SHT I to SHT II		+ New entries of PT
4	MSH 361		Checks
5	MSH 363	1	Raj 171
	+ New entries	2	ICMV 221
	Checks	3	Dhanshakti
5	86M64	4	ICMV 155
6	Proagro 9444	5	Pusa Comp. 612
7	Nandi 75	6	ABV 04
8	MP 7366		

Table I.1 Details of Centres and Trials Conducted During kharif 2021/Summer 2022 in Zone A₁ and A

LOCATIONS	IHT (E)	IHT (M)	IHT (L)	AHPT (E)	EDV	AHT (M)	AHT (L)	PT	RHVT	SHT
ZONE A₁										
RAJASTHAN										
Mandor (ICAR-AICRP)	*	*		*	*	*				*
Mandor (ARS, AU Jodhpur)								*	*	
Jodhpur (ICAR-CAZRI)	*			*	*					
Bikaner (SKRAU)	*	*		*	*	*		*	*	
Fathehpur Shekhawati (SKNAU)	*			*	*					
Samdari (AUJ)	*			*	*					
ARS, Jalore (AUJ)	*			*	*					
Nagaur (AU, Jodhpur)	*			*	*					
GUJARAT										
Kothara (SDAU)	*	*		*	*	*				
HARYANA										
Bawal (CCSHAU)	*	*		*	*	*				
Total Trials Zone A₁	9	4	0	9	9	4	0	2	2	1
ZONE A										
RAJASTHAN										
Jaipur (SKNAU)		*	*			*	*	*	*	
Jaipur (Seedworks)			*				*			
Jaipur (Corteva)		*				*				
Tabiji (SKNAU)		*				*				

Paota (Limagrain)			*							
Tijara (Rallis)		*	*			*				
Alwar (Corteva)			*				*			
Dausa (Rasi Seeds)		*	*							
GUJARAT										
Talaja (JAU)		*				*				
Anand (AAU)		*				*				*
Jamnagar (JAU)		*	*			*	*	*	*	*
S.K.Nagar (SDAU)	*	*		*	*	*				*
Visnagar (Apex Seedstech)										*
Ahmedabad (Nandi)			*							*
Dhanera (J K Seed)		*	*			*	*			
Dehgam (Rallis)										*
Dehgam (Kaveri Seeds)			*				*			
Palanpur (Corteva)										*
Deesa (J K Seed)										*
UTTAR PRADESH										
Jhansi (RLBCAU)		*						*	*	
Eglas (Bioseeds)			*							
Aligarh (Hytech)							*			
Hathras (Ganga Kaveri)			*							
Agra (Kartik Bio Seeds)		*	*							*
Agra (Mahindra)							*			
Bichpuri (Kaveri Seeds)						*	*			
HARYANA										
Hisar (CCS,HAU)	*	*	*	*	*	*	*	*	*	
Gurugram (Tierraagrotech)		*	*					*		
MADHYA PRADESH										
Gwalior (RVSKVV)		*	*			*	*	*	*	
Morena (RVSKVV)						*		*		
PUNJAB										
Ludhiana (PAU)		*	*			*	*	*		*
DELHI										
New Delhi (ICAR-IARI)		*				*		*		
JHARKHAND										
Ranchi (BAU)									*	
JAMMU & KASHMIR										
Jammu (SKUAST)									*	
Total Trials Zone A	2	17	17	2	2	15	12	9	7	10

Table I.1 Details of Centres and Trials Conducted During Kharif 2021/Summer 2022 in Zone B

LOCATIONS	IHT (M)	IHT (L)	AHT (M)	AHT (L)	PT	RHVT	SHT
MAHARASHTRA							
Aurangabad (NARP)	*	*	*	*	*	*	*
Aurangabad (Ajeet Seed)			*	*			
Aurangabad (Crystal)	*						
Aurangabad (Seedworks)		*		*			*
Niphad (MPKV)			*	*	*		
Dhule (MPKV)	*	*	*	*	*	*	*
Jalna (Mahyco)		*					*
Jalna (Krishidhan Ghanewadi)		*					
Pachora (Nirmal Seed)	*	*					*
Buldana (Dr. PDKV)		*	*	*			
Malkapur (Ankur Seed)		*					
Gangapur (Ganga Kaveri)		*					
KARNATAKA							
Vijayapur (UAS Dharwad)	*	*	*	*	*	*	
Malnoor (UAS, Raichur)	*		*		*	*	
Dharwad (KSSC Ltd)	*						
ANDHRA PRADESH							

Ananthapuram (ANGRAU)	*	*	*	*	*	*	
Perumallapalle (ANGRAU)	*				*		
Vizianagaram (ANGRAU)			*		*	*	
TELANGANA							
Palem (PJ TSAU)	*		*		*	*	*
Hyderabad (Nuziveedu)		*					
Toopran, Medak (NU Genes)		*					
TAMIL NADU							
Coimbatore (TNAU)	*	*	*	*	*	*	*
ODISHA							
Semiliguda (OUAT)	*				*	*	
Total Trials Zone B	12	14	11	9	11	9	7

Observations to be recorded in initial and advanced trials:

1. Days to 50% Flowering –Rounded to 0 decimal
2. Plant Height (cm) –Rounded to 0 decimal
3. No. of productive tillers/plant -Rounded to one decimal
4. Panicle length (cm) -Rounded to one decimal
5. Panicle Diameter (cm) - Rounded to one decimal
6. Seed set under bagging (In hybrid trials only) –Rounded to 0 decimal
7. Grain yield (kg/plot) -Rounded to three decimals
8. Fodder yield (kg/plot)- Rounded to three decimals
9. Days to maturity- Rounded to 0 decimal
10. Plant population at harvest (No./Plot)
11. 1000-seed wt (g)
12. Diseases and pest incident (Under natural conditions)

New entries for testing in initial trial Kharif 2021/ Summer 2022

S. No.	Organization/Institution	Name of Entries				
		IHT (E)	IHT (M)	IHT (L)	PT	Summer
1	ICAR-CAZRI, Jodhpur	CZH 260	CZH 262			
		CZH 261				
2	ICAR-AICRP on PM, JAU, Jamnagar	GHB 1283	GHB 1308	GHB 1282		GHB 1286
			GHB 1325	GHB 1288		GHB 1268
				GHB 1312		
				GHB 1313		
3	ICAR-AICRP, RARI, SKRAU, Bikaner	BHB2101				
		BHB2102				
		BHB2103				
		BHB2104				
		BHB2105				
4	ICAR-AICRP, CCSHAU, Hisar			HHB 342		
				HHB 343		
5	NARP, Aurangabad		AHB-1606			
			AHB-1607			
			AHB-1732			
6	ICAR-IARI New Delhi		Pusa 2101		Pusa Comp 726	
			Pusa 2102		Pusa Comp 727	
			Pusa 2103		Pusa Comp 728	
7	ICAR-AICRP, TNAU, Coimbatore		TNBH 17025	TNBH 17032		TNBH 17025
8	CCI, SDAU, SK Nagar			GDHB 15		
9	ICAR-AICRP, RARI, SKNAU, Jaipur	RHB-273		RHB-271	RCB-32	
				RHB-272		
10	ICAR-AICRP on PM, RVSKVV, Gwalior	RVBH18-42				
		RVBH18-43				
11	ICAR-AICRP on PM, PAU Ludhiana			PHB 3507	GBL 6	
					FBL 4	
12	RARS, Vijayapur		VPMH 16	VPMH 15	VPMV 9	
			VPMH 17		VPMV 12	
					VPMV 13	
13	ICAR-IIMR, Hyderabad			HMH002	IIMR PT1	
14	RARS, PJTSAU, Palem			PBH 217		
15	ICAR-AICRP on Pearl Millet, Dhule		DHBH 1925	DHBH 2112		
			DHBH 1774			
16	Seed Works PVT. LTD. Hyderabad					US7306
17	Hi-Yield Agri Genetics Pvt. Ltd.	HYMH-75		HYMH 4069		HYMH 4046
18	Nuziveedu Seed Pvt. Ltd., Secunderabad		NBH 5992	NBH 5994		NBH 5922
19	Kaveri Seed Com. Ltd., Secunderabad		KPH6122			KPH6499
20	Nu Genes Pvt. Ltd., Hyderabad			NU 441		NU 440
				NU 446		
21	Bayer Bio Science Pvt. Ltd., Hyderabad		PB1937	PB1779		PB1970
			PB1938	PB1858		PB1977
				PB1939		
				PB1948		
22	Corteva Agriscience, Hyderabad		PB2116604	PB2116604		
			PB2118621			
23	Ganga Kaveri Seeds Pvt. Ltd Hyderabad			GK 1279		
24	Hytech Seed India Pvt. Ltd., Hyderabad			HT 421366		HT 421310
						HT 421311
25	Maharashtra state seeds corp. Ltd, Akola		MBH-2022			
26	JK Agri Genetics Ltd, Hyderabad			JKBH 1835		
27	Mahindra Agri Solutions Ltd., Telangana			18119		
				18140		
28	Shakti Vardhak Hybrid Seeds Pvt. Ltd.,		SVPMH-115	SVPMH-121		SVPMH-118
29	Mahyco Pvt. Ltd., Jalna, Aurangabad			MRB 2234		MRB 2222
				MRB 2244		
30	Limagrain India Pvt. Ltd., Hyderabad			LG 70401		
				LG 70501		
31	Crystal Crop Protection Ltd., Aurangabad		MLBH 301	MLBH 1001		MLBH 1002
32	VNR Seeds Pvt. Ltd., Hyderabad			VNR 6738		VNR 3688
				VNR 7908		VNR 9025
33	Rallis India Ltd., Hyderabad		MP7104	MP7214		MP7314
34	Nath Bio-Genes Ltd., Hyderabad		NBBH 2044			
35	RASI Seeds Pvt., Ltd., Hyderabad			RBX 254		
36	Kamadgiri Seeds LLP, Agra		7272			
37	Kamadgiri Crop Science Pvt. Ltd., Agra		KGBH-1296			

Experimental details:

Initial Trials: No. of rows – 3 (net) Row length – 4m(net) Spacing- 60 cm x 15 cm (Zone A ₁) 50 cm x 15 cm (Zone A & B) Plot size – 4m x 1.8 m (net) (Zone A ₁) 4 m x 1.5 m (net) (Zone A & B) Fertilizer – As per recommendations	Advanced Trials: No. of rows – 6 (net) Row length – 4m (net) Spacing- 60 cm x 15 cm (Zone A ₁) 50 cm x 15 cm (Zone A & B) Plot size – 4m x 3.6 m (net) (Zone A ₁) 4m x 3.0 m (net) (Zone A & B) Fertilizer – As per recommendations
Population Trials: No. of rows – 6 (net) Spacing- 60 cm x 15 cm (Zone A ₁) 50 cm x 15 cm (Zone A & B) Plot size – 4m x 3.6 m (net) (Zone A ₁) 4m x 3.0 m (net) (Zone A & B) Fertilizer – As per recommendations	EDV Trial: No. of rows – 6 (net) Row length – 4m (net) Spacing- 60 cm x 15 cm Plot size – 4m x 3.6 m (net) Fertilizer – As per recommendations

Proposed entries for initial trials

IHT (E) A ₁ : 12	PT A & B Zone : 10
IHT (M) A & B Zone : 27	Summer 2022: 18
IHT (L) A & B Zone : 39	

Seed Requirement (per entry)

IHT (E) A ₁ Zone : 1.5 Kg	AHT (M) A : 2.0 Kg	AHT (L) A: 2.0 Kg
IHT (M) A & B Zone : 2.0 Kg	AHT (M) B : 2.0 Kg	AHT (L) B: 2.0 Kg
IHT (L) A & B Zone : 2.250 Kg	RHVT A : 1.250 Kg	EDV Trials : 1.5 Kg
Initial Population Trial A & B Zone: 2.0 Kg	RHVT B : 1.250 Kg	
Population Trial A Zone : 1.5 Kg	Summer Hybrid Trial : 2.0 Kg	
Population Trial B Zone: 1.5 Kg		
AHPT (E) A ₁ Zone: 1.5 Kg		

Additional seed requirement for entries of IIIrd year testing for agronomical trials (Separate pack)

AHT Zone A: 3.500 Kg	AHT Zone B : 3.500 Kg
PT Zone A: 2.500 Kg	AHPT Zone A ₁ : 2.500 Kg
PT Zone B: 2.500 Kg	Summer Hybrid Trial : 2.000 Kg

Seed requirement of checks:

86M86: 10.0 Kg	RHB 173: 8.0 Kg	86M01: 6.0 Kg	ICMV 155: 3.0 Kg
ICMH 356: 3.0 Kg	MP-7792: 6.0 Kg	HHB 272: 5.0 Kg	ICMV 221: 6.0 Kg
GHB 558: 6.0 Kg	NBH 5061: 8.0 Kg	NBH 5767: 8.0 Kg	JBV 2: 4.0 Kg
HHB 67 Imp.: 8.0 Kg	HHB 223: 2.0 Kg	PB 1705: 4.0 Kg	Raj 171: 7.0 Kg
RHB 177: 7.0 Kg	Pratap: 6.0 Kg	NBH 4903: 4.0 Kg	Dhanshakti: 7.0 Kg
GHB 538: 3.0 Kg	MPMH 17: 8.0 Kg	86M64: 4.0 Kg	Pusa Comp. 383: 5.0 Kg
KBH 108: 8.0 Kg	MPMH 21: 5.0 Kg	Proagro 9444: 3.0 Kg	Pusa Comp. 701: 3.0 Kg
RHB 223: 5.0 Kg	AHB 1269: 6.0 Kg	MP 7366: 3.0 Kg	ABV 04: 4.0 Kg
Kaveri Super Boss: 6.0 Kg	GHB 905: 5.0 Kg	Nandi 75: 3.0 Kg	Pusa Comp. 612: 3.0 Kg

Seed requirement of Released Hybrids/varieties: 1.5 Kg seed of all national released hybrids/ varieties since 2005 should be sent for RHVT Trial positively (Separate pack).

The required quantity of seed material (**untreated**) of entries along with pedigree selected for

organizing the trials as above with new entries should reach to the office of the Project Coordinator (Pearl Millet), ICAR-AICRP on Pearl Millet, ARS, Mandor, Jodhpur 342304 (Rajasthan) **latest by 25th May 2021 for kharif and by 15th January 2022 for summer trials** along with required testing fee of Rs. 75,000 + GST 18% /entry (Private Sector) in form of DD/cheque at par in favour of Project Coordinator (Pearl Millet), Mandor, payable at Jodhpur. **If the testing fee is increased by the council, upon the receipt of information from council, increased testing fee will be charged from this season. Entries without fee and pedigree of hybrids/varieties will not be accepted.** Seed of each entry should be packed in cloth bag separately for each zone and also for agronomic trials.

PLAN OF WORK 2021-22 FOR BIOTECHNOLOGY

PMBT1: MOLECULAR CHARACTERIZATION OF GERMPLASM OF PEARL MILLET

Experiment 1: Genetic diversity analysis and molecular characterization of released hybrids and varieties of pearl millet

Background: Database on various morphological parameters for these hybrids/varieties is already available but till now no molecular database is existing. Thus, this experiment will be conducted to study molecular genetic diversity of released hybrids and varieties.

Objective: Molecular characterization and diversity analysis of released hybrids and varieties of pearl millet.

Experiment 2: DNA fingerprinting of identified/advanced hybrid entries of third year testing

Background: The entries promoted for third year testing will be later identified for release and hence need DNA profile for submission of proposal. Thus, this experiment will be useful for authenticity of identification proposal and can meet the basic requirements of proposal submission.

Objective: DNA profiling of advanced hybrid entries of pearl millet using SSR markers.

PMBT 2: VALIDATION OF MARKERS IN PEARL MILLET

Experiment 1: Validation of already reported high Fe/Zn markers among pearl millet lines rich in Fe and Zn content

Background: Pearl millet is rich in Fe & Zn content and ICAR-AICRP on Pearl Millet has already included minimum standard for micronutrient (Fe = 42 ppm; Zn = 32ppm) in the promotion criteria. Hence, screening of pearl millet lines rich in Fe and Zn content using molecular markers and their validation will be helpful for developing high Fe/Zn pearl millet hybrids.

Objective: Screening and validation of already reported high Fe/Zn markers in Fe/Zn rich lines.

Experiment 2: Validation of drought tolerance markers in pearl millet drought/heat tolerant genotypes suitable for A₁ zone

Background: Development of high yielding, dual purpose disease resistant cultivars for low rainfall areas i.e. A₁ zone is of utmost priority for increasing pearl millet productivity at national level and some new initiatives were taken last year to screen germplasm for A₁ zone and develop some hybrids for this specific zone. Keeping this in view, this experiment will be useful for screening and developing drought/heat tolerant hybrids for A₁ zone.

Objective: Validation of drought tolerance markers in drought tolerant lines suitable for A₁ zone using SSR markers.

PLAN OF WORK 2021-22 FOR CROP PRODUCTION (AGRONOMY)

Chairman	Dr. R.K. Pannu Ex. Dean & Prof. Emeritus, CCSHAU, Hisar Dr. D.C. Uprety Ex. Pr. Scientist, ICAR-IARI, New Delhi
Rapporteur	Dr. Anil Kumar, Principal Scientist (Agronomy), Bajra Section, CCSHAU, Hisar Minakshi Grover, Principal Scientist, Division of Microbiology, ICAR-IARI, New Delhi
Date	22 nd March, 2021

The virtual meeting was held under the guidance of PAMC expert committee members with regard to finalization of technical programme for crop production group. The committee was of the view that before finalization of the 1-2 new experiments, the background information related to farmer oriented problems of the respective locations/ Zones must be collected. It was decided by the chairman of the session (Dr. R.K. Pannu) that a separate meeting of the Agronomist may be called and then new trial will be finalized after receiving the feedback. The PAMC members as well as Hon'able DDG in his PI presentations directed all the centres that soil physico-chemical properties in the nutrition experiments must be analyzed before sowing and after harvesting of the crop.

The second virtual meeting was held between 11.00 AM to 2.00 PM under the chairmanship of Dr. R.K. Pannu, PAMC Agronomy expert on dated 31.05.2021 to finalize the another two experiments for the Plan of work for 2021-22. Dr. Pannu has put up so many new ideas to work on i.e. yield gap between potential and actual realized yield at farmer's/experimental level, balance nutrition, use of nano fertilizer, optimum plant population maintenance, summer success stories to increase the yield and profitability of the farmers. Therefore, two new experiments were planned. The details are given in the Plan of work for 2021-22.

The following recommendations were made by the Crop production group;

- The weed control studies conducted during 2018-2020 with an objective to improve/ fine tune the existing recommendations of weed management in pearl millet with new broad spectrum post emergent herbicide Tembotrione 42 SC recommended that the application of Tembotrione 42% SC @ 120 g a.i./ha at 3-4 leaf stage of weed in Zone A₁, at Hisar and Jamnagar in Zone A and at Dhule in Zone B whereas, the doses of 90 & 100 g a.i./ha at Vijayapur and Dhule were found comparable to the recommended practices of weed control in terms of weed control efficiency, yield and economics.
- The three years (2018-2020) study recommended that application of nutrients through organic source of FYM or Vermicompost along with biofertilizer Biomix (*Azospirillum* + PSB) in Zone A₁ & A produced equal yield and more protein content to the application of RDF through inorganic fertilizers. The soil physico-chemical properties pH & EC were decreased whereas, organic carbon (%), available N,P & K (kg/ha) were improved under organic nutrition compared to their initial status at

Hisar. However, in Zone B, the application of nutrients through Vermicompost along with biofertilizer Biomix (*Azospirillum* + PSB) produced equal and having more protein content than RDF.

Trials to be continued during 2021-22 of Agronomy

- **PMAT 1** : Response of pearl millet advance hybrids and/or populations to different levels of nitrogen.
- **PMAT 2** : Moisture conservation through polymers and crop residues under rainfed conditions
- **PMAT 5** : Effect of tillage and nutrient management systems on pearl millet yield and soil properties

AGRONOMY - TECHNICAL PROGRAMME FOR 2021-22

PMAT 1 : Response of pearl millet advance hybrids and/or populations to different levels of nitrogen

Objective : To study the response of advance hybrid and population entries to nitrogen application.

a) Performance of advance hybrids or populations to nitrogen levels in Zone A₁

Nitrogen levels (4) : 0, 20, 40 & 60 kg N/ha

Hybrids (1+4 check) : MH 2474, HHB 67 (Imp.) (c), MPMH 21 (c), HHB 223 (c) & RHB 177 (c)

Design : Split plot (Nitrogen in main plot and entries in sub-plots)

Replications : Three

Plot size

Gross : 5.00 m x 4.00 m

Net : 4.00 m x 3.60 m

Locations : Bikaner and Mandor

b) Response of advance late hybrid entries to nitrogen levels

Nitrogen levels (4) : 0, 30, 60 & 90 kg N/ha

Hybrids (1+4 checks) : MH 2480, MPMH 17 (c), 86M01 (c), GHB 905 & PB 1705 (c)

Design : Split plot (Nitrogen in main plot and entries in sub-plots)

Replication : Three

Plot size

Gross : 5.00 m x 4.00 m

Net : 4.00 m x 3.60 m

Locations : Jaipur, Hisar, Jamnagar and New Delhi (Zone A)

c) Performance of advance summer hybrids to nitrogen levels

Nitrogen levels (4) : 0, 60, 90 & 120 kg N/ha

Hybrids (2+3check) : MSH 361, MSH 363, Nandi 75 (c), 86M64 (c) & Proagro9444 (c)

Design	: Split plot (Nitrogen in main plot and entries in sub-plots)
Replication	: Three
Plot size	
Gross	: 5.00 m x 4.00 m
Net	: 4.00 m x 3.60 m
Locations	: S. K. Nagar, Jamnagar, Aurangabad and Dhule

Observations to be recorded

1. Plant population (final) in thousands/ha
2. Plant height (cm)
3. Days to 50% flowering
4. Total number of tillers/plant
5. Effective number of tillers/plant
6. Test weight (g)
7. Grain yield (q/ha)
8. Dry fodder yield (q/ha)

Note: Chemical analysis of the properties of the soil (pH, EC, organic carbon and available NPK) before sowing & after harvesting of the crop.

PMAT 2 : Moisture conservation through polymers and crop residues under rainfed conditions

Objective : To find out the effect of polymers and crop residues on the productivity, water use efficiency and microbial count of pearl millet.

Year of Start : 2020

Treatment	T ₁ : Control (RDF)
	T ₂ : T ₁ +Crop residue mulch @ 5.0 t/ha after 10-15 DAS
	T ₃ : T ₁ + Pusa Hydrogel dry application @ 5.0 kg/ha
	T ₄ : T ₁ + SPG 1118 dry application @ 5.0 kg/ha
	T ₅ : T ₁ + Pusa Hydrogel slurry application @ 5.0 kg/ha
	T ₆ : T ₁ + SPG 1118 slurry application @ 5.0 kg/ha
	T ₇ : T ₃ + Crop residue mulch @ 5.0 t/ha after 10-15 DAS
	T ₈ : T ₄ + Crop residue mulch @ 5.0 t/ha after 10-15 DAS
	T ₉ : T ₅ + Crop residue mulch @ 5.0 t/ha after 10-15 DAS
	T ₁₀ : T ₆ + Crop residue mulch @ 5.0 t/ha after 10-15 DAS

Locations : Bikaner & Mandor (Zone A₁)
Jaipur, Hisar, Jamnagar and New Delhi (Zone A)
Aurangabad, Dhule, Vijayapur & Coimbatore (Zone B)

Note : Pusa Hydrogel & SPG 1118 will be supplied by IARI, New Delhi

Entries : MPMH 17
Design : RBD
Replication : Three
Treatment : Ten
Plot size :
Gross : 5.00 m x 4.00 m
Net : 4.00 m x 3.60 m

Observations to be recorded

1. Plant population (final) in thousands/ha
2. Plant height (cm)
3. Total number of tillers/plant
4. Effective number of tillers/plant
5. Test weight (g)
6. Grain yield (q/ha)
7. Dry fodder yield (q/ha)
8. Microbial activities (MBC, Dehydrogenase, Alkaline phosphatase, Urease activities)*
9. Depthwise soil moisture content at different growth stages
10. Consumptive use (cm) & Water use efficiency (kg/ha-mm)
11. Economics of the treatments [Gross Returns (Rs/ha), Net returns (Rs/ha) & B:C ratio]

**At Mandor & New Delhi*

Note: Chemical analysis of the properties of the soil (pH, EC, organic carbon and available NPK) before sowing & after harvesting of the crop.

PMAT 3: Enhancing biofortified/non- biofortified pearl millet hybrids productivity and quality through micronutrients under irrigated situation

Objective : To find out the effect of micronutrients on the crop growth, productivity, quality and economics of biofortified pearl millet under irrigated condition.

Year of start : 2021

A. Main plot : Hybrids

V₁ : MPMH 17

V₂ : HHB 299

B. Sub plot : Micronutrient Management

T₁ : Control

T₂ : Soil application ZnSO₄ @ 25 kg/ha

T₃ : 0.5% ZnSO₄ Foliar spray at 20-25 DAS

T₄ : Soil application FeSO₄ @ 20 kg/ha

T₅ : 0.5% FeSO₄ Foliar spray at tillering stage (20-25 DAS)

T₆ : 0.5% MnSO₄ Foliar spray at tillering stage (20-25 DAS)

T₇ : 0.2% CuSO₄ Foliar spray at tillering stage (20-25 DAS)

T₈ : 0.2% Borax Foliar spray at tillering stage (20-25 DAS)

T₉ : ZnSO₄ (25 kg/ha) + FeSO₄ (20 kg/ha) + 0.2 % Borax

Note: RDF will be applied of the respective zones under irrigated situations to all the treatments.

Locations	: Bikaner & Mandor (Zone A ₁) Jaipur, Hisar, Jamnagar and New Delhi (Zone A) Aurangabad, Dhule, Vijayapur & Coimbatore (Zone B)
Entries	: HHB 299
Design	: SPD
Replication	: Three
Treatment	: Eighteen
Plot size	:
Gross	: 5.00 m x 4.00 m
Net	: 4.00 m x 3.60 m

Observations to be recorded

1. Plant population (final) in thousands/ha
2. Plant height (cm)
3. Total number of tillers/plant
4. Effective number of tillers/plant
5. Test weight (g)
6. Grain yield (q/ha)
7. Dry fodder yield (q/ha)
8. Fe, Zn, Mn, Cu and B content in plant and grain at harvest
9. Economics of the treatments [Gross Returns (Rs/ha), Net returns (Rs/ha) & B:C ratio]

Note: Chemical analysis of the properties of the soil (pH, EC, organic carbon and available NPK before sowing) and Fe, Zn, Mn, Cu and B content before sowing & after harvesting of the crop.

PMAT 4: Contribution of production factors to the yield and economics of pearl millet

Objective: To study the quantification of individual production factors of management towards productivity and economics in the pearl millet crop.

Year of Start: *kharif* 2021

Treatment details:

- T₁ : Full package & practices of the location [(RDF+ ZnSO₄ @ 25 kg/ha+ FeSO₄ @ 0.5-0.75% at 20-25 DAS + bioinoculant seed treatment (Azoteeka/as per availability) + thinning & gap filling + weeding & hoeing (3 & 5 Weeks after sowing)+ Irrigation]
- T₂ : T₁- RDF
- T₃ : T₁- ZnSO₄ @ 25 kg/ha
- T₄ : T₁- FeSO₄ @ 0.5-0.75% at 20-25 DAS
- T₅ : T₁- bioinoculant seed treatment (Azoteeka)
- T₆ : T₁- thinning & gap filling
- T₇ : T₁- weeding & hoeing (3 & 5 Weeks after sowing)
- T₈ : T₁- Irrigation

Note: RDF will be applied of respective state under irrigated condition. Full P&K as basal will be applied at sowing time

Locations : Bikaner & Mandor (Zone A₁)
Jaipur, Hisar, Jamnagar and New Delhi (Zone A)
Aurangabad, Dhule, Vijayapur & Coimbatore (Zone B)

Hybrid : Popular high yielding hybrid of the location

Design : RBD

Replication : Three

Treatment : 8

Plot size :

Gross : 5.00 m x 4.00 m

Net : 4.00 m x 3.60 m

Observations to be recorded

1. Plant population (final) in thousands/ha
2. Plant height (cm)
3. Total number of tillers/plant
4. Effective number of tillers/plant
5. Test weight (g)
6. Grain yield (q/ha)
7. Dry fodder yield (q/ha)
8. Economics of the treatments [Gross Returns (Rs/ha), Net returns (Rs/ha) & B:C ratio]

* Microbial analysis will be done at Mandor and New Delhi.

Note: Chemical analysis of the properties of the soil (pH, EC, organic carbon and available NPK before sowing.

PMAT 5 : Effect of tillage and nutrient management systems on pearl millet yield and soil properties

Objective : To study the effect of different tillage manipulations and nutrient management practices on the productivity, water use efficiency, physico-chemical and Energy analysis in pearl millet crop.

Year of Start : 2020

Treatment : **A. Main Plot (Tillage practices)**

1. Conventional tillage (Two harrow + one cultivator and planking + Two Inter culture operations by kasola/wheel hand hoe/power weeder at 15-20 & 30-35 DAS)
2. Conventional tillage (Two harrow + one cultivator and planking + One Inter culture operations by kasola/wheel hand hoe/power weeder at 21-28 DAS)
3. Minimum tillage (One harrow + One cultivator and planking + Two Inter culture operations kasola/wheel hand hoe/power weeder at 15-20 & 30-35 DAS)
4. Minimum tillage (One harrow + One cultivator and planking One Inter culture operations by kasola/wheel hand hoe/power weeder between 21-28 DAS)

B. Sub Plot (Nutrient supply)

- I. 100% RDF of the Zones

- II. 75 % N through RDF + 2.5 t/ha FYM
- III. 50 % N through RDF + 5.0 t/ha through FYM
- IV. 100% N through FYM

*RDF : (40 kg N/ha + 20 Kg P₂O₅) for Zone A₁ & A
(60 kg N/ha + 30 Kg P₂O₅) for Zone B*

Locations	:	Bikaner & Mandor (Zone A ₁) Jaipur, Hisar, Jamnagar and New Delhi (Zone A) Aurangabad, Dhule, Vijayapur & Coimbatore (Zone B)
Entries	:	MPMH 17/ Latest Recommended Hybrid for the State
Design	:	SPD
Replication	:	Three
Treatment	:	16
Plot size	:	
Gross	:	5.0 m x 4.5 m
Net	:	4.0 m x 3.6 m

Observations to be recorded

1. Plant population (Initial & final) in thousands/ha
2. Plant height (cm)
3. Total number of tillers/plant
4. Effective number of tillers/plant
5. Test weight (g)
6. Grain yield (q/ha)
7. Dry fodder yield (q/ha)
8. Depthwise soil moisture content at different growth stages
9. Consumptive use (mm) & Water use efficiency (kg/ha-mm)
10. Energy Input & Output Analysis (MJ/ha)
11. Economics of the treatments [Gross Returns (Rs/ha), Net returns (Rs/ha) & B:C ratio]

Note: *Physico-chemical properties of the soil (Bulk Density, pH, EC, organic carbon and available NPK before and after harvesting of the crop)*

PMAT 6: Response of pearl millet to split application of nitrogen at different growth stages under irrigated condition

Objectives:

- 1) To study crop growth and productivity in response to split application of urea at different stages
- 2) To find out optimum time of urea application for higher grain yield in pearl millet.
- 3) To work out the economics of different management practices.

Year of Start: *kharif* 2021

Treatment details:**Main plot treatments:****Nutrient management**

N₁ – 100 % RDN

N₂ – 112.5% RDN

N₃ – 125 % RDN

Sub plot treatments: Nitrogen split application

S₁: Entire dose of N at sowing

S₂: 50% N at sowing + 50% N at tillering (20-25 DAS)

S₃: 50% N at sowing + 50% N at boot stage (35-40 DAS)

S₄: N will be applied in three splits (25% basal), 50% at tillering (20-25 DAS) and 25% at boot stage (35-40 DAS);

Note: RDN will be applied of respective state under irrigated condition. P&K as per zone recommendation under irrigated condition will be applied as basal.

Locations	:	Bikaner & Mandor (Zone A ₁) Jaipur, Hisar, Jamnagar and New Delhi (Zone A) Aurangabad, Dhule, Vijayapur & Coimbatore (Zone B)
Hybrid	:	HHB 299
Design	:	SPD
Replication	:	Four
Treatment	:	12
Plot size	:	
Gross	:	5.00 m x 4.00 m
Net	:	4.00 m x 3.60 m

Observations to be recorded

1. Plant population (final) in thousands/ha
2. Plant height (cm)
3. Total number of tillers/plant
4. Effective number of tillers/plant
5. Test weight (g)
6. Grain yield (q/ha)
7. Dry fodder yield (q/ha)
8. Available N,P & K in soil before sowing and after harvesting
9. N, P & K content & their uptake in plant and grain at harvest
10. Protein content in grain
11. Economics of the treatments [Gross Returns (Rs/ha), Net returns (Rs/ha) & B:C ratio]

Note: Chemical analysis of the properties of the soil (pH, EC, organic carbon NPK before sowing) and after harvesting of the crop.

PLAN OF WORK 2021-22 FOR PLANT PHYSIOLOGY

The technical program of plant physiology has been reformed as per suggestions of Dr. D.C. Uprety, Ex. Principal Scientist, Division of Plant Physiology, ICAR-IARI, New Delhi and PAMC Experts. He gave various suggestions for reformation of technical program and also suggested to continue same technical program. One trial PMPHY 1 (Screening of advance summer hybrids against heat stress) should be dropped.

PMPHY 2 : Characterization for drought tolerance to identify parental lines of pearl millet suitable for *kharif* and summer cultivation

Objectives : To identify heat tolerant donor parents for hybrid and population development in pearl millet

Year of Commencement : 2014
Modified as per suggestion of the expert Dr. D.C. Uprety, Ex. Principal Scientist, Division of Plant Physiology, ICAR-IARI, New Delhi during 55th online AGM on 29th April, 2020.

Locations : Summer : Jamnagar and Mandor
Kharif : Jamnagar, Jaipur and Mandor

Conditions Summer : Irrigated
kharif : Rainfed

Treatment : 20 inbred (R lines and B lines)

Design : RBD

Replication : Three

Spacing : 50 cm X 10 cm

Plot size : 4 Rows of 4 M length

Fertilizer : As per PoP

Observations:

1. Chlorophyll content at anthesis and 65 DAS
2. Relative water content (RWC) at anthesis and 65 DAS
3. Seed setting %
4. Panicle initiation
5. Days to 50% flowering
6. Grain yield (kg/ha)
7. Productive tillers/plant
8. Test weight (g) (1000 grains)
9. Threshing percentage (Panicle harvest Index)
10. Fodder yield (q/ha)
11. Harvest index (%)
12. Days to Maturity
13. Ear head weight (kg/ha)
14. Soil temperature ($^{\circ}\text{C}$) at anthesis and 65 DAS
15. Air Temperature ($^{\circ}\text{C}$) at anthesis and 65 DAS

PMPHY 3 : To study the photosynthate partitioning & remobilization in pearl millet under rain-fed condition

Year of Commencement: 2019, As per the QRT, suggestions and Dr. C. Vishwanathan, HoD, Division of Plant Physiology, ICAR-IARI, New Delhi during 54th AGM.

Location : Jaipur, Jamnagar and Mandor
Season : *kharif*
Treatment : Six genotypes, released hybrids and varieties (Pusa composite 443, MPMH 17, MPMH 21, RHB 177, AHB 1200 & Pusa composite 612)
Design : RBD
Replication : Three
Spacing : 60 X 10-15 cm
Plot size : 2 Rows of 5 M length
Fertilizer : AS per PoP

Methodology

Tag ten similar plants, Biomass sampling at anthesis (Record height of the plant; Record dry weight of stem, leaf & panicle separately of whole plant. 10 samples per treatment), Biomass sampling at physiological maturity (Record height of the plant; Record dry weight of stem, leaf, panicle, grains separately; HI use only main shoot, 10 samples per treatment)

Observations:

At Anthesis

1. Plant height (cm)
2. Dry weight of stem (g)
3. Leaf dry weight (g)
4. Ear head weight (g)

At Physiological maturity

1. Plant height (Main stem)
2. Dry weight of stem (g)
3. Leaf dry weight (g)
4. Ear head weight (g)
5. Grain yield (g)
6. Panicle harvest index (PNHI)
7. Harvest index (HI)

PMPHY4: Identification of physiological traits for drought tolerance in pearl millet

Objectives : Find out drought tolerant traits in pearl millet

Year of Commencement : 2020
Modified as per suggestion of the expert Dr. D.C. Uprety, Ex. Principal Scientist, Division of Plant Physiology, ICAR-IARI, New Delhi during 55th online AGM on 29th April, 2020.

Location : Mandor, Jaipur and Jamnagar
Season : Field (*kharif*)
Replication : Three
Design : RBD
Genotypes : (Released hybrids of A and A₁ zone of India)

Methodology:

Tag five similar plants, Biomass sampling at 30 DAS (Record Chlorophyll content, height of the plant, number of leaf, number of tillers, dry weight of stem, leaf & panicle separately of whole plant - five samples per treatment), Biomass sampling 45 DAS (Record Chlorophyll content, height of the plant, number of leaf, number of tillers, dry weight of stem, leaf & panicle separately of whole plant - five samples per treatment), 60 DAS (Record Chlorophyll content, height of the plant, number of leaf, number of tillers, dry weight of stem, leaf & panicle separately of whole plant - five samples per treatment) and at maturity (Record Chlorophyll content, height of the plant, number of leaf, number of tillers, dry weight of stem, leaf & panicle, Grain yield separately of whole plant - five samples per treatment).

At 30 DAS, 45 DAS and 60 DAS

1. Chlorophyll content (mg/g f.wt)
2. height of the plant cm)
3. Number of leaf
4. Number of tillers
5. Dry weight of stem (g)
6. Dry weight of leaf (g)
7. Dry weight of panicle (g)

At Physiological maturity

1. Chlorophyll content (mg/g f.wt)
2. Number of leaf
3. Number of tillers
4. Dry weight of stem (g)
5. Dry weight of leaf (g)
6. Dry weight of panicle (g)
7. Dry weight of era head weight (g)
8. Grain yield (g)
9. Panicle harvest index (PNHI %)
10. Harvest index (HI %)
11. Crop growth rate (CGR per unit land area per unit time)
12. Relative growth rate (RGR $\text{gg}^{-1} \text{day}^{-1}$ or $\text{gg}^{-1} \text{week}$)

PMPHY 7 : **Identification of heat stress tolerance in pearl millet genotype at seedling stage.**

Objectives :

- i. To identify heat stress tolerance mechanism in pearl millet at seedling stage.
- ii. To identify physiological parameters for identification of heat stress tolerance mechanism in pearl millet

Year of Commencement : 2017

Modified in 2019 during 54th AGM by Dr. C.
Vishwanathan, HoD, Division of Plant Physiology, ICAR-
IARI, New Delhi

Location : Jaipur and Mandor

Season : Laboratory trial (*Kharif*)
In the Field also (kharif) Rain fed

Entries : Study material : Parental line(A and B lines) of pearl millet (15-20)

Replication : Three

Design : CRD

Temperature : Three temperature treatments 20 DAS (40 °C for 4 hours, 44 °C for 4 hours and 46 °C for 2 hours)

Observations:

Growth parameters – 22 DAS

1. Shoot length(cm)
2. Root length(cm)
3. Shoot dry weight(mg)
4. Root dry weight (mg))
5. Root -shoot ratio
6. seedling vigour index

Physiological parameters –

1. RWC
2. Membrane stability index
3. Pigment content (chlorophyll content (mg/g f.wt)), chlorophyll stability index

Field observation at 15, 22 and 30 DAS

1. RWC
2. Membrane stability index
3. Pigment content (chlorophyll content), chlorophyll stability index

PLAN OF WORK OF PLANT PATHOLOGY (2021-2022)

The group decided to continue the same experiments as mentioned below:

PMPT I: Disease screening trial of Initial Pearl Millet Hybrids and Varieties.

PMPT II: Disease screening trial of Advanced Pearl Millet Hybrids and Varieties.

PMPT III: Monitoring disease resistance stability of released popular hybrid/varieties.

Downy Mildew	:	
Location		Zone A & A₁ Mandor, Jaipur, Hisar, Gwalior, Jamnagar and Anand Zone B Mysore, Aurangabad, Dhule, Coimbatore and Patancheru
Smut		
Location	:	Zone A & A₁ Jaipur, Jamnagar, Hisar and Gwalior Zone B Dhule
Blast		
Location	:	Zone A & A₁ Jaipur, Jamnagar, Mandore, Gwalior, Hisar and New Delhi (PMPT-II) : Zone B Dhule, Aurangabad and Mysore
Rust		
Location	:	Zone A & A₁ Jaipur, Jamnagar, Hisar and Gwalior Zone B Aurangabad, Dhule, Mysore and Coimbatore
Ergot		
Location	:	Zone A & A₁ Jaipur Zone B Aurangabad, Dhule and Coimbatore

PMPT IV: Pearl millet downy mildew virulence nursery (PMDMVN).

1. Pathogenic diversity analysis by virulence nursery

Location

Mandor, Jaipur, Hisar, Gwalior, Jamnagar and Anand

Zone B

Mysore, Aurangabad, Dhule, Coimbatore and Patancheru

Note: Observations of Blast and Downy mildew disease should be recorded 30 and 60 days after sowing in all the experiments.

PMPT V: Pearl millet blast variability nursery (PMBVN)

Location : **Zone A & A₁**
Gwalior, Anand, Mandor, Jamnagar, Hisar, New Delhi, and Jaipur

Zone B
Dhule, Aurangabad, Mysore, Patancheru and Vijayanagaram

PMPT VI: Basic and strategic research: (Mysore and ICRISAT)

- Biochemical and molecular of host pathogen interaction of blast and downy mildew system

PMPT VII: Management of downy mildew and blast disease by using chemicals and bio-agents for the year 2021-2022.

PMPT VIII: Monitoring of Pearl Millet diseases at Farmers' fields: All AICRP on Pearl millet centres in their respective zones

PMPT IX: Disease screening trial of pearl millet hybrids in summer **Locations:** Anand, Jamnagar, Dhule and Coimbatore

The criteria for the acceptability of new genotypes for diseases, the following criteria finalized for the year 2021-2022.

- **Downy mildew:** Up to 5% downy mildew incidence under sick plot condition must be considered for varietal promotion.
- **Blast:** group decided to submit the data using 0-9 scale. Up to the Score 3 for blast be considered for promotion of genotypes i.e., varietal promotion under the category of blast resistant. The blast screening under artificial inoculation at seedling stage /infecter row system (ICMB 95444).
- **Smut:** Up to 20% smut severity under artificial inoculation to the flower must be considered for varietal promotion.
-
- **Ergot:** Up to 20% ergot severity under artificial inoculation to the flower must be considered for varietal promotion.
- **Rust:** Rust severity under artificial inoculation at flowering stage and during hard dough stage data should be recorded (% leaf area of upper four leaves). Rust up to the score 20% can be considered for promotion.

Disease Screening Trials

Following procedures should be adopted to conduct the disease screening trials

- I. Downy Mildew: Downy mildew sick plot using infector rows system (seed should not be treated with fungicide)
- II. Smut and Ergot: to be inoculated artificially to the flower
- III. Rust: artificial inoculation to flowering stage
- IV. Blast: Artificial inoculation at seedling stage/Infector row system

****The group decided that all the Centres should record incidence of Downy mildew, blast, and rust in PMPT I, II, & III entries during 2021-2022.**

Smut: Jaipur, Jamnagar, Hisar and Gwalior (Zone A) and Dhule (Zone B)

Ergot: Jaipur (Zone A) and Aurangabad, Dhule and Coimbatore (Zone B)

PMPT I: Disease screening trial of Initial Pearl Millet Hybrids and Varieties.

PMPT II: Disease screening trial of Advanced Pearl Millet Hybrids and Varieties.

PMPT III: Monitoring disease resistance stability of released popular hybrid/varieties.

Downy Mildew	:	
Location	:	Zone A & A₁ Mandor, Jaipur, Hisar, Gwalior, Jamnagar and Anand Zone B Mysore, Aurangabad, Dhule, Coimbatore and Patancheru (PMPT-II)
Smut	:	
Location	:	Zone A & A₁ Jaipur, Jamnagar, Hisar and Gwalior Zone B Dhule
Blast	:	
Location	:	Zone A & A₁ Jaipur, Jamnagar, Mandore, Gwalior, Hisar and New Delhi (PMPT-II) Zone B Dhule, Aurangabad and Mysore
Rust	:	
Location	:	Zone A & A₁ Jaipur, Jamnagar, Hisar and Gwalior Zone B Aurangabad, Dhule and Coimbatore
Ergot	:	
Location	:	Zone A & A₁ Jaipur Zone B Aurangabad, Dhule and Coimbatore

PMPT IV: Pearl millet downy mildew virulence nursery (PMDMVN).**Pathogenic diversity analysis by virulence nursery**

Location : **Zone A & A₁**
Mandor, Jaipur, Hisar, Gwalior, Jamnagar and Anand
: **Zone B**
Mysore, Aurangabad, Dhule, Coimbatore and Patancheru

PMPT V: Pearl millet blast variability nursery (PMBVN)

Location : **Zone A & A₁**
Gwalior, Anand, Mandor, Jamnagar, Hisar, New Delhi, and Jaipur
Zone B
Dhule, Aurangabad, Mysore, Patancheru and Vijayanagaram

PMPT VI: Basic and strategic research:

- Biochemical and molecular of host pathogen interaction of blast and downy mildew system

Location : Mysore and ICRISAT

PMPT VII: Management of downy mildew and blast disease by using chemicals and bio-agents

(Experiment Started for 2019-2022)

a. DOWNY MILDEW**Treatments:**

1. *Trichoderma harzianum* formulation (JAU @ 8g/kg) (Jamnagar Centre will supply)
2. PSB formulation (PSB @8g/kg) (Mysore Centre will supply)
3. Neem oil (3%) (Mandor Centre will supply)
4. Metalaxyl 35SD (6g/Kg) (Mandor Centre will supply)
5. Control

Replication: 4 (4 rows in 4 meter length)

Observation to be recorded:

- a) Seedling emergence
- b) Per cent Downy Mildew Incidence at 30 and 60 DAS
- c) Grain and Fodder Yield - Should be calculated per hectare

Location : **Zone A & A₁**
Mandor, Jaipur, Hisar, Gwalior, Jamnagar
Zone B
Aurangabad, Dhule, Coimbatore, Mysore and Patancheru

b. BLAST DISEASE**(Experiment Started for 2019-2022)****Treatments:**

1. Seed treatment with Chitosan @3.75g/kg seed + 2 sprays of *Pseudomonas fluorescens* @10g/lt after 20 DAE (days after emergence) and 35 DAE (Mysore Centre will supply)
2. Seed treatment with Chitosan @3.75g/kg seed + 2 sprays of *Bacillus subtilis* @10g/lt after 20 DAE and 35 DAE (Mysore Centre will supply)
3. Spray treatment with *Pseudomonas fluorescens* @10g/lt 20 DAE and Trifloxystrobin + Tebuconazole @ 0.04% after 35 DAE (Mysore Centre will supply)
4. Spray treatment with Trifloxystrobin + Tebuconazole @ 0.04% 20 DAE and *Bacillus subtilis* @10g/lt after 35 DAE (Mysore Centre will supply)
5. Trifloxystrobin + Tebuconazole @ 0.04% 2 sprays after 20 DAE and 35 DAE (Mandor Centre will supply)
6. Control – Moderately susceptible cultivar (Mandor Centre will supply- Dhanashakti)

Replication: 4 (4 rows in 4 meter length)**Observation to be recorded:**

- a) Seedling emergence
- b) Per cent blast disease severity at 30, 45 & 60 DAS
- c) Grain and Fodder Yield –Should be calculated per hectare

Location**: Zone A & A₁**

Mandor, Jaipur, Hisar, Gwalior, Jamnagar

Zone BAurangabad, Dhule, Mysore and Patancheru,
Vijayanagaram**Note:**

1. Cultivar ICMB 95444 should be used as an indicator after each treatment
2. Observation of Blast disease should be recorded 30, 45 and 60 days and Downy mildew should be recorded 30 & 60 days, in each treatment.
3. For blast disease severity should be recorded 0-9 scale and PDI should be calculated
4. The soft copy (CD) of the disease incidence of different genotypes of the respective Centre should be recorded and as to submit along with annual report.
5. The coefficient of variation (CV) values of each experiment should be provided for consideration for further analysis and interpretation of results.

PMPT VIII: Monitoring of Pearl Millet diseases at Farmers' fields: All AICRP on Pearl millet centres in their respective zones

Method: Record survey information by preparing chart listing farmers name, source of seed samples/field number, location, cultivar/area, crop stage (F and SDS), disease incidence/severity and Collect the infected leaves samples of highly susceptible cultivars of downy mildew and blast samples for pathogen characterization.

PMPT IX: Disease screening trial of pearl millet hybrids in summer Locations:

- Anand,
- Jamnagar,
- Dhule
- Coimbatore

PLAN OF WORK 2021-22 FOR ENTOMOLOGY

Chairman	Dr. H.S. Sekhar Shetty, Ex Professor, Downy Mildew Research Lab, Univ. of Mysore
Rapporteurs	Prof. Rajkumar P. Juneja, Assistant Research Scientist (Entomology) & PI Entomology, ICAR-AICRP-PM, JAU, Jamnagar
Date	22 nd March, 2021

Recommendation:

On the basis of 4 years study, it was found that, soil drenching of Imidacloprid 17.8 SL @ 60 g a.i/ha. in standing crop after 21 days of sowing recorded lowest white grub & termite incidence at harvest, recorded highest grain & fodder yield. This treatment also recorded highest additional income, net return & the ICBR (1:12.98). The next best treatment was Clothianidin 50 WDG @ 150 g a.i /ha. in its effectiveness (ICBR 1:4.01).

Technical Programme for *kharif* 2021-22

No.	Expt. No.	Title of the experiment	Centres
1	PMET-1A	Screening of different pearl millet lines against major insect-pests (Initial/population lines)	Jamnagar & Jaipur
2	PMET-1B	Screening of different pearl millet lines against major insect-pest (advanced lines)	Jamnagar, ARS Mandor-Jodhpur & Jaipur
3	PMET-1C	Screening of pearl millet germ plasm against major insect pests (Mini-core from ICRISAT)	Jamnagar & Jaipur
4	PMET-2	Monitoring of major insect-pests of pearl millet (On Research Station)	Jamnagar, Anand, ARS Mandor-Jodhpur, Jaipur, Aurangabad & Vijayapur
5	PMET-3	Survey of insect- pests of the pearl millet crop on farmers' field (<i>Kharif</i> & summer)	<i>kharif</i> : Jamnagar, Anand, ARS Mandor-Jodhpur, Jaipur, Aurangabad. summer: Jamnagar & Anand
6	PMET-5	Testing of IPM modules against pest complex of pearl millet	Jamnagar, ARS Mandor-Jodhpur & Jaipur
7	PMET-8	Relative susceptibility of pearl millet advanced entries to storage insect pests (storage- trial), Modified.	Jamnagar, Anand & Jaipur
8	PMET-9	Monitoring of Fall Army Worm (<i>Spodoptera frugiperda</i>) in <i>Kharif</i> pearl millet	Jamnagar, Anand, ARS Mandor-Jodhpur, Jaipur, Aurangabad.

Details of experiments to be conducted 2021-22

1. PMET-1A: Screening of pearl millet lines against major insect pests (Initial lines/populations)

Objective/Target: To find out resistant/promising pearl millet material against major insect pests.

Location: Jamnagar & Jaipur

Experimental details: Design: RBD, **No of replications:** 2, **No. of rows:** One

Row length: 4.0 m and **Spacing:** 50 x 15 cm. **No. of entries:** Initial & population lines to be provided by PC unit.

Observations to be recorded:

- a. **Shoot fly** – Per cent infestation at 28 DAG (Vegetative stage) and ear head stage.
- b. **Stem borer** – Per cent plant damage at 28 DAG (Vegetative stage) and at ear head stage.
- c. *Helicoverpa* larvae – Number of larvae/ 5 ear heads.
- d. **Leaf roller** – Damage score (0-10) and number of larvae/ 5 plants.

2. PMET-1B: Screening of pearl millet lines against major insect pests (Advance lines)

Objective/Target: To find out resistant/promising pearl millet material against major insect pests.

Location: Jamnagar, Jaipur & ARS Mandor-Jodhpur

Experimental details: Design: RBD, **No of replications:** 2, **No. of rows:** Two

Row length: 4.0 m and **Spacing:** 50 x 15 cm. **No. of entries:** Advance Promising lines to be provided by PC unit

Observations to be recorded:

- a. **Shoot fly** – Per cent infestation at 28 DAG (Vegetative stage) and ear head stage.
- b. **Stem borer** – Per cent plant damage at 28 DAG (Vegetative stage) and at ear head stage.
- c. *Helicoverpa* larvae – Number of larvae/ 5 ear heads.
- d. **Leaf roller** – Damage score (0-10) and number of larvae/ 5 plants.

3. PMET-1C: Screening of pearl millet germ plasm against major insect pests (Mini-core from ICRISAT)

Objective/Target: To find out resistant/promising donor material against major insect pests.

Location: Jamnagar & Jaipur

Experimental details: Design: RBD, **No of replications:** 2, **No. of rows:** One

Row length: 2.0 m and **Spacing:** 50 x 15 cm. **No. of entries:** Mini-core/germ plasm supplied by gene bank ICRISAT

Observations to be recorded:

- a. **Shoot fly** – Per cent infestation at 28 DAG (Vegetative stage) and ear head stage.
- b. **Stem borer** – Per cent plant damage at 28 DAG (Vegetative stage) and at ear head stage.
- c. *Helicoverpa* larvae – Number of larvae/ 5 ear heads.
- d. **Leaf roller** – Damage score (0-10) and number of larvae/ 5 plants.

N.B.: Seed to be selfed for next year.

4. PMET-2: Monitoring of major insect pests of pearl millet (On Research Station)

Location: Jamnagar, Anand, Jaipur, ARS Mandor-Jodhpur, Aurangabad & Vijayapur,

Objective/Target: To study the intensity & population fluctuation of key pests of pearl millet with weather parameters.

Experimental details:

Design: Nil (Observation plot)

Replications: Nil

Treatment: Untreated plot/treated plot

Spacing: 50 x 15 cm.

Variety: Any released pearl millet hybrid of that zone

Methodology:

Sowing of released pearl millet variety will be done over an area of 200 m² which will be kept free from insecticidal application during crop season. Incidence (%) and population of various insect pests observed during the crop period will be recorded at weekly interval from 20 randomly selected plants 7 days after germination (DAG) of the crop till maturity. The presence of bio agents will also be recorded simultaneously. Weather data may also be recorded on weekly basis (Meteorological Standard Weather Week) at least, Temperature Minimum & Maximum, RH Morning & Evening, Rainfall mm & Rainy days. If some other facility available than other parameters may be recorded for correlation. **N.B.: One treated plot may be maintained by taking recommended package of practices for insect pest management to get the information for losses.**

The following treatments will be adopted for treated plot.

1. Shoot fly, stem borer, white grub & termite: Seed treatment imidacloprid 600 FS @ 8.75 ml/kg seed.
2. Shoot fly, stem borer foliar spray: Spray of fipronil 5 SC @ 0.01%, at 35 days after germination of crop or spray of imidacloprid 17.8 SL 0.009% at 35 DAG or spraying of novaluron 10 EC 0.01%, at 35 DAG.
3. *Helicoverpa armigera* : Spraying of novaluron 10 EC 0.01%, at ear head stage at pest appearance.
4. Fall Army Worm: *Beauveria bassiana* 5 g/ litre whorl application (1X10⁸ CFU/g) repeat after 10 days if required.
5. Leaf binder, grass hopper, grey weevil, hairy cater pillar, FAW and any other leaf feeding insects: Spraying of NSKE 5%.

N.B.: The proforma for recording the observations will be sent by PI to the scientists concerned.

5. PMET-3: Survey of insect- pests of the pearl millet crop on farmers' field (*Kharif* & summer).

Location-Kharif: Jamnagar, Anand, Jaipur, ARS Mandor-Jodhpur & Aurangabad.

Location-Summer: Jamnagar & Anand in Gujarat only

Objective/Target: To know the magnitude of insect-pests at farmer's field and to identify the hot spot of insect-pests in the region.

Observations to be recorded:

Survey of insect pests will be carried (minimum 25-50 fields) out at vegetative and at ear head stage of bajra crop during *Kharif* & summer season at different locations. Percent incidence of various insect pests and population per 5 plants will be recorded infesting pearl millet. The presence of bio-agents will also be recorded simultaneously.

N.B.: The proforma for recording the observations will be sent by PI to the scientists concerned.

6. PMET-5: Testing of IPM modules against pest complex of pearl millet.

Objective/Target: To test the effectiveness of IPM modules against major insect pest (shoot fly, stem borer, *Helicoverpa*, grass hopper, white grub & termite) of pearl millet.

Location: Jamnagar, Jaipur & ARS Mandor-Jodhpur

Experimental details: Design: RBD, **No. of Replications:** 4

Gross plot size: 4.0 x 3.0 m (5 rows), **Net plot size:** 3.0 x 1.80 m (3 rows) and

Spacing: 50 x 15 cm.

Treatment details: 7

1. T1-IPM module-I: 10% higher seed rate + seed treatment of imidacloprid 600 FS @ 8.75 ml/kg + removal of shoot fly dead hearts + fish meal trap @ 10/ha.
2. T2-IPM module-II: T1 + seed treatment of PSB @ 10 ml/kg seed + spray azadirachtin 1500 ppm (40 ml/10 litres of water) at 30 DAG and at ear head stage.
3. T3-IPM module-III: T1 + seed treatment of PSB @ 10 ml/kg seed + furrow application of *Trichoderma harzanium* @ 2.5 kg/ha mixed in 500 kg well decomposed FYM at the time of sowing + spray azadirachtin 1500 ppm (40 ml/10 litres of water) at 30 DAG and at ear head stage.
4. T4-IPM module-IV: T1 + seed treatment of PSB @ 10 ml/kg seed + neem cake @ 250 kg/hactare furrow application at the time of sowing + spray azadirachtin 1500 ppm (40 ml/10 litres of water) at 30 DAG and at ear head stage.
5. T5-IPM module-V: T1 + seed treatment of PSB @ 10 ml/kg seed + neem cake @ 500 kg/hactare furrow application at the time of sowing + spray azadirachtin 1500 ppm (40 ml/10 litres of water) at 30 DAG and at ear head stage.
6. T6-IPM module-VI: Seed treatment of imidacloprid 600 FS @ 8.75 ml/kg, installation of fish meal trap @ 10/ha and spraying of NSKE 5% at ear head stage (Standard check-earlier recommendation)
7. T7-Untreated-control

Methodology and observation to be recorded

- a. Per cent incidence of shoot fly at 28 DAG (vegetative stage) and at ear head stage.
- b. Per cent incidence of stem borer at 28 DAG (vegetative stage) and at ear head stage.
- c. Per cent termite and white grub at ear head stage.
- d. Larval population of *Helicoverpa* to be recorded on 5 ear heads in each replication before & after spray (24 hrs before & 1, 3 & 7 days after spray).
- e. Grass hopper per cent damage at 45 DAG of the crop
- f. Leaf roller damage score at ear head stage.
- g. Grain & fodder yield.

N.B.: PSB treatment will be given after imidacloprid treatment.

7. PMET-8: Relative susceptibility of pearl millet varieties and hybrids to *Tribolium castaneum* Herbst, and *Rhizopertha dominica* Fab. in storage (Modified).

Objective/Target: To find out the resistant/tolerant/ susceptible variety/hybrid against storage insect pests.

Locations: Jamnagar, Jaipur & Anand

Design: CRD, **Replications:** 2, **Treatment/varieties/hybrids:** Approximately 20-30 (Advanced entries)

Methodology & Observations to be recorded:

One Hundred gram seeds of each variety of pearl millet will be taken in plastic container (250 g capacity). Ten pairs of adults of *Tribolium castaneum* Herbst (At Jamnagar) and *Rhizopertha dominica* Fab. (At Jaipur & Anand) will be released in each treatment/variety for egg laying, replicated twice. The plastic container will be covered with muslin cloth and will be fastened with rubber bands. The insects will be removed after 10 days of exposure. The set of experiment will be kept as such for recording the observations till 35 days at $27 \pm 2^{\circ}$ C and 60 to 70 per cent relative humidity. Observations on average number of adults emerged, average percentage of seed damage, average percent weight loss and germination will be recorded at 35 days after removal of insects. The data recorded will be subjected to statistical analysis.

Note: The pearl millet seeds will be used from experiment of PMET-1B (advanced entries) trial after harvesting of *kharif* trial.

8. PMET-9: Monitoring of Fall Army worm (*Spodoptera frugiperda*) in *kharif* pearl millet.

Locations: Jamnagar, Anand, Jaipur, ARS Mandor-Jodhpur & Aurangabad

Objective/Target: To know the presence of adults of fall army worm in pearl millet eco system and simultaneously damage in pearl millet

Treatment: Pheromone traps of fall army worm

Methodology & Observations to be recorded: The pheromone traps of fall army worm (Minimum 5 traps) will be installed in the general pearl millet crop field of the station. The mean catches per trap will be recorded at weekly interval as per standard weather week. The mean catches per week will be worked out to know the population fluctuations. The plant damage percentage will also be recorded weekly. The weather data will also be recorded to work out the correlation.

N.B.: The traps will be supplied by PI (Entomology), Pearl millet Research Station, JAU, Jamnagar to the above locations.

SESSION III**Review of Research Results of ICAR-ICRISAT Collaborative Project 2020-21 and Plan of Work 2021-22; Review of Frontline Demonstrations for 2020-21 and Action Plan 2021-22**

Chairman	Dr. S.K.Malhotra, Agri. Commissioner, DAC, New Delhi
Co-chair	Dr. C. Tara Satyavathi, Project Coordinator (Pearl Millet) AICRP-PM, Jodhpur
PAMC Experts	Dr. P. Raghava Reddy, Ex VC, ANGRAU, Hyderabad Dr. R.K. Pannu, Ex Dean, CCS HAU, Hisar Dr. H. Shekhar Shetty, Ex Professor, Downy Mildew Research Lab, Univ. of Mysore Dr. M.L. Lodha, Division of Bio-Chemistry, IARI, New Delhi Dr. DC Uprety, Ex Principal Scientist, Division of Plant Physiology, IARI
Rapporteurs	Dr. K. D. Mungra, Res. Sci.(Pearl Millet), JAU, Jamnagar
Date	22 nd March, 2021

The results of ICAR-ICRISAT trials conducted during 2020-21 were presented by Dr. B. R. Beniwal, Senior Technical Assistant, AICRP on pearl millet Mandor, Jodhpur. He informed that during kharif 2020, a total 7 trait based restorer and female line nurseries and 2 marker assisted breeding trials and during summer 1 forage OPV/hybrid trial conducted nurseries were conducted successfully at 11 different locations. Based on the results compiled, best entries which performed superior to the check entries were also presented for all the trials.

Dr. S.K.Gupta (Principal Scientist), Pearl Millet Breeding, ICRISAT, Hyderabad presented the trials to be taken up during 2021-22 and the locations to be included for different trials. He has also presented the detailed information about Seed Parent Nursery, Restorer Parent Nursery, Drought Tolerant Hybrid Parent Nursery, Blast Resistant Nursery and High Fe inbred and Joint Biofortification trial to be implemented during 2021-22. Dr. Rakesh Srivastava, Principal Scientist, ICRISAT presented 2021-22 work plan for two marker assisted breeding trials viz, Blast Resistance trial and Seedling stage heat tolerance and adaptation to A₁ zone trial.

ICAR-ICRISAT COLLABORATIVE PROJECTS PLAN OF WORK 2021-22

ICAR-ICRISAT Trials/Nurseries 2021

Sl. No.	Name of the Trial/Breeding nursery	No of Entries	Plot Size	Locations (as were in 2020)
Trials/Nursery Rainy 2020				
1.	Potential B-line nursery	60	1 row x 2 reps	1. AICRP, SKRU, Bikaner 2. RARI, Durgapura 3. MPKV, Dhule 4. CAZRI, Jodhpur 5. RVSKVV, Gwalior 6. JAU, Jamnagar 7. ICAR-IIMR, Hyderabad 8. CCS HAU, Hisar
2.	Potential R-line nursery	60	1 row x 2 reps	1. AICRP, SKRAU, Bikaner 2. RARI, Durgapura 3. MPKV, Dhule 4. CAZRI, Jodhpur 5. RVSKVV, Gwalior 6. JAU, Jamnagar 7. ICAR-IIMR, Hyderabad 8. CCS HAU, Hisar 9. IARI, New Delhi 10. RARS, Vijayapur, Karnataka 11. ARS, Malnoor, UAS, Raichur, Karnataka 12. PC Unit, Jodhpur
3.	Drought tolerant hybrid parent nursery	40	1 row x 2 reps	1. AICRP, SKRAU, Bikaner 2. RARI, Durgapura 3. CAZRI, Jodhpur 4. CCA HAU, Hisar 5. PC Unit, Jodhpur
4.	Blast Resistant Nursery	40	1 row x 2 reps	1. RVSKVV, Gwalior 2. IARI, New Delhi 3. RARI, Durgapura 4. MPKV, Dhule 5. ARS, Ananthapuramu
5.	Elite Joint Bio-fortification Trial (coordinated by AICRP on Pearl Millet)	45	1 row x 2 reps	1. ARS, Malnoor, UAS, Raichur, Karnataka 2. RARI, Durgapura 3. PAU, Ludhiana 4. AICRP, SKRAU, Bikaner 5. MPKV, Dhule 6. CAZRI, Jodhpur 7. JAU, Jamnagar 8. IARI, New Delhi 9. PC Unit, Jodhpur

The FLD results of 2020-21 were presented by Mr. Manoj Kumar, Assistant Professor (Agronomy), PC Unit, Jodhpur. He informed the house that FLDs were conducted on a total of 350 ha area under A₁, A and B zones during *kharif*, summer and semi-rabi seasons with different technologies including, varietal component, improved practices and full package of practices. Out of total FLDs area, 60.4 ha area i.e.18.64 % area was covered with biofortified hybrids. During 2021-22, FLDs will be conducted on a total of 400 ha area covering A₁, A and B zones in different seasons. During this year, the proportion of FLDs with biofortified hybrids will be also increased. Dr. Malhotra emphasized on conducting FLDs in clusters.

Proposal of FLD's on pearl millet for the year 2021-22 (*Kharif* & Summer)

Sr. No.	Name of the coordinating centre	(Area in ha)			Technology to be demonstrated
		<i>Kharif</i>	Summer	Total	
1	RARI, (SKNAU), Durgapura (Jaipur), Rajasthan	20	-	20	<ul style="list-style-type: none"> Improved variety (MPMH 17, HHB 299 & RHB 223) V/s Local variety Full Package of practices Weed management
2	Agricultural Research Station (SKRAU), Bikaner (Rajasthan)	20	-	20	<ul style="list-style-type: none"> Improved variety (MPMH 17, HHB 299, RHB 173 & RHB 177) V/s Local variety Full package of practices Weed management
3	Millet Research Station, JAU, Jamnagar (Gujrat)	10	20	30	<ul style="list-style-type: none"> Improved variety (HHB 299, GHB 558) V/s Local variety in <i>kharif</i> Improved hybrid (GHB 538) v/s Local variety in summer Full package of practices in summer
4	Bajra Section, CCSHAU, Hisar (Haryana)	10	-	10	<ul style="list-style-type: none"> Improved hybrids (HHB 299) V/s Local variety Weed management by Atrazine Efficient nutrient management Use of micro nutrient v/s Farmer's practices
5	KVK, Shikohpur (IARI, New Delhi), Gurgaon	10	-	10	<ul style="list-style-type: none"> Improved hybrids (HHB 299) V/s Local variety Improved variety v/s local variety Full package of practices Weed management
6	AICRP-PM, COA (RVSKVV), Gwalior (MP)	10	-	10	<ul style="list-style-type: none"> Improved hybrids (RHB 223, HHB 299 & RHB 173) v/s local variety

					<ul style="list-style-type: none"> • Full package of practices
7	AICRP on Pearl Millet, NARP, Aurangabad (MH)	10	-	10	<ul style="list-style-type: none"> • Improved hybrid AHB 1200 v/s Local variety
8	Department of Millets, CPBG, TNAU, Coimbatore	10	-	10	<ul style="list-style-type: none"> • Improved hybrids (TNAU Cumbu hybrid Co9 and Improved variety Co (cu) 10) V/s Farmer's practice • Weed management
9	AICRP on Pearl Millet, Regional Agricultural Research Station, Vijayapur (Karnataka)	10	-	10	<ul style="list-style-type: none"> • Improved hybrid/variety AHB 1200 and Dhanshakti v/s Local variety •
10	College of Agriculture, (MPKV, Rahuri), Dhule (MH)	10	-	10	<ul style="list-style-type: none"> • Improved variety Dhanshakti • Full package of practices
11	Agricultural Research Station, (ANGRAU), Ananthapuram (AP)	10	-	10	<ul style="list-style-type: none"> • Improved Hybrid (ABV 04) V/s Local Variety • Full package of practices • Weed management
12	DEE (AU, Jodhpur), Jodhpur (Rajasthan)	20	-	20	<ul style="list-style-type: none"> • Improved hybrids (HHB 299, MPMH 21, MPMH 17 & RHB 177, RHB 223) V/s Local variety • Full package of practices
13	KVK, CAZRI, Jodhpur (Rajasthan)	10	-	10	<ul style="list-style-type: none"> • Improved hybrids (HHB 299, MPMH 21, MPMH 17 & RHB 177, RHB 223) V/s Local variety
14	Incharge Forage & Millet section, Department of Plant Breeding, PAU, Ludhiana (Punjab)	10	-	10	<ul style="list-style-type: none"> • Improved hybrids V/s Local variety • Full package of practices
15	Agricultural Research Station, (ANGRAU), Vizianagaram (AP)	10	10	20	<ul style="list-style-type: none"> • Improved hybrids V/s Local variety • Full package of practices
16	KVK Phalodi, Jodhpur (Rajasthan)	10	-	10	<ul style="list-style-type: none"> • Improved hybrids (HHB 299, MPMH 21, MPMH 17 & RHB 177, RHB 223) V/s Local variety
17	KVK Gudamalani, Barmer (Rajasthan)	20	10	30	<ul style="list-style-type: none"> • Improved hybrids (HHB 299, MPMH 21, MPMH 17 & RHB 177, RHB 223) V/s Local variety • Full package of practices
18	KVK Sirohi (Rajasthan)	0	10	10	<ul style="list-style-type: none"> • Improved hybrids (HHB 299, MPMH 21, MPMH 17 & RHB 177, RHB 223) V/s Local variety
19	KVK Athiyasan, Nagaur	10	-	10	<ul style="list-style-type: none"> • Improved hybrids (HHB 299,

	(Rajasthan)				MPMH 21, MPMH 17 & RHB 177, RHB 223) V/s Local variety
20	KVK Molasar, Nagaur (Rajasthan)	10	-	10	• Improved hybrids (HHB 299 , MPMH 21, MPMH 17 & RHB 177, RHB 223) V/s Local variety
21	KVK Jalore (Rajasthan)	10	10	20	• Improved hybrids (HHB 299 , MPMH 21, MPMH 17 & RHB 177, RHB 223) V/s Local variety
22	KVK Chandgothi, Churu (Rajasthan)	20	-	20	• Improved hybrids (HHB 299 , MPMH 21, MPMH 17 & RHB 177, RHB 223) V/s Local variety
23	College of Agriculture Sumerpur, AU, Jodhpur (Rajasthan)	10	-	10	• Improved hybrids (HHB 299 , MPMH 21, MPMH 17 & RHB 177, RHB 223) V/s Local variety
24	Agricultural Research Station, (ANGRAU), Perumallapalli (AP)	0	10	10	• Improved Hybrid (ABV 04) V/s Local Variety • Full package of practices
25	ICAR, Research Complex for NEH Region, Umiam, Meghalaya	0	10	10	• Improved hybrids V/s Local variety • Full package of practices
Total		270	80	350	

Note: The monitoring team will be constituted after planting of the crop.

The session ended with vote of thanks.

SESSION IV

Proceedings of Varietal Identification Committee Meeting of AICRP on Pearl millet held on 22.03.2021 on 5:30 pm (Virtual) under the Chairmanship of Dr. T.R. Sharma, DDG (CS).

Varietal Identification Committee Meeting of ICAR-AICRP on Pearl millet was held on 22.03.2021 at 5:30 PM in Virtual mode. The following committee members were present:

1.	Dr. T.R. Sharma, Deputy Director General (CS)	- Chairman
2.	Dr. D.K. Yadava, Assistant Director General (Seeds)	- Member
3.	Dr. Y.P. Singh, Assistant Director General (FFC) Acting	- Member
4.	Dr. Sanjay Kumar, Director, Project Director (ICAR-IISS, Mau)	- Member
5.	Dr. Subhash Jhajharia, Director, DMD, Jaipur	- Member
6.	Sh. Brij Kishore Dwivedi, Manager, RSSCO, Jodhpur	- Member
7.	Sh. Ponam Chand Ji, DYSCO, RSSC, Jodhpur	- Member
8.	Sh. Sachin Vidhale, JK Agri Genetics, Hyderabad	- Member
9.	Dr. C. Tara Satyavathi, PC, ICAR-AICRP on Pearl millet, Jodhpur	- Member Secretary
Principal Investigator (Special invitees)		
1.	Dr. Vikas Khandelwal, Sr. Scientist, ICAR-AICRP on PM, Jodhpur	- Facilitator
2.	Dr. Anil Kumar Yadav, Prof. (Agronomy), CCS HAU, Hisar	- Facilitator
3.	Dr. Chandra Nayak, Professor (Patho.), UOM, Mysore	- Facilitator
4.	Dr. Dr. Rajkumar P. Juneja, Asstt. Prof. (Ento.), JAU, Jamnagar	- Facilitator

Four proposals of pearl millet hybrids were considered for identification by the Committee. After proposal-wise detailed discussions, recommendations of the committee are as under:

Summer hybrid MSH 353 (PB 1877) for Zone A₁, A & B (Rajasthan, Gujarat, Punjab, UP, Maharashtra, Tamil Nadu)

The proposal of one summer hybrid MSH 353 (PB 1877) was considered by the committee. The hybrid MSH353 (PB 1877) had recorded 8.8 percent higher grain yield over the best check and found resistant to downy mildew, blast, smut, rust and ergot. Hence, the hybrid was identified for release for cultivation in the states of Rajasthan, Gujarat, Punjab, UP, Maharashtra, Tamil Nadu.

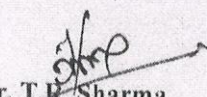
Late maturing hybrids MH 2423 (NBH 5929) and MH 2439 (86M80) for Zone A (Rajasthan, Gujarat, Haryana, Uttar Pradesh, Madhya Pradesh, Punjab and Delhi)

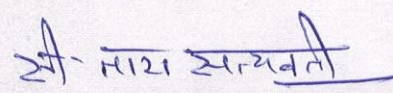
The proposals of two hybrids MH 2423 (NBH 5929) and MH 2439 (86M80) were considered by the committee for late maturity group. Hybrid MH 2423 (NBH 5929) and MH 2439 (86M80) recorded 4.2 and 2.5 percent higher grain yield over the best check, respectively. These hybrids were also found resistant to downy mildew, blast, smut, rust and ergot and have good iron & zinc content. Hence, the hybrids MH 2423 (NBH 5929) and MH 2439 (86M80) were identified for release for cultivation in the states of Rajasthan, Gujarat, Haryana, Madhya Pradesh, Uttar Pradesh, Punjab and Delhi under late maturity group.

Kharif hybrid MH 2545 (HHB 67 Improved 2-7) for Zone A₁ and A (Rajasthan, Haryana and Gujarat)

The proposal of MH 2545 (HHB 67 Improved 2-7) an EDV of HHB 67 Improved introgressed with downy mildew resistance was discussed and due to incomplete data, the proposal was referred to a Committee under Chairmanship of ADG (Seed) with ADG (FFC), ICAR and Director, IISS, Mau as members and Project Coordinator (Pearl millet) as convener of the meeting. The committee examined the whole data of yield and disease reaction generated under AICRP trials and found that the hybrid (EDV) was having superiority in yield (15%) in comparison to HHB 67 Improved and low incidence of downy mildew (2.6 in EDV) compared to the check HHB 67 Improved (6.7%). Hence, MH 2545 (HHB 67 Improved 2-7) was identified for release for cultivation in Rajasthan, Haryana and Gujarat under rainfed conditions in Kharif season.

The meeting ended with the vote of than to the chair.


Dr. T.R. Sharma
Chairman


Dr. C. Tara Satyavathi
Member Secretary

SESSION V

New Initiative for Pearl millet Research

Chairman	Dr. T. R. Sharma, DDG (CS), ICAR, New Delhi
Co-chairs	Dr. Y. P. Singh, ADG (FFC), ICAR, New Delhi Dr. Vilas A Tonapi, Director, ICAR-ICMR, Hyderabad
Rapporteurs	Dr. R. K. Kakani, ICAR-CAZRI, Jodhpur Dr. Supriya, ICAR-AICRP on Pearl millet, Jodhpur
Date	23 rd March, 2021

The session started with the opening remarks by the chairman along with congratulating PC, AICRP of Pearl millet for planning this session in this meeting. In this session, a total of six presentations were made by the distinguished speakers on various new initiatives taken up in Pearl millet research.

Dr. Tara Sayavati, PC, AICRP on PM presented the details of Genetic Gains in pearl millet and reported that highest genetic gain i.e. 2.81 and 3.61 were observed in 1990 to 2000 era in A and B zone respectively. This may be due to the development of hybrid and seed availability to the farmers. She further added the importance of development of genetic material for A₁ zone, as it has the maximum area of pearl millet with less productivity. She had elaborated the challenges, requirement, priorities and desirability of material for this zone along with new initiatives taken.

Dr. Ranjeet Ranjan, Senior Scientist, IARI, New Delhi presented the development of biochemical and physical processing technology to arrest oxidation of Lipid/flavons to enhance the shelf life of pearl millet flour including technologies for reducing rancidity in pearl millet by hydro-hydrothermal and thermal-NIR treatments. He elaborated transcriptomic approach for identification of lipase genes and identified putative TAG lipase genes from developing pearl millet grains and proteomic characterization of some of the hybrids and populations. He further described antidiabetic potential of pearl millet through the phenolics available in grains along with proximate analysis through Near-Infrared Reflectance Spectroscopy (NIRS). He also presented the improvement of dough making quality by adding wheat gluten. This improved flour is released with the name of Hallur-Soft Bajra Atta.

Dr. PG Padmaja, Principal Scientist, ICAR-IIMR, Hyderabad presented her views on the rancidity in flour along with lipase, volatile organic compounds of different millets including pearl millet. She elaborated thermal, packaging and modified atmosphere packaging as a whole to increase the shelf life in pearl millet flour with reduced rancidity.

Dr. Pooja Bhatnagar Mathur, Principal Scientist, ICRISAT, Hyderabad presented the efforts made by ICRISAT along with CORTEVA Agriscience to address the rancidity through molecular and advance breeding interventions using inbred lines with diverse and contrasting free fatty acid accumulation and dysfunctional lipase gene pearl millet for reduced rancidity in milled flour. She further elaborated the work carried with biofortified and non-biofortified material for rancidity parameters using millet grain along with heat treated (microwave 100s) milled grain and identified candidate gene(s) from biochemistry

and omics. She presented the use of CRISPR for single and double cuts with no repair template to shift in fatty acid profile; reducing FFA levels that are prone to oxidation.

Dr. Rajendra Prasad, Director, IARI, New Delhi presented the process and development of automation system in All India coordinated Research Project on pearl millet. He elaborated the research data management in ICAR/DARE and its importance and also explained how it works for different individual crop including group head, experimenter, experiment-in-charge for creation of new experiment along with entries, observations to be recorded, randomization, datasheet download, recording the data and uploading it to platform by the experimenter; review, data approvals and use in analysis as per requirement.

Dr. Abhishek Rathore, Principal Scientist & Theme Leader for Statistics, Bioinformatics and Data Management (SBDM), ICRISAT presented AICRP-Pearl millet digitalization and data analysis. He elaborated that breeding data informatics include advanced experimental designs, pedigree analysis, genetic gain estimation, low and medium density marker panel, advanced genetic diversity and grouping etc. The research data ecosystem developed can be used very easily with barcode solutions up to single plant level along with real time data transfer to server.

In the end, few queries were raised and answered thoroughly by everyone. Chairman suggested that the next year theme for this session should be on Prebreeding and Disease Resistance in Pearl millet.

The session ended with vote of thanks to chairman and co-chairman.

SESSION VI

Review of DUS Testing Project, Progress Report 2020 -21 and Review of BSP 2020-21 and Action Plan 2021-22

Chairman	Dr. O.P. Yadav, Director, ICAR-CAZRI, Jodhpur
Co-chairs	Dr. C. Tara Satyavathi, PC, ICAR-AICRP on Pearl millet, Jodhpur
Rapporteurs	Dr. Dev Vart Yadav, CCS HAU, Hisar Dr. Arun Kumar M.B., ICAR-IARI, New Delhi
Date	23 rd March, 2021

During the session, Dr. Vikas Khandelwal, ICAR- AICRP on Pearl millet, Jodhpur presented the progress made in 2020-21 under DUS Testing Project and Breeder Seed Production. Under DUS testing, a total of 11 varieties (8 in 2nd year and 3 in 1st year) were evaluated on 28 DUS traits. A total of 7.11 q indent of breeder seed was there for five varieties and 31 parental lines of hybrids. There was a deficit production in certain lines/varieties which shall be overcome by taking production in summer season. A lot of deliberations were made during the session pertaining to the DUS testing, variety registration, breeder seed conversion rate to foundation seeds, non-lifting issues of indented breeder seeds by the DAC, popularization of the new hybrids and possibilities of taking up early summer season seed production in Rajasthan. Based on the presentations and deliberations, the following recommendations were emerged:

- The PC unit should sensitize the centers/breeders to register their varieties and hybrids and also get clarification from PPVFRA regarding re-registration of varieties/hybrids after expiry of stipulated protection period.
- All the AICRP centers should report to the PC Unit about the outcomes of the MoUs signed with the private companies under PPP mode for new hybrid/variety's seed production and commercialization.
- The house has agreed in principle to take up the breeder seed production of the required varieties and required quantity as per the DAC's indent which is yet to be communicated from the DAC.
- Availability of the seeds of newly released, biofortified hybrids should be ensured and taken up by the respective centers, so that the constant supply to the frontline demonstrations and popularization activities of such hybrids are not hampered.
- Efforts need to be taken up by the respective centers to bring in the new released hybrids into seed multiplication chain by pursuing the State Agricultural Departments.

The session ended with thanks to the Chairman.

BREEDER SEED PRODUCTION (ACTION PLAN 2021-22)

Programme of production of Breeder Seed of Pearl millet varieties and parental lines (BSP 1)

Crop: Pearl millet
2022

Year of Production: 2021

Year of supply: February

S. No.	Name of Producing center/state	Name of parental line/ variety	DAC indent (q)	Actual allocation as per BSP-I Target (q)
A	Varieties			
1	ANGRAU, Ananthapuram	ABV-04 (MP 552)	0.25	0.25
2	ICAR-IARI, New Delhi	Pusa Composite 612 (MP 480)	0.25	0.25
3	ICAR-IARI, New Delhi	Pusa Composite 701 (MP 535)	0.85	0.85
4	ICRISAT, Patancheru	Dhansakti (ICTP 8203 Fe 10-2)	2.82	2.82
5	NARP, Aurangabad	ABPC-4-3 (MP 484)	0.01	0.01
	Total	Total (A)	4.18	4.18
B.	Parental lines			
1	ICRISAT, Patancheru	ICMA 02333 (A line HHB 311, RHB 234)	0.07	0.07
2	ICRISAT, Patancheru	ICMB 02333 (B line HHB 311, RHB 234)	0.04	0.04
3	ICRISAT, Patancheru	ICMA 98222 (A line AHB 1269 & AHB 1200)	0.08	0.08
4	ICRISAT, Patancheru	ICMB 98222 (B line AHB 1269 & AHB 1200)	0.04	0.04
5	ICRISAT, Patancheru	ICMA 04888 (A line HHB 299)	0.04	0.04
6	ICRISAT, Patancheru	ICMB 04888 (B line HHB 299)	0.025	0.025
7	ICRISAT, Patancheru	ICMA 93333 (A line MPMH 21)	0.01	0.01
8	ICRISAT, Patancheru	ICMB 93333 (B line MPMH 21)	0.01	0.01
9	ICRISAT, Patancheru	ICMA 843-22 (A line HHB 67 Imp, HHB 67 Imp 2-7)	0.17	0.17
10	ICRISAT, Patancheru	ICMB 843-22 (B line HHB 67 Imp, HHB 67 Imp 2-7)	0.07	0.07
11	ICRISAT, Patancheru	ICMA 04999 (A line MPMH 17)	0.01	0.01
12	ICRISAT, Patancheru	ICMB 04999 (B line MPMH 17)	0.01	0.01
13	MPKV, Dhule	DHLB-8A (A line PHULE ADISHAKTI)	0.04	0.04
14	MPKV, Dhule	DHLB-8B (B line PHULE ADISHAKTI)	0.02	0.02
15	MPKV, Dhule	DHLBI-967 (R line PHULE ADISHAKTI)	0.02	0.02
16	NARP, Aurangabad	AUBI 1105 (R line AHB 1269)	0.02	0.02
17	NARP, Aurangabad	AUBI 1101 (R line AHB 1200)	0.02	0.02
18	CCSHAU, Hisar	HMS 7A (A line HHB 234)	0.01	0.01
19	CCSHAU, Hisar	HMS 7B (B line HHB 234)	0.01	0.01
20	CCSHAU, Hisar	H 14/003 (R line HHB 311)	0.02	0.02
21	CCSHAU, Hisar	H 13/0001 (R line HHB 299)	0.035	0.035
22	CCSHAU, Hisar	H 77/833-2-202 (R line of HHB 67 Imp, HHB 234)	0.07	0.07
23	CCSHAU, Hisar	[((ICMR 01004-P7 x P1449-2-P1-P6))-P9 x ((ICMR 01004-P13 x 863B-2-P1-P2))-P3]-2-B (R line of HHB 67 Imp 2-7)	0.04	0.04
24	SKNAU, Jaipur	RIB 15177 (R line RHB 234)	0.03	0.03
25	AU, Jodhpur	MIR 524 (R line MPMH 21)	0.02	0.02
26	AU, Jodhpur	MIR 525-2 (R line MPMH 17)	0.02	0.02
		Total (B)	0.95	0.95
		Total (A)+(B)	5.13	5.13

SESSION VII**Plenary Session/ Session-Wise Presentations & Recommendations**

Chairman	Dr. TR Sharma, DDG (CS), ICAR, New Delhi
Guest of Honour	Dr YP Singh, ADG (FFC) (Acting), ICAR, New Delhi Dr Vilas Tonapi, Director, ICAR-IIMR, Hyderabad
Date	23 rd March, 2021

During this session, respective rapporteurs of different sessions presented their reports followed by release of different publications including Summary of Research Experiments, Project Coordinator Review, Pearl millet News and two Technical Bulletins. Dr. DL Kadvani, JAU Jamnagar and Dr AC Mathur, SKNAU, Jaipur were felicitated on their superannuation and their significant contributions were shared with the house. AICRP on Pearl millet, Jamnagar and AICRP on Pearl millet, Coimbatore and AICRP on Pearl millet, Mysore centres were awarded appreciation certificates for their excellent work done on Pearl millet. Dr. Supriya, Dr. RC Meena, Sh. Arjun Singh Nathawat and Sh. Sanjay Solanki were awarded appreciation certificates for their contribution in different areas in PC Unit, Jodhpur. In the end, PAMC Members, Chairman and Guest of honour presented their remarks:

Dr Raghav Reddy appreciated the research work and presentations made during various sessions. He suggested to look into the narrow genetic base and to identify diverse line in the germplasm stock available in ICRISAT and NBPGR. The identified donors should be shared among centers, A₁ zone productivity should be focused and gene pools should be developed for A₁ zone. Seed production programme of public released hybrids should be strengthened in the seed chain. The agronomic PoP should be characterized zone wise and wherever production constraints are there they should be looked on priority. The FLD programme should be conducted in large numbers for popularization of new technologies.

Dr R K Pannu suggested for collecting experimental site weather data and study in detail their effect on crop performance. Complete soil analysis including chemical and physical factors is needed. Yield maximization trials should consider the status of nutrients. Organic matter addition or recycling should be considered for long term sustainability as pearl millet is an exhaustive crop, hence, long term experiments should be planned, the water holding capacity *vis a vis* organic carbon content should also be studied. The plant physiologist needs to study drought and heat nurseries in collaboration with ICAR-CAZRI, Jodhpur. DDG (CS) suggested for preparation of two experiments in consultation with Dr Pannu on agronomic aspects.

Dr Shekhar Shetty in his remarks said about the five most important diseases. Downy mildew has been addressed by development of better hybrids. The attention should be on blast too, due to environment change blast spread has increased, definition to pathotype and races need to be done. Rapid screening technique for blast disease need to be developed specifically for seedling stage and flowering stage both. Rust is emerging disease, seedling

stage is not a problem but at flowering or grain filling stage resistant lines need to be identified. Smut and Ergot are widely spread but are not causing economic damage. It is important to understand the biology of pathogens, life cycle and dynamics in association with environment factors. Epidemiology studies should be done. Management practices should be simple to be adopted. The focusing should sharply be on defined problems for betterment.

Dr. M L Lodha in his remarks appreciated the performance of the centers, he emphasized on quality publication. Rancidity should be addressed by tagging genes responsible using markers. High Fe and Zn, bioavailability of the nutrients should be looked into; Phytic acid variation should be studied. The Division of Biochemistry IARI can be collaborated to work on rancidity.

Dr. Uprety in his remarks suggested to record metrological data related to change in weather conditions in association to diseases and pest. The available data should be correlated to know the dynamic changes happening in abiotic and biotic stress. Water potential, RWC, source to sink relationship, organic carbon status etc, parameters are simple parameters for study and can give needful information on genotypic performance with respect to abiotic stress.

Dr. Y P Singh (ADG) (FFC), appreciated the efforts and suggested that SOP should be followed for plant protection experiments. Long term data available on plant protection should be analyzed for development of forecasting models. Conservation agriculture should be focused. Research on nutritional aspects should be given weightage.

Dr Tonapi, Director, IIMR in his remarks emphasized on sharing of material and reorientation of the programme for developing better hybrids.

DDG (CS) in his closing remarks thanked the members and experts and congratulated the awardees including PC AICRP-PM for bringing out good publications. He also congratulated the superannuating members of the AICRP team. He emphasized that all the AICRP centers should clearly give the target and achievements in brief for the experiments conducted and clear product profiles should be developed for different agroecologies. Creation of variability, germplasm screening available at NBPGR should be taken up under specific collaborative programme. ICRISAT is having small programme on pre breeding, IIMR and IARI can be looked into by analyzing the strength and weakness of the centres and plan the strategies to strengthen pre breeding activities. Periodical review by Project Coordinator should be done of the entire programme. He appreciated the annual progress under COVID situation and told that the outcome was very good. Innovation in reducing rancidity should go long way, product preparation, the Fe and Zn available in the final value added product should be analyzed along with other important nutrients. He extended his best wishes to the entire team.

In the end, Dr. Vikas Khandelwal presented vote of thanks.

Proceedings of the Pearl millet Breeders Meeting to finalize activities to be taken by AICRP centers

An online meeting was held on 12th April, 2021 to discuss the pearl millet breeding programme along with experts and generate product profiles for different agro ecological zones. Based on the interaction with the Project Coordinator (Pearl millet) and scientists, the following suggestions were offered for the improvement of pearl millet improvement programme (s) by experts :

- Intensify efforts for germplasm collection, evaluation and its utilization.
- Generate wide genetic variability through different breeding methods including population improvement.
- Attempt more crosses having broader genetic diversity.
- Choose diverse parents with the higher per se performance along with desirable traits to develop elite experimental hybrids with higher performance.
- Intensify efforts for parental line development with diverse germplasm /diverse gene pools.
- Develop more number of experimental hybrids, evaluate them critically for all the desirable traits and nominate only a few elite lines for multi location testing.
- Seed production programme in respect of released hybrids including A, B, R lines should be taken up effectively for quick spread of the newly released cultivars.
- Plan the breeding programme meticulously right from germplasm collection, choice of parents, crosses to be effected, evaluation of breeding material & Experimental hybrids, seed production etc. and execute it effectively with dedication.

Areas of Research to be undertaken by ICAR-AICRP on Pearl millet

Pre-breeding activities

S. No.	Program	Main Center	Cooperating Center	Other Centers	Major activity
1.	Breeding for drought tolerance	ICAR-AICRP on Pearl millet, PC Unit, Jodhpur	ICAR-CAZRI	Bikaner, Dhule, Ananthapuram, Hisar, Jaipur	<ul style="list-style-type: none"> Identification of drought resistant /susceptible parental lines Evaluation of high yielding lines under drought condition Germplasm collection and their use in crossing with elite lines and developing elite material
2.	Breeding for blast resistance	UOM, Mysore/ ICAR-IARI, New Delhi	ICAR-IIMR	Jaipur, Hisar, Gwalior, Jodhpur, Jamnagar, Dhule, Aurangabad, Coimbatore, Vijayapur, Anantapur	<ul style="list-style-type: none"> Development of screening protocol for blast disease. Collection of isolates for blast pathogens Evaluation of lines for blast resistance Germplasm collection and their use in crossing with elite lines and developing elite material
3.	Breeding for DM resistance	Dhule / Mysore	ICAR-CAZRI	Hisar, Gwalior, Jodhpur, Jamnagar, Jaipur, Aurangabad, Coimbatore, Vijayapur	<ul style="list-style-type: none"> Collection of isolates for DM pathogens Evaluation of lines for DM resistance Germplasm collection and their use in crossing with elite lines and developing elite material
4.	Fodder Breeding	PAU, Ludhiana/ ICAR-IIMR	ICAR-IGFRI	Hisar, Bikaner, Coimbatore	Germplasm collection and their use in crossing with elite lines and developing elite material
5.	Base broadening	ICAR-IIMR / CCSHAU, Hisar	Jamnagar, Dhule	Jaipur, Gwalior, Jodhpur, Aurangabad, Coimbatore, Vijayapur, Anantapur	Collection of germplasm & crossing available germplasm with parental lines to develop new genetic material
6.	Quality Traits (Reduction in Rancidity)	ICAR-IARI/ ICAR-IIMR	CCSHAU, Hisar	Jaipur, Bikaner, Jodhpur, Dhule, Aurangabad	Collection of landraces & crossing with parental lines to develop new genetic material Evaluation of genetic material for rancidity

Breeding for Abiotic stress

S. No.	Program	Main Center	Cooperating Center	Other Centers	Major activity
1.	Drought/ Heat tolerance (seedling stage stress) breeding program for Kharif	ICAR-AICRP on Pearl millet, PC Unit, Jodhpur	Bikaner /ICAR-CAZRI	Samdhari, Bawal (Hisar), Dhule, Ananthapuram	Standardization of field & controlled environment screening protocols to identify parental lines Crossing elite lines with drought tolerant sources and generation advancement
	Heat tolerance (flowering stage) for Summer	SK Nagar	JAU, Jamnagar / centre in U.P.		Identify the parents producing profuse pollen & viability at high air temperature (42-44°C)
		SK Nagar	JAU, Jamnagar / centre in U.P		Identification of A line having stigma viability at high air temperature (42-44°C)
	Physiological Screening for Drought/ Heat tolerance	ICAR-AICRP on Pearl millet, PC Unit, Jodhpur	Bikaner, Jamnagar	Dhule, Ananthapuram	Screening of germplasm/parental lines for drought and thermo tolerance

Breeding for disease resistance (Biotic stress)

S. No.	Program	Main Center	Cooperating Center	Other Centers	Major Activity
1	Downy mildew resistance breeding	Dhule/ Mysore	ICAR-CAZRI	Jodhpur, Hisar, Jamnagar, Gwalior, Jaipur, Aurangabad, Coimbatore, Vijayapur, Anantapur	<ul style="list-style-type: none"> Crossing elite lines with DM resistant sources and advancing the crosses
				Jodhpur, Jaipur, Gwalior, Aurangabad, Coimbatore,	<ul style="list-style-type: none"> Screening of DM resistance for breeding material Collection of isolates of DM and their characterization for virulence diversity.
2	Breeding for Blast resistance	ICAR-IARI/UOM Mysore	ICAR-IIMR	Jaipur, Gwalior, Jamnagar, Jodhpur, Hisar, Dhule, Aurangabad, Anantapur, Coimbatore	<ul style="list-style-type: none"> Crossing elite lines with blast resistant sources and advancing the crosses

		UOM, Mysore		Jaipur, Gwalior, Hisar, Dhule, Aurangabad, Coimbatore	<ul style="list-style-type: none"> Screening for blast resistance in segregating material Collection of isolates of blast pathogens and their characterization for virulence diversity
3	Breeding for rust resistance	MPKV, Dhule/NA RP, Aurangabad	ICAR-IIMR	Jaipur, Gwalior, Jamnagar, Jodhpur, Hisar, Vijayapur, Coimbatore, Anantapur	<ul style="list-style-type: none"> Crossing elite lines with rust resistant sources and advancing the crosses
		UOM, Mysore	ICAR-IIMR	Hisar, Aurangabad, Coimbatore	<ul style="list-style-type: none"> Screening for rust resistance in segregating material Collection of isolates of rust pathogens and their characterization for virulence diversity
4	Breeding for Smut resistance	Aurangabad/ Jaipur	ICAR-IIMR	Jamnagar, Gwalior, Hisar, Dhule	<ul style="list-style-type: none"> Identification and crossing of elite lines with smut resistance sources and advancing the generations
		UOM, Mysore		Jamnagar, Gwalior, Hisar, Dhule, Aurangabad	<ul style="list-style-type: none"> Screening for smut resistance in segregating material Collection of isolates of smut pathogens and their characterization for virulence diversity
5	Breeding for Ergot resistance	MPKV, Dhule/ Jaipur	ICAR-IIMR	Jamnagar, Gwalior, Hisar, Coimbatore, Aurangabad	Identification and crossing of elite lines with ergot resistance sources and advancing the generations
		UOM, Mysore		Jamnagar, Gwalior, Hisar, Dhule, Aurangabad	<p>Screening for ergot resistance in segregating material</p> <p>Collection of isolates of ergot pathogens and their characterization for virulence diversity</p>

Target traits for crossing at different centres

S. No.	Product type	Trait	Centers involved
1	Kharif Pearl Millet Days to flowering Spike thickness Spike length Spike compactness 1000 grain weight No. of Productive tillers Biotic/Abiotic stresses Fe/Zn content	Parental line improvement	Hisar, Jodhpur, Jaipur, Gwalior, Bikaner, Dhule, Aurangabad, Jamnagar, Coimbatore, Ludhiana, Vijayapura, Ananthapuram
		Mapping population for DM	Jaipur, Jamnagar, Ananthapuram, Coimbatore, Jodhpur
		Mapping population for blast	Hisar, Ludhiana, Dhule, ICAR-IARI
		Mapping population for drought tolerance	Jodhpur, Bikaner
2.	Quality traits	Fe, Zn, Protein, Rancidity	ICAR-IIMR, ICAR-IARI, Hisar, Jaipur, Bikaner, Jodhpur, Dhule, Aurangabad
3.	Summer Pearl Millet Days to flowering Spike thickness, length Spike compactness 1000 grain weight No. of Productive tillers Biotic/Abiotic stresses Fe/Zn content	Flowering stage heat tolerance	Jamnagar, SK Nagar

Centerswise Activities

S. No.	Center	Zone	Product Type		Priority of research	Biotic/Abiotic/ any other	Proposed Activities
			K	S			
1	Jodhpur	A ₁	K	-	R line development (Drought/Heat tolerance) Hybrids & Varieties development	Drought, Heat Tolerance, Early maturity	Generation of breeding material Evaluation of parental lines and breeding material for target traits
2	Bikaner	A ₁	K	-	MS & R line development (Drought/Heat tolerance) Hybrids & Varieties development	Drought, Heat Tolerance, Early maturity	Generation of breeding material Evaluation of parental lines and breeding material for target traits
3	Jaipur	A	K	-	MS & R line development Hybrids & Varieties development	Downy mildew, Blast, Early to Medium maturity	Generation of breeding material Evaluation of parental lines and breeding material for target traits
4	Hisar	A	K	-	MS & R line development Hybrids & Varieties development	Downy mildew, Blast, Early to Medium maturity	Generation of breeding material Evaluation of parental lines and breeding material for target traits Biochemical characterization of breeding material, Rancidity in bajra and value addition of bajra product
5	Jamnagar	A	K	S	<ul style="list-style-type: none"> MS & R line development Hybrids & Varieties development 	Downy mildew, Blast, Early to Medium maturity	<ol style="list-style-type: none"> Generation of breeding material Evaluation of parental lines and breeding

							material for target traits 3. Identify parents that produce profuse pollen under high temperature for summer season
6	Punjab	A	K	-	<ul style="list-style-type: none"> R line development (Fodder) Hybrids & Varieties development 	Downy mildew, Blast, Fodder, Medium maturity	1. Generation of breeding material 2. Evaluation of parental lines and breeding material for target traits
7	Gwalior	A	K	-	R line development Hybrids & Varieties development	Downy mildew, Blast, Medium maturity	Generation of breeding material Evaluation of parental lines and breeding material for target traits
8	Dhule	B	K	-	MS & R line development Hybrids & Varieties development	Downy mildew, Blast, Drought, Heat Tolerance, Medium to Late maturity	Generation of breeding material Evaluation of parental lines and breeding material for target traits
9	Aurangabad	B	K	-	<ul style="list-style-type: none"> R line development Hybrids & Varieties development 	Downy mildew, Blast, Smut, Rust and Ergot, Medium to Late maturity	1. Generation of breeding material 2. Evaluation of parental lines and breeding material for target traits
10	Vijaypur	B	K	-	R line development Hybrids & Varieties development	Downy mildew, Blast, Medium to Late maturity	3. Generation of breeding material 4. Evaluation of parental lines and breeding material for target traits

11	Ananthapuram	B	K	-	R line development Hybrids & Varieties development	Drought, Early to Medium maturity	5. Generation of breeding material 6. Evaluation of parental lines and breeding material for target traits
12	Coimbatore	B	K	-	<ul style="list-style-type: none"> MS & R line development Hybrids & Varieties development 	Fodder, Downy mildew, Blast, Smut, Rust and Ergot,	Generation of breeding material Evaluation of parental lines and breeding material for target traits
13	Mysore	B	K	-	Screening for Downy mildew and Blast disease	Downy mildew, Blast, Ergot, Smut, Rust	1. Develop screening protocols for downy mildew and blast disease 2. Collection of isolates of DM and blast and their characterization for virulence diversity

Pearl Millet Product profile for A₁ zone (Early duration)

Name of the commercial to be replaced	HHB 67 (Improved)
Agro-ecology zone	Arid zone (A ₁ zone)
Year of release	2005
Basic traits/unique selling features	
Basic trait 1	Early duration (<45 days)
Basic trait 2	Grain yield (~ 2.0t/ha)
Basic trait 3	Stover yield (~ 3.7 t/ha)
Basic trait 4	Downy mildew (5%)
Basic trait 5	Blast resistance (3 score)
Basic trait 6	Ru st, Smut and Ergot ≤ 20 %
Basic trait 7	Iron ≥ 42 ppm
Basic trait 8	Zinc ≥ 32 ppm
Commitment	
Commitment Value added trait 1	Grain yield
Future unique selling point	High yield under arid zone
Your trait compared to the bench mark	10 % more grain yield
Value added trait 2	Better blast resistance
Assuming adequate funding and your efforts to reduce the breeding cycles, how many years will the breeding team need for market- oriented breeder to nominate this product for advanced testing for government registration or private sector licensing	5 years

Name of the commercial to be replaced	RHB 177
Agro-ecology zone	A ₁ zone (Early Duration)
Year of release	2011
Basic traits/unique selling features	
Basic trait 1	Duration (46 days)
Basic trait 2	Grain yield (2.05 t/ha)
Basic trait 3	Stover yield (4.3 t/ha)
Basic trait 4	Downy mildew (3.4%) < 5%

Basic trait 5	Blast resistance (3.2 score)
Basic trait 6	Rust, Smut and Ergot ≤ 20 %
Basic trait 7	Iron 42 ppm
Basic trait 8	Zinc 39 ppm
Commitment	
Value added trait 1	Grain yield
Future unique selling point	High yield under A ₁ zone
Your trait compared to the bench mark	10% more grain yield
Value added trait 2	Downy mildew and Blast resistance
Assuming adequate funding and your efforts to reduce the breeding cycles, how many years will the breeding team need for the market oriented breeder to nominate this product for advanced testing for government registration or private sector licensing	5 years

Name of the commercial to be replaced	HHB 272
Agro-ecology zone	A ₁ zone (Early Duration)
Year of release	2016
Basic traits/unique selling features	
Basic trait 1	Duration (45 days)
Basic trait 2	Grain yield (2.42 t/ha)
Basic trait 3	Stover yield (4.4 t/ha)
Basic trait 4	Downy mildew (3.8%) < 5 %
Basic trait 5	Blast resistance (2.9 score)
Basic trait 6	Rust, Smut and Ergot ≤ 20 %
Basic trait 7	Iron 44 ppm
Basic trait 8	Zinc 33 ppm
Commitment	
Value added trait 1	Grain yield
Future unique selling point	High yield under A ₁ zone
Your trait compared to the bench mark	10% more grain yield
Value added trait 2	Downy mildew and Blast resistance

Assuming adequate funding and your efforts to reduce the breeding cycles, how many years will the breeding team need for the market oriented breeder to nominate this product for advanced testing for government registration or private sector licensing	5 years
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Pearl Millet Product profile for A zone (Medium duration)

Name of the commercial to be replaced	MPMH 17
Agro-ecology zone	A Zone
Year of release	2012
Basic traits/unique selling features	
Basic trait 1	Medium duration (48 days)
Basic trait 2	Grain yield (2.8 t/ha)
Basic trait 3	Downy mildew (5%)
Basic trait 4	Blast resistance (3 score)
Basic trait 5	Rust, Smut and Ergot $\leq 20\%$
Basic trait 6	Iron 41 ppm
Basic trait 7	Zinc 34 ppm
Commitment	
Value added trait 1	Grain yield
Future unique selling point	High yield under semi-arid zone
Your trait compared to the bench mark	10 % more grain yield
Value added trait 2	Better blast resistance
Assuming adequate funding and your efforts to reduce the breeding cycles, how many years will the breeding team need for market- oriented breeder to nominate this product for advanced testing for government registration or private sector licensing	5 years

Pearl Millet Product profile for B zone (Medium duration)

Name of the commercial to be replaced	Pratap
Agro-ecology zone	B zone (Medium duration)
Year of release	2012
Basic traits/unique selling features	
Basic trait 1	Medium duration (51 days)
Basic trait 2	Grain yield (2.9 t/ha)
Basic trait 3	Stover yield (6.2 t/ha)
Basic trait 4	Downy mildew (3.26%) < 5%
Basic trait 5	Blast resistance (4.5 score)
Basic trait 6	Rust, Smut and Ergot ≤ 20 %
Basic trait 7	Iron 49 ppm
Basic trait 8	Zinc 45 ppm
Commitment	
Value added trait 1	Grain yield
Future unique selling point	High yield under B zone
Your trait compared to the bench mark	10% more grain yield
Value added trait 2	Blast resistance
Assuming adequate funding and your efforts to reduce the breeding cycles, how many years will the breeding team need for the market-oriented breeder to nominate this product for advanced testing for government registration or private sector licensing	5 years

Pearl Millet Product profile for A & B zones (Late duration)

Name of the commercial to be replaced	86M86
Agro-ecology zone	A & B zone (Late duration)
Year of release	2012
Basic traits/unique selling features	
Basic trait 1	Late duration (54 days)
Basic trait 2	Grain yield (3.4 t/ha)
Basic trait 3	Stover yield (8.7 t/ha)
Basic trait 4	Downy mildew (0.58%) < 5%

Basic trait 5	Blast resistance (2.5 score)
Basic trait 6	Rust, Smut and Ergot ≤ 20 %
Basic trait 7	Iron 53 ppm
Basic trait 8	Zinc 45 ppm
Commitment	
Value added trait 1	Grain yield
Future unique selling point	High yield under All India
Your trait compared to the bench mark	10% more grain yield
Value added trait 2	Blast resistance
Assuming adequate funding and your efforts to reduce the breeding cycles, how many years will the breeding team need for the market oriented breeder to nominate this product for advanced testing for government registration or private sector licensing	5 years

Pearl Millet Product profile for Populations A zone

Name of the commercial to be replaced	Pusa Comp. 701
Agro-ecology zone	A Zone (Medium duration)
Year of release	2016
Basic traits/unique selling features	
Basic trait 1	Duration (50 days)
Basic trait 2	Grain yield (2.31 t/ha)
Basic trait 3	Stover yield (7.1 t/ha)
Basic trait 4	Downy mildew (2.4%) < 5 %
Basic trait 5	Blast resistance (2.7 score)
Basic trait 6	Rust, Smut and Ergot ≤ 20 %
Basic trait 7	Iron 48 ppm
Basic trait 8	Zinc 41 ppm
Commitment	
Value added trait 1	Grain yield
Future unique selling point	High yield under Arid zone
Your trait compared to the bench mark	

Value added trait 2	Downy mildew and Blast resistance
Assuming adequate funding and your efforts to reduce the breeding cycles, how many years will the breeding team need for the market oriented breeder to nominate this product for advanced testing for government registration or private sector licensing	5 years

Pearl Millet Product profile for Populations B zone

Name of the commercial to be replaced	ABV 04
Agro-ecology zone	B zone
Year of release	2019
Basic traits/unique selling features	
Basic trait 1	Duration (52 days)
Basic trait 2	Grain yield (2.86 t/ha)
Basic trait 3	Stover yield (5.8 t/ha)
Basic trait 4	Downy mildew (5.9%) >5%
Basic trait 5	Blast resistance (2.6 score)
Basic trait 6	Rust, Smut and Ergot ≤ 20 %
Basic trait 7	Iron 70 ppm
Basic trait 8	Zinc 63 ppm
Commitment	
Value added trait 1	Grain yield
Future unique selling point	High yield under B zone
Your trait compared to the bench mark	
Value added trait 2	Downy mildew and Blast resistance
Assuming adequate funding and your efforts to reduce the breeding cycles, how many years will the breeding team need for the market oriented breeder to nominate this product for advanced testing for government registration or private sector licensing	5 years

Pearl Millet Product profile for Summer ecology

Name of the commercial to be replaced	Proagro 9444
Agro-ecology zone	Summer pearl millet area
Year of release	2004
Basic traits/unique selling features	
Basic trait 1	Late duration (58 days)
Basic trait 2	Grain yield (4.0 t/ha)
Basic trait 3	Stover yield (7.7 t/ha)
Basic trait 4	Downy mildew (2.44%) <5%
Basic trait 5	Blast resistance (4.7 score)
Basic trait 6	Rust, Smut and Ergot ≤ 20 %
Basic trait 7	Iron 48 ppm
Basic trait 8	Zinc 36 ppm
Commitment	
Value added trait 1	Grain yield
Future unique selling point	High yield under Summer Cultivation
Your trait compared to the bench mark	5% more grain yield
Value added trait 2	Downy mildew and Blast resistance
Assuming adequate funding and your efforts to reduce the breeding cycles, how many years will the breeding team need for the market oriented breeder to nominate this product for advanced testing for government registration or private sector licensing	5 years

Name of the commercial to be replaced	86M64
Agro-ecology zone	Summer Pearl millet area
Year of release	2011
Basic traits/unique selling features	
Basic trait 1	Duration (52 days)
Basic trait 2	Grain yield (3.1 t/ha)
Basic trait 3	Stover yield (6.3 t/ha)
Basic trait 4	Downy mildew (6.56%) >5%
Basic trait 5	Blast resistance (4.4 score)
Basic trait 6	Rust, Smut and Ergot ≤ 20 %

Basic trait 7	Iron 46 ppm
Basic trait 8	Zinc 43 ppm
Commitment	
Value added trait 1	Grain yield
Future unique selling point	High yield under Summer Cultivation
Your trait compared to the bench mark	5% more grain yield
Value added trait 2	Downy mildew and Blast resistance
Assuming adequate funding and your efforts to reduce the breeding cycles, how many years will the breeding team need for the market oriented breeder to nominate this product for advanced testing for government registration or private sector licensing	5 years