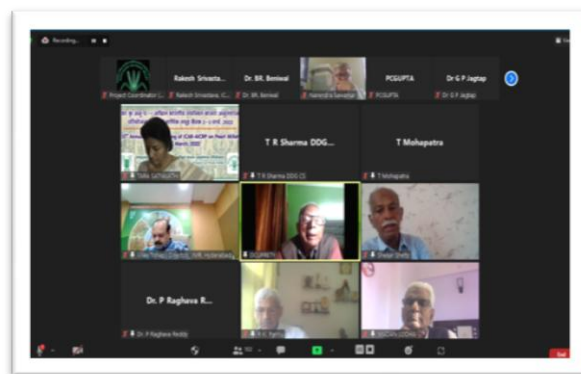
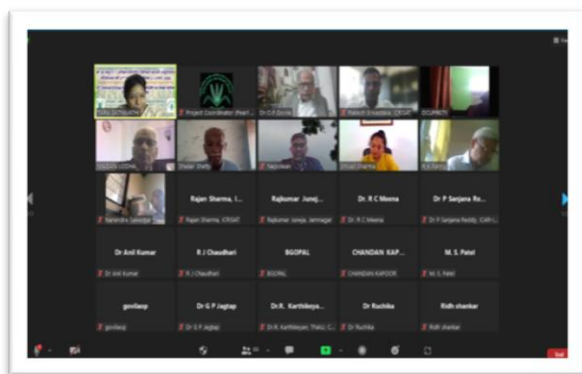
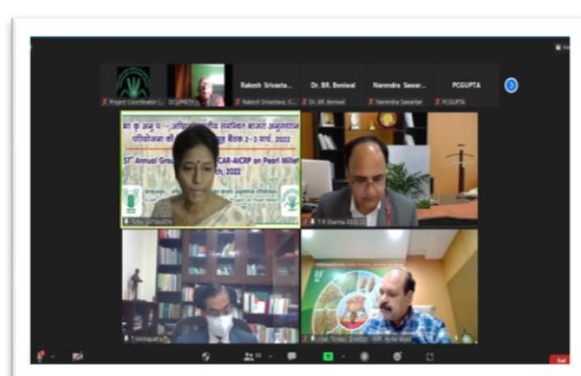


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**Proceedings of 57th Online Annual Group Meeting
of
ICAR-All India Coordinated Research Project on Pearl Millet
(March 02-03, 2022)**



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

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

www.aicpmip.res.in



AGENDA

23rd February, 2022

09:30 – 17:00	Review of Research Results of AICRP-PM Centres 2021-2022 (Centre-wise presentation of significant results and progress report)
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Day 1: 2nd March, 2022 (Wednesday)

10:00 – 11:30	Session I: Review of Research Results and Progress report 2021-22
Chairman	Dr. T.R. Sharma, DDG (CS) ICAR, New Delhi
Co-chairs	Dr. R.K. Singh, ADG (CC & FFC), ICAR, New Delhi 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.S. Sekhar Shetty, Ex Professor, Downy Mildew Research Lab, Univ. of Mysore Dr. M.L. Lodha, Division of Bio-Chemistry, IARI, New Delhi Dr. D.C. Upreti, Ex-Principal Scientist, Division of Plant Physiology, IARI, New Delhi
Rapporteurs	Dr. S.P. Singh, ICAR-IARI, New Delhi Dr. Sanjana Reddy, ICAR-IIMR, Hyderabad

10:05-10:25	Presentation of Research Highlights in Pearl Millet 2021-22	Dr. C. Tara Satyavathi, Project Coordinator, 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 Nayaka, 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
11:30-11:40	Break	
11:30 – 13:30	Session II: Discipline-wise planning and finalization of technical programmes	
Discipline	Co-chairs	Rapporteurs
Crop Improvement (11:40-12:25)	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, Jodhpur
Crop Production (12:25-12:55)	Dr. R.K. Pannu, Ex. Dean, CCS HAU, Hisar Dr. D.C. Upreti, Ex-Principal Scientist, Division of Plant Physiology IARI, New Delhi	Dr. Anil Kumar, CCS HAU, Hisar Dr. Meenakshi Grover, ICAR-IARI, New Delhi
Crop Protection (12:55-13:35)	Dr. H.S. Shekhar Shetty, Ex Professor, Downy Mildew Research Lab, Univ. of Mysore, Mysore	Dr. Chandra Nayak, UoM, Mysore Dr. Raj Kumar Juneja, ICAR-AICRP-PM, Junagarh
13:35-14:30	Lunch	
14:30 – 15:30	Session III: Review of Research Results of ICAR-ICRISAT Collaborative Projects 2021-22 and Plan of Work 2022-23	
Chairman	Dr. R.K. Singh, ADG (CC & FFC), ICAR, New Delhi	

Co-Chairs	Dr. Vilas A. Tonapi, Director, IIMR, Hyderabad Dr. C. Tara Satyavathi, PC, ICAR-AICRP on Pearl millet, Jodhpur	
Rapporteur	Dr. S.P. Singh, ICAR-IARI, New Delhi	
14:30-14:50	Progress report of ICAR-ICRISAT Partnership trials 2021- 22	Dr. B.R. Beniwal ICAR-AICRP on Pearl millet, Jodhpur
14:50-15:00	Partnership trials for 2021-22 Breeding	Dr. S.K. Gupta, Principal Scientist (Pearl millet breeding), ICRISAT
15:00-15:10	Marker assisted breeding trials	Dr. Rakesh Srivastava, Principal Scientist (Pearl millet Molecular breeding), ICRISAT
15:30-15:40	Break	
15:40-16:15	Session IV: Review of Frontline Demonstrations for 2021-22 and Action Plan 2022-23	
Chairman	Dr. S.K. Malhotra, Ex -Agri. Commissioner, DAC, New Delhi & Director, DKMA	
Co-Chair	Dr. Ishwar Singh, Director, Directorate of Extension Education, AU, Jodhpur	
Rapporteur	Dr. S.P. Singh, ICAR-IARI, New Delhi Dr. Supriya, ICAR-AICRP on Pearl Millet, Jodhpur	
15:40-16:15	Progress reports on FLDs	Dr. Manoj Kumar ICAR-AICRP on Pearl millet, Jodhpur

16:30– 17:30	Session V: 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: 3rd March, 2022 (Thursday)

10:00 – 12:30	Session VI: New initiatives for pearl millet research	
Chairman	Dr. O.P. Govila, Ex-Project Coordinator (Pearl millet) & Ex-Professor, Division of Genetics, IARI, New Delhi	
Co-chairs	Dr. R.K. Singh, ADG (CC & FFC), ICAR, New Delhi Dr. C. Tara Satyavathi, PC, ICAR-AICRP on Pearl millet, Jodhpur	
Rapporteurs	Dr. R.K. Kakani, ICAR-CAZRI, Jodhpur Dr. Supriya, ICAR-AICRP on Pearl Millet, Jodhpur	
10:05-10:30	Tapping the untapped: Pre breeding for Pearl millet improvement	Dr. Shivali Sharma, Senior Specialist, Plant Genetic Resources & Pre breeding, Global Crop Diversity Trust (GCDT), Bonn, Germany
10:30-10:55	Pearl millet genomics and molecular breeding: advances and prospects	Dr. Rakesh Srivastava, Principal Scientist, Pearl millet molecular breeding, ICRISAT, Patancheru
10:55-11:20	The way to breed winning hybrids rapidly through Next-Gen breeding approaches in Pearl millet	Dr. Nepolean T, Principal Scientist (Pearl millet breeding) ICAR-IIMR, Rajendranagar, Telangana
11:20-11:50	Creation of demand for Pearl millet through nutritional labeling, value addition and entrepreneurship development	Dr. B. Dayakar Rao, Principal Scientist & CEO (Nutri Hub) IIMR, Rajendranagar, Telangana
11:50-12:00	Break	
12:00-13:00	Session VII: Review of DUS Testing Project, Progress Report 2021-22 and Review of BSP 2021-22 and Action Plan 2022-23	

Chairman	Dr. D.K. Yadav, ADG (Seeds), ICAR, New Delhi
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	Progress Report of DUS testing in Pearl millet - Dr. Vikas Khandelwal, ICAR-AICRP on Pearl millet, Jodhpur Breeder Seed Production- Dr. Vikas Khandelwal, Sr. Scientist (GPB), ICAR-AICRP on Pearl Millet, Jodhpur
13:00-14:30	Lunch

14:30 – 16:55	Session VIII: Plenary Session	
Chief Guest	Dr. Trilochan Mohapatra, Secretary, DARE & DG, ICAR, New Delhi	
Chairman	Dr. T.R. Sharma, DDG (CS), ICAR, New Delhi	
Guest of Honour	Dr. B.R. Choudhary, Vice-Chancellor, Agriculture University, Jodhpur	
	Dr. R.K. Singh, ADG (CC & FFC) , ICAR, New Delhi	
	Dr. Vilas A. Tonapi, Director, ICAR-IIMR, Hyderabad	
Rapporteur	Dr. Mukesh Sankar, ICAR-IARI, New Delhi Dr. Supriya, PC unit, ICAR-AICRP on Pearl millet, Jodhpur	
14:30-14:40	Welcome and initial remarks	Dr. C. Tara Satyavathi, Project Coordinator, ICAR-AICRP on Pearl millet, Jodhpur
14:40-15.10	Technical Sessions	Compiled presentation of different technical sessions by Dr. Sanjana Reddy, Principal Scientist, IIMR, Hyderabad
15:10-15:40	Remarks by PAMC experts	All experts
15:40-16:00	Remarks by Guest of honors	Dr. B.R. Choudhary, Vice-Chancellor, Agriculture University, Jodhpur Dr. R.K. Singh (CC & FFC), ICAR, New Delhi Dr. Vilas A. Tonapi, Director, ICAR-IIMR, Hyderabad
16:00-16:10	Release of Publications, Felicitation of retiring employees, Awards	
16:10-16:40	<i>Plenary Address</i>	Dr. Trilochan Mohapatra, Secretary, DARE & DG, ICAR, New Delhi
16:40-16:50	Chairman's Remarks	Dr. T.R. Sharma, DDG (CS), ICAR, New Delhi
16:50-16:55	Vote of thanks	Dr. Vikas Khandelwal, Senior Scientist, ICAR-AICRP on Pearl millet, Jodhpur

Review of Research Results of ICAR-AICRP on Pearl millet funded centers (2021-22)

An online meeting was held via zoom platform on 23rd February, 2022 to evaluate the performance of different centers of ICAR-AICRP on Pearl millet. The evaluation was done by the PAMC comprised of Dr. P. Raghava Reddy, Ex VC, ANGRAU, Hyderabad; Dr. R.K. Pannu, Ex. Dean CCS HAU, Hisar; Dr. H.S. Sekhar Shetty, Ex Professor, Downy Mildew Research Lab, Univ. of Mysore; Dr. M.L. Lodha, Ex-Head Division of Bio-Chemistry, IARI, New Delhi; Dr. DC Uprety, Ex Principal Scientist, Division of Plant Physiology. 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. The progress made during 2021-2022 was presented by respective centre PIs of different ICAR-AICRP on Pearl millet centres. The centre wise observations and suggestions are briefly mentioned below:

SKRAU, Bikaner- Dr P.C. Gupta presented the progress report and following observations were made:

- Seven plant breeding, four ICAR-ICRISAT, six agronomy trials and 20 FLDs were conducted by the centre.
- Good hybrids have been developed for A₁ zone. Efforts on parental line multiplication of these hybrids should be enhanced for taking up demonstration of these hybrids on a large scale.
- Efforts for MoU with private sector should be made for enhancing the hybrid adoption by the farmers.
- Fertility status of the soil (status of major and micro-nutrients) and physio-chemical properties of the soil should be recorded treatment-wise in the experiments.
- Inherent fertilizer levels should be considered while planning fertilizer treatment experiments.
- Soil water content and water use efficiency should be recorded.
- Contribution of weed management on yield should be calculated and presented.

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

- The centre was appreciated for MoU made with One Life Foundation, New Delhi on Jan 7th 2022 for the commercialization of Hybrid RHB 234.

CCS HAU, Hisar- Dr. Anil Kumar presented the progress report and the different salient achievements and observations are given below:

- CCS HAU has made non-exclusive licensing (NEL) agreement with three private seed companies for three pearl millet hybrids viz., HHB 299, HHB 311 and HHB 67 Improved.
- HHB 67 Improved-2 was identified and released during 2021 which is an essentially-derived variety (EDV) version of Immensely popular pearl millet hybrid HHB 67 Improved.
- An unidentified phenolic compound (Retention Time; RT 8.00 min), taxifolin (RT 7.90 min), naringin (RT 11.00 min) and apigenin (RT 14.10 min) detected in pearl millet flour on Ultra Performance Liquid Chromatography (UPLC) for the first time, which may be the major contributing factor for its poor shelf life.

- First report of stem rot identified to be caused by *Klebsiella aerogenes* and published in Plant Disease Journal.
- Nine plant breeding, three ICAR-ICRISAT, six agronomy and five pathology trials/nurseries were also conducted.
- Basic research initiatives should be taken up for the newly reported stem rot disease.
- Possibilities of making new MoUs with private sector should be explored.

RVSKVV, Gwalior- Dr. R.K. Pandya presented the progress of the centre and important achievements and suggestions are given below:

- Six plant breeding, three ICAR-ICRISAT, six station trials (plant breeding) and seven pathology trials/nurseries were conducted.
- Environment friendly management of Pearl millet blast: Performance of Cow urine @ 10% with Propiconazole is a good sign in the direction of low cost environment friendly management of pearl millet blast.
- On the basis of disease indexing under field conditions of 75 germplasm lines, twelve viz., IP-310, IP-240, IP-317, IP-126, IP-205, IP-102, IP-247, IP-386, IP-338, IP-208, IP-101 and IP-210 were found highly resistant to blast.
- It was suggested that in coordinated trials of pathology, 70% infection on infector rows to be checked and if the level of infection is low, data should not be sent to the PC-Unit.
- Inheritance and mapping of gene should be done.

PAU, Ludhiana- Dr. Ruchika presented the progress report and the presentation was appreciated. Salient achievements and suggestions are mentioned below:

- One fodder Bajra variety PCB 166 was released during 2021.
- Six plant breeding, one ICAR-ICRISAT, six station trials and 10 FLDs were conducted.
- It was suggested that harvest index should also be considered in the entries tested.
- It was suggested to check the % superiority (given as 11 to 14%) of PBL4 and efforts must be made to get it released.
- Shelf life should be checked in products for added advantage.

JAU, Jamnagar- Dr. K.D. Mungra presented the progress report and the following observation were made:

- Parental lines were identified with flowering stage heat tolerance.
- A non-exclusive MoU was made by the centre for five years with Surya Seed Farm, Gandhinagar for seed production, marketing and commercialization of biofortified hybrids GHB 1129 and GHB 1231 on 21-06-2021.
- It was suggested that research data available at the center should be compiled and published.
- Ten Plant Breeding, 3 ICAR-ICRISAT, 6 Plant Pathology, 9 Entomology trials and 30 FLDs were conducted.
- Number of slides should be minimized.

ANGRAU, Ananthapuramu- The progress report was presented by Dr. C.V. Chandra Mohan Reddy and the following observations and suggestions were made:

The centre informed that variety ABV04 released during 2019-20, is being popularized. The suggestions given are as follows:

- Productivity variations in FLDs and station trials should be looked into.

- Farmers should be made aware of nutritional superiority of biofortified material in FLDs.

NARP, Aurangabad- Dr. SB Pawar presented the progress report and following suggestions were made:

- Parameters for estimation of rancidity should be looked into.
- Benchmark should be decided by PC Unit exclusively for biofortified cultivars.
- Biofortified products should be distributed to Anganwadis for creating demand.
- Extension activities for biofortified hybrids should be strengthened.
- NAAS rating of the journals should be given in presentation.
- Possibilities of making new MoUs with private sector should be explored.

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

- Quality of publications should be improved.
- Soil analysis should be done before sowing and after harvesting.
- Fe and Zn data should be logically presented.
- Data should be presented as range across treatments
- Plant sample data should also be given.
- Rainfall pattern should be presented in histogram.
- Value addition and product development work should be given priority.
- Time of sowing should be adjusted to avoid rains during flowering.

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

- High disease pressure is observed in farmers' field as against the station screening facility. The facility should be checked for the virulence levels.
- Effective screening procedure for disease screening needs to be developed at the center.
- The area under Phule Adishakthi should be increased from current 4-5% in the state.
- Feasibility of seed treatment with proline and foliar spray with KCl to be worked out for improving yield under stress.
- NAAS rating should be given in publications.

UOM, Mysore- Dr. S. Chandra Nayaka presented the progress report. The work done at the center was appreciated by Project Coordinator and the PAMC members. The following major observations are mentioned below:

- Eight plant pathology trials were conducted.
- High incidence of blast (>30% incidence) and rust (15%) was observed in farmers' field in Karnataka.
- Symptoms of bacterial leaf blight were observed on pearl millet for the first time.

UAS, Vijayapur- Dr. B.K. Athoni presented the progress report and the following observations and suggestions were made:

- One composite variety VPMV-9 was released and notified for zone III of Karnataka during 2021.
- It was pointed out that no central release is available from centre. Breeding activity needs to be strengthened.

General observations made by Project Coordinator and PAMC experts:

- Pre-breeding work should be strengthened.
- Parental lines should have tolerance to biotic and abiotic stresses
- In genomic studies, genes on genetic map should be established before use.
- Seed production of new hybrids should be taken on priority.
- Production technologies should be made available for different production systems which should be cost-effective and sustainable.
- Influence of soil nutrients on grain quality should be studied and data should be generated on grain content and soil nutrients.
- Organic farming techniques should be developed and standardized and an experiment on organic farming should be planned.
- Effect of climate variability should be taken into consideration while formulating the experiments.
- Popularization of hybrids and varieties in the areas of respective centers should be done.
- FLDs should be conducted in representative environments more efficiently and effectively.
- Promotion of pearl millet in tribal areas should be done.
- Disease screening should be efficient and relationship should be established between weather data and disease incidence.
- Disease and pest resistant lines should be involved in breeding programs. Available breeding lines should also be screened for biotic constraints.
- Pest and disease surveillance in farmer's fields and disease screening nurseries have to be correlated.
- Pests and diseases should be closely monitored.
- Metalaxyl treatment should be used as a control to compare different entries in downy mildew studies.
- Studies on Consortium of microorganisms should be initiated.
- Higher percentage of lines will be susceptible at appropriate disease pressure in sick plot. Hence, disease pressure should be properly checked and corrected.
- Strategic research on newly reported pathogens should be done under quarantine.
- There has been significant improvement in the experiments as well as presentations from all centers.
- Data from different centers should be compiled and published and more focus should be given on quality of publications with more than 6 NAAS rating.
- Budget should be utilized in the current financial year itself so that re-validation is not required.
- Presentation should be focused and precise and there should not be more than 50 slides in centrewise presentation.

The meeting ended with the vote of thanks.

SESSION I

Review of Research Results and Progress Report 2021-22

Chairman	Dr. T.R. Sharma, DDG (CS) ICAR, New Delhi
Co-chairs	Dr. R.K. Singh, ADG (CC & FFC), ICAR, New Delhi 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, Mysore Dr. M.L. Lodha, Ex Principal Scientist, Division of Bio-Chemistry, IARI, New Delhi Dr. DC Upreti, Ex Principal Scientist, Division of Plant Physiology, IARI, New Delhi
Rapporteurs	Dr. S.P. Singh, ICAR-IARI, New Delhi Dr. Sanjana Reddy, ICAR-IIMR, Hyderabad
Date	2 nd March, 2022

The 57th Annual Group Meeting of ICAR-AICRP on Pearl millet was held online on Zoom platform on 2nd-3rd March, 2022. Dr. T. R. Sharma, DDG (Crop Science), ICAR, New Delhi chaired the session while Dr. R.K. 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. Upreti (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 2021-22

Dr. C. Tara Satyavathi, Project Coordinator, ICAR-AICRP on Pearl millet, Jodhpur welcomed all the guests and participants and presented research highlights of various Pearl millet experiments conducted during 2021-22. She informed the house that many of the centres have taken up programme on parental line improvement. She highlighted product profile developed for each zone and trait specific germplasm identified and pre-breeding work initiated at various centers. She also informed that in online meeting to review the bench mark levels for Fe and Zn, group decided to continue with the same levels (Fe: 42 ppm, Zn: 32 ppm) for another two years. A total of 23.23 q breeder seed was produced during 2021-22 which is higher than the indented quantity of 5.13 q. Breeder seed production of 26 parental lines and 5 OPVs was also undertaken during 2021-22. Out of 340 ha area under FLDs, around 141 (41.5%) ha was covered under biofortified hybrids. She informed that more incidences of rust and blast were observed during 2021-22. 13 candidate varieties were characterized for DUS traits. Project coordinator also told that a total of six MoUs were signed with private seed companies by different AICRP centres. Dr. T.R. Sharma, DDG (CS) ICAR, New Delhi appreciated presentation made by Project Coordinator and the significant efforts made by AICRP on Pearl millet. He also complimented Project Coordinator for developing 10 product profiles for each zone and signing six MoUs with different private companies for pearl millet hybrids.

Presentations were made by Principal Investigators of different disciplines on progress made during 2021-22 in this session:

Plant Breeding: The presentation was done by PI, Plant Breeding, Dr. Vikas Khandelwal, ICAR-AICRP on Pearl Millet, Jodhpur. He reported that no entry was promoted from IHT (E) to APHT 1(E) and PT A to APHT I (E). Two entries from AHPT I (E) to AHPT II, two entries from IHT (L) A to AHT I (L)A, two entries from AHTI (L) A to AHT II (L) A, two entries from IHT (M) A to AHT II (M)A were promoted. Three entries were promoted from PT A to PTI A while no entry was promoted from PTIA to PT IIA. It was suggested to repeat one EDV entry MH 2661 which was observed to have 3.5% yield superiority over check for testing under the same trial for one more year. Dr. T.R. Sharma, DDG (CS) ICAR, New Delhi pointed out that some of the varieties were not fulfilling the criteria for promotion and thus there is a need to broaden the genetic base of the material and pre-breeding can play an important role in broadening the genetic base. He suggested that IIMR, Hyderabad, IARI New Delhi and ICRISAT can play an important role in pre-breeding activities. Dr R.K. Singh, ADG (CC & FFC), ICAR suggested that for basic and strategic research IIMR, Hyderabad should also be included. He stressed upon considering bioavailability of Fe and Zn while evaluating genotypes for iron and zinc. Dr. Vilas A Tonapi, Director, ICAR-IIMR, Hyderabad pointed out that specific crosses should be attempted for production of iron and zinc enriched parental lines.

Agronomy: PI, Agronomy, Dr. Anil Kumar, CCS HAU, Hisar presented the progress report of Agronomy discipline. He reported that a total of 6 different trials were undertaken under the crop production. Chairman suggested to generate 2-3 major recommendations.

Pathology: PI, Pathology, Dr. Chandra Nayaka, UoM, Mysore presented the report on trials taken up during *kharif* 2021. A total of eight trials were conducted during the year 2021-22. Application of different bioagents for the management of downy mildew was found effective. A new disease bacterial leaf blight caused by *Pantoeastewartii* sub spp. *indologenes* was reported for first time in India. In addition, stem rot caused by *Klebsiella aerogenes* was reported from Hisar, Bhiwani, Rewari and Mohindergarh districts of Haryana. Eleven genotypes were identified with multiple disease resistance which can be utilized in crop improvement program.

Dr. T.R. Sharma, DDG (CS) ICAR, New Delhi suggested that clear cut recommendations should be given for various technologies. A committee can be constituted for identifying various technologies both in sorghum and pearl millet. He appreciated the efforts of screening of 235 pearl millet germplasm for different biotic and abiotic stresses and suggested that these germplasms should also be screened under artificial conditions. Chairman also suggested that multiple disease resistant lines should be artificially screened for disease reaction.

Entomology: PI, Entomology, Dr. R.K. Juneja, JAU, Jamnagar presented the progress report. He reported that a total of 8 trials were conducted and informed the house regarding pest incidence of shoot fly and stem borer at various centres. Germplasm line **IP 2704** identified to be free from majority of pests at all stages of plant growth. A mini-core collection of 235 entries were screened for pest incidence. Dr Juneja reported that experiment on IPM modules for pest management has been initiated for effective management of pest.

Plant Physiology: The presentation was done by PI, Plant Physiology, Dr. R.C. Meena, ICAR-AICRP on Pearl Millet, Jodhpur. He reported that a total of six experiments were conducted at Mandor, Jaipur and Jamnagar during summer and *kharif*, 2021 for heat and drought tolerance at different stages of crop. Chairman suggested that data should be analyzed statistically and plant physiology experiments should be integrated with production experiments and contribute towards abiotic stress tolerance. Dr R.K. Singh, ADG (CC & FFC), ICAR suggested that physiological traits should also be included while evaluating genotypes for heat and drought tolerance. Soil moisture and soil nutrient data must be also presented.

Plant Biotechnology: The presentation was made by Dr. Supriya, PI, Plant Biotechnology, ICAR- AICRP on Pearl Millet, Jodhpur. She presented results of four experiments-diversity analysis and molecular characterization of pearl millet germplasm, DNA fingerprinting of advanced entries, validation of markers for high Fe and Zn and drought tolerance in different pearl millet genotypes conducted during 2021. Dr R.K. Singh, ADG (CC & FFC), ICAR suggested that molecular breeding should be used in place of plant biotechnology. He also pointed out that work on validation of the markers should be done in mapping populations and other genetic backgrounds. More number of genotypes should be studied for diversity and fingerprinting.. Chairman suggested that molecular breeding work should be done in collaboration with IARI, New Delhi, IIMR, Hyderabad and ICRISAT, Hyderabad. In addition, molecular breeding activities taken up at IARI, IIMR should also be presented for the benefit of pearl millet researchers.

SESSION - II**PLAN OF WORK 2022-23****A. CROP IMPROVEMENT (PLANT BREEDING)**

Chairman	Dr. P. Raghava Reddy, Chairman, PAMC
Co-chairs	Dr. C. Tara Satyavathi, PC, ICAR-AICRP on Pearl Millet, Jodhpur
Rapporteurs	Dr. Vikas Khandelawal and Dr. Supriya, ICAR-AICRP on Pearl millet, Jodhpur
Date	2 nd March, 2022

**FORMULATION OF TECHNICAL PROGRAMME FOR 2022-23
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 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.

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 2023 Zone A₁ and A

S. No.	Advanced Hybrid & Population Trial (E) Zone A ₁	S. No.	Advanced Hybrid Trial (L) Zone A [AHT(L)]
	IHT (E) to AHPT I (E)		IHT (L) A to AHT I (L) A
	Nil	1	MH 2626
	PT A to AHPT I (E)	2	MH 2631
	Nil	3	MH 2654
	AHPT I (E) to AHPT II (E)		AHT I (L) A to AHT II (L) A
1	MH 2553	1	MH 2577
2	MH 2555	2	MH 2580
	Checks		Checks
1	HHB 67 (Imp.)	1	86M86
2	RHB 177	2	KBH 108
3	RHB 223	3	MP 7792
4	MPMH 21	4	MP 7878
5	HHB 272		
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 2618	1	MP 610
2	MH 2619	2	MP 612
	AHT I (M)A to AHT II (M) A	3	MP 613
	Nil		PT I A to PT II A
	Checks		Nil
1	MPMH 17		+ New entries of PT
2	86M01		Checks
3	PB 1705	1	Raj 171
4	GHB 905	2	Pusa Comp. 383
5	PB 1852	3	JBV 2
6	JKBH 1326	4	Pusa Comp. 701
7	DHBH 1397	5	Dhanshakti
		6	ICMV 221
S. No.	Essentially Derived Varietal Trial (EDV) A ₁		
	EDV to EDV I		
1	MH 2661		
	+ New entries of EDV		
	Checks		
1	GHB 538		

Entries promoted to next higher stage of testing in kharif/summer 2023 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 2606		Nil
2	MH 2618		AHT I (L) B to AHT II (L) B
3	MH 2619		Nil
4	MH 2562 (Repeat)		Checks
5	MH 2564 (Repeat)	1	86M86
	AHT I (M) B to AHT II (M) B	2	Kaveri Super Boss
	Nil	3	NBH 4903
	Checks		
1	Pratap		
2	NBH 5767		
3	86M01		
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 381		Nil
2	MSH 389		PT I B to PT II B
	SHT I to SHT II		Nil
1	MSH 371		
2	MSH 372		+ New entries of PT
3	MSH 377		Checks
	+ New entries	1	Raj 171
	Checks	2	ICMV 221
1	86M64	3	Dhanshakti
2	Proagro 9444	4	ICMV 155
3	Nandi 75	5	Pusa Comp. 612
4	MP 7366	6	ABV 04

Table I.1 Details of Centres and Trials Conducted During Kharif 2022/Summer 2023 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		4	0	2	2	1
ZONE A										
RAJASTHAN										
Jaipur (SKNAU)		*	*			*	*	*	*	
Jaipur (Seed works)			*				*			
Jaipur (Corteva)		*				*				
Tabiji (SKNAU)		*				*				
Paota (Limagrains)			*							
Tijara (Rallis)		*	*			*				
Alwar (Corteva)			*				*			
Alwar (Bioseed)			*					*		
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)		*						*	*	
Aligarh (Hytech)			*				*			
Hathras (Ganga Kaveri)			*							
Agra (Kartik Bio Seeds)		*	*							*
Agra (Mahindra)							*			
Bichpuri (Kaveri Seeds)						*	*			
Mathura (Kamagiri)		*	*							
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	18	19	2		15	12	10	7	10

Table I.1 Details of Centres and Trials Conducted During Kharif 2022/Summer 2023 in Zone B

LOCATIONS	IHT (M)	IHT (L)	AHT (M)	AHT (L)	PT	RHVT	SHT
MAHARASHTRA							
Aurangabad (NARP)	*	*	*	*	*	*	*
Aurangabad (Ajeet Seed)			*	*			
Aurangabad (Seed works)		*		*			*
Niphad (MPKV)			*	*	*		
Dhule (MPKV)	*	*	*	*	*	*	*
Jalna (Mahyco)		*					*
Jalna (Krishidhan Ghanewadi)		*					
Pachora (Nirmal Seed)	*	*					*
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	13	10	8	11	9	8

Observations to be recorded in initial and advanced trials:

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

New entries for testing in initial trial Kharif 2022/Summer 2023

S. No.	Organization/Institution	Name of Entries				
		IHT (E)	IHT (M)	IHT (L)	PT	Summer
1	ICAR-CAZRI, Jodhpur	CZH 263				
		CZH 264				
		CZH 265				
		CZH 266				
		CZH 267				
2	ICAR-AICRP on PM, JAU, Jamnagar	GHB 1305	GHB 1330	GHB 1337		GHB 1347
		GHB 1349	GHB 1351	GHB 1352		GHB 1349
		GHB 1350				
3	ICAR-AICRP, RARI, SKRAU, Bikaner	BHB 2201			BCB 2201	
		BHB 2202			BCB 2202	
		BHB 2203				
		BHB 2204				
		BHB 2205				
		BHB 2206				
4	ICAR-AICRP, CCSHAU, Hisar	HHB 344		HHB 345		
5	NARP, Aurangabad		AHB-1732			
			AHB-1609			
			AHB-1610			
6	ICAR-IARI New Delhi	Pusa 2201	Pusa 2203		Pusa Composite 729	
		Pusa 2202	Pusa 2204		Pusa Composite 730	
			Pusa 2205		Pusa Composite 731	
7	ICAR-AICRP, TNAU, Coimbatore		TNBH 17016	TNBH 19005		TNBH 19005
			TNBH 19013			TNBH 1619
8	ICAR-AICRP, RARI, SKNAU, Jaipur	RHB-273	RHB-275		RCB-32	
		RHB-274				
9	ICAR-AICRP on PM, RVSKVV, Gwalior	RVBH-2251				
		RVBH-2252				
10	ICAR-AICRP on PM, PAU Ludhiana			PHB 3767	GBL 3	
					GBL 8	
11	RARS, Vijayapura		VPMH 18	VPMH 20	VPMV 14	
			VPMH 19		VPMV 15	
					VPMV 16	
12	ICAR-IIMR, Hyderabad	IIMRPH1	IIMRPH2	IIMRPH3	IIMRPV1	
		HMHE2201	HMHM2203			
		HMHE2202	HMHM2204			
13	ICAR-AICRP on Pearl Millet, Dhule	DHBH-21005	DHBH-21001	DHBH-21003		DHBH-1925
			DHBH-21002	DHBH-21007		DHBH-26
			DHBH-21004			
			DHBH-21006			
14	ARS, ANGRU, Perumallapalle				PPBV-5	
					PPBV-8	
15	ICAR-AICRP on Pearl Millet, Ananthapuramu		APHB 126			
			APHB 135			
			APHB 234			
16	Seed Works PVT. LTD. Hyderabad			US7712		US7307
				US7773		
17	Nuziveedu Seed Pvt. Ltd., Secunderabad		NBH 2340	NBH 5992		NBH 5922
18	Kaveri Seed Com. Ltd., Secunderabad	KPH6111		KPH6277		KPH6320
19	Nu Genes Pvt. Ltd., Hyderabad			NU 447		
20	Corteva Agriscience, Hyderabad			9025A428-01		
21	Hytech Seed India Pvt. Ltd., Hyderabad			HT 422316		
22	JK Agri Genetics Ltd, Hyderabad			JKBH1870		JKBH1989
				JKBH1924		JKBH1992
23	Shakti Vardhak Hybrid Seeds Pvt. Ltd., Hisar					SVPMH-128
24	Limagrains India Pvt. Ltd., Hyderabad		BLPMH 111	BLPMH 112		BLPMH 113
25	Crystal Crop Protection Ltd., Aurangabad			PB1987		PB2046
				PB1991		PB2064
				PB1948		
				PB1858		
26	VNR Seeds Pvt. Ltd., Hyderabad		VNR-106	VNR-107		VNR-109
				VNR-108		VNR-110
				MP7173		
27	Rallis India Ltd., Hyderabad			MP7179		
				TMBH 680		
28	Trimurti Plant Sciences Pvt. Ltd.					
29	Nirmal Seeds Pvt. Ltd., Pachora		NPH-5654			
30	Nandi Seeds Pvt. Ltd., Ahmedabad		NANDI-11	NANDI-31		
31	Hi-Yield Agri Genetics Pvt. Ltd.			HYMH 4081		
				HYMH 4091		
32	Navbharat Seeds Pvt. Ltd.			NBBH 4092		NBBH 4062
				NBBH 4093		
				NBBH 4094		
33	Bioseed Research India					BIO 463

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 : 26	PT A & B Zone : 14
IHT (M) A & B Zone : 28	Summer 2023: 19
IHT (L) A & B Zone : 34	

Seed Requirement (per entry)

IHT € 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:

HHB 67 Imp.: 7.0 Kg	86M86: 10.0 Kg	HHB 299: 5.0 kg	Raj 171: 7.0 Kg
RHB 177: 7.0 Kg	KBH 108: 8.0 Kg	GHB 538: 3.0 Kg	Pusa Comp. 383: 5.0 Kg
RHB 223: 5.0 Kg	MP-7792: 6.0 Kg	86M64: 4.0 Kg	JBV 2: 4.0 Kg
MPMH 21: 5.0 Kg	MP-7878: 4.0 Kg	Proagro 9444: 3.0 Kg	Pusa Comp. 701: 3.0 Kg
HHB 272: 5.0 Kg	Pratap: 6.0 Kg	Nandi 75: 3.0 Kg	Dhanshakti: 7.0 Kg
MPMH 17: 8.0 Kg	NBH 5767: 8.0 Kg	MP 7366: 3.0 Kg	ICMV 221: 6.0 Kg
86M01: 6.0 Kg	AHB 1269: 6.0 Kg	ICMH 356: 4.0 Kg	ICMV 155: 3.0 Kg
PB 1705: 4.0 Kg	Kaveri Super Boss: 6.0	GHB 558: 4.0 Kg	Pusa Comp. 612: 3.0 Kg
GHB 905: 5.0 Kg	NBH 4903: 4.0 Kg	RHB 173: 4.0 Kg	ABV 04: 4.0 Kg
PB 1852: 4.0 Kg	RHB 233: 5.0 kg		
JKBH 1326: 4.0 Kg	RHB 234: 5.0 kg		
DHBH 1397: 5.0 kg	AHB 1200: 5.0 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 2022 for kharif and by 15th January 2023 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 2022-23 FOR MOLECULAR BREEDING

PMMB 1: VALIDATION OF MARKERS IN PEARL MILLET

Experiment 1: 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

Plant material: Young leaf samples of 2-3 leaf stage of drought/heat tolerant genotypes.

Methodology

- ❖ Phenotyping will be done at PC Unit, Jodhpur
- ❖ DNA isolation and genotyping will be done at PC Unit, Jodhpur using SSR markers.
- ❖ Genotyping using SNP panel will be done in collaboration with IIMR, Hyderabad.
 - DNA isolation will be done using CTAB method.
 - Molecular characterization using SSR markers.

Experiment 2: Molecular characterization of disease tolerant genotypes

Background: Downy mildew and blast are two major diseases affecting pearl millet. Hence, screening of pearl millet lines resistant to these diseases will be useful for developing disease resistant pearl millet hybrids.

Objective: Screening of disease resistant pearl millet genotypes using molecular markers.

Plant material: Young leaf samples of 2-3 leaf stage of disease tolerant genotypes tested under nursery trials at UoM, Mysore

Methodology

- ❖ Phenotyping will be done at UoM, Mysore
- ❖ Genotyping will be done at PC Unit, Jodhpur
 - DNA isolation will be done using CTAB method.
 - Screening and molecular characterization using markers identified for blast and downy mildew.

PMMB 2: MOLECULAR CHARACTERIZATION OF GERMPLASM OF PEARL MILLET

Experiment 1: Molecular characterization of hybrids and varieties of pearl millet released during last 5 years

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 screen some SSR markers and initiate genomic studies in pearl millet under ICAR-AICRP on Pearl millet.

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

Plant material: Young leaf samples of 2-3 leaf stage of released hybrids/varieties.

Methodology

- DNA isolation will be done using CTAB method.
- Molecular characterization using SSR markers.

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.

Plant material: Young leaf samples of 2-3 leaf stage of identified/advanced hybrid entries.

Methodology

- DNA isolation will be done using CTAB method.
- DNA fingerprinting using SSR markers.

Plant material: Young leaf samples of 2-3 leaf stage of drought/heat tolerant genotypes.

Methodology

- DNA isolation will be done using CTAB method.
- Molecular characterization using SSR markers.

PLAN OF WORK 2022-23 FOR CROP PRODUCTION (AGRONOMY)

Chairman	: Dr. R.K. Pannu Ex. Dean & Prof. Emeritus, CCS HAU, Hisar –cum- PAMC Expert Dr. D.C. Upreti Ex. Pr. Scientist, ICAR-IARI, New Delhi –cum- PAMC Expert
Rapporteur	: Dr. Anil Kumar, Principal Scientist (Agronomy), Bajra Section, CCS HAU, Hisar Dr. Minakshi Grover, Principal Scientist, Division of Microbiology, ICAR-IARI, New Delhi
Date	: 02 nd March, 2022 & 29 th April, 2022

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 house was of the view that before finalization of the one new experiment on Organic Farming or Natural Farming especially on Zero Budget Natural Farming (ZBNF), it was decided that a separate meeting of the Agronomists may be called under the chairmanship of Dr. R.K. Pannu & Dr. D.C. Upreti and then new trial will be finalized after the thorough discussion in the meeting. It was also decided that Plant Physiologist should plan out some experiments out in association with Agronomists. All the Six experiments conducted during previous year will continue and one New Trial is formulated and will be finalized later in the Agronomist meet. As per the decision taken during the virtual meeting, a separate online meeting was held to finalize the T.P. of Agronomy and Plant Physiology for 2022-23 on 29.04.2022 under the chairmanship of Dr. R. K. Pannu. The chairman impressed upon to work on the priorities area viz. to evolve climatic resilient and nutrient efficient varieties/hybrids, moisture and resource conservation crop production technologies. As per the decision taken one new experiment on Organic and Natural Farming was finalized after thorough discussion among the Agronomist across different centers. The Plant Physiology technical programme was also finalized. The chairman again asked all the scientists to record all the observations especially on nutrient mining and moisture conservation.

The details are given in the Plan of work for 2022-23.

Agronomy Experiments to be continued during 2022-23

- 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 3** : Enhancing biofortified/non- biofortified pearl millet hybrids productivity and quality through micronutrients under irrigated situation
- PMAT 4** : Contribution of production factors to the yield and economics of pearl millet.
- PMAT 5** : Effect of tillage and nutrient management systems on pearl millet yield and soil properties
- PMAT 6** : Response of pearl millet to split application of nitrogen at different growth stages under irrigated condition

New Experiment

- PMAT 7** : Productivity of Pearl millet-Mustard/Chickpea cropping sequence as influenced by organic and natural farming.

AGRONOMY - TECHNICAL PROGRAMME FOR 2022-23

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 2553, MH 2555, HHB 67 (Imp.) (c), MPMH 21 (c), RHB 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 2577, MH 2580, 86M86 (c), KBH 108(c) & MP 7792 (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 371, MSH 373 & MSH 377, Nandi 75 (c), 86M64 (c), MP 7366 & Proagro 9444 (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 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 T₁ : Control (RDF)
 T₂ : T₁+Crop residue mulch @ 5.0 t/ha after 10-15 DAS
 T₃ : T₁+ Pusa Hydrogel dry application @ 5.0 kg/ha
 T₄ : T₁+ SPG 1118 dry application @ 5.0 kg/ha
 T₅ : T₁+ Pusa Hydrogel slurry application @ 5.0 kg/ha
 T₆ : T₁+ SPG 1118 slurry application @ 5.0 kg/ha
 T₇ : T₃+ Crop residue mulch @ 5.0 t/ha after 10-15 DAS
 T₈ : T₄+ Crop residue mulch @ 5.0 t/ha after 10-15 DAS
 T₉ : T₅+ Crop residue mulch @ 5.0 t/ha after 10-15 DAS
 T₁₀: T₆+ 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. Soil moisture content at 0-15,15-30,30-60 & 60-90 cm soil depth before sowing and at 20 days interval up to harvesting of the crop.
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 A₁**)
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]

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 P_2O_5) for Zone A₁ & A
(60 kg N/ha + 30 Kg P_2O_5) for Zone B*

Locations Bikaner & Mandor (**Zone A₁**)

: 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. Soil moisture content at 0-15, 15-30, 30-60 & 60-90 cm soil depth before sowing and at 20 days interval up to harvesting of the crop.
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:

A. Main plot: Nutrient management

N₁ – 100 % RDN

N₂ – 112.5% RDN

N₃ – 125 % RDN

B. Sub plot: 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 A₁) 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 (kg/ha) in soil before sowing and after harvesting
9. N, P & K content (%) & their uptake (kg/ha) 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]

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

New Experiment

PMAT-7 Productivity of pearl millet [*Pennisetum glaucum* (L.) R.Br. Emend. Stuntz]-Mustard/ Chickpea cropping sequence as influenced by organic and natural farming.

- Objectives**
1. To evaluate the effect of organic and natural farming on productivity and quality of pearl millet and mustard/chickpea crops.
 2. To study the impact of organic and natural farming on soil properties and microbial counts.
 3. To find out the relationship among yield and soil properties.

Year of Start 2022

Treatment details:

- T₁ Control
- T₂ RDN* through Farm yard manure (FYM)
- T₃ RDN through Vermicompost (VC)
- T₄ RDN through Poultry manure(PM) for Zone A &B / *Sheep or Goat manure for Zone A₁
- T₅ RDN through FYM+ Biofertilizer
- T₆ RDN through Vermicompost+ Biofertilizer
- T₇ RDN through Poultry manure + Biofertilizer
- T₈ *** Cow based bio formulation
- T₉ RDF**

*RDN or **RDF /ha for irrigated pearl millet & Mustard/ Chickpea crops of respective Zones along with P, K & ZnSO₄/FeSO₄ in RDF treatment will be applied.

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

1. Biofertilizer will be used as seed treatment for respective crops.

***250 kg/ha **Cow Urine Based Solid Organic bio-Formulation (CUBSOF)**/ha before sowing along with sieved dry FYM @ 250 kg/ha will be applied into the soil before sowing and **Cow Urine Based Liquid Organic bio-Formulation (CUBLOF)** @ 500 litre/ha with irrigation water or foliar spray of 10 % will be applied two times at 15-20 & 35-40 DAS during the crop season.

2. Analysis of FYM, VC and PM/Sheep or Goat manure for total N (%)

Variety Best performing Latest hybrid /varieties of Pearl millet, Mustard or Chickpea of the locations.

Design RBD

Replications Three

Plot size 4.0 m x 3.6m

Observations to be recorded

1. The moisture content in the Organic manure sources at the time of application should be compensated with higher dose in that proportion of moisture content.
2. Collection of soil samples (0-15 cm) for their analysis of soil pH, EC, SOC, available N, P, K, S and DTPA-extractable Zn & Fe (before sowing and after harvesting)
3. Analysis of bacterial count in soil samples (before sowing and after harvesting)
4. Pearl millet: Plant height (cm), Number of total and effective tillers/ plant, Ear head length (cm), Ear head girth (mm) and Test weight (g)
5. Mustard: Number of Primary & Secondary Branches, Number of siliquae/plant, No. of seeds/silique, test weight (g)
6. Chickpea: Number of Primary & Secondary Branches, Number of pods/plant, no. of grains/pod, test weight (g)
7. Grain and straw yield (q/ha) of both the crops
8. Protein content in pearl millet/ chickpea & Oil content (%) in mustard

Note : The experiment will have to be conducted on a permanent site for at least 3-4 years.

Composition of 250 kg/ha Cow Urine Based Solid Organic bio-Formulation (CUBSOF)/ha: Take 250 kg desi cow dung+2.5 kg Jaggery+ 5.0 kg Gram Flour (Arhar/Chickpea/Moong/Urd)+ Two handful of soil near to tree of that field + 5.0 litre cow urine. Mix all these components and dry it under shade. Make it into powder form by beating with stick. Mix it with sieved dry FYM @ 250 kg/ha and apply into the soil before sowing.

Composition of 500 litre/ha or @ 10% as foliar spray of Cow Urine Based Liquid Organic bio-Formulation (CUBLOF): Take 25 kg desi cow dung+ 25 litre cow urine +5.0 kg/ha Jaggery+ 5.0 kg Gram Flour (Arhar/Chickpea/Moong/Urd)+ Two handful of soil near to tree of that field + 500 litre water. Mix all these components into a plastic drum and stir daily for 2 times in the morning & evening for 2-3 minutes for 2-3 days. Cover the plastic drum with some cover or cloth.

The meeting ended with thanks to the Chairman as well as Project Coordinator. All the members strongly applauded Dr. R. K. Pannu for publication of two books on Fundamentals of Agronomy in both English & Hindi versions. The house also acknowledged the all round help and support received from Dr. Tara Satyavathi.

PLAN OF WORK 2022-23 FOR PLANT PHYSIOLOGY

The technical program of plant physiology has been reformulated 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 they also agreed to continue same technical program. A new trial (PMPHY5-Agro-physiological management of the drought in Pearl millet genotypes) was also formulated in collaboration with Agronomy discipline as per suggestions received from DDG (CS) ADG (FFC) and PAMC experts after conducting an online meeting on 29th April, 2022 in collaboration with Agronomy discipline under chairmanship of Dr. R.K. Pannu, Ex-Dean, CCS HAU, Hisar.

PMPHY 2 : Characterization for drought tolerance to identify parental lines of (a &b) 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, 2021.

Locations : Summer : Jamnagar and Mandor

Kharif : Jamnagar, Jaipur and Mandor

Conditions Summer : Irrigated (PMPHYa)

Kharif : Rainfed (PMPHYb)

Treatment : 20 inbred (R lines and B lines)

Design : RBD

Replication : Three

Spacing : 50 cm X 10 cm (Summer) , 60 cm X 10 cm (*Kharif*)

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 (⁰C)
15. Air Temperature (⁰C)

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

Year of Commencement: 2019, As per the QRT and Dr. C. Viswanathan, HoD, Division of Plant Physiology, ICAR-IARI, New Delhi suggestions 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)

PMPHY 4: Identification of physiological traits for drought tolerance in pearl millet

Objectives : To identify 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 5: Agro-physiological management of the drought in Pearl millet genotypes (Released hybrids and varieties of A₁ zone of India)

Year of Commencement : 2022

Location : Mandor, Durgapura (Jaipur) and Jamnagar
(Dr. Seema Sharma, Associate Professor (Agronomy) will conduct this trial at Durgapura centre, Jaipur)

Season : *Kharif*

Replication : Three

Design : RBD

Treatment : A) Factor

1. Control
2. Seed priming with water with ratio 1/2 for 6 hr
3. Seed priming with ABA 150 ppm for 6 hrs
4. Seed priming with KNO_3 0.5% for 6 hrs
5. Seed priming with KNO_3 0.5% for 6 hrs + Spray of KNO_3 @ 1% at panicle initiation
6. Seed priming with salicylic acids 200 mg/L SA for 6 hrs
7. Spray of thiourea @ 1000 ppm at tillering stage and panicle initiation
8. Spray of KNO_3 @ 1% at tillering and panicle initiation

B) factor- Genotypes

(Released hybrids / varieties of A_1 zone of India)

I. MPMH 21, II. BHB 1602, III. MPMH 35

Design : FRBD

Replication : Three

Spacing : 45 cm X 15 cm

**Plot size : 6 Rows (Gross plot size 2.7X 4.5 M)
4 Rows (Net plot size 1.8 X 3.5 m)**

Fertilizer : As per PoP

(Also required soil nutrient status and moisture level)

Observations**A- Biomass partitioning at different stages****At 30 DAS, 45 DAS and 60 DAS and 75 DAS**

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

B- Yield Observations:

1. Seed setting %
2. Days to 50% flowering
3. Days to maturity

4. Grain yield (kg/ha)
5. Productive tillers/plant
6. Test weight (g)
7. Threshing percentage
8. Fodder yield (q/ha)
9. Harvest index (%)
10. Days to Maturity
11. Ear head weight (kg/ha)
12. Nutrient uptake Seed and straw

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

- 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. Viswanathan,
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)),
4. Chlorophyll stability index

Field observation at 15, 22 and 30 DAS

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

PLAN OF WORK OF PLANT PATHOLOGY (2022-23)

Chairman	Dr. P. Raghava Reddy, Chairman, PAMC
Co-chairs	Dr. H.S. Shekhar Shetty, Ex Professor, Downy Mildew Research Lab, Univ. of Mysore, Mysore Dr. C. Tara Satyavathi, PC, ICAR-AICRP on Pearl Millet, Jodhpur
Rapporteurs	Dr. Chandra Nayaka, UOM, Mysore
Date	2 nd March, 2022

- **ANAND Centre (Zone A) wishes to not to conduct PMPT trails, hence the centre was not included in the year 2022-23 for pathological trials.**

The group decided to continue the same experiments under:

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 and Jamnagar 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

Note- Minimum 70% of diseases incidence should be there on IR-I, IR-2 at the locations to score at 30DAS or 60 DAS, otherwise the data for that centre and stage will be rejected and not included in the report.

PMPT IV: Pearl millet downy mildew virulence nursery (PMDMVN).**Pathogenic diversity analysis by virulence nursery****Location : Zone A & A₁**

Mandor, Jaipur, Hisar, Gwalior and Jamnagar

: 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: (Mysore)

- a) Biochemical and molecular characterization of host pathogen interaction of blast and downy mildew system
- b) Unravelling the pearl millet microbiome –Rhizosphere and Root microbiome

PMPT VII: New Experiment: Management of downy mildew and blast disease by using microbial consortia for the year 2022-2023.

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:

Jamnagar, Dhule and Coimbatore

The criteria for the acceptability of new genotypes for diseases, the following criteria finalized for the year 2022-2023.

- **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. Score up to 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 /infector 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 score up to 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 row 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 from 2022-2023 onwards.**

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 and Jamnagar
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 and Jamnagar

: 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 characterization of host pathogen interaction of blast and downy mildew system
- Unravelling the pearl millet microbiome –Rhizosphere and Root microbiome
- Mapping of blast and downy mildew resistance QTLs in new stable donor parents

Location : Mysore & ICRISAT**PMPT VII: Management of downy mildew and blast disease by Microbial consortia -**

Seed treatment & Soil Treatment @ 10 ml/l

(Seed treatment before sowing/ Soil treatment after 15 DAS by Soil drenching Method)**Treatments:**

- Microbial Consortia (Combination of 3 microbes: Trichoderma/Bacillus/Pseudomonas)
(Aurangabad centre will supply)
- Microbial Consortia (Combination of 4 microbes:
Mycorhiza/PSB/Pseudomonas/Trichoderma)
(Mysore centre will supply)
- Metalaxyl 35SD (6g/Kg)
- Control

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

- Seedling emergence
- Per cent Downy Mildew and Blast disease Incidence at 30 and 60DAS
- Grain and Fodder Yield -Should be calculated per hectare

Location : Zone A & A₁

Mandor, Jaipur, Hisar, Gwalior, Jamnagar

Zone BAurangabad, Dhule, Coimbatore, Mysore, Perumallapalle,
and Patancheru*Note: Observation of Blast disease should be recorded 30, 45 and 60 days and Downy mildew 30 & 60 days after sowing in all the experiments.***a. BLAST DISEASE****(Experiment to be conducted as such in 2022)**

Treatments:

1. Seed treatment with Chitosan @3.75g/kg seed + 2 sprays of *Pseudomonas fluorescens* @10g/lit 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/lit after 20 DAE and 35 DAE (Mysore Centre will supply)
3. Spray treatment with *Pseudomonas fluorescens* @10g/lit 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/lit 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 B

Aurangabad, 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: Jamnagar, Dhule and Coimbatore

PLAN OF WORK 2022-23 FOR ENTOMOLOGY

Chairman	Dr. T. R. Sharma DDG (CS) ICAR, New Delhi
Co-chairs	Dr. H.S. Sekhar Shetty, Ex Professor, Downy Mildew Research Lab Univ. of Mysore, Mysore
Rapporteurs	Prof. Rajkumar P. Juneja, Assistant Research Scientist (Entomology) & PI Entomology, ICAR-AICRP-PM, JAU, Jamnagar
Date	2 nd March, 2022

Significant findings/Achievements:

- 1 Out of 104 initial lines/populations screened, 25 entries were found moderate resistant (0.1-5.0%) at ear head stage and they were viz., KBH 108, MH 2644, MH 2615, MH 2611, Kaveri S Boss, MH 2628, 86M86, MH 2617, MH 2621, MH 2657, MH 2591, MH 2592, MH 2609, MH 2626, MH 2650, MP 614, ABV 04, MH 2610, MP 615, MH 2645, Pusa Comp. 701, MH 2616, MH 2603, MP 612 & MH 2648 against shoot fly.
- 2 Out of 42 advanced entries screened, 28 entries were found moderate resistant (0.1-5.0%) at ear head stage and they were viz., Pusa Comp. 612, MH 2559, GHB 538, 86M86, MH 2562, MH 2564, KBH 108, MH 2480, MH 2574, Raj 171, MP 609, PB 1705, Kaveri Super Boss, Dhanshakti, MH 2580, MH 2581, ICMV 221, GHB 905, MH 2577, Pratap, MH 2573, MH 2474, MH 2658, MH 2661, ABV 04, MH 2555, MH 2660 & NBH 5767 against shoot fly.
- 3 Out of 235 germ plasm lines screened, the accession number, IP 2704 (ICRISAT) was found to be free from shoot fly & stem borer at all the stages of the crop along with *Helicoverpa* at ear head stage (Multiple resistance).
- 4 Out of 30 advanced entries screened, HHB 67 Imp., MH 2423, MH 2545, Dhanshakti, MH 2543 & ICMV 221 were found to be promising against *Tribolium sp* at 6 months during storage.
- 5 Out of 30 advanced entries screened, Pusa composite 383, Pusa composite 701, MH 2512, JBV 2, MH 2423, MH 2522, MH 2546, MH 2543, MH 2547, MH 2480, RHB 177, MPMH 21, MP 596 & HHB 272 were promising against *Rhizopertha dominica* at 6 months during storage.
- 6 Correlation of shoot fly incidence with different weather parameters was worked out for Jamnagar & Jaipur centre. On the basis of pooled data of last 5 years (2017-2021), negative and highly significant correlation was observed with temperature minimum at Jamnagar (-0.414**) and Jaipur (-0.413**) centre.
- 7 Correlation of stem borer with different weather parameters was worked out for Jamnagar centre. On the basis of pooled data of last 5 years (2017-2021), negative and highly significant correlation was observed with temperature minimum (-0.569**) at Jamnagar centre.

PLAN OF WORK/TECHNICAL PROGRAMME FOR *KHARIF* & SUMMER 2022-23

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
4	PMET-2	Monitoring of major insect-pests of pearl millet (On Research Station)	Jamnagar, Anand, ARS Mandor-Jodhpur, Jaipur, Aurangabad, Vijayapur & ARS Fatehpur-Shekhawati (New centre)
5	PMET-3	Survey of insect- pests of <i>kharif</i> pearl millet crop on farmers' field	Jamnagar, Anand, ARS Mandor-Jodhpur, Jaipur, Aurangabad
6	PMET-5	Testing of IPM modules against pest complex of pearl millet	Jamnagar, ARS Mandor-Jodhpur & Jaipur
7	PMET-7	Survey of insect- pests of the summer pearl millet crop on farmers' field	Jamnagar & Anand
7	PMET-8	Relative susceptibility of pearl millet advanced entries to storage insect pests (storage- trial),	Jamnagar, Anand, Jaipur, Jodhpur (New centre) & Anantapur (New centre)
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 & ARS Fatehpur-Shekhawati (New centre).

Details of experiments to be conducted 2022-23

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.

Methodology: At vegetative stage (28 DAG), observations will be recorded from total plants of net plot plants by counting the dead hearts. Thus, shoot fly dead heart percent incidence will be worked out. For stem borer, plant showing parallel holes due to stem borer larvae in the leaves will be considered as damaged plant and percent damaged plant will be calculated. At ear head stage, number of ear heads showing shoot fly (deformed ear head) and stem borer (empty/white ear head) damage will be recorded separately and thus percent ear head

damage will be worked out from ear heads of total plants of net plot. Whereas, for *Helicoverpa armigera*, the population of larvae will be counted from 5 ear heads of the randomly selected. Leaf roller damage score (0-10) will be worked out on 5 plant basis at ear head stage.

Observations to be recorded:

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

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:** 3, **No. of rows:** One

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

Methodology: At vegetative stage (28 DAG), observations will be recorded from total plants of net plot plants by counting the dead hearts. Thus, shoot fly dead heart percent incidence will be worked out. For stem borer, plant showing parallel holes due to stem borer larvae in the leaves will be considered as damaged plant and percent damaged plant will be calculated. At ear head stage, number of ear heads showing shoot fly (deformed ear head) and stem borer (empty/white ear head) damage will be recorded separately and thus percent ear head damage will be worked out from ear heads of total plants of net plot. Whereas, for *Helicoverpa armigera*, the population of larvae will be counted from 5 ear heads of the randomly selected. Leaf roller damage score (0-10) will be worked out on 5 plant basis at ear head stage.

Observations to be recorded:

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

N.B.: After the harvest of the seeds of different entries of this trial, the experiment number PMET-8 (Storage trial) will be installed. Jamnagar, Anand, Jaipur & Jodhpur centres are instructed to collect and store the seeds of PMET-1B (Advance lines) as reserve for any of the centre if need arises. Do not mix or remove the seeds before prior permission from PI, Entomology, JAU, Jamnagar.

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

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

Row length: 2.0 m and **Spacing:** 50x15 cm.

No. of entries: 235 (Mini-core/germplasm-ICRISAT).

Methodology: At vegetative stage (28 DAG), observations will be recorded from total plants of net plot plants by counting the dead hearts. Thus, shoot fly dead heart percent incidence will be worked out. For stem borer, plant showing parallel holes due to stem borer larvae in the leaves will be considered as damaged plant and percent damaged plant will be calculated. At ear head stage, number of ear heads showing shoot fly (deformed ear head) and stem borer (empty/white ear head) damage will be recorded separately and thus percent ear head damage will be worked out from ear heads of total plants of net plot. Whereas, for *Helicoverpa armigera*, the population of larvae will be counted from 5 ear heads of the randomly selected.

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.

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

Location: Jamnagar, Anand, Jaipur, ARS Mandor-Jodhpur, Aurangabad, Vijayapur & ARS Fatehpur-Shekhawati (New centre).

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

Experimental details:

Design: Nil (Observation plot)

Replications: Nil

Treatment: 2, Untreated plot/treated plot (Full package of practices to be followed)

Spacing: 50 x 15 cm.

Variety: Any released pearl millet hybrid of that zone

Methodology:

(A) Untreated plot: Sowing of released pearl millet variety will be done over an area of 100 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.

(B) Treated plot: One treated plot of 100 m² may be maintained by taking recommended package of practices for insect pest management to get the information of yield purpose 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 (1×10^8 cfu/g) at the initiation of pest appearance and repeat it after 10 days if required.
5. Leaf binder, grass hopper, grey weevil, hairy cater pillar and any other leaf feeding insects: Spraying of NSKE 5%.

Observations to be recorded:

1. From Un-treated plot, 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.
2. Yield kg/ha from treated as well as Un-treated plot.

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 Kharif pearl millet crop on farmers' fields

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

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.

Methodology & 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* 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: Seed treatment and furrow application will be given initially at the time of sowing. While, foliar application will be given at 30 DAG and at ear head stage as stated in treatments. At vegetative stage (28 DAG), observations will be recorded from randomly selected 20 plants of net plot plants by counting the dead hearts. Thus, shoot fly dead heart percent incidence was worked out. For stem borer, plant showing parallel holes due to stem borer larvae in the leaves will be considered as damaged plant and percent damaged plant will be calculated. At ear head stage, number of ear heads showing shoot fly (deformed ear head) and stem borer (empty/white ear head) damage were recorded separately and thus percent ear head damage will be worked out from ear heads of 20 plants of net plot. Grain and fodder yield recorded from net plot area at harvest and data thus data obtained analyzed statistically. Economics of the treatments will be calculated on the basis of current market prices.

Observations 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 (0-10).
- g. Grain & fodder yield.

N.B.: PSB treatment will be given after imidacloprid treatment. The pooled data of this experiment should be sent to PI after the completion of this experiment in kharif 2022.

7. PMET-7: Survey of insect- pests of summer pearl millet crop on farmers' fields

Location: Jamnagar & Anand

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.

Methodology & 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 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.

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

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

Locations: Jamnagar, Anand, Jaipur, Jodhpur (New centre) & Anantapur (New centre).

Design: CRD, **Replications:** 2, **Treatment/varieties/hybrids:** Approximately 30-40 (Advanced entries)

Methodology & Observations to be recorded: The seeds of the trial number PMET-1B will be collected and will be utilized for this experiment. After the harvest dry the seeds properly and disinfect it properly. One hundred gram seeds of each variety of pearl millet will be taken in plastic container (250g capacity). Ten pairs of adults of *Tribolium castaneum* Herbst (At Jamnagar) and *Rhizopertha dominica* Fab. (At Jaipur, Jodhpur, Anand & Anantapur) 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 6 months at $27 \pm 2^{\circ}\text{C}$ and 60 to 70 per cent relative humidity. Observations on number of adults emerged per 100g seed, percentage of seed damage on 400 grain basis & percent weight loss on 100g will be recorded at 3 & 6 months after release of insects. Germination will be recorded at the end of the experiment (At 6 months storage period). The data recorded will be subjected to statistical analysis (CRD design).

Note:

- 1. The pearl millet seeds will be used from experiment of PMET-1B (advanced entries) trial after harvesting of kharif trial.*
- 2. For Anantapur centre, 200 gram seed of each entry will be arranged by PI entomology, JAU, Jamnagar.*

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

Locations: Jamnagar, Anand, Jaipur, ARS Mandor-Jodhpur, Aurangabad & ARS Fatehpur-Shekhawati (New centre).

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/lures will be supplied by PI (Entomology), Pearl millet Research Station, JAU, Jamnagar to the above locations.

Schedule of sending the data to PI:

No.	Experiment number & Observations	Time/period of data sending
1	Screening trials: PMET-1A, PMET-1B, PMET-1C, 28 DAG observations	Send the data as soon as the data is recorded.
2	Screening trials: PMET-1A, PMET-1B, PMET-1C, ear head observations	Send the data as soon as the data is recorded.
3	PMET-2: Monitoring trial	At crop maturity (End of October) except yield of treated and un-treated plot.
4	PMET-3: <i>Kharif</i> Survey	As soon as the survey is over-October end.
5	PMET-5: IPM module testing	Till end of November.
6	PMET-7: Summer Survey	Till end of June.
7	PMET-8: Storage trial	As soon as the trial is over.
8	PMET-9: FAW pheromone trap trial	End of October

N.B.: Please follow the schedule of sending the data. The word as well as excel data sheet will be sent to you shortly. Kindly adhere and fill the data in the sheets sent to you.

SESSION III

Review of Research Results of ICAR-ICRISAT Collaborative Project 2021-22 and Plan of Work 2022-23

Chairman	Dr. R.K. Singh, ADG (CC & FFC), ICAR, New Delhi
Co-chairs	Dr. Vilas A Tonapi, Director, ICAR-IIMR, Hyderabad Dr. C. Tara Satyavathi, PC, ICAR-AICRP on Pearl millet, Jodhpur
Rapporteur	Dr. S.P. Singh, ICAR-IARI, New Delhi

The results of ICAR-ICRISAT trials conducted during 2021-22 were presented by Dr. B. R. Beniwal, Senior Technical Assistant, AICRP on Pearl millet, Jodhpur. He informed that during kharif 2021, a total of five trials namely potential B line nursery, potential R line nursery, drought tolerant hybrid parent nursery, elite inbred joint biofortification nursery and blast resistant B and R line nursery were conducted at different locations. Observations on traits like days to 50 % flowering, head length, head diameter, tillering, stay green, blast tolerance and agronomic score were recorded in these trials. Promising entries with respect to each trait were identified based on multi-location data.

Dr. S.K.Gupta, Principal Scientist (Pearl Millet Breeding) ICRISAT, Hyderabad proposed five trials viz., promising B-line nursery, promising R-line nursery, drought tolerant restorer nursery, blast resistant nursery and elite joint biofortification trial to be taken up during 2022-23 over different locations. He has also presented number of entries, replications and plot size of these trials.

Dr. Rakesh Srivastava, Principal Scientist, ICRISAT presented work plan for 2022-23. He proposed that marker assisted breeding trials & nurseries namely blast resistance trial: GWAS (Entries: 350; Reps: 2 and Rows: 2) and blast resistance trial: bi-parental QTL mapping (Entries: 300; Reps: 2 and Rows: 2) can be conducted at Delhi, Jaipur and Dhule.

Dr. Vilas A Tonapi, Director, ICAR-IIMR, Hyderabad suggested to reduce number of trials, number of entries and number of locations due to financial crunch. Possibility of contingency sharing by ICRISAT to be also explored. He also suggested that more focus should be given to develop early maturing (<45 days) materials for A₁ zone. Project Coordinator suggested including Bikaner and Mandor centres for drought screening in addition to CAZRI, Jodhpur. Mysore center and PC-Unit should be involved for marker validation work for blast. It was also suggested that donors and female parents for early maturity to be identified/developed. Female parents of ICRISAT widely used in A₁ zone and lacking for certain traits to be improved. Off-season nursery facility of IIMR in Warangal needs to be explored for seed multiplication during summer. Trial data to be compiled on zonal basis.

ICAR-ICRISAT COLLABORATIVE PROJECTS PLAN OF WORK 2022-23

ICAR-ICRISAT Trials/Nurseries 2022

S. No.	Name of the Trial/Breeding nursery	No of Entries	Plot Size	Locations
Trials/Nursery Rainy 2022				
1.	Promising B-line nursery	50-60	1 row x 2 reps	<ol style="list-style-type: none"> 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.	Promising R-line nursery	50-60	1 row x 2 reps	<ol style="list-style-type: none"> 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 restorer parent nursery	40-50	1 row x 2 reps	<ol style="list-style-type: none"> 1. AICRP, SKRAU, Bikaner 2. RARI, Durgapura 3. CAZRI, Jodhpur 4. CCA HAU, Hisar 5. PC Unit, Jodhpur
4.	Blast Resistant Nursery	20-25	1 row x 2 reps	<ol style="list-style-type: none"> 1. RVSKVV, Gwalior 2. IARI, New Delhi 3. RARI, Durgapura 4. MPKV, Dhule 5. ARS, Ananthapuram 6. PAU, Ludhiana
5.	Elite Joint Bio-fortification Trial (coordinated by AICRP on Pearl Millet)	40-50	1 row x 3 reps	<ol style="list-style-type: none"> 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

S. No.	Name of the Trial/Breeding nursery	No of Entries	Plot Size	Locations
Marker-assisted Breeding Trial and Nurseries-2022				
6.	Blast resistance trial: GWAS	350	2 rows x 2 reps	1. Bawal 2. Jaipur 3. Mandor 4. Dhule 5. Delhi
7.	Blast resistance trial: mapping population.	300	2 rows x 2 reps	1. Jaipur 2. Dhule 3. Delhi

SESSION IV

Review of Frontline Demonstrations for 2021-22 and Action Plan 2022-23

Chairman	Dr. S.K. Malhotra, Ex -Agri. Commissioner, DAC, New Delhi & Director, DKMA
Co-chairs	Dr. Ishwar Singh, Director, Directorate of Extension Education, AU, Jodhpur
Rapporteur	Dr. S.P. Singh, ICAR-IARI, New Delhi Dr. Supriya, ICAR-AICRP on Pearl millet, Jodhpur
Date	2 nd March, 2022

The FLD results of 2021-22 were presented by Dr. Manoj Kumar, Assistant Professor (Agronomy), PC Unit, Jodhpur. He informed the house that FLDs were conducted on a total of 340 ha area under A₁, A and B zones during *khariif*, summer and semi-rabi seasons with different technologies including, varietal component, improved practices and full package of practices. Out of total FLDs area, 141 ha area i.e.41.5% area was covered with biofortified hybrids. Adoption of improved production technologies recorded 16.9 to 48.5% higher grain yield compared to the yield recorded with the farmer's practice in Zone A₁,13.6 to 36.4% in Zone A and the increase was 13.2to 45.4% in Zone B. During *summer* season in Rajasthan state, 31.1 to 43.5% higher grain yield compared to the yield was recorded with the farmer's practice. During *summer* season in Gujarat state, 8.5% higher grain yield compared to the yield recorded with the farmer's practice. He proposed that during 2022-23, 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. S.K. Malhotra, Ex-Agri. Commissioner, DAC, New Delhi & Director, DKMA emphasized on conducting FLDs in clusters. Dr. Ishwar Singh, Director, Directorate of Extension Education, AU, Jodhpur suggested that agronomical management practices and plant protections strategies should also be included in FLDs. Dr. P Raghava Reddy, Chairman, PAMC and Dr. RK Pannu, Member, PAMC suggested to analyze all constraints of pearl millet and stressed upon using all practices in order to enhance farmer's interest in FLDs. Dr. Anil Kumar suggested Dr. Manoj Kumar to present data of rained and irrigated condition separately. Project coordinator, Dr. C Tara Satyavathi emphasized the role of biofortified hybrids/varieties in FLDs and suggested the centres to include biofortified hybrids/varieties in their FLDs.

The session ended with vote of thanks.

**Tentative proposal of FLD's on Pearl Millet for the year 2022-23 (kharif & summer)
discussed during workshop**

S. No.	Name of the coordinating centre	(Area in ha)			Technology to be demonstrated
		Kharif	Summer	Total	
1	RARI, (SKNAU), Durgapura (Jaipur), Rajasthan	20	-	20	<ul style="list-style-type: none"> Improved biofortified hybrid (RHB 233, RHB 234 and HHB 299) V/s Local variety Full Package of practices Weed management
2	Agricultural Research Station (SKRAU), Bikaner (Rajasthan)	30	-	30	<ul style="list-style-type: none"> Improved biofortified hybrid (HHB 299, RHB 233, RHB 234 and BHB 1202) V/s Local variety
3	Millet Research Station, JAU, Jamnagar (Gujrat)	10	20	30	<ul style="list-style-type: none"> Improved biofortified hybrid (GHB 1129, GHB 1231, HHB 299 and AHB 1200) V/s Local variety Full package of practices in summer
4	Bajra Section, CCSHAU, Hisar (Haryana)	10	-	10	<ul style="list-style-type: none"> Improved hybrids (HHB 299 and HHB 311) 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 and HHB 311) 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 biofortified hybrid (HHB 299, HHB 311 and AHB 1200) V/s Local variety Full package of practices
7	AICRP on Pearl Millet, NARP, Aurangabad (MH)	10	-	10	<ul style="list-style-type: none"> Improved biofortified (AHB 1200 and AHB 1269) v/s Local variety
8	Department of Millets, CPBG, TNAU, Coimbatore	10	-	10	<ul style="list-style-type: none"> Improved biofortified (AHB 1200 and AHB 1269) v/s Local variety
9	AICRP on Pearl Millet, Regional Agricultural Research Station, Vijayapur (Karnataka)	10	-	10	<ul style="list-style-type: none"> Improved biofortified (AHB 1200 and AHB 1269) v/s Local variety

S. No.	Name of the coordinating centre	(Area in ha)			Technology to be demonstrated
		Kharif	Summer	Total	
10	College of Agriculture, (MPKV, Rahuri), Dhule (MH)	10	-	10	<ul style="list-style-type: none"> Improved biofortified hybrid (HHB 299 and AHB 1200) V/s Local variety
11	Agricultural Research Station, (ANGRAU), Ananthapuram (AP)	10	-	10	<ul style="list-style-type: none"> Improved biofortified (ABV 04, AHB 1200 and AHB 1269) v/s Local variety
12	DEE (AU, Jodhpur), Jodhpur (Rajasthan)	20	-	20	<ul style="list-style-type: none"> Improved biofortified hybrid (HHB 299, RHB 233, RHB 234 and HHB 311) V/s Local variety Full package of practices
13	KVK, CAZRI, Jodhpur (Rajasthan)	10	-	10	<ul style="list-style-type: none"> Improved biofortified hybrid (HHB 299, RHB 233, RHB 234 and HHB 311) V/s Local variety Full package of practices
14	Incharge Forage & Millet section, Department of Plant Breeding, PAU, Ludhiana (Punjab)	10	-	10	<ul style="list-style-type: none"> Improved biofortified hybrid (HHB 299) V/s Local variety Full package of practices
15	Agricultural Research Station, (ANGRAU), Vizianagaram (AP)	20	10	30	<ul style="list-style-type: none"> Improved biofortified (ABV 04, AHB 1200 and AHB 1269) v/s Local variety
16	KVK Phalodi, Jodhpur (Rajasthan)	20	-	20	<ul style="list-style-type: none"> Improved biofortified hybrid (HHB 299, RHB 233, RHB 234 and HHB 311) V/s Local variety Full package of practices
17	KVK Gudamalani, Barmer (Rajasthan)	20	10	30	<ul style="list-style-type: none"> Improved biofortified hybrid (HHB 299, RHB 233, RHB 234 and HHB 311) V/s Local variety Full package of practices
18	KVK Sirohi (Rajasthan)	0	10	10	<ul style="list-style-type: none"> Improved biofortified hybrid (HHB 299, RHB 233, RHB 234 and HHB 311) V/s Local variety Full package of practices
19	KVK Athiyasan, Nagaur (Rajasthan)	10	-	10	<ul style="list-style-type: none"> Improved biofortified hybrid (HHB 299, RHB 233, RHB 234 and HHB 311) V/s Local variety Local variety Full package of practices
20	KVK Molasar, Nagaur (Rajasthan)	10	-	10	<ul style="list-style-type: none"> Improved biofortified hybrid (HHB 299, RHB 233, RHB 234 and HHB 311) V/s Local

S. No.	Name of the coordinating centre	(Area in ha)			Technology to be demonstrated
		Kharif	Summer	Total	
					variety • Full package of practices
21	KVK Jalore (Rajasthan)	10	10	20	• Improved biofortified hybrid (HHB 299, RHB 233, RHB 234 and HHB 311) V/s Local variety • Full package of practices
22	KVK Chandgothi, Churu (Rajasthan)	20	-	20	• Improved biofortified hybrid (HHB 299, RHB 233, RHB 234 and HHB 311) V/s Local variety • Full package of practices
23	College of Agriculture Sumerpur, AU, Jodhpur (Rajasthan)	10	-	10	• Improved biofortified hybrid (HHB 299, RHB 233, RHB 234 and HHB 311) V/s Local variety • Full package of practices
24	Agricultural Research Station, (ANGRAU), Perumallapalli (AP)	0	10	10	• Improved biofortified (ABV 04, AHB 1200 and AHB 1269) v/s Local variety
25	ICAR, Research Complex for NEH Region, Umiam, Meghalaya	0	10	10	• Improved biofortified hybrid (RHB 223, RHB 234 and HHB 299) V/s Local variety • Full package of practices
26	ICAR-AICRP on Pearl Millet, Jodhpur	20	-	20	• Improved biofortified hybrid (HHB 299, RHB 233, RHB 234 and HHB 311) V/s Local variety • Full package of practices
Total		320	80	400	

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

SESSION-V

VARIETAL IDENTIFICATION COMMITTEE MEETING

Dated: March 02, 2022

Time: 04.30 PM

Proceedings of Varietal Identification Committee Meeting held on 02.03.2022 at 04:30 pm (Virtual mode)

Varietal Identification Committee Meeting of ICAR-AICRP on Pearl millet was held on 02.03.2022 at 4:30 PM in Virtual mode. The following committee members were present:

S. No.	Particulars	Proposed Name	Position
1.	Deputy Director General (CS)	Dr. T.R. Sharma	Chairman
2.	Assistant Director General (CC & FFC)	Dr. R.K. Singh	Member
3.	Assistant Director General (Seeds)	Dr. D.K. Yadava	Member
4.	Project Director (ICAR-IISS, Mau)	Dr. Sanjay Kumar	Member
5.	Director, ICAR-IIMR, Hyderabad	Dr. Vilas A Tonapi	Member
6.	Agriculture Commissioner (Department of Agriculture), Rajasthan	Dr. Om Prakash (IAS)	Member
7.	One Director of Agriculture (State Government)	Sh. R.P. Singh, Director, DMD, Jaipur	Member
8.	One representative of Rajasthan State Seed Corporation Ltd and Organic Certification Agency.	Sh. Brij Kishore Dwivedi, Manager, RSSCO, Jodhpur	Member
9.	Representative of crop-based processing/ manufacturing industry	Sh. Ponam Chand Ji, DYSCO, RSSC, Jodhpur	Member
10.	One representative of the private seed agency	Sh. Bramareswara Rao K	Member
11.	Principal Investigators/ Resource persons	Dr. Vikas Khandelwal	Plant Breeding
		Dr. Anil Kumar Yadav	Agronomy
		Dr. Chandra Nayak	Plant Pathology
		Dr. Rajkumar P. Juneja	Entomology
12.	Project Coordinator	Dr. C. Tara Satyavathi	Member Secretary

The proposals of 4 hybrids/varieties/EDV as per detail given below were discussed:

S. No.	Hybrid/ Variety/EDV	Identity	Zone/States/Maturity Group
1	MH 2474	MPMH 35	Zone A ₁ (Early Maturity)
2	MH 2480	86M94	Zone A (Medium Maturity)
3	MSH 363	BLPMH 109	Summer growing Areas of Rajasthan, Gujarat, Punjab, UP, Maharashtra, Tamil Nadu, Telangana
4	MSH 361	SVPMH-101	Summer growing Areas of Rajasthan, Gujarat, Punjab, UP, Maharashtra, Tamil Nadu, Telangana

The Committee took following decision:

Zone A₁ (Early Maturity) (Drier parts of Rajasthan, Gujarat and Haryana)

The proposal of one hybrid MH 2474 (MPMH 35) considered by the committee for early maturity group. The hybrid MH 2474 (MPMH 35) recorded 24.8 percent higher grain yield over the best check. This hybrid was also found resistant to downy mildew, blast, smut, rust and ergot and has good iron & zinc content. Hence the hybrid was identified for release for cultivation in drier parts of Rajasthan, Gujarat and Haryana for early maturity group.

Zone A (Medium maturity) (Rajasthan, Gujarat, Haryana, UP, MP, Punjab and Delhi)

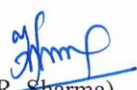
The proposal of one hybrid MH 2480 (86M94) was considered by the committee for medium maturity group. Hybrid MH 2480 (86M94) recorded 4.8 percent higher grain yield over the best check. This hybrid was also found resistant to downy mildew, blast, smut, rust and ergot and has good iron & zinc content. Hence the hybrid MH 2480 (86M94) was identified for release for cultivation in Rajasthan, Gujarat, Haryana, MP, UP, Punjab and Delhi for medium maturity group.

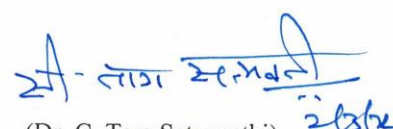
Summer hybrid for the state of Rajasthan, Gujarat, Punjab, UP, Maharashtra, Tamil Nadu, Telangana of Zone A₁, A & B

The proposal of two summer hybrids MSH 363 (BLPMH 109) and MSH 361 (SVPMH-101) were considered by the committee. The hybrids MSH 363 (BLPMH 109) and MSH 361 (SVPMH-101) had recorded 3.8 and 3.7 percent higher grain yield over the best check, respectively and found resistant to downy mildew, blast, smut, rust and ergot. Hence the hybrids were identified for release.

The list of identified hybrids/varieties/EDV is as per detail given below:

1	MH 2474	MPMH 35	Zone A ₁ (Early Maturity)
2	MH 2480	86M94	Zone A (Medium Maturity)
3	MSH 363	BLPMH 109	Summer growing Areas of Rajasthan, Gujarat, Punjab, UP, Maharashtra, Tamil Nadu, Telangana
4	MSH 361	SVPMH-101	Summer growing Areas of Rajasthan, Gujarat, Punjab, UP, Maharashtra, Tamil Nadu, Telangana


 (Dr. T.R. Sharma)
 Chairman


 (Dr. C. Tara Satyavathi)
 Member Secretary

SESSION VI

New initiatives for pearl millet research

Chairman	Dr. O.P. Govila, Ex-PC (ICAR-AICRP on Pearl millet, Jodhpur & Ex-Professor, Division of Genetics, IARI, New Delhi)
Co-chairs	Dr. R.K. Singh, ADG (CC & FFC), ICAR, New Delhi Dr. C. Tara Satyavathi, PC, ICAR-AICRP on Pearl millet, Jodhpur
Rapporteur	Dr. R.K. Kakani, ICAR-CAZRI, Jodhpur Dr. Supriya, ICAR-AICRP on Pearl Millet, Jodhpur
Date	3 rd March, 2022

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 four presentations were made by the distinguished speakers on various new initiatives taken up in Pearl millet research.

First presentation was made by Dr. Shivali Sharma, Senior Specialist, Plant Genetic Resources & Pre-breeding, Global Crop Diversity Trust (GCDT), Bonn, Germany. She delivered her views on Tapping the untapped: Pre breeding for Pearl millet improvement. During her presentation she highlighted the importance of pre-breeding and CWR along with gene pool available in different gene banks for pearl millet. She informed how pre-breeding can be a link between gene banks and breeding programs. She also emphasized the role of pre breeding and her wonderful work carried out at ICRISAT for pre flowering, terminal heat resistance and blast resistance, striga resistance. She also briefed about the lessons learnt from the pre breeding that can be useful for selection of trait and useful genes, potential donors, compressing the pre-breeding timeframe, capacity building etc. along with lesson learned from pre breeding programme.

Dr. Rakesh Srivastava, Principal Scientist, Pearl millet molecular breeding, ICRISAT, Patancheru presented the Pearl millet genomics and molecular breeding: advances and prospects. He exhibited the journey of pearl millet molecular breeding from limited marker situation to genome sequencing, medium to dense SNPs, SNP based QC panel. He also discussed about the availability of different genomic resources in pearl millet and the different advanced genomic approaches. He highlighted the development of 32.90 million SNP based QC panel and availability of 30 genome-wide SNPs platform for fingerprinting. He also reported that more than 25 traits have been mapped and more in progress along with QTLs for Fe-Zn, downy mildew resistance and rust resistance.

Dr. Nepolean T, Principal Scientist (Pearl Millet Breeding), ICAR-IIMR, Telangana presented his thoughts on-The way to breed winning hybrids rapidly through Next- Gen breeding approaches in Pearl millet. He presented the challenges in pearl millet production along with genetic gain observed over the period as compared to maize. He discussed his thoughts for enhancing genetic gain using identification of parents using breeding value identified through genomic approaches, early generation selection through predicting breeding values, rapid generation advancement using speed breeding, complementary technologies, BMS, optimizing and efficient field testing. He also informed about the availability of 4K Mid-density SNP panel for genomic selection, line development etc.

Dr. B. Dayakar Rao, PS & CEO (Nutri Hub), IIMR, Telengana, presented his views on Creation of demand for Pearl millet through nutritional labeling, value addition and entrepreneurship development. He exhibited millets as smart food due to benefits in production and consumption in terms of consumer, farmer, business and environment. He exhibited a journey of growth and demand in various industries and scope of startups and entrepreneurs in use of pearl millet in FMCG products. He also discussed about the challenges and constraints in this area. He also focused on how the pearl millet processing increases the demand. He also briefed about the different pearl millet products and the efforts made by nutri-hub for capacity building programs and trainings organized for enhancing value addition in pearl millet.

Chairman summed up the session with appreciation for the wonderful presentations by all the speakers.

The session ended with vote of thanks to Chairman, Co-Chairman and the presenters.

SESSION - VII**Review of DUS Testing Project, Progress Report 2021 -22 and Review of BSP 2021-22 and Action Plan 2022-23**

Chairman	Dr. D.K. Yadav, ADG (Seeds), ICAR, New Delhi
Co-chairs	Dr. T.K. Nagarathna, Registrar, PPV&FRA, New Delhi
Rapporteur	Dr. Dev Vart Yadav, CCS HAU, Hisar Dr. Arun Kumar M.B., ICAR-IARI, New Delhi
Date	3 rd March, 2022

During the session, Dr. Vikas Khandelwal, ICAR- AICRP on Pearl millet, Jodhpur presented the progress made in 2021-22 under DUS Testing Project and Breeder Seed Production. Under DUS testing, a total of 27 varieties (two farmers' varieties, 4 in 2nd year and 21 in 1st year) were evaluated on 28 DUS traits. A total of 5.13 q indent of breeder seed was there for five varieties and 26 parental lines of hybrids against which a total of 23.23 q breeder seed was produced. There was a deficit production in certain lines/varieties which shall be overcome by taking production in summer season. Deliberations were made during the session pertaining to the DUS testing, variety registration, popularization of the new hybrids etc. Based on the presentations discussions, the following points emerged:

- The PC unit should sensitize the Centers/breeders to register their varieties and hybrids by generating DUS database alongside 2nd year of trial itself. PC unit should coordinate and facilitate the annual registration fee related issues of extant and new varieties especially of the public sector organizations. Dr T.K. Nagarathna, Registrar, PVFRA clarified that the registration process of extant, old and VCK varieties has been stopped from Jan 03, 2022 and only new varieties registration are allowed after undertaking DUS testing.
 - Both the Chairman and Co-Chairperson suggested that the registration of farmers' variety should be encouraged so that the pearl millet germplasm which is the wealth of the country can be protected. The use of molecular markers in DUS testing is under consideration and a committee report is expected soon in this direction.
 - The Chairman, Dr. D.K. Yadava suggested that both the centre and state indents as well as breeder seed supply under various MoUs/non-exclusive agreements should be included for providing the total BSP figure to ICAR to reflect a holistic true picture.
 - The house agreed to take up the breeder seed production of the varieties and parental lines 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 by the respective centers, so that the constant supply for the frontline demonstrations and popularization activities of such hybrids are not hampered. Strong efforts must be made to popularize these hybrids at farmers' level.
 - Efforts have to be taken up by the respective centers to bring the new released hybrids into seed multiplication chain by pursuing the State Agricultural Departments.
- The session ended with thanks to the Chair.

BREEDER SEED PRODUCTION (ACTION PLAN 2022-23)

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

Crop: Pearl millet

Year of Production: 2022

Year of supply: February 2023

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)	0.50	0.50
2	ICAR-IARI, New Delhi	Pusa Composite 612 (MP 480)	0.36	0.36
3	ICAR-IARI, New Delhi	Pusa Composite 701 (MP 535)	0.88	0.88
4	ICRISAT, Patancheru	Dhanshakti (ICTP 8203 Fe 10-2)	3.54	3.54
5	NARP, Aurangabad	ABPC-4-3 (MP 484)	0.01	0.01
6	RVSUVV, Gwalior	JBV-2	0.20	0.20
	Total	Total (A)	5.49	5.49
B.	Parental lines			
1	ICRISAT, Patancheru	ICMA 843-22 (A line HHB 67 Imp, HHB 67 Imp 2-7)	0.72	0.72
2	ICRISAT, Patancheru	ICMB 843-22 (B line HHB 67 Imp, HHB 67 Imp 2-7)	0.11	0.11
3	ICRISAT, Patancheru	ICMA 04888 (A line HHB 299)	0.08	0.08
4	ICRISAT, Patancheru	ICMB 04888 (B line HHB 299)	0.04	0.04
5	ICRISAT, Patancheru	ICMA 02333 (A line HHB 311, RHB 234)	0.11	0.11
6	ICRISAT, Patancheru	ICMB 02333 (B line HHB 311, RHB 234)	0.07	0.07
7	ICRISAT, Patancheru	ICMA 99222 (A line PhuleMahashakti)	0.01	0.01
8	ICRISAT, Patancheru	ICMB 99222 (B line PhuleMahashakti)	0.01	0.01
9	ICRISAT, Patancheru	ICMA 99444 (A line RHB 233)	0.01	0.01
10	ICRISAT, Patancheru	ICMB 99444 (B line RHB 233)	0.01	0.01
11	ICRISAT, Patancheru	ICMA 94555 (A line VPMH 7)	0.02	0.02
12	ICRISAT, Patancheru	ICMB 94555 (B line VPMH 7)	0.01	0.01
13	ICRISAT, Patancheru	ICMA 98222 (A line AHB 1200)	0.01	0.01
14	ICRISAT, Patancheru	ICMB 98222 (B line AHB 1200)	0.01	0.01
15	ICRISAT, Patancheru	ICMA 04999 (A line MPMH 17)	0.02	0.02
16	ICRISAT, Patancheru	ICMB 04999 (B line MPMH 17)	0.01	0.01
17	ICRISAT, Patancheru	ICMA 96666 (A line RHB 223)	0.09	0.09
18	ICRISAT, Patancheru	ICMB 96666 (B line RHB 223)	0.07	0.07
19	ICRISAT, Patancheru	ICMA 93333 (A line MPMH 21)	0.09	0.09
20	ICRISAT, Patancheru	ICMB 93333 (B line MPMH 21)	0.08	0.08
21	MPKV, Dhule	DHLB-8A (A line PHULE ADISHAKTI)	0.06	0.06
22	MPKV, Dhule	DHLB-8B (B line PHULE ADISHAKTI)	0.06	0.06
23	MPKV, Dhule	DHLBI-967 (R line PHULE ADISHAKTI)	0.06	0.06
24	MPKV, Dhule	DHLB 16A (A line DHBH 1397)	0.01	0.01
25	MPKV, Dhule	DHLB 16B (B line DHBH 1397)	0.01	0.01
26	MPKV, Dhule	DHLBI 1035 (R line DHBH 1397)	0.01	0.01
27	MPKV, Dhule	DHLBI 1201 (R line PhuleMahashakti)	0.01	0.01
28	MPKV, Dhule	RHRB 1A (A line SHRADDHA)	0.02	0.02
29	MPKV, Dhule	RHRB 1B (B line SHRADDHA)	0.01	0.01
30	MPKV, Dhule	RHRBI 138 (R line SHRADDHA)	0.01	0.01
31	MPKV, Dhule	RHRB 5A (A line SABURI)	0.02	0.02
32	MPKV, Dhule	RHRB 5B (B line SABURI)	0.01	0.01
33	MPKV, Dhule	RHRBI 458 (R line SABURI)	0.01	0.01
34	NARP, Aurangabad	AUBI 1101 (R line AHB 1200)	0.01	0.01
35	UAS, Dharwad	CPRT-112 (R line VPMH 7)	0.01	0.01
36	CCSHAU, Hisar	H 77/833-2-202 (R line of HHB 67 Imp)	0.10	0.10
37	CCSHAU, Hisar	H 77/833-2-202-6 (R line of HHB 67-2 Imp)	0.01	0.01
38	CCSHAU, Hisar	H 14/003 (R line HHB 311)	0.05	0.05
39	CCSHAU, Hisar	H 13/0001 (R line HHB 299)	0.04	0.04
40	SKNAU, Jaipur	RIB 15176 (R line RHB 233)	0.01	0.01
41	SKNAU, Jaipur	RIB 15177 (R line RHB 234)	0.04	0.04
42	SKNAU, Jaipur	RIB 3135-18 (R line RHB 223)	0.07	0.07
43	AU, Jodhpur	MIR 525-2 (R line MPMH 17)	0.01	0.01
44	AU, Jodhpur	MIR 524 (R line MPMH 21)	0.10	0.10
	Total (B)		2.33	2.33
	Total (A)+(B)		7.82	7.82

Session VIII

Plenary Session

Chief Guest	Dr. Trilochan Mohapatra, Secretary, DARE & DG, ICAR
Chairman	Dr. TR Sharma, DDG (CS), ICAR, New Delhi
Guest of Honour	Dr. B.R. Choudhary, Vice-Chancellor, Agriculture University, Jodhpur Dr. R.K. Singh, ADG (CC & FFC) , ICAR, New Delhi Dr. Vilas Tonapi, Director, ICAR-IIMR, Hyderabad
Rapporteurs	Dr. Mukesh Sankar, ICAR-IARI, New Delhi. Dr. Supriya, PC unit, ICAR-AICRP on Pearl millet, Jodhpur
Date	03 rd March, 2022

During this session, Dr. Sanjana Reddy on behalf of respective rapporteurs of different sessions presented the observations and recommendations generated during different sessions. The proceedings of Varietal Identification Committee was presented by Project Coordinator, ICAR-AICRP on Pearl millet. All the observations and recommendations of each session were approved after discussions. Later PAMC Members, Chief Guest, Guest of honor and Chairman presented their remarks:

Dr. Raghava Reddy appreciated efforts done by AICRP and the identification/released of new varieties for A₁ zone but he also suggested that narrow genetic base exists among the cultivated pearl millet and more focused effort should to be followed in order to diversify the genepool through introgression of various important germplasm available at ICRISAT and NBPGR. He also emphasized on sharing of identified donors among centers. He stressed upon the mass production of good quality seeds of newly released hybrids and varieties to upscale the area of cultivation and to speed up their adoption by farmers. The FLD programme should be conducted in large numbers over years for assessing the consistency of new technologies.

Dr. R K Pannu suggested for location specific reinforcement of FLD trials and need to take experimental site, weather and soil data also when doing analysis of experimental data. Weed control measures at critical stages of the crop should be also taken care of and micronutrient analysis of crop and grain should be done. Yield maximization trials should consider the status of nutrients before and after the experiment. The plant physiologist needs to work along with the agronomist and devise various experimental modules utilizing growth regulators, anti-transpirants, chemicals for seed priming etc to mitigate the terminal drought. Research on organic and conservation agriculture should be focused and MSP of organic products should be increased by Govt. and procurement of Pearl millet should be done for benefit of farmers.

Dr Shekhar Shetty pointed out that the pathological data over the years need to be studied to work out new disease forecasting model using new algorithms. There is a need to promote more collaboration with ICRISAT, Molecular Breeding discipline of AICRP (Pearl millet) and Pathology division of University of Mysore to carry out basic and applied research in the field of molecular pathology and breeding. Pathologist need to understand the GXE to identify the emergence of new strains or diseases in pearl millet. Genotypes with multiple disease resistance need to be identified to be utilized in future plant breeding activities. Recording of data and validation of the data should be focused to understand the emergence

of new diseases. Research on biomaterials, nanotechnology and microbial consortium need to be implemented along with ongoing research to further strengthen the programme and more invited lectures should be included to enlighten the young researchers to take up the research in that field.

Dr. M L Lodha in his remarks appreciated the overall performance of all centres and PC Unit. He also emphasized that more efforts are needed to highlight the nutritional and health benefit of pearl millet. Large germplasms need to be screened against the flour rancidity in pearl millet. The Division of Biochemistry, IARI can be collaborated to work on rancidity. The Fe and Zn data of all the trials should be available before the AICRP group meeting. Breeding and processing efforts are also needed to reduce the phytic acid content in pearl millet varieties.

Dr. Upreti in his remarks suggested to clearly define the climate resilience parameters with respect to pearl millet. Stage of vulnerability to a particular abiotic stress need to be identified and should be clearly defined. Utilization of wild species needs to be initiated to improve the grain as well as fodder quality in pearl millet. A separate criteria must be there for forage and grain hybrid identification. In addition, some correlation studies of used data are also required.

Dr. B.R. Choudhary, Vice chancellor, Agriculture University, Jodhpur, appreciated the efforts of AICRP (Pearl millet) in the field of pearl millet research particularly in arid zones of Rajasthan but still concentrated efforts are needed to popularize the millet among farmers, consumers and processing industries. Research on improving shelf life of pearl millet flour need to be initiated. He emphasized the need for the availability of good quality seeds of new hybrids and varieties along with creating linkages and MoUs with seed industries.

Dr. R.K. Singh, ADG (CC & FFC), ICAR, New Delhi showed concern towards the promotion of entries to next season of testing in AICRP trials. Only less entries being promoted, which need a concentrated effort to broaden the genetic base through pre-breeding activities and include good germplasm to improve the breeding programme and focus on basic strategic research. He also pointed out that various programmes need to be planned to celebrate the “International Year of Millets” during 2023.

During the session, different publications including Summary of Research Experiments (2021-22), Project Coordinator Review, Pearl millet News and two Technical Bulletins- “Nutritional Profiling of Pearl Millet Genotypes” and “Processing of Pearl millet Grains to Develop Nutri-Smart Food” were released. Certificate of appreciations for the excellent work done on Pearl millet by various centers, individual scientist and teams were awarded. In the end, Chief Guest of the session, Dr. Trilochan Mohapatra appreciated the performance of the ICAR-AICRP on Pearl millet, co-operating centers and the award recipients during the workshop. He sensitized various centers to plan various activities in order to create awareness among people to consume nutri-cereal and celebrate the forthcoming “International Year of Millets”. He emphasized on the need of public private partnership, natural farming and suggested to develop new varieties/hybrids/varieties with multiple disease resistance along with yield, micronutrient levels and organoleptic characters. He stressed upon popularization of farmers varieties and local landraces like Jafrabadi having good organoleptic properties.

DDG (CS) in his closing remarks thanked the members and experts and congratulated the awardees including AICRP-PM for bringing out eight product recommendations and four

new hybrids. He suggested Project Coordinator to conduct the mid-term evaluation of fixed objectives of all the AICRP trials. Production and protection technologies should be released during workshop. Most of the varieties are not surpassing the yield and other criteria set for release of the varieties which requires the programmes to broaden the genetic base and plan the strategies to strengthen pre-breeding activities. Only few varieties being developed though molecular breeding and IARI, IIMR and ICRISAT should focus more on developing molecular markers and come out with MAS derived varieties. Multiple resistant or tolerant lines need to be identified and should be used as donor for future plant breeding. Separate biofortification program need to initiate to improve the Fe/Zn status beyond Fe (42ppm) and Zn (32ppm) along with lesser anti-nutritional factors. High quality breeder seed of newly released hybrids and varieties need to produce through PPP mode. He extended his best wishes to the entire team.

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