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भाकृ अनुप
ICAR

MILLETS

ANNUAL REPORT - 2022

IIMR
भारतीय कदन्न अनुसंधान संस्थान
ICAR-Indian Institute of Millets Research

ICAR - Indian Institute of Millets Research
Rajendranagar, Hyderabad 500 030

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सत्यमेव जयते

IIMR
भारतीय कदन्न अनुसंधान संस्थान
ICAR-Indian Institute of Millets Research

Food and Agriculture Organization of the United Nations

CELEBRATING..

INTERNATIONAL YEAR OF MILLETS 2023

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Contents

Preface

It is a matter of immense pleasure and great satisfaction to bring out the Annual Report 2022 of ICAR-Indian Institute of Millets Research, Hyderabad (ICAR-IIMR-Hyderabad), the institute with the great tradition of carrying out research, training and capacity building to farmers, startups, and entrepreneurs in the area of millets science. IIMR-Hyderabad is country's premier National Institute on Millets under Indian Council of Agricultural Research (ICAR), has pioneered research on millets improvement, value chain modelling, capacity building, and entrepreneurship development and has admirably supported the Government of India's Plan through DAC&FW in designing and implementation of the sub-mission on Nutricereals under NFSM. The institute also coordinates the largest network of multi-disciplinary and multi-location testing program of various millets and provides effective linkage with seed production and developmental agencies.

I am extremely happy to share that, during the period of the report, "Indian Institute of Millets Research" has been placed in 6th position among 93 ICAR Institutes and in first position under Crop Science Division according to the recent list on Ranking of Indian Council of Agricultural Research Institutes year 2019-20 and 2020-21 (Combined) released on 28 September, 2022. This year, The Agriculture Leadership Award - 2022 of the Agriculture Today Group was bestowed on ICAR - Indian Institute of Millets Research, Hyderabad for the leadership role and exemplary contribution to agriculture development and Farmers welfare. Further, this institute received the prestigious RAY Consulting's Agri Business Summit and Agri Awards (ABSA) – 2022 –under Best Government Institute Award category for "IIMR's Nutrihub –TBISC". Besides this recognizing the IIMR's earnest contributions, Ni-MSME has declared 'Valuable client' award to ICAR-IIMR. IIMR also bagged Patent for preparation of sorghum flakes this year. The year is also momentous in that the scientists of the institute were conferred with several awards and fellowships.

The progress of research during the period is also quite encouraging. ICAR-IIMR-Hyderabad has developed three sorghum cultivars, Kharif sorghum hybrid– CSH 48, Red sorghum variety -CSV 50 and one Sweet sorghum cultivar CSV 52 SS- which were released for general cultivation in the country. A total of 48,462 accessions of millets are being conserved in the Millets Genebank. During Rabi 2021-22, a total of 5472 accessions of sorghum and small millets germplasm were characterized. Identified stay green QTL introgressed drought tolerant lines in rabi sorghum were valuable in imparting terminal drought tolerance. A total of 772 SSRs were identified in little millet and primers were designed to develop 181 hypervariable SSR markers. Sweet sorghum high biomass varieties endowed with high brix

and digestibility are going to play an important role in biofuel and forage industry. The total breeder seed production during 2021-22 by AICSIP centers was 194.25 which is 389% more than DAC indent. New initiatives are in pipeline for developing heat and drought tolerant genetic material in pearl millet, rapid generation advancement schemes, partial male sterile mutants in finger millet, crossing techniques in small millets, have great scope to enhance the genetic gains in these climate-resilient crops. Towards commercialization of millet technologies, 49 MoUs were signed. The institute has published 38 research articles in reputed international and national journals, published 2 books, 11 book chapters, and several other publications.

I am immensely happy to share that due to ICAR and IIMR and the Government of India – UNO has declared the year 2023, as “International Year of Millets” to make it peoples' movement so that the Indian millets, recipes, value added products are accepted globally. ICAR- Indian Institute of Millets Research –Hyderabad will play a pivotal role in operating successful and sustainable millet value chain in other countries through millet fair-cum-exhibitions, capacity building, skill development and strengthening stakeholder linkages and linking farmers to markets.

We are thankful to Dr. Himanshu Pathak, Secretary (DARE) & Director General (ICAR), Dr. Trilochan Mohapatra, Former Secretary (DARE), and Former Director General, ICAR; Dr. TR Sharma, Dy. Director General (Crop Science), ICAR, Dr. RK Singh, ADG - FFC and several other administrative functionaries at the headquarters for their guidance and generous support in implementing the mandate of the institute.

Due credit must be given to the expert services rendered by the members of various committees, especially those of the Research Advisory Committee, Institute Management Committee, all the Project Leaders, Scientists and other staff members of this institute for their efforts, support and help. I also appreciate the Principal Investigators and the multi-disciplinary teams of millet scientists at AICRP centers, voluntary centers and private sector participants for their contribution in making the nation-wide millet research network a success. We place on record our sincere thanks to the National, International, Non-Governmental, Private organizations and all other stakeholders that have been supporting us in our accomplishments.

The scientists, technical personnel, administrative, finance and other staff of the institute have put in their best efforts in accomplishing the mandate of the Institute. I extend my appreciation to all of them. My sincere admiration to the efforts of Dr. R Madhusudhana, Dr. PG Padmaja, Dr. J Stanley, Dr. N.Anuradha, Dr. S Srividhya, Dr. KV Raghavendra Rao and Mr. HS Gawali for their efforts and cooperation in bringing out this annual report right on time.

Hyderabad
31 December 2022

CV Ratnavathi
|Acting Director

1 Executive Summary

1. Genetic Enhancement for Productivity, Quality, and Stress tolerance

1.1 Genetic Resources Management

- Sorghum: During Rabi 2021-22, 4064 accessions of sorghum germplasm were characterized at ICAR-IIMR-Hyderabad for 22 morpho-agronomic traits (9 quantitative and 13 qualitative traits)
- Finger millet: 1408 accessions of finger millet germplasm are characterized along with four checks viz., VL 376, GPU 67, CLMV 1 and MR 6 in Augmented Block Design at ICAR-IIMR-Hyderabad during Kharif 2022 for 22 agro-morphological traits
- A total of 1549 accessions of sorghum germplasm under CRP-AB were characterized during Rabi 2021-22. As on 31 December 2022, a total of 48,462 accessions of millets are being conserved in the Millets Genebank. Sorghum has the maximum accessions (27,366) followed by finger millet (8,057), pearl millet (4,765), and foxtail millet (4,575). A total of 11,353 acc. of millets genetic stocks were distributed to the bona fide users during 2022.
- Nine genetic stocks were registered with ICAR-NBPGR. Five sorghum genetic stocks are identified for grain mold resistant, high seed weight, high tannin content and early flowering traits; three finger millet for early flowering and early maturing, finger blast and leaf blast resistant; one foxtail millet for early flowering and early maturing.

1.2. Crop Improvement

Kharif sorghum

- An early maturing kharif sorghum hybrid (CSH 48) with 151A x NR10-15 parentage was released for cultivation in Karnataka, Tamil Nādu, Telangana, Madhya Pradesh, Gujarat, and Rajasthan with 8.2% grain yield improvement over CSH 30. The hybrid CSH48 gave 3876 kg/ha grain yield while CSH30 gave 3617 kg/ha over three years of AICRP testing.
- CSV 50, a high yielding medium maturing specialty type grain sorghum variety with red grain color based on its superiority for grain yield and grain mold resistance, it was released for cultivation in the states of Karnataka, Telangana, and Maharashtra.
- 42 kharif local land races (white, red, and yellow grain types) from 7 states were evaluated in RCBD under AICRP on Sorghum.
- Sorghum lines with high amylopectin content, HAS 4, HAS 5, HAS 8 and HAS 11 evaluated across four locations (Akola, Hagari, Vijaypur and Hyderabad) with a grain yield of 2.47 to 2.59 t/ha, were numerically superior to the check M35-1 (2.43 t/ha).

Rabi sorghum

- Diversity was worked out during rabi 2020 involving 104 landraces involving 12 traits (Grain yield per plant (g), 100 grain weight (g), seed hardness, days to 50% flowering, plant height (cm), panicle weight (g), panicle length (cm), number of green leaves, number of primary branches per panicle, number of secondary branches per panicle, total number of grains per panicle, seeds per secondary branch).
- In a Line x Tester analysis 39 hybrids were developed by crossing 13 male parents on to 3 CMS systems (milo-104A and AKMS66-2A) and Maldandi (M31-2A). The seed set data identified IS5581 and IC345198 as fertility restorers on both cytoplasms which can be used in restorer line improvement program.
- 136 germplasm lines consisting of exotic and indigenous collections, popular Maldandi landraces were evaluated for two consecutive Rabi seasons (2020-21 & 2021-22) at CRS, Solapur for broadening genetic base of rabi sorghum

Sweet sorghum

- During Kharif 2021, 15 hybrids including the check CSH 22SS were evaluated for sweet sorghum productivity traits. The check hybrid CSH 22SS recorded the highest juice yield of 18110 L/ha. For brix content, hybrid NSS 1008A x SSV 84 was promising with a brix value of 22.6 % followed by NSS 1007A x CSV 19SS (20.3%) and NSS 1008A x SPV 2018 (20.2%). NSS 1008A x SSV 84 and 296A x 11 NRL recorded >1600 L/ha of ethanol and were 11% and 7% more yielding than the check CSH 22SS which recorded 1510 L/ha.
- Among the varietal trials with 25 advanced breeding progenies including the checks, the entries viz., WL BN 61 and WL BN 226 performed superior in terms of highest total biomass yields of >75 t/ha, recorded >20000 L/ha of juice and highest ethanol yield of 2007 L/ha over the check CSV 24SS.

Sorghum DUS testing and PPV&FRA related activities

- Replicated field trials for characterizing the DUS descriptors in candidate varieties and reference varieties of sorghum were conducted during Rabi 2021-22 and Kharif 2022 seasons as per the PPV&FR Authority guidelines.

Pearl millet

- Among the promising hybrids evaluated for arid regions, 18 hybrids were superior for pooled grain yield (2.04 to 3.81 t/ha) over best check MPMH 21. Hybrids, 843-22A x 1151 (3.81t/ha), 04999A x 1153 (3.72 t/ha), 843-22A x 1356 (3.54 t/ha) and 843-22A x 129R (3.44 t/ha) were superior for grain yield over check MPMH 21 (2.01 t/ha).
- Among the promising hybrids evaluated for semi-arid regions, 13 hybrids were superior for pooled grain yield (2.48 to 4.94 t/ha) over best check Kaveri Super Boss (2.05 t/ha).
- The line SFD 152 was found to have tolerance for blast disease at both Mandor as well as Hyderabad locations while, SFD 155 was tolerant at Hyderabad and SFD 156 was tolerant at Mandor. Four sources each were tolerant at two locations as compared to the resistant check, 93333B and all were tolerant compared to B-line (843-22B) of popular hybrid HHB 67 improved.
- Three R lines namely, ICMR 11003 and ICMR 06444 were identified as a resistance source for blast resistance in pearl millet and were used as donors in the backcross breeding to impart the resistance of the parental lines, ICMB 98222, ICMB 99222, ICMB 04999, and ICMB 1508.

Finger millet

- For diversification through gene(s) introgression from wild to cultivated, MR-P310 (partial sterile) and GE 1 (Virescence) test crossed with wild species *E. africana* (GE 7123) and *E. jaegari* (GE 7144). Derivatives obtained from cross with E. jaegari showed larger variability for tillering which is an important trait associated with grain yield improvement.

Little millet

- Germplasm lines IC0482980, IC0482980, IC0405074, IC0404929 were identified with grain iron more than 35 -40 ppm while the germplasm lines IC0405074, IC0404919, IC0482852, IC0404953 were identified with zinc content 30 ppm.

Foxtail millet

- At IIMR Hyderabad, selections from ERP 82, Haalu Navane, KOPFM 17, ELS 43 and ESD 42 recorded marginal grain yield advantage over the best check SiA 3156.
- At Solapur, Selections from ISe 1488, CB-GS-747/1, Kempu Navane and GS 760 had significantly longer panicle compared to SiA 3156 at Hyderabad.
- Advance breeding lines FxM 5001 (S.Nandi × SiA 3156) and FxM 5044 (SiA 3156 × ISe 301) recorded above 2000 kg/ha grain yield. The superior selections will be further evaluated in replicated station trials.

Barnyard millet

- A total of 119 advanced stabilized lines consisting of mutants, advanced F4, F5 lines were evaluated in kharif 2021. Superior lines were identified for different economic traits.

Proso millet

- Out of the 32 lines evaluated over two years, four lines were found superior for earliness and were on par for yield with the leading checks, TNAU 202 and TNPm 230. Two lines Sel-19-5 and Sel-19-19 were early maturing and produced higher grain yield than the checks, TNAU202 and TNPm230.
- Of the evaluated progenies, Sle2020-41, Sel2020-18 and Sel2020-19 and Sel2020-12 were found to be superior for plant height and grain yield per plot.
- The genotypes viz., IC0484201, TNPM301, IC0484187, IC0483939, TNPM485, IC0405168, TNPM544, TNPM304, IC0344996, TNPM498, TNPM348, TNPM548, IC0483941 showed more than 20-21% grain protein.

Kodo millet

- Among the core germplasm accessions evaluated, Line GPLM-941 was found early in flowering with yield 998kg/ha, line GPLM-942 is medium duration with yield 1168kg/ha.

Brown top millet

A set of 24 genetic stocks of brown top millet were evaluated for agronomical traits during kharif 2021, where most of the genetic stocks were of semi-erect type (13 of 24) and with loose panicle (15 of 24).

1.3. Seed Science

- During Rabi season, Zinc, and zinc + Boron foliar application has markedly enhanced the seed yield per plant over no spray control in finger millet.
- Among the methods of micronutrients application, foliar spray at PI + FL stages had significantly superior effect on most of the seed quality traits followed by foliar spray at PI stage, and soil application over foliar spray at FFL stage with most of the seed physiological quality traits in finger millet.
- In foxtail millet, Zn + B foliar applications at both PI + FFL stages being at par with their PI stage application have markedly higher seed yield per plant than all other treatments.
- Among the methods of application, the foliar sprays at both PI and FFL stages resulted in significantly better values of seed quality traits followed by foliar spray at PI stage and soil application.
- Of the genotypes tested for cold tolerance in sorghum, 467B, CSV20 and MR750, SSV84, N15 and CSV15, EG34, EC24 and IS3098, IS3074 were found promising in terms of seed set under cold.

Seed production

- The total breeder seed production during 2021-22 by AICSIP centers was 194.25 which is 389% more than DAC indent (49.89 q) and 341% more than BSP-I allocation (56.96 q). There was surplus production of breeder seed for most of the allocated lines and varieties of sorghum at 15 AICSIP centers in Kharif and Rabi seasons during 2021- 22.

2. Application of Basic and Strategic Sciences in Crop Improvement

2.1 Pre-breeding

- Among the derivatives from three interspecific crosses involving two elite parents, the 27B and 126B, with two wild species, *S. versicolor* and *S. usumbarense*, ISC304-2 and ISC304-3 were superior to resistant check for grain mold.

2.2 Molecular breeding

- A total of 772 SSRs were identified in little millet and primers were designed to develop 181 hypervariable SSR markers. About 831 SSRs were identified in kodo millet and primers were designed to develop 169 hypervariable SSR markers.
- Towards the whole genome sequencing of kodo millet, long read sequencing of the popular kodo millet cultivar RK 390-25 was performed through long-read sequencing using PacBio Sequel II platform.
- 373 genetically diverse pearl millet inbreds were genotyped using the newly developed 4K SNPs through the AgriSeq Targeted Genotyping by Sequencing technology. The SNP panel successfully differentiated the accessions into two major groups namely, B and R lines through genetic diversity, PCA, and structure models as per their pedigree.

2.3 Biotechnology

- In order to develop marker free sorghum transgen-

ics, a total of 348 putative transgenic plants out of 470 shoot tips were infected with pCAMBIA0390 binary vector carries three Bt genes individually. PCR assay with gene-specific primers revealed the presence of hygromycin gene in 18 independent transgenic events out of 20 T_0 generation events tested.

2.4. Crop Physiology

- Post flowering and season long drought stress have affected the grain filling dynamics in most of the rabi sorghum varieties. Both grain number and grain size were affected under moisture stress conditions.
- Stem Non-structural carbohydrate reserves (NSC) reserves and chlorophyll fluorescence was estimated under moisture stress conditions
- Lysimeter studies showed that drought stress plants in barnyard and proso millet have recorded lower Transpiration Efficiency (TE) when compared to the control plants.

2.5. Biochemistry & Functional Foods

- A simple and rapid HPLC method was developed and validated for oxalic acid estimation in finger millet grains.
- Calcium storage sites and distribution of nutrients in different portions of the grain was determined by separating the floury and fibrous portions. High calcium content in the endosperm portion of finger millet grain compared to other cereals may be an important physiological requirement for seeds of finger millet.
- The total phytic acid content in proso and kodo millet varieties, determined by spectrophotometric method, showed that highest phytic acid content was up to 1.427±0.16 (g/100g) in the proso millet variety (TNAU 202), while the highest phytic acid content recorded among the studied kodo millet variety (RK-390-25) was 1.023±0.08 g/100g).

3. Host Plant Resistance against Insects and Diseases

3.1 Insect management

- Sorghum germplasm lines (106) screened against shoot fly, (Atherigona soccata) revealed that lines like, EJN 34 (23.3%), and ER24 (27.5%) were tolerant.
- Among 25 genotypes of proso millet evaluated for shoot fly (*Atherigona pulla*) tolerance, IPM 2904 (11.4%), IPM 2270 (16.7%) and Pro 689 (20.0%) were found to be tolerant whereas IPM 2635, GPMS 806 and GPMS 534 were susceptible.
- Among the 54 sorghum lines screened, CSV-29R, CSH 13R, Hathikunta, ICSV 745, PUG-L-9, RSV 1988, SPV 2217, SSV 84 and TAM 428 were found to be resistant to aphids on per plant basis.
- Nine species of aphids were recorded from all millets and the predatory potentials of predators, *Coccinella transversalis* (148 aphids/day), *Cheilomenes sexmaculata* (93 aphids/day), *Scymnus sp.* (27 aphids/day), *Ischiodon scutellaris* larva (46 aphids/day) were quantified. Many parasitoids were found parasitizing the pests to an extent of 21% by *Neotrichophoroides* sp., *Trichogrammatoidea* sp. (13%), *Braconid* sp. (16%), *Brachymeria* sp. (11%), *Cotesia flavipes* (19%), *Aprostocetus diplosidis* (57%) etc.
- Release of *Trichogramma chilonis* @ one card/acre twice at weekly intervals followed by spray of *Metarhizium anisopliae* (Ma 35) 0.5% at 20 & 35 DAE was found effective in reducing the eggs, larvae and the whorl damage
- Broflanilide was found to be the most effective insecticide against fall armyworm registering the least median lethal concentration values (0.13 ppm) followed by chlorantraniliprole (2.54 ppm), spinosad (2.64) and spinetoram (2.96). Broflanilide at 5 ppm caused 95% mortality to fall armyworm larva at 24 hours.
- Chlorantraniliprole was found to be the most effective insecticide against stem borer, *Chilo partellus* with least median lethal concentration values (1.03 ppm) followed by spinetoram (LC50 = 3.52 ppm). Among five insecticides tested for contact toxicity, broflanilide was found to be effective against shoot bug, *Perigrinus maidis* in filter paper bioassay followed by emamectin benzoate.
- In a field experiment, to evaluate biointensive pest management module with that of the chemical module in sorghum, the latter recorded the least number of shoot fly egg, dead hearts by shoot fly and stem-borer and shoot bug incidence. The grain yields/ha were recorded highest in chemical-based module

(3.20 tonnes/ha; followed by biointensive module (2.60 tonnes/ha) and farmers practice (1.90 tonnes/ha).

3.2 Disease management

- Foxtail millet accessions (176) were evaluated for foliar disease resistance at Bengaluru, Nandyal and Vizianagaram. Sheath blight was found to be severe at Vizianagaram (mean 5.9) and >60% accessions were found susceptible (≥6) whereas IC0403442, IC0479317, IC0479713 and IC0480417 were highly resistant.
- In case of zonate leaf spot, mutants were either more susceptible or at par in resistance with their respective wild type, except the mutant Early Hagaris Sart (bmr6) (5.5), which had significantly more resistant zonate leaf spot than its wild type (6.5). Two mutants with bmr genes viz., Atlas (bmr6 + bmr12) (score 5.0) and Rox Orange (bmr12) (score 3.5) exhibited significantly better anthracnose resistance than their respective wild type.
- The bacterial isolates of all small millets were screened against the banded sheath blight pathogen (*Rhizoctonia solani*). Among the finger millet isolates, FM18 recorded 61.11%, little millet isolate LM42 recorded 57.78% and Kodo millet isolate LM24 recorded 60.37% of mycelial inhibition of *Rhizoctonia solani* under in-vitro.
- The best performing isolates of endophytes from sorghum, finger millet, little millet and kodo millet were amplified by using 16S rRNA intervening sequence specific primers.

4. Resources Management for Higher Millets Productivity

- Intercropping studies in grain sorghum showed that bajra, grain amaranth (30.8, 27.7%) have inflicted the highest yield penalties on sorghum; while buckwheat (6.3%), foxtail millet (10.8%) and proso millet (14.9%), the least. Intercrop nutricereals have the highest yield in 1:3 ratio.
- Application of UPH-2221 postemergence herbicide @ 187.5 g a.i./ha at 2-4 leaf stage of sorghum has resulted in at par GFY as that of hand weeding's twice treatment.

5. Extension research, Economics and Value-addition

5.1 Extension Research

- Determination of yield gap-I on kharif sorghum of last three years, between potential and demonstration yield was found to be 7.57 q/ha, extension gap (9.17 q/ha) and technology index of 19%, on an average.
- Millet farmers were facilitated with various activities and awareness related to improved millet production and processing along with the group members which led to empowerment of millets farmers in Kolli Hills of Namakkal district of TN, and Koraput district of Odisha.

5.2 Economics

- It is observed that the Total Factor Productivity (TFP) for sorghum in Maharashtra increased from 1.11 in 1992 to 2.02 in 2018-19. The average TFP index for overall period was 1.78.
- In case of Andhra Pradesh the TFP was positive and moderate which increased from 1.20 in 1992-93 to 2.11 in 2018-19 even though there was decline in input index. The TFP grew at the rate of 3.03 per cent per annum.

5.3 Value-addition and Commercialization

- Among the trials to develop Low GI, Gluten free kodo millet based analog processing and value addition, assisting in getting management cost, equity grants.
- Diary analogue, ragi curd has 3184.3mg/100g of calcium followed by ragi cheese, 4729.3mg/100g and ragi whey powder,6970.01mg/100g. The iron content in ragi cheese is more. The zinc content is control milk paneer is 59.33ppm±19.50 whereas in Ragi paneer it is 61.42ppm±19.50.
- ICAR-IIMR is handholding 41 FPOs across different states and supporting by providing millets seeds, technologies of processing and value addition, assisting in getting management cost and equity grants.

2 Introduction

The Indian Institute of Millets Research (ICAR-IIMR), Hyderabad with its linkages with All India Coordinated Research Projects (AICRPs) on Sorghum, Pearl millet and Small millets has been instrumental in developing high yielding varieties and hybrids of Sorghum and Pearl Millet, and high yielding varieties of Small millets, as well as novel production, protection and product development technologies. The IIMR conducts basic and strategic research, while AICRPs on sorghum with 18 centres across 11 states, pearl millet with 14 centres located in 10 states, and small millets with 14 centres over 9 states undertake applied research and pilot extension work in a network mode. In fact, the All-India Coordinated Research Project on Sorghum (AICRPS) was established in December 1969 with the main objective of conducting research on grain and forage sorghum improvement. Its coordinating unit was initially located at the main station of Indian Agricultural Research Institute (IARI) at New Delhi, which in 1970 was shifted to IARI Regional Station, Hyderabad. The IARI regional station at Hyderabad was reframed as the National Research Centre for Sorghum (NRCS) in 1987 and the AICRPS was integrated with this centre, which was later upgraded as Directorate of Sorghum Research (DSR) in 2009 and as the Indian Institute of Millets Research (IIMR) in 2015. During 1991, a research station to support the research activities of rabi sorghum was established at Solapur (Maharashtra). Another centre on off-season nursery was also established at Warangal (Telangana) in 1995 as a national facility to support AICRP-sorghum researchers of the country.

The overall objective of IIMR is to enhance

Vision

IIMR vision is to transform subsistence farming of millets into a globally competitive climate resilient nutri-cereal enterprise through value addition to meet food, feed, fodder, nutrition, and bio-fuel requirements of the country for equitable prosperity.

Mandate of IIMR

- Basic and strategic research to increase productivity of millets and their diversified utilization for enhancement of profitability.
- Coordination and development of improved crop production and protection technologies of millets.
- Training and consultancy on millet production and utilization.
- Dissemination of technologies and capacity building.

production, productivity and profitability of millets to enable the agricultural sector to accelerate the transformation of "subsistence farming" to "market and income-generation oriented" millet production system. Accordingly, IIMR focuses on resolving commodity-specific production constraints, matching agricultural, processing and value addition processes and technologies to market opportunities which provide additional farm income and creating off-farm employment especially in the semi-arid tropical millet growing regions in India to usher in livelihood, food and nutritional security, thus justifying amply the need for public and private investment in millets research and development.

AICRP on Sorghum, Hyderabad

At present, the All India Coordinated Research Project on Sorghum (AICRP on Sorghum) has 18 centres, spread throughout the sorghum-growing areas of the country, covering the kharif and rabi types of sorghum. Out of these, eleven centres conduct research on kharif sorghum (Akola-Maharashtra, Indore - Madhya Pradesh, Palem - Telangana, Nandyal-Andhra Pradesh, Coimbatore-Tamil Nadu, Chamrajnagar- Karnataka, Surat and Deesa-Gujarat, Udaipur-Rajasthan, Pantnagar-Uttarakhand, Hisar-Haryana, Ludhiana -Punjab), while 4 centres (Rahuri-Maharashtra, Vijayapura and Hageri –Karnataka, and Tandur-Telangana,) concentrate on rabi sorghum. Two centres work on both kharif and rabi sorghums (Dharwad-Karnataka and Parbhani-Maharashtra). The centres at Hisar, Pantnagar, Ludhiana and Deesa also conduct research on forage sorghum. Besides above centres, several voluntary centres also work in tandem to conduct multi-location trials and add to novel technology and products. Under Tribal Sub-Plan focused efforts and execution of the programmes is in place in tribal areas of Maharashtra, Andhra Pradesh to popularize the new high yielding cultivars to increase profitability to tribal farmers. The improved sorghum production technologies and practices are also being demonstrated in tribal areas, apart from extensive training for improving sustainable livelihood of tribals.

Mandate of AICRP-Sorghum

- Develop hybrids, varieties, parental lines, novel genetic stocks and conduct and monitor multi-location testing of coordinated trials.
- Develop and popularize integrated crop production technologies and plant protection practices to major insects and diseases.
- To participate in Breeder Seed Production (BSP), Front-line Demonstrations (FLDs) and Tribal Sub-Plan (TSP) programmes.

AICRP- Pearl Millet

Project Coordinating Unit of All India Coordinated Research Project on Pearl Millet (AICRP-PM) is based at Jodhpur. The coordinated research programme is multi-locational and it is being conducted at 14 project centers including Jodhpur, two voluntary centers, 18 cooperating centres in public sector and more than 30 partners in private sector.

AICRP- Small Millets

Project Coordinating Unit of All India Coordinated Research Project on Small Millets (AICRP-SM) is located at GKVK, Bengaluru. The project has been designed to carry out multi-location testing in 14 project centres and about 20 voluntary centres covering more or less all the major small millet growing regions of the country to work on location specific problems.

Staff Position

As on 31 December, 2022

Category	Sanctioned	In position	Vacant
RMP	1	0	1
Scientific	49	44	05
Technical	36	23	13
Administrative	30	10	20
Supporting Staff	18	12	06
Total	134	89	45

Financial Status: 2021-22

As on 31 March, 2022

Rs. In Lakhs

Scheme	Sanctioned	Expenditure	Utilization %
ICAR-IIMR-Hyderabad	2975.98	2975.98	100%
AICRP-Sorghum	1068.76	1068.76	100%
AICRP-Pearl Millet	1192.43	1192.43	100%
AICRP-Small Millets	653.00	653.00	100%

3 Research Achievements

1.0 Genetic enhancement for productivity, quality, and stress tolerance

1.1 Genetic Resources Management

IIMR/CI/2021-2026/150: Nutri-cereals Genetic Resources Management (PI: M Elangovan)

Augmentation: A total of 17 accessions of millets genetic resources augmented from other Sahaja Samrudha, Bengaluru, of which, 12 accessions were of little millet and 5 were of brown top millet.

Characterization:

Sorghum: During Rabi 2021-22, 4064 accessions of sorghum germplasm were characterized at ICAR-IIMR-Hyderabad for 22 morpho-agronomic traits (9 quantitative and 13 qualitative traits) (Fig.1.1). The plant height was the most variable trait followed by grain yield per plant. days to maturity, leaf length. A total of 378 trait-specific germplasm identified. 52 accessions were identified as multi-trait specific germplasm for 2-5 traits. IS 14714, IS 12061 and IS 11862 were identified for a greater number of leaves (>12), longer leaf (> 86 cm), wider leaf (>8 cm), taller plant (> 300 cm) and higher grain yield (> 70 g/plant). IS 33023, IS 12104, IS 24040, IS 11270, IS 12078, IS 12099, IS 12073 were the other germplasm lines with useful traits, which can be employed in breeding.

Finger millet: 1408 accessions of finger millet germplasm were characterized along with four checks viz., VL 376, GPU 67, CLMV 1 and MR 6 in Augmented Block Design at ICAR-IIMR-Hyderabad during Kharif 2022 for 22 agro-morphological traits (Fig.1.2). Plant height was the most variable trait followed by days to 50% flowering, flag leaf blade length. In the qualitative traits, erect growth habit was the most frequent (875 accessions), absence of plant pigmentation in leaf juncture (1217 accessions), absence of leaf sheath pubescence (1494 accessions), absence of culm branching (1060 accessions), absence of leaf sheath pigmentation (1240 accessions), semi-compact ear head shape (399 accessions), absence of finger branching in (751 accessions), absence of finger multi-whorls (1091 accessions), and position of branching in all the fingers (1059 accessions).

Fig. 1.1. Variability for panicle traits in sorghum germplasm (*rabi* 2021-22)

Fig. 1.2. Variability in finger millet germplasm (kharif 2022)

Table 1.1: Descriptive statistics of sorghum germplasm

S.No	Traits	Mean	Min	Max	SD	Accessions
1	Number of tillers	3.32	1.00	19.00	1.94	
2	Number of leaves	7.28	2.33	14.00	1.50	IC0376264, EC0486027, EC0487168, EC0487209, EC0488133, EC0485941, EC0488185, IC0283920, IC0415612
3	Leaf length (cm)	63.40	16.72	99.90	9.58	
4	Leaf width (cm)	5.82	1.40	9.44	0.99	
5	Plant height (cm)	190.95	55.00	317.00	41.60	
6	Days to maturity	123.19	98.00	135.00	10.29	
7	Ear head length (cm)	23.06	5.20	57.60	8.48	
8	Ear head width (cm)	4.69	1.20	8.20	0.83	
9	Grain yield (g/plant)	23.92	0.37	97.35	13.93	
10	100-Seed weight (g)	2.84	0.25	6.72	0.90	

Consortia Research Platform on Agrobiodiversity (CRP-AB) (PI: M Elangovan)

A total of 1549 accessions of sorghum germplasm under CRP-AB were characterized at ICAR-IIMR-Hyderabad during Rabi 2021-22 for different morpho-agronomic traits (22 traits- includes 9 quantitative and 13 qualitative traits). A wide variability was observed for the panicle traits (Fig. 1.3). The summary of the descriptive statistics of sorghum germplasm evaluated is provided under Table 1.1 along with some good accessions identified for multiple traits.

Multiplication: 6,799 accessions of millets (Sorghum - 4,784; Finger millet -1,408; pearl millet reference set -607) were multiplied.

Conservation: As on 31st December 2022, a total of 48,462 accessions of millets are being conserved in the Millets Genebank. Sorghum has the maximum accessions (27,366) followed by finger millet (8,057), pearl millet (4,765), and foxtail millet (4,575).

Fig. 1.3. Variability sorghum germplasm characterization under CRP-AB (Rabi 2021-22)

Distribution: A total of 11,353 acc. of millets genetic stocks were distributed to the bona fide users during 2022, which includes Finger millet (6,826), Sorghum (1,417 acc.), Proso millet (1,139), Barnyard millet (720), Little millet (517), Foxtail millet (474), Kodo millet (111), Pearl millet (94), and Brown top millet (54). In the category, AICRP on Small millet received 4,868 acc., followed by ICAR institutes (1,864), ICAR-IIMR Scientists (1,860), SAUs and Universities (1,660), AICRP on Sorghum (1,202) and Others (468).

Registration: Nine genetic stocks were registered with ICAR-NBPGR (Table 1.2). Five sorghum genetic stocks are identified for grain mold resistant, high seed weight, high tannin content and early flowering traits; three finger millet for early flowering and early maturing, finger blast and leaf blast resistant; one foxtail millet for early flowering and early maturing.

Table 1.2: List of novel genetic stocks registered.

S. No.	Crop name	Donor identity	INGR No.	Pedigree	Novel unique features
1	Finger millet	VR 1141	INGR22022	VR 708 × GPU 48	Banded blight resistant
2	Finger millet	VR 1122	INGR22023	VR 708 × GPU 48	Finger Blast Resistance.
3	Sorghum	SPV 2804	INGR22024	Selection from IC0288432	More number of leaves, More leaf: stem ratio and Low HCN
4	Sorghum	SPV 2805	INGR22025	Selection from IS 40921	Taller plant height, longer leaves and greater number of leaves per plant
5	Sorghum	SPV 2596 (SM-2288-3)	INGR22026	SPV 2596: SM-2288-3 (MR750 Sorghum × CM208 Maize)	High fresh stalk yield and High biomass
6	Sorghum	IS 1212-4-1-1	INGR22027	Selection from IS 1212	High oil content and Hard seed with bigger germ size
7	Sorghum	IS 31714-2-1-1	INGR22028	Selection from IS 31714	High oil content and very bold seed with medium hardness and small germ size
8	Sorghum	SPV 2017	INGR22029	SPV 2017 = (CSV 15 X IS 21891)-1-1-1-1	High in-vitro True Digestibility of Dry Matter (TDDM), Organic Dry Matter (ODM), and Metabolizable Energy (ME), Low Acid Detergent Fiber (ADF) and Acid Detergent Lignin content (ADL)
9	Finger millet	VR 1128	INGR22030	Uduru Mallige × GPU 48	Neck Blast Resistance.
10	Sorghum	SPV 2595 (SM-2144-8)	INGR22031	SPV 2595 (SM-2144-8) 27A Sorghum × CM211 Maize	Early flowering, Early maturing and Higher brix and total sugars
11	Finger millet	WWN 55	INGR22032	Collection from Village Dagdiambha, Tal. Waghai. Dist. Dangs	White color, bold grains, Multi finger, long fingers, High grain yielding

S. No.	Crop name	Donor identity	INGR No.	Pedigree	Novel unique features
12	Finger millet	GPU28-2081	INGR22033	Induced gamma mutant of GPU 28 variety (GPU28-2081)	Long finger length
13	Barnyard millet	Glumeless mutant DHBM93-3	INGR22034	Mutant line identified in M5 generation (DHBM 93-3-8-3-32-43) = VL 13 x IEC 566 (18-6)	Glumeless mutant line
14	Pearl millet	170-SB-19 (J-2642)	INGR22035	(J-2532 X J-2571)-23-1-1-B-B	High Fe content (84 ppm). High Zn content (50 ppm)
15	Foxtail millet	IIMR FxM-7 (FXV 645)	INGR22076		Early duration with high grain yield. Multiple disease resistance. Thick and Compact inflorescence
16	Little millet	LMV 533	INGR22077		Early flowering and early maturity with grain and fodder yield
17	Sorghum	SPV 2625	INGR22078		Early maturing yellow grained sorghum. Dwarf yellow grained sorghum
18	Finger millet	VL 360	INGR22096		Early maturity (100 days). White grain

1.2. Crop Improvement

Sorghum

a) Kharif sorghum

IIMR/CI/2021-2026/139: Breeding for genetically diverse kharif sorghum genotypes with improved grain yield, quality, and resistance to important biotic stresses (PI: C Aruna)

CSH 48: An early maturing kharif sorghum hybrid with 151A x NR10-15 parentage was released for cultivation in Karnataka, Tamil Nādu, Telangana, Madhya Pradesh, Gujarat, and Rajasthan with 8.2% grain yield improvement over CSH 30. The hybrid CSH48 gave 3876 kg/ha grain yield while CSH30 gave 3617 kg/ha over three years of AICRP testing.

CSV50: CSV 50 is a high yielding medium maturing specialty type grain sorghum variety with red grain color. It is a derivative of the cross CSV 15 x IS 23514. It recorded 10.3% superiority for grain yield over the promising white sorghum variety, CSV 20 and 11.4% improvement over the red sorghum variety, Paiyur 2 with mean grain yield of 4119 kg/ha. CSV 50 Red recorded a better level of tolerance to grain molds which is the important biotic stress in kharif. It showed a 3.6 field grade score, while CSV 20 recorded 4.15 score. Based on its superiority for grain yield and grain mold resistance, it was released for cultivation in the states of Karnataka, Telangana, and Maharashtra. CSV 50 Red recorded better level of protein, iron, zinc and DPPH radical scavenging activity compared to CSV 20.

Evaluation of kharif local landraces: 42 kharif local land races from 7 states were evaluated in RCBD under AICRP on Sorghum. These include white, red, and yellow grain types. The range of variation observed for different traits is presented in Table 1.3. Promising land races like Macia, Bundela are being used in crossing program.

CSH 48: field view

CSV50: field view

Table 1.3. Range of variation in kharif local land races

Trait	Minimum	Maximum	Mean	CD (5%)	Check CSV 20	Promising lines
Days to flower	60	85	74.3	7.37	70	Byhatti local, Palem local 4, Palem local 3
Plant height (cm)	150.5	332.5	295.6	52.3	283.5	Short: Macia, Byhatti local Tall: Gird 3, Gird 31, Porbandar local
Panicle length (cm)	9.6	32.3	21.0	6.76	24.3	Palem local 4, Chinnavellai cholam, Black jowar, GGUB 59
Panicle weight (g)	11.5	66.5	35.1	21.2	40.5	Balapur local, Tenkasivellai, Bundela
Grain yield/pl (g)	9.0	47.0	24.1	17.3	33.5	Balapur local, Bundela
100 seed wt (g)	1.28	3.0	2.17	0.9	2.25	Balapur local, Kalagunda local, GGUB 59
Grain Mold Score	3.0	8.0	5.84	0.5	6.00	Porbandar local, Balapur local, Palem local, Seethamma Jonna, Black jowar, GGUB 59, Irungucholam, Bundela, Paiyur

High amylopectin lines: Thirteen lines (IS23964, Hattigudur cross 2, IS5624, IS17994, IS18020, IS22119, IS33815, IS33887, IS641, IS829, IS2269, IS24346 and IS27021) that were identified to possess high amylopectin content were subjected to selection for uniformity and yield and the selected lines (HAS 1 to HAS 13) were evaluated across four locations (Akola, Hagari, Vijaypur and Hyderabad) along with the checks, C43, CSV22 and M35-1 during 2021 *rabi* season. Data were recorded for agronomic traits and the grain was collected for nutrition analysis at ICAR-IIMR biochemistry laboratory. Amylopectin content (as % of starch) was derived from estimated grain amylose and starch contents. Among the 13 lines, the amylopectin content ranged from 96.7 to 99.1% while the checks recorded 78.1% (M35-1) to 81.8% (CSV22). Among the high amylopectin lines, HAS 4, HAS 5, HAS 8 and HAS 11 with a grain yield of 2.47 to 2.59 t/ha were numerically superior to the check M35-1 (2.43 t/ha) (Table 1.4). Among the 13 lines, 8 lines had red grain pericarp while one had brown and the remaining four lines had cream grain pericarp colour. These lines have good potential for grain ethanol production on an industrial scale.

Table 1.4. Performance of high grain amylopectin lines across four locations during 2021 *rabi* season

Entry	Pedigree	Amylopectin (% of starch)					Grain yield (t/ha)					Grain colour
		A	H	HY	V	Pooled	A	H	HY	V	A	
HAS 1	IS 641-2-2-1-1-B	99.2	98.0	99.3	98.2	98.7	1.75	3.04	2.21	1.28	2.07	Red
HAS 2	IS 829-1-2-1-1-B	99.2	98.8	99.1	97.7	98.7	2.21	2.92	1.18	0.36	1.67	Brown
HAS 3	IS 2269-2-2-1-1-B	99.2	99.2	99.5	98.4	99.1	2.00	2.97	1.81	2.06	2.21	Red
HAS 4	IS 33887-3-3-1-1-B	99.2	99.0	98.7	97.9	98.7	2.05	2.84	3.49	1.98	2.59	Red
HAS 5	IS 5624-3-2-1-2-B	98.7	99.2	99.5	98.9	99.1	2.92	3.60	3.27	0.43	2.56	Cream
HAS 6	IS 17994 -2-2-1-1-B	98.9	99.3	99.1	99.0	99.1	2.29	3.63	2.77	1.03	2.43	Cream
HAS 7	IS 18020-1-2-1-2-B	98.9	99.0	99.0	97.9	98.7	2.63	2.43	2.45	0.63	2.03	Cream
HAS 8	IS 23964-1-3-1-1-B	98.9	98.1	99.0	98.9	98.7	1.83	2.51	3.42	2.12	2.47	Red
HAS 9	IS 24346-3-2-2-1-B	98.0	98.2	93.1	97.6	96.7	2.34	2.67	2.33	1.56	2.22	Red
HAS 10	IS 27021-4-1-2-1-B	98.6	97.5	98.6	97.6	98.1	1.92	2.62	2.21	0.44	1.80	Cream
HAS 11	IS 33815-3-2-2-1-B	99.1	99.2	99.3	97.9	98.9	2.17	2.98	2.80	1.93	2.47	Red
HAS 12	H cross 2 -3-2-1-2-B	99.5	98.9	98.8	99.1	99.1	2.25	3.27	2.85	0.95	2.33	Red
HAS 13	IS 22119-3-2-1-1-B	98.5	99.1	98.9	98.6	98.8	2.25	3.25	1.25	0.74	1.87	Red
CSV 22	Check	85.5	84.1	77.5	80.1	81.8	2.96	3.73	3.25	1.69	2.91	Cream
C 43	Check	79.3	78.7	75.1	82.3	78.9	2.58	3.83	2.59	2.32	2.83	Cream
M 35-1	Check	83.5	77.2	75.4	76.1	78.1	2.59	2.91	2.75	1.46	2.43	Cream
Mean		95.9	95.2	94.4	94.8	95.1	2.30	3.08	2.54	1.31	2.31	
LSD (5%)		2.3	2.5	1.6	1.9	1.1	1.18	1.29	0.50	0.74	0.45	

A: Akola; H: Hagari, HY: Hyderabad, V: Vijayapura

b) Rabi sorghum

IIMR/CI/2017-22/116: Development of genetically diversified high yielding Rabi sorghum Hybrids (PI: R Madhusudhana)

Diversity in Landraces: Understanding genetic diversity in the breeding material is fundamental to the crop improvement program. Diversity was worked out during rabi 2020 involving 104 landraces involving 12 traits (Grain yield per plant (g), 100 grain weight (g), seed hardness, days to 50% flowering, plant height (cm), panicle weight (g), panicle length (cm), number of green leaves, number of primary branches per panicle, number of secondary branches per panicle, total number of grains per panicle, seeds per secondary branch). Euclidean distances were worked out and UPGMA (Unweighted Pair Group Method with Arithmetic Mean) hierarchical clustering method was applied for the formation of groups. Analysis clearly indicated 8 groups (Fig.1.4), and existence of good levels of trait diversity in the material for exploitation for genetic improvement.

Common restores on milo and Maldandi cytoplasms: In a Line x Tester analysis 39 hybrids were developed by crossing 13 male parents on to 3 CMS systems (milo-104A and AKMS66-2A) and Maldandi (M31-2A). The hybrids were evaluated for the fertility restoration by bagging the panicles before anthesis and observing the seed set. The seed set data identified IS5581 and IC345198 as fertility restorers on both cytoplasms (Fig.1.5). These lines can be used in restorer line improvement program.

Superior hybrids for rabi sorghum: Thirty-line hybrids were evaluated in randomized block design with 3 replications during rabi 2021 at IIMR, Hyderabad for grain yield and other yield attributes. The hybrids were compared with commercial check, CSH15R. Over CSH15R, 5 of the best hybrids were identified for grain yield, grain size and grain number per panicle, and are depicted in Fig. 1.6. The superior hybrids clearly indicate that grain size and grain number contribute for the grain yield and can be targeted for improvement for higher productivity in rabi sorghum.

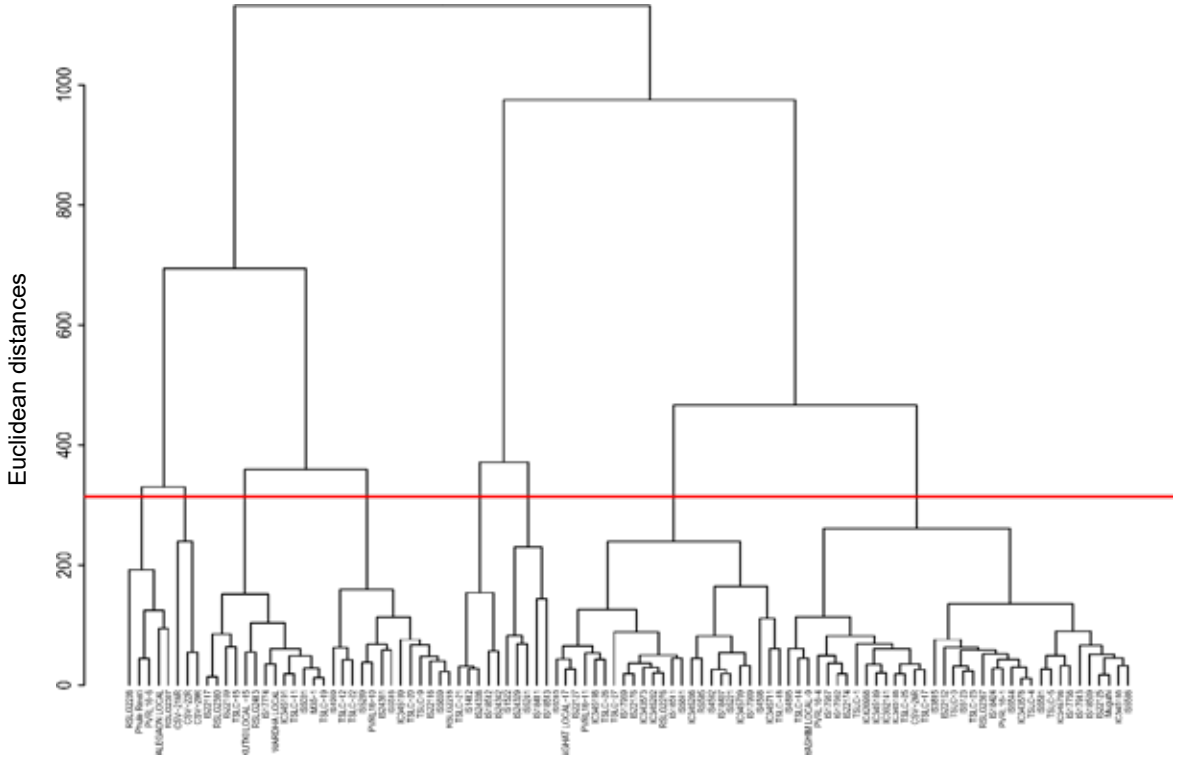


Fig. 1.4. Clustering of 104 rabi sorghum landraces

Fig.1.5. Common fertility restorers on milo and Maldandi cytoplasm

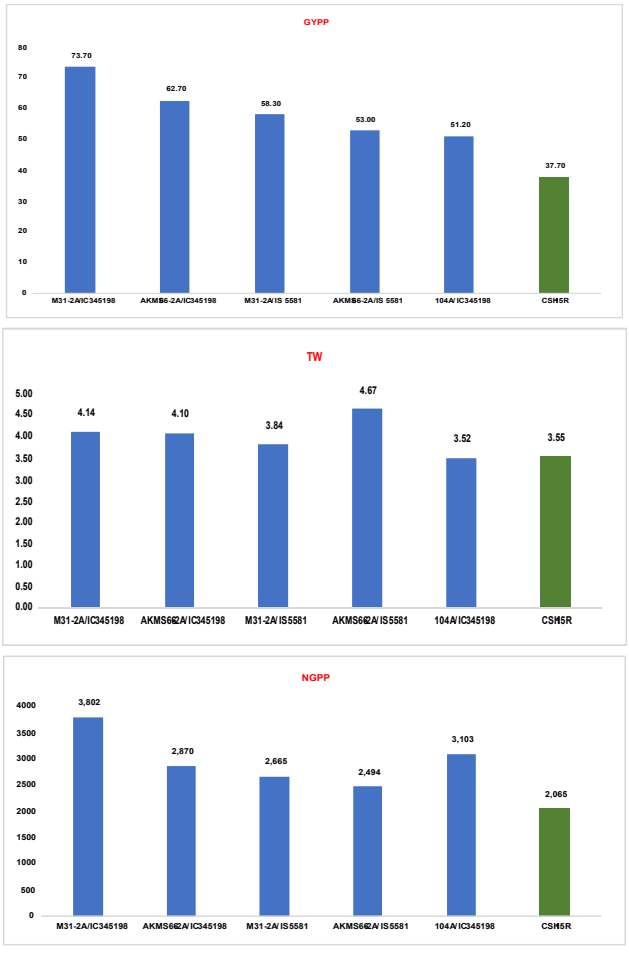


Fig.1.6. Five best hybrids for grain yield (GYPP), test weight (TW) and number of grains per panicle (NGPP).

IIMR/CI/2020-2025/122: Genetic enhancement of rabi sorghum adaptive traits for improved varietal performance (PI: Parashuram Patroti)

Backcrosses (BC_2F_1s) generated: High yielding rabi cultivars were crossed with trait donors for enhanced resistance to biotic, abiotic stresses and fodder qulaity: The list of crossed made along with trait donors are given in below Table.1.5

Deployment of indigenous and exotic germplasm for broadening genetic

136 germplasm lines consisted of exotic and indigenous collections, popular Maldandi landraces were evaluated in a RBD design in three replications for two consecutive Rabi seasons (2020-21 & 2021-22) at CRS, Solapur. Based on the diversity analysis the lines were grouped into seven clusters (Fig.1.7) and the highest inter cluster distance was observed between cluster no. 3 and 2 and 3 and 5. The lines belonging to these two clusters were selected as parents for hydration programme.

Table. 1.5. List of BC_2F_1s generated with targeted traits.

BC_2F_1	Trait	BC_2F_1	Trait
(SPV2217 x IS4698) x SPV2217	Stem borer	(SPV2217 x RSV2121) x SPV2217	Shoot bug
(Parbhani Jyoti x IS4698) x Parbhani Jyoti	Stem borer	(BJV44 x RSV2121) x BJV44	Shoot bug
(CSV29R x HC308) x CSV29R	Stem borer	(Phule Vasudha x SLR10) x Phule Vasudha	Shoot bug
(BJV44 x SLR31) x BJV44	Aphid	(SPV2217 x SLR 10) x SPV2217	Shoot bug
(Parbhani Jyoti x SLR31) x Parbhani Jyoti	Aphid	(CSV26 x SLR10) x CSV26R	Shoot bug
(CSV29R x SLR31) x CSV29R	Aphid	(BJV44 x IS23684) x BJV44	Rust
(PKV Kranti x SLR31) x PKV Kranti	Aphid	(CSV29R x RSV827) x CSV29R	Drought
(CSV29R x SLR 10) x CSV29R	Shoot bug	(CSV29R x RNTN-13-37) x CSV29R	Stay green
(Parbhani Jyoti x RSV2121) x Parbhani Jyoti	Shoot bug	(BJV44 x RNTT- 8-32) x BJV44	Stay green
(PKV Kranti x SLR 10) x PKV Kranti	Shoot bug	(Parbhani Jyoti x RNTT- 8-32) x Parbhani Jyoti	Stay green
(PKV Kranti x Y-75) x PKV Kranti	Shoot bug	(BJV44 x RNTN-13-37) x BJV44	Stay green

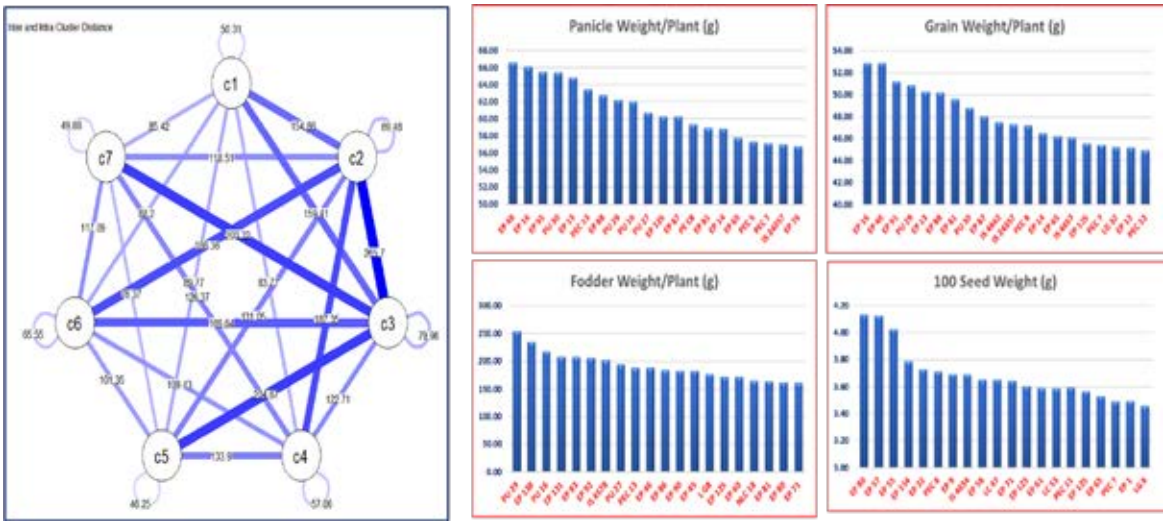


Fig.1.7. Clustering of Indian and exotic genetic material.

Multi-parent cross induced genetic variability.

Forty-eight different 8 parent cross derived F_2 populations were raised with a minimum plant population size of 500 plants in an un-replicated trial. Observations on each individual plant were recorded, and the data was analyzed to understand the amount of variability created through multi-parent crossing approach in a segregating generation (Fig.1.8). The range and mean of the different populations are depicted in Table 1.6.

Table 1.6. Range and mean performance of F_2 Population

Trait	Range of Variability		Mean		
	Parents	F_2 population	Parents	F_2 population	Selected population
Days to 50% flowering	19.5 (53 - 72.5)	33 (53 - 86)	64.03	72.68	62.30
Plant height (cm)	177.5 (161.5 - 339)	280 (90 - 370)	269.36	315.8	206.00
Panicle length (cm)	10.4 (13.5 – 23.55)	33 (7 - 33)	19.28	20.21	29.00
Panicle weight (g)	54.76 (31.24 - 86)	175 (5 -180)	58.07	58.66	116.00
100 grain weight (g)	43.62 (25.89 – 69.51)	155 (2 - 157)	46.1	47.28	91.00

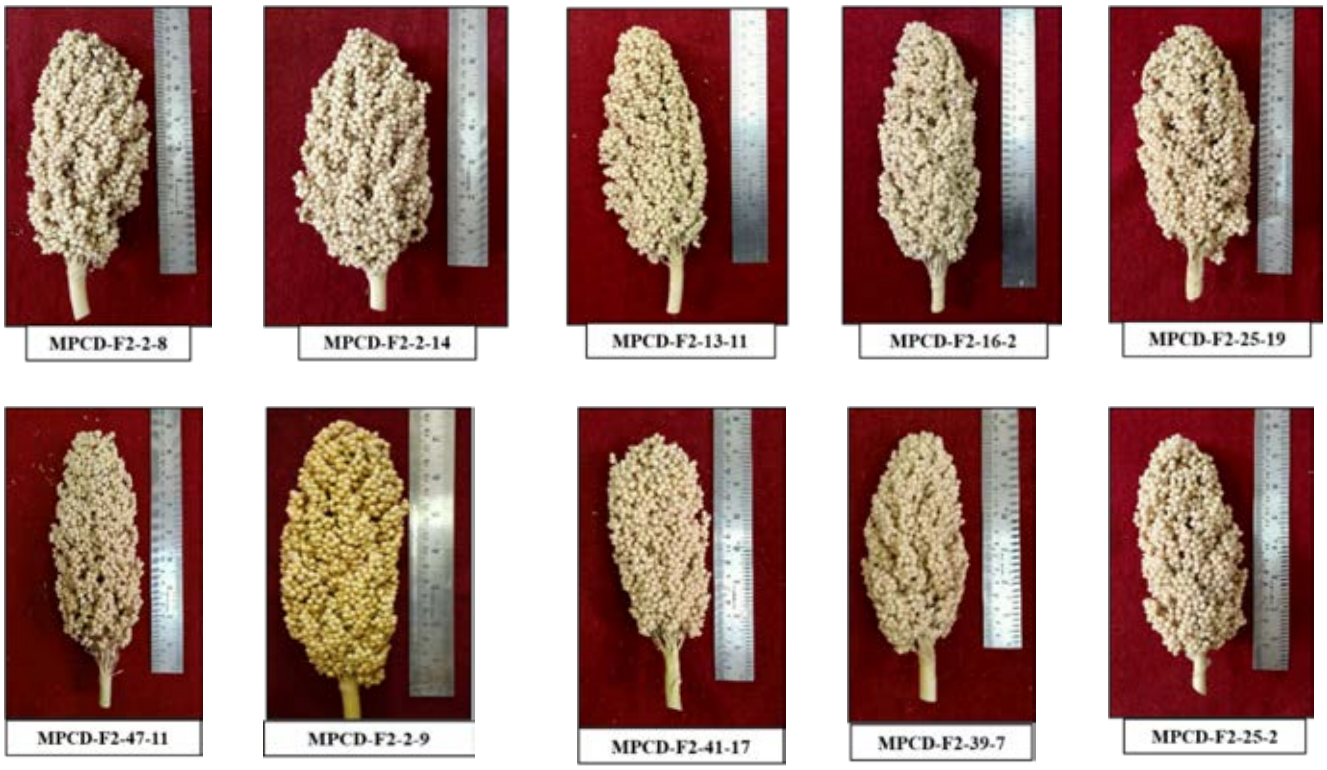


Fig.1.8. Panicles of selected individuals from F2 populations

c) Sweet sorghum

IIMR/CI/2021-2026/140: Genetic enhancement of energy sorghums for renewable fuels and fodders (PI: AV Umakanth)

Sweet sorghum hybrid evaluation: During Kharif 2021, 15 hybrids including the check CSH 22SS were evaluated for sweet sorghum productivity traits. Significant differences were observed among the hybrids for most of the characters studied. For total fresh biomass, hybrid 296A x 11 NRL recorded the highest biomass yield of 68.7 t/ha which was 30% higher than the check CSH 22SS (53 t/ha) (Table 1.7). The same hybrid also recorded the highest stem girth of 2.1 cm. For fresh stalk yields, 474A x CSV 19SS and 296A x 11 NRL were promising with >40 t/ha. The check hybrid CSH 22SS recorded the highest juice yield of 18110 L/ha. For brix content, hybrid NSS 1008A x SSV 84 was promising with a brix value of 22.6 % followed by NSS 1007A x CSV 19SS (20.3%) and NSS 1008A x SPV 2018 (20.2%). NSS 1008A x SSV 84 and 296A x 11 NRL recorded >1600 L/ha of ethanol and were 11% and 7% more yielding than the check CSH 22SS which recorded 1510 L/ha.

Table 1.7. Performance of hybrids for sweet sorghum productivity traits

S No	Pedigree	Stem girth (cm)	Plant height (cm)	Total fresh biomass (t/ha)	Fresh stalk yield (t/ha)	Juice extraction (%)	Juice yield (L/ha)	Brix (%)	Computed ethanol yield (L/ha)
1	296A x 11 NRL	2.1	379	68.7	43.0	45	17604	19.6	1617
2	474A x CSV 19SS	1.8	372	65.3	44.0	42	15804	17.7	1320
3	NSS1007A x IS18542	1.8	343	63.7	36.3	38	12264	19.6	1131
4	I30A x R Line 17	1.9	353	63.0	41.7	46	17088	17.6	1401
5	St11A$_2$ x SSV74	1.8	349	60.3	30.7	76	13944	18.0	1186
6	NSS 1007A x CSV 19SS	1.8	310	59.0	36.0	45	14496	20.3	1378
7	NSS 1008A x SSV 84	1.8	287	57.0	35.0	50	15804	22.6	1677
8	NSS 1008A x CSV 19SS	1.7	354	56.3	33.7	48	13207	20.7	1286
9	185A x 11NRL	1.7	267	55.7	34.3	35	10980	18.5	957
10	I30A x SSR 10	1.9	383	54.7	25.7	45	10212	16.7	801
11	NSS 1008A x SPV 2018	1.8	330	54.3	32.0	44	12432	20.2	1178
12	NSS 1008A x SSR 10	1.8	373	48.3	32.0	35	10452	18.6	1007
13	NSS 1008A x RS 647	1.8	285	41.7	24.3	58	12768	17.9	1070
14	St 11A$_2$ x SSR 1	1.8	248	40.7	20.0	61	10338	18.8	906
15	CSH 22SS	1.8	358	53.0	41.0	51	18110	17.2	1510
	Mean	1.8	332	57.7	34.1	48	13830	19.1	1244
	C.V.	10	9	13	13	32	19	5	17
	F Prob.	0.733	0.000	0.000	0.000	0.176	0.001	0.000	0.000

Sweet sorghum varietal evaluation:

Under station varietal trials with 25 advanced breeding progenies including the checks, the entries viz., WL BN 61 and WL BN 226 recorded the highest total biomass yields of >75 t/ha and were >30% superior to the check CSV 24SS (56.7 t/ha) (Table 1.8). The entry WL BN 61 was also promising for fresh stalk yields (54.3 t/ha). WL BN 61, WL BN 226, and WL BN 62 recorded >20000 L/

Table 1.8. Performance of varieties for sweet sorghum productivity traits

S No	Pedigree	Stem girth (cm)	Plant height (cm)	Total fresh biomass (t/ha)	Fresh stalk yield (t/ha)	Juice extraction (%)	Juice yield (L/ha)	Brix (%)	Computed ethanol yield (L/ha)
1	WL BN 61	2.0	373	78.0	54.3	48	23688	18.1	2007
2	WL BN 226	2.0	321	76.7	46.7	55	23508	17.9	1972
3	WL BN 62	2.0	386	66.0	48.7	50	21756	17.4	1781
4	SMBC 1-4-29	1.9	331	63.0	42.0	49	18396	20.3	1769
5	WL BN 220	2.0	316	61.0	41.7	55	20124	17.7	1674
6	WL BN 41	1.8	319	52.3	38.3	61	20376	17.2	1648
7	SMBC 1-11-130	1.8	362	75.3	51.0	40	18180	19.2	1631
8	WL BN 36	1.9	295	61.7	40.7	50	18024	16.8	1413
9	SM BC 1-4-45	1.9	362	46.0	37.7	47	15720	18.7	1378
10	WL BN 143	1.9	339	62.3	41.3	47	17352	16.8	1375
11	WL BN 63	1.9	317	53.7	37.3	46	15228	19.3	1369
12	WL BN 58	1.8	349	59.7	42.3	44	16872	16.9	1353
13	WL BN 92	1.9	330	46.7	33.0	54	16080	17.2	1297
14	WL BN 42	1.9	304	49.7	32.7	51	14844	18.0	1248
15	WL BN 108	1.9	314	55.7	36.3	45	14772	17.7	1243
16	WL B 186	1.9	309	58.0	37.0	47	15384	17.2	1240
17	WL BN 188	1.9	309	55.3	38.7	43	14916	17.0	1190
18	WL BN 20	1.7	301	52.7	31.7	50	14142	17.7	1172
19	WL BN 93	1.8	336	51.7	35.0	44	13908	17.7	1154
20	WL BN- 19	1.8	301	49.3	31.0	46	13176	17.2	1058
21	WL BN 35	1.9	343	48.7	26.7	59	13536	16.5	1049
22	SMBC 1-12-166	1.8	305	39.3	25.7	46	10632	17.3	863
23	SPV 2600	1.9	328	60.3	37.0	55	18210	17.8	1522
24	CSV 19SS	1.9	347	61.3	40.3	39	14076	17.6	1160
25	CSV 24SS	1.8	305	56.7	37.7	41	14016	17.5	1153
	Mean	1.9	328	57.6	38.6	48	16677	17.7	1389
	C.V.	5	10	16	15	14	19	6	21
	F Prob.	0.12	0.04	0.00	0.00	0.02	0.00	0.03	0.00

ha of juice yield against 14016 L/ha in CSV 24SS and the superiority was >50%. It was gratifying to note that the sorghum x maize derivative SMBC 1-4-29 recorded the highest brix content of 20.3%. For computed ethanol yields, WL BN 61 recorded the highest ethanol yield of 2007 L/ha which was 74% more than the check CSV 24SS (1153 L/ha). The other promising varieties for this trait were WL BN 226, WL BN 62 and SMBC 1-4-29 which have recorded >1700 L/ha.

Sorghum DUS testing and PPV&FRA related activities (PI: K Hariprasanna)

Replicated field trials for characterizing the DUS descriptors in candidate varieties and reference varieties of sorghum were conducted during *Rabi* 2021-22 and *Kharif* 2022 seasons as per the PPV&FR Authority guidelines. During *Rabi* 2021-22, maintenance breeding and characterization was undertaken for 117 reference varieties (including OPVs, parental lines and hybrids) under enforced selfing/controlled pollination. Genetically pure single plants were harvested in each genotype for maintenance of reference varieties. Characterization data on 32 DUS traits were collected as per the revised guidelines and reference variety database was updated and submitted to PPV&FR Authority.

During *kharif* 2022, five candidate varieties (two new and three farmers' varieties) were tested for DUS traits along with four national checks under 1st year testing (Fig.1.9). Under 2nd year testing three candidate varieties were characterized in a replicated trial. Data was recorded for all the 32 DUS descriptors. All the 56 *kharif* adapted reference varieties were planted in a replicated trial for characterization and data were recorded. Twenty-eight entries from the advanced trials (grain, forage, sweet, specialty and high biomass) of AICRP on Sorghum including checks were also characterized for DUS traits to enable faster plant variety protection in case of varietal identification and release. The compiled candidate variety data along with photographs have been submitted to PPV&FR Authority. During the year, four new applications were submitted to PPV&FRA for registration, and an annual fee was paid to all the registered varieties.

Fig.1.9. Field testing of a candidate variety

II. Pearl millet

IIMR/CI/2021-2026/141: Genetic enhancement of pearl millet for yield and adaptation to arid regions (PI: P Sanjana)

Creation of new variability

The 2552 F_3 progenies derived from 65 crosses (31 for B-line development and 34 for R-line development) involving good combining parental lines, parental lines of released arid hybrids and landraces through single seed descent method were evaluated at Mandor, Rajasthan. From them 322 progenies (12.6% selection intensity) were selected from 51 crosses. These involved 147 R-progenies, 124 B-progenies and 51 landrace introgressed progenies.

Promising hybrids for arid regions: A total of 32 hybrids based on 843-22A, and 54 hybrids based on 04999A were evaluated in advanced hybrid trial at Bikaner and Hyderabad locations during 2022 *kharif* season along with arid checks MPMH 21 and RHB 223. Of them, 18 hybrids were superior for pooled grain yield (2.04 to 3.81 t/ha) over best check MPMH 21. Hybrids, 843-22A x 1151 (3.81t/ha), 04999A x 1153 (3.72 t/ha), 843-22A x 1356 (3.54 t/ha) and 843-22A x 129R (3.44 t/ha) were superior for grain yield over check MPMH 21 (2.01 t/ha)

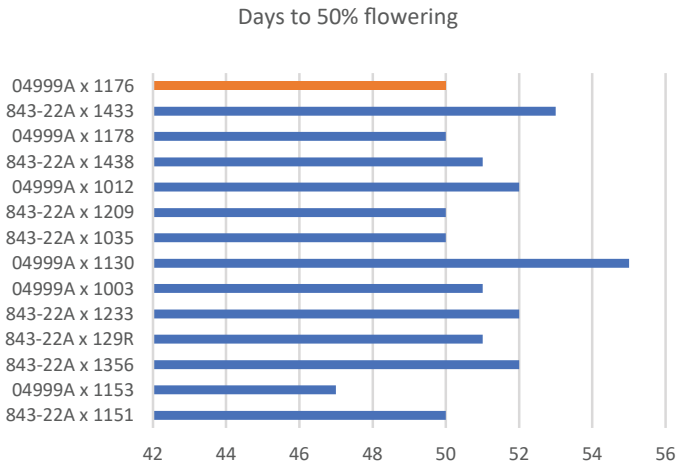


Fig.1.10. Good hybrids for grain yield suited to semi-arid regions.

Promising hybrids for semi-arid regions: A total of 29 advanced hybrids were evaluated in advanced hybrid trial at IIMR-Solapur and IIMR-Hyderabad during 2022 *kharif* season along with semi-arid checks MPMH 17 and Kaveri Super Boss. Of them, 13 hybrids were superior for pooled grain yield (2.48 to 4.94 t/ha) over best check Kaveri Super Boss (2.05 t/ha). Of them, twelve hybrids were based on newly designated A-lines IPMA 1 (242A) and IPMA 2 (269A) though the initial trial involved 30 new A-lines (Figure 1.10).

Identification of new sources for blast tolerance: Nine blast resistant sources that are claimed to be resistant against 5 to 7 isolates (Pg 45,118,138,186,204

Table 1.9. Performance of blast tolerant sources at Mandor and Hyderabad locations for blast resistance and agronomic traits during 2022 *kharif* season

Genotype	Days to 50% flowering	Plant height (cm)	Panicle length (cm)	Panicle width (cm)	Blast score*		Gain yield (t/ha)	Fodder yield (t/ha)
					Mandor	Hyderabad		
SFD152	57	110	17.0	2.0	1.5	1.0	3.5	4.6
SFD153	65	158	13.5	1.7	3.0	2.0	4.3	17.5
SFD154	64	130	21.0	2.3	2.3	2.0	3.3	10.0
SFD155	60	135	20.0	2.0	1.8	1.0	2.3	4.2
SFD156	56	165	20.2	1.4	1.5	2.0	7.0	16.7
SFD157	56	145	21.5	2.0	2.0	1.5	2.8	11.7
SFD158	70	105	16.0	2.0	3.0	3.0	2.5	4.2
SFD159	70	190	22.2	1.8	1.8	1.5	2.9	4.2
SFD161	63	148	17.5	2.1	2.5	3.0	5.0	5.6
93333B (R. check)	59	135	19.7	2.2	2.5	2.0	4.6	16.1
843-22B	53	115	13.7	2.1	3.5	5.0	3.5	10.0

*Score taken on a 1 to 5 scale where 1= resistant, 5=susceptible

and 232) were obtained from ICRISAT. These were evaluated for blast tolerance at PC-Unit, AICRP on Pearl Millet, Mandor and IIMR-Hyderabad. The line SFD 152 is found to have tolerance at both Mandor as well as Hyderabad locations while, SFD 155 was tolerant at Hyderabad and SFD 156 was tolerant at Mandor. Four sources each were tolerant at two locations as compared to the resistant check, 93333B and all were tolerant compared to B-line (843-22B) of popular hybrid HHB 67 improved (Table 1.9).

IIMR/CI/2018-23/120: Improving the yield potential of pearl millet hybrids for favorable and marginal environments (PI: T Nepolean)

New parental lines: Development and diversification of pearl millet B and R lines continued to develop potential parental lines for different production ecologies. More than 5000 lines were developed in the last year and advanced to the next generation from different F4/ F5/F6 populations. These lines were segregated for traits such as flowering time, panicle traits, biotic and abiotic stress tolerance, nutritional superiority, and grain yield. Around 10% of lines were selected based on performance and superiority to cater to the product profiles of different ecologies. The performance of B and R lines developed (Fig.1.11 and 1.12) from various breeding nurseries was measured for 50% flowering, plant height, panicle length, panicle width, and 100-grain weight. Based on the performance of the lines, different traits lines were selected and included in the recycling program for new line development as well as for the development of experimental hybrids.

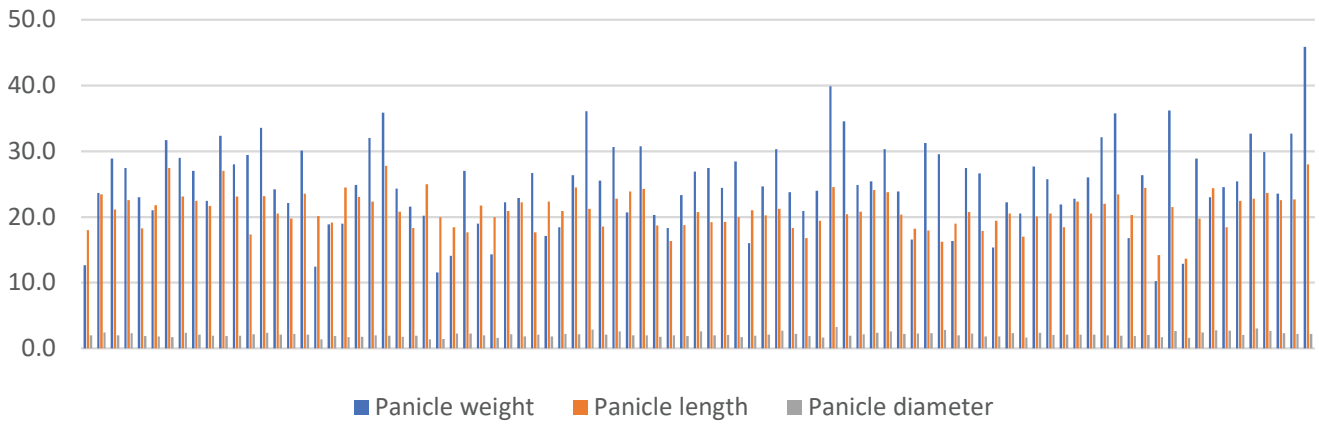


Fig.1.11. Genetic variability available in pearl millet B lines for panicle weight, panicle length and panicle diameter.

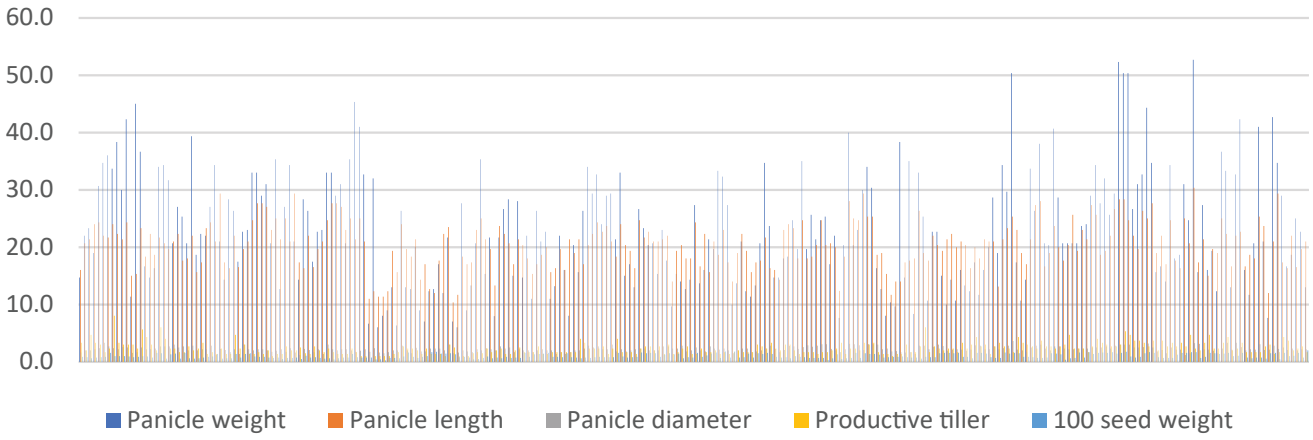


Fig.1.12. Genetic variability available in pearl millet R lines for panicle weight, panicle length and panicle diameter.

Fig.1.13. Susceptible progenies in various backcross populations.

Fig.1.14. Resistant progenies identified from the backcross populations.

Backcross breeding for developing blast resistance pearl millet hybrids:

Three R lines namely, ICMR 11003 and ICMR 06444 were identified as a resistance source for blast resistance in pearl millet and were used as donors in the backcross breeding to impart the resistance of the parental lines, ICMB 98222, ICMB 99222, ICMB 04999, and ICMB 1508. Nine BC_1Fn populations were developed across donor by recurrent parent crosses in 2020. The populations were advanced to BC_2F_n generation to develop resistant lines during *Kharif* 2021. From various combinations of BC progenies that were segregating for resistant and susceptible reactions, new resistant lines were identified (Fig.1.13 and 1.14). Development of new hybrids was initiated using the resistant BC lines and superior R lines in the Summer of 2022.

III. Small millets

a) Finger millet

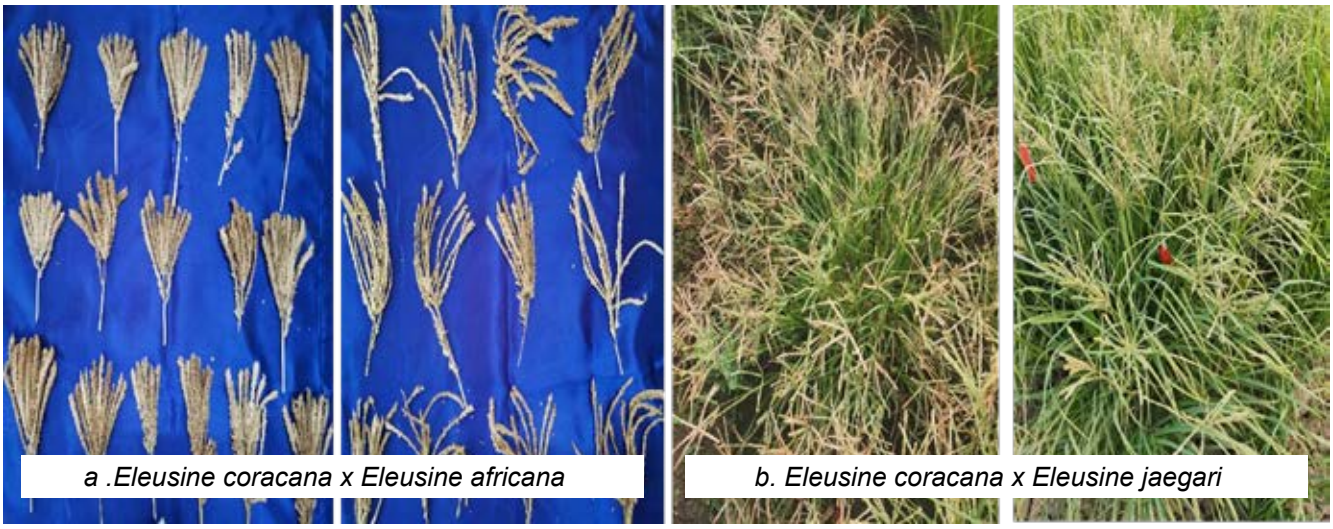
IIMR/CI/2021-2026/143: Development of improved finger millet genotypes for grain yield and related traits (PI: KN Ganapathy)

Creation of novel variability:

Diversification through gene(s) introgression from wild to cultivated holds key for successful improvement programs. *E. Africana* are also known to possess traits for moisture stress. The cultivated types, MR-P310 (partial sterile) and GE 1 (Virescence) were test crossed with wild species *E. africana* (GE 7123) and *E. jaegari* (GE 7144) respectively. True F1s were identified using the wild traits which were observed to be dominant over the cultivated types. The partial seed set obtained from interspecific hybrids were used to advance the generation to F_2s. A total of 528 F_4 interspecific derivatives were evaluated for finger traits and tillering. The interspecific derivatives obtained from cross with *E. africana* showed large variability for finger traits and test weight and could serve as ideal population for diversification of cultivated gene pool for finger traits and for genetic studies (Table 1.10). Derivatives obtained from cross with *E. jaegari* showed larger variability for tillering which is an important trait associated with grain yield improvement (Fig 1.15). Backcrossing of promising Interspecific derivatives with cultivated types is planned for targeted trait improvement in finger millet.

Table 1.10. Variability for finger traits and test weight in interspecific derivatives

Traits	Min	Maximum	Average
No. of fingers	5	18	9.71
Finger length (cm)	5.8	18	11.74
Finger width (cm)	0.2	1.4	0.70
Test weight (g/500 seeds)	0.6	3.4	2.02



Compact fingers *Loose fingers* *High tillering* *High tillering*

b) Little millet

IIMR/CI/2021-2026/144: Development of improved little millet genotypes for grain yield and related traits (PI: KN Ganapathy)

Evaluation for grain iron and zinc:

Fifteen bold seeded little millet germplasm were evaluated at four locations (Hyderabad-K21, Hyderabad-R-20, AkolaK-21 and Vizianagaram K-21) to identify superior lines with high grain iron and zinc. From combined data (Table 1.11), the values for grain iron ranged from 27.8 to 43.8 ppm and for grain zinc the value ranged from 26.8 to 31.5 with a mean of 32.61 and 28.57 respectively. Germplasm lines IC0482980, IC0482980, IC0405074, IC0404929 were identified with grain iron more than 35 -40 ppm while the germplasm lines IC0405074, IC0404919, IC0482852, IC0404953 were identified with zinc content 30 ppm. The identified lines can be used as potential donars for developing improved lines combining bold seed and high grain micronutrients.

Table 1.11: Mean performance of bold seeded lines for grain Iron and Zinc

Germplasm	Mean of 4 locations	
	Grain Fe(ppm)	Grain Zn(ppm)
IC0482980	43.8	27.2
IC0482988	32.1	27.7
IC0483040	28.0	26.8
IC0483042	27.8	28.1
IC0483072	31.3	28.4
IC0483133	28.8	28.8
IC0483302	27.2	28.2
IC0482808	38.0	28.3
IC0482852	30.3	29.8
IC0404953	33.1	29.7
IC0404919	32.6	29.7
IC0404929	35.2	28.6
IC0405074	37.4	31.5
IC0405076	31.6	27.0
IC0405046	31.9	28.8
Minimum	27.2	26.8
Maximum	43.8	31.5
Mean	32.6	28.6

c) Foxtail millet

IIMR/CI/2021-2026/142: Genetic improvement of Foxtail millet for grain yield and nutritional quality (PI: K Hariprasanna)

Evaluation of promising foxtail millet genotypes: Twenty-seven genotypes were evaluated along with three released varieties as checks for two years (2020-21 & 2021-22) at IIMR, Hyderabad and CRS, Solapur. Significant variation was observed for all the traits. At IIMR, grain yield ranged from 1045 kg/ha to 1619 kg/ha with a mean of 1241 kg/ha. Days to flowering ranged from 55 to 63 days, maturity from 81 to 90 days, panicle length from 12.2 to 17 cm, grain yield per panicle from 2.16 to 3.41 g, and test weight from 2.35 to 3.12 g. Selections from ERP 82, Haalu Navane, KOPFM 17, ELS 43 and ESD 42 recorded marginal grain yield advantage over the best check SiA 3156. Grain yield per panicle and per plant were found to be positively related with days to flower and maturity, while grain yield per unit area had significant negative association. Grain yield had a significant positive correlation with bristle length. The number of lobes had significant correlation with grain yield per panicle but not on grain yield per plant. Lobe length had no significant association with both, while it had significant negative correlation with number of productive tillers.

At Solapur a very high variation was observed for grain yield and ranged from 582 kg/ha to 3123 kg/ha. Thirteen entries had grain yield advantage of >10% over the best check, SiA 3156. Selections from GS 760, GS 2091,

Table 1.12. Performance for panicle length at IIMR, Hyderabad over two years

Code	Selection from	DTF	DTM	PH (cm)	PL (cm)	BL (cm)	NPT	GY/ PI (g)	1000-SW (g)	GY (kg/ ha)
V411	ISe 1488	64.0	93.0	128	23.8	0.57	2.2	6.19	2.70	1148
V424	CB-GS-747/1	61.8	87.5	96	19.3	0.48	2.4	4.89	2.64	1233
V427	Kempu Navane	69.5	95.0	95	19.3	0.35	2.1	5.00	2.28	462
V413	GS 760	61.8	88.8	92	18.6	0.60	2.2	4.64	2.56	1377
V414	GS 2091	62.8	88.0	97	17.4	0.51	2.6	4.98	2.61	1228
V410	GS 363	59.0	86.3	92	17.1	0.43	2.1	4.74	3.08	1155
V421	ESD 42	63.3	86.8	96	17.0	0.33	2.0	6.47	2.35	1458
V420	ERP 82	61.8	87.0	99	16.8	0.22	2.3	5.19	2.52	1619
V422	IC 77875	59.0	83.5	88	16.8	0.48	2.0	4.43	2.22	1283
V401	KOPFM 15	62.0	91.0	101	16.8	0.51	2.7	7.48	2.91	1421
V419	ERP 40	72.8	100.3	102	16.6	0.27	2.2	12.78	2.18	702
V428	Prasad (Ch)	60.0	85.0	94	16.5	0.29	2.1	5.67	2.56	1045
V430	SiA 3156 (Ch)	55.3	81.8	80	15.3	0.49	2.5	5.38	2.77	1442
V429	Suryanandi (Ch)	55.0	80.5	75	12.2	0.21	2.6	5.16	2.74	1138
	Mean	61.3	88.0	93	16.2	0.43	2.3	5.89	2.64	1241
	C.D. (0.05)	2.6	2.9	15	2.4	0.16	-	3.21	0.45	435

Table 1.13. Performance for panicle length at CRS, Solapur over two years

Code	Selection from	DTF	PH (cm)	PL (cm)	NPT	GY/Pl (g)	GY (kg/ha)
V415	GS 450	55.5	157.3	25.9	7.1	47.7	2350
V423	IC 479618	52.5	143.3	25.9	4.9	39.2	1601
V411	ISe 1488	58.3	151.3	25.7	4.5	32.7	1108
V413	GS 760	55.3	139.8	24.9	7.1	63.9	3123
V420	ERP 82	57.3	171.0	24.9	3.0	56.4	1019
V416	GS 1617	57.5	154.0	23.8	9.3	41.7	2249
V421	ESD 42	58.8	171.3	23.7	4.0	27.7	582
V412	ISe 1059	59.8	164.8	23.3	3.7	45.8	833
V419	ERP 40	68.5	171.5	23.1	3.2	35.6	1061
V404	KOPFM 25	52.5	150.3	22.7	8.6	36.5	1871
V424	CB-GS-747/1	55.5	157.3	22.6	7.3	32.0	1971
V427	Kempu Navane	68.3	167.5	21.9	4.4	32.1	1777
V428	Prasad (Ch)	49.3	139.0	20.3	5.8	39.4	1628
V430	SiA 3156 (Ch)	51.0	140.5	20.0	6.1	47.1	1707
V429	Suryanandi (Ch)	46.8	129.5	18.5	6.3	31.2	1286
	Mean	54.5	150.6	21.9	6.6	44.3	1772
	C.D. (0.05)	3.8	21.0	3.7	3.7	-	1285

(DTF: Days to flower; DTM: Days to mature; PH: Plant height; PL: Panicle length; NPT: No.of productive tillers; GY: Grain yield; GY/Pl: Grain yield/plant; TW: 1000-seed weight)

GS 1489 recorded > 50% grain yield advantage and GS 2091 had same flowering duration that of SiA 3156. Grain yield was significantly correlated with number of productive tillers and grain yield/plant, while it was negatively related with plant height. Panicle length was positively related with days to flowering and plant height. Grain yield per plant was negatively related to panicle exsertion.

Selections from ISe 1488, CB-GS-747/1, Kempu Navane and GS 760 had significantly longer panicle compared to SiA 3156 at Hyderabad (Table 1.12). While at Solapur, selections from GS 450, IC 479618, ISe 1488 and GS 760 had significantly longer inflorescence than SiA 3156 (Table 1.13). Hence, performance of selection from ISe 1488 for inflorescence length was found to be stable across locations and seasons. Selections from Haalu Navane and GS 363 had better seed size (> 3 g) compared to SiA 3156 at Hyderabad.

Segregating material: Segregating material were advanced in the breeding nursery for phenotypic selection of superior genotypes based on plant and panicle traits. In the F_2 generation, 110 selections were made from six populations, which will be advanced further. In the F_4 generation, out of 297 single plant progenies planted, 364 selections were made. Forty-six had big and long panicles, while 72 were very early compared to the parents. Out of 156 single plant progenies in F_5 generation, 11 recorded grain yield above 1500 kg/ha. Advance breeding lines FxM 5001 (S.Nandi × SiA 3156) and FxM 5044 (SiA 3156 × ISe 301) recorded above 2000 kg/ha grain yield. The superior selections will be further evaluated in replicated station trials.

Novel mutants:

A total of 10 selections in mutants of Suryanandi and 32 selections in mutants of SiA 3156 were planted for advancement to assess the stability during kharif 2021. Among the 10 mutants of Suryanandi, panicle length varied from 17.3 to 25 cm, while grain yield per panicle ranged from 2.3 to 7.1 g. Three mutants had very long and loose panicles (Fig. 1.16) while three others had strong culm with less or no tillering. In case of mutants derived from SiA 3156, panicle length ranged from 13.5 to 28.5 cm. Six mutants had grain yield above 5 g/panicle (829-4, 832-2, 816-1, 822-1, 827-1 and 830) (Fig. 3). FxM 827-2, 829-1, 829-2, 832-1, 832-2, 832-3, 833-1, 833-2 and 833-3 had thick and strong stem, big panicles, large and thick lobes (Fig. 1.17). F×M 832-1, 832-2 and 832-3 had prominent auricle pigmentation (Fig. 1.18), which was stable over the seasons. The majority of the mutants had very less tillering with strong culm amenable for mechanical harvesting.

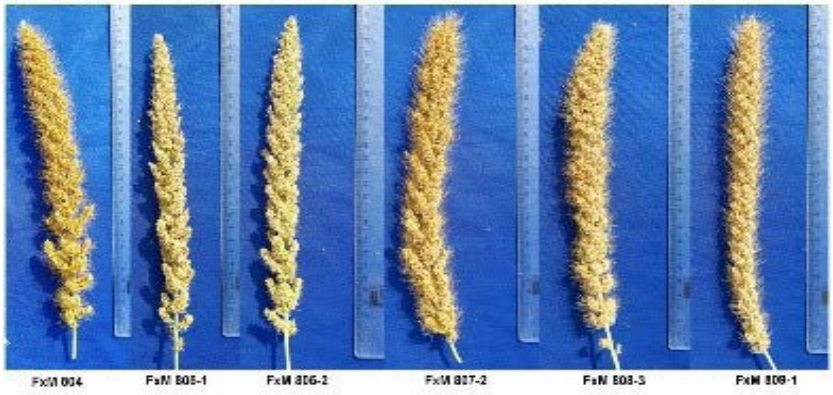


Fig.1.16. Novel mutants of Suryanandi

Fig.1.17. Novel mutants of SiA 3156

Fig.1.18. Auricle pigmentation in FxM 832-2 and FxM 832-3

d) Barnyard millet

IIMR/CI/2021-2026/145: Development of Dual-purpose barnyard millet cultivars with improved quality (PI: B Amasidda)

Evaluation of advanced genetic material: A total of 119 advanced stabilized lines consisting of mutants, advanced F4, F5 lines were evaluated in augmented design with two replications in kharif 2021. Superior lines were identified for different economic traits. The lines were identified specifically for grain yield related traits like 5 panicle weight, 5 panicle seed weight, 1000 seed weight and high biomass (Fig.1.19). The details of the selected lines after screening were listed above in the table. The genotypes (DHBM 93-3 × IEc 217)-208-1-1-1-107, (DHBM 93-3 × IEc 217)-208-2-1-1-108, DHBM 93-3 × IEc 217, (DHBM 93-3 × IEc 217)-209-1-1-118, (DHBM 93-3 × PRJ 1)-210-1-1-119 and (DHBM 93-3 × PRJ 1)-32-59-1-1-90 were finalized for grain yield because of high 5 panicle weight (figure 1) and the genotypes BAR 1012, BAR 1452, (DHBM 93-3 × VL 207)-25-1-36-2-1-1, (DHBM 93-3 × VL 207)-30-58-1-1, (DHBM 93-3 × IEc 566)-48-67-1-1-1, (DHBM 93-3 × IEc 566)-58-70-1-1-1, (DHBM 93-3 × IEc 566)- 58-70-2-1-1 and (DHBM 93-3 × IEc 566)- 210-4-1-1 were identified for high biomass and the genotypes BAR 590, BAR 1221-2, BAR 1261, BAR 1270, BAR 565, BAR 571, BAR 600, Mutant DHBM 93-3-55-2-45-8-1-1-71, Mutant DHBM 93-3-41-61-1-1-92 and IIMR-BM-29-17 × DHBM 93-3 were identified for high 1000 grain weight and will be involved in breeding programs and multi-location evaluation.

Adaptability of barnyard millet: A total of 22 genotypes were used in the adaptability study which was conducted at 4 locations representing northern hilly areas (Ranichauri and Almora) and Southern plain area (Hyderabad and Athiyandal). Data was recorded on 14 agro-morphological traits and AMMI analysis was done to know the adaptability of genotypes to environments (locations). Stable genotypes identified across four locations were, DHBM 93-2, IIMR-BM-3, DHBM 93-3, DHBM 23-3, K1, VL 207, while genotypes found unstable but high yielding across four locations were, PRJ1, CO-1, VL 246, VL 249, VL 254, VL 243, BAR 1452, K2, Co-2, MDU 1, VL 181, VL 29, VL 172.

Fig. 1.19. DHBM 93-3 × IEc 217)-208-1-1-1-107 and DHBM 93-3 × PRJ 1)-210-1-1-119, lines with high panicle weight.

e) Proso millet

IIMR/CI/2021-2026/147: Genetic improvement of proso millet for yield and protein content (PI: Avinash S)

Early maturing varieties: Out of the 32 lines evaluated over two years, four lines were found superior for earliness and were on par for yield with the leading checks, TNAU 202 and TNPm 230. Two lines Sel-19-5 and Sel-19-19 were early maturing and produced higher grain yield than the checks, TNAU202 and TNPm230 (Table 1.14).

New lines for higher grain yield: 56 lines developed from 13 cross combinations converging traits like compact panicle, tallness, earliness, high tillering, and bold seed. These lines were selected for higher yield in F5 generation and evaluated. For comparison, two checks were used TNAU202 and TNPm 230. Of the evaluated progenies, Sle2020-41, Sel2020-18 and Sel2020-19 and Sel2020-12 were found to be superior for plant height and grain yield per plot (Table 1.15 and Fig.1.20).

Table 1.14. Performance of the promising lines.

S no.	Selection	2020 Kharif				2021 Kharif			
		GY (kg/ ha)	FY (kg/ha)	DF (Days)	DM (Days)	GY (kg/ ha)	FY (kg/ha)	DF (Days)	DM (Days)
1	Sel-19-5	2445	3882	42	79	2385	3800	40	79
2	Sel-19-22	2336	3452	40	76	2188	3389	40	76
3	Sel-19-23	2452	3695	40	75	2338	3469	40	75
4	Sel-19-16	2251	3628	40	75	2341	3700	40	75
5	Sel-19-30	2333	3762	38	70	2357	3713	38	70
6	Sel-19-38	2339	3592	35	68	2312	3495	35	68
7	Sel-19-32	2396	3452	40	75	2215	3393	40	75
8	Sel-19-19	2482	3552	39	75	2455	3612	40	75
9	Check TNAU202	2382	3467	40	80	2382	3406	40	80
10	Check TNPm230	2352	3512	39	78	2352	3449	39	78
	CV	10.25	15.8	15.2	18.5	10.25	15.8	15.2	18.5
	CD@5%	345	550	3.1	3.2	345	550	3.1	3.2

Fig. 1.20. Field view of selected F5 progenies

Table 1.15. Performance of advance generation lines

Line	PH (cm)	Days to 50% flowering	Biomass (g/plot)	GY (g/plot)
TNPm230	95	47	1000	150
TNAU202	95	50	1600	156
Sel2020-32	70	50	1200	82
Sel2020-56	70	49	1700	77
Sel2020-41	89	52	1300	169
Sel2020-13	68	46	800	69
Sel2020-12	105	49	1200	182
Sel2020-09	71	52	700	100
Sel2020-25	55	50	1200	98
Sel2020-33	51	50	600	99
Sel2020-17	45	49	800	111
Sel2020-18	108	50	900	109
Sel2020-19	75	38	800	184

Protein content in proso millet: Proso millet is rich in protein, generally it contains 11-13 % proteins. The single panicle selections from germplasm lines were evaluated for yield and other yield related parameters. The genotypes viz., IC0484201, TNPM301, IC0484187, IC0483939, TNPM485, IC0405168, TNPM544, TNPM304, IC0344996, TNPM498, TNPM348, TNPM548, IC0483941showed more than 20-21% grain protein.

f) Kodo millet

IIMR/CI/2021-2026/146: Improvement of kodo millet for economically important traits and assessing genetic diversity using genomic markers (PI:C Deepika)

Evaluation of selected core germplasm accessions: During kharif 2021, 69 core germplasm lines including checks (RBK 155, APK1) were characterized. Wide range and variation were observed for all measured traits in core germplasm as compared to the checks (Table1.16). Based on Euclidean distance 69 genotypes were grouped into three distinct clusters (Fig 1.21). There are 10 accessions in Cluster 1 that belong to early flowering group, 36 accessions in cluster 2 that belongs to medium flowering group and 23 accessions in cluster 3 that belongs to late flowering group. Line GPLM-941 was found early in flowering with yield 998kg/ha, line GPLM-942 is medium with yield 1168kg/ha. All the high yielding accessions in all flowering groups will be evaluated in station and multilocation trials.

Table 1.16. Trait variation in core germplasm

Traits	Core germplasm		Checks	
	Mean	Range	Mean	Range
Days to 50% flowering	72.18	57.6-85.6	69.17	67.6-70.6
Plant height (cm)	78.87	57-99	94.37	86.3-102.4
Panicle length(cm)	7.76	5.2-9.5	7.44	7.2-7.6
Number of basal tillers	17.30	12.3-22.6	17.07	15.6-18.5
Thumb length	4.90	3.8-6.7	4.96	4.3-5.6
Peduncle length	4.41	2.9-5.6	4.17	4.0-4.3
500 seed weight (g)	2.07	1.7-2.4	2.05	2.04-2.06
Grain yield (g/plant)	46.49	13.5-89.0	46.50	38.7-54.2

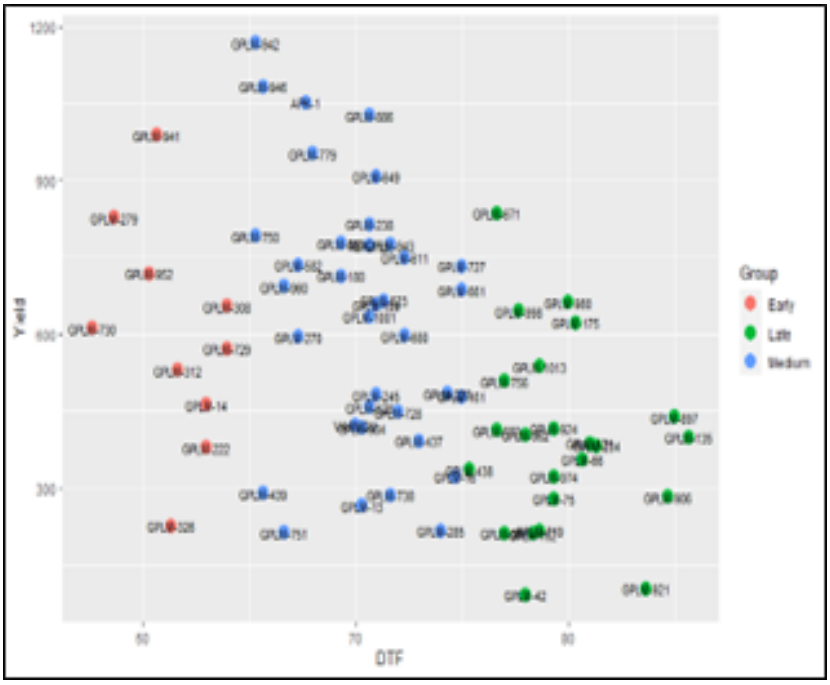


Fig.1.21 Clustering of kodo core germplasm

g) Brown top millet

IIMR/CI/2017-22/115 Brown Top Millet-Characterization and Genetic Improvement (PI: Venkatesh Bhat)

Evaluation of genetic stocks: A set of 24 genetic stocks of brown top millet were evaluated for agronomical traits during kharif 2021. Relatively narrow variability was observed for economic traits such as panicle length, number of tillers and fodder yield, while moderate variability was seen in grain yield, with lower absolute values (Table 1.17). Negligible variability for panicle length.

Most of the genetic stocks were of semi-erect type (13 of 24) and with loose panicle (15 of 24). There was no significant association of panicle type with grain yield.

Mutation and selection

Mutant lines from irradiated local collections were advanced to M_4 and screened for useful mutations. *De novo* yield-enhancing traits were not observed (Table 1.18). The lines were tested for grain yield and related traits. Selections with high grain yield (5 no) were advanced. Selection 5-2 was taller with high grain and fodder yield. Selection 8-3-1 recorded both high grain and fodder yield.

Table 1.17. Summary of trait values in genetic stocks

Parameter	Plant height (cm)	Panicle length (cm)	No of Tillers	Productive tillers	Grain yield/ plant (g)	Grain yield (q/ ha)	Green fodder yield (t/ ha)	Dry fodder yield (q/ ha)
Minimum	64.1	13.9	14.3	8.8	6.8	12	11.49	5.96
Maximum	90.7	16.4	23.7	15.7	23.4	39.83	26.39	14.27
Average	73.9	15	19.2	12.2	13.5	25.14	18.23	10.14

Table.1.18. Evaluation of brown top millet selections during 2021-22

Selection	Plant height (cm)	Panicle length (cm)	No of tillers	Grain yield (kg/ha)	Green fodder yield (q/ha)	Dry fodder yield (q/ha)
Bt-3-1	71.8	15.1	16.8	2555	181.4	94.7
Bt-3-2	71.7	15.7	17.1	2883	202.2	113.8
Bt-4-1	81.0	16.4	22.1	2377	178.4	103.4
Bt-4-2	78.2	15.5	17.3	2879	263.9	132.3
Bt-4-1	83.2	16.0	18.7	2829	204.2	110.2
Bt-5-2	90.7	16.1	18.9	3983	237.0	130.3
Bt-6-1	78.9	14.7	22.0	2990	129.9	72.6
Bt-7-1	77.9	15.3	19.8	2384	176.2	97.7
Bt-7-2	75.0	15.7	16.8	2075	200.4	112.9
Bt-8-1	75.5	14.5	21.2	2659	167.4	90.8
Bt-8-2	75.5	15.3	19.4	3088	195.0	112.3
Bt-8-3-1	72.9	14.5	18.7	3406	242.7	142.7
Bt-8-4-1	70.5	13.9	16.2	3047	214.1	130.9
Bt-9-1-1	77.3	14.8	19.1	2166	193.2	111.5
Bt-9-2-1	72.4	14.1	14.3	3017	190.1	108.2
Bt-9-3-1	67.9	14.1	19.9	2783	159.5	86.9
Bt-9-4-1	67.3	14.4	23.7	1709	151.1	77.3
Bt-9-5-1	64.1	14.5	16.6	1733	156.9	89.5
Bt-9-6-1	67.7	15.0	18.8	1811	205.2	120.4
Bt-10-1	69.7	15.7	17.9	1992	114.9	59.6
Bt-11-1-1	67.7	14.5	18.0	1775	130.6	78.3
Bt-12-1	65.3	14.5	19.9	1200	156.3	85.7
Bt-12-2-1	77.8	15.3	23.5	2879	190.7	105.6
BT-12-3	72.3	14.7	23.1	2116	133.8	67.2

1.3. Seed Science

IIMR / SS / 2020-2025 / 126: Investigations on genetics of seed vigour and longevity, and effect of foliar plant nutrition on seed yield and quality in small millets (PI: N Kannababu)

Two experiments were conducted in split plot design (SPD) with 3 replications during Rabi 2020-21 and Kharif 2021-22 to study the 'effect of foliar sprays and soil application of Boron and Zinc on seed yield and seedling vigour in finger millet (cv. VL347) and foxtail millet (cv. SIA3156).

Finger millet:

During Rabi season, Zinc, and zinc + Boron foliar application has markedly enhanced the seed yield per plant over no spray control (Fig. 1.22a). The enhanced seed yield was due to concomitant increase in productive tillers per plant and fingers per panicle (Fig.1.22b). Regarding methods of micronutrient

application, foliar spray proved superior to soil application and further within times of foliar spray, panicle initiation stage proved ideal as compared to 50% flowering stage for seed yield. Both Boron and Zinc foliar sprays individually and also in combination (B + Zn) were at par and significantly increased the seed germination (SG), field emergence (FE), seedling dry weight (SDW), root length, and seedling vigour index (SVI-2) values (Fig. 1.22c). Interaction effects on seed yield shows that, soil application Zn is inferior to its foliar spray at PI or PI and FFL stages while for B and Zn + B applications, times of application (method) have no impact. FFL stage application of B is as good as soil application (Fig. 1.22d). Among the methods of micronutrients application, foliar spray at PI + FL stages had significantly superior effect on most of the seed quality traits followed by foliar spray at PI stage, and soil application over foliar spray at FFL stage with most of the seed physiological quality traits (Fig. 1.22e). More or less similar to results were obtained during Kharif season also.

Fig. 1.22. Effect of foliar sprays and soil application of Boron and Zinc on seed yield and quality traits in finger millet

Foxtail millet:

Seed yield and related traits: During Rabi season, Boron (B), Zinc (Zn) and zinc + Boron foliar application being at par with each other have markedly enhanced the seed yield per plant over no spray control (Fig. 1.23a). Unlike Rabi results, the Kharif results revealed that Boron (B), Zinc (Zn) and zinc + Boron foliar application have markedly enhanced the seed yield per plant of foxtail millet over no spray control, B and Zn Spray, respectively (Fig. 1.23a). In both the seasons, the enhanced seed yield was due to concomitant increase in productive tillers per plant, primaries per panicle and panicle weight. The foliar spray at both panicle initiation (PI) and 50% flowering (FFL) brought significant gains in seed yield over soil or foliar application at PI or FFL stage (Fig. 1.23d). During Rabi season, the interaction effects on seed yield showed that B or Zn, or Zn + B foliar applications at both PI and FFL stages have equal impact on seed yield (Fig. 1.23d). Whereas in Kharif season, the interaction effects on seed yield indicated that Zn + B foliar applications at both PI + FFL stages being at par with their PI stage application have markedly higher seed yield per plant than all other treatments.

Seed quality traits: During Rabi season, the foliar sprays with micronutrients, B, Zn, and B + Zn were on par for seed germination and field emergence traits over control (Fig. 1.23c). Whereas B and Zn application

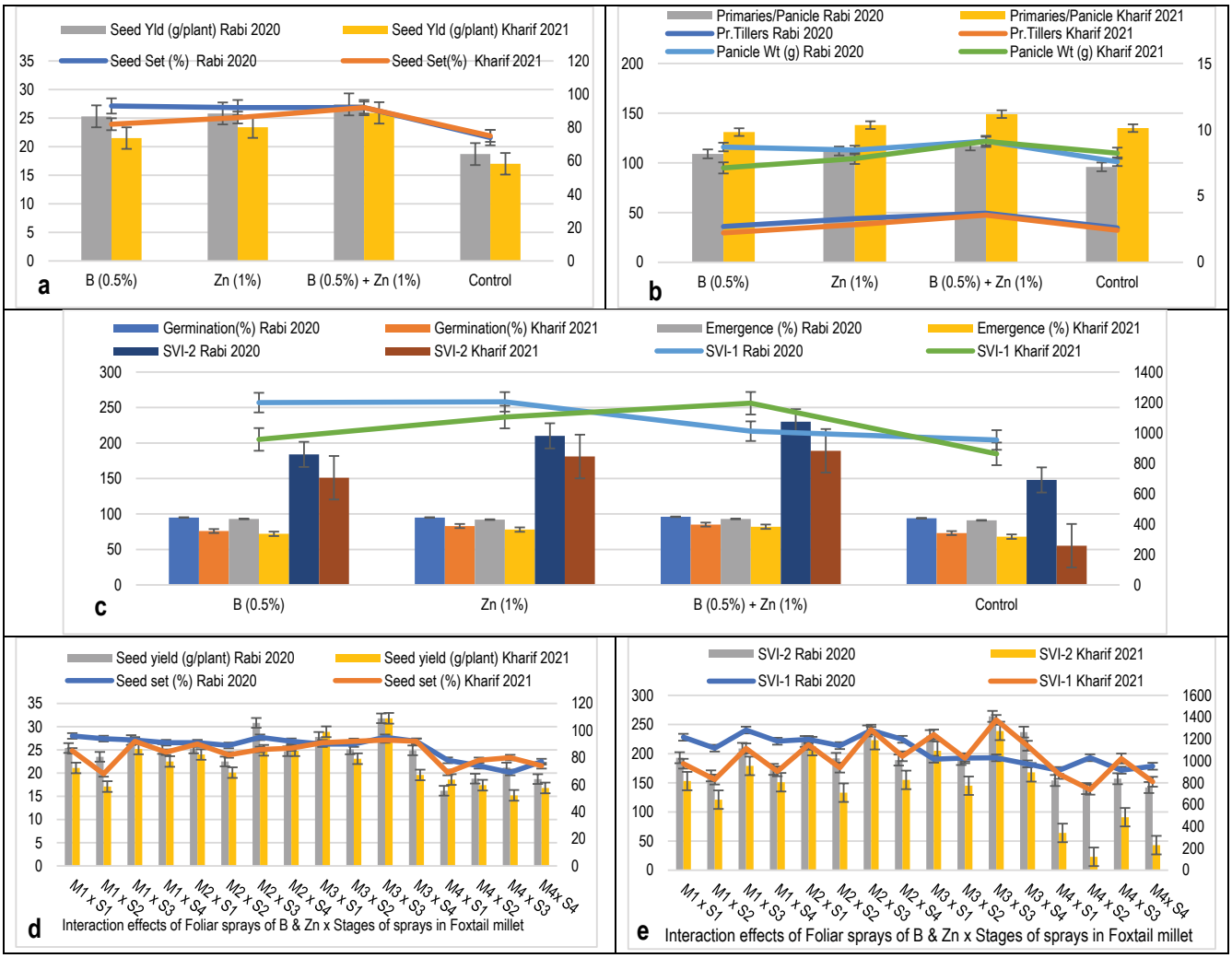


Fig. 1.23. Effect of foliar sprays and soil application of Boron and Zinc on seed yield and quality traits in **finger millet**

individually were at par for seedling vigour index (SVI-I) and root length. The combination of B + Zn was significantly superior over individual sprays of B or Zn for seedling dry weight and seedling vigour index (SVI-II). Whereas, during Kharif season, the combination of Boron + Zinc showed significantly higher values of all the seed quality traits over other treatments of Boron or Zinc individually in foxtail millet (Fig. 1.23c). However, the effects of B + Zn combination and Zn on seedling dry weight and seedling vigour index (SVI-II) were on par during Kharif season. Among the methods of application, the foliar sprays at both PI and FFL stages resulted in significantly better values of seed quality traits followed by foliar spray at PI stage and soil application (Fig. 1.23e).

IIMR/CPD/ 2018-23/119: Studies on cold tolerance in sorghum and foxtail millet (PI: Sooganna)

Variability study for cold tolerance in sorghum:

An experiment was conducted to study the variability for cold tolerance at flowering stage in sorghum at MPKV Rahuri during rabi 2021. The temperature recorded during flowering was 14.0 °C (Min) and 28.0 °C (Max). Of the genotypes tested, 467B, CSV20 and MR750, SSV84, N15 and CSV15, EG34, EC24 and IS3098, IS3074 were found promising in terms of seed set under cold.

SEED PRODUCTION

Seed production during 2021-22:

The total breeder seed production under BSP/NSP crops was 106.92 q which is 93.10 (773.66%) more than DAC indent (13.82 q) and 91.33 (685.82%) more than BSP-I allocation (15.59 q). In farmer's participatory seed production, a total of 513.16 q seed was produced.

The total breeder seed production during 2021-22 by AICSIP centers was 194.25 which is 389% more than DAC indent (49.89 q) and 341% more than BSP-I allocation (56.96 q). There was surplus production of breeder seed for most of the allocated lines and varieties of sorghum at 15 AICSIP centers in Kharif and Rabi seasons during 2021- 22.

2. Application of Basic and Strategic Sciences in Crop Improvement

2.1 Pre-breeding

IIMR/CI/2021-2026/148: Pre-Breeding of Sorghum and finger millet for specific trait improvement (PI: K. Venkatesh)

A new project titled, pre-breeding of Sorghum and finger millet for specific trait improvement was initiated with specific objectives to screen *S. purpureo-sericeum* accessions against shoot fly and transfer trait to adapted germplasm through wide hybridization. During the year 2021-22, 30 accessions of wild sorghum were collected from ICAR-IIMR Genebank for screening against shoot fly (Table 2.1). In addition, 151 inter-specific derivatives of wide hybridization were collected from Dr. Visarada for further evaluation, generation advancement, selection and backcrossing to improve the adaptability of the lines. During the year, 13 wide crosses were attempted between CSV 29R and *Sorghum lanceolatum, Sorghum controversum, Sorghum purpureocerecium* and *Sorghum usumbarense* in the project.

IIMR/CI/2020-2025/125: Genetic and molecular characterization of intergeneric and interspecific derivatives for enhanced utilization in sorghum breeding (PI: KBRS Visarada)

Derivatives from three interspecific crosses involving two elite parents, the 27B and 126B, with two wild species, *S. versicolor* and *S. usumbarense*, were initially evaluated and 13 promising lines were selected and tested in six multi-location trials. All the derivatives in ISC304 (27B x *S. versicolor*), were taller, in ISC320 (126B x *S.versicolor*), two lines were as short as parents, while in ISC812, (27B x *S. usumberance*) all were as short as parents. ISC320-1, ISC320-3 and ISC812-2 were on par with the superior resistant checks, IS 18551 and IS2205 at 1% CD for shoot fly dead heart percentage in multilocation trials for shoot fly resistance. All the entries were on par with

Table. 2.1. Sorghum wild accessions collected from ICAR-IIMR

Acc. No	Species names	Acc. No	Species names
IS 14340	*Cleistachne sorghoides Benth*	IS 18895	*Sorghum almum*
IS 18841	*Sorghum halepense*	IS 18896	*Sorghum hewisonii*
IS 18842	*Sorghum halepevnse*	IS 18901	*S. rhizomatores*
IS 18843	*Sorghum purpureocerecium*	IS 18926	*Sorghum versicolor* Andersson
IS 18845	*Sorghum halepense*	IS 18934	*Sorghum halepense*
IS 18847	*Sorghum halepense*	IS 18939	*Sorghum purpureocerecium*
IS 18849	*Sorghum halepense*	IS 18947	*Sorghum purpureocerecium*
IS 18850	*Sorghum halepense*	IS 18951	*Sorghum purpureocerecium*
IS 18853	*Sorghum halepense*	IS 18953	*Sorghum matarenkense*
IS 18858	*Sorghum usumbarense*	IS 18958	*Sorghum nitidum*
IS 18860	*Sorghum hewisonii*	IS 21661	*S. bicolor* subsp *arundinaceum*
IS 18888	*Sorghum lanceolatum*	IS 23147	*Para sorghum*
IS 18889	*Sorghum lanceolatum*	IS 23159	*Para sorghum*
IS 18890	*Sorghum lanceolatum*	IS 24417	*Wild*
IS 18891	*Sorghum halepense*	IS 26778	*Sorghum halepense*

resistant checks in terms of dead-hearts for stem-borer infestation. ISC304-2 and ISC304-3 were superior to resistant check in grain mold score. We conducted molecular analysis through PCR using 50 sorghum specific GATA markers. The samples were divided into two major cluster, Cluster I (ISC320-2) and cluster II with all the other samples. (Fig 2.1). All the test lines were close to the parental lines (27B, 126B) indicating genetic proximity to the cultivated parent.

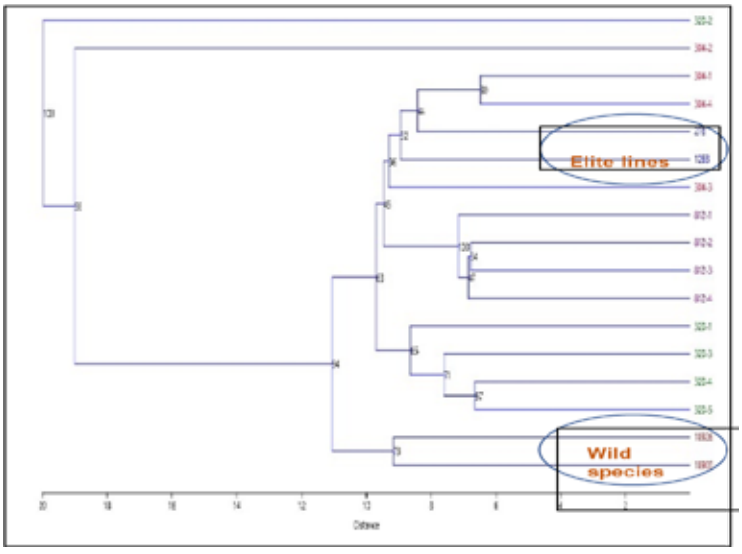


Fig 2.1. Cluster diagram of interspecific derivatives and elite parental lines

2.2 Molecular breeding

IIMR/CI/2021-2026/149: Generation of genomic resources and its application for the improvement of millets (PI: P Rajendrakumar)

Little millet and kodo millet are the indigenous small millets, which are rich in nutrients and grown as a subsistence crop. These small millets lack the basic genomic resources required for efficient genetics and breeding applications. Towards the development of genomic resources in these two crops, DNA sequence data was generated from 24 diverse genotypes using Genotyping-by-Sequencing (GbS) approach. For SSR identification, consensus sequences were extracted from the GbS data and the simple sequence repeats (SSRs) were identified using the KRITssr finding pipeline. A total of 772 SSRs were identified in little millet and primers were designed to develop 181 hypervariable SSR markers. Similarly, about 831 SSRs were identified in kodo millet and primers were designed to develop 169 hypervariable SSR markers. The occurrence of different types of SSRs in little and kodo millet is represented in Fig. 2.2.

Towards the whole genome sequencing of kodo millet, long read sequencing of the popular kodo millet cultivar RK 390-25 was performed through long-read sequencing using PacBio Sequel II platform. A total of 69,86,096 reads were obtained accounting for 109,877,542,353 bases with the assembly length of 982.72 Mb and the N50 value of 41.24 Mb. In some parts of the genome, regional heterogeneity is so high that haplotype homology is not recognized during assembly, and they end up getting assembled as separate contigs. Purging of the assembly was performed to identify such contigs and remove the duplications. Purging has minimal effect on the genome assembly and completeness. The statistics for the primary assembly and purged assembly are given in Table 2.2.

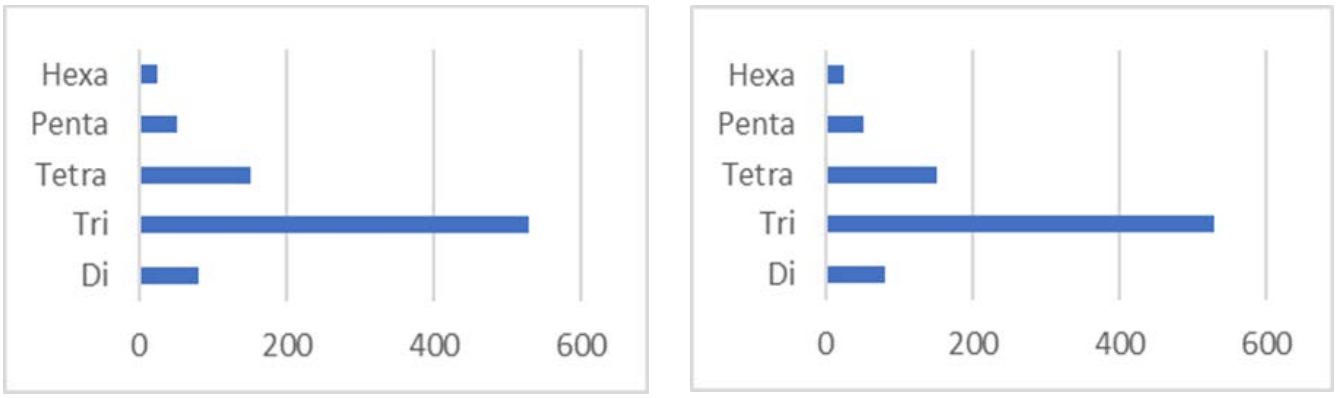


Fig. 2.2. Occurrence of different types of SSRs in little millet (a) and kodo millet (b)

Table 2.2. Statistics for the primary assembly and purged assembly of Kodo millet

Metric	Primary Assembly	Purged Assembly
Total Length (>= 1000 bp)	982,718,169	950,615,434
Total Length (>= 5000 bp)	982,718,169	950,615,434
Total Length (>= 10000 bp)	982,718,169	950,615,434
Total Length (>= 25000 bp)	979,192,471	949,372,256
Total Length (>= 50000 bp)	948,333,020	936,996,819
Largest Contig	60,991,951	60,991,951
Total Length	982,718,169	950,615,434
GC (%)	45.84	46.00
N50	41,243,391	41,243,391
N90	12,138,862	18,563,505
Ns per 100 kbp	0.00	0.02

ICAR-BMGF project funded project: Application of Next-Generation Breeding, Genotyping, and Digitalization Approaches for Improving the Genetic Gain in Indian Staple Crops. (PI: Nepolean T)

Mid-density SNP panel of pearl millet

Since the genomic resources in pearl millet are very limited, a mid-density 4K SNP panel was developed to use in various genetic studies. A set of 4K SNPs were mined from 925 whole-genome sequences through a comprehensive *in-silico* pipeline. Three hundred and seventy-three genetically diverse pearl millet inbreds were genotyped using the newly developed 4K SNPs through the AgriSeq Targeted Genotyping by Sequencing technology. The 4K SNPs were uniformly distributed across the pearl millet genome and showed considerable polymorphism information content (0.23), genetic diversity (0.29), expected heterozygosity (0.29), and observed heterozygosity (0.03). The SNP panel successfully differentiated the accessions into two major groups namely, B and R lines through genetic diversity, PCA, and structure models as per their pedigree (Fig 2.3). The linkage disequilibrium (LD) analysis showed Chr3 had more high LD regions while Chr1 and Chr2 had more low LD regions. The genetic divergence between the B and R line populations was 13% within sub-population variability was 87%. The 4K mid-density SNP panel will be useful in genomics and molecular breeding experiments such as assessing the genetic diversity, trait mapping, back-cross breeding, and genomic selection in pearl millet.

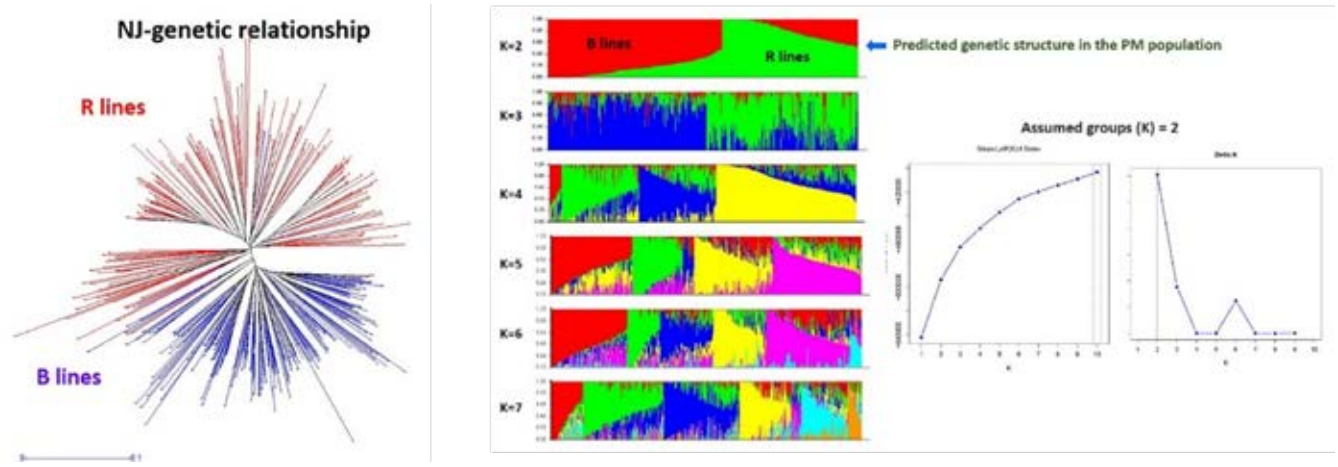


Figure 2.3. Grouping of pearl millet B and R lines by the 4K mid-density SNP panel.

2.3 Biotechnology

IIMR/CI/2017-22/113 Biochemical and molecular mechanisms of thermotolerance in pearl millet (PI: Jinu Jacob)

Seedling heat tolerance in pearl millet

Knowing the genetics of a trait is an essential step in the development of superior varieties and hybrids. To understand the genetics of seedling thermotolerance trait in pearl millet, some of the heat tolerant lines were crossed with susceptible ones and hybrids were generated. From the 150 genotypes screened for seedling heat tolerance, 48 genotypes were selected as heat tolerant and heat sensitive and these were studied for genotype × environment interaction. Among these, four (ICMB 04999, 516B, 669R and ICMR 07444) were heat tolerant and four (2B, 97B, 660R and 632R) heat sensitive lines were selected.

IIMR/CI/2017-2/112: Development of sorghum transgenic plants for stem borer resistance through Agrobacterium mediated transformation with Bt genes

Sorghum genotype C43 was transformed with the binary vectors (pBINAR and pCAMBIA0390) carrying three *Bt* genes (*cry2Aa, cry1Aabc* and *cry1AacF*) (Fig 2.4 a-f) individually through *Agrobacterium* mediated transformation. A total of 522 *hygromycin* resistant putative transgenic plants were developed out of 2464 shoot tips infected with pBINAR binary vector carries three *Bt* genes individually (182 plants out of 840 shoot tips infected with pBINAR-*cry2Aa* gene construct, 155 plants out of 804 shoot tips with pBINAR-*cry1Aabc* and 185 plants out of 860 shoot tip with pBINAR-*cry1Aacf*). In order to develop marker free sorghum transgenics, a total of 348 putative transgenic plants out of 470 shoot tips were infected with pCAMBIA0390 binary vector carries three *Bt* genes individually (158 plants out of 185 shoot tips infected with pCAMBIA0390-*cry2Aa* gene construct, 110 out of 150 with p pCAMBIA0390-*cry1Aabc* and 80 out of 135 with pCAMBIA0390-*cry1Aacf*). PCR assay with gene-specific primers revealed the presence of the 932 bp amplification product specific to *hygromycin* gene in 18 independent transgenic events out of 20 T_0 generation events tested (Fig 2.5) and no amplification was observed from genomic DNA of non-transformed control plant indicated the integration of *hygromycin* gene in sorghum genome.

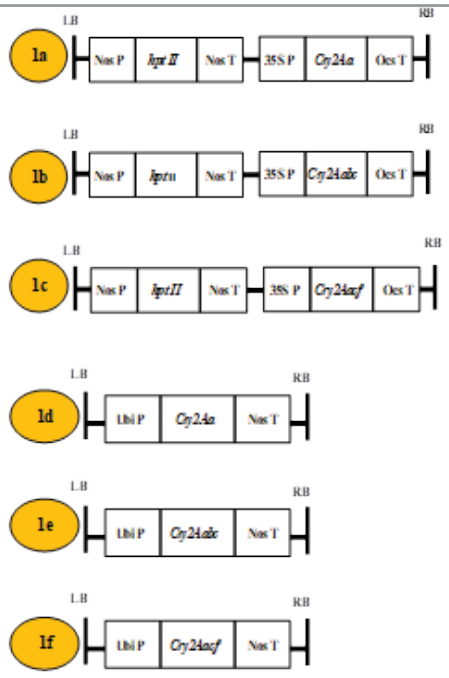


Figure 2.4. Diagrammatic representation of the binary vectors and genes used for development of sorghum transgenics for stem borer resistance: **1a:** Partial map of pBINAR carries *cry2Aa* and *hygromycin* genes; **1b:** Partial map of pBINAR carries *cry1Aabc* and *hygromycin* genes; **1c:** Partial map of pBINAR carries *cry1Aacf* and *hygromycin* genes; **1d:** Partial map of pCAMBIA0390 carries *cry2Aa* gene; **1e:** Partial map of pCAMBIA0390 carries *cry1Aabc* gene; **1f:** Partial map of pCAMBIA0390 carries *cry1Aacf* gene; **hpt II:** Hygromycin gene; **Nos T:** Nos terminator; **Nos P:** Nos promoter; **Ubi P:** Ubiquitin promoter; **35S P:** CaMV 35S promoter; **Ocs T:** Ocs terminator

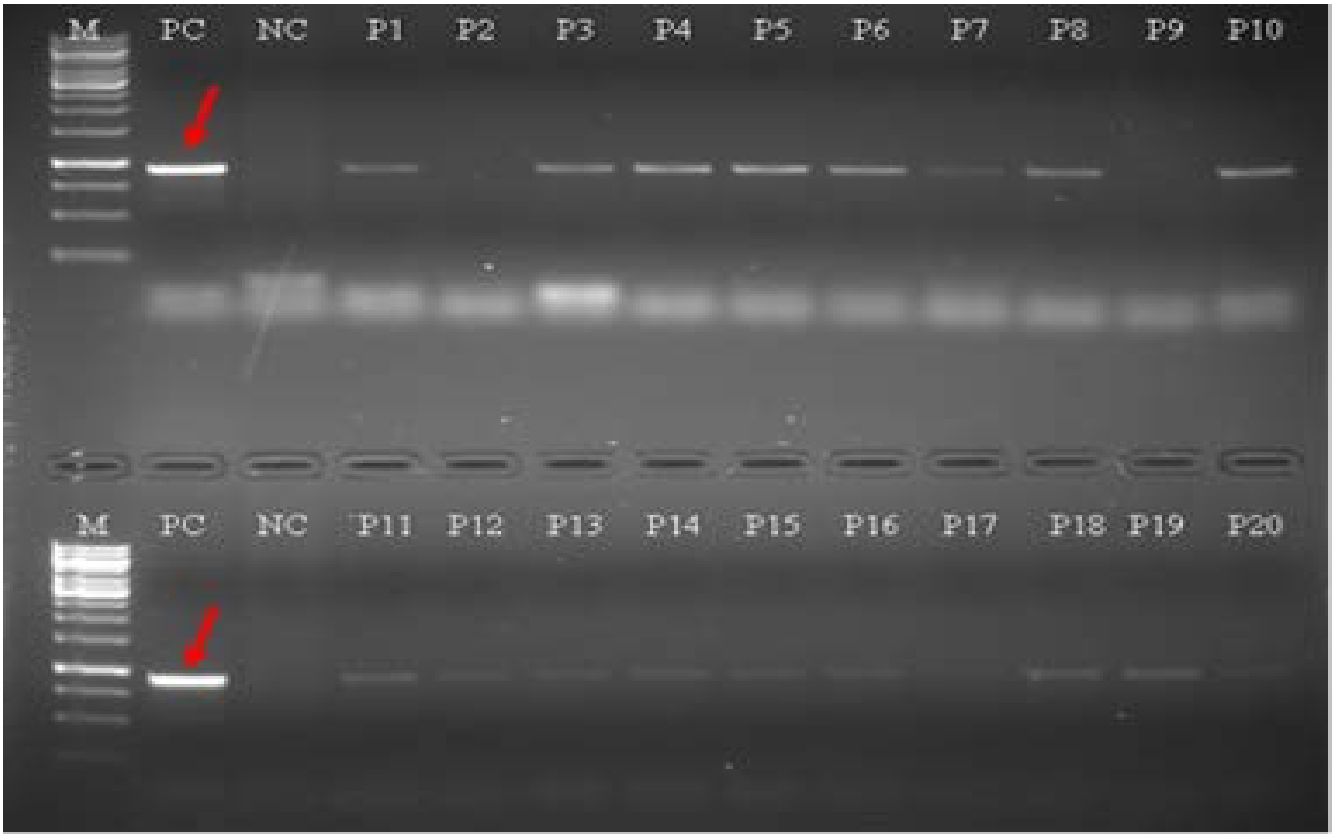


Figure 2.5. Molecular characterization of T_0 transgenic sorghum plants. Gel image of PCR amplification of 932 bp fragment of *hygromycin* gene: **M:** 1 Kb DNA ladder (Fermentas); **PC:** Positive Control-pBINAR-*cry2Aa* Plasmid DNA; **NC:** Negative Control-DNA from Non-transformed sorghum plant (C43); **P1-P20:** DNA from hygromycin resistant T_0 transformed sorghum plants; **Arrow:** 932 bp amplified *hygromycin* gene

IIMR/CI/2020-2025/124: Genome editing of sorghum SbSERK gene(s) for aposporic apomixis through CRISPR-Cas9 technology

Three sg RNAs designed for *sbSERK1-2*, *sbSERK2-2* and *sbSERK3-2* genes were cloned individually in binary vector pGREB31 driven by U3 promoter, also carries Cas9 coding region driven by 2x 35S promoter and hygromycin (*hpt*) gene driven by 35S promoter (Fig 2.6 a-c). These three binary vectors were mobilized individually into *Agrobacterium tumefaciens* strain LBA4404 for plant transformation. Hundred shoot meristems of male sterile line 296A for each gene construct were infected for 30 min in LBA4404 *Agrobacterium* cell suspension and co-cultivated for 3 days. A total of three hundred shoot meristem explants were subjected two rounds of hygromycin (5.0 mg/l) selection. After selection the regenerants were transferred to rooting medium (Fig 2.6 d-f), later these regenerants with well-established root system were acclimatized for 10 days in the soil mixture (Vermiculate, perlite and cocopeat) in tissue culture room with 16:8 hours of light and dark conditions (Fig 2.6). A total of 135 putative hygromycin resistant transgenic plants (42 plants with SERK1-2 sgRNA, 44 plants with SERK2-2 sg RNA and 49 plants with SERK-3-2 sg RNA) were transferred to transgenic glass house (Fig 2.6) for further growth and analysis.

Figure 2.6. Sorghum transgenic plants developed through *Agrobacterium* mediated transformation harboring T-DNA constructs carries *SbSERK* gene(s) to understand their effect on generating apomixis
a: T-DNA of pRGEB31 carries SERK1-2 sg RNA; **b:** T-DNA of pRGEB31 carries SERK2-2 sg RNA; **c:** T-DNA of pRGEB31 carries SERK3-2 sg RNA; **d:** Putative transgenic plants in rooting

2.4. Crop Physiology

IIMR/CPD/2020-2025/128: Physiological dissection of key traits contributing for moisture stress adaptations in post rainy sorghum: with an emphasis on root architectural traits (PI: S Srividhya)

Rabi sorghum genotypes were screened for moisture stress adaptation at critical phenophases using key physiological traits and yield responses under field conditions during rabi. Moisture stress treatments were imposed at T_1- Moisture stress at post flowering stage and T_2- Season long stress after seedling establishment. Control plot was maintained as well irrigated condition. The Phenological progress under moisture stress conditions showed that there was a significant advancement of almost 8-9 days of panicle emergence and 8-9 days of early flowering for all the genotypes studied. Moisture stress right from the seedling stage (for prolonged drought period) has resulted in poor panicle formation, rapid grain filling of top panicles, resulting in significant reduction in panicle weight and panicle width.

Total grain yield: Yield loss was maximum under season long drought stress compared to moisture stress after post-anthesis stage. Under T_2, it was observed that almost all the genotypes had above 50 per cent yield loss (Table 2.3).

Post flowering and season long drought stress have affected the grain filling dynamics in most of the rabi sorghum varieties. Both grain number and grain size were affected under moisture stress conditions. We could observe that sorghum panicle growth is predominantly source limited during grain filling period due to moisture limited conditions. There was almost two times reduction in bottom/middle/top part of panicles for all genotypes (Fig 2.7.)

Table 2.3. Grain yield under moisture stress environments

	Total Grain yield (g/ m²)			% Reduction over control	
Genotypes	Control	T1	T2	T1	T2
CSV 29R	438.1	175.2	147.0	60.02	66.44
BJV 44	346.4	262.8	140.9	24.13	59.32
SPV 2217	344.3	170.9	155.0	50.35	54.97
CSH 39R	392.7	209.5	82.9	46.65	78.88
SPV 2758	207.8	88.7	68.7	57.34	66.96
CSV 26	338.6	185.9	104.9	45.09	69.01
M35-1	322.3	289.5	205.6	10.16	36.20
SPV 2407	340.3	189.8	92.1	44.21	72.94
Mean	341.3	192.4	121.9		

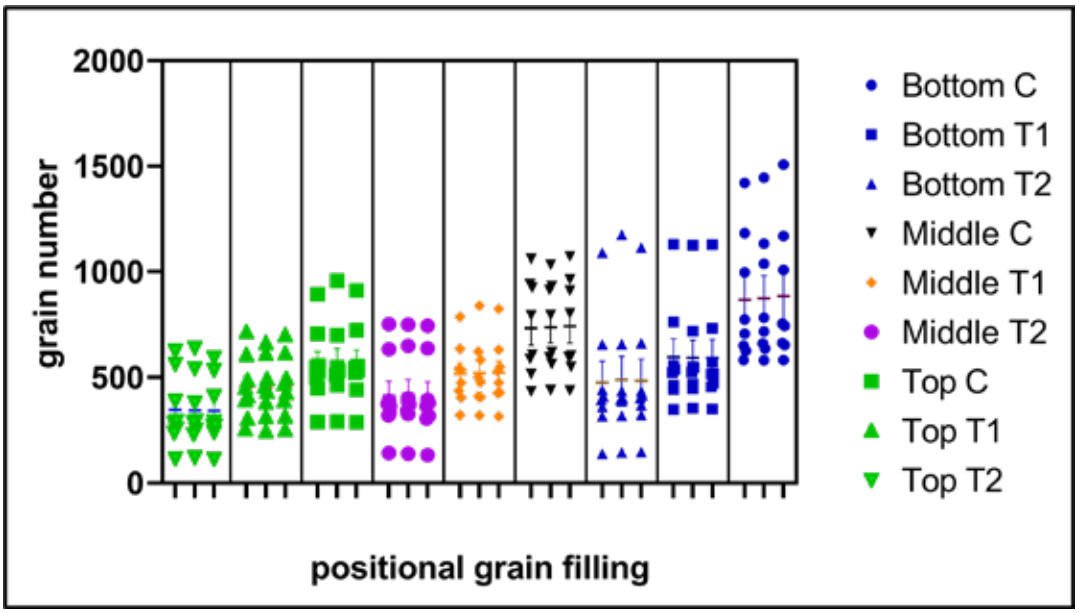


Fig 2.7. Positional grain filling in rabi sorghum genotypes under moisture stress conditions.

The effect of Non-structural carbohydrate reserves (NSC) on grain filling is related to sink strength as the higher leaf/stem carbohydrate reserves during grain filling signifies better economic yield. The estimation of NSC reserves under moisture limited conditions 15 days post-anthesis stress and prolonged drought stress conditions showed that the reserves decreased to 100-130 mg per g of dry weight as compared to 125-180 mg per g of dry weight under control conditions. But SPV 2217, M35-1, CSV 29R retained higher stem NSC reserves while CSH 39R, SPV 2758 had major reduction in the stem reserves (Fig 2.8). Genotype with high Chlorophyll Fluorescence has higher quantum yield of PS II (Fv/Fm)- responsible for higher photo assimilation. 15 days post anthesis stress, when Chlorophyll fluorescence was recorded in C, T_1, T_2 plants, decrease in PS-II efficiency was huge under T_2 stress below optimum levels of Fv/Fm values, considerably more in T_1 also (Fig 2.8)

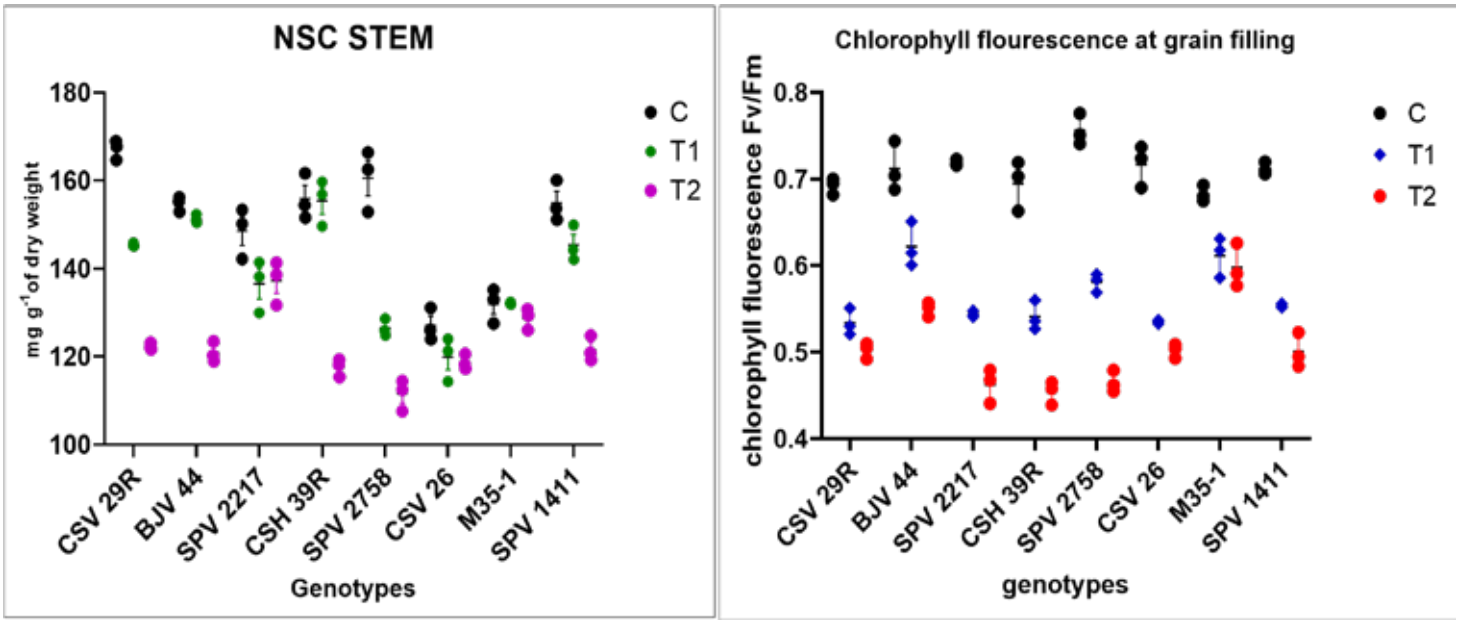


Fig 2.8. Stem NSC reserves and chlorophyll fluorescence estimated under moisture stress conditions

SERB-SRG funded project: Characterization of sensitive phenophases, Water Use Efficiency (WUE) and genetic variability of Barnyard millet and Proso millet under drought stress (PI: S Srividhya)

Variation in Transpiration efficiency: Field and lysimeter experiments were undertaken during Rabi, 2021 where 21 lines in barnyard millet and 16 lines in proso millet were taken for understanding the variability for transpiration efficiency (TE). The study has revealed high genetic variation in both barnyard and Proso millet genotypes for TE. It is observed that drought stress plants have recorded lower Transpiration Efficiency (TE) when compared to the control plants. Also, biomass of drought plants was significantly less compared to control plants in both barnyard and proso millet genotypes. There was also a significant decline in the seed yield and 1000 seed wight.

2.5 Biochemistry & Functional Foods

IIMR/FF/2020-2023/127- High calcium accumulation in finger millet and its relationship to grain constituents (PI: Venkateswarlu Ronda)

Oxalic acid and its relationship to grain nutrients:

Oxalic acid is a dicarboxylic acid which forms insoluble precipitates with calcium. Oxalic acid content of finger millet grain samples (88 no.) constituting elite lines, land races and released cultivars was determined using HPLC. A simple and rapid HPLC method was developed and validated for oxalic acid estimation in finger millet grains. Finger millet flour sample of 1.0 g was extracted with acidified water (mobile phase) to obtain total oxalic acid content. The sample was separated in Rezex fast acid H+ column and oxalic acid identified with PDA detector at 210 nm (Fig 2.9). The oxalic acid content of the finger millet grains was in the range of 18-88 mg/100 g with an average of 41.5 mg/100 g. Furthermore, oxalic acid was found to have no significant correlation with Protein, Iron, Zinc, Calcium, and Magnesium while was positively correlation with phosphorus content. Hence, the dietary availability of calcium from finger millet may not be significantly hindered due to low oxalic acid content.

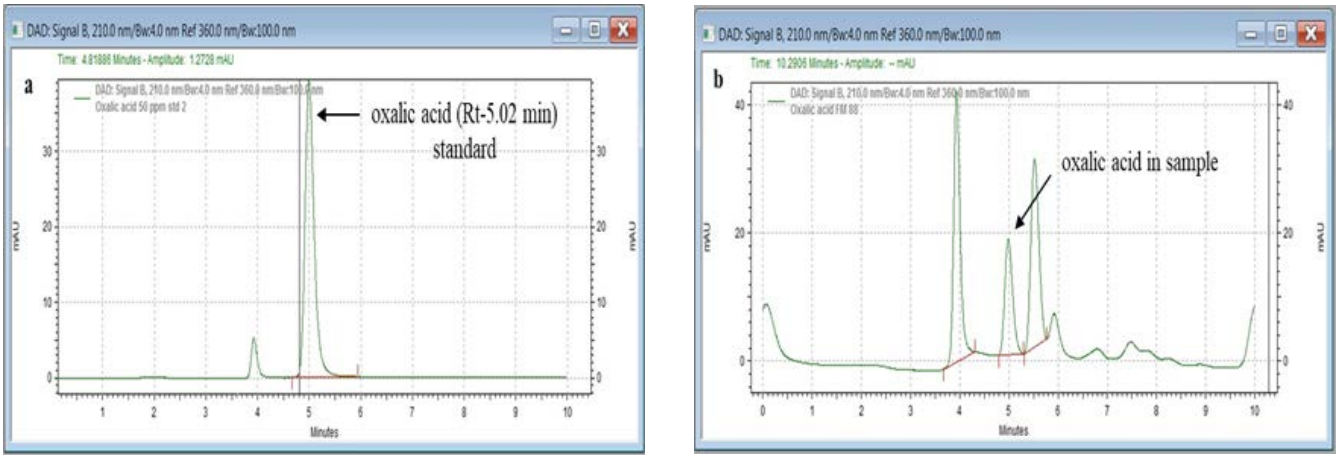


Fig 2.9. HPLC chromatograms of standard (a) and finger millet sample (b)

Distribution of nutrients in finger millet grain:

Calcium storage sites and distribution of nutrients in different portions of the grain was determined by separating the floury and fibrous portions. A sample of 50 g finger millet was moistened with 3.5 ml ultrapure water and crushed in a mortar and pestle. The resulting mass was sieved to separate a fine flour fraction (powder) and fibrous residue fraction (residue) (Fig 2.10). The experiment was repeated four times and samples were analyzed for Protein, Calcium, Iron, Zinc and Total dietary fibre. Protein, Iron, Zinc and Total dietary fiber are concentrated in the residue portion i.e., peripherally while Calcium is more or less equally distributed throughout the grain. (Fig 2.11). High calcium content in the endosperm portion of finger millet grain compared to other cereals may be an important physiological requirement for seeds of finger millet.

Fig 2.10. Powder and residue fractions of finger millet grain

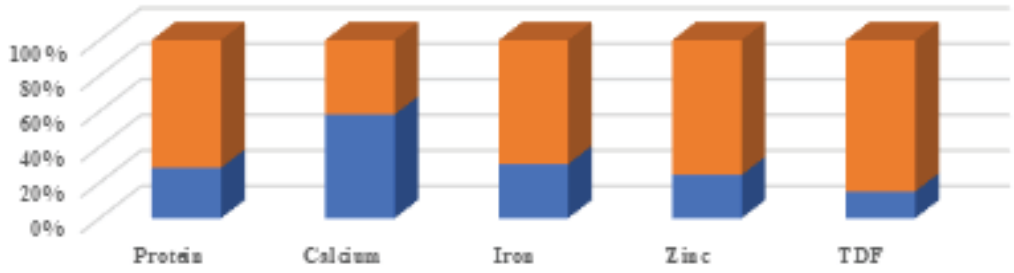


Fig. 2.11. Distribution of nutrients in central and peripheral portion of finger millet grains

IIMR/FF/ 2021-2026/154 Nutritional composition, phenolic profile and bioactivities of sorghum, foxtail, kodo and proso millet grains (PI: VM Malathi)

Proximate composition

The proximate composition of foxtail millet varieties *viz*. SIA-3085, SIA-3156, Krishnadevaraya, Srilakshmi, Suryanandhi, Prasad, RAU 2, DHFT 109-3, PS4, SR 16, HMT 100–1, CO 7, Narasimharaya, Lepakshi, CO 1, CO 2 and CO 4 were studied. The fat content of the genotypes ranged from 3.22 ± 0.004 in CO-7 to 4.71 ± 0.325 in SIA-3085 (Fig. 2.12). The ash content of the samples varied from 1.56± 0.14 in CO-4 to 2.04 ± 0.10 in CO-7). The protein content ranged from 10.09 ± 0.04 in CO-1 to 15.22 ± 0.22 in Lepakshi variety.

Mineral composition

The composition of minerals (ppm), *viz*., Fe, Zn, Ca and Mg in proso millet (TNAU 151, IIMR 225, TNAU 145, TNAU 202) and kodo millet (RK-390-25, JK 41, GPUK-3, Indira Kodo 1) varieties are presented in Table 2.4. The Fe content of proso millet varieties ranged from 40.06±0.74 in IIMR 225 to 60.05±1.48 ppm in TNAU 151. For kodo millet, the Fe content ranged from 19.07±0.91 in JK 41 to 21.23±0.36 ppm to Indira kodo 1.

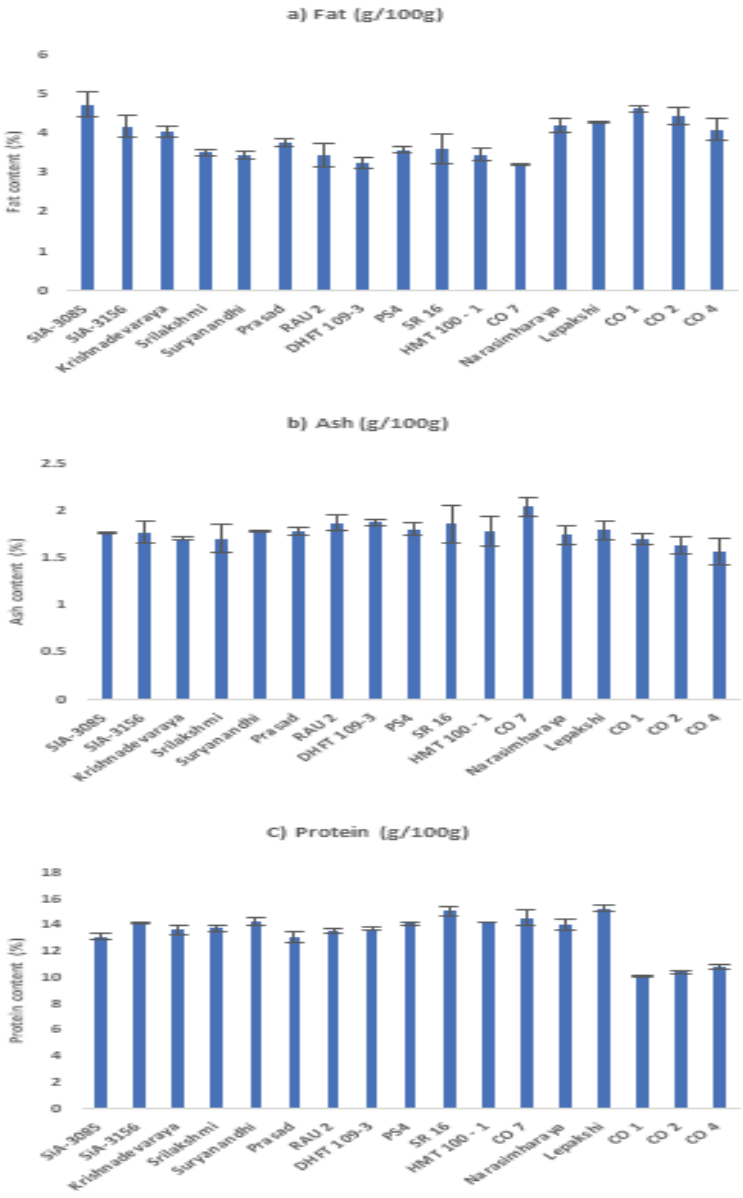


Fig. 2.12. Fat (a), Ash (b) and Protein (c) content of foxtail millet varieties

Table 2.4. Mineral composition of proso and kodo millet varietiesv

	Fe (ppm)	Zn (ppm)	Ca (ppm)	Mg (ppm)
Proso millet				
TNAU 151	60.05±1.48	39.62±0.50	80.22±2.70	2805.5±4.54
IIMR 225	40.06±0.74	39.49±0.19	133.93±5.67	2585.14±9.42
TNAU 145	41.59±0.54	43.58±0.35	120.73±2.40	2706.88±10.48
TNAU 202	56.47±1.31	49.17±0.02	108.21±6.17	2891.41±1.99
Kodo millet				
RK-390-25	21.42±0.42	22.14±0.28	92.04±2.27	2668.5±4.39
JK 41	19.07±0.91	22.72±0.14	83.33±1.12	2656.2±6.39
GPUK-3	19.50±0.74	23.72±0.66	100.65±3.28	2683.0±0.32
Indira Kodo 1	21.23±0.36	25.22±0.12	106.79±2.21	2704.9±23.9
TNAU 86	20.22±0.03	25.95±2.09	91.61±3.61	2752.17±6.04

Phytic acid composition

Phytic acid is an important anti-nutrient present in millets. The total phytic acid content in proso and kodo millet varieties were determined by spectrophotometric method. The results (Table 2.5) showed that phytic acid content was up to 1.427±0.16 (g/100g) in the proso millet variety, TNAU 202. The highest phytic acid content among the studied kodo millet varieties was reported for RK-390-25 (1.023±0.08 g/100g).

Table 2.5. Phytic acid content in proso and kodo millet varieties

Phytic acid (g/100g)	
Proso millet	
TNAU 145	0.825±0.07
TNAU 151	1.084±0.04
TNAU 202	1.427±0.16
IIMR 225	0.850±0.11
Kodo millet	
Indira kodo 1	0.798±0.02
RK-390-25	1.023±0.08
GPUK-3	0.850±0.09
TNAU -86	0.455±0.001
JK - 41	0.667±0.08

3. Host Plant Resistance Against Insects and Diseases

3.1. Insect management

IIMR/CPT/2018-21/118: Assessment of crop losses due to major endemic insect pests and role of natural enemies in reducing pest load in millets (PI: A Kalaisekar)

Crop loss assessment in millets

Field trial to assess the yield losses due to shoot fly in sorghum, proso millet, little millet, barnyard millet was conducted during 2021-22. We imposed four treatments namely protected, unprotected, two sets of partially protected crop growth period, i.e., up to 30 days and after 30 days of crop growth. Analyses of data on yield loss assessment showed that the treatments significantly differed for all the response variables tested in small millets which proved that the yield levels in four treatments significantly varied among them. Panicle damage significantly reduced yield level in small millets while seedling damages had lesser effect on yields. Panicle damage was not significant in sorghum due to very less damage scores, panicles not fully damaged unlike in small millets. Seedling damage significantly reduced yields in sorghum.

Natural enemies of aphids

Natural enemy pressure on aphids in millets was assessed to identify potential parasitoids and predators. Nine species of aphids were recorded from all millets and their proposition are presented in Fig. 3.1. Predatory potentials of *Coccinella transversalis* (148 aphids/day), *Cheilomenes sexmaculata* (93 aphids/day), *Scymnus* sp. (27 aphids/day), *Ischiodon scutellaris* larva (46 aphids/day) were quantified. Parasitoid potentials of *Neotrichophoroides* sp. (21%), *Trichogrammatoidea* sp. (13%), *Braconid* sp. (16%), *Brachymeria sp.* (11%), *Cotesia flavipes* (19%), *Aprostocetus diplosidis* (57%) were assessed.

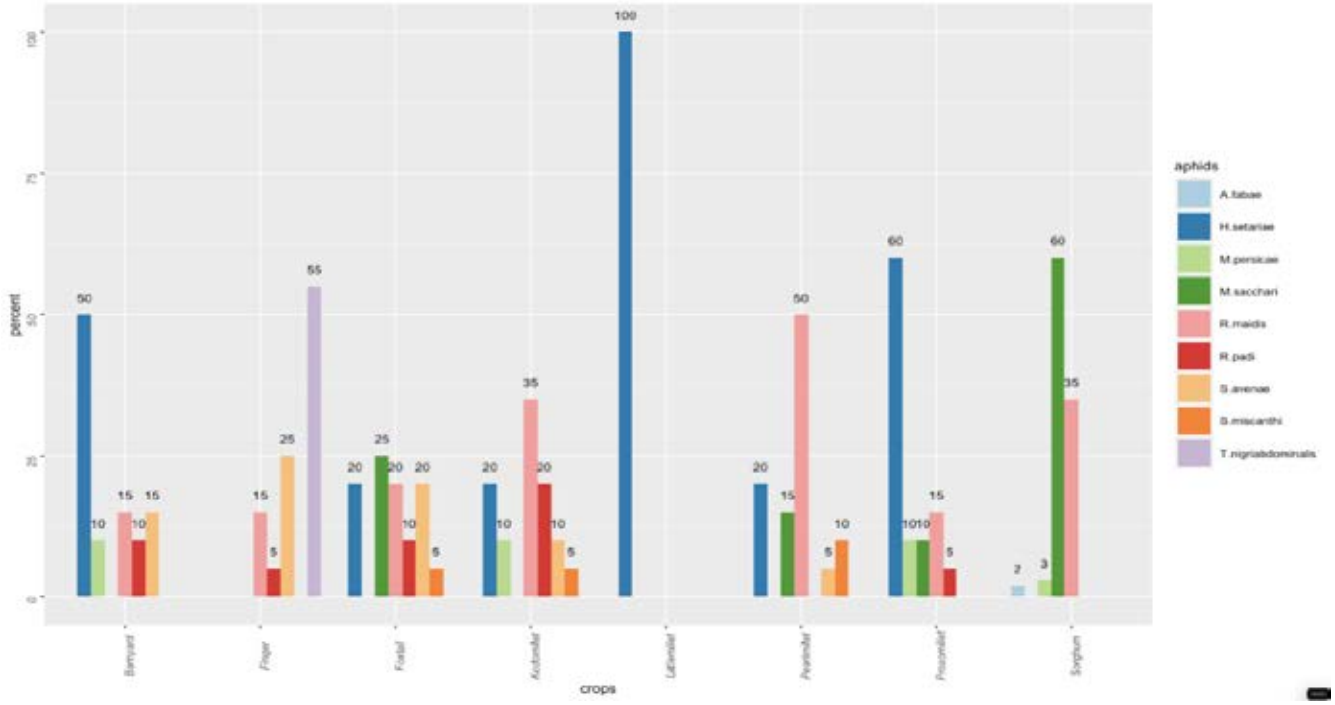


Fig.3.1 Proportion of aphid species occurring on millets

IIMR/CPT/2020-2025/135 Studies on major insect pests of rabi sorghum and development of EILs (PI: K Srinivas Babu)

Resistant sources against aphids, *Melanaphis sachari*

The screening of previously identified sorghum lines (54) in dual background were screened at Solapur. The following lines CSV-29R, CSH 13R, Hathikunta, ICSV 745, PUG-L-9, RSV 1988, SPV 2217, SSV 84 and TAM 428 were found resistant to aphids on per plant basis (Fig.3.2). Similarly, on visual scoring of 1-9 scale, the lines CSV 29R, CSH 13R, KR 191, IS 18363, AKR 354, KR 191, KR 196, PKV Kranti, SSV 84, SPV 2214 and TAM 428 were found to be resistant. From Shoot Pest Nursery the lines AKSV2001, RSV2491, RSV2500, RSV2479, RSV2495, RSV2482, RSV9496 and RSV2434 were promising.

IIMR/CPT/2020-2025/133: Understanding the host pest interactions of shoot fly, stemborer and fall armyworm in millets and management through semiochemicals (PI: PG Padmaja).

Sorghum germplasm tolerant to shoot fly, *Atherigona soccata*

About 106 sorghum germplasm lines collected from different states of India were evaluated for shoot fly, (*Atherigona soccata)* reaction during *kharif*, 2021. The germplasm lines EJN 34 (23.3%) and ER24 (27.5%) were tolerant to shoot fly. The resistant check, IS 18551 and the susceptible check, DJ 6514 recorded 28.6% and 75.6% deadhearts respectively (Fig 3.3).

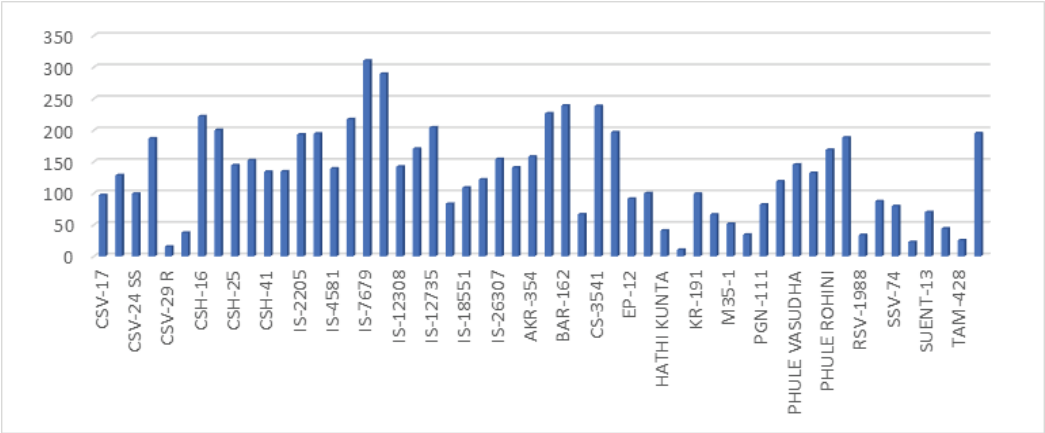


Fig. 3.2. Evaluation of elite lines of sorghum against aphids (No of aphids/plant)

Fig. 3.3 Shoot fly, Atherigona soccata tolerant sorghum germplasm

IPM

Deadhearts at seedling stage

IPM 2270 tolerant to shoot fly

Deadhearts at panicle stage

Fig. 3.4. Proso millet tolerance to shoot fly, *Atherigona pulla*

Proso millet genotypes tolerant to shoot fly, *Atherigona pulla*

Twenty-five proso millet genotypes were evaluated during kharif season, 2021 for shoot fly resistance following standard fish meal technique. Overall resistance was recorded as the percentage of deadhearts (DH%) caused by shoot fly infestation. Plants with deadhearts were recorded in all the plots at seedling stage and panicle stage. There were significant differences among the genotypes for deadheart formation. The genotypes IPM 2904 (11.4%), IPM 2270 (16.7%) and Pro 689 (20.0%) were tolerant to shoot fly whereas the dead heart formation was greater on the genotypes IPM 2635, GPMS 806 and GPMS 534 (Fig. 3.4).

IIMR/ CPT /2020-2025/131: Yield loss assessment in millets due to invasive fall army worm and its integrated management with special emphasis on sorghum (PI: G Shyam Prasad).

Resistance of sorghum to fall army worm

Sixty sorghum entries comprising 7 hybrids, 53 varieties, germplasm lines were screened during Rabi, 2022 against FAW under natural infestation. The entries CSH 16, CSH 13R, CSH 25 were very susceptible when both parameters were considered and could be used as susceptible checks (Fig. 3.5). The entries CSV 20, Phule Anuradha, Rampur local, IS 12308, C 43, TAM 428, 104 B, CSV 27, CSV 38F, IS 2122, IS 7679, IS 12735, IS 26307, EP 117, M 35-1, PUGL 9, PKV Kranthi, RSV 1988, Y 75, ICSB 29004 were tolerant to *Spodoptera frugiperda*. This will be conformed during rabi 2022-23 season.

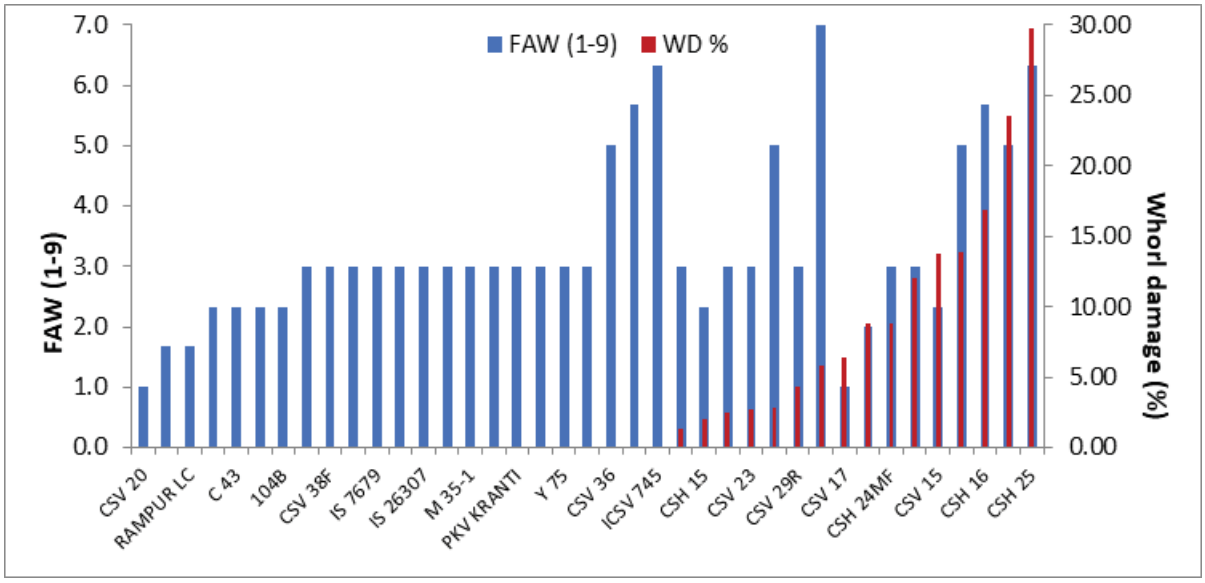


Fig. 3.5. Evaluation of sorghum against fall army worm (Rabi 2021-22).

Biocontrol agents against fall armyworm

For the management of fall armyworm biocontrol agents were tried during Rabi, 2019-20, Rabi 2020-21 in collaboration with ICAR-NBAIR, Bengaluru. The biocontrol agents comprised of egg parasitoid, *Trichogramma pretiosum*, use of entomopathogenic bacteria, *Bacillus thuringenesis,* entomopathogenic fungus, *Metarhizium. anisopliae* NBAIR-Ma35, entomopathogenic nematode, *Heterorahabditis indica* NBAIR H38, growth promoting bacteria, *Pseudomonas fluorescens* (Pf DWD 1%), use of pheromones, with insecticidal check and untreated control.

Release of *Trichogramma chilonis* one card/acre twice at weekly intervals followed by spray of *Metarhizium anisopliae (*Ma 35) 0.5 % at 20, 35 DAE (T1) was found to decrease the egg patches/10 plants (0.83), larvae numbers per 10 plants (1.25) and whorl damage (13.98%) significantly over the recommended package of practice (T2) (Table 3.1). Thus, was a 55 % reduction in whorl damage over the recommended package of practice. There was an 8.2 and 13.8 % increase in grain and fodder yield. This experiment will be further taken up at multi-locations for validation.

Acute toxicity of insecticides

This study was taken up through diet contamination bioassay of insecticides viz., chlorantraniliprole, spinetoram, fipronil, spinosad, broflanilide, indoxacarb, thiomethoxam and emamectin benzoate to fall army worm, *Spodoptera frugiperda*. Broflanilide (a new insecticide) was the most effective insecticide with

Table 3.1. Validation of FAW management module in Sorghum using bio-control agents, Rabi 2022

Treatment	Egg mass/10 plants	Larvae/10 plants	Whorl damage (%)	Grain Yield (t/ha.)	Fodder Yield (t/ha)
T1	0.83	1.25	13.98	4.35	7.23
T2	1.64	2.85	31.33	3.94	6.48
CD (0.05)	0.42	0.44	2.95	0.13	0.24

least median lethal concentration values (0.13 ppm) followed by chlorantraniliprole (2.54 ppm), spinosad (2.64) and spinetoram (2.96). A concentration of 5 ppm of broflanilide caused 95% mortality to fall armyworm larva at 24 hours. Chlorantraniliprole, spinosad, spinetoram and emamectin were also effective. Broflanilide was found to cause mortality in less time than any other insecticide tested that too in very low concertation of 0.5 ppm. Spinosad, chlorantraniliprole, and spinetoram at 5 ppm caused 50% mortality in 34, 41 and 47 hours, respectively. Broflanilide was 10 times more effective than chlorantraniliprole, spinetoram and spinosad

IIMR/CPT/2020-2025/132: Risk of pesticide sprays on sorghum: Acute and field toxicities on stem borers & shoot bug and their natural enemies (PI: J Stanley).

Acute toxicity of insecticides to stem borer, *Chilo partellus*

Acute toxicities of insecticides were tested through filter paper disc bioassay in the third instar larva of stem borer, in the laboratory. Based on mortality of larva at different concentrations of insecticides, median lethal concentration was estimated through Probit analysis. Chlorantraniliprole was found to be the most effective insecticide with least median lethal concentration values (1.03 ppm) which was followed by spinetoram (LC50 = 3.52 ppm) (Table 3.2). Neonicotinoids are generally used for sucking pest management and thus not effective against stem borer larva.

Acute toxicity of insecticides to shoot bug, *Perigrinus maidis*

Acute toxicity of insecticides was evaluated against shoot bug nymphs using filter paper and twig bioassays. In filter paper bioassay, nymphs were allowed to crawl in the treated filter papers for specified time and in twig bioassay, sorghum twigs were dipped in insecticides for 10 seconds, shade dried and shoot bugs nymphs released. Observations were taken after 24 and 48 hours after treatment and probit analysis carried out. Among five insecticides tested, broflanilide was found effective against *P. maidis* in filter paper bioassay followed by emamectin benzoate. Spinetoram and thiamethoxam are more toxic to the pest through ingestion than through contact mode (Table 3.3). Emamectin is equally toxic both through contact and ingestion mode.

Table 3.2. Acute toxicity of insecticides to stem borer, *Chilo partellus*

Insecticide	Field con-centration (ppm)	LC_{50} (ppm)	Fiducial limits	LC_{95} (ppm)	Equation (y= a+bx)	Hetero-genicity (χ^2)
Imidacloprid	50	236.46	173.59-316.9	943.98	Y=2.37+0.61±0.23x	3.29
Thiamethoxam	50	459.84	341.36-649.61	1826.01	Y=0.71+1.61±0.23x	0.91
Thiacloprid	240	42.56	28.71-70.18	271.18	Y=1.38+1.89±0.09x	0.72
Emamectin	20	10.81	8.88-13.93	28.31	Y=2.77+1.30±0.21x	0.10
Fipronil	100	11.26	6.93-16.51	204.62	Y=3.62+1.31±0.18x	3.78
Spinetoram	120	3.52	1.07-7.20	49.71	Y=1.83+3.71±0.11x	1.58
Indoxacarb	60	24.93	11.77-41.03	67.36	Y=2.25+1.41±0.24x	2.07
Chlorantraniliprole	60	1.03	0.17-5.37	33.45	Y=1.71+1.07±0.74x	1.42
Flubendiamide	120	13.57	6.64-28.04	44.63	Y=0.79+1.31±0.27x	2.73
Broflanilide	-	20.93	15.51-28.22	166.08	Y=2.58+1.83±0.27x	1.13

Table 3.3. Acute toxicity of insecticides to *Perigrinus maidis*

Method	Insecticide	Field concentration (ppm)	LC_{50} (ppm)	Fiducial limits	LC_{95} (ppm)	Equation (y= a+bx)	Heterogenicity (χ^2)
Filter paper bioassay	Thiamethoxam	50	242.53	153.39-389.97	3217.91	Y=2.51+1.04±0.15x	5.58
	Thiacloprid	240	81.52	56.19-121.06	907.88	Y=2.57+1.27±0.19x	2.09
	Spinetoram	120	100.41	60.47-154.91	1172.43	Y=2.80+1.09±0.15x	6.72
	Emamectin	20	27.25	18.44-39.57	323.25	Y=3.16+1.28±0.30x	0.39
	Broflanilide		5.33	3.06-8.99	244.51	Y=4.34+0.91±0.13x	0.91
Twig bioassay	Spinetoram	120	36.85	22.07-53.95	373.68	Y=2.95+1.30±0.21x	0.69
	Thiacloprid	240	38.86	24.70-55.14	436.804	Y=2.71+1.44±0.21x	1.15
	Emamectin benzoate	20	28.75	17.51-43.17	272.94	Y=3.38+1.11±0.15x	2.13

IIMR/CPT/2020-2025/134: Integrated pest management for major shoot pests of sorghum during post rainy season in dryland regions (P.I. Dr. B. Subbarayudu)

Integrated management of shoot pests

A trial was carried out during the rabi 2021-22 at Centre on Rabi Sorghum, Solapur to find out the cost-effective Integrated pest management technology for shoot pests in three modules. The cultivar CSV 29R was raised with proper agronomic practices for the experimentation. The modules, namely, Module 1: (Chemical Module): High seed rate @ (10 kg/ha), Seed treatment with imidacloprid @ 6 ml/kg of seed, whorl application of fipronil 0.3 GR @ 7.5 kg/ha (21 days after germination (DAG)) & spray of emamectin benzoate 5 % SG (0.3 g/litre) (35 DAG). Module 2: (Bio-intensive Module): Seed treatment with thiamethoxam 19.8 w/w (6 ml/kg of seed) + Cyantraniliprole 19.8 w/w @ 6 ml/kg of seed, Release of egg parasitoid, *Trichogramma chilonis* released twice at 20 & 30 DAG @ 125000/ha, Spray of entomopathogenic fungi, *Metarhizium anisopliae* (Ma 35) @ 5ml/liter (NBAIIR) at 45, 60 DAG. Module 3: (Farmer's Practice Module): Seed rate @ 7.5kg/ha; spray of emamectin benzoate 5 %SG @ 0.3 g/litre at 30 DAG.

The shoot fly eggs and its deadhearts were recorded at 21 days after germination (DAG), stemborer deadhearts recorded at 45 days and shoot bug adults recorded at 60 days. All agronomic practices were adopted to raise the crop successfully. The chemical based module recorded the least number of shoot fly eggs/ 3 plants at 21 DAG (7.2) and deadhearts (6.0 %); stemborer deadhearts recorded at 45 days after germination (10.20 % DH); shoot bug adults /3 plants recorded at 60 DAG (4.0). The grain yields/ha were recorded highest in chemical based module (3.20 tonnes/ha; followed by biointensive module (2.60 tonnes/ha) and with farmers Practice based module (1.90 tonnes/ha). The economics of these modules were also calculated and found that chemical based module found cost effective (BC ratio = 2.63:1); biointensive module (BC ratio = 1.98:1) and farmer's Practice (BC ratio = 1.55:1).

3.2. Disease management

IIMR/CPT/ 2016-21/107: Studies on millet diseases with emphasis on blasts (PI: IK Das).

Sources of rust, brown spot and sheath blight resistance in foxtail millet

In foxtail millet, diseases like rust, brown spot and sheath bight affect the grain yield apart from blast other diseases (Fig. 3.6). A total of 176 accessions

of foxtail millet along with resistant and susceptible checks were evaluated for foliar disease resistance under natural field conditions using augmented design at Bengaluru, Nandyal and Vizianagaram. Moderate to severe disease appeared at Vizianagaram (rust, brown spot, sheath bight), Bengaluru (rust) and Nandyal (rust) (Table 3.4). Disease severities were scored on a 1-9 scale (1 = highly resistant, 9 = highly susceptible).

Rust severity was moderate to severe (mean score 4.2-4.5 on a 1-9 scale) in all the locations and around 19% accessions were susceptible (≥6). Eleven acc. were resistant at two out of three locations and acc. IC0308976 and IC0404266 were resistant at all the locations (Fig. 3.7). Brown spot was severe at Vizianagaram (mean 5.3) and low at Bengaluru (mean 2.1). Twelve acc. were resistant, of which IC0404112 was highly resistant (score 1) at both the locations (Fig. 3.8). Sheath blight was severe at Vizianagaram (mean 5.9) and around 64% accessions were susceptible (≥6). Eleven acc. were resistant of which 4 acc. (IC0403442, IC0479317, IC0479713 and IC0480417) were highly resistant (Fig. 3.9). Accession IC0308976 was resistant to all these three diseases and will serve as an important source material for future breeding programme on disease resistance.

Fig. 3.6. Leaf diseases of foxtail millet; (a) rust, (b) brown spot, and (c) sheath blight.

Table 3.4. Foliar disease reactions of 176 foxtail millet accessions over multiple locations

	Severity score (1-9)		No. of lines in different disease reaction category		
Locations	**Range**	**Mean**	**Resistant**	**Moderately resistant**	**Susceptible**
	Rust				
Nandyal	3−6	4.5	47	94	35
Vizianagaram	1−8	4.2	40	108	28
Bengaluru	1−7	4.4	38	102	36
	Brown spot				
Vizianagaram	1−8	5.3	17	63	96
Bengaluru*	1−3.5	2.1	176	0	0
	Sheath blight				
Vizianagaram	1−9	5.9	13	51	112

*Location not to be considered as disease pressure was low. Resistant (≤3), Susceptible (≥6).

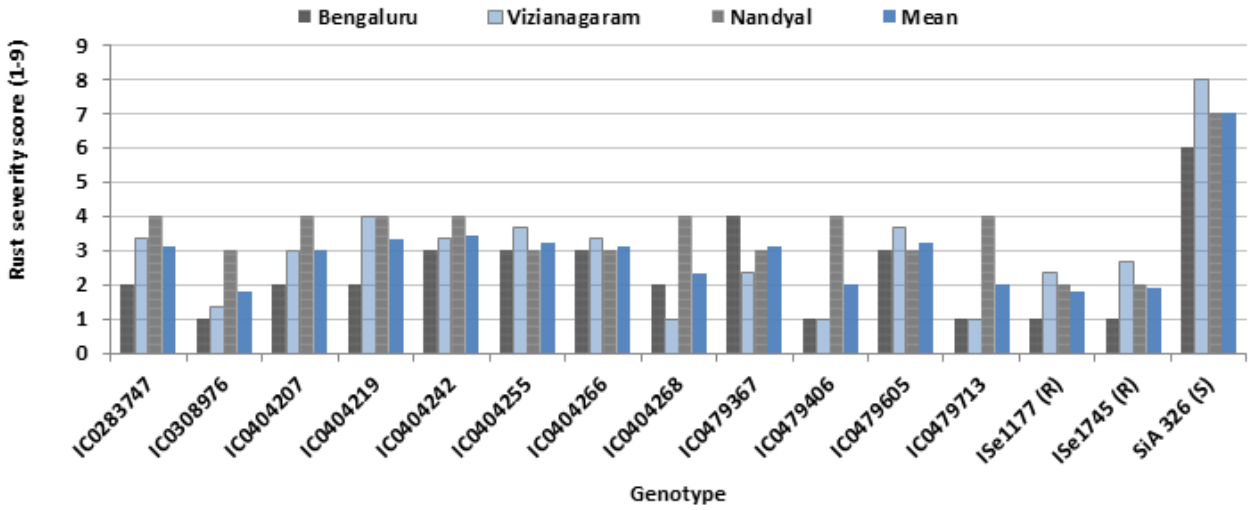


Fig. 3.7. Rust resistance accessions of foxtail millet across growing locations

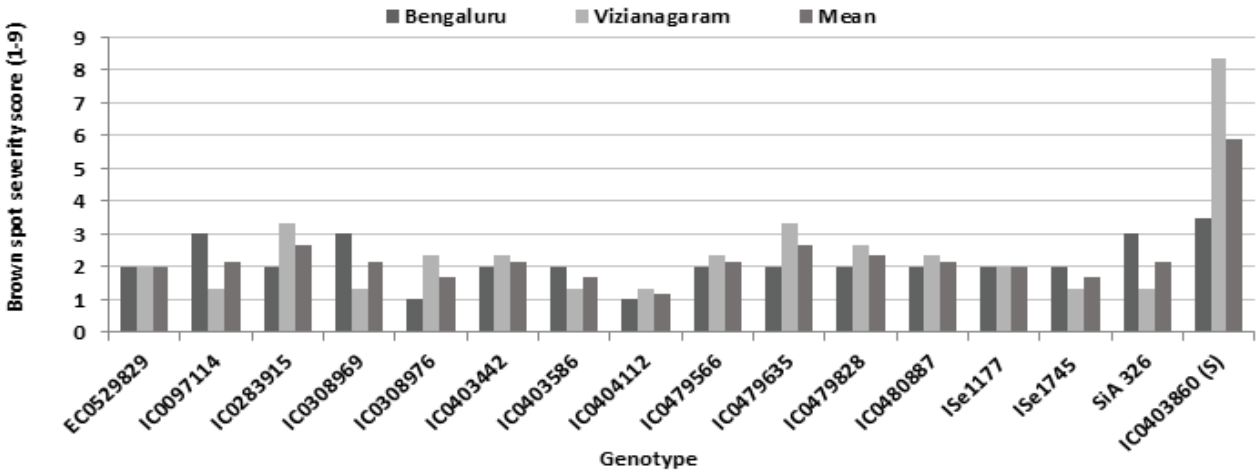


Fig. 3.8. Brown spot resistant accessions of foxtail millet across growing locations

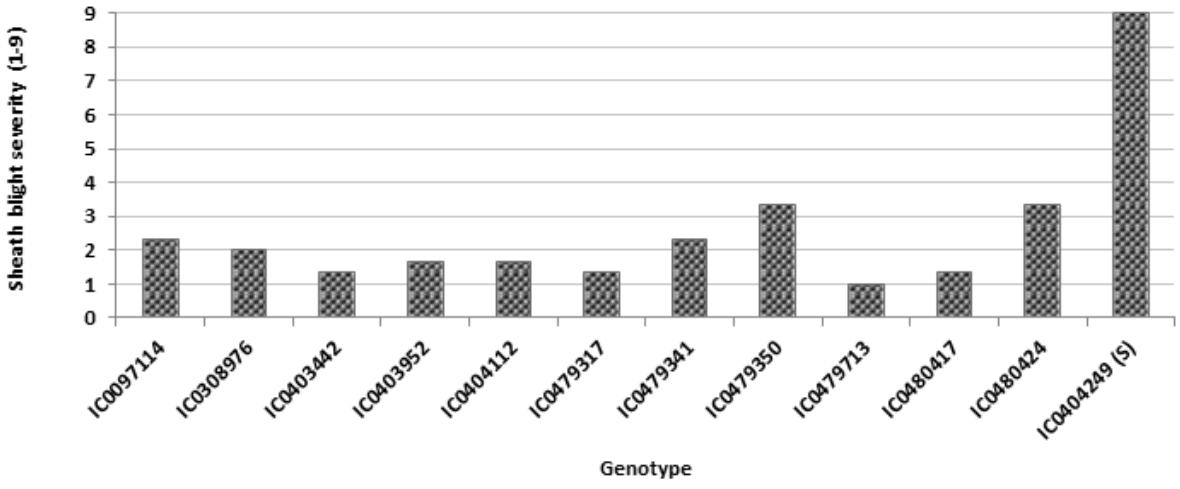


Fig. 3.9. Sheath blight resistant accessions of foxtail millet

Response of brown mid-rib sorghum to foliar diseases resistance

Foliar disease resistance is an important requirement for forage sorghum. Brown mid-rib forage sorghums improve forage quality as they contain less lignin, which increase fiber digestion and overall performance of animal. However, reduced lignin may sometimes lower disease resistance properties. Therefore, BMR 12 mutants (*bmr*6 and *bmr*12) along with their five wild types were evaluated for foliar disease reactions against natural inoculums during kharif 2021 and 2022. Anthracnose and zonate leaf spot appeared naturally during 2021 and their severity was recorded on 1-9 scale. During 2022 only target leaf spot appeared, and the disease was scored as percent disease index (PDI). In Kansas Kolliera and Texas background mutants had no difference in anthracnose resistance over wild type (Table 3.5). Early Hagaris Sart mutants were more susceptible than wild type. However, two mutants with bmr genes *viz*., Atlas (*bmr*6 + *bmr*12) (score 5.0) and Rox Orange (*bmr*12) (score 3.5) exhibited significantly better anthracnose resistance than their respective wild type. In case of zonate leaf spot, mutants were either more susceptible or at par in resistance with their respective wild type, except the mutant Early Hagaris Sart (bmr6) (5.5), which had significantly more resistant zonate leaf spot than its wild type (6.5). For target leaf spot there were no differences among mutants and their wild types on resistance. The information will be useful for improvement of foliar disease resistance in forage sorghum.

Table 3.5 Foliar disease reaction of BMR mutants of sorghum

BMR lines	Kharif 2021		Kharif 2022
	Anthracnose (1-9)	Zonate leaf spot (1-9)	Target leaf spot (PDI)
Atlas (WT)	6.5	5.5	34.2
Atlas (bmr6)	6.5	6.5	33.8
Atlas (bmr12)	6.5	6.5	31.5
Atlas (bmr6+bmr12)	5.0	6.5	30.7
Kansas Kollier (WT)	5.5	6.5	30.0
Kansas Kollier (bmr6)	5.5	8.0	31.4
Kansas Kollier (bmr12)	5.0	6.5	29.6
Rox Orange (WT)	6.0	7.5	36.9
Rox Orange (bmr6)	5.0	7.0	37.8
Rox Orange (bmr12)	3.5	7.0	35.4
Early Hagaris Sart (WT)	5.0	6.5	29.1
Early Hagaris Sart (bmr6)	6.5	5.5	25.1
Early Hagaris Sart (bmr12)	6.5	6.5	30.3
Tx430 (WT)	7.0	5.5	26.7
Tx430 (bmr6)	6.5	6.0	32.7
Tx430 (bmr12)	6.5	5.5	32.3
Tx430 (bmr6+bmr12)	7.0	6.0	32.8
CD at 5%	0.9	0.8	NS
CV %	16.1	12.3	15.2

WT= wild type; NS= non-significant

IIMR/CPT/2020-2025/130: Studies on endophytes for management of major soil-borne diseases of millets (PI: G Rajesha)

Isolation of endophytes from small millets

The plant samples of finger millet, little millet and kodo millets were collected from different growing locations of India for isolation of endophytes. The root, shoot and sheath portion of the plant samples were used for isolation of bacterial endophytes through sterility check method. A total of 118 bacterial endophytes were isolated from root, shoot and sheath portion of finger millet (42), little millet (37) and kodo millet (39).

Screening of small millets endophytes against *Rhizoctonia*

The bacterial isolates of all small millets were screened against the banded sheath blight pathogen (*Rhizoctonia solani*). Among the finger millet isolates, FM18 recorded 61.11%, little millet isolate LM42 recorded 57.78% and Kodo millet isolate LM24 recorded 60.37% of mycelial inhibition of *Rhizoctonia solani* under *in-vitro* (Table 3.6). Based on the inhibition level, isolates of 12, 12 and 10 were selected from finger millet, little millet and kodo millet respectively for the plant growth promotion tests (Fig. 3.10.).

Screening of bacterial endophytes for plant growth promotion activities

Based on the inhibition level, 46 best performing bacterial endophytes were selected from Sorghum, finger millet, little millet and Kodo millet for the plant growth promotion activities (Table 3.7.). Out of 47 bacterial endophytes, 26, 34, 6 and 7 number reported positive for Ammonia production, Phosphate solubilisation Siderophore production and HCN production respectively (Fig. 3.11.).

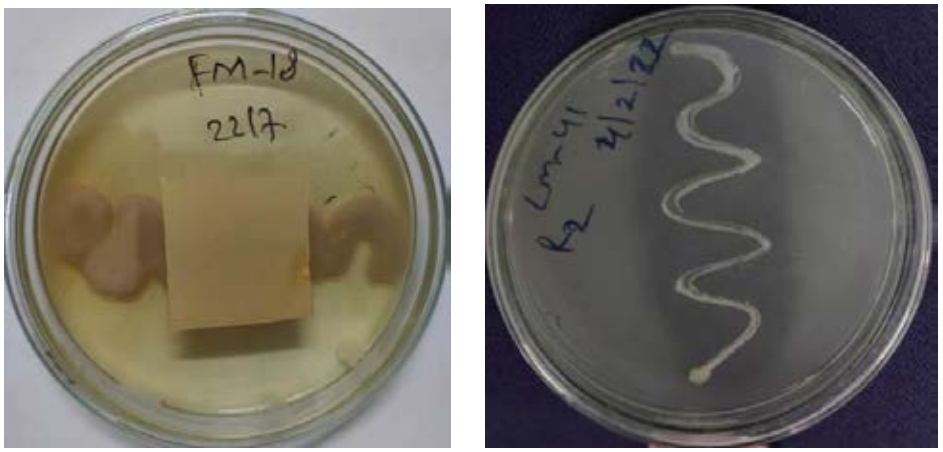
Table 3.6. Screening of small millets endophytes against *Rhizoctonia solani*

Sl No.	Endophytes	No. of isolates	Mycelial Growth inhibition (%)	
			Range	Mean
1	Finger millet	42	5.19 - 61.11	31.24
2	Little millet	37	20.37 - 57.78	41.12
3	Kodo millet	39	20.37 – 60.37	37.96

Fig. 3.10. *In-vitro* screening of bacterial endophytes of small millets against *Rhizoctonia solani*

Table 3.7. Screening of bacterial endophytes for plant growth promotion activities

Sl No.	Endophytes	Ammonia production	Phosphate solubilization	Siderophore production	HCN production
1	FM isolates	8	9	1	1
2	LM isolates	5	11	2	4
3	KM isolates	4	9	2	1
4	Sorghum isolates	9	5	1	1
	Total isolates	26	34	6	7



Siderophore production (FM18) Phosphate solubilization (LM41)

Fig. 3.11. Siderophore production and phosphate solubilisation as growth promotion activities

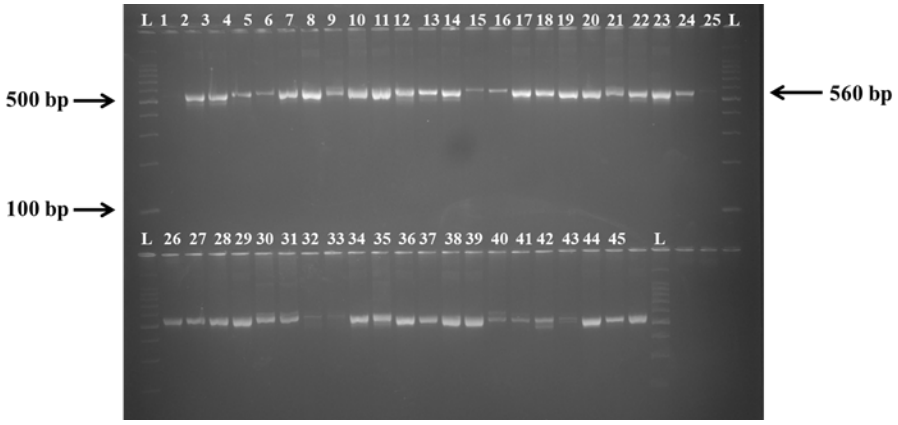


Fig. 3.12. PCR amplification of bacterial endophytes of millets

Molecular characterization of bacterial endophytes

The best performing isolates of sorghum, Finger millet, little millet and kodo millet were amplified by using 16S rRNA intervening sequence specific primers. All the endophytes were amplified at 560bp (Fig. 3.12).

IIMR/CPT/2022-2027/159: Characterization, symptomatology and advanced diagnostics of viruses infecting sorghum (PI: Baswaraj Raigond)

Symptoms of viral disease on rabi sorghum

Viruses cause various types of symptoms on sorghum. There are twenty-three viruses known to infect the sorghum globally, whereas in India, there are three groups of viruses naturally infect sorghum i.e., potyvirus, Tenuivirus and Rhabdovirus. A survey was undertaken in farmer's field and at the experimental farms at Solapur to record the type of symptoms produced on sorghum during rabi (2021-22).

A wide range of symptoms including mosaic, mottling, yellowing, chlorotic streaks or stripes, reddening of leaves, necrotic spots, dwarfing/stunting, sterility and poor exertion of panicle were observed (Fig. 3.13). However, the recorded viral diseases need to be confirmed by serological or molecular based diagnostic assays. Transmission electron micrograph (TEM) of the symptomatic leaf samples showed the presence of spherical particles of 38 nm diameter and also filamentous particles of 800 nm length (Fig. 3.14). This gave a clear pitchure that the plants showing typical symptoms of viral diseases were carrying the virus particles.

Fig 3.13. Expression of various viral symptoms like continuous and discontinuous chlorotic streaks, red stripes and mosaics on foliage and also the panicle with poor exertion.

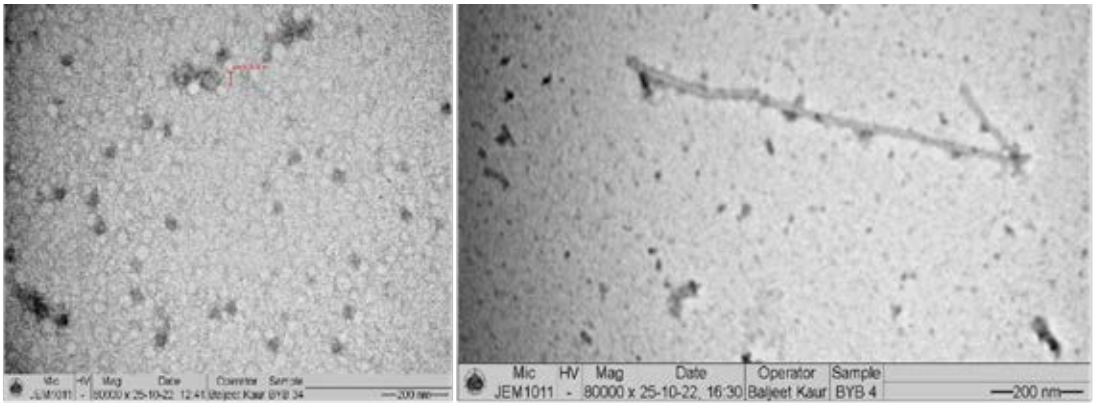


Fig 3.14. Transmission Electron microscopic examination, where we observed spherical particles of 38 nm diameter (A) and Filamentous particles of 800 nm length (B).

4. Resources Management for Higher Millets Productivity

IIMR/CPD/2020-2025/129: Development of intra millet intercropping systems for resilience and sustainability (PI: B Gangaiah)

Intercropping in grain sorghum:

Field study with 39 treatments (12 sole crops (11 nutricereals & pigeon pea) and 27 additive series intercrops i.e., 7 small millets & buckwheat as additive intercrops (1, 2 and 3 rows) between two rows of sorghum (8 x 3 =24 intercrops), 1 row of pearl millet and grain amaranth between 2 rows of sorghum and 1 row of pigeon pea after 2 rows of sorghum (1:2) as a check) was conducted during *kharif*-2021 in RBD with 2 replications.

Temporal data has indicated that buckwheat, proso millet, bajra, foxtail millet and brown top millet have shorter crop duration (maturing in 45-84 days) than sorghum (105 days) and are suitable candidates for intercropping. Finger millet, grain amaranth and pigeon pea have longer duration (20, 24 and 45 days) and Kodo millet with similar duration as that of sorghum. Buckwheat and proso millet (45 and 68 day) thus have huge temporal difference with sorghum. Spatial (plant height) data has indicated that except grain amaranth (159.8 cm) all other nutricereals are shorter in stature to sorghum (165.3 cm) at its flowering. Other tall nutricereals of bajra (142.3 cm) and barn yard millet (131.9 cm) were also spatially shorter to sorghum. Spatially all nutricereals can be intercrops of sorghum, while temporally, finger millet and grain amaranth are not suitable intercrops with sorghum. Pigeon pea is both temporally (despite long duration) and spatially suitable for intercropping with sorghum.

Sorghum has incurred a yield penalty of 14.96, 15.69 and 22.04% in 1:1,1:2 and 1:3 intercropping with nutricereals as compared to its sole cropping (3390 kg/ha). Among the intercrops, bajra, grain amaranth (30.8, 27.7%) have inflicted the highest yield penalties on sorghum; while buckwheat (6.3%), foxtail millet (10.8%) and proso millet (14.9%), the least. Intercrop nutricereals have the highest yield in 1:3 ratio. Intercropping of sorghum with nutricereals in 1:1, 1:2 and 1:3 rows has improved the land equivalent ratio (LER) by 56, 34 and 21% (Table 4.1).

Table. 4.1. Land Equivalent ratio sorghum as influenced by intercropping with nutricereals.

Crop	Intercropping (sorghum: inter-crop rows)			Mean
	(1:1)	(1:2)	(1:3)	
Sorghum (S)	-	-	-	1.00
S + Brown top millet	1.55	1.24	1.13	1.31
S + Foxtail millet	1.62	1.38	1.22	1.41
S + Finger millet	1.65	1.46	1.39	1.50
S + Kodo millet	1.60	1.42	1.31	1.44
S + Little millet	1.52	1.23	1.10	1.28
S + Proso millet	1.59	1.30	1.10	1.33
S + Barnyard millet	1.53	1.31	1.20	1.35
S + Bajra	1.49	-	-	1.49
S + Grain amaranth	1.39	-	-	1.39
S + Buck wheat	1.67	1.39	1.24	1.43
Mean	1.56	1.34	1.21	1.39

Rain water use efficiency (WUE) of grain sorghum (5.85 kg/ha-mm) was enhanced by 57.9% due to nutricereal intercropping (8.92). Among intercropping systems (ICS), rain WUE was highest with sorghum + bajra ICS (14.16) and least with barnyard millet ICS (7.27). Intercropping of sorghum with nutricereals in 1:1, 1:2 and 1:3 has reduced the weed biomass at 20 days after sowing by 22.5, 27.1 and 31.9%, respectively over sole sorghum (32.5 g/m^2). No major pest and disease build up was observed due to intercropping.

Intercropping sweet sorghum with millets

Temporal data has indicated that sorghum and bajra have a 24- and 49-days' shorter duration than sweet sorghum (129 days) and are suitable candidates for intercropping. Spatial (plant height) data has indicated that bajra has more differences than sorghum with sweet sorghum. Grain sorghum has inflicted an 8.1% yield penalty on sweet sorghum (45.5 t/ha cane yield) while bajra has insignificant impact on sweet sorghum productivity (5.5% yield penalty). Additional yield of sorghum and bajra intercrops (72.3 and 75.3%) has improved the LER by 64.2 and 69.8% as compared to sole sweet sorghum and thus intercropping of grain sorghum or bajra in sweet sorghum in 1:1 ratio is promising.

Testing of "UPH 2221" for its bio-efficacy against weed flora of in Sorghum (external funded project from UPL): (B. Gangaiah et al)

A field experiment on sorghum (non-transgenic) was conducted during *kharif* 2021 season at GTC farm, Rajendranagar with the objective of finding out the impact of post-emergence application of UPH-2221 herbicide at 4 levels (112.5, 150, 187.5 and 300 g a.i/ha) at 2-4 leaf stage of weeds on weed management including crop toxicity. Seven weed control treatments (Table 4.2) were evaluated in RCBD with four replications.

Data reveals that uncontrolled weeds have reduced the sorghum green fodder yield (GFY) by 58.75% when compared with weed free through hand weeding's twice at 15 and 30 days after sowing (DAS). Application of UPH-2221 @ 187.5 g a.i./ha at 2-4 leaf stage of sorghum has resulted in at par GFY as that of hand weeding's twice treatment. Further, it was at par with UPH-2221 @ 150 g and 300 g a.i/ha. Application of 2-4, D Na ethyl amine proved as effective as UPH-2221 application @ 112.5 g a.i/ha, though it has controlled only broad leaved weeds. UPH-2221 application @ 300 g a.i/ha resulted in crop phytotoxicity and the symptoms are seen on leaves as scorching, that

Table 4.2. Effect of weed management through UPH-2221 on fodder production of sorghum

Weed management treatment	Green fodder yield (t/ha)
UPH 2221 @ 112.5 g a.i/ha	18.59
UPH 2221 @ 150.0 g a.i/ha	21.13
UPH 2221 @ 187.5 g a.i/ha	22.84
2-4, D-Na ethyl amine salt @ 1800 g a.i/ha	17.76
Hand weeding twice at 15 & 30 DAS	24.68
Weedy check	10.18
UPH 2221 @ 300 g a.i/ha	21.07
CD 5%	1.854
CV %	6.413

however, has killed all the weeds more effectively than all other treatments present in the crop and thus did not cause any significant reduction in GFY over its 150 and 187.5 g a.i/ha application.

IIMR/CPD/2021-26/152: Improving water use efficiency of finger millet & foxtail millet under limited moisture conditions (PI: Swarna Ronanki)

Field experiments were conducted to evaluate the productivity and water use efficiency of finger millet varieties under different irrigation regimes during rabi 2021 in split plot design with three replications.

The data revealed that among the three irrigation regimes (Table 4.3), significantly higher plant height, grains per ear head, finger length, grain yield and stover yield were reported with I1. The percent reduction of grain yield in I2 and I3 over I1 is 12 and 32% respectively. Among the 12 finger millet varieties, GPU 66 gave significantly higher grain yield followed by ML 365 and CFMV 1. PR 202 recorded significantly lower grain yield. With respect to water use efficiency, significantly higher values were recorded with ML 365 followed by GPU 66 and CFMV1 &2. Significantly lower water use efficiency was recorded with GPU 67 & PR 202 (Table 4.4).

Table 4.3 Effect of irrigation regimes on growth, yield parameters, yield and water use efficiency of finger millet varieties

Irrigation regime (% DASM)	Plant height (cm)	DFF	Grains/ ear head	Finger length (cm)	Grain yield (kg/ha)	Stover yield (kg/ha)	Harvest Index	WUE (kg/ ha-mm)
I1: 25%DASM	70.6	68.8	1591.2	6.80	2301.6	3945.5	36.66	3.51
I2: 50%DASM	68.4	67.5	1543.0	6.50	2031.6	3771. 0	34.89	5.12
I3: 75%DASM	65.6	66.2	1306.9	6.41	1579.4	3266. 6	32.41	6.02
CD (P 0.05)	1.13	1.88	84.48	NS	205.22	128.53	2.17	0.40

Table 4.4. Performance of finger millet Varieties at different irrigation regimes

Genotype	Grain yield (kg/ha)	WUE (kg/ ha-mm)
GPU 67	1726.4	4.20
KMR 340	1896.9	4.56
PR 202	1693.1	4.29
MR 1	1851.4	4.40
VL 376	1750.5	4.37
KMR 630	1852.9	4.49
CFMV 1	2170.6	5.46
GPU 28	2060.4	5.03
GPU 66	2240.7	5.54
GPU 48	2072.8	5.17
CFMV 2	2143.8	5.46
ML 365	2190.9	5.67
CD (P 0.05)	301.67	0.80

5. Extension research, Economics and Value-addition

5.1 Extension Research

IIMR/ER/2021-2026/156: Yield gap and constraints analysis of sorghum production in traditional area (PI: RR Chapke)

To determine yield gap at different levels, data on sorghum yields were collected from farmers directly and secondary sources on *kharif* sorghum of last three years (2019-2022). The Yield Gap (YG), Extension Gap (EG) and Technology Index (TI) of *kharif* sorghum production were computed (Table 5.1). During theses three years of cultivation, Yield Gap-I which was between potential and demonstration yield was found to be 7.57 q/ha, extension gap (9.17 q/ha) and technology index of 19%, on an average. The technology gap between potential yield of the cultivars and their yield under demonstrations was observed to be 7.57 q/ha. The reason for high technology gap was due to local climate coupled with variation of soil fertility status and adoption of management practices by farmers. Regarding Yield Gap-II which is extension gap was found to be 9.17 q/ha. This shows need of emphasizing on enhancing dissemination of improved technologies and adoption of the high yielding cultivars along with improved cultivation practices.

In order to understand, the reasons for not adopting sorghum cultivation by non-beneficiary farmers, various constraints were analysed. When compared the results of beneficiary and non-beneficiary farmers' constraints, indicated that major constraint for declining sorghum cultivation was due to severe damage of crop by birds or wild animals was on top. The non-beneficiary farmers ranked, high labour requirement (MWS=294), lack of attractive market prices (MWS=250) and shoot fly infestation at initial stages (MWS=248) on 2nd, 3rd and 4th rank, respectively. Whereas, both farmers had serious constraints of lack of regulated markets. The study indicated yield gaps of 34%, technology gap (7.57q/ha) and extension gap (9.17 q/ha) was identified. Technology Index was found to be of 19%, which indicated that there is need to make the technology more feasible to the farmers. Significant knowledge gap was also determined (t value 20.15**). Moreover, crop damage by birds and animal was found to be a major constraint in sorghum production. Therefore, problem-based solutions in the form of production technologies will help farmers to sustain sorghum production.

Farmer FIRST Project on Participatory Technology Validation, Diversification, Value Addition for Small Holders Livelihood Improvement of Central Telangana Zone (PI: Chapke RR)

A total of thirteen technology interventions were provided under this project to the farmers. Primary processing facilities on millets were updated which were helping the farmers to realize higher income from de-hulled grains under the same module.

Table 5.1 Yield, extension gaps and technology index of rainy sorghum production

Year	Potential yield (q/ha)	Demonstration yield (q/ha)	Farmers practice yield (q/ha)	Increase over FP (%)	Technology gap (q/ha)	Extension gap (q/ha)	Technology Index (%)
2019-2020	39.0	31.2	23.4	33	7.8	7.8	20
2020-2021	40.5	33.3	22.7	31	7.2	10.6	18
2021-2022	40.5	32.8	23.7	38	7.7	9.1	19
Mean	40	32.43	23.27	34	7.57	9.17	19

FP = Farmers' practice

Though improved millets technologies were proven to be profitable under crop module (Fig. 5.1) in this study, millets, and allied enterprise like, livestock and business move could assure the enhancement of farmers' income in rainfed areas. Millets-based faming like, backyard poultry, dairying and goat farming were enabled to make additional income through utilizing by-products and farm-waste which was found to be an imperative move for optimum output.

Farmer-led extension strategy for enhancing farmers' income through millets-based farming system in hilly and tribal areas (PI: Chapke RR)

Millets Farmer Facilitators were facilitated with various activities and awareness related to improved millet production and processing along with the group members which led to empowerment of millets farmers. The group has been holding community seed banks and facilitating adoption of millet technologies also in Kolli Hills of Namakkal district of TN, and Koraput district of Odisha by personal interview data collection method. Overall, it was found that the majority of the fellow farmers had poor socio-economic status and low level of education. Based on the above survey from the group members, some of the following important technology interventions emerged (Fig. 5.2).

Fig 5.1 Field view of little millet (GNV 3)

Fig. 5.2. skill development (b) and demonstration of seed drill.

5.2 Economics

IIMR/EVA/2020-2025/136: Economic analysis of production, marketing, utilization, and policy perspectives of sorghum in India (PI: Anuradha Narala)

Collected consumption data and market wise price data of sorghum from all the secondary sources of all sorghum growing states. Analyzed Total Factor Productivity (TFP) of sorghum in Karnataka, Maharashtra and Andhra Pradesh by using DES, GOI data (Includes both Kharif and Rabi) from 1991-92 to 2018-19. The total factor productivity estimates in sorghum crop in Karnataka indicates that there is substantial growth with fluctuations in TFP, and the research and extension contributions were the reasons for positive TFP growth. During the period I (1991-92 to 2004-05) TFP of sorghum increased significantly with a growth rate of 3.29 percent per annum but during Period II (2005-06 to 2018-19) TFP of sorghum registered a negative growth even though there is a positive growth in input index. It is observed that the TFP for sorghum in Maharashtra increased from 1.11 in 1992 to 2.02 in 2018-19. The highest TFP index was observed in 2015-16 (2.56). The average TFP index for overall period was 1.78. The TFP grew at the rate of 4.15 per cent per annum. In case of Andhra Pradesh the TFP was positive and moderate which increased from 1.20 in 1992-93 to 2.11 in 2018-19 even though there was decline in input index. The TFP grew at the rate of 3.03 per cent per annum.

5.3 Value-addition and Commercialization

IIMR/VA/2021-2026/155: Development of millet based composite foods in fortification with fisheries, dairy, meat and horticultural commodities in collaboration with the ICAR Institutes. (PI: B Dayakar Rao)

Kodo millet Analogue rice

Different trials have been undertaken to develop Low GI, Gluten free kodo millet based analogue rice (Fig.5.3). Among all the trials Kodo millet semolina (79%): Arrowroot powder (19.5%) has showed the highest textural and overall acceptability.

Foxtail millet- chicken biryani

Different trials have been done to develop ready to eat (RTE) foxtail millet chicken biriyani (X-press foods) with polished foxtail millet, chicken and other ingredients (Fig.5.4). Pre-cooked foxtail millet and chicken were dried with different drying techniques (tray drying, microwave drying and freeze drying) after drying chicken biriyani formulation was made with different treatments. Analyzed physio-chemical parameters, rehydration test and organoleptic evaluation for developed products. Among all the treatments T3

Fig 5.3 Kodo millet analogue rice and analogue rice recipe

Tray Dried formula | Rehydrated biriyani. | Microwave Dried formula | Rehydrated biriyani. | Freeze Dried formula | Rehydrated biriyani.

Fig.5.4 Foxtail millet-chicken biryani

Table 5.2 Average Utilization (%) of Millets by farmers in major millet producing states (2020)

	Sorghum		Bajra	Ragi	Small Millets (I)	Small Millets (II)
	Kharif	Rabi				
Self-Consumption (q)	31.13	67.82	34.69	55.00	29.00	55.00
Feed (q)	19.37	5.19	15.26	4.00	1.00	2.00
Seed (q)	1.27	2.03	1.05	1.00	2.00	2.00
Marketed (q)	48.23	24.96	49.00	40.00	68.00	41.00
Total	100.00	100.00	100.00	100.00	100.00	100.00

from tray and T3 from freeze drying are selected. Rehydration time was observed lesser in Freeze dried (3 min), followed by Tray Dryer (8 min), Microwave Drying (8 min).

APEDA - Refinement of millet value chain for export markets in the wake for international markets. (PI: B Dayakar Rao)

Utilization of Millets: An attempt was made to understand the utilization pattern of millets by farmers in major millet growing states in the country (Table 5.2). Information on self-consumption including the amount of grain given away as gift to daughters and relatives, requirement for seed and feed, marketed surplus were important components identified under the utilization pattern of millets by farmers in different states.

MoFPI - R&D - Development and standardization of Millet Based Functional Foods for distribution in a public funded program. (PI: B Dayakar Rao)

Barnyard millet Weaning Mix

Barnyard millet weaning mix (Fig.5.5) was prepared with barnyard millet rice by using dehulling, milling and sieving technologies. The barnyard millet grain contains

Fig 5.5 Barnyard millet weaning mix.

Table 5.3 Proximate composition and available carbohydrates of millet recipes:

Samples	Protein	Fat	Ash	Moisture	Dietary Fiber	Avl CHO (g/100g)
Jowar Roti	9.47%	2.51±0.07	1.52±0.08	11.55±0.2	10.84	68.6
Bajra Flakes poha	7.84%	10.47±0.46	2.67±0.21	4.19±0.1	10.18	70.7
Proso roti	12.85%	1.85±0.18	1.49±0.01	8.25±0.3	11.04	65.1
Kodo millet puffs ugani	7.44%	9.20±0.31	2.31±0.02	4.01±0.1	11.03	72.4
Barnyard tomato rice	13.07%	15.82±0.23	6.38±0.15	3.13±0.1	16.36	52.9
Foxtail lemon rice	12.37%	13.35±0.28	5.64±0.02	3.05±0.1	17.42	55.2
Little millet upma	11.01%	13.05±0.62	4.69±0.16	3.69±0.2	15.95	64.1
Ragi ambali	5.54%	0.88±0.22	1.83±0.02	7.33±0.2	11.28	71.5

about 65% carbohydrate, majority of which is in the form of non-starchy polysaccharide and dietary fibre. This helps in the prevention of constipation, lowering of blood cholesterol and slow release of glucose into the blood stream during digestion. Barnyard millet has been found to be most effective in reducing blood glucose and lipid levels compared to other millets (Proso, Foxtail, Kodo and Little millet) and rice. The product is developed by incorporating Barnyard millet flour, Bengal gram dhal flour, Milk powder, Groundnuts, Sugar powder. The Product is high in Energy (K. Cal) 332.98, Protein (g) 7.03, Fat (g) 3.99 and Dietary fibre (g) 13.12 which will give optimum nutrition to children who is suffering from malnutrition.

NFSM- A comprehensive study to establish the health benefits (in vivo) of Nutri cereals: A way forward for mainstreaming millets. (PI: B Dayakar Rao)

Value addition:

Millets have been recommended for several non-communicable diseases due to their nutritional properties with high micronutrient and dietary fiber content and medium-low glycemic indices. Millets reduce the postprandial blood glucose level, glycosylated hemoglobin. To assess the *In-vitro* and *In-vivo* health benefits of millets this study has been designed. Accordingly, 8 millet-based recipes were standardized and analyzed for proximate composition and available carbohydrate content (Table 5.3).

IIMR/EVA/2020-2025/137: Development of selected value-added products of dairy analogue, pigments extraction from millets and its evaluation for enhanced shelf life. (PI: Er. P. Hemashankari)

The value-added product of ragi included ragi paneer, ragi curd, ragi cheese, ragi whey powder and compared with milk paneer as control. The ragi paneer calcium is 15% less than the ordinary milk pannier. Ragi curd has 3184.3mg/100g of calcium followed by ragi cheese, 4729.3mg/100g and ragi whey powder,6970.01mg/100g. The iron content in ragi cheese is more, 76.16ppm±25.13 followed by ragi whey powder, 33.00 ppm ± 25.13, ragi curd, 29.32ppm±25.13 and ragi panneer,13.50ppm±25.13. Milk paneer iron content is 16.5ppm±25.13. The zinc content is control milk paneer is 59.33ppm±19.50. Ragi paneer is 61.42ppm±19.50 followed by ragi curd is 28.88ppm±19.50, ragi cheese is 23.90ppm ±19.50 and ragi whey powder, 22.41ppm±19.50. The above values were tested for its statistical significance at 5% level of significance and found to be significant. The values obtained were replication of 2 values.

Table 5.4: List of FPOs formed and handholding by IIMR state wise.

Implementing Agency	States			
	Telangana	Andhra Pradesh	Karnataka	Madhya Pradesh
SFAC	1	2	14	1
NABARD	5	7	0	0
NCDC	2	0	0	0
WDD	0	0	9	0
Total	8	9	23	1
	Grand Total = 41			

Formation and Promotion of Farmers Producer Organization FPO Project (PI: Dr. Sangappa)

Farmer Producer Organizations (FPOs) are the farmers' collectives, formed by farmers to support themselves. With the aim to aggregate the farmers, harness the effectiveness of the work, and strengthen their bargaining power and to become agricultural entrepreneurs, the Government of India aims to form and promote 10,000 new FPOs across the country. Majority (60%) of Indian farmers depend on rain-fed farming and millet's cultivation suits to their agro-climatic situations. Millets are the rich sources of proteins, dietary fiber, carbohydrates and other minerals. Hence, they act as both food and fodder in providing nutritional security. Regardless of their benefits, millets are forgotten in the system of agricultural production and their consumption in daily life. Table 5.4 indicates the number of FPOs state wise formed and handholded by IIMR. IIMR is handholding 41 FPOs and supporting by providing millets seeds, technologies of processing and value addition, assisting in getting management cost, equity grants.

4 Trainings & Capacity Building

Training programmes attended – 2022

S.No	Name of the participant	Title of the training and organized by	Venue /place	Dates
1	Amasiddha Bellundagi and P Rajendrakumar	Online Training Program on "Advanced Statistical Techniques for Data Analysis using R"	ICAR-IIRR, Hyderabad	03-15 Jan., 2022.
2	V M Malathi	“Data Visualization in Agribusiness and Agricultural Research” by ICAR-NAARM	online	17-22 Jan., 2022
3	Amasiddha Bellundagi	Online Training Program on “Competency Enhancement programme for Effective Implementation of Training Functions by HRD Nodal Officer’s of ICAR**".**	ICAR-NAARM, Hyderabad	21-23 Feb.,, 2022.
4	Jinu Jacob, S Srividhya, V M Malathi, Rajesha G	Data management sponsored by “Consortium Research Platform on Agrobiodiversity” and organized by ICAR-Indian Institute of Millets Research, Hyderabad	Online	3-5, Mar., 2022
5	Rajesha G	“Data Visualization Using R” organized by ICAR-NAARM, Hyderabad	Online	09 -11 Mar., 2022
6	Rajesha G & S Srividhya	“Genotype to Genomics and advanced laboratory tools” organized by ICAR – IIMR, Hyderabad.	Online	28 - 30 Mar. 2022
7	Rajesha G	Whole Genome Sequencing Data Analysis organized by Biodeavour Research Lab, Pune	Online	24 - 28 May - 2022.
8	A. Kalaisekar	Orientation workshop for nodal officers of disaster management of Ministries and Departments of Government of India, NIDM.	National Institute of Disaster Management, New Delhi.	27-28 June 2022
9	A. Kalaisekar	AIDMI-NIDM Training 'Intersectionality Approach to Securing Women's Livelihoods, Food and Nutrition Security: Agenda for APMCDRR, NIDM, New Delhi	Online	28-30 June 2022
10	D. Revati	Advances in Web and Mobile Application Development Organized by ICAR-NAARM	Online	02-06 Aug., 2022
11	Venkateswarlu Ronda	Response Surface Methodology organized by ICAR- NAARM, Hyderabad	On-line	18-20 Aug., 2022
12	A. Kalaisekar	National Training Programme for Scientists on ‘Big Data Management & Comprehensive Analysis’, CDAC - Mohali	Online	14-18 Nov., 2022

S.No	Name of the participant	Title of the training and organized by	Venue /place	Dates
13	J. Stanley	Insect Conservation for sustainable agricultural systems	Dept. of Agrl. Entomology, TNAU, Coimbatore	22 Nov – 12 Dec., 2022
14	A. Kalaisekar	Short course training on Biostatistics, IISER - Pune	Online	10-18 Dec., 2022
15	A. Kalaisekar Jinu Jacob; Venkateswarlu Ronda	NABL Assessors training program for ICAR Scientists, NAARM - Hyderabad	NAARM - Hyderabad	19-23 Dec., 2022

Trainings organized at IIMR 2022

Start-up Ignition training program on- Entrepreneurship opportunities in Millets Sector

A total of 40 participants from six states of India participated in the Start-up Ignition training program entitled - Entrepreneurship opportunities in Millets Sector at Nutrihub, ICAR- Indian Institute of Millets Research, Hyderabad on 6-7 January, 2022. Dr. B. Dayakar Rao, CEO Nutrihub delivered the inaugural address and also interacted with the participants on various business opportunities in millets. In general, participants were given an Overview of Millets Post-Harvest Technologies, processing, and marketing of millet health food products. the trainees also visited facilities at IIMR, Centre of Excellence, Primary and Secondary processing units, Incubation facilities at Nutrihub for Startup units. Procedures for Technology transfer with IIMR were also explained. Dr. V. Ravi Kumar, Technical Officer, ICAR-IIMR coordinated the training program.

Training programme to stakeholders of Odisha Millet Mission

ICAR-Indian Institute of Millets Research organized four days - training program for the research team of Odisha Millet Mission project during 10-13 of January, 2022. A total of 16 participants of various departments involved in promotion of millets in the Odisha state participated in this programme. The training encompassed both theoretical and practical aspects of millets production, processing and value addition. The exposure visit was also arranged to get an idea of what best can be harnessed with the millets processing and value addition. Dr. Vilas A Tonapi, Director, IIMR and Dr. Muthu Kumar, IAS, Director of Agriculture and Farmers' welfare participated virtually during the valedictory session. The seeds were distributed to the stakeholders to mainstream the cultivation of good quality seeds new varieties of millets in their region. The training was coordinated by Sh. K Srinivas Babu, Dr. Sangappa, Co-PIs and staff of OMM project.

Training on Data Digitalization with ICAR-IISR-Calicut

ICAR-IIMR coordinated Online Training on Data Digitalization with ICAR-Indian Institute of Spices Research (IISR), Calicut and AICRP on Spices during 22-24 February 2022. Lectures and demonstrations were organized during the training on Digitalization of Field Data, Scientific presentation, Statistical protocols for field experiments and data analysis etc. A total of 81 participants attended the training programme from ICAR-IISR and AICRP on Spices. The training was

coordinated by Drs. C. Sarathambal, S. Aarthi, Sharon Aravind from ICAR-IISR-Calicut and M Elangovan from ICAR-IIMR, Hyderabad.

Training on "Genotype to Genomics and advanced laboratory tools"

ICAR-IIMR-Hyderabad organized Training on "Genotype to Genomics and advanced laboratory tools" during 28-30th Mar 2022. The training was attended by 40 participants from both Scientific and Technical staff of ICAR-IIMR-Hyderabad, AICRP on Sorghum and Small millets. Lectures were delivered on "Developments from Genotype to Genomics in millets" by Dr. T Nepolean, Principal Scientist, "Applications of MAS in Millets Improvement" by Dr P Rajendrakumar, "A Journey of Biochemistry Research at IIMR with Advanced laboratory equipment and protocols" by Dr CV Ratnavathi, Principal Scientist. During the training, latest development in genomics research in millets, available genetic and genomic resources and their utilization strategies, application of advanced and precise breeding techniques etc. were discussed through interaction mode with trainees. The training was coordinated by Drs M Elangovan, B Amasiddha and KN Ganapathy.

Online Training on Data Management

ICAR-IIMR-Hyderabad organized Online training on Data Management during 3-5 March 2022. The training was attended by 130 participants from All-India Coordinated Research Project on Sorghum and Small millets, ICAR-IIMR-Hyderabad-Solapur, ICAR-NBPGR-RS-Hyderabad and other Universities and Colleges by Scientists, Technical, Research Fellows and Research Scholars. The participants learned about Data Processing for Better Interpretation and Publication Using SAS and R, Bioinformatics in Agriculture, Geospatial Technologies in Agriculture, DIVA-GIS: Tool for Data Visualization, MS Excel – Tool for Germplasm Database; Digital Field Book for Paperless Data Collection, MS Access – Tool for Connecting Germplasm Database and Scientific Video Editing through lectures and demonstrations. Dr G Prabhu from ICAR-IARI-New Delhi; Dr M Balakrishnan and Dr PD Sreekanth from ICAR-NAARM-Hyderabad and Dr M Elangovan of ICAR-IIMR-Hyderabad handled the training sessions. The training was coordinated by Drs M Elangovan, KN Ganapathy, B Amasiddha, K Venkatesh and Mr. OV Ramana.

Training on "Farm Mechanization and Management"

ICAR-IIMR-Hyderabad organized training on "Farm Mechanization and Management during 23-25 March 2022. The training was attended by 15 Technical and Supporting staff of ICAR-IIMR-Hyderabad. Lectures-demo-visit on Farm mechanization in millets cultivation by Dr. Gangaiah, Principal Scientist, weed management in millet cultivation by Dr R Swarna, Scientist, freedom from Parthenium-a noxious weed by Dr KBRS Visarada, Principal Scientist were arranged. During the training, strengthening the farm mechanization for farm operations to tackle the labour shortage in agricultural operations, hiring of farm implements, operation based labour skill development, integrated approach for pest, disease and weed management, recommendation of weedicides to farmers especially to the mass seed production farmers, exclusive institute team for *Parthenium* eradication and year-round activity to control the *Parthenium* in the field in addition to the existing *Parthenium* week were discussed for implementation. The training was coordinated by Drs M Elangovan, B Amasiddha and C Deepika.

Start-up Ignition programs

14 March, 2022: A total of 50 women belongs to a Self-help Group were trained at Nutrihub TBI - ICAR- Indian Institute of Millets Research on 14 March, 2022. These women were belonging to 6 mandals of Mahabubnagar, Narayanpet and Wanaparthy distircts of Telangana. Hands-on training on preparations of millet health foods such as millet cookies, Millet cakes or muffins provided to these participants at the CoE of IIMR. Majority women showed their keen interest in starting a new business by doing millets value addition. Finally, Dr. B Dayakar Rao, CEO, Nutrihub distributed certificates to the trainees. This programme was coordinated by Dr. Ravi Kumar Vemula, Technical officer, ICAR – IIMR.

16 March, 2022: Nutrihub of ICAR- Indian Institute of Millets Research organized training programme on "Start-up Ignition - Emerging business opportunities in processing of Millets" for aspiring entrepreneurs those who are willing to start a business in Millets domain on 16 March 2022. A total of 50 participants including farmers from Sangli distirct, Maharashtra and Entrepreneurs of different states participated in this one-day training program. All the participants were given exposure visit to Millet Fields by Dr. R Chapke, Principal Scientist, IIMR and guided tour of Primary and Secondary processing units were shown. All the participants were given hands-on experience on making Millet cookies, cakes, muffins and other millet recipes. During the interactive session, Dr. B Dayakar Rao, CEO, Nutrihub explained the activities at Nutrihub and clarified the doubts of the participants. This programme was coordinated by Dr. Ravi Kumar Vemula, Technical officer, ICAR – IIMR.

International training on "Post-harvest Technologies for Better Seed Quality "

International training programme was organized by ICAR-IIMR, Hyderabad under Indo-German Collaborative Programme on "Post-harvest Technologies for Better Seed Quality" in sorghum, pearl millet and soybean- for the year 2022 during 2 - 4 March, 2022. The training was conducted in webinar mode. A total of 112 persons participated in the training programme drawn across from officials from state agricultural departments, seed certification agencies, state agricultural universities, private seed companies, seed corporations, ICAR institutes and agriculture-related NGOs. The training was conducted by 24 resource persons/panelists including 3 international experts. Drs. Sooganna and B Venkatesh Bhat coordinated the training programme, under the guidance of Dr. Vilas A Tonapi.

International training on "Seed Testing for Quality Assurance"

An International training on "Seed Testing for Quality Assurance" under the aegis of Indo-German Bilateral Cooperation on Seed Sector Development was jointly organized by Seed Centre, TNAU, Coimbatore and ICAR-IIMR, Hyderabad during 7 - 10 March, 2022. In the inaugural session, Dr. A.S. Krishnamoorthy, the acting Vice-Chancellor of TNAU emphasized the importance of seed testing on quality assurance. Shri. Ashwani Kumar, Joint Secretary (Seeds), Ministry of Agriculture & Farmers Welfare, GOI, New Delhi delivered the special address on seed testing and the schemes of GOI to strengthen the seed testing laboratories of India.

Dr. D.K. Yadava, ADG (Seeds), ICAR, New Delhi, India highlighted the role of Seed Testing Laboratories in India in quality seed supply. Dr. K. S. Subramanian, Director of Research addressed the gathering to use modern technologies for seed testing. Dr. Vilas A. Tonapi, Director, ICAR - Indian Institute of Millets Research, Hyderabad welcomed the gathering and delivered the opening remarks of the programme. Dr. S. Sundareswaran, Director, Seed Centre proposed the vote of thanks. During the technical sessions deliberations were made on National and International scenario on various aspects of seed testing. Around 250 participants including the Scientists from ICAR Institutes, State Agricultural Universities, Officials from the Department of Seed Certification, Seed Industrialists and Research Scholars participated in the training. Drs. Sooganna and B Venkatesh Bhat coordinated the training programme from ICAR-IIMR, under the guidance of Dr. Vilas A Tonapi.

Capacity building and training for CEOs and BoDs of AP and Telangana FPOs

Three days training program on "Capacity building for CEOs and BoDs of Millets FPOs" was organized by ICAR-Indian Institute of Millets Research, Hyderabad from 26 May to 28 May, 2022. All the FPO CEOs and BoDs from Andhra Pradesh and Telangana FPOs formed and promoted by ICAR-IIMR participated in the training. The training was organized to make the stakeholders to understand the opportunities, scope and imbibe the requisite knowledge, skills for governance, management, maintenance, and marketing so as to equip the CEOs to effectively play their roles and undertake responsibilities. Mr. Chandrashekar from Eco

Club, Mr. Jayaram Killi, National Mission Manager from NRLM, Dr. Manjuprakash, Senior Research Fellow in IIMR, Mr. Srinivas Bollam and Mr. Sripani from Upayam foundation, Mr. Mohan Kumar, Chartered Accountant and Mr. D. Rafi, Senior Research Fellow served as Resource persons in the training programme. The program was coordinated by Dr. Sangappa, scientist and team.

Pre-season awareness-cum-interaction programme

As a part of the Farmers First project, farmers' pre-season awareness-cum-interaction programme with selected farmers was organized at Chalki village of Nyalkal Mandal, Sangareddy district on 30 May, 2022. Over 50 farmers who were selected for testing project interventions participated and were briefed about the plan of field trials and activities of the project. On this occasion, farmers were happy with previous year's results of millets trials and they were informed about the benefits of processing facility on millets which was established at Gangapur village. In view of early approaching of monsoon, seeds of various high yielding variety of millets namely, sorghum, Kodo millet, pearl millet, little millet, barnyard millet, foxtail millets, yellow sorghum and red-gram were allocated to them at Chalki and surrounded villages for conducting trials in kharif. The project staff had briefly explained about the project interventions and imparted hands-on training on improved millets cultivation and value-addition. The project staff namely, Mr. D Uttej, SRF, Miss. K Rajitha, Field Assistants and Mr. Vinodh, outsource person from ICAR-IIMR participated in this event. This programme was coordinated by Dr. Rajendra R. Chapke, Principal Scientist & PI, FFP, ICAR-IIMR, Hyderabad.

Farmers' orientation programme

Farmers' orientation meeting with selected farmers was organized under farmers first at Gangapur village of Jharasangam Mandal, Sangareddy district on 29 May, 2022. More than 50 farmers who were selected for conducting project trials, were educated about the plan of field trials and activities of the project briefly. As a part of this visit, in view of early approaching of monsoon, seeds allocation programme for *kharif* trials was also conducted and seeds of various high yielding variety of millets namely, sorghum, Kodo millet, pearl millet, little millet, barnyard millet, foxtail millets, yellow sorghum and redgram were allocated to the farmers of the Gangapur and surrounded villages. The project staff had briefly explained about the interventions and to make use of processing facility which was established at Gangapur village as custom hiring center on millets. FFP staff namely, Mr. D. Uttej, SRF, Mr. Raghunath Reddy and Miss. K. Rajitha, Field Assistants from ICAR-IIMR participated in this event. This programme was coordinated by Dr. Rajendra R. Chapke, Principal Scientist & PI, FFP, ICAR-IIMR, Hyderabad.

Training for FPOs stakeholders of Odisha state

A four-day training programme on "Value Addition and Scope of Natural Farming in Millets for Sustainable Farming" was organized by ICAR-Indian Institute of Millets Research, Hyderabad, in association with ARS, Vijayanagaram, and Odisha Millet Mission (OMM) during 20-23 June, 2022 at ARS, Vijayanagaram. Officials of line department, stakeholders of OMM, CEOs and BoDs of FPOs from different districts of Odisha participated in the training. The training addressed the importance of millets, natural farming for sustainable farming, processing and value addition of millets and business opportunities. Dr. TSSK Patro, Head, ARS-Vijayanagaram, Sh. K Srinivasa Babu, Dr. Sangappa and their team coordinated this training program.

Training on "Advanced Capacity building for CEOs and BoDs of millets FPOs"

ICAR-IIMR organized a virtual training program on "Advanced Capacity building for CEOs and BoDs of millets FPOs" from 27-29 June, 2022 for six FPOs located at Telangana and Andhra Pradesh states. On the first day of training Ms. Chandrika, SRF gave a lecture on "Challenges for small and marginal farmers and business opportunities for FPOs". The second day session was on "Formulation and implementation of business plans in FPOs" by Ms. M. Sri Sandhya. The final day session was on "Financial management" by

Ms. Anuradha, semi-qualified CA. Dr. Sangappa and team coordinated the training programme.

Training programme on "Certified Farm Advisor" (CFA)

Six-days training program on "Certified Farm Advisor" (CFA) was inaugurated by Dr. CV Ratnavathi, Acting Director, ICAR - IIMR, on 25 July, 2022. Twelve officials of line departments from Tamil Nadu, Odisha and Maharashtra states participated in this programme. Dr. Sangappa, Scientist and Course Director of the training program, Dr. Srinivas Babu K, Scientist, ICAR-IIMR, Ms. Sadalakshmi of MANAGE, staff of ICAR-IIMR FPO were present during the inaugural session. This training was organized in collaboration with MANAGE to create professionals in millets value chain.

Awareness Programme on Millets Cultivation

The awareness programme on millets cultivation and value addition was organized at Ramanapalem village, in Bapatla District, Andhra Pradesh under the Bapatla Agro and Food Processing cluster on 24 July, 2022. Dr. B Subbarayudu explained the purpose of the project in detail and motivated the farmers. About 50 farmers participated and acquired the knowledge of the processing and value addition of millets. This project is funded by National Institute for Micro, Small and Medium Enterprises (ni-MSME) and ICAR-IIMR plays the lead role of Technical Agency. Dr. B Subbarayudu, PI of the Project, IIMR, Hyderabad coordinated this event.

Training program on millets for input dealers of Ranga Reddy District

ICAR-Indian Institute of Millets Research conducted One-day training program on "Crop production practices in millets" exclusively for input dealers of Ranga Reddy District, Telangana on 20 September, 2022. A total of 40 participants of Diploma in Agricultural Extension Services for input dealers (DAESI) attended this programme. The training aimed to create awareness on the nutritional and health benefits and crop production practices of millets. Dr. Swarna delivered a lecture on Crop production technologies in millets and Dr. Deepika delivered a lecture on Nutritional and health benefits and varietal diversity in millets. Dr. Amasiddha explained about improved millet cultivars and their cultivation practices to get higher yields and facilitated in field visit of trainees. As a part of training program, visit to IIMR processing centre was facilitated to enhance the knowledge of trainees on millet processing machineries developed and their availability for processing, labeling and packing, meanwhile they were educated about the millet processed product development and popularization and importance. The programme was organized by Dr. Swarna, Dr. Deepika and Dr. Amasiddha.

Training on "Digitalization of Field Book – Paperless Data Collection"

ICAR-IIMR-Hyderabad organized one-day National Virtual Training on "Digitalization of Field Book – Paperless Data Collection" at Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar on 8 September 2022 in collaboration with AICRP on Small millets, Dholi. Dr Sweta Mishra, OIC of AICRP on SM, Dholi briefed about the training programme. Dr C V Ratnavathi, Director (Acting), ICAR-IIMR, Hyderabad delivered her address of Guest of Honour. She emphasised more digital training programmes to the researchers and inclusion of digitalization of data. Dr M Elangovan, Principal Scientist, ICAR-IIMR delivered his lecture on "Digitalization of Field Book – Paperless Data Collection" followed by demonstration of the field book mobile application which includes the creation of field book, customization of trait file, collection of data, taking photos, recording audio and other user friendly settings etc., The virtual training was attended by 100 participants including Scientists, Technical, Research Students, BSc/MSc students etc., This training programme was coordinated by Drs Sweta Mishra, Kaushal Kishor, GS Giri and M Elangovan.

List of Students -2022

S.No	Name of the Student	Year	University	Degree	Advisor /Co-Advisor from IIMR	Title of the Research work
1	Mr Chenneboyina Rakesh Yadav	2021	LPU, Punjab	M.Sc	Dr. R Madhusudhana	Morphological and molecular characterization of advanced rabi sorghum breeding lines
2	Mr Vasa Dilesh Reddy	2021	LPU, Punjab	M.Sc	Dr. R Madhusudhana	Morphological and molecular diversity analysis in mutants of M35-1 and 296 B genotypes of sorghum
3	Ms J Sri Lekha	2022	PJTSAU, Hyderbad	M.Sc	Dr. Rajendra Kumar	Characterization of Kodo millet (*Paspalum scrobiculatum* L.) genotypes using DNS markers, morpho-agronomic and biochemical traits
4	Ms Ballolla Tejashwini	2022	PJTSAU, Hyderbad	M.Sc	Dr. Rajendra Kumar	Agro-morphological, biochemical and molecular characterization of little millet (*Panicum sumatrense* Roth. Ex Roem and Schultz) genotypes
5	Mr Jitendra Kumar Meena	2022	PJTSAU, Hyderbad	M.Sc	Dr. Avinash Singode	Identification of heterotic combinations from indigenous germplasm for higher forage yields in pear millet [*Pennisetum glaucum* (L.) R. Br.]
6	Mr Venkateshwarlu Bheemanaboina	2022	ANGRAU, Bapatla	M.Sc	Dr. B Gangaiah	Impact of nutrient omission on performance of sweet sorghum [*Sorghum bicolor*(L.) Moench]
7	Ms Alakuntla Likhitha	2022	PJTSAU, Hyderbad	M.Sc	Dr. Swarna Ronanki	Simulation of Optimum sowing dates and irrigation scheduling practices in rabi sorghum using APSIM
8	Ms Anusha T	2022	PJTSAU, Hyderbad	M.Sc	Dr. Anuradha Narala	Economic and marketing analysis of Sorghum production in Mahbubnagar district of Telangana
9	Ms Hanumakonda Soumya	2023	Vellore Institute of Technology	M.Sc	Dr. Rajendra Kumar	Molecular characterization of finger millet [*Eleusine coracana* (L.) Gaertn]genotypes using simple sequence repeat markers
10	Vanacharla Uma Maheswari	2021	Prof. Jayashankar Telangana State Agricultural University	M.Sc.	Dr. P Sanjana Reddy	Heterosis and combining ability for grain yield and flag leaf photosynthetic efficiency in pearl millet (*Pennisetum glaucum* (L.) R. Br.)
11	T. Supriya	2022	Loyola academy/ Osmania university	M.Sc	Dr. KBRS Visarada	Introduction of novel sweet sorghum alleles

S.No	Name of the Student	Year	University	Degree	Advisor /Co-Advisor from IIMR	Title of the Research work
12	M. Bhavyasri	2022	Loyola academy/ Osmania university	M.Sc	Dr. Jinu Jacob	Assessing the genetic diversity of improved parental lines developed through interspecific hybridization in sorghum with SSR markers.
13	J.Srilekha	2021	PJTSAU, Hyderabad	M.Sc	Dr. Deepika C	Morpho-agronomic,Biochemical and molecular characterisation of kodomillet genotypes
14	Mr Rajappa P V	2018	UAS, Dharwad	Ph.D	Dr. R Madhusudhana	Marker-assisted backcrossing for transferring the staygreen QTL to elite rabi varieties of sorghum
15	Ms A Anisha	2019	PJTSAU, Hyderbad	Ph.D	Dr. R Madhusudhana	Genetic studies for fertility restoration on maldandi cytoplasm in Sorghum [*Sorghum bicolor*(L.) Moench]
16	Ms Sushma Sannidi	2020	PJTSAU, Hyderbad	Ph.D	Dr. B Gangaiah	Carbon sequestration by rabi sorghum and its response to carbon fertilization
17	Mr Trinath Chadarajupalli	2021	ANGRAU, Bapatla	Ph.D	Dr. B Gangaiah	Fertilization impacts on Zinc and Iron enrichments in a bio-fortified and non-bio fortified rabi grain Sorghum cultivars and their residual effects on summer fodder sorghum
18	Ms Patel Supriya	2022	PJTSAU, Hyderbad	PhD	Dr. Avinash Singode	Genome wide association studies for forage yield and quality in forage pearl millet [*Pennisetum glaucum* (L.) R. Br
19	Ms Rajyalakshmi Bommidi	2022	PJTSAU, Hyderbad	PhD	Dr. B Gangaiah Dr. Srividhya, S (Co-Advisor)	Biochar fertilization impacts on pearl millet productivity, soil quality and resource use efficiency
20	B. Nandini Priya Yadav	2019	Acharya NG Ranga Agricultural University	Ph.D.	Dr. P Sanjana Reddy	Studies on Genetics of Heat Tolerance in Pearl Millet (*Pennisetum glaucum* (L.) R. Br)
21	D. Sravani	2021	Acharya NG Ranga Agricultural University	Ph.D.	Dr. P Sanjana Reddy	Heterotic grouping of low rancid inbred lines based on morphological and molecular markers in pearl millet [*Pennisetum glaucum* (L.) R. Br.]
22	N. Pugahendhi	2019	Annamalai University, Tamil Nadu	Ph.D	Co Advisor 1: Dr. M. Elangovan Co Advisor 2: Dr. P. Rajendrakumar	Agro-Morphological and Molecular Characterization of Kharif Sorghum Landraces (*Sorghum bicolor* (L.)
23	Rajayalakshmi B	2021	ANGRAU, Bapatla	Ph.D.	Co-Advisor: Dr. Srividhya, S	Biochar fertilization impacts on pearl millet productivity, soil quality and resource use efficiency

5 Awards and Recognitions

Indian Institute of Millets Research secured 6th rank

"Indian Institute of Millets Research" has been placed in 6th position among 93 ICAR Institutes and in first position under Crop Science Division according to the recent list on Ranking of Indian Council of Agricultural Research Institutes year 2019-20 and 2020-21 (Combined) released on 28 September, 2022.

Awards

Best scientist Award to Dr. CV Ratnavathi

Dr. Ratnavathi, Principal Scientist, Bio chemistry and Acting Director of IIMR received the Best Scientist Award for her contribution towards value addition research in millets. She received this award from Shri S Niranjan Reddy, Hon'ble Agriculture Minister, Government of Telangana in the presence of Dr Ashok Dalwai, IAS, CEO NRAA Ms. Shubha Thakur, JS (Crops, Oilseeds & Admn), DA&FW and others during the National Nutri-cereal Convention (NNCC) 4.0 was organized by Nutrihub - ICAR- Indian Institute of Millets Research, jointly with Department of Agriculture, Cooperation and Farmers' Welfare, (DAC & FW) Government of India at Hyderabad International Convention Centre at (HICC) Hyderabad on 23 September, 2022.

IIMR's Nutrihub -TBISC bagged ABSA-2022 Award

Dr. B Dayakar Rao, Principal Scientist, IIMR received the prestigious RAY Consulting's Agri Business Summit and Agri Awards (ABSA) – 2022 –under Best Government Institute Award category for "IIMR's Nutrihub –TBISC". M/s. RAY Consulting was founded with the mission to provide competent consulting services to support agriculture and agribusiness sector by delivering sustainable solutions to projects in agriculture, agribusiness and allied sectors in India. Dr. Dayakar received the award Trophy and Certificate from Honourable Agricultural Minister of Telangana State Sh. Singireddy Niranjan Reddy during the Awards ceremony held on 29 August, 2022. It is pertinent to mention here that Dr. B Dayakar Rao, Principal Scientist, IIMR also bagged the prestigious

ABSA – 2021 Award for his leadership qualities with strategic vision and Millet Start-up incubation as CEO.

Ni-MSME's 'Valuable client' award to ICAR-IIMR.

ICAR-Indian Institute of Millets Research, Hyderabad (IIMR) has been collaborating with Ni-MSME for facilitating the development MSME enterprises and FPO to engage in production, processing and value addition of millets. Recently, IIMR was sanctioned a project to act as a technical agency for development of Bapatla Agro-processing Cluster in Andhra Pradesh. Recognizing the IIMR's earnest contributions, Ni-MSME has declared 'Valuable client' award to ICAR-IIMR. The award was received by Dr. B Subbarayudu, Principal Scientist, IIMR on behalf of the Institute during the Diamond Jubilee Celebrations of Ni-MSME held at Hyderabad on 29 August 2022.

Awards at ICFM-2022

During the International Conference on Finger Millet – ICFM-2022 held at Zonal Agricultural Research Station (ZARS), VC Farm, Mandya, Karnataka during 19-22 January, 2022, Scientists from IIMR- Hyderabad received the following Best Oral Presentation and Best poster presentation awards:

ICAR-IIMR-Hyderabad bagged The Agriculture Leadership Award - 2022

Agriculture Today, is India's leading agriculture magazine that covers the latest news and analysis of pressing agricultural issues of national and international importance and helps in disseminating such information to the grassroots and to all agriculture related agencies and institutes. The AT group offers Leadership Awards and prizes to the students, faculty, researchers, and public figures recognizing their services of excellence in the field of Agriculture. This year, The **Agriculture Leadership Award - 2022** of the Agriculture Today Group was bestowed on ICAR - Indian Institute of Millets Research, Hyderabad for the leadership role and exemplary contribution to agriculture development and Farmers welfare. Dr. CV Ratnavathi, Director, ICAR-IIMR received the award from the hands of Hon'ble Secretary DARE and DG ICAR at the 13th Leadership Award Ceremony held at New Delhi during 13 December, 2022.

IIMR Bagged Patent for preparation of sorghum flakes

A novel technology for value addition of grain sorghum, developed by IIMR was granted patent certificate by the Patent office, Government of India for the application No. 5711/CHE/2014, on "Preparing flakes from sorghum grains" on 29 June, 2022. The invention enumerates the process for preparation of flakes from sorghum starting from hydration, gelatinization and flattening through an edge runner machine, in which all the conditions and parameters were standardized for sorghum. The main advantage of this invention is getting quality flakes in which sand is not used as heat transfer medium as with other flakes preparations. The inventors are Dr. B Dayakar Rao (Principal Scientist and CEO Nutrihub), Dr. CV Ratnavathi (Principal Scientist and Acting Director, IIMR), Dr. JV Patil (Former Director, IIMR) and Dr. NG Malleshi, Retd. Sr. Scientist and Head, Department of Grain Science and Technology, CFTRI, Mysuru.

Best Oral presentations

- Title: Development of gamma mutants with improved grain yield and blast resistance in finger millet (Authors: Ganapathy KN, TSSK Patro, Palanna KB, Das IK, Hariprasanna K, M Elangovan, TE Nagaraja, B Amasiddha, Prashant B and Vilas A. Tonapi)
- Title: Biochemical changes in finger millet Flour during storage (Authors: PG Padmaja, A Kalaisekar, R Venkateswarlu, S Shwetha, G Shyam Prasad, V Bhat, B Dayakar Rao & Vilas A. Tonapi)

Best Poster presentations

- Title: Genetic diversification of cultivated gene pool of finger millet using interspecific hybridization (Authors: Ganapathy KN, Prabhakar B, M Elangovan, K Venkatesh and Vilas A. Tonapi)
- Title: Relevance of MSP for Ragi Farmers in India: An Analysis (Authors: Anuradha Narala, Dayakar Rao.B and Vilas A. Tonapi)
- Title: Farmer Producer Organizations are connecting dots between farmers and consumers for achieving nutritional security through millets (Authors: Sangappa, Manjuprakash, Laxmi B., K Srinivasa Babu, Amasiddha B. And Vilas A. Tonapi).

Best paper presentation award

Dr. Sangappa, Scientist, ICAR-IIMR presented a paper during the National seminar entitled "The Comprehensive extension strategies for sustainable development of FPOs: Challenges and opportunities" organized by MANAGE, Hyderabad and International Society of Extension Education, Nagpur during 22-24 April, 2022 at MANAGE, Hyderabad. Dr. Sangappa received best paper presentation award for his presentation on "Linking Millets Farmers Producer Organizations to Market through startups" from Dr. Ashok Dalwai, Dr. P. Chandrashekara, DG, MANAGE, Dr. Narayanagowda, President, INSEE.

ICAR-South Zone Sports Tournament 2022

ICAR-Indian Institute of Millet Research (IIMR) participated in the ICAR-South Zone Sports Tournament 2022 organized by the ICAR-National Academy of Agricultural Research Management (NAARM) at the South Central Railway Recreation Club ground during 22-25 November, 2022. There were 25 out of 26 ICAR institutes of South India participated in this tournament with 753 participants. ICAR-IIMR participated with 20 Men and 5 Women participants. **Dr. B Amasiddha** won Bronze in 100 m race for Men (13.3 sec) and Silver in Long-jump for Men (5.00 m). **Dr. S Srividhya** won Bronze in 100 m race for Women (17.8 sec). **Smt. D Revati** won Bronze in Chess. **Drs. S Srividhya, C Deepika, VM Malathi** and **R Swarna** won Bronze in 4 x 100 m relay.

6 Linkages and Colloboratios

Externally funded projects -2021

S.No	Project Title	PI	Co-PIs	Funding Agency	Budget (in lakh Rupees)	Duration
1	Ensuring sustainable enhancement of millets production and value chain system for Food and Nutritional security of Odisha	K Srinivasa Babu	Ganapathy KN, Sangappa & R Venkateshwarlu	Dept. of Agriculture, Govt. of Odisha	86.24	2020-2023
2	Consortia Research Platform on Agro-biodiversity (CRP-AB) - PGR Management and Use in Small millets	M Elangoan	-	ICAR	141.7	2015-2021
3	Metabolic engineering of triacylglycerol (TAG) biosynthetic pathway to enhance the nutritional quality of forage sorghum and rumen protection of dietary lipids	D Balakrishna	-	Science and Engineering Research Board (SERB)	23.36	2020-2023
4	Shelf-life Enhancement in millets	PG Padmaja	R Venkateswarlu, A Kalaisekar, G Shyam Prasad & B Dayakar Rao	NFSM	99.40	2019-2021
5	Empowerment of Women through Application of Multifaceted Bio-technological Innovations in Millets for Sustainable Income Generation and Nutritional Security	Sangappa	B Dayakar Rao, Bhavani Kammar& B Amasiddha	Department of Biotech-nology	251.82	2018-2021
6	Promotion of Farmers Producer Organization in Nutricereals under NFSM	Sangappa	K Srinivasa Babu	SFAC, New Delhi	122.22	2019-2024
7	Formation of Millets and Other Crops FPOs under Central Sectoe Scheme	Sangappa	K Srinivasa Babu	SFAC, New Delhi	250.00	2021-2026

S.No	Project Title	PI	Co-PIs	Funding Agency	Budget (in lakh Rupees)	Duration
8	Formation of Millets FPOs under Central Sector Scheme in Karnataka	Sangappa	K Srinivasa Babu	WDD, Govt. of Karnataka	214.26	2021-2026
9	Characterization of sensitive phenophases, water use efficiency (wue) and genetic variability of barnyard millet and proso millet under drought stress	S Srividhya	-	SERB- START-UP Research grant	28.91	2020-2022
10	NAIF-ABI (Agri Business Incubator)	B Dayakar Rao	Sangappa	NAIF	100.00	2017-2022
11	Development of a national data base on millets and establishing benchmarks for production, consumption and utilization of millets	B Dayakar Rao	CV Ratnavathi, VenkateswarluR, N Anuradha &P Mukesh	NFSM	100.00	2019-2021
12	Technology Business Incubator	B Dayakar Rao	Sangappa, A Srinivas, P Hemasankari	DST	800.00	2017-2022
13	RKVY –RAFTTAR	B Dayakar Rao	Sangappa,A Srinivas, & P Hemasankari	DAC&FW	233.00	2019-2021
14	Participatory technology validation, diversification, value-addition for small holders livelihood improvement of Central Telangana Zone	Rajendra R. Chapke	Srinivas, Swarna, Anuadha	ICAR-Agricultural Extension Division, New Delhi	109.00	2020-2025
15	Farmer-led extension strategy for enhancing farmers' income through millets-based farming system in hilly and tribal areas	Rajendra R. Chapke	Shyam Prasad	ICAR-NASF, New Delhi	117.49	2019-22
16	Frontline demonstrations on sorghum	Rajendra R. Chapke	-	DAC&FW, Min. of Agriculture & Farmers' Welfare, New Delhi	12.00	2022-23
17	Socio-economic up-liftment of tribal farmers using primary processing technology of millets under component of Tribal Sub Plan (TSP) Sorghum-AICRP	Rajendra R. Chapke	-	ICAR-TSP Sorghum (AICRP)	35.00	2020-21
18	CRP on Biofortification in selected crops for nutritional security	Hariprasanna K.	Rajendrakumar P, & Venkateswarlu R.	ICAR	46.79	2017-2021

S.No	Project Title	PI	Co-PIs	Funding Agency	Budget (in lakh Rupees)	Duration
19	Centrally Sponsored Scheme of PPV&FRA - DUS testing of Sorghum	Hariprasanna K.	Amasiddha B.& Deepika C.	PPV&FRA	8.90	2008-ongoing
20	Application of next generation breeding, genotyping and digitization approaches for improving the genetic gain in Indian staple crops	T Nepolean	R Madhusudhana, Aruna C Reddy & P Sanjana Reddy	Bill and Melinda Gates Foundation and ICAR	398.00	2018-2022
21	Ensuring sustainable enhancement of millets production and value chain development for food and nutritional security of Odisha	K Srinivasa Babu	Ganapathy KN, R Venkateshwarlu, &C Sangappa	Directorate of Agriculture and Food Production, Odisha	86.54	2020-2021
22	Identification of SNP-trait associations for seed longevity traits through association mapping in pearl millet and finger millet	N KannaBabu	T Nepolean	SERB-DST-CRG	49.28	2022-2024
23	Testing of “UPH 2221” for its bio-efficacy against weed flora of in Sorghum	B Gangaiah	KSrinivasa Babu &R Swarna	UPL Limited Mumbai	5.35	2021-2022
24	AICRP on Seed Crops	B Venkatesh Bhat	Sooganna	ICAR-IISS, Mau	10.00 /p.a	2021-2026
25	Enhancing Breeder Seed Production for Increasing Indigenous Production of Millets in India	B Venkatesh Bhat	Sooganna	NFSM	140.00	2018-2023
27	Creation of Seed-Hubs for Increasing Production of Millet Crops in India	B Venkatesh Bhat	Sooganna	NFSM	175	2018-2023
26	Modifying the lignin composition in biomass sorghum and its deployment for enhanced ligno-cellulosic (2G) biofuel production	AV Umakanth	-	DBT	24.80	2021-2024
27	Refinement of Millet Value chain for export markets: Preparation of Export Strategy in wake of International Year of Millets -2023	B Dayakar Rao	CV Ratnavathi, B Venkatesh Bhat, R Venkateswarlu, Sangappa, N Anuradha, & P Hemasankari	APEDA	652.6	2020 - 2023
28	Formation & Incubation of FPOs in Telangana	Sangappa	K Srinivasa Babu	NABARD Telangana	50.00	2021-2026
29	Formation & Incubation of FPOs in Andhra Pradesh	Sangappa	K Srinivasa Babu	NABARD Andhra Pradesh	50.00	2021-2026

S.No	Project Title	PI	Co-PIs	Funding Agency	Budget (in lakh Rupees)	Duration
30	Formation & Incubation of Cooperative FPOs in Telangana	Sangappa	KSrinivasa Babu	NCDC-ATARI Hyderabad	50.00	2021-2026
31	Research & Development for Resolving Gaps in scaling up of Millet Value Chain for Technical backstopping micro units under PMFME	B Dayakar Rao	A Srinivas, VM Malathi & P Hemasankari	MoFPI -PMFME	354.00	2021-2024
32	Development and standardization of Millet Based Functional Foods for distribution in a public funded program	B Dayakar Rao	P Hemasankari	MoFPI	43.27	2020-2023
33	NAIF-ZTMC	B Dayakar Rao	Stanley	NAIF	80.00	2017-2022
34	Combined effect of elevated CO2 and temperature on water use efficiency, productivity, quality of major cereal fodder crops and soil health	SevaNayak D (PI)	Dr. VenkateswarluR, Dr. Manasa V, Dr. Bandeppa S.	SERB-CGR	42.86347	2022-2025
35	Leaf Colour Chart (LCC) development based on SPAD readings for fertilizer nitrogen top dressing in sorghum, bajra and ragi	B. Gangaiah	-	Nitrogen parameters, Chennai	13.00	2022-2024
36	Agriculture Drone Project	B. Gangaiah	K. Srinivasa Babu, G. Rajesha, Basavaraj Raigond & R. Swarna	ICAR-Division of Agricultural Extension, New Delhi	35.00	2022-2023
37	Development and characterization of trait-specific lines from wide hybridization in sorghum	K B R S Visarada	Jinu Jacob, G Shyam Prasad	SERB POWER Grant	30.4	2022-2025
38	Molecular prediction and candidate gene(s) identification for grain yield heterosis in kharif sorghum through genomics and transcriptomics approaches	P Rajendra kumar	C Aruna	SERB-DST	38.91	2022-2025*

**This project was sanctioned during Feb 2022*

7 Highlights of AICRP on sorghum and millets

52nd Annual Group Meeting of AICRP on Sorghum and 33rd Annual Group Meeting of Small millets

The 52nd Annual Group Meeting of AICRP on Sorghum and 33rd Annual Group Meeting of Small millets was organized virtually during 28-29 April 2022. On the first day, Dr. RK Singh, ADG (FFC), ICAR Chaired the sessions and 10 Principal Investigators of AICRP on Sorghum and 7 Principal Investigators of AICRP on Small millets presented their discipline-wise progress and achievements made during 2021-22. On the second day, Dr. TR Sharma, DDG-CS, ICAR Chaired the sessions. Dr. PV Vara Prasad, Professor and Director, Department of Agronomy, Kansas State University, USA delivered his special lecture on "Improve sorghum and millet productivity in the semi-arid regions – Way forward" for the benefit of millets researchers in the country. The special lecture was followed by Varietal Identification Committee Meeting Chaired by the Dr. TR Sharma, DDG-CS, ICAR and attended by Dr. RK Singh, ADG (FFC), Dr. DK Yadav, ADG (Seeds), ICAR and other designated members from University, Seed Sector and industry by the Council. During the plenary session, all the Principal Investigators presented their Technical Programme for 2022-23 under AICRP on Sorghum and Small millets. Dr. Trilochan Mohapatra, Secretary, DARE and DG, ICAR was the Chief Guest during the closing of the plenary session and addressed

the millets fraternity and spoke in length about plans and need to prepare well for the forthcoming International Year of Millets 2023 (IYoM2023). Dr. Rajendra Prasad, Vice Chancellor, University of Agriculture Sciences – Bengaluru was the Guest of Honour and delivered his address to the participants and universities' preparedness for the IYoM2023. The meeting was also attended by the Expert Group in Sorghum and Small millets Viz., Dr. JV Patil, Former Director, ICAR-IIMR; Dr. N Seetharama,Former Director, DSR; Dr. Chanabyre Gowda and Prabhakar, Former Project Coordinator (s) AICRP on Small millets and Dr. N Devakumar, Director of Extension, UAS-B. The Annual Group Meeting 2022 of Sorghum and Small millets was coordinated by Dr.s M Elangovan, IK Das, B Amasiddha, KN Ganapathy and D Sooganna.

Pre-AGM 2022 - AICRP on Sorghum & Small Millets

ICAR – IIMR successfully conducted online Pre - Review of Research: Scientific audit based on presentations of AICRP on Sorghum and Small Millets Centres during 31 March and 1 April 2022, and finalization of the Technical Programme Planning for 2022-23 of the AICRPs Sorghum and Small were organized 4 -5 April, 2022. The PIs of various disciplines presented the progress made during 2021-22. All the AICRP on Sorghum and Small millet scientists participated in the above scheduled meetings and participated in the discussion to develop the Technical Program for 2022-23. However, based on the expert comments and Director, IIMR suggestions, the improved and refined presentations were planned for the AGM main meeting for final approval by the dignitaries from the Council. M Elangovan, Principal Scientist and Co-Nodal officer-AGM 22 coordinated this virtual zoom meeting. The detailed information of the meetings is as follows:

Review of Research and scientific audit: Review of research through scientific audit based presentation of AICRP on Sorghum and Small millets was organized through virtual mode during 31 March 2022 - 1st April 2022 as part of the 52nd Annual Group Meeting of AICRP on Sorghum and 33rd Annual Group Meeting of AICRP on Small millets. The session started with the welcome and initial remarks by the Dr. Vilas A Tonapi, Director and Project Coordinator Sorghum and Small millets. The session was Chaired by Dr. JV Patil, former Director, ICAR-IIMR and Co-chaired by Dr. Prabhakar, Ex. Project Coordinator Small millets. Dr. JV Patil emphasized on the forthcoming International Year of Millets 2023 and added responsibilities. Dr. Prabhakar mentioned that the expectation on small millet centres and workers are very high and equally important. He also further categorised the best and better working small millets centers and stressed to improve small millets centres in the North-eastern states through allocation of more funds in the years to come. They also further requested Sorghum and Small millets centres to fine-tune their programmes to deliver the targets for International Year of Millets. The Officer In-charge / Senior Breeders made the presentations in AICRP on Sorghum. The AICRP on Sorghum and Small millets achievements were audited by the Experts, Project Coordinator and Principal Investigators of the disciplines and suggested the wayward.

Technical Programme (2022-23) Planning Meeting: Technical programme (2022-23) planning meeting of AICRP on Sorghum and Small millets was organized through virtual mode during 4 – 5 April 2022 as part of the 52nd Annual Group Meeting of AICRP on Sorghum and 33rd Annual Group Meeting of AICRP on Small millets. The session started with the welcome and initial remarks by the Dr. Vilas A Tonapi, Director and Project Coordinator (Sorghum and small millets). The session was Chaired by Dr. JV Patil, Former Director, ICAR-IIMR and Co-chaired by Dr. N Seetarama, Former Director, DSR for Sorghum programme discussion and Dr. Prabhakar, Former Project Coordinator, AICRP on Small millets for Small millets discussion. The other experts who participated in the planning meeting were Dr. Chanabyre Gowda, Former Project Coordinator, AICRP on Small millets; and Dr. N Devakumar, Director of Extension, UAS-Bengaluru.

8 Publications

Journal Papers

International

1. Chengeshpur A. Goud, Vanisri S, Renuka M, Aswini V, Janani S, Himabindu K, Santosha R, Abhishek R, Govindaraj M, Nepolean T. 2022. Identification of iron and zinc responsive genes in pearl millet through genome-wide RNA-Seq approach. Frontiers in Nutrition doi: 10.3389/fnut.2022.884381 (JrnID: F090a; IF:12.58).

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1. Padmavathi Ch, Padmaja P G. 2022. Insect resistance in field crops. *Indian Journal of Entomology* 84 (Spl. Issue):1-28 eRef.No. 22925. doi.10.55446/IJE.2022.911. (*JrnID:* I*059; IF:* 5.08).

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Book Chapters

1. 1. Ashok Kumar A, Shivaji P Mehtre, Gaddameedi Anil, Sunita Gorthy, Kotla Anuradha, Rahul M Phuke, Jayakumar Jaganathan, Hari Prasanna, Sharad Rao Gadakh, Uttam Chavan, Kalpande H V, Vilas A. Tonapi. 2022. Biofortifying sorghum for delivering grain micronutrients in high yielding cultivars with market-preferred traits. In: Kumar, S., Dikshit, H.K., Mishra, G.P., Singh, A. (eds) Biofortification of Staple Crops. Springer, Singapore. doi.org/10.1007/978-981-16-3280-8_8.

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6. Dayakar Rao B, Kiranmai E, Srenuja D, Vilas A Tonapi. 2022. Holistic value chain approach in finger millets. A. Anil kumar et al. (eds), The Finger Millet Genome, Compendium of Plant Genomes, published by Springer Nature Switzerland AG 2022. ISBN. 978-3-031-00867-2, PP.277-296. doi.org/10.1007/978-3-031-00868-9_1.

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11. Vilas A Tonapi, Venkatesh Bhat, Sangappa, Sreenivasababu, Dayakar Rao B. 2022. Strategies for enhancement of production and productivity of millets. In: Nagaraja TE, et al. (editors), Finger millet: Nature's master grain- a souvenir. International Conference on harnessing the potential of finger millets for achieving food and nutritional security: Challenges and Prospects, ISBN: 978-93-91355-33-3, January, UAS Bangalore, 19-22, 2022. Pp. 1-16.

Technical Bulletins

1. Chapke R R, Kanthisri B S, Bharat, Tonapi V A. 2022. Doubling farmers' income through millets technology interventions: success stories of Farmer FIRST Project. ICAR-Indian Institute of Millets Research, Hyderabad: 148p. (ISBN: 978-81-946973-3-6)

2. Chapke R R, Satyavathi C T, Sanjana Reddy P, Sukanya T S, Palanna K B, Sangappa C, Tonapi V A. 2022. Millets Production Technologies in Doubling Farmers' Income: Success stories. ICAR-Indian Institute of Millets Research, Hyderabad: 192p. (ISBN: 978-81-946973-7-4).

3. Elangovan M, Amasiddha B, Ganapathy K N, Karnam Venkatesh, Sai Karthik A, Raghavendra Rao K V, Vilas A Tonapi. 2022. Pedigree database on sorghum elite breeding stocks (ICAR-AICRP on Sorghum: 2017 - 2022). ICAR-All India Coordinated Research Project on Sorghum, ICAR-Indian Institute of Millets Research (IIMR), Rajendranagar, Hyderabad 500 030, Telangana, India. PP 137. ISBN 978-93-94673-07-6.

4. Elangovan M, Amasiddha B, Ganapathy K N, Venkatesh K, Sooganna D, Sai Karthik A, Prabhakar, Vilas A Tonapi. 2022. Pedigree

database on small millets elite breeding stocks: AICRP on small millets (2016-2022). All India Coordinated Research Project on Small Millets, ICAR–Indian Institute of Millets Research (IIMR), Rajendranagar, Hyderabad 500030, Telangana, India, 99 pp. ISBN: 978-93-94673-04-5.

5. Elangovan M, Karnam Venkatesh, Amasiddha B, Sai Karthik A, Vilas A Tonapi. 2022. The distribution and utilization of sorghum genetic resources in India (2012-2015). ICAR-Indian Institute of Millets Research (IIMR), Rajendranagar, Hyderabad 500 030, Telangana, India. PP 1445. ISBN 978-93-94673-09-0.

6. Elangovan M, Karnam Venkatesh, Amasiddha B, Sai Karthik A, Vilas A Tonapi. 2022. Distribution and utilization of millets genetic resources in India (2015-2021).ICAR-Indian Institute of Millets Research (IIMR), Rajendranagar, Hyderabad 500 030, Telangana, India. PP 1877. ISBN: 978-81-946973-6-7.

7. Shyam Prasad G, Stanley J, Kalaisekar A, Srinivasa Babu K, Subbarayudu B, Padmaja P G, Tonapi V A. 2022. A Pocket Guide on Pests of Millets, ICAR-Indian Institute of Millets Research, 92p, ISBN: 978-81-946973-0-5.

Publications in proceedings of Conferences/Seminar/Symposium

Lead speaker

International

1. Das I K. 2022. Blast of finger Millet: The pathogen, its variation, virulence, fitness and management. T-II. Theme 2- Production Systems and Crop Management Sub-themes: Good agricultural practices for sustainability, Diversification of cropping systems, Biotic and abiotic stress management, Seed systems and quality seed management. In: International Conference on Harnessing the Potential of Finger millet for achieving food and nutritional security: challenges and prospects during 19-22, 2022 organized by University of Agricultural Sciences, Bangalore In Collaboration with ICAR- IIMR and ICRISAT. ISBN: 978-93-91355-32-6.

2. Vilas A Tonapi. 2022. Way forward for millets: Indian and Global. T-V. In: International Conference on Harnessing the Potential of Finger millet for achieving food and nutritional security: challenges and prospects during 19-22, 2022 organized by University of Agricultural Sciences, Bangalore In Collaboration with ICAR- IIMR and ICRISAT. ISBN: 978-93-91355-32-6.

Invited speaker

National

1. Padmavathi Ch, Padmaja P G. 2022. Host plant resistance in crop plants. Technical Session I: Agricultural, Horticultural and Forest Entomology. In: 3rd National Symposium Entomology 2022: Innovation and Entrepreneursip during 8-10 December 2022 at Hyderabad, India organized by Entomology, Hyderabad, Professor Jayashankar Telangana State Agricultural University, Entomological Society of India, Plant Protection Association of India and Agri Biotech Foundation.

2. Sangappa C. 2022. A connecting dot between farmers & consumers for achieving nutritional security. T-V. Theme 4 - Government Policies and Support Systems Sub-themes: Building Sustainable Farmer-Producer Organizations (FPOs), Central and State government initiatives for mainstreaming millets, Public Distribution System and Social welfare schemes, Role of NGOs in millets promotion. In: International Conference on Harnessing the Potential of Finger millet for achieving food and nutritional security: challenges and prospects during 19-22, 2022 organized by University of Agricultural Sciences, Bangalore In Collaboration with ICAR- IIMR and ICRISAT. ISBN: 978-93-91355-32-6.

Oral Presentations

International

1. Dayakar Rao B, Prudhvi P V V P, Jyotsna Patel. 2022. Microwave assisted hydrothermal pre-treatment of finger millets: A novel alternative industrially feasible technology. T-III-O1 pp.124. In: Proceedings International Conference on Harnessing the Potential of Finger millet for achieving food and nutritional security: challenges and prospects (eds) TE Nagaraja, CA Deepak, YG Shadakshari, Vilas A Tonapi and S Rajendra Prasad during 19-22, 2022 organized by University of Agricultural Sciences, Bangalore In Collaboration with ICAR- IIMR and ICRISAT. ISBN: 978-93-91355-32-6.
2. Ganapathy K N, Patro T S S K, Palanna K B, Das I K, Hariprasanna K, Elangovan M, Nagaraja T E, Amasiddha B, Prashant, Vilas A Tonapi. 2022. Development of gamma mutants with improved grain yield and blast resistance in finger millet. T-I-O4 pp. 4. In: Proceedings International Conference on Harnessing the Potential of Finger millet for achieving food and nutritional security: challenges and prospects (eds) TE Nagaraja, CA Deepak, YG Shadakshari, Vilas A Tonapi and S Rajendra Prasad during 19-22, 2022 organized by University of Agricultural Sciences, Bangalore In Collaboration with ICAR- IIMR and ICRISAT. ISBN: 978-93-91355-32-6.
3. Hemasankari P, Dayakar Rao B, Sai Prasanna E, Vilas. A. Tonapi, Kailappan R. 2022. Design and development of double head dehuller and its performance testing using selected minor millets. In: Technical Compendium of 56th Annual Convention of Indian Society of Agricultural Engineers on “Agricultural Engineering Innovation for Global Food Security” and International Symposium on “India @ 2047: Agricultural Engineering Perspective” held during 9-11 November, 2022 at the Agricultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.
4. Kannababu N, Gangaiah B, Venkateswarlu R, Vilas A Tonapi. 2022. Finger millet seed yield and seedling vigour as influenced by micronutrients boron and zinc foliar spray. T-II-O2 pp. 50. In: Proceedings International Conference on Harnessing the Potential of Finger millet for achieving food and nutritional security: challenges and prospects (eds) TE Nagaraja, CA Deepak, YG Shadakshari, Vilas A Tonapi and S Rajendra Prasad during 19-22, 2022 organized by University of Agricultural Sciences, Bangalore In Collaboration with ICAR-IIMR and ICRISAT. ISBN: 978-93-91355-32-6.
5. Padmaja P G, Kalaisekar A, Venkateswarlu R, Shwetha B L, Shyam Prasad G, Venkatesh Bhat B, Dayakar Rao B, Vilas Tonapi. 2022. Biochemical changes in finger millet flour during storage. T-III-O8 pp. 128. In: Proceedings International Conference on Harnessing the Potential of Finger millet for achieving food and nutritional security: challenges and prospects (eds) TE Nagaraja, CA Deepak, YG Shadakshari, Vilas A Tonapi and S Rajendra Prasad during 19-22, 2022 organized by University of Agricultural Sciences, Bangalore In Collaboration with ICAR- IIMR and ICRISAT. ISBN: 978-93-91355-32-6.

Abstracts

National

1. Baswaraj Raigond, Parashuram Patroti, Utkarsha Thorat, Das I K, Vilas Tonapi. 2022. Status of foliar diseases of sorghum during post rainy season in semi-arid region of Maharashtra. In: National Symposium on “Novel Strategies in Plant Stress Diagnosis and Management” during 6-7th May, 2022 organized at Dr YS Parmar University of Horticulture & Forestry Nauni, Solan (HP).
2. Khandelwal V, Sanjana Reddy P, Bala Bharathi M, Tara Satyavathi C. 2022. Prevalence of better parent heterosis for multiple traits in top cross hybrids of pearl millet. In: The Tending Mendel’s garden for a perpetual and bountiful harvest-symposium commemorating birth centenary of

Gregor Johann Mendel (MENDELSYM), 19-21 July 2022, New Delhi, India, Pp. 199.

Posters

International

1. In: Proceedings International Conference on Harnessing the Potential of Finger millet for achieving food and nutritional security: challenges and prospects (eds) TE Nagaraja, CA Deepak, YG Shadakshari, Vilas A Tonapi and S Rajendra Prasad during 19-22, 2022 organized by University of Agricultural Sciences, Bangalore In Collaboration with ICAR- IIMR and ICRISAT. ISBN: 978-93-91355-32-6.
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3. Bharathi G, Anuradha N, Elangovan M, Patro T S S K. 2022. Genetic divergence analysis in finger millet (*Eleusine coracana* L. Gaertn.) genotypes. T-I-P5 pp.9.
4. Das I K, Kannababu N, Palanna K B, Rajesha G, Sunil Kumar. 2022. Seed mycoflora of finger millet and other small millets from field and storage. T-II-P97 pp.122.
5. Dayakar Rao B, Peddi Priyanka V, Barbhai Mrunal D, Manjula D Ghoora. 2022. Effect of processing on resistance starch in finger millet (*Eleusine coracana* L.) – An overview. T-III-P11 pp.137.
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3. Ganapathy K N, Venkatesh Bhat B, Sujay Rakshit, Elangovan M, Das I K, Amasiddha B, Vilas A Tonapi. 2022. SPV 2315 (IC0635700; INGR20086), a sorghum (*Sorghum bicolor*) germplasm resistance to foliar diseases (anthracnose, zonate leaf spot, leaf blight and grey leaf spot). High per day productivity for green fodder, high seed yield. *Indian Journal of Plant Genetic Resources* 35(1):114.

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9 List of Ongoing Projects -2022

List of ongoing projects

S. No	Project Title	Principal investigator	Duration
Crop Improvement Sorghum			
1	Breeding for genetically diverse kharif sorghum genotypes with improved grain yield, quality, and resistance to important biotic stresses	C Aruna	2021-2026
2	Genetic enhancement of energy sorghums for renewable fuels and fodders	AV Umakanth	2021-2026
3	Utilization of wide hybridization derivatives in breeding program and molecular characterization in sorghum	KBRS Visarada	2020-2023
4	Genetic enhancement of rabi sorghum adaptive traits for improved varietal performance	Parashuram Patroti	2020-2025
Pearl Millet			
5	Improving the yield potential of pearl millet hybrids for favorable and marginal environments	T Nepolean	2018-2023
6	Genetic enhancement of pearl millet for yield and adaptation to arid regions	P Sanjana Reddy	2021-2026
7	Forage pearl millet improvement for high biomass	Avinash Singode	2021-2026
Small Millets			
8	Genetic improvement of foxtail millet for grain yield and related traits	K Hariprasanna	2021-2026
9	Genetic diversification for grain yield and related traits in finger millet genotypes	KN Ganapathy	2021-2026
10	Development of end-use specific little millet genotypes with improved grain yield and grain micronutrients	KN Ganapathy	2021-2026
11	Genetic improvement of proso millet for yield and protein content	Avinash Singode	2021-2026
12	Development of dual purpose cultivars with improved quality in barnyard millet	B Amasiddha	2021-2026
13	Improvement of kodo millet for economically important traits and development of markers for cultivar identification	Ch Deepika	2021-2026
Genetic resources management			
14	Nutri-cereals genetic resources management	M Elangovan	2021-2026
15	Pre-breeding of sorghum and finger millet for specific trait improvement	Karnam Venkatesh	2021-2026
	Biotechnology		

S. No	Project Title	Principal investigator	Duration
16	Manipulating SbSERK gene(s) to understand their effect on generating apomixis components through CRISPR-Cas9 mediated gene editing technology	D Balakrishna	2020-2025
17	Generation of genomic resources and its application for the improvement of millets	P Rajendra Kumar	2021-2026
Crop Protection			
18	Studies on virulence and host plant resistance on important diseases of millets	IK Das	2021-2026
19	Studies on endophytes for management of major soil-borne diseases of millets	G Rajesha	2020-2024
20	Yield loss assessment in millets due to invasive fall army worm, and its integrated management with special emphasis on sorghum	G Shyam Prasad	2020-2024
21	Understanding the host-pest interactions of shoot fly, stem borer and fall armyworm in millets and management through semio-chemicals	PG Padmaja	2020-2025
22	Integrated pest management for major shoot pests of sorghum during post rainy season in dryland region	B Subbarayudu	2020-2024
23	Studies on major insect pests of rabi sorghum and development of EILs	K Srinivas Babu	2020-2025
24	Assessment of crop losses due to major insect pests and role of enemies in reducing the pest load in millets	A Kalaisekar	2018-2023
25	Risk of pesticide sprays on sorghum: Acute and field toxicities on stem borers & shoot bug and their natural enemies	J Stanley	2020-2023
Crop Production & Physiology			
26	Development of intra millet intercropping systems for resilience and sustainability	B Gangaiah	2020-2024
27	Improving water use efficiency of finger millet & foxtail millet under limited moisture conditions	Swarna Ronanki	2021-2026
28	Physiological dissection of key traits contributing for moisture stress adaptations in post rainy sorghum: with an emphasis on root architectural traits	S Srividhya	2020-2025
29	Livelihood security of millets stakeholders through production and processing technologies in NE region	B Sangappa	2020-2023
	Nutritional quality & Seed Science		
30	Biochemical characterization of millets and millet food products for nutraceuticals and health benefits	CV Ratnavathi	2021-2026
31	High calcium accumulation in finger millet and its relationship to grain constituents	R Venkateshwarulu	2020-2023
32	Nutritional composition, phenolic profile and bioactivities of sorghum, and foxtail, kodo and proso millet grains	VM Malathi	2021-2026
33	Investigations on genetics of seed vigor and longevity, and effect of foliar plant nutrition on seed yield and quality in small millets	N Kannababu	2020-2025
34	Studies on cold tolerance in sorghum and foxtail millet	Sooganna	2018-2023

S. No	Project Title	Principal investigator	Duration
Socioeconomics & Extension			
35	Development of millet based composite foods in collaboration with fishery, dairy, horticulture and meat commodities	B Dayakar Rao	2021-2026
36	Yield gap and constraints analysis of sorghum production in traditional area	RR Chapke	2021-2026
37	Economic analysis of production, marketing, utilization, and policy perspectives of sorghum in India	Anuradha Narala	2020-2025
38	Development of selected value-added products of dairy analogue, pigments extraction from millets and its evaluation for enhanced shelf life	P Hemashankari	2020-2023
39	Development of online web application for hybrid and varietal germplasm PME students database information and data retrieval system	P Mukesh	2021-2023

List of Completed Projects

S. No	Project Title	Principal Investigator	Duration
1	Development of genetically diversified high yielding Rabi sorghum Hybrids	R Madhusudhana	2017-2022
2	Brown top millet- Characterization and genetic improvement	B Venkatesh Bhat	2017-2022 Revised duration (2017-2025)
3	Sorghum transgenic for stem borer resistance	D Balakrishna	2017-2022
4	Biochemical and molecular mechanisms of thermo-tolerance in pearl millet	Jinu Jacob	2017-2022

List of New Projects

S.No	Title of the Project	Name of PI/ Co-PIs	Duration
1	Breeding forage sorghum for higher productivity	**B Venkatesh Bhat** (PI),Avinash Singode, AV Umakanth, G Shyam Prasad, R Venkateshwarulu	2022-2027
2	Viral diseases of sorghum: A focused study on characterization, developing advanced diagnostic and strategy towards management	**Baswaraj Raigond** (PI), IK Das, Parasuram Patroti, N Manjunath, (NRCP), YB Basavaraj (IARI), M Elangovan	2022-2027
3	Physiological basis of high temperature stress on summer sorghum	**Seva Nayak** (PI), S Srividhya, Swarna Ronanki, R Madhusudhana	2022-2025
4	Adoption and impact of improved finger millet production technologies	**A Srinivas** (PI), B Dayakar Rao, U Triveni (RARS, Vizianagaram), TS Sukanya (PC Unit, UAS, Bangalore)	2022-2026

10 RAC and other Institute meetings and significant decisions

Research Advisory Committee meeting

The XXIII meeting of Research Advisory Committee (RAC) of ICAR - Indian Institute of Millets Research, Hyderabad was held during 3 - 4 November, 2022 under the Chairmanship of Dr. SL Mehta, Former Vice-Chancellor, (Agricultural University - Udaipur) to review the progress made under various research projects during the period 2021-22. Other members of RAC present were: Drs. SS Patil, Former Director of Research & Former Professor (Plant Breeding & Genetics) – University of Agricultural Sciences, Dharwad; P Parthasarathi, Rao, Principal Scientist (Retd.), Economics and Policy Studies and RP Thakur, Former Principal Plant Pathologist & Head PQL, International Crops Research Institute for Semi-Arid Tropics (ICRISAT), Patancheru; Arun Kumar Sharma, Former Head, Food Science Division, Bhabha Atomic Research Centre (BARC), Mumbai; Sh. J. Sri Ranga Rao and Shri Jangam Reddy Ankula Reddy (ICAR nominated member representing Agricultural / rural interests), Dr. CV Ratnavathi, Acting Director, IIMR and Dr. P Rajendrakumar, Principal Scientist and Member-Secretary, RAC. Dr. Prabhakar, former Project Coordinator (Small Millets), Bengaluru and Dr. Tara Satyavathi, Project Coordinator (Pearl Millet), Jodhpur also graced the occasion as Special Invitees. Action Taken Report on the recommendations of the previous RAC meeting was presented by the Member Secretary.

Dr. CV Ratnavathi, Acting Director, IIMR presented the current scenario of millets cultivation and the strategies to increase the area under millets cultivation. She briefed about institute's significant achievements and infrastructure created during the year and emphasized the role of IIMR on the promotion of millets. and current climate change scenario and their nutritional value in improving the health of the population. She also explained the initiatives and activities taken-up by the IIMR in the light of forthcoming International Year of Millets Research including implementing the National Sub-mission on Millets towards creating the

awareness on millets, encouraging millet cultivation, establishment of Seed Hubs, creation of Farmers Producer Organizations (FPOs), establishment of millets processing units and making them as an essential part of our daily diet.

The scientists representing different thematic areas presented the progress, achievements and expected outcome from their projects. The RAC team also visited and monitored the field experiments, Nutri-Hub and other facilities at IIMR. The Chairman, Dr. SL Mehta appreciated the efforts of scientists and other staff of the Institute and congratulated them for the excellent work carried out. The Chairman and members gave valuable suggestions for the improvement of various projects and congratulated the team IIMR on their efforts towards bringing millets to the forefront. The minutes were finalized and submitted to the council for approval. The ICAR-approved proceedings will be circulated among the RAC members.

Salient Recommendations:

No.	XXIII RAC Suggestion/ Recommendation
1	Collection of germplasm through exploration in the tribal regions where millets have been grown over years.
2	Development of R-population based on sterile cytoplasm in *rabi* sorghum.
3	Establishment of a pilot plant for sweet sorghum-based ethanol production at the Institute.
4	Effecting crosses between bunchy type with normal spikes and long spikes as well as pigmented and non-pigmented types in little millet.
5	Making crosses between Indian and Japanese Barnyard millets and selection of segregants for grain, fodder and dual-purpose types.
6	Development of a suitable package for the biocontrol of insect pests in small millets, which will help in organic cultivation of millets.
7	Identification and molecular characterization of new endophytes from rhizosphere of millets crop.
8	Studying the root architecture of some key sorghum varieties and its relationship with drought tolerance.
9	Involvement of Krishi Vigyan Kendras (KVKs) in the promotion of millets and having effective reach of farmers.
10	Analysis of the stability of the millet products and the changes happening during their storage.

Institute Management Committee Meeting

The 29th Institute Management Committee Meeting of ICAR- Indian Institute of Millets Research was held on 25 May 2022 virtually. The following members were present during the meeting: Dr. Vilas A Tonapi, Director, IIMR, Chairman, Dr. RK Singh, Asst. Director General (FFC), ICAR, Member, Ms, G NarimaniJ Director, SAMETI, Telangana., Member, Dr. Seema, Dean of Agriculture, PJTSAU, Member, Dr. Firoz Hussain, Principal Scientist, IARI, Member, Dr. M Maheshwari, former Head, CRIDA, Member, Dr Bharat S Sontakki, Head, NAARM, Member, Sh. J Sri Ranga Rao, Hyderabad, Member, Sh. K Srinivasa Rao, FAO, IRR, Member. Other special invitees from ICAR-IIMR, Hyderabad were Dr. R Madhusudhana, Pr. Scientist & PME Cell In-charge, and Dr. D Balakrishna, Pr. Scientist & Officer In-charge (Works).

Dr. Vilas A Tonapi, Director, ICAR-IIMR and Chairman, IMC welcomed the members of the Institute Management Committee of IIMR and made a brief presentation on the achievements during 2021-2022, on-going research work of the institute and about the linkages with national and international agencies. He also appraised the house about the developmental

activities taken up by the institute viz., infrastructure developed, on-going works at Centre of Excellence, Nurtihub, promotion of FPOs and Incubation centre. He briefly explained about the works being carried out by the institute administration, budget utilization, dropping of audit paras. He also informed the members regarding submission of documents to PMOs office on the Blue print and position paper as part of initiative and planning being done for the forthcoming International Year of Millets 2023. During the course of the meeting the various agenda points were taken up. The meeting ended with a vote of thanks proposed by Ms. Ritu Dalal, Member Secretary of IMC.

Institute Research Council Meeting - 2022

Institute Research Council(IRC) of ICAR- Indian Institute of Millets Research (IIMR) met during 2-4 Aug 2022 in virtual mode under the chairmanship of Dr. CV Ratnavathi, Director, IIMR, to Review of progress in ongoing projects, and Review of progress and achievements in projects concluded during 2022. The meeting was attended by external Experts-Drs. Prabhakar Bhat, Former PC, AICRP Small Millets, Bengaluru, and JC Sekhar, Principal Scientist and Officer In-charge, Indian Institute of Maize Research, Winter Nursery, Hyderabad, and R Madhusudhana, In-charge PME cell, IK Das, Member Secretary – IRC, IIMR-Hyderabad, apart from all the scientists of this institute. During the 3-day-long deliberations a total of 43 projects were discussed and thoroughly reviewed. The RPPs were presented by the principal investigators. IIMR Institute Research Council (IRC) again met in virtual meeting on 8 August, 2022, to discuss about new project proposals under regular institute projects. The RPP-I of the proposals (total 4) were initially reviewed by PMC. Comments of PMC were addressed by PI and modified RPP-I were presented in IRC, which was attended by all scientist-members along with the external experts. The details of the projects, progress and output, and comments and suggestions made during the IRC meeting are documented in “IRC proceedings". At the end of the meeting Chairman extended his appreciation for all the presentations in general and expressed his satisfaction on the annual progress made in most of the projects. Drs. IK Das, the member secretary and R Madhusudhana, PME Cell in-charge organized the IRC meeting.

11 Participation of IIMR staff in coferences, meetings etc

S. No.	Name of Employee	Programme details	Category	Dates
1	VA Tonapi, Sangappa and Mahesh Kumar	All –India Seminar on Official Language usage for Scientists and Technical Officers held at Advanced Systems Laboratory (ASL), DRDO, Hyderabad.	Seminar	06 -07 Jan., 2022
2	Rajesha G	Microbial Biotechnology for Novel Food and Food Ingredients.	Webinar	11 Jan., 2022
3	M Elangovan	Plant Genome Saviour Community Awardee(s) virtual meeting on organized by PPVFRA.	Webinar	12 Jan., 2022
4	P Hemashankari, A Srinivas, Jinu Jacob, V Ravi Kumar and P Rajappa (In person) and all other scientists of IIMR (Virtually)	International Conference on Finger Millet – ICFM-2022, held at Mandya, Karnataka.	Conference	19 -22 Jan., 2022
5	B Dayakar Rao	Harnessing the potential of finger millet for achieving food and nutritional security: challenges and prospects (ICFM-2022)	Conference	22 Jan., 2022
6	Parashuram Patroti	Agriculture Technology Festival at KVK Solapur-I, Barshi Road, Solapur	Workshop	20 Jan, 2022
7	B Dayakar Rao	First meeting on 4 Task Force on nutrition & Health benefits of millets (IYoM)-2023	Meeting	1 Feb., 2022
8	B Dayakar Rao	Meeting on International Year of Millets (IYoM)	Meeting	04 Feb., 2022
9	B Dayakar Rao	Meeting with Indian Delegation for Dubai Expo - Interaction with Startups	Meeting	04 Feb., 2022
10	Vilas A Tonapi, Ritu Dalal & KV Raghavendra Rao	Physical Meeting with Sanjeev Kumar, IAS, Financial Adviser to ICAR at NAARM, Hyderabad.	Meeting	09 Feb, 2022
11	B Dayakar Rao	Webinar on Business Opportunities in Millet Processing at NIFTEM, Thanjavur	Webinar	11 Feb., 2022
12	Parashuram Patroti	Agriculture Technology Festival: Workshop on PM-Formalization of Micro food enterprises Scheme (PM-FME) and Mahila Melava at KVK Mohol, Solapur	Workshop	17 Feb., 2022
13	B Dayakar Rao	Webinar on Millets Quality, it's Nutritional Benefits and Value Chain at Dubai EXPO-2020	Webinar	18 Feb., 2022

S. No.	Name of Employee	Programme details	Category	Dates
14	B Dayakar Rao, Hariprasanna K.	Webinar on Smart agriculture - bringing back glory	Webinar	24 Feb., 2022
15	AV Umakanth	European Union-India-BCE conference on "Progress in Advanced Biofuels".	Webinar	02-03 Mar., 2022
16	P Sanjana Reddy	57th Annual Group Meeting of ICAR-AICRP on Pearl millet	W	2-3 march 2022
17	Rajesha G	Sorghum Germplasm Field Day at ICAR-IIMR	Field day	03 Mar.,, 2022
18	Vilas A Tonapi	ICAR level meeting on Budget utilization	Meeting	04 Mar., 2022
19	Mahesh Kumar	Official Language Implementation Committee meeting as a Member Secretary at ICAR-IIRR, Hyderabad.	Meeting	05 Mar., 2022
20	Vilas A Tonapi	SOC meeting organized by ICAR	Meeting	07 Mar., 2022
21	Vilas A Tonapi	NFSM meeting on millets organized by GoI	Meeting	07 Mar., 2022
22	D Revati	Webinar on "Use of AI and ICT in Agriculture Information Access and Dissemination" organised by IASRI, New Delhi.	Webinar	14 Mar., 2022
23	Vilas A Tonapi & B Dayakar Rao	Conference on Incentivizing millets (Karnataka and Odisha model), mapping of area under millets and diversification for growing millets.	Meeting	15 Mar., 2022
24	CV Ratnavathi	Internal complaints committee meeting of NIPHM, Hyderabad	Meeting	16 Mar., 2022
25	Vilas A Tonapi	Millets for Health of all-Seminar organized by Maulana Azad Urdu University, Hyderabad	webinar	19 Mar., 2022
26	B Dayakar Rao	International conclave on millets	Webinar	21 Mar., 2022
27	CV Ratnavathi	Meeting with Industry Associations/ stakeholders to discuss proposed PLI scheme for millet based RET/ RTC products by PLISFPI Division, Ministry of Food Processing Industries, New Delhi	Meeting	22 Mar., 2022
28	Vilas A Tonapi	UN commemorative meeting on International Year of Millets - 2023 organized by FAO –UNO.	Meeting	22 Mar., 2022
29	B Dayakar Rao	Annual General meeting	Meeting	22 Mar, 2022
30	Vilas A Tonapi & B Venkatesh Bhat	Brainstorming meeting on Strengthening informal seed sector –organized by IISS-Mau	Meeting	23 Mar., 2022
31	Vilas A Tonapi	Meeting on Biofuels from sorghum with Parle India.	Meeting	24 Mar., 2022

S. No.	Name of Employee	Programme details	Category	Dates
32	B Dayakar Rao	Meeting of task force on millet promotion council	Meeting	28 Mar., 2022
33	P Sanjana Reddy	Induced mutations and TILLING in the era of genome editing	Seminar	30 Mar., 2022
34	P Sanjana Reddy	**Plant Improvement to Increase Crop Drought Resilience by Dr. Thomas Sinclair**	Seminar	8 April 2022
35	Vilas A Tonapi	Directors Conference organized by ICAR, New Delhi	Meeting	13 April, 2022
36	Mahesh Kumar	Meeting of Town Official Language Implementation Committee (Central Govt. Offices-2) organized by NIRDPR, Hyderabad in collaboration of Software Technology Parks of India, Hyderabad at MCRHRDI, Hyderabad	Meeting	27 April, 2022
37	B Dayakar Rao	Invitation on RIC meeting under RkVY-RAFTAAR	Meeting	28 Apr., 2022
38	P Sanjana Reddy and AV Umakanth	PJTSAU -State level technical programme meetings pertaining crop improvement	Meeting	9-12 May, 2022
39	CV Ratnavathi	4th Graduation Ceremony of PGDM-ABM held in the ICAR - NAARM Auditorium, Hyderabad	Meeting	14 May, 2022.
40	Rajesha G	Climate Change Concerns: Challenges for Agriculture Sector and Food and Nutrition Security	Meeting	14 May, 2022
41	M Elangovan, Hariprasanna K, Jinu Jacob, Rajendra R. Chapke, P Sanjana Reddy, Rajesha G	National Seminar cum Webinar on Climate Change Concerns: Challenges for Agriculture Sector and Food and Nutrition Security organized by ICAR-Indian Institute of Millets Research (IIMR), Hyderabad and Karnataka Agri-Professionals Association (KAPA), Hyderabad.	Seminar	14-15 May, 2022.
42	Hariprasanna K.	CRP Biofortification review meeting	Meeting	20-21 May, 2022
43	Hariprasanna K.	International Webinar on “Prospects of Varieties/ Crops Developed through Genome Editing (regulatory framework, technologies and experience)”, by PPV&FRA and Federal Ministry of Food, Agriculture and Consumer Protection (BMEL), Germany.	Webinar	24 May, 2022
44	B Dayakar Rao	2 days national Conference on "Agri, start-ups	Conference	26-27 May, 2022
45	B Dayakar Rao	Interaction meeting with NAFED (The Virtual platform will provide an opportunity to interact with start-ups to interact with NAFEO	Meeting	27 May, 2022
46	Parashuram Patroti	*Garib Kalyan Sammelan* and *Shetkari Melava* organized by KVK Mohol and ATMA, Solapur	Conference	31 May, 2022

S. No.	Name of Employee	Programme details	Category	Dates
47	P Sanjana Reddy	Healthy soil, water and atmosphere for healthy environment under climate change conditions	Seminar	6 June 2022
48	B Dayakar Rao	BIRAC Start-up Expo 2022	Meeting	10 Jun., 2022
49	Jinu Jacob	4th international conference on innovative and current advances in agriculture and allied sciences.	Conference	12-14 Jun., 2022
50	Aruna C, Hariprasanna K.	88th CVRC Meeting	Meeting	17 Jun., 2022
51	Mahesh Kumar	Inspection Meeting of ICAR-Indian Institute of Rice Research by the Committee of Parliament on Official Language to review the activities of Official Language Implementation at Hotel Taj Krishna, Hyderabad	Meeting	18 Jun., 2022
52	Parashuram Patroti	2 days' workshop on Ph. D. Course work – Botany (PET 7) at School of Life sciences, PAHSU, Solapur	Workshop	18-19 Jun., 2022
53	Mahesh Kumar	Official Language Implementation Committee meeting as a Member Secretary at IIRR, Hyderabad	Meeting	27 Jun., 2022
54	Rajesha G	AICRP on Biological Control of Crop Pests and Diseases held at ICAR NBAIR, Bengaluru	Meeting	27 - 28 Jun.., 2022
55	B Dayakar Rao	Invited 2 experts to speak on Agri loan and mudra loan by Ari Ramakrishna, HDFC bank	Webinar	30 Jun., 2022
56	Rajendra R. Chapke	Zonal Workshop of KVKs organized by ICAR-ATARI, Pune at AAU, Anand, Gujarat	Workshop	7 July, 2022
57	B Dayakar Rao	Orientation Program on Export of Millets and Millet based products, organized by ICAR-IIMR and APEDA	Webinar	8 July, 2022
58	B Dayakar Rao	Keynote address on Role and relevance of millets for sustainable development at the Centre for Agrarian Studies, NIRD	Workshop	15 July, 2022
59	Rajendra R. Chapke	Online Workshop on ICAR-APAARI Knowledge Management organized by DKMA, New Delhi	Workshop	23 July, 2022
60	B Dayakar Rao	Millets Culinary Festival organized by IHM Pusa, ICAR-IIMR sponsored by Ministry of Agriculture and Farmers Welfare held at Delhi Haat	Conference	29-31 July, 2022
61	M Elangovan	A consultation meeting among researchers, engaged in utilizing plant genetic resources employing traditional and modern tools in their basic or applied studies organized by ISPGR and ICAR-NBPGR on the preparedness for the 9th Session of the Governing Body of ITPGRFA (GB9).	Meeting	5 Aug., 2022
62	B Dayakar Rao	16th RAC meeting of ICAR-National Research Centre on Meet	Physical Meeting	5 Aug., 2022
63	B Dayakar Rao	ADG international Conference Launch -1YOM 2023,	Virtual Meeting	8 Aug., 2022
64	B Dayakar Rao	To participate in workshop on "Bio-fortified Rice-way forward for Adoption at IGKV, Raipur	Workshop	17 Aug., 2022

S. No.	Name of Employee	Programme details	Category	Dates
65	Rajendra R. Chapke	National Workshop on “Pathways for the Successful Implementation of SC Sub-Plan Scheme in ICAR” at ICAR-NAARM, Hyderabad	National Workshop	18 Aug.,2022
66	M Elangovan	12th General Body Meeting of the Indian Society of Plant Genetic Resources (ISPGR) organized by ICAR-NBPGR-New Delhi	Meeting	20 Aug., 2022
67	Hariprasanna K.	Brain storming session on “Researchable issues in Millets”, Dept. of Millets, TNAU, Coimbatore	Meeting	21 Aug., 2022
68	B Dayakar Rao	First meeting of FaD16/ (Panel for formulation of Indian standards on millet-based products) BIS officials	Meeting	26 Aug., 2022
69	M Elangovan	National webinar on “Genetic Resources of Underutilized Tuber Crops for Nutritional Security” organized by ICAR-CTCRI, Trivandrum	Webinar	27 Aug., 2022
70	CV Ratnavathi, B Dayakar Rao, Hariprasanna K, K Srinivasa Babu, Amasiddha B, Sangappa and Srinivas	"Millets Conclave 2022" held at University of Agriculture Sciences, Raichur	Conclave	26-27 Aug., 2022
71	B Dayakar Rao	Webinar on Recent advances in Millet Processing and Value addition during Millet Conclave held at UAS, Raichur	Conference	29 Aug, 2022
72	B Dayakar Rao	Millet India Conference by BIOFACH India, APEDA and ICAR- IIMR	Conference	1 Sep, 2022
73	All Scientists and Technical Staff of IIMR	National Nutri Cereal Convention 4.0 (NNCC), Hitex, Hyderabad	Convention	23-24 Sept., 2022
74	B Dayakar Rao	National Consultation on Natural Farming	Meeting	27 Sept., 2022
75	B Dayakar Rao	Millet association, executive meeting	Meeting	28 Sept., 2022
76	Hariprasanna K., Malathi VM	Webinar on “Leveraging Millets for Nutrition and Health”, National Institute of Technology (NIT), Calicut	Webinar	30 Sept., 2022
77	P Sanjana Reddy	Pearl Millet Scientists Field Day	Meeting	3-4 October 2022
78	B Dayakar Rao	Multi-stakeholders’ workshop-cum seminar on millets" under TSP 2022-2023 in Collaboration at MSSRF	Workshop	11 Oct., 2022
79	B Dayakar Rao	International workshop on STI SDGs Roadmaps	Workshop	11 Oct., 2022
80	B Dayakar Rao	National conference" Resilience: A tool for Empowering Communities and strengthening Networks"	Conference	13-14 Oct., 2022
81	B Dayakar Rao	Seminar at the Mahila Kisan Diwas Celebration organized by Ministry of Agriculture and Farmers Welfare in collaboration with MANAGE-CIA, Hyderabad	Seminar	15 Oct, 2022

S. No.	Name of Employee	Programme details	Category	Dates
82	B Dayakar Rao	Workshop on support provided by GVT under various schemes for creation of Common infrastructure facilities.	Workshop	20 Oct., 2022
83	Mahesh Kumar	Meeting of Town Official Language Implementation Committee (Central Govt. Offices-2) organized by NIRDPR, Hyderabad at NFDB, Hyderabad	Meeting	21 Oct., 2022
84	CV Ratnavathi	"Women Scientists Conclave: Self Reliance" organized by National Academy of Sciences, India, Hyderabad Chapter and Academy of Science and Technology & Communication at Vivekananda Auditorium, IICT, Hyderabad	Graduation Ceremony	10 Oct., 2022
85	Rajendra R. Chapke	"Multi-stakeholders workshop-cum-seminar on millets" was organized at Namakkal of Tamil Nadu State	Workshop-cum-seminar	11 Oct., 2022
86	Hariprasanna K.	Sorghum Scientists' Field day, ICRISAT	Field day	14 Oct., 2022
87	Parashuram Patroti	PRERANA-2022 in house research festival in collaboration with Institutions Innovation Council (IIC) at Walchand College of Arts & Science, Solapur	Conference	20 Oct, 2022
88	T Nepolean, P Sanjana Reddy, C Aruna	BPAT Workshop	Workshop	25-26 October, 2022
89	Aruna C, Hariprasanna K.	89th CVRC Meeting	Meeting	26 Oct., 2022
90	Srividhya. S.	International Conference on Physiological & Molecular Mechanisms for abiotic stress tolerance in plants organized by Univ. of Calicut & ISSP	Conference	26-28 Oct., 2022
91	Hariprasanna K.	DUS Project Review meeting, PPV&FRA, New Delhi	Meeting	10-11 Nov., 2022
92	Mahesh Kumar	Online Hindi Workshop organized at ICAR-Central Coastal Agricultural Research Institute, Goa	Workshop	15 Nov., 2022
93	B Dayakar Rao	Meeting with NDA (Anti-doping) Sports Authority of India	Meeting	16 Nov., 2022
94	B Dayakar Rao	Meeting with secretary, ministry of Housing of urban Affairs, for international Year of millets (IYOM) 2023	Meeting	17 Nov., 2022
95	B Dayakar Rao	Meeting to discuss showcasing millet Products in the ambassadors Lunch on event	Meeting	18 Nov., 2022
96	B Dayakar Rao	Lecture on 'Overview of Millets & Value Chain Development' organised by the School of Life Sciences, University of Hyderabad	Seminar	19 Nov, 2022
97	Rajesha G	NATIONAL WORKSHOP-CUM-AWARENESS PROGRAMME ON J-Gate@ CeRA	Workshop	21 Nov., 2022
98	B Dayakar Rao	Delhi-Ambassador Meeting by Ministry of Agri-IYoM – 2023	Meeting	24 Nov., 2022

S. No.	Name of Employee	Programme details	Category	Dates
99	B Venkatesh Bhat and Soogannna	Seminar on “Strengthening of Seed Supply Systems for Food Security: from breeders to farmers” organized byTelangana State Seed & Organic Certification Authority, Government of Telangana, Hyderabad with the support of Government of India	Swminar	26 Nov., 2022
100	T Nepolean, P Sanjana Reddy, C Aruna	Brainstorming workshop on improving the shelf-life of the millets	Workshop	6 Dec., 2022
101	G Shyam Prasad, Mahesh Kumar	International conference on System of crop Intensification for Climate–Smart Livelihood and Nutritional Security at ICAR-Indian Institute of Rice Research, Hyderabad	Conference	12-14 Dec., 2022
102	B Dayakar Rao	" A seminar on nutri cereals "Protein foods & nutrition Development association of India (PFNDAI)	Seminar	14 Dec., 2022
103	B Dayakar Rao	World Millet Summit' organized by Food Processing Committee, MCCIA, Pune.	Meeting	16 Dec, 2022
104	Madhusudhana R, Hariprasanna K., AV Umakanth	Utilization of Modern Breeding Tools - perspectives and a way forward, ISGPB Hyderabad Chapter	Meeting	20 Dec., 2022
105	Parashuram Patroti	Scientific Advisory Committee (SAC) meeting at KVK Solapur –I, Barshi road, Solapur	Meeting	28 Dec, 2022

12 Meetings, Field Days and Exhibition stalls

Meetings

VIII Institute Germplasm Identification Committee (IGIC) meeting

The meeting of the 8th Institute Germplasm Identification Committee (IGIC) was held at ICAR-IIMR on 28 January 2022 in the presence of Dr. Vilas A Tonapi, Director, ICAR-IIMR. The meeting was Chaired by Dr. M Elangovan (Chairman, IGIC) and attended by other member's viz., Dr. C Aruna Reddy, Dr. P Sanjana Reddy, Dr. Avinash Singode and Dr. B Amasiddha (Member Secretary). A total of 8 new applications were screened for registration. In which, 3 applications were recommended for registration without any changes, 4 applications were suggested modifications and one application was suggested to resubmit with more data. High dry biomass, grain iron content, number of leaves, leaf length, leaf: stem ratio in Sorghum; neck blast, finger blast, banded leaf blight diseases, finger number and finger length in Finger millet were the important trait-specific genotypes identified in combination with grain yield during the meeting for registration.

Review Meeting of NASF - funded Extension project

The progress of an ongoing ICAR-NASF funded extension project entitled "Farmer-led extension strategy for enhancing farmers' income through millets-based farming system in hilly and tribal areas" was reviewed by ICAR-NASF appointed, Chairman, Advisory Committee namely; Dr. RK Samanta, Ex-VC, BCKV, Mohanpur, West Bengal on 10 March, 2022 at Koraput, Odisha. It is one of the project sites where the project was implemented with an objective to develop Farmers-led extension system based on using latest millets technologies and allied enterprises. The chairman visited the adopted village in Koraput, observed the progress under each component of the project and interacted with the beneficiary farmers. Dr. RK Samanta evaluated overall progress of NASF-Extension project by observing all the components of the project along with the project staff in Barbeda village. He enquired about impact of the interventions made under the project and their future mode of action to sustain these activities. He narrated "Convergence for millets promotion" and urged participants to work together in cohesive manner to promote millets which is main source of livelihood of this area. He appreciated the facilities which were being provided on primary processing and value-addition to millets. This programme was led by Dr. Rajendra R. Chapke, Principal Scientist, ICAR-IIMR, Hyderabad as Principal Investigator in collaboration with MSSRF, Chennai.

PGRC approved Registration of 14 Genetic Stocks of Millets

A total of 14 trait specific millets genetic stocks were recommended for registration during the 47th Meeting of Plant Germplasm Registration Committee (PGRC) organized by ICAR-National Bureau of Plant Genetic Resources (NBPGR), New Delhi on 29 March 2022. The 14 genetic stocks recommended encompassed Sorghum (7), Finger millet (5), Pearl millet (1) and Barnyard millet (1). The meeting was chaired by Dr Tilak Raj Sharma, DDG (CS), ICAR in the presence

of Dr. Ashok Kumar, Director (Acting), ICAR-NBPGR, New Delhi and attended by Directors and PC and PDs of the various crop institutes. Dr Vilas Tonapi, Director and Drs. M Elangovan, C Aruna and B Amasiddha attended from ICAR-IIMR-Hyderabad.

Meeting of Official Language Implementation Committee

The 60th meeting of Official Language Implementation Committee was conducted at the ICAR - Indian Institute of Millets Research, Hyderabad on 10 March, 2022 under the Chairmanship of Dr. Vilas A Tonapi, Director, IIMR, Hyderabad. The other members including Dr. Jinu Jacob, OIC, Hindi Cell, Dr. R Madhusudana, OIC, PME Cell; Dr. B Venkatesh Bhat, OIC, Technical & Medial Cell and OIC, Computer & Website; Dr. Sooganna, OIC, Library, Ms. Ritu Dalal, SAO; Sh. AN Murty, SFAO and Member Secretary, Dr. Mahesh Kumar, STO (OL) participated in this meeting. During the discussions, the committee reviewed the status of Hindi implementation in day to day office activities. It was also decided to publish a special Hindi bulletin on the eye of forthcoming “International Year of Millets-2023”.

Midterm Review meeting of RAC

The Chairman of Research Advisory Committee of ICAR-Indian Institute of Millets Research Dr. SL Mehta and other members, Dr. P Parthasarathi Rao and Dr. RP Thakur visited IIMR, Hyderabad on 25 April 2022. Dr. Vilas A Tonapi, Director IIMR welcomed the team and gave a brief account of activities of IIMR and the efforts undertaken during last 6 months after the RAC last year. The team visited Gene Bank, Laboratories of Entomology, Biochemistry, biotechnology, CoE, Nutrihub and start-up facilities. finally, the team had an interaction with all scientists and reviewed the progress and ongoing activities up to date.

Review Meeting of Farmer FIRST Projects by ADG (Agril. Extn.), ICAR, New Delhi

A review meeting of farmer FIRST projects (FFPs) was organized at ICAR-Indian Institute of Millets Research on 15 June, 2022 under chairmanship of Dr. VP Chahal, ADG (Agril. Extn.), ICAR, New Delhi in presence of Dr. CV Ratnavathi, Director, ICAR-IIMR, Hyderabad, Dr. JV Prasad, Director, ICAR-ATARI, Hyderabad and Dr. Shiv Kumar, Principal Scientist, ICAR-NIAEPR, New Delhi. PIs and Co-PIs of Farmer FIRST Projects from ICAR-IIMR, ICAR-CRIDA and ICAR-IIOR, Hyderabad participated in the meeting. The meeting was started with the welcome and brief about the FFP by Dr. Rajendra R. Chapke, PI of FFP on millets, ICAR-IIMR, Hyderabad. Dr. Ratnavathi welcomed all the participants and briefed about the institute and research activities of the ICAR-IIMR, Hyderabad. After brief address by the chairman Dr. VP Chahal, Dr. JV Prasad, Director, ICAR-ATARI, Hyderabad and Dr. Shiv Kumar, Principal Scientist, ICAR-NIAEPR, New Delhi, the proceeding of the meeting was initiated. Dr. Chapke, Principal Investigator (PI) of FFP project on millets presented the progress report of 2021-22 and salient achievements of last five years (2016-17 to 2020-21), technical programme for the current year and budget position. It was followed by Dr. KT Ramya, Co-PI along with Dr. P Lakshmamma, Co-PI presented the progress report 2021-22 of FFP on oilseeds and Dr. G. Nirmala, PI, FFP, ICAR-CRIDA presented the progress made during 2021-22 of FFP on dryland technologies. Dr. C. Sangappa, Scientist (Agril. Extension) & Co-PI, FFP on millets, ICAR-IIMR, Hyderabad also participated in this meeting. The meeting was coordinated by Dr. Rajendra R. Chapke, ICAR-IIMR, Hyderabad.

Institute Technology Management Council (ITMC) Meeting

Institute Technology Management Committee meeting of ICAR-IIMR was held on 25 July.2022 in virtual mode. The members present were: Drs. CV Ratnavathi, Acting Director IIMR & Chairman ITMC, S.K. Soam, Head (ICM), NAARM, Hyderabad and External Expert Member; B Dayakar Rao, Pr. Scientist, CEO Nutrihub & Nodal Officer ZTMC; Principal Scientists of IIMR - Aruna C, B Venkatesh Bhat, R. Madhusudhana, A.V. Umakanth, K. Hariprasanna, and A. Srinivas, Scientist,

Mrs. Ritu Dalal, SAO, IIMR, Dr. Sangappa, Scientist & Member ITMU, Anuradha Narala, Sr. Scientist & Member ITMU and J. Stanley, Sr Scientist and Nodal Officer ITMU, Member Sec. ITMC.

The meeting started with welcome address by J. Stanley. The ITMC congratulated Dr. CV Ratnavathi for becoming Director of IIMR. Later, Nodal officer ITMU presented the progress report for the period September 2021 to July, 2022. He stated that the institute has bagged two patents during this period, four copyrights and other IPs. He informed that 21 MoUs were made during the period with different organizations for collaborative research besides another 19 MoUs with universities and research stations for student's research. ITMU has facilitated MoU with 5 hospitals for treating of IIMR beneficiaries at CGHS rates. He informed the house about the licensing of cultivars by 13 private seed companies and value added products by 11 companies for 55 products. The agenda for the meeting was discussed and deliberated in detail taking the inputs of all the members present in the meeting.

Institute Germplasm Identification Committee (IGIC) meeting

The meeting of the 9th Institute Germplasm Identification Committee (IGIC) was held on 15 July 2022 in the presence of Dr. CV Ratnavathi, Acting Director, ICAR-IIMR. The meeting was Chaired by Dr. M Elangovan (Chairman, IGIC) and attended by other member's viz., Dr. C Aruna Reddy, Dr. Avinash Singode and Dr. B Amasiddha (Member Secretary). A total of 29 new applications were screened for registration. Twenty-four applications were recommended for registration, in which, 6 applications were recommended without any changes and 18 applications were recommended with few modifications. Two applications were suggested for re-submission to IGIC for next meeting and 3 applications were not recommended for registration due to lack of proper data. Diverse genetic stocks were recommended for registration in Sorghum (9), Finger millet (8), Foxtail (4), Kodo millets (2) and Little millet (1). The important trait-specific genotypes identified and considered for registration in millets are high iron and zinc content, hurda making quality, quantity and fragrance, low HCN content, shoot fly and stem borer resistance, anthracnose and banded blight resistance, neck and finger blast resistance, leaf length and width, stem girth, fresh stalk yield, juice yield, fresh biomass, brix content, early flowering and maturity, more number of productive tillers, longer panicle size, 1000 seed weight etc., in combination with grain yield during the meeting for registration. These applications were thoroughly screened to select or reject or to know the requirement of any modifications in the applications from applicants.

Virtual Mid-term Monitoring of AICRP on Sorghum & Small Millets

The mid-term monitoring meeting of the AICRP on Sorghum and Small millets was organized virtually during 15-16 September 2022. Dr CV Ratnavathi, Director (Acting) and Project Coordinator (Sorghum and Small millets) in her opening remarks highlighted the ICAR-IIMR's preparedness of the Celebrations of International Year of Millets 2023. She has requested all the centres to organize various programmes as per the template provided during September 2022 to December 2023 on the eve of IYoM2023. The officer in-charges of 18 AICRP on Sorghum centres and 12 AICRP on Small millets centre made presentations on the mid-term progress of their centre. Principal Investigators of all the discipline interacted with the Scientists of the AICRP on Sorghum and Small millets centres and made suggestions for the improvement. During the virtual meeting various issues like high rainfall during the kharif 2022 season, release of fund to the centres, prioritize the research as per the availability of the resources etc. were discussed.

Interaction meeting with ICAR-NBPGR, New Delhi

An interaction meeting was organized between ICAR-IIMR, Hyderabad and ICAR-NBPGR, New Delhi on 14 September 2022 to discuss various issues related to value addition, popularization and inclusion of nutri-cereals in research and development, especially

Amaranthus, Quinoa, Buckwheat, Faba bean and Kankoda. Dr. Ashok Kumar, Director (Acting), ICAR-NBPGR, New Delhi, Dr. Hanuman Lal Raiger, Principal Scientist & Network Coordinator, AICRN on Potential Crops from ICAR-NBPGR, New Delhi and Drs. CV Ratnavathi, Director (Acting), KBRS Visarada, M Elangovan, C Aruna, KN Ganapathy, Avinash S, Amasiddha B and Deepika C from ICAR-IIMR, Hyderabad attended the meeting. The meeting started with the welcome address by Dr. M Elangovan. Dr. CV Ratnavathi gave opening remarks where she explained the institute mandatory areas of research in millets, importance of millets, health benefits and celebrations of International Year of Millets-2023. At the end of the meeting, it has been suggested to develop two projects, one on biochemical analysis and identification of superior nutrient rich genotypes in nutri-cereals and other one on suitability of nutri-cereals for product development, blending with millet products and popularization based on health benefits. The meeting was organized by Drs M Elangovan, B Amasiddha and KN Ganapathy.

Institute Advisory Committee Meeting of Farmer FIRST Project

An Institute Advisory Committee (IAC) meeting of Farmer FIRST project (FFP) was organised at ICAR-IIMR, Hyderabad on 3 September, 2022 under the chairmanship of Dr. CV Ratnavathi, Director, ICAR-IIMR. The purpose of the meeting was to review progress and update the action plan of the project 2022-23 with inputs of the multidisciplinary team of institute's scientists in view of objectives of the project. Total 14 multidisciplinary scientists from the institute namely, Drs. C. Aruna, B Venkatesh Bhat, G Shyam Prasad, Hariprasanna K, KN Ganapathy, Avinash Singode, N. Anuradha, Dr. Swarna Ronanki, C. Sangappa, Rajendra R. Chapke, participated. Besides project staff Mr. Veer Shetty, local coordinator of the project from Ms. SS Bhavani Foods, Sangareddy district, also participated in this meeting.

Dr. CV Ratnavathi, Director, ICAR-IIMR welcomed all the participants and informed that three scientists namely Drs. Anuradha, Swarna and A. Srinivas have been deputed as Co-PIs in order to attend objectives and requirements of the project. Dr. Rajendra R. Chapke, Principal Investigator (PI) of FFP presented the progress of 2021-22 in brief and ongoing activities of the current year 2022-23. The major points discussed and points were noted for further improvement. Since, farmers were reluctant to take up small millets trials due to low remuneration compared to the commercial crops, the Millet-based intercropping or mixed cropping with commercial crops may be tried with few farmers. The IAC members should visit the project farmers' fields and provide them problem-based solutions and collect their feedback. There is a need to organize more awareness and training programmes on primary processing and preparation of value-added products especially of small millets.

The chairperson, Dr. CV Ratnavathi suggested that the recommendations of the review committee, horticulture and NRM modules should be implemented by the Co-PIs besides, current three modules to fulfil requirements of the project. She further suggested that component-wise economics should be studied at micro level to make millet cultivation is more remunerative.

DUS testing related activities

Replicated field trials for characterizing the DUS descriptors in candidate varieties and reference varieties of sorghum were conducted during Rabi 2021-22 and Kharif 2022 seasons as per the PPV&FR Authority guidelines. During Rabi 2021-22, maintenance breeding and characterization was undertaken for 117 reference varieties (including OPVs, parental lines and hybrids) under enforced selfing/controlled pollination. Genetically pure single plants were harvested in each genotype for maintenance of reference varieties. Characterization data on 32 DUS traits were collected as per the revised guidelines and reference variety database was updated, and submitted to PPV&FR Authority.

During kharif 2022, five candidate varieties (two new and three farmers' varieties) were tested for DUS traits along with four national checks under 1st year testing. Under 2nd year testing three candidate varieties were characterized in a replicated trial. Data were recorded for all the 32 DUS descriptors. All the 56 kharif adapted reference varieties were planted in a replicated trial for characterization and data were recorded. Twenty-eight entries from the advanced trials (grain, forage, sweet, speciality and high biomass) of AICRP on Sorghum including checks were also characterized for DUS traits to enable faster plant variety protection in case of varietal identification and release. The compiled candidate variety data along with photographs have been submitted to PPV&FR Authority. During the year, four new applications were submitted to PPV&FRA for registration, and annual fee was paid to all the registered varieties.

Field Days

Sorghum Germplasm Field Day Organized

ICAR-IIMR-Hyderabad organized Sorghum Germplasm Field Day on 3rd March 2022 in collaboration with ICAR-NBPGR-RS-Hyderabad under the Consortium Research Platform on Agrobiodiversity (CRP-AB). Dr K Anita, Officer In-Charge, ICAR-NBPGR-RS-Hyderabad in her Chief Guest address emphasized on building more diverse germplasm from International Centres. Dr Vilas A Tonapi, Director, ICAR-IIMR highlighted the progress made under wide hybridization programme and more efforts to reduce duplicate accessions in the National Genebank and Millets Genebank. There were 40 participants from ICAR-NBPGR and ICAR-IIMR visited 1549 acc. of sorghum under CRP-AB and 4064 acc. under Institute project. Drs M Elangovan and K Venkatesh briefed the trait diversity of sorghum germplasm along with its plan of utilization. Germplasm field was coordinated by Drs M Elangovan, KN Ganapathy, B Amasiddha and K Venkatesh.

Field Day on Millets organized under FFP

ICAR–Indian Institute of Millets Research, Hyderabad organized a Field Day on Millets at its adopted village Rukmapur, Chalki and Gangapur villages in Sangareddy District in Telangana on 27 September, 2022 under Farmer First Project. The main objective of the programme was evaluating performance of the field trials and interact with farmers for collecting their feedback on the technology interventions, and build-up confidence to adopt them for increasing profitability of the millet growers.

Around 150 farmers from above villages and trial farmers, total 50 trainee women entrepreneurs of the millets processing facilities established at Gangapur from Warangal district Participate in this programme. From organizers side, Principal Investigator (PI) of the Farmers first Project Dr. Rajendra R. Chapke and ICAR-IIMR scientists Drs. C. Aruna, IK Das, Dr. Hariprasanna, Principal Scientist (Plant Breeding), KN Ganapathy, Avinash Singode, N. Anuradha, Swarna Ronanki, C. Sangappa, and Project staffs actively participated in this field day programme. Mr. Veer Shetty, local coordinator of the project from Ms. SS Bhavani Foods also took part in the programme.

At the beginning, a finger millet trial with GPU 67 improved variety and red-gram variety (WR V97) planted on Mr. G. Ramesh, farmer of Rukmapur village was visited by the team of scientists. The growth performance of red-gram variety (WR V97) was found to be satisfactory. While addressing the farmers gathering at FPO office at Chalki, Dr. RR Chapke, asked the

farmers' feedback about the crop performance. During interaction session, they raised serious concerns about crops damaged by birds while 'Herbolive" was found effective to control wild boar on sugarcane crop too. All the scientists were interacted with the farmers and offered their suggestions. Dr. Aruna explained how to produce quality grains. They also advised that benefits can be enhanced by making judicial use of inputs and follow improved package of practices for realizing better yields in millets.

It was followed by, visit to the millets processing unit established at Gangapur where hands-on training was offered to 50 women entrepreneurs from Parvathgiri mandal of Warangal district. They were taught on how to operate the machinery, prepare products and packaging. They expressed that it will boost up the utilization and consumption of millets. The field day programme was coordinated by the project PI, Dr. Chapke, PS, ICAR-IIMR.

Field Day on Millets organized under Farmers First Project

A Field Day on Millets was organized by ICAR–Indian Institute of Millets Research, Rajendranagar, Hyderabad in project village; Thatpally in Sangareddy District of Telangana State under Farmer First Project on 15 October, 2022. Millets technology interventions were introduced in this area for *rabi* season. The main objective of the programme was to orient farmers about latest *rabi* sorghum production technology and impart short training to adopt them for increasing profitability of the millet growers. The field day programme was coordinated by project PI, Dr. RR Chapke, PS, ICAR-IIMR. Around 25 farmers from Thatpally and project team participated in this event. Besides trial farmers, several non-trial farmers also took part in the programme. During interactive session, farmers raised concern regarding crop damage by birds and marketing problem, however they have shown their willingness to cultivate sorghum. They were advised to cultivate high yielding *rabi* sorghum variety, CSV 29R which gives better yield under irrigated conditions too and also to sell their produce in the FPOs where there is no middlemen problem. Some farmers concerned about crop damage due to wild boar attacks and birds. They were suggested to spray wild animal repellent solution "Herbolive" on crop and to employ noise making device to avoid damage by birds.

Field day on Millets organized

ICAR–Indian Institute of Millets Research, Hyderabad organized a Field Day on Millets at Chalki and Mungi villages in Sangareddy district in Telangana on 5th December, 2022 under Farmer First Project. The main objective of the programme was to introduce technology interventions under NRM and horticulture module of the farmer first project and to orient the farmers for implementing technologies and their feedback. Around 50 farmers from the above villages including trial and non-trial farmers participated in this programme. Dr. Swarna explained the importance of NRM modules viz., millets based intercropping, balanced fertilization, seed treatment with bio-fertilizers, line sowing, mulching and dead furrows for soil & moisture conservation and its implementation for increasing the productivity and profitability of millet cultivation. Dr. Srinivas introduced the horticulture technology interventions by allotting vegetable seed kits to selected farmers, Dr. Anuradha interacted with the beneficiaries of FFP project and collect data to compute the cost benefit analysis of the demonstrated technologies. Dr. Deepika elaborated about improved millet cultivars and their potential for increasing the productivity of millet crops. Dr. Malathi made aware about health and nutritional benefits of millet crops and incorporating millets in daily diet. It was followed by visit to the farmers' field and to observe the performance of the rabi sorghum variety CSV 29R and redgram variety WR 97 demonstrated by IIMR. The farmers expressed their gratitude for the valuable information and the trial farmers gave a positive feedback about demonstrated improved varieties by IIMR. This event was organized by Co-PIs of the Farmers first Project Drs. Swarna Ronanki, A. Srinivas, N. Anuradha and ICAR-IIMR scientists; Drs. C. Deepika, Malathi and Project staff of FFP project Spanditha, Meghana, Vinod and Chandrakanth under

the guidance of project PI, Dr. Rajendra Chapke, PS, ICAR-IIMR.

Kisan Diwas

At IIMR, the celebration of Kisan Diwas, 2022 was held on 23 December, 2022 virtually under the Chairmanship of Shri Narendra Singh Tomar, Hon'ble Minister of Agriculture & Farmers Welfare was attended by the Staff of ICAR-IIMR. Around 50 farmers from neighbouring villages of FPO gathered to celebrate Kisan Diwas at Mudhol oilseeds and millets Farmer Producer Company, Mudhol promoted by ICAR-Indian Institute of Millets Research, Hyderabad. The Board of Directors and staff of FPO participated in the event. Mr. Bharath, represented IIMR during the occasion and spoke about the importance and objectives of celebration of Kisan Diwas in India and he also highlighted the importance of cleanliness and hygiene in the FPO office. Mr. Sanjaysingh Rajput, CEO of the company addressed the gathering and created awareness on the importance of adopting collective approaches to harness the benefits of it. Further, he sought the help of the Board of Directors of the company to undertake shareholders drive to improve the authorized capital to initiate business in the days to come. The program was coordinated by a team of scientists' Drs Sangappa, Amasiddha, Anuradha, Deepika, Srividhya and Malathi with the technical guidance from Dr. P Sanjana Reddy, Chairperson, Swachatha Pakhwada, ICAR-IIMR, Hyderabad.

Exhibition Stalls

Millet Exhibition Stall

IIMR, Hyderabad participated in International Conference on Finger Millet – ICFM-2022 held at Zonal Agricultural Research Station (ZARS), VC Farm, Mandya, Karnataka during 19-22 January, 2022 and showcased millet health foods products and technologies. More than 1500 people including farmers, delegates, visitors, dignitaries from Karnataka and other states, students, and entrepreneurs visited IIMR stall and appreciated the efforts made by the institute in creation of the demand and promotion of millets.

CRS Solapur Millet Exhibition stall at KVK Solapur:

ICAR-IIMR's – Centre on Rabi Sorghum, Solapur has organized a Millet Exhibition stall to showcase the seed samples of millets and Millets value added products during the *Kisan Bhagidari Prathmikta Hamari* Campaign organized on 26 April 2022 at Solapur. A total of about 300 farmers, women from self-help groups, FPOs besides the dignitaries including MLA s, Head KVK, Solapur, DDM of NABARD, Deputy Director of Agriculture and others visited the stall. They highly appreciated the efforts of CRS Solapur for research, extension and promotion of these millets. Dr. Parashuram Patroti, Officer In-charge of the centre interacted with all the delegates and explained the way forward and government intervention in promoting and upscaling of these millets.

IIMR Technologies showcased in *Kharif* Seed *Mela*

ICAR-IIMR organized exhibition stall and showcased technologies developed by the institute and seed of various millets during the "Kharif Seed Mela - 2022" organized by Professor Jayashankar Telangana State Agricultural University (PJTSAU) at Rajendranagar, Hyderabad on 24 May, 2022. The Seed Mela was launched by the Sri Kondabala Koteswararao, Chairman, Telangana State Seed Development Corporation; Dr. V Praveen Rao, Vice-Chancellor, PJTSAU, and K. Hanumanthu, Special Commissioner, Department of Agriculture, Telangana State.

Hon'ble Vice-Chancellor Dr. V Praveen Rao, and Chief Guest visited IIMR stall and appreciated the efforts made by IIMR to promote millets in the country. Drs. CV Ratnavathi, Principal Scientist, Dr. B Venkatesh Bhat - Principal Scientist, and Dr. Sooganna, Scientist from IIMR elaborated the activities of IIMR to the dignitaries. More than 500 farmers visited IIMR's seed stall.

IIMR- Stall at UAS, Raichur.

ICAR-IIMR's Nutrihub organized exhibition stalls of its incubatees and showcased technologies developed by the institute during a two-day Millets Conclave as a curtain raiser during 26-27 August, 2022 at University Campus, Raichur. About 3 incubatees / start-ups of ICAR-IIMR exhibited their innovative products which attracted many policy makers to know the importance of millets. More than 1,000 Visitors visited our stalls including Union Finance Minister Smt. Nirmala Sitharaman, Shri Narendra Singh Tomar, Union Minister of Agriculture Minister, Ms. Shobha Karandlaje, Hon'ble Minister of State, Ministry of Agriculture and Farmers Welfare, and Karnataka Chief Minister Basavaraj Bommai and other dignitaries from state Agriculture departments, Farmers, students and women from self-help groups. The visitors showed keen interest especially on the innovative food products developed from sorghum and other millets. The importance of millets as health and nutritious food was explained to the visitors and relevant literature was distributed.

Millets Stall

The team from ICAR-IIMR and project partners from FPO of Bapatla Agro-processing Cluster have setup a millets stall during the Diamond Jubilee Celebrations held at National Institute for Micro, Small and Medium Enterprises (ni-MSME), Yousufguda, Hyderabad on 29 August, 2022. The project was funded by Ni-MSME through SFURTI scheme for promotion of millet primary processing clusters managed by FPOs in millet cultivating areas in Bapatla district of Andhra Pradesh, where IIMR providing technical guidance to Farmers. Various value added products from millets and different varieties of millet grains were displayed at Millets Stall for educating the public on the diversity and health benefits of millets. Sh. Bhanu Pratap Singh Verma, Hon'ble Minister of State in Ministry of Micro, Small and Medium Enterprises in Government of India visited the stall and appreciated the efforts of IIMR in promotion of millets. Morre than 500 persons visited our stall and enquired about the availability of seeds, food products and availability of training for entrepreneurship and technology.

Millet Stall

ICAR-Indian Institute of Millets Research was organized the Millet exhibition stall of at the venue of the ninth session of the Governing Body (GB 9) of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) held during 19-24 September 2022 at New Delhi. Hon'ble Union Minister of Agriculture & Farmers' Welfare - Shri Narendra Singh Tomar, visited the ICAR-IIMR stall after inaugurating the exhibition on 19 September 2022. More than 1500 people including farmers, delegates, visitors, dignitaries from New Delhi and other states, students, and entrepreneurs visited our stall and appreciated the efforts made by the institute in terms of collection of millet germplasm, creation of the demand and promotion of millets. The ICAR-IIMR stall was managed by Dr. Karanam Venkatesh and Dr. V Ravi Kumar.

Exhibition - Stall

ICAR-IIMR participated in the "Bio-Agri 2022", a Bio Agricultural Solutions Conference and Expo held at Hotel Park Hyatt, Hyderabad on 19 -20 October, 2022. ICAR-IIMR put up a millet stall to showcase the technologies developed at IIMR and disseminate the benefits of millet health foods among public and popularize the brand ICAR-IIMR. Dr. Anuradha Narala, Sr. Scientist and Dr. V Ravi Kumar, STO organized the stall and represented the ICAR-IIMR, Hyderabad.

Millets Germplasm displayed at Kisan Mela

Millets diversity was displayed during the Kisan Mela organized with the theme "Agrobiodiversity for Sustainability" at ICAR-Central Plantation Crops Research Institute (CPCRI), Research Centre, Kidu, Dakshin Kannada, Karnataka during 19-20 Nov 2022. Dr. M Elangovan, Principal Scientist, IIMR Interacted with Kerala and Karnataka farmers for growing millets along with plantation crops as mixed cropping. More than 800 farmers visited the Kisan Mela.

13 Distinguished visitors

Visit of Sanjiv Kumar, IAS

Sh. Sanjiv Kumar, IAS, Financial Advisor to ICAR visited IIMR on 10 February, 2022. At the outset, Dr. Vilas A Tonapi, Director IIMR, briefed him about the institute's research and development activities including improved millets cultivation. During his visit to Millet Gene Bank, Sh. Sanjiv Kumar appreciated the effort of IIMR on genetic conservation, characterization and germplasm sharing for crop improvement. Dr. B Dayakar Rao, CEO, IIMR-Nutrihub explained about technology developed and role of IIMR for increasing the benefits from millets value chain and entrepreneur development. Sh. Sanjiv Kumar also Centre of Excellence, other processing facilities and Nutrihub.

Visit of Minister for Agriculture, Govt. of Karnataka

Sh. BC Patil, Hon'ble Minister of Agriculture, Government of Karnataka visited ICAR-IIMR, Hyderabad on 11 March 2022. Dr. Vilas A Tonapi, Director, IIMR welcomed the Minister and the delegation from Karnataka. The delegation comprising of Sri. Uma Shankar, Principal Secretary, (Agriculture), Smt. CN Nandini Kumari, Director of Agriculture, Sri Venkataramireddy Patil, Additional Director of Agriculture – Organic Farming, Dr. MV Venkatesh, Commissioner -Watershed Management, Sri GT Putra, Managing Director-KSSC, Dr. Ashokraj B Patil, OSD to Agri-minister. At the outset, Dr. Tonapi apprised the Minister about the ongoing R and D activities at IIMR including health benefits of consuming millets as nutri-cereals to overcome lifestyle diseases. Sh. Patil was shown all the start-up processing facilities including CoE and Nutri Hub at IIMR by Dr B Dayakar Rao and Gene bank facilities by Dr. M Elangovan. During the interactive session, all scientific, technical and other staff participated in the felicitation event and deliberations with the Minister. The minister emphasized about the need for more work on promotion of millets based value-added products in urban and peri-urban areas. Sh. Patil also suggested the deployment of processing machinery right in the villages where the millets produced are processed through farm gate processing programme to ensure better returns to farmers.

Visit of the Chairman, RAC to adopted villages under FFP

Dr. SL Mehta, Ex.-VC, MPUAT, Udaipur, Rajasthan and Chairman, Research Advisory Committee (RAC) along with Dr. Rajendra R. Chapke, Principal Scientist and PI of farmer FIRST project (FFP), and Dr. Rajendra Kumar, Principal Scientist, visited two adopted villages under Farmer FIRST project namely, Chalki village in Nyalkal mandal and Gangapur village in Jharasangam mandal of Sangareddy district of Telangana on 24 April, 2022. The purpose of visit was to review the progress of project at village level. This project has been implemented in three millets-based modules namely Crop based, Livestock-based module and Enterprise-based module. Dr. Mehta visited field trials organized on rabi sorghum under crop module and enquired with the farmers about its performance. He tasted various value-added millets food products prepared by one of entrepreneur, Mr. Veer Shetty of M/s. SS Bhavani Foods. Dr. Mehta expressed his satisfaction about overall progress and impact of the project and suggested to include of allied farming interventions and strengthening the FPO from institute side. This programme was coordinated by Dr. Rajendra R. Chapke, Principal Scientist, ICAR-IIMR, Hyderabad.

Visit of CEO, NRAA

Dr. Ashok Dalwai, CEO, National Rainfed Area Authority (NRAA), Ministry of Agriculture and Farmers' Welfare, Government of India visited IIMR on 23 April, 2022. Dr. Vilas A Tonapi, Director, IIMR explained him about the ongoing research activities, action plans for conduct of International Year of Millets 2023, and monitoring techniques being practiced at IIMR to increase the research and scientific output. On this occasion he had a detailed interaction with the scientific staff of IIMR. He also delivered a lecture on "Approaches for better delivery of products for food and nutrition security". This lecture was organized to mark the year-long celebrations of "*Azadi Ka Amrit Mahotsav*" at IIMR, Hyderabad.

Vice Chancellor, UHS, Bagalkot, Karnataka

Dr. **KM Indiresh**, Vice-Chancellor, University of Horticultural Sciences UHS, Bagalkot, visited ICAR-Indian Institute Millets Research, Hyderabad on 10 June 2022. His visit was focused on exposure to millet processing facilities established at IIMR. The different primary processing machineries developed for millets and secondary processing machineries were observed in demonstration mode. He appreciated the efforts put in developing the facilities and running them by establishing incubation infrastructure for emerging entrepreneurs. Later he had interaction with Director, IIMR for probable future collaborative area in millet-horti crops blended product development and research. The visit was coordinated by Drs. B Amasiddha, A Srinivas and Ravi Kumar Vemula.

Visit of Director (OL), ICAR, New Delhi

Smt. Seema Chopra, Director (OL) & Shri Manoj Kumar, CTO (OL), Indian Council of Agricultural Research, New Delhi visited the ICAR-Indian Institute of Millets Research, Hyderabad on 18 June, 2022. Dr. C V Ratnavathi Director, ICAR-IIMR briefed them about

Research and Development activities, besides the Official Language Implementation activities conducted at IIMR, Hyderabad. Smt. Seema Chopra suggested her to ensure Official Language Implementation, so that we do not unbalance during the inspection done by the Committee of Parliament on Official Language.. Dr. Mahesh Kumar, Senior Technical Officer (OL) was coordinated the visit.

Visit of Joint Secretary, (Extn. & MPS) – MoA&FW

Sh. Samuel Praveen Kumar, IAS, Joint Secretary, (Extn. & MPS) Department of Agriculture and Farmers Welfare, Government of India, New Delhi visited IIMR on 07 July, 2022. After formal welcome, Dr. CV Ratnavathi, Acting Director, IIMR explained the Joint Secretary about the ongoing research activities, action plans, and value added technologies being practiced and developed at IIMR. Dr. B Dayakar Rao, PS, ICAR-IIMR and CEO- Nutrihub and his team at CoE explained in detail about the incubation facilities, start-up ignition programmes and facilities for the young

entrepreneurs, large-scale processing and production facilities and technologies available at IIMR. The team also visited various research and development facilities at IIMR. Sh. Samuel complimented the work done by the institute including the achievements and opined that millets need to be brought back to food plate to provide alternate grains to address malnutrition and steps need to be taken to remove the bottlenecks in supply chain, value chain and Farm gate processing.

Visit of Dr. VV Sadamate, Ex-Member of Planning Commission, GoI, New Delhi

Dr. VV Sadamate, Ex-Member of Planning Commission, GoI, New Delhi along with Mrs. Prashanthi, Manager, PRDIS-NGO, Hyderabad visited our institute on 12 July, 2022. Dr. CV Ratnavathi, Acting Director, ICAR-IIMR welcomed them and Dr. Rajendra R. Chapke, Principal Scientist and Principal Investigator of NASF-Extn. Project also participated in the discussion. Dr. Sadamate briefed about NASF-Extn. Project as it is lauding well at national level in view of upliftment of tribal community in Odisha and Tamilnadu. He wants to visit at project site of Odisha and urge to organize a meeting involving local players in this year. He will plan with Dr. Chapke, PI, NASF-Extn. Project. He told that a planning of organizing international conference on Food & nutritional Security in Dhaka, Bangaladesh is going-on by the PRDIS-NGO, Hyderabad involving FAO, TAAS, New Delhi, etc., during 24-26 Nov., 2022. For this, they seek guidance and mode of participation of ICAR-IIMR, Hyderabad in the conference. They also want participation of IIMR's registered start-ups in the conference and he had discussion with CEO, Nuti-Hub, ICAR-IIMR, Hyderabad.

Visit of Shri Manoj Ahuja IAS, Secretary Agriculture

Shri Manoj Ahuja IAS, Secretary, Ministry of Agriculture & Farmers Welfare, Government of India, New Delhi visited IIMR, Hyderabad on 26 August, 2022. Dr. CV Ratnavathi, Director (A), IIMR explained him about the ongoing research activities, action plans, and monitoring techniques being practiced at IIMR to

increase the research and scientific output. Sh. Manoj Ahuja was taken to Nutrihub, Centre on Excellence, Technology Business Incubator and other millet processing facilities. He was explained the ongoing research progress and demonstrated all facilities by Dr B Dayakar Rao. He was very much impressed on the R&D activities, millet processing technologies and value chain developed by IIMR.

Visit of Director, NSI, Kanpur

Dr. Narendra Mohan, Director, National Sugar Institute along with his team visited ICAR-IIMR –Hyderabad on 25 August 2022. Dr. CV Ratnavathi, Acting Director of IIMR briefed him about the ongoing collaboration programmes on promotion of sweet sorghum as an alternate feedstock for bioethanol production in the sugar mill areas of the country. The NSI team discussed various critical issues in promotion of sweet sorghum crop and the ways and means to overcome them. They also planned possible big mill tests and intercropping studies of sweet sorghum with sugarcane in sugar mill areas in association with IIMR. The team also visited Nutrihub facility, and they were apprised of the ongoing research activities in millet primary and secondary processing and value addition of millets. Dr. AV Umakanth, Principal Scientist and PI (Sweet Sorghum) coordinated the visit.

International Trainees Visited IIMR

National Institute of Agricultural Extension Management (MANAGE) was conducted training programme on “Computer Applications in Agricultural Extension” during 13-27 September 2022 as an International Training programme under the Indian Technical &

Economic Cooperation (ITEC) by the Ministry of External Affairs, Government of India. As a part of the training, 25 participants from 14 countries viz., Sudan, Morocco, Jordan, Colombia, Tajikistan, Eritrea, Kenya, Ethiopia, Myanmar, Iraq, Niger, Mozambique, Uganda and Sri Lanka visited ICAR-IIMR on 16 September 2022 to know how the millets value chain and commercialization. Dr. CV Ratnavathi, Director (Acting), briefed about the institute’s research activities and preparedness of India towards the Celebrations of International Year of Millets (IYoM2023). The trainees visited NUTRIHUB and about millets based entrepreneur development and commercialization. Dr. B Dayakar Rao, CEO, briefed the activities of NUTRIHUB. Dr Stanley, Senior Scientist accompanied them to the millets primary processing and secondary processing laboratories which visualized them the potential of millets value added products and its importance to the Global market. Dr M Elangovan, Principal Scientist showcased the seed and ear head diversity of 10 different millet crops and its collection, conservation, characterization and utilization activities in millet research. This trainees visit was coordinated by Drs. N Anuradha, and M Elangovan.

JIRCAS, Japan team visited IIMR

Dr Guntur Subbarao and Dr Yoshihashi, Scientists from Japan International Research Center for Agricultural Sciences (JIRCAS), Tsukuba, Japan visited ICAR-Indian Institute of Millets Research (IIMR) on 15 September, 2022. Dr. G Subbarao and his team made short presentation on the recent development in Biological Nitrification Inhibition (BNI) Research, technology to reduce nitrogen fertilizer application and tackle agricultural greenhouse gas emissions

Visit of Ms. Shobha Karandlaje, Hon'ble Union Minister of State for Agriculture

Ms. Shobha Karandlaje, Hon'ble Union Minister of State for Agriculture & Farmers Welfare visited ICAR-ICAR-Indian Institute of Millets Research (IIMR), Hyderabad on 14 September 2022. Dr. CV Ratnavathi, Acting Director, IIMR welcomed the Minister and the delegation. At the outset, Dr. Ratnavathi explained the minister about the research priorities of IIMR and the activities taken up in the areas of millets crop improvement, value chain and entrepreneurship development programmes. Ms Shobha Karandlaje was shown the facilities and infrastructure at ICAR-IIMR, which includes conservation of millets germplasm in the Millets Genebank, millets value added products in the Centre for Excellence on millets value addition, NUTRIHUB - the single window solution for promoting millets entrepreneurs in the country for marketing and commercialization of millet value added products, millet food processing laboratories and machineries. During this visit, the Millet Roadshow vehicle was inaugurated by Hon'ble Minister which displays millets technologies and importance of millets as health and nutritional food to the common public.

During the interactive session of IIMR Scientists with Minister, Dr. Ratnavathi, made a brief presentation on the achievements of ICAR-IIMR. Hon'ble Minister also interacted with IIMR – Nutihub – Start-ups. The Hon'ble Minister emphasized India's contribution of millets as nutritional and health food to the world and urged the scientists to demonstrate millets to the Global market through more value addition and varietal technologies. She also lauded the vivid food products manufactured at IIMR under Ready to Eat and Ready to Cook and the contribution of entrepreneurs and start-ups for bringing more millets products and creating demand for millets, in turn, which helps the farmers to grow more millets and double their income.

into the environment. The team has received the PNAS “Cozzarelli Prize-2021” for the BNI research developments in wheat. The team also highlighted that the technology has received global attention for tackling the effects of global warming. They also interacted with ICAR-IIMR Scientists for a possible collaboration. They also visited the Millets Genebank to witness the diversity of millets genetic resources conservation, characterization and utilization efforts. They appreciated the activities under millets genetic resources management at ICAR-IIMR-Hyderabad. They also visited Centre of Excellence for millets value addition, Nutrihub, value addition processing laboratories. They appreciated the ICAR-IIMR’s model on varietal technology, value addition to commercialization. It has been discussed to include ICAR-IIMR-Hyderabad as one of the consortium partner in the BNI research in the coming years. The visit was coordinated by Drs KN Ganapathy, M Elangovan and Stanley.

Director General, Rotary International

Shri Raja Sekhar Reddy Talla, Director General, Rotary International District - 3150 visited RI-Krishi Rajendranagar, located at ICAR-IIMR, Hyderabad on 17 September 2022. He was appraised of Gram Vikas and other service activities taken up by the Krishi Rajendranagar. He was received by Dr. Vilas A Tonapi, former director, IIMR and other RI member scientists. He visited the research facilities, Nutrihub, Genebank, processing unit at ICAR-IIMR. He also inaugurated the primary millet processing unit installed in association with Rotary club. This programme was coordinated by Sh. K Srinivasa Babu, Scientist, ICAR-IIMR.

DR and Officials from CSKHPKV, Palampur

Dr. SP Dixit, Director of Research and other officials from Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya – CSKHPKV, Palampur visited ICAR-IIMR – Hyderabad on 30 September, 2022. At the outset, Dr. CV Ratnavathi, Director, IIMR explained the team about the ongoing research activities of IIMR. The team also interacted with the IIMR scientists. Later, they visited Gene Bank, Centre on Excellence, Technology Business Incubator and other millet processing facilities. The team was very much impressed with the millet processing technologies and value chain developed by IIMR and shown keenness for research collaboration with IIMR.

Former MD, Syngenta and MD & CEO, PAN Seeds (P), Ltd

Mr. Bipin Solanki, Former Managing Director, Syngenta (Agritech Company) and **Mr. Alok Marodia**, MD & CEO, PAN Seeds (P) Ltd. visited ICAR-IIMR-Hyderabad on 28 September 2022. They interacted with Scientists on possible collaboration in the research and capacity building. The meeting was attended by Drs. C Aruna Reddy, B. Venkatesh Bhatt, M Elangovan, K Hariprasanna and Stanley. They also visited the ICAR-IIMR infrastructures - Millets Genebank, Centre of Excellence for Value Addition in Millets, Nutrihub and Common Facility Centre. The visit was coordinated by Drs J Stanley, M Elangovan and KN Ganapathy.

14 Personnel

As on 31 December, 2022

Dr. Vilas A Tonapi:

Director, IIMR & Project Coordinator, AICRP (Sorghum & Small Millets)

(Up to 31 May, 2022)

Dr. CV Ratnavathi:

Acting Director, IIMR & Project Coordinator, AICRP (Sorghum & Small Millets) (From 1 June, 2022)

Scientific Staff

S.No	Name	Designation	Discipline
1	Dr. KBRS Visarada	Principal Scientist	Genetics & Cytogenetics
2	Dr. B Dayakar Rao	Principal Scientist	Agril. Economics
3	Dr. G Shyam Prasad	Principal Scientist	Agril. Entomology
4	Dr. B Venkatesh Bhat	Principal Scientist	Genetics & Cytogenetics
5	Dr. Aruna C Reddy	Principal Scientist	Plant Breeding
6	Dr. R Madhusudhana	Principal Scientist	Plant Breeding
7	Dr. AV Umakanth	Principal Scientist	Plant Breeding
8	Dr. IK Das	Principal Scientist	Plant Pathology
9	Dr. M Elangovan	Principal Scientist	Economic Botany
10	Dr. PG Padmaja	Principal Scientist	Agril. Entomology
11	Dr. N Kanna Babu	Principal Scientist	Seed Technology
12	Dr. B Subbarayudu	Principal Scientist	Agril. Entomology
13	Dr. P Rajendrakumar	Principal Scientist	Biotechnology
14	Dr. K Hariprasanna	Principal Scientist	Plant Breeding
15	Dr. A Kalaisekar	Principal Scientist	Agril. Entomology
16	Dr. Rajendra R Chapke	Principal Scientist	Agril. Extension
17	Dr. D Balakrishna	Principal Scientist	Biotechnology
18	Dr. P Sanjana Reddy	Principal Scientist	Plant Breeding
19	Dr. T Nepoleon	Principal Scientist	Genetics
20	Dr. B Gangaiah	Principal Scientist	Agronomy
21	Dr. J Stanley	Sr. Scientist	Agri. Entomology
22	Sh. K Srinivasa Babu	Scientist	Agril. Entomology
23	Sh. P Mukesh	Scientist	Computer Applications
24	Dr. KN Ganapathy	Scientist	Plant Breeding
25	Dr. Jinu Jacob	Scientist	Biotechnology

S.No	Name	Designation	Discipline
26	Dr. R Venkateswarlu	Scientist	Biochemistry
27	Dr. Avinash Singode	Scientist	Plant Breeding
28	Dr. Sangappa Chillarge	Scientist	Agril. Extension
29	Dr. Amasiddha Bellundagi	Scientist	Plant Breeding
30	Dr. Deepika Cheruku	Scientist	Plant Breeding
31	Dr. Swarna Ronanki	Scientist	Agronomy
32	Dr. Sooganna	Scientist	Seed Science & Technology
33	Dr. Anuradha Narala	Scientist	Agril. Economics
34	Dr. Srividhya S	Scientist	Plant Physiology
35	Ms. Hemasankari	Scientist	Agril. Engineering
36	Dr. G Rajesha	Scientist	Plant Breeding
37	Dr. VM Malathi	Scientist	Biochemistry
38	Dr. Venkatesh Karanam	Scientist	Genetics & Plant Breeding
39	Sh. A. Srinivas	Scientist	Agri. Extension
40	Dr. D Sevanayak	Scientist	Physiology
	CRS, Solapur		
41	Dr. Baswaraj Raigond	Sr. Scientist & O/I	Pathology
42	Dr. Parashuram Patroti	Scientist	Plant Breeding

Senior Technical Staff

Name	Designation
Dr. KV Raghavendra Rao	Chief Technical Officer
Sh. OV Ramana	Chief Technical Officer
Sh. HS Gawali	Assistant Chief Technical Officer
Smt. D Revati	Assistant Chief Technical Officer
Sh. DM Bahadure	Assistant Chief Technical Officer
Sh. AR Limbore	Assistant Chief Technical Officer
Dr. Mahesh Kumar	Assistant Chief Technical Officer

Senior Administrative Staff

Name	Designation
Ms. Ritu Dalal	Senior Administrative Officer
Sh. A Narasimha Murty	Senior Finance & Accounts Officer
Ms. VSG Parvati	Assistant Administrative Officer
Ms. G Saraswati	Assistant Administrative Officer
Sh. D Rambabu	Assistant Administrative Officer
Ms. N Kanaka Durga	Private Secretary
Ms. A Usha Rani	Personal Assistant

Personnel Promoted

Name	From	To
Sh. Aghav Vilas Dnyanoba	Senior Technical Assistant (T4)	Technical Officer (T5).
Ms. N Kanaka Durga	Personal Assistant	Private Secretary
Sh. OV Ramana	ACTO (T 7-8)	CTO (T-9)
Dr. Mahesh Kumar	STO (T-6)	ACTO (T 7-8)
Mr. C Bikshapathi	Technician (T-1)	Senior Technician (T-2).
Mr. A Sai Karthik	Technician (T-1)	Senior Technician (T-2).
Sh. Ramachandra M Patil	Technical Assistant (T-3)	Technical Assistant (T-4)

Promotions

Based on the recommendations of Selection Committee the following scientists were promoted to the next higher grade under new Career Advancement Scheme: Drs. J Stanley, Avinash Singode, KN Ganapathy, R Venkateswarlu, B Amasiddha, C Deepika, Sangappa, Swarna Ronanki and Sooganna.

Personnel Transferred

Name	Designation	Transferred to	Relieved on
Sh. Sunil Kumar	Senior Technical Assistant	ICAR- Directorate of Rapeseed and Mustard Research, Bharatpur.	16 February, 2022
Sh. K Sanath Kumar	Private Secretary	ICAR-NAARM, Hyderabad on promotion	11 August, 2022

Personnel Superannuated

Name	Designation	Retired on
Dr. Vilas A Tonapi	Director	31 May, 2022

15 Major Events

International Conference on Finger Millet – ICFM-2022

International conference on Harnessing the potential of Finger Millet for Achieving Food and Nutritional Security: challenges and Prospects was organized UAS-Bangalore in collaboration with ICAR-Indian Institute of Millets Research and ICRISAT –Hyderabad during 19-22 January, 2022 at Zonal Agricultural Research Station (ZARS), VC Farm, Mandya, Karnataka. Mandya is a district located in Karnataka and is famous for one of the oldest research centres on Finger millet, where stalwarts such as Dr. Lesli Coleman and Dr. Ragi Lakshmanaiah have made significant contributions in the field of Finger millet improvement. On the other Hand, the main objective of this conference was to analyze the latest developments taking place in finger millet, both at national and international level, identify the gaps and chalk out a road map for crop improvement strategies for future under the changing climate. ICFM-2022 provided a forum to discuss the entire gamut of issues relating to advances and challenges in finger millet. The conference provided practical solutions for researchers across the globe to exchange their experiences and vision on development and improvement in finger millet Research at large. Genetic resources, production for its sustainability, integrated pest management strategies and biotechnological interventions were also discussed. Dr. Vilas A Tonapi, Director, ICAR-IIMR and Co chairman for the ICFM-2022 spoke virtually on Strategies for enhancement of production and Productivity of millets. He also said that among millet crops, Finger Millet figures out prominently with several health benefits such as hypo-cholesterolemic, hypoglycemic and anti-ulcerative properties. Dignitaries and several scientists from UAS-Bangalore, ICAR-IIMR-Hyderabad and ICRISAT took part in the sessions with their presentations through video conferencing and participated in deliberations. Sh. A Srinivas, Ms. P Hemashankari, Dr. V Ravi Kumar and Sh. P Rajappa participated in person in this conference and exhibited Finger Millet value added prodcuts. Other scientists participated in the sessions virtually. Dr. TE Nagaraja, Professor (Plant Breeding) and Head, ICAR-AICRP (Small Millets), UAS, Bangalore was the organizing Secretary of ICFM-2022.

FPOs of ICAR-IIMR at Dubai Expo

Millets were exclusively showcased in Dubai Expo 2021. The Dubai Expo brought out technological innovations, conferences on solutions to global challenges, cultural displays and performances, culinary treats and much more from across 192 countries under one roof. The Government of India sent Indian delegation for participation in the Dubai-Expo for promotion of Indian millets, as a run up to the celebration of International Year of Millets - 2023. In the India Pavilion - Millets were a focal point for promoting value added food products and millet cuisines and recipes globally utilizing the business platform in Dubai. In this context, Six Millets FPOs promoted by ICAR-IIMR participated in the expo along with Millets Startups incubated

at IIMR. The delegation led by Dr. Dayakar Rao, CEO Nutrihub visited Expo 2020, Dubai from 17-19 February 2022. The FPOs and incubatees showcased their millet value added food products, and explained how the technologies developed by IIMR helped them to increase income and business of FPOs. Dr. Vilas A. Tonapi, Director, ICAR-IIMR, Hyderabad said that these events play important role in connecting consumers and positioning of millets at global level to promote export of millets. Dr. Sangappa, and Sh. K Srinivasa Babu, PIs, FPO Projects at ICAR-IIMR, Hyderabad enabled the FPO participation in Dubai Millet Expo.

NABARD team visits Sarpanaplly village

NABARD Inspection team monitored the activities carried out in the project entitled on “Promotion of millets technology and entrepreneurial skills among the farmers/ youth of Vikarabad district of Telangana” at Sarpanpally village, Vikarabad district on 9 February, 2022. The team consisting of Mr. Praveen Kumar, DDM, NABARD and Mr Rohit, AM, NABARD interacted with the beneficiaries and enquired about the benefits they have obtained by this project activity. Progressive farmers from Sarpanpalli – Mr. Krishna Reddy, Mr. K Anji Reddy, Mr. K Satyanarana Reddy, Mr. Gouse, Mr. Tajuddin, Mr. Gopal, Smt K. Paddamma, and Sri Gopal Reddy participated in the deliberations. The team also visited the recently installed millets processing unit, supported by NABARD at Sarpanpally village. They interacted with the members of FPO - Anantagiri millet growers, producers and Millet value added products society. Overall, the NABARD team expressed their satisfaction about the activities carried out in this project, till the date. Dr. B Subbarayudu, PI of the project and Mr. OV Ramana, TO, and Dr. S Ravikumar, Sr. Scientist (Retd) from IIMR took part in this programme. All COVID-19 preventive protocols were followed.

Eye camp by Rotary Club at IIMR

An eye camp was organized at Indian Institute of Millets Research by Rotary club of Krishi Rajendranagar for the farm workers on 28 February, 2022. The eye camp aimed at testing the vision defects and providing free

glasses to the beneficiaries. SIDBI is the financial partner for sponsoring 170 free spectacles. While inaugurating the programme, Dr. Vilas A Tonapi, Director, IIMR lauded the efforts of the Rotary Club for their generous services to the poor and needy.

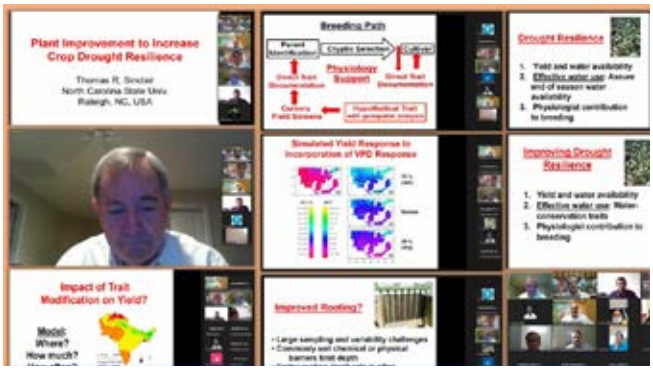
The glasses given to farm workers are patented, snap-together with adjustable frames and scratch- resistant lenses - designed by a subsidiary of Mercedes Benz. Each pair of glasses with lenses costing approximately Rs. 300 per unit were given as a service activity to 100 Farm workers at free of cost and in total 170 people got tested for vision defects. This programme was organized in collaboration with Rotary Club of Jubilee Hills and SIDBI. Dr. SV Ram Prasad, District General Secretary, Mr. Murthy Vadapalli, Assistant Governor and Mr. Suresh Gupta, President of Rotary Club Jubilee Hills participated in the program. Dr. Raman Meenakshi Sundaram, Director, IIRR and other local Rotarians participated in this camp. This event at IIMR was successfully coordinated by Sh. K Srinivasa Babu, Sr. Scientist.

Biodiversity festival-cum-millets seminar organized

A "Biodiversity festival-cum-millets seminar" was organized during 9-10 March, 2022 at Koraput, Odisha. The main objective of the programme was creating awareness about importance of millets to secure sustainable livelihood security. The programme was inaugurated by Dr. RK Samanta, Dr. RK Samanta, Ex.-VC, BCKV, Mohanpur, West Bengal and Chairman, Advisory Committee of NASF project as a chief guest in presence of Dr. Hariharan, Executive Director, Dr. Hossain, Director, Drs. Prashant, Oliver King, MSSRF, Jeypore, Mr. Prabhakar Adhikari, Pragati, Koraput, Mr. Susanta Sekhar Choudhury, WASSAN, Dr. Varaprasad K, RRA Network on 9 March, 2022. He expressed that millets promotion is need of the hour in view of existing resource-poor condition and livelihood perspective of Odisha farmers. He urged to extend help to needy and poor people to ease their livelihood. Thereafter, a lecture was delivered on "Improved millets production and processing technologies". Experience of TSP and NASF project were shared by Drs. Prashant and Oliver King, Principal Scientist, MSSRF. It was followed by Scientists-Farmers-Stakeholders' interaction session wherein farmers discussed about millets cultivation and information on new schemes. Five ICAR-IIMR scientists namely, Drs. Shyam Prasad, Srinivas Babu, Hariprasanna, Rajendra Chapke and Ganapathy including Dr. Samuel Patro, officer-in-charge, AICRP-SM, Vizinagaram addressed the gathering on different issues raised by the participants. On the next day 10 March, 2021 Dr. Samanta narrated on "Convergence for millets promotion" and urged participants to work together in cohesive manner to promote millets which is main source of livelihood of this area. It was followed by a lecture on Value-addition to millets wherein the farmers were sensitized to develop their small business platforms on value added food products of millets. The programme concluded with valedictory function, chaired by Vice Chancellor, Central University. Koraput. More than 300 participants participated in this programme. This programme was coordinated by Dr. Rajendra R. Chapke, Principal Scientist, ICAR-IIMR, Hyderabad.

National Webinar on Drought Resilience by Dr. Thomas R Sinclair, USA

ICAR-Indian Institute of Millets Research (IIMR) organized a National Webinar on "Plant improvement to Increase Drought Resilience" on 8 April 2022. The distinguished Scientist Dr Thomas Sinclair, a renowned Plant Physiologist, North Carolina State University, United States of America delivered the lecture on virtual mode. Dr Vilas A Tonapi, Director, ICAR-IIMR introduced the speaker and highlighted the National and Global importance of the webinar topic in the present day context. Dr Thomas R. Sinclair in his lecture emphasized on water use efficiency, the impact of physiological trait modification in grain yield, Simple Simulation Model, use of GIS database, improving the root structure etc. A total of 145 participants from different states attended the webinar. Which included Scientists, Technical, Research Fellows, Research Scholars and Students from ICAR-IIMR, AICRP on Sorghum and Small millets, ICAR institutes, State Agricultural Universities etc. The interactive Q&A session focussed on discussion around managing



the drought tolerant traits, current climate conditions and strategies needed for future scenario. Overall, the webinar focused on water conservation traits for drought resilience and role of Plant Physiologist in breeding program. The webinar was coordinated by Drs Srividhya, B Amasiddha and M Elangovan.

National Webinar on "Impact of High Temperature and Drought Stress on Grain Sorghum"

ICAR-IIMR organized National Webinar on "Impact of High Temperature and Drought Stress on Grain Sorghum" on 19 April 2022 under the *Azadi Ka Amrut Mahotsav*. Dr. PV Vara Prasad, Distinguished Professor and Director, Sustainable Intensification Innovation Lab, Kansas State University, USA delivered the lecture. The webinar was organized on physical and virtual mode and was attended by 120 participants which includes scientists from ICAR-IIMR-Hyderabad, other ICAR Institutes viz., ICAR-CAZRI, ICAR-IARI, ICAR-IIOR, ICAR-NBPGR, ICAR-NBSSLUP, ICAR-VPKAS, ICAR-CRIDA, ICAR-IIOPR, ICAR-DWR and AICRP on Sorghum and Small millets centres, Technical, Research Fellows and Research Scholars and Students. Dr. Vilas A. Tonapi, Director, ICAR-IIMR welcomed all and introduced the distinguished speaker. Dr. PV Vara Prasad in his lecture gave the insights on the impact of short and long term stress effect on major plant processes, key traits for genetic improvement and use of High Throughput Phenotyping for abiotic stress studies in crops especially sorghum, millets and other cereals. The lecture was followed by discussion session both physically and virtually around the key aspects of stress effects on sorghum grain yield and key traits that contribute for stress tolerance especially limited transpiration trait. The webinar was coordinated Drs. S Srividhya, B Amasiddha and M Elangovan.

National Seminar on Climate Change Concerns: Challenges for Agriculture Sector and Food and Nutrition Security

ICAR-Indian Institute of Millets Research (IIMR), Hyderabad in collaboration with Karnataka Agri-Professionals Association (KAPA) organized National

Seminar cum Webinar on "Climate Change Concerns: Challenges for Agriculture Sector and Food and Nutrition Security" by Virtual Mode during 14-15 May 2022. There were more than 500 participants of ICAR, ICRISAT, SAUs, Private Sector companies from all over India participated in the deliberations. During the inauguration Dr. Vilas A Tonapi, Director, ICAR-IIMR-Hyderabad welcomed the delegates briefed the background about the National Seminar cum Webinar. Dr. Ramesh Kalghatagi, President, KAPA informed about the KAPA. Dr. Jacqueline Hughes, Director General, ICRISAT, Patancheru delivered her keynote address and Dr CL Laxmipathi Gowda, Former DDG, ICRISAT chaired the inauguration session.

There were 7 technical sessions covering Climate Change Concerns- - Challenges for India; Impact of Climate Change on Agriculture and Horticulture; Impact of Climate Change on Aquaculture, Poultry and Animal food resources; Climate Resilience: Green energy, Seed industry and Policy; Biodiversity, Carbon and Land Management for Food and Nutrition security; and Novel Dimensions to Address Food and Nutrition Security; Approaches to Address Climate Vulnerability, Risk Assessment. Twenty-five eminent speakers from India, USA and Australia delivered their lectures covering the all the technical sessions. The speakers were from ICAR, NRAA, ISRO, Niti Ayog, TFRI, ICRISAT, CANSA, Bioversity International, Advanta Pvt Ltd., Bayer Group, Seed-works, Agreeva Agrigenetics Pvt. Ltd and Nurture Farm.

Dr. Arun Tiwari delivered special lecture on "Philosophical and Vedic concepts: approaches to mitigate climate

change" during the valedictory session and Dr. H Pathak, Director, ICAR-National Institute of Abiotic Stress Management, Baramati delivered his valedictory address on "Emerging Technologies and Innovations for Addressing Climate Change in Agriculture" Mr. Narayan Bhat proposed vote of thanks at the end. The seminar was organized by ICAR-IIMR in collaboration with KAPA and sponsored by Gubba Cold Storage Private Limited, Secunderabad. Drs. Vilas A Tonapi, Ramesh Kalghatagi, B Venkatesh Bhat, M Elangovan and Narayana Bhat were the organizing committee members of the seminar. Drs B Amasiddha, KN Ganapathy, Jinu Jacob, S Srividhya, Swarna R, VM Malathi and Sri OV Ramana were the coordinators for the logistic arrangements.

Launch Agro & Food Processing cluster at Bapatla.

ICAR –Indian Institute of Millets Research (IIMR) Hyderabad organised Launching programme of Bapatla Agro and Food Processing cluster in the premises of Agricultural College, ANGRAU, Bapatla on 26 May, 2022 under the project implementation of Scheme of Fund for Regeneration of Traditional Industries (SFURTI). This project is funded by National Institute for Micro, Small and Medium Enterprises (ni-MSME). IIMR is associated with Socio Economic Alternative Research and Resource community for Humanity (SEARCH), a NGO as Implementing Agency and Bapatla Agro Producer company Limited as its Special Purpose Vehicle and ICAR-IIMR plays the lead role of Technical Agency.

The event was chaired by Dr. Dayanand, Professor,

Ag. College, in the presence of Sh. L Venkata Ramana, Director, Bapatla Agro Producer company Limited, Smt. A Divya Jyothi, as Representative of SEARCH - NGO and Bapatla Agro Producer company Limited Dr. B Subbarayudu, PI of the Project, IIMR, Hyderabad. A total of 50 members including Board of Directors, men and women farmers participated in this interactive session. The programme started with the Lighting of lamp. Dr. Dayanand gave the Inaugural Remarks. Dr. B Subbarayudu explained the purpose of the project in detail and motivated all the budding entrepreneurs to strive hard in their entrepreneurial journey and take millets to the global market. Dr. L Venkata Ramana, in his address gave an insightful overview of the program. He encouraged FPOs to perform well and make efforts towards uplifting the presence of millets in the market. Dr. S Ravikumar, former Sr. Agronomist, IIMR given the tips to get the information and contingent plans from IIMR. Dr. R Venkateswarlu, Sr. Scientist, IIMR explained the value added products of Millets and Health Benefits. Sh. OV Ramana, CTO, IIMR explained the market strategies and the role of statistics in improving the market avenues. On this occasion, various farmers and Board of Directors of FPOs also shared their preliminary training experience at IIMR.

The meeting ended with the vote of thanks proposed by Dr. KV Raghavendra Rao, CTO, IIMR. The meeting. Nevertheless, the session was very informative and all the participants left the session with more enthusiasm.

Millets farmers participated in Hon'ble Prime Minister's interaction programme "*Kishan Kalyan Sammelan*"

A farmers' interaction programme with Hon'ble Prime Minister's to address the farmers in Telangana State was organized on 31 May 2022 by ICAR-CRIDA, Hyderabad at Hayatnagar Research Farm along with all ICAR institutes located in Hyderabad. In this programme, 200 millets farmers of a FPO, Mahbubnagar, were brought by IIMR to participate. They were exposed with latest technologies developed by each ICAR institutes located in Hyderabad. Over 5000 farmers from Telangana State participated in this event.

Sh. G. Kishan Reddy, Hon'ble Union Minister, Ministry of Tourism visited ICAR-CRIDA and graced the occasion of Kishan Kalyan Sammelan along with Dr. VK Singh, Director, ICAR-CRIDA and higher officials of HPCL. Sh. G. Kishan Reddy narrated about the various schemes and programmes of the central Government implemented for welfare of the farmers and other people. The designated ICAR-IIMR, Hyderabad scientists under different committees namely; Drs. Umakanth, Rajendra R. Chapke, K. Srinivas Babu, Anuradha, Sangappa, Srinivas A., Amasidhha, Seva Nayak, Rajesha and Ravi kumar performed their duties to make the programmes successful. Dr. Rajendra R. Chapke, Principal Scientist and Chairman of Overall Coordination Committee from the ICAR-IIMR, Hyderabad coordinated the programme.

Awareness programme on Efficient & Balanced use of fertilizers

An awareness programme on "Efficient and Balanced use of fertilizers" programme was organized by ICAR-Indian Institute of Millets Research, Hyderabad in adopted village Chalki in Raikode mandal of Sangareddy District of Telangana State under Farmer First Project on 21 June, 2022. The main objective of the programme was creating awareness about importance of Efficient and balanced use of fertilizers in agriculture. About 200 farmers including farm women, students and teachers of Zilla Parishad School, project staff of ICAR-IIMR, Sh. Rajesh, Ex-Sarpanch of the village, other farmers from Gangapur village of Jharasangam mandal, Sh. Veer Shetty, NGO persons from SS Bhavani Food and village farmers took part in the programme. All the participants gathered at office of Chalki-Farmers Producer Organization (FPO), Shri Rajappa, Chairman, Chalki-FPO welcomed all the participants and IIMR team. Dr. Rajendra R. Chapke, Principal Scientist (PS) and Principal Investigator (PI) of the project briefed about the programme, details of the project objectives which were much useful for their socio-economic upliftment. He urged participants to make efficient and balanced fertilizers use which is one of the most important elements of the sustainable agriculture. Maintaining the soil health gives long term dividend to human being. Dr. Anuradha, Scientist, ICAR-IIMR, Hyderabad explained about importance of the programme including role of fertilizers in crops cultivation in light of maintaining soil health and enhancing food requirement of the increasing population. She also narrated importance of soil heath card, judicious use of fertilizers and nano-fertilizers. Mr. Veer Shetty, Entrepreneur, SS Bavani Foods, Hyderabad advised them to get their soil test in view to combat problems of crop-specific over or under use of fertilizers. He also informed that the requirements of food are increasing and promotion of millets food products would be most profitable options. They were given resource material on improved production and processing millets technologies in Telugu language as ready reference. Thereafter, the same awareness programme was conducted for all the students in the Zilla Parishad High School of the same village sensitized the students on " Efficient and balanced use of fertilizers" and importance of agricultural research in farming. All the students took part in the programme enthusiastically. All the participants expressed that they could learn more about importance of efficient and balanced use of fertilizers and millets cultivation. This programme was coordinated by Dr. Rajendra R. Chapke, ICAR-IIMR, Hyderabad.

Millets Culinary Carnival @ New Delhi.

Ministry for Agriculture and Farmers Welfare sponsored event "**Millets Culinary Carnival**" organized at

Dilli Haat INA, New Delhi during 29 -31 July 2022. This event was curated by ICAR-Indian Institute of Millets Research (IIMR), Hyderabad; Institute of hotel management catering and nutrition, and Indian Federation of Culinary Association (IFCA), New Delhi.

Shri **Narendra Singh Tomar**, Hon'ble Union Minister for Agriculture and Farmers Welfare was the chief guest of the event. Shri. **Kailash Choudhary**, Hon'ble Minister of State for Agriculture and Farmers Welfare were invited guests along with Shri. Manoj Ahuja, Secretary DA &FW, Trilochan Mohapatra, Secretary DARE & Director General (ICAR), Dr. Abilaksh Likhi, Additional Secretary DA &FW, Ms Shubha Thakur, Joint Secretary (Crops & Oilseeds) DA & FW and Dr. Devendra Kumar Yadava, Assistant Director General (Seed). Dr CV Ratnavathi, Director ICAR-IIMR welcomed the guests during the millets culinary carnival.

Shri. Narendra Singh Tomar in his inaugural address advised that millets should be given utmost importance in our diet. He also informed that through the initiatives and recommendation taken by Honourable Prime Minister of India Shri Narendra Modi Ji, United Nations Organizations has declared year 2023 as International Year of Millets (IYOM). With this great gesture, Millets will be promoted across the globe. He also said that all Ministries in India are given responsibility and accountability to promote the Millets in the possible way and many events are planned by Central ministry, as a run-up for IYOM 2023, across the Globe.

Earlier on first day of event, Hon'ble Minister of State (Agri & Farmers Welfare) Sushri. Shobha Karandlaje graced the event and was impressed by the street play on millets performed by the students of IHM, Pusa. Quiz on Millets were conducted to the participants where the response was very good. A live cooking show was organized to demonstrate the use of millets innovatively in different dishes. Eminent Chefs like Chef Gunjan Goela, Chef Kunal Kapur, Chef Satinder Pal Singh Shergill and other Chefs participated. This was an opportunity to discuss the environmental benefits of growing millets and benefits of inclusion of millets in mid-day meals.

Millet startups participated actively in the programme by showcasing various products in millets. A power packed event with many activities like live millet food stalls, Food demonstrations of bakery products – Indian and Mexican delicacies, Food Security and Nutrition benefits of Millets were taken place. Quiz competition

on millets saw active participation from the audience.

There was a panel discussion on 'Delicious snacks made from Millets & their health benefits' chaired by Dr. B Dayakar Rao, PS, ICAR-IIMR and CEO-Nutrihub, with Mr. KK Pant, Principal, IHM, Pusa, Ms. Mamta Bist, Chef, Dr. Anshu Singh, IHM, Pusa, Dr. Vinuta, ICAR-IARI, Delhi, and Ms. Sharmila Sinha. On the concluding day a panel discussion on "Business Possibilities & Probabilities for Small Scale Industries and Entrepreneurs" with panel of successful entrepreneurs was chaired by Dr. B Dayakar Rao, PS, ICAR-IIMR and CEO- Nutrihub.

Millet Startups based in Delhi viz., Slurrp Farm, SatGuru Super Foods, One Organic, Golden Millets, Native roots and Millets for Health had set up their stalls in the carnival. More than 500 people participated in the three-day event including higher officials from Ministries and other State Government. Live demonstration of Millet plants along with nutritional and health benefits were displayed.

The carnival ended with a cultural program with participants from different states in India. The carnival was coordinated by Mr KK Pant, Principal, IHM Pusa, Chef Manjit Singh Gill, President IFCA and Dr B Dayakar Rao, PS, ICAR-IIMR and CEO- Nutrihub. Dr. Karanam Venkatesh, Sr. Scientist, ICAR-IIMR and Dr. Ravi Kumar V, Technical Officer, ICAR-IIMR participated in the event along with Project Staff ICAR-IIMR – Ms. Kiranmai, Dr. Amarnath Reddy and Ms. Humera.

Inauguration of Community Millet Processing Unit

Inauguration of Community Oriented Millet Processing Unit was organized at Thimmapur village, Kundagol Taluk, Dharwad district, Karnataka State on 17 July 2022 to encourage and support the tribal farmers to cultivate and consume millets at community level. The inauguration of processing unit was jointly organized by ICAR–IIMR, Hyderabad, KVK-Gadag and M/s. Sahaja Samruddha, Bengaluru. This processing unit encompassed with a unit of de-stoner, grader and de-huller mainly meant for small millets. About 150 farmers including women farmers from Thimmapur and surrounding villages besides head of the gram panchayat took part in the programme. During this demonstration event, tribal women have been given training on handling and maintenance of millet processing unit. Dr. Sooganna, Scientist, IIMR, Hyderabad, Dr. Hiregoudar Head, KVK Gadag and Shri Krishna Prasad, Director, Sahaja Samruddha, Bengaluru, addressed the farmers and explained importance of millets, production technologies, and future market scenario in the light of gaining consumption of millets among public due to their nutritional aspects and health benefits. Dr. Sooganna from IIMR was the coordinator of this event.

ICAR-IIMR dedicates Millets Processing Unit to FPOs

ICAR-Indian Institute of Millets Research (IIMR), Hyderabad is a premier institute working exclusively on Millets. It also supports the promotion of millets through Farmer Producer Organizations (FPOs) and doubling farmers' income. The institute is performing as Cluster Based Business Organization (CBBO) for the promotion and handholding of 33 Millets FPOs in four states - Andhra Pradesh, Karnataka, Telangana, and Madhya Pradesh to implement its "Millets FPO Model". In view of the forth coming International Year of Millets- 2023, ICAR-IIMR took initiative to provide a processing facility to millet farmers and FPOs. In this regard, ICAR- IIMR signed an MoU with M/s. Nabhitha Engineering Private Ltd. and Rotary Club, Krishi Rajendranagar for establishing primary processing unit at premises of ICAR-IIMR, Hyderabad.

On eve of Independence Day and *Azadi Ka Amrit Mahotsav* programme the processing unit was inaugurated on 15 August, 2022 by Dr. CV Ratnavathi, Director, ICAR-IIMR, in presence of invited guests Dr. Vilas A Tonapi, Former Director, ICAR-IIMR and President Rotary Club Krishi Rajendranagar, Mr. Raghu, General Manager of Nabhitha Engineering Private Ltd. and other members of Rotary club graced the occasion. Dr. Sangappa and Dr. Srinivas Babu of FPO Unit, ICAR-IIMR have taken the initiative of Public Private Partnership (PPP) for installing this millets processing unit.

This unit will help FPOs and farmers to process their millets at nominal cost. It also inspires the fellow farmers to cultivate millets, and helps indirectly expansion of the area under millets cultivation. ICAR-IIMR primary processing unit also offers better marketing linkages to millet farmers and helps to receive fair prices for their produce. IIMR also provides hands-on training to FPOs & farmers.

Millets Conclave at Raichur

To mark the occasion of the International Year of Millets – 2023, the University of Agricultural Sciences, Raichur, in collaboration with the Agriculture and allied departments hosted a two-day Millets Conclave as a curtain raiser during 26-27 August, 2022 at University Campus, Raichur. This event organized jointly by Atal Innovation Mission, UAS and NABARD, where ICAR-IIMR-Hyderabad was a knowledge partner. During the conclave, farmers, FPOs, entrepreneurs, Agri-Startups, investors, exporters, agricultural scientists, NABARD and lead banks, and agricultural development departments discussed issues related to nutritious cereal production and value addition. The Programme was Inaugurated by Union Finance Minister Nirmala Sitharaman, and Union Agriculture Minister – Narendra Singh Tomar and Karnataka Chief Minister Basavaraj Bommai.

The Finance Minister awarded Agri Startups one crore rupees each under the Millet Innovation Challenge for their unique contribution. In addition, 15 Agri Startups will receive Rs.20 lakh each, and 15 other Agri Startups will receive Rs.10 lakh each. She also announced providing Rs 25 crore under the NABARD's rural infrastructure development fund to University of Agricultural Science (UAS), Raichur, Karnataka, for creating facilities focused on research, setting up of laboratories and support to farmers by the UAS and establishment of incubation centre for processing and value addition for promotion of millets. Union Agriculture Minister – Sh. Tomar praised Agri Startups for doing an excellent job of increasing millet processing. Now is the time to give Millet a proper place on the world's food plate, not just in India. Chief Minister Bommai discussed the state's millets cultivation area and assured that all possible steps would be taken to promote it further.

Prior to this inauguration programme, there was a knowledge sharing session conducted and during this session five invited lectures were delivered by eminent scientists. Dr. Vilas A Tonapi, former Director, IIMR-Hyderabad and Dr. B Dayakar Rao, CEO-Nutrihub and PS, IIMR-Hyderabad also delivered lectures. This session was chaired by Dr. CV Ratnavathi, Director, IIMR, Hyderabad. The scientific fraternity Drs. Hariprasanna, Sangappa, Amasiddha, K Srinivasa Babu and Srinivas, from ICAR-IIMR also participated in this event.

Multi-stakeholders workshop-cum-seminar on millets at Tamil Nadu

A "Multi-stakeholders workshop-cum-seminar on millets" was organized on 11 October, 2022. The main objective of the programme was to build convergence among various stakeholders in Namakkal district of Tamilnadu for promotion millets and allied farming in order to secure sustainable livelihood of the hilly and tribal farmers. The programme was inaugurated by Dr. RK Samanta, Ex.-VC, BCKV, Mohanpur, West Bengal and Chairman, Advisory Committee of NASF funded extension project as a chief guest in presence of Dr. Oliver King, Director-Biodiversity, MSSRF, Kolli Hills, Dr. Prashant, Sr. Scientist, MSSRF, Jeypore, Odisha. Mr. S. Loganathan, Founder & Executive Director, ASSEFA-NGO, Madurai, Mr. S. Ramesh, DM, NABARD, Salem Cluster and Scientists from KVK, Namakkal. The dignitaries expressed that millets promotion is need of the hour in view to combat increasing lifestyle diseases and adverse climate change impact on resource poor farmer's livelihood. They urged to extend help to needy and poor people to ease their livelihood keeping human values. Exhibition on value-added millets products was also inaugurated by the dignitaries. Wherein various value added products were exhibited by the entrepreneur women SHGs. In technical session, there was live discussion on "National status, trends, improved millets production and processing technologies" wherein the

Nutri-Cereal Multi Stakeholders Mega Convention 4.0

The National Nutri-cereal Convention (NNCC) 4.0 was organized by Nutrihub - ICAR- Indian Institute of Millets Research, jointly with Department of Agriculture, Cooperation and Farmers' Welfare, (DAC & FW) Government of India at Hyderabad International Convention Centre at (HICC) Hyderabad during 23-24 September, 2022. This two-day grand event was inaugurated in the presence of Dr Ashok Dalwai, IAS, CEO NRAA Ms. Shubha Thakur, JS (Crops, Oilseeds & Admn), DA&FW, Dr RK Singh, ADG (FFC), ICAR, Dr CV Ratnavathi, Director, ICAR-IIMR, and Dr B Dayakar Rao, CEO Nutrihub, ICAR-IIMR. Shri S Niranjan Reddy, Hon'ble Agriculture Minister, Government of Telangana was the chief guest. The Millet Cookery Show was conducted by Telangana Chefs Association and Chef Gunjan Goela, Consultant ITC Hotels on various millet dishes. About 80 stalls were made to showcase the strategies and products especially of millet value added products in the Exhibition of Start-ups entrepreneurs and government agencies working in millet sector.

In the inauguration function, Dr B Dayakar Rao, CEO Nutrihub, ICAR-IIMR welcomed the dignitaries. Dr CV Ratnavathi, Director, ICAR-IIMR presented the Overview of the Convention. Ms. Shubha Thakur, JS (Crops, Oilseeds & Admn), DA&FW explained the significance of the International year of Millets-2023. Dr. R.K. Singh ADG (FFC) ICAR, explained the role of Indian Council of Agricultural Research in R&D and promotion of millets in the country through its various crop science institutes especially through ICAR-Indian Institute of Millets Research, Hyderabad. Shri S Niranjan Reddy, Hon'ble Agriculture Minister in his chief guest address stressed the importance of Millet crops and the steps taken by the Government of Telangana to promote millet cultivation. Dr. J. Stanley proposed vote of thanks followed by inauguration of exhibition stalls by the hon'ble Minister of Agriculture, Shri Niranjan Reddy.

Technical session on Millets for SDGs: Transformation from food to nutritional security was chaired by Dr. Ashok Dalwai, IAS, CEO, NRAA. During this Panel

discussion Dr. M Govindaraj from Harvest-Plus, Dr. Raj Bhandari, Member NTBN, Dr Tara Satyavathi, Project Co-ordinator, AICPMIP, Jodhpur, Dr. C Aruna, Principal scientist ICAR-IIMR and Dr. B. Venkatesh Bhat, Principal scientist, ICAR-IIMR participated. The Session on Experience sharing by State Millet Missions was Chaired by Mrs Shubha Thakur, JS (Crops, Oilseeds and Admin), Ministry of Agriculture, GoI and co-chaired by Dr. C.V. Ratnavathi, Director ICAR-IIMR. The top officials of state millets missions belong to Odisha, Karnataka, Chhattisgarh, Madhya Pradesh, Uttarakhand, Rajasthan, Telangana and Maharashtra participated and explained their experiences and success stories.

Many other technical sessions were conducted viz., Millet Value Chain – replication and upscaling for mainstreaming millets, Multi-stakeholder engagement – Industry perspectives, Policy for production, processing and promotion of millets, Post-harvest processing, value addition and recipe development in millets. Officials from various state governments, representatives from Exporters, FPOs, Processors, start-ups and progressive farmers also participated in this deliberations.

On the second day, Dr Himanshu Pathak, Secretary DARE & DG, ICAR graced the occasion and delivered Presidential Address. Dr. CV Ratnavathi, Director ICAR-IIMR, welcomed DG ICAR and other dignitaries. Hon'ble DG ICAR visited all the millet stall organized by various state departments, private entrepreneurs, start-ups, NGOs and SHGs. He applauded the Institute's efforts in creating awareness on millets, Start-Ups for Millets processing and value-added food products. He also stressed the role of ICAR-IIMR in the popularization of millets cultivation and their value addition as a sustainable enterprise in the near future and creating a healthy atmosphere around the farming communities. Dr B Dayakar Rao, CEO Nutrihub, ICAR-IIMR delivered a Keynote address on Post-harvest processing, value addition and recipe development in millets and Dr Tarun Bajaj, Director APEDA on Millet exports - Marketing, branding, and commercialization approaches. Valedictory function was conducted at the end of second day deliberations which was attended by Dr Ashok Dalwai, IAS, CEO NRAA. Dr D K Yadava, ADG (Seeds), ICAR, Dr Vijaya Lakshmi Nadendla, IAS JS (Policy & Marketing), Dr Chindi Vasudevappa, VC, NIFTEM-K, Dr. Raj Bhandari, Member NTBN and Dr. C.V. Ratnavathi, Director ICAR-IIMR. In the valedictory function, Millets Start-ups Graduation ceremony 2022 was conducted along with distribution of Poshak Anaaj Awards 2022.

The program Committee include, Drs. B. Dayakar Rao, B Venkatesh Bhat, AV Umakanth, R Madhusudhana, IK Das, J Stanley, N Anuradha, A. Srinivas and V Ravi Kumar of ICAR-IIMR. The rapporteur committee includes, Drs. K. Hariprasanna, Rajendra Kumar, Venkateswarlu R., Anuradha Narala, Jinu Jacob, Karnam Venkatesh, G Rajesha, Deepika C, S Srividhya, VA Malathi, A Srinivas, P Hemasankari from ICAR-IIMR, Dr Ganesh Kumar, ICAR-NAARM, Dr. Ravindranath, ICMR-NIN, Dr. P Muthukumar, ICAR-NRC Meat. All Scientists, Technical staff of ICAR-IIMR and staff of Nutrihub and CoE actively participated in this mega event in various committees. Dr. B Dayakar Rao, CEO-Nutrihub, ICAR-IIMR was the convener of this event and Dr. J. Stanley, Sr. Scientist as the coordinator.

millet farmers were sensitized about national status of millets and trends in production and new millets varieties available for cultivation. Experience of TSP and NASF project were shared by the scientists. Total 13 topics related to millets development was delivered by the eminent experts. It was followed by 'Scientists-Experts-Farmers-Stakeholders' interaction session wherein important aspects of millets were discussed including problems in millets cultivation and information on new schemes. Three ICAR-IIMR scientists namely, Dr. S. Kalaisekar, Srinivas Babu, and Rajendra Chapke addressed the gathering on different issues raised by the participants. Around 200 farmers including farm women and entrepreneurs took part in the programme and interacted with various stakeholders. The project staff namely, Mr. S. Yugender Reddy, SRF, from ICAR-IIMR and project staff from kolli hills and koraput centre participated in this event. All the participants expressed their satisfaction of getting latest updates on millets technologies and marketing channels for their promotion. Most of them were enquiring about seeds of high yielding varieties of millets and training opportunities on preparation and value added food products. This programme was organized by Dr. Rajendra R. Chapke, Principal Scientist, ICAR-IIMR, Hyderabad as Principal Investigator in collaboration with MSSRF, Chennai.

Review of NASF-funded Extension project

The progress of an ongoing ICAR-NASF funded extension project entitled "Farmer-led extension strategy for enhancing farmers' income through millets-based farming system in hilly and tribal areas" was reviewed by ICAR-NASF appointed, Chairman, Advisory Committee namely; Dr. RK Samanta, Ex.-VC, BCKV, Mohanpur, West Bengal on 12th October, 2022 at Kolli Hills, Tamil Nadu. It is one of the project sites where the project was implemented with an objective to develop farmers-led extension system based-on using latest millets technologies and allied enterprises. The chairman visited the adopted five villages in Kolli Hills and monitored the progress under each component of the project and interacted with the beneficiary farmers. Dr. RK Samanta evaluated overall progress of the project by seeing performance of all the components of the project along with the project staff in Palapadi, Aleripatti, Orpuram, Ettadiparai and Pellakadu villages. He enquired about impact of the interventions made under the project and their future mode of action to sustain these activities. He expressed satisfaction regarding performance of the project interventions whereas, he urged from the selected millet farmer facilitators (MFFs) to put emphasis on marketing of the produce so that farmers could get desired price. He also emphasized to build convergence among various stakeholders for promotion millets in order to secure sustainable livelihood of the hilly and tribal farmers. He appreciated the facilities which were being provided on primary processing and value-addition to millets farmers. Millet farmers told that they received quality certificate for their produce from FSSAI and MSME for processing and value addition. This programme was coordinated by Dr. Rajendra R. Chapke, Principal Scientist, ICAR-IIMR, Hyderabad as Principal Investigator in collaboration with MSSRF, Chennai.

Cognizance programme for Bapatla Agro and Food Processing Cluster artisans

In the NIMSME project "Bapatla Agro and Food Processing Cluster" artisans made an exposure visit from Bapatla to ICAR-IIMR on 25 November 2022. The primary objective of their visit was to acquaint with the primary and secondary processing technologies and also to see the relevant machines for their ongoing cluster at Bapatla. They have visited various IIMR facilities, namely, Centre of Excellence, primary, secondary processing units and Nutrihub. Dr CV Ratnavathi, Acting Director of Indian Institute of Millets Research, Hyderabad gave the overview of the institute. Dr. B. Subbarayudu, Project Leader said about the project objectives and entrepreneurial benefits of this cluster. Further, he had also explained production, productivity and value addition in millets, inter-cultivation with black gram and red gram with reference to Bapatla Agro Processing Cluster. Dr. Venkateswarlu, Project Associate presented various nutritional status

and health benefits of millets. Dr. Anuradha N, Project Associate briefed about millet value chain, start-ups and activities of COE of Institute. Dr. B Dayakar Rao and team briefed about primary processing and secondary processing aspects of millets and also showed the Nutrihub activities. Further, they also visited NIRD and acquainted with the rural technology park entrepreneurial activities. They also visited NIMSME and interacted with Smt. Glory Swarupa, DG; Sri K Surya Prakash Goud, Sri Vijay Kumar and team on the role of Bapatla Agro Processing Cluster activities and its implementation. Smt. Glory Swarupa, DG gave an overview of NIMSME start-up activities and actively interacted with the artisans. Mr. C Parthasarathy, Mr. L Venkataramana, Mr. S Krishnarjun and Mr. Tupakula Srikanth, of Bapatla Agro and Processing Cluster coordinated the artisans from Bapatla to Hyderabad for the exposure visit. The artisans interacted actively with the scientists at IIMR, NIRD-RTP and NIMSME. Drs. B. Subbarayudu, R Venkateswarlu and N Anuradha coordinated this exposure visit and made it grand success.

Special days / Weeks

Republic day celebrated

The Nation's 73rd Republic Day was celebrated this day with patriotism, enthusiasm and unity at Indian Institute of Millets Research on 26 January, 2022. Dr. Vilas A Tonapi. Director, IIMR unfurled the national flag and addressed the staff. On this occasion, Dr. Tonapi said the 2022 is to re-build and recreate the productive days. He also highlighted the sacrifices of martyrs and said that we should all follow principles of dedication, service and human welfare to contribute your right to nation building. He reminded that during 2021, a total 8 new sorghum and 3 small millet varieties have been identified for national release and IIMR successfully organized Nutri-Cereal Multi Stakeholders Mega Convention 3.0, where the Union Minister of agriculture was the Chief guest besides all dignitaries from the council including Dr. Trilochan Mohapatra, DG of ICAR. He also stressed on the need to repeat the productive performance of 2021 also in 2022 with higher deliverables in the light of forthcoming International Year of Millets - 2023. Dr. M Elangovan, PS organized this event with the help of Sh. Vilas, Farm superintendent and J Bhagavantham, Technical Assistant and his team were the coordinators of the event.

National Science Day Observed

On the occasion of National Science Day on 28 February 2022, Thirty students from Kommuri Pratap Reddy Institute of Technology visited ICAR-IIMR-Hyderabad. They visited - millets genebank and observed the conservation procedures and utilization of local landraces, biochemistry laboratory to know nutritional benefits of millets, NUTRIHUB for business opportunities, CoE for diverse millet products and Value Addition Processing Units for machineries and experimental fields to see different millet crop cultivation. This visit was sponsored by Samskruti Foundation and M/s Midhani Ltd, Hyderabad. This visit was coordinated by Drs. M Elangovan, R Venkateshwarlu, V Ravi Kumar and Mr. Shetty Mahesh at IIMR.

International Women's Day celebrations

On the eve of celebrations of International Womens' Day-2022, a special lecture and interactive session with Ms. Divya Devarajan, IAS, Principal Secretary, Women and Child Welfare Department, Telangana State, was arranged at ICAR-Indian institute of Millets Research, Hyderabad on 5 March 2022. Ms. Ritu Dalal, SAO, IIMR welcomed and introduced the extraordinary contribution of Smt. Divya. The notable among them is,

a village is named in honour of her in the tribal areas of Telangana, where she served.

While addressing the staff members Ms. Divya Devarajan pointed out that women have to be self-motivated and they have to realise their hidden potential because of the pivotal role they play in the family and society. She reminded women to help each other in recognising their talent and in overcoming social stigma. She mentioned about the interest of Telangana government in programs for millets as nutrition and food items. She showed her interest in the ongoing programs on food and nutrition at IIMR and promised for a future collaboration for research and product development. Ms. Divya visited the Millet Gene Bank, and CoE and primary and secondary millet processing facilities. Dr. B Dayakar Rao, CEO, IIMR-Nutrihub explained her about technology developed and role of IIMR for increasing the benefits from millets value chain and entrepreneur development. All the women staff members of IIMR enthusiastically participated in the session. The meeting ended with vote thanks by Dr, CV Ratnavathi, PS, IIMR.

At Visakhapatnam: ICAR-Indian Institute of Millets Research associated with M/s. Jal jeevan mission and Tata Foundation, Visakhapatnam in organizing the celebrations of International women's day at Chodavaram village, Visakhapatnam district, Andhra Pradesh on 8 March, 2022. Ms. Chandrika, FFP - Project Staff represented ICAR-IIMR and explained the women about the health benefits of millet value-added products. A Total of 54 members participated in the event.

Anti-Terrorism Day Observed

Anti-Terrorism Day was observed at ICAR-IIMR-Hyderabad on 21 May, 2022, to raise awareness about terrorism and violence and the way it affects the common people. It also aims to show how detrimental terrorism is to the nation. Officials at IIMR took the 'Anti-Terrorism Pledge' in their respective rooms/offices to avoid public gathering due to COVID-19 pandemic.

International Yoga Day celebrated

ICAR- Indian Institute of Millets Research, Hyderabad Celebrated the 8th International Day of Yoga on 21 June, 2022 under the theme of "Yoga for Humanity", in the series of events on "*Azadi ka Amrit Mahotsav*". The program was conducted in a physical as well as virtual mode, in compliance to ministry of Ayurveda (AYUSH) and ICAR's guidelines. Shri. Santhosh Polimera, Yoga Expert from Sri Ramakrishna Seva Samithi, Bapatla, Andhra Pradesh was the Chief Guest, who exhibited and demonstrated yoga asanas for rectifying and healing the ailments we come across during our office and field professional life. A seven-year-old girl (Miss. Arshitha) demonstrated all the asanas along with the expert. A total of 60 participants (30 offline and 30 online) from ICAR-IIMR, Hyderabad and Centre for Rabi Sorghum, Solapur enthusiastically participated in this event. Dr. CV Ratnavathi, Acting Director, ICAR-IIMR welcomed Shri. Santhosh and briefed the importance of Yoga for human beings. She said yoga helps us to become strong which in turn, leads to the creation of healthier and happy family cum society. The Chief Guest, Shri. Santhosh Polimera explained the scientists and

staffs on the benefits of yoga-asanas along with the demonstration. He also enlightened as to how yoga enhances teamwork and effective communication in day-to-day office work, and also imparts a lasting sense of joy, peace and fulfilment. Staffs of ICAR-IIMR including Scientific, technical, administrative and field workers enthusiastically participated in this event. ICAR-IIMR staffs also participated in the mass yoga event where Shri. M. Venkaiah Naidu, Hon'ble Vice President of India, addressed the gathering at the Parade Ground, Secunderabad. Dr. CV Ratnavathi, Acting Director ICAR-IIMR thanked the coordinators of the event Drs. KBRS Visarada, M Elangovan, S. Srividhya, B Amasiddha and OV Ramana for the successful conduct and celebrations of the International Day of Yoga.

ICAR-IIMR Celebrated Independence Day

The staffs of ICAR-IIMR celebrated the 76th Independence Day on 15 August 2022. Dr. CV Ratnavathi, Acting Director hoisted the tricolour and delivered her independence day address. In her message she remembered the patriotic leaders who sacrificed their lives for the independence of India. She also appreciated the hard work of IIMR Staffs who brings laurels to the institute. She also highlighted the responsibilities of the institute and its preparedness for the forthcoming International Year of Millets 2023. During the celebrations, many sports and games were organized to the all the permanent and temporary staffs of ICAR-IIMR including the contractual. The Director distributed the prizes to the successful participants in the competitions.

Parthenium Awareness Week Observed

The 17th *Parthenium* Awareness week was observed at ICAR-Indian Institute of Millets Research (IIMR), Hyderabad as per ICAR's guidelines from 16 - 22 August, 2022 with the theme "Join hands to eliminate *Parthenium* to save health, environments and biodiversity". A wide range of activities were conducted at various IIMR fields and office premises including regional centre Solapur to spread maximum awareness

among staff members as well as farm and campus workers during this period. Parthenium eradication was carried out as per the Govt. guidelines, by uprooting the weed as well by spraying of glyphosate herbicide. A program cum lecture about the harmful effects of Parthenium weed and ways of management was also organized on 19 August, 2022 to spread the awareness among the young community involving school children and teachers of Spring Fields High School at Rajendranagar, Hyderabad. All the staffs and field workers of the institute actively participated in the week long Parthenium eradication drive. Around forty to fifty participants including scientific, technical, administration and field workers were actively involved in everyday activity. The institute has taken appropriate measures to achieve *parthenium* free campus in near future. This programme was coordinated by Scientists Drs. R Swarna, S Srividhya, B Amasiddha and KBRS Visarada at IIMR- Hyderabad, and Drs.Parashuram Patroti, Baswaraj Raigond at CRS Solapur. Mr. Gawali, Mr. Bhagvantham, Mr. AR Limbore and Dr. V Ravikumar extended their support during the field operations.

World Soil Day - 2022 organized

ICAR-Indian Institute of Millets Research, Hyderabad organized “World Soil Day” On 5th December 2022 at Chalki village of Sangareddy District, Telangana with the theme “Soils, where food begins”. In this event about 25 farmers from the Chalki village participated. Scientific staff of ICAR-IIMR – Drs. R Swarna, A Srinivas, N Anuradha, C Deepika and VM Malathi organized the event and addressed the farmers. They explained about the importance of soil testing, method of soil sample collection, maintaining soil health and measures to prevent soil erosion and degradation. They emphasized the importance of balanced fertilization as unscientific use of fertilizers results in degradation of soil health and occurrence of multi-nutrient deficiencies in soil. They also encouraged farmers to take millets cultivation as they act as soil preservers with their fibrous root system. The farmers and villagers were encouraged to take initiatives to protect our soils collectively as a community activity.

Swachh Bharat Abhiyan

Special Swachhata Programme

ICAR-Indian Institute of Millets Research, Hyderabad organized a Special Swachhata Abhiyaan programme on 19 March, 2022 at Peddarevally village, Balanagar Mandal, Mahaboobnagar district, Telangana state. This programme was organized by ICAR-IIMR-Hyderabad as part of Swachh Bharat Mission (Gramin), to generate awareness to motivate communities to adopt sustainable sanitation practices, and encourage the use of appropriate technologies for sanitation. A total of 200 farmers from Peddarevally village and neighbouring villages Himajipur and Devunigutta Tanda participated in the cleanliness drive and attended the awareness programme.

At the outset, Dr. B Subbarayudu, Principal Scientist, IIMR briefed the villagers about the development of community managed environmental sanitation systems focusing on solid and liquid waste management for overall cleanliness in the village as well as in the farms. Smt. Narmada Reddy, President of the village, seeks support from the villagers to eliminate open defecation. She also highlighted the importance of toilets and the support extended by the Government for creation of individual toilet facilities.

Besides this programme, Dr. B Subbarayudu, Principal Scientist also organized awareness campaign about the Millets cultivation and Health benefits. He explained the farmers about the Improved methods of millets cultivation, production practices and their value addition in this event. All millet value added food products manufactured at IIMR were displayed in this event. Drs. B Subbarayudu and RR Chapke were the coordinators of this this event. COVID 19 preventive protocols were followed in this programme.

Swachhta Abhiyaan Special Campaign 2.0 at IIMR

Special Campaign 2.0 for Disposal of Pending Matters of DARE and ICAR and Swachhata was organized at ICAR- Indian Institute of Millets Research from 02-31 October, 2022. Prior to organize these programmes, A preparatory phase meeting was organized on 15 September 2022 to plan various activities to plan according to 'Pendency Identification Form'. The meeting was organized by Dr. P. Sanjana Reddy, Nodal Officer for co-ordinating the special campaign and attended by Ms. Ritu Dalal, SAO; Sh. AN Murthy, SFAO; Ms. Parvathi, AAO (Est); Sh. D Rambabu, AAO (Stores), Ms. Saraswathi, DDO, Mr. HS Gawali, Dr. KV Raghavendra Rao, and Mr. Vilas (In-charge, Farm Section).

Activities taken up:

- Campus cleanliness drive was organized from 02-09 October and co-ordinated by Dr Stanley, Dr K Venkatesh, Dr V. Ravi Kumar, Mr. Vilas Aghav and Mr. Bhagawantham. Cleanliness program was carried out in all the campus roads and pathways, buildings and terraces/ roof tops, areas around the field laboratory facility, conference halls, Common Facility Centre, Nutrihub facility in the office campus.

- Field cleanliness drive was organized from 10-16 October and co-ordinated by Dr. Swarna, Dr Amasiddha, Dr Rajesha, Sh.Sunil Sharma, Sh.Bhagawantham and Sh.Raghunath. Cleanliness program was carried out by taking up weeding activity along the road sides and fields boundaries to keep the fields weed free in IIMR fields at four locations.

- Field labs cleanliness drive was organized from 17-19 October and co-ordinated by Dr Deepika, Dr Srinivas, Sh. D.M Bahadure, Sh.Prashanth, Sh. Mantri Kumaraswamy Cleanliness program was carried out at NGP Rao crop improvement building in the field labs of grain sorghum, forage sorghum, rabi sorghum, sweet sorghum, bajra and all small millets.

- Laboratory cleanliness drive was organized from 20-23 October and co-ordinated by Dr Jinu Jacob, Dr Venkateswarlu, Dr Malathi, Ms.Usha Satija, Sh.Naresh and Sh. Karthik. Cleaning and sorting of old periodicals and consumable catalogues; clearing laboratory work benches of unused containers, arranging chemical shelves, sorting of plasticware and glassware and discarding damaged and unused items, dusting and cleaning activities was carried out in the biotechnology, biochemistry, insect-rearing labs and the gene bank. Used paper and cartons were collected and were kept apart for re-cycling purposes.

- Outdoor research facilities cleanliness drive was organized from 24-30 October and co-ordinated by Dr. Srividya, Dr. Sevanayak, Sh. Rajappa and Sh.Bhagawantham. Cleaning was taken up at pot culture and rainout shelter. Unwanted/ damaged waste materials like plastic bags, plastic pots, *pollination bags, weeds,* damaged *bird* nets, stones, waste t*hreshing* materials were disposed. Bird net bags were pooled from different sources, cleaned, and arranged at the field lab facility with the help of technical assistants, farm in charge and field workers

- Swachhata activity was taken up along the roadsides of nearby community area and all the waste plastics were collected and areas were cleaned. This activity was co-ordinated by Drs. N Anuradha, Hemasankari, Sh. Vilas Aghav and Sh. Bhagawantham.

- Sh.K Srinivasa Babu, Dr. Sangappa, Dr. Rafi from ICAR-IIMR along with Chandra Sekhar Eco-club organized Swachhala Campaign 2022 and special campaign 2.0 for Disposal of pending matters at Mahbubnagar Millets Farmers Producers Company, Ganded Mandal, Mahbubnagar District on 19 October. Dealers were sensitized on maintaining cleanliness in storages.

- As the special campaign focused on disposal of pending activities, periodical updates were provided to ICAR regarding record management giving the number of physical files received, number of filed identified for weeding and number of files weeded out. This activity was co-ordinated by AAO (Est), AAO (Stores), DDO undeerthe guidance of, Ms. Ritu Dalal, SAO, IIMR.

Swachhta Pakhwada

ICAR-Indian Institute of Millets Research, Hyderabad observed Swachhta Pakhwada during 16-31 December 2022. The programme started with the Swachhta Pledge taken by all the scientific, administrative, technical and supporting staff on 16 December, 2022. During the Swachhta Pakhwada, several identified places such as areas around guest house, gene bank, Nutrihub,

pathways, parking areas were cleaned. Plastic waste such as nylon bags were collected from all the fields and segregated into non-usable and reusable stock. Dr. N G P Rao crop improvement building containing field labs of sorghum, bajra and all small millets premises were cleaned.

Off-campus cleaning activity as a part of Swachhta Pakhwada was organized at Bharatiya Vidya Bhavan School, NIRD Campus, Rajendranagar, Hyderabad on 21 December 2022. The premises were cleaned of all the pebbles and unwanted items. On 22 December 2022 Plantation of saplings programme was taken up in the school premises. Ms. Ritu Dalal, SAO, Drs. C. Aruna, P. Sanjana Reddy, N. Anuradha, C. Deepika, Scientists of IIMR, Mr. A. Vilas Farm In-charge, IIMR and Principal BVB School, Faculty and X Class students participated in this event.

Several competitions were conducted to bring awareness on Swachhta. An elocution competition was held for the staff of ICAR-Indian Institute of Millets Research on 28 December 2022. The topic was 'Swachhta measures for fighting COVID in work area'. The speakers emphasized on the importance of personal hygiene, workplace sanitation, avoiding congregations, importance of proper ventilation and vaccination as well as measures to enhance individual immunity. The competition was organised by IIMR Scientists, Drs. Anuradha N, Jinu Jacob and Deepika C.

Quiz competition was held for the staff of ICAR-Indian Institute of Millets Research on 29 December, 2022. Twenty members participated in the quiz competition, and questions on Swachhta and COVID 19 were covered. The competition was organised by IIMR Scientists, Dr. Srividhya, Dr. Amasiddha and Dr. Sanjana Reddy.

A painting competition was organised for the students of Springfield High School, Rajendranagar, Hyderabad on 30 December, 2022. A total of 31 students participated in the competition. The topics for the competition were 'Swachhta at School' for the students of class 6 and 7 and 'Green city clean city' for the students of class 8 and 9. All the students had actively participated in the competition. A small meeting was also organised including the school Principal and the participants. The Principal, IIMR Scientists, Drs. Anuradha and V M Malathi described the importance of Swachhta, especially in the post COVID era. The students also shared their thoughts on keeping the surroundings clean. Besides these activities Swachhta Pakhwada banners were displayed at the prominent places of the institute.

All the above programmes were coordinated by the organising committee constituting of Dr. P. Sanjana Reddy (Chairman), Dr N. Anuradha, Dr. Sangappa, Smt. Ritu Dalal and Mr. A. Vilas Dnyanoba as members.

Memorandum of Agreements / Understandings

The following Memorandum of Agreements / Understandings were made through ITMU, ICAR-IIMR, signed at ICAR-IIMR during the year 2022. Dr Vilas A Tonapi, Director / Dr. CV Ratnavathi, Acting Director– IIMR on behalf of IIMR signed the agreements. The details are as follows:

S. No	Date of Agreement	Licensee/ Second party	Purpose/ License of	Signatory of Licensee	Witnessed by
1	03.01.22	TSSDC, Telangana	Production & Sale CSH 24 MF	Dr. K. Keshavulu, MD	Drs. Aruna C and J. Stanley
2	06.01.22	Ushodaya Enterprises, Telangana	Jowar Flakes thin	Ms. Geniya Banerjee, GM (Fin. & Acc.)	Drs. B. Dayakar Rao and J Stanley
3	10.01.22	Assam Agricultural University, Assam	Students Research	Dr. Ashok Bhattacharyya, Director (Res)	Drs. Madhusudhana R and J. Stanley
4	13.01.22	Retra Foods, Gujarat	Jowar & Bajra flakes	Mrs Rachna Sargam, Partner	Drs. B. Dayakar Rao and J Stanley
5	04 Feb., 2022	Nitrogen Parameters, Chennai	Leaf colour chart for Sorghum, Bajra, Finger millet	Mr. Benny Thomas, Managing Partner	Drs. J. Stanley and B. Gangaiah
6	22 Feb., 2022	National Institute of Rural Development and Panchayati Raj, Hyderabad	Research & Development	Dr. G. Narendra Kumar, DG, NIRDPR	Drs. V. Bhat, J. Stanley, Sangappa and H.S. Gawali
7	01.03.22	Sri-Bio Aesthetics, Hyderabad	Collaborative research on Microbiome	Dr. KRK Reddy, Founder, Director & CEO	Drs. Anuradha Narala and Rajesha G
8	25.03.22	Southern Health Foods, Chennai	Licensing for production and sale of little millet rice, barnyard millet rice and multi-millet cookies	Mr. Murugan Narayana Swamy, CEO	Drs. Dayakar Rao, J. Stanley
9	31.03.22	Sarva Seva Samity Sanstha, Kolkata	Licensing for production and sale of 6 value added millet products	Kumar Gaurav, Asst. Director (P)	Drs. Dayakar Rao, J. Stanley
10	21.04.22	Classic Hybrid Seeds Pvt Ltd., Ahmedabad	Licensing of fodder sorghum hybrid CSH24 MF for seed production and sale	Mr. Ashwin Kumar Patel Director & CEO	Drs. K Srinivasa Babu and J. Stanley
11	21.04.22	Manav Rachna International Institute of Research and Studies, Haryana	Joint research and promotion in millet especially millet diet	Prof. RK Arora, Registrar	Drs. B Dayakar Rao and J. Stanley
12	05.05.22	Banda University of Agriculture and Technology, Banda	Collaboration for research and promotion of millets including students research	Dr. N.P. Singh, Vice Chancellor	Drs. R Madhusudhana and J. Stanley
13	25.05.22	Medicover Cancer Institute, Hyderabad	For treating IIMR beneficiaries	Dr. Swapnil Rai, Centre Head	Dr. J Stanley
14	01.06.22	Shahushree Herbal Ayurvedic products, Solapur	Collaboration for Research and Extension	Mrs. Archana Ranware, Proprietor	Drs. Parashuram Patroti and J Stanley

S. No	Date of Agreement	Licensee/ Second party	Purpose/ License of	Signatory of Licensee	Witnessed by
15	08.06.22	UPAYAM Foundation, Hyderabad	Collaboration for millet FPO Promotion	Dr. Abhilash Varma, COO	Drs. K Srinivas Babu, Sangappa and J Stanley
16	16.06.22	Horticulture Produce Management Institute, UP	Collaboration for promotion of millets	Dr. Satyen Yadav, President	Drs. B Dayakar Rao and J Stanley.
17	18.06.21	Germanten Hospitals, Hyderabad	Treatment of IIMR Beneficiaries	Dr. Mir Jawed Zar Khan, Chairperson	Dr. J Stanley
18	18.06.22	Citizens Specialty Hospitals, Hyderabad	Treatment of IIMR Beneficiaries	Dr. Prabhakar Palacharla, Regional Director	Dr. J Stanley
19	18.06.22	Avani Ayurveda Pvt Ltd, Chhattisgarh	10 Millet Value added products	Mr. Mukesh K Agarwal, Prod. Manager	Drs. B Dayakar Rao and J. Stanley
20	28.06.22	Raichur, Ballari, Koppal & Vijayanagar Dist Coop Milk Producers Societies Union Ltd, Karnataka	Licensing of Forage Sorghum hybrid CSH 24 MF for seed production and sale	Dr. T. Thirupathappa, MD	Drs. AV Umakanth, B Venkatesh Bhat and J Stanley
21	02.07.22	Sanskriti University, Mathura, UP	Students Research	Dr. Sachin Gupta, Chancellor	Drs. R Madhusudhana and J. Stanley
22	07.07.22	Picante Foods, Pune, Maharashtra	Licensing of 9 millet value added products	Mr. A.K. Baldota, Founder	Drs. Dayakar Rao and J. Stanley
23	12.07.22	AND Technologies, Bengaluru, Karnataka	Jowar cookies and multi millet cookies	Mr. Samesh O. Thomas, Manager	Dr. J. Stanley
24	23.07.22	Green Protein Foundation, Mumbai	Collaborative research on plant proteins	Dr. Varun Deshpande, MD	Dr. J. Stanley
25	01.08.22	Vellore Institute of Technology, Tamil Nadu	Collaborative Research	Dr. T. Jayabarathi Registrar	Drs. Dayakar Rao and J. Stanley
26	01.08.22	Mahyco Pvt Ltd, Mumbai	Licensing of CSH 41 for seed production and sale	Dr. Chandrakumar Saragur, Business Head	Dr. J. Stanley
27	01.08.22	Mahyco Pvt Ltd., Mumbai	Licensing of CSH 39R for seed production and sale	Dr. Chandrakumar Saragur, Business Head	Dr. J. Stanley
28	01.08.22	University of Agricultural Sciences, Raichur	Collaborative Research incl students research	Dr. M. Veerangaunda, Registrar	Drs. R. Madhusudhana and J. Stanley
29	01.08.22	Nabhitha Engineering Pvt Ltd, Hyderabad	Promotion of millet processing machines	Ms. B. Radha, Director	Drs. K.S. Babu and Sangappa
30	19.08.22	Flipkart	Collaborative promotion and sale of FPO products	Mr. Rajneesh Kumar, Chief Corporate Affairs Officer	Drs. K.S. Babu and Sangappa
31	26.08.22	RR Solutions Pvt Ltd, Vijayawada	Licensing of 7 value added millet products	Mr. Prasanna Kumar G., Director	Dr. J. Stanley
32	29.08.22	Healthy soil, food and People, Punjab	Licensing of two value added millet products	Mr. Talwinder Singh, Director	Dr. Dayakar Rao

S. No	Date of Agreement	Licensee/ Second party	Purpose/ License of	Signatory of Licensee	Witnessed by
33	02.09.2022	DBT-National Agri-Food Biotechnology Institute, Punjab	Collaborative Research	Prof. Ashwani Pareek, Executive Director	Dr. J. Stanley
34	05.09.2022	Indian Farmers Fertilizer Cooperative (IFFCO)	FPO promotion	Mr. Praveer Srivastava, COO	Drs. Sangappa and Srinivasa Babu
35	07.09.2022	Indian Millet Association	Promotion of millets	Mr. P. Venkatesam, Project Director	Dr. J. Stanley & N Anuradha
36	07.09.2022	Shrishaila Enterprises, Bellari	Licensing of fodder sorghum hybrid, CSH 43MF for seed production and sale	Mr. M. Girimallana Gouda, Director	Dr. J. Stanley
37	08.09.2022	NRL seeds Pvt. Ltd.	Licensing of fodder sorghum hybrid, CSH 43MF for seed production and sale	Mr. Pankaj Garg, Director	Dr. J. Stanley
38	12.09.2022	ITC Ltd	Promotion of millets	Mr Rahul Gouraha,Head New Business	Dr. J. Stanley
39	22.09.2022	AVINASH, Visakhapatnam	Licensing of Jowar idli rawa, Finger millet vermicelli, Iron rich jowar pasta, Foxtail millet pasta, Zinc rich jowar vermicelli and Zinc rich jowar cookies	Mr. Pragnanand, Managing Partner	Drs. Dayakar Rao and J. Stanley
40	03.10.2022	CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur	Collaborative Research	Dr. H.K. Chaudhary Vice Chancellor	Drs. R. Madhusudhana and J. Stanley
41	21.10.2022	Jeevamrut Pvt Ltd, Hyderabad	FPO products promotion and sale	Mr. Mayur R Nar, Chief Executive Officer	Drs. Anuradha Narala and Sangappa
42	21.10.2022	ICICI foundation, Hyderabad	Training and collaborative promotion	Mr. Anuj Agarwal, COO	Drs. Anuradha Narala and Sangappa
43	28.10.2022	Mahyco Pvt Ltd, Mumbai, Maharashtra	Licensing of CSH 43MF for seed production and sale	Mr Chandrakumar Saragur, Business Head-Row Crops	Dr. J. Stanley
44	01.11.22	Hima Agro and Textiles, Hyderabad	Licensing of six value added products	Mr. M. Madhavan, Proprietor	Dr. J. Stanley
45	09.11.22	Ozone Hospitals, Hyderabad	Treatment of IIMRBeneficiaries	Mr. Y. Madhusudhan Reddy, Operational Director	Dr. J. Stanley
46	29.11.22	SSSB Natural Products, Hyderabad	Licensing of Barnyard millet puff and finger millet flakes	Smt. Gubba Sowmya, Managing Partner	Dr. Anuradha Narala
47	28.12.2022	Mulukanoor Women's Cooperative Dairy, Telangana	Licensing of CSH 43 MF for seed production and sale	Dr. M. Bhaskar, General Manager	Dr. J. Stanley

S. No	Date of Agreement	Licensee/ Second party	Purpose/ License of	Signatory of Licensee	Witnessed by
48	30.12.2022	CMS College of Science & Commerce, Coimbatore	Student Research	Dr. H. Balakrishnan Principal	Drs. R. Madhusudhana and J. Stanley
49	30.12.2022	HDFC Bank	Collaborative programs for promotion of millets	Mr. S. Sridhar, Regional Head (Rural)	Drs. K.Srinivas Babu and J Stanley

MoUs signed by Nutrihub, ICAR-IIMR for collaboration during 2022

Date	Second Party	Purpose
05.05.22	Dhuni Exim Pvt Ltd., Delhi	Technical knowledge partnership
11.05.22	Godrej Tyson Foods Ltd, Karnataka	Collaboration in processing and other research in millets
17.06.22	Ravi Foods Pvt Ltd., Telangana	Collaboration in processing and other research in millets
12.07.22	Vishra Agro Sales, Tamil Nadu	Collaboration for millet Processing machine
12.07.22	The Akshaya Patra Foundation	Collaborative millet promotion
18.07.22	Minkan Agro Industries Pvt Ltd., Hyderabad	Collaborative millet promotion
22.07.22	Sri Vithaldas Thackersey College of Home Science, Mumbai	Collaborative research and training
23.07.22	Green Protein Foundation, Mumbai	Collaborative research and promotion
28.07.22	IKP Knowledge Park, Hyderabad	Collaboration in IP protection and commercialisation
12.08.22	Carey Joehln International Pvt Ltd, Telangana	Joint development, co-branding and marketing of millet processing machinery
26.08.22	Entrepreneurship Cell, IIT Kharagpur	Co-incubation and promotion of millets
27.08.22	FICCI Ladies Organization, Hyderabad Chapter	Creating Women Entrepreneurs
05.09.22	ALS Testing Services India Pvt Ltd, Karnataka	Nutritional analysis
09.09.22	Dugitr Kadann Kutter, Hyderabad	Sale of Eatrite products
12.09.22	Hindustan Unilever Limited	Collaborative research and product development

MoU HPMI

MoU Upayam

Flipkart

Ballari Milk society

GOOD FOOD

NIRD

VIT

Advanta

16 Official Language Implementation

Hindi Chetana Maas Celebration

Hindi Chetana Maas was celebrated during 14 September – 13 October, 2022 at IIMR, Hyderabad. The programme was started with lightning the lamp by Dr. CV Ratnavathi, Director (Acting) on 26th September, 2022 at IIMR, Hyderabad. Total 10 various Hindi competitions such as Extempore, Noting & Drafting, Essay writing, Hindi Text Reading, Antyakshari, Quick recognition of Hindi Alphabets, Interview, Poster Presentation were held during the Hindi Chetana Maas. Scientists, Technical, Administrative personnel and RA, SRF etc. of the institute participated in the above competitions with great enthusiasm. Besides, there was a signature campaign in Hindi during the month, in which all the officers and employees signed their official documents in Hindi.

Prize distribution ceremony was organized on 20 October, 2022. The programme started with ICAR song. At the outset, Dr. Jinu Jacob, presented the report on official language implementation at IIMR during last year. Dr. Mahesh Kumar presented a report on the programmes organized during Hindi Chetana Mass & he expressed gratitude to the Director, OIC- Hindi Cell and all the officers of IIMR, Hyderabad for making the

event a grand success.

Dr. CV Ratnavathi distributed the cash prizes and certificates to the winners of various competitions and gave away the consolation prizes and certificates to the other participants. She also honored the judges and felicitators of the various competitions organized during Hindi Chetana Maas by presenting them Mementos & certificates. Besides this Dr. C V Ratnavathi gave a cash prize & Citation letter to Smt. Ritu Dalal, SAO as an incentive to promote official Language in routine official work.

Dr. Ratnavathii in her presidential address expressed happiness for more participation in the programmes organized during Hindi Chetana maas and said that our institute is ready to way forward for the implementation

of Official Language. The programme was concluded with vote of thanks by Dr. Mahesh Kumar. The above programme was coordinated by Dr. Jinu Jacob and Dr. Mahesh Kumar under the guidance of Dr C V Ratnavathi.

Hindi Workshops

Indian Institute of Millets Research, Hyderabad organized Four Hindi workshops on 10th March, 2021, 13th June, 2021, 28th September 2021 and 22nd December, 2022. Dr. Mahesh Kumar, Assistant Chief Technical Officer (OL), ICAR-IIMR, Hyderabad & subject experts from outside were delivered the lectures on the various aspects of Official Language Implementation & provided hands on trainings to the participants. The above workshops were coordinated by Dr. Jinu Jacob and Dr. Mahesh Kumar under the guidance of Dr. Vilas A Tonapi, Director & Dr. C V Ratnavathi, Director (Acting), IIMR.

Visit of Smt. Seema Chopra & Shri Manoj Kumar

Smt. Seema Chopra, Director (OL) & Shri Manoj Kumar, CTO (OL), Indian Council of Agricultural Research, New Delhi visited the ICAR-Indian Institute of Millets Research, Hyderabad on 18th June, 2022. Dr. C V Ratnavathi Director, ICAR-IIMR briefed them about Research and Development activities, besides the Official Language Implementation activities conducted at IIMR, Hyderabad. Smt. Seema Chopra suggested her to ensure Official Language Implementation, so that we do not unbalance during the inspection done by the Committee of Parliament on Official Language. She also suggested that all the boards & banners of the institute should be in trilingual/bilingual as per Official Language Rules. Dr. Mahesh Kumar, Assistant Chief Technical Officer (OL) was coordinated the visit.

Other Official Language Implementation Vactivities done at IIMR

Official Language Implementation of IIMR in Highlights: "Hindi Milap", "Swatantra Vaartha", "Shubha Labha", Rajbhasha Alok" etc. published the news regarding different activities related to Official Language Hindi & other programme organized at IIMR, Hyderabad.

Official Language Implementation Committee (OLIC) Meetings: The meetings of the OLIC were held during every quarter i.e. on 10th March, 2022, 28th June, 2022; 8th September, 2022 and 14th November, 2022. The committee reviewed the progress made in Official Language Implementation at IIMR and discussed the ways to improve it according to Department of Official Language targets.

Quarterly Progress Report of Official Language Hindi: The quarterly progress report of IIMR regarding progressive use of official language Hindi is being sent to the Regional Implementation Office (South), Dept. of Official Language, Bangalore, ICAR, New Delhi and TOLIC-Hyderabad-Secunderabad.

Hindi Edition of Annual Report: The IIMR Annual Report 2021 published in Hindi version also.

Publishing of IIMR News Letter in Hindi: IIMR Newsletters is publishing in Hindi version also.

IIMR Advertisement in Hindi: On the occasion of *Science Day* & *Hindi Divas* Two advertisements in Hindi were published in daily Hindi newspaper "Hindi Milap" & "Swatantra Vaartha" on 28th February, 2022 & on 14th September 2022.

Bilingual forms: The official forms used for various purposes in the IIMR were prepared in bilingual (Hindi and English) & uploaded on IIMR Server.

Hindi Roster: A roster was prepared on 'Hindi knowledge' of IIMR officers and employees and it is being updated regularly.

Hindi Learning Board: Daily one Hindi word, its pronunciation in English and its equivalent English word was written on Hindi Learning Board at IIMR premises and compiled. It was found very useful for increasing the Hindi vocabulary of IIMR staff.

NEW RELEASES

CSH 48 (SPH 1938)

Grain Yield : 38 q/ha.

Fodder yield : 40 q/ha

Maturity: 104 Days

Salient features: Semi long compact panicle with complete emergence of neck, non-lodging.

Recommended for: Karnataka, Tamil Nadu, Telangana, Madhya Pradesh, Rajasthan and Gujarat

CSV 50 (SPV 2612)
(Red Sorghum variety)

Grain Yield : 40 q/ha.
Fodder yield : 132 q/ha
Maturity: 110-118 Days
Salient features: Suitable for both kharif and rabi seasons. Semi long compact panicle with complete emergence of neck, non-lodging.
Recommended for: Karnataka, Telangana, Maharashtra under rainfed conditions.

CSV 52 SS (SPV 2697)
(Sweet Sorghum variety)

Fresh stalk yield: 49 q /ha.
Maturity: 120-123 Days
Salient features: Tan, semi-loose panicle with medium bold gray red seed with medium glumes.
Recommended for: Maharashtra Telangana, Tamil Nadu and Punjab.

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हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद
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Agrisearch with a human touch

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