Annual Report

2023

भाकृअनुप
ICAR

राअस्ट्रैप्रसं
NIASM

भाकृअनुप-राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान

ICAR-National Institute of Abiotic Stress Management

राअस्ट्रैप्रसं

NIASM

MISSION

Managing abiotic stresses for sustainable agriculture.

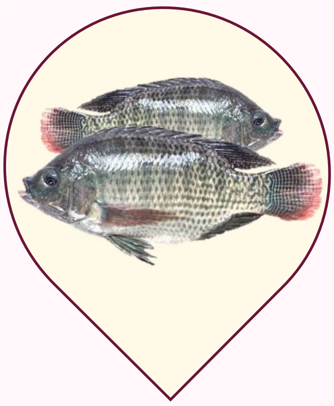
MANDATE

Basic & strategic research to manage abiotic stresses in crops, livestock & fisheries.

Repository of information on abiotic & biotic stresses, adaptation & mitigation strategies & policies.

Building sustainable agriculture in multi-stressed agro-ecosystems.

Serve as Center of Academic Excellence in managing multiple stresses in agriculture.



Annual Report 2023

वार्षिक प्रतिवेदन २०२३

Indian Council of Agricultural Research

NATIONAL INSTITUTE OF ABIOTIC STRESS MANAGEMENT

ISO 9001:2015

Malegaon, Baramati 413 115, Pune Maharashtra, India

https://niasm.icar.gov.in/

Citation
ICAR-NIASM Annual Report 2023, ICAR-National Institute of Abiotic Stress Management, Malegaon (Kh.), Baramati, Pune 413 115, Maharashtra, India.

Published by
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Preface

Climate change coupled with strong interactions of the natural, social and human systems is causing significant impacts on nature and people across sectors and regions. With the intensification of cascading impacts and compounded risks above 1.5°C warming, there is an increasing demand for adaptation and climate resilient development linked to achieving sustainable development goals. Furthermore, India, being a tropical country, is more vulnerable to a wide range of abiotic stresses, posing a serious threat to food and nutritional security. ICAR-NIASM has been working towards exploring scientific, technical and socio-economic solutions feasible and effective in addressing these challenges of climate change in agriculture.

During 2023, institute made significant achievements. To commemorate 'International Year of Millets', a national seminar on "Abiotic stress management for sustainable millet-based production systems" was organized, showcasing the potential of India in science led development of millet production. The event was attended by more than 400 delegates from sixteen states. This year marked the initiation of B.Sc. (Hons) Agriculture degree programme at IARI-NIASM, Baramati Hub, an important milestone in the journey of the institute.

Significant research outputs viz., developing abiotic stress information system, screening germplasms for abiotic stress tolerance, identifying tolerant rootstocks, developing package and practices for sustainable management for crop, fruit, medicinal and forest species as well as fish, cattle and poultry, conservation of natural resources, improving resource use efficiency, isolation of endophytes and their potential application for abiotic stress mitigation, abiotic and biotic stress interactions are highlighted in this document. It also provides a detailes of 168 institute publications and software packages (100research papers, 05 review papers, 04 books, 04 technical bulletins, 22 book chapters, 29 popular articles and extension folders and 04 software packages), teaching, extension, linkages and other collaboration activities.

I sincerely thank Dr H Pathak, Secretary (DARE) & Director General (ICAR); Shri Sanjay Garg, Additional Secretary (DARE) & Secretary (ICAR); Ms. Alka Nangia Arora, Additional Secretary (DARE) & Financial Advisor (ICAR); Dr Suresh Kumar Chaudhari, Deputy Director General (Natural Resource Management); Dr A Velmurugan Assistant Director General (Natural Resource Management) and Dr Rajbir Singh, Assistant Director General (Agronomy, Agro-forestry and climate change) for their continued support and guidance. I also acknowledge the guidance and support received from Dr B Venkatswarlu, Chairman and other esteemed members of Research Advisory Committee; members of Institute Management Committee and Institute Research Council. The support of state agriculture departments, farmers, KVKs and the funding agencies is also gratefully acknowledged. I sincerely thank the Heads of the Schools; Scientists; Technical, Administration and Finance staff of the institute for their wholehearted efforts and dedication in carrying out the activities of the institute.

I also appreciate the efforts made by the members of Publication Committee in compiling this document. I sincerely hope that this will be useful for researchers, policymakers, development functionaries, farmers, students and other stake holders.

Date: 31-12-2023 **(K Sammi Reddy)**
Baramati **Director**

प्रस्तावना

प्राकृतिक, सामाजिक और मानवीय प्रणालियों की मजबूत अंतःक्रिया के साथ जलवायु परिवर्तन, विभिन्न क्षेत्रों और क्षेत्रों में प्रकृति और लोगों पर अपरिवर्तनीय प्रभाव डाल रहा है। १.५ डिग्री सेल्सियस से ऊपर बढ़ते प्रभावों और जटिल जोखिमों की तीव्रता के साथ, सतत विकास लक्ष्यों को प्राप्त करने से जुड़े अनुकूलन और जलवायु लचीले विकास की मांग बढ़ रही है। भारत, एक उष्णकटिबंधीय देश होने के नाते, विभिन्न प्रकार के अजैविक तनावों के प्रति अधिक संवेदनशील है, जो इसकी बढ़ती आबादी की खाद्य और पोषण सुरक्षा के लिए एक गंभीर खतरा है। इस संदर्भ में, आईसीएआर-राष्ट्रीय अजैविक तनाव प्रबंधन संस्थान नवनवीन वैज्ञानिक, तकनीकी और सामाजिक-आर्थिक ज्ञान खोजने की दिशा में काम कर रहा है जो कृषि में जलवायु परिवर्तन की चुनौतियों से निपटने में व्यवहार्य और प्रभावी रहेंगे।

२०२३ के दौरान, संस्थान ने कुछ महत्वपूर्ण उपलब्धियाँ हासिल कीं। 'अंतर्राष्ट्रीय पोषक अनाज वर्ष २०२३' मनाने के लिए, संस्थान ने वैश्विक स्तर पर पोषक अनाज उत्पादन के विकास में भारत की क्षमता को प्रदर्शित करने का एक अनूठा अवसर प्रदान करने के लिए "टिकाऊ पोषक अनाज-आधारित उत्पादन प्रणालियों के लिए अजैविक तनाव प्रबंधन" पर एक राष्ट्रीय सेमिनार का आयोजन किया। इस कार्यक्रम में सोलह राज्यों के करीब ४०० प्रतिनिधियों ने भाग लिया और यह संस्थान के लिए एक बड़ी सफलता रही। संस्थान ने IARI-NIASM, बारामती हब के अंतर्गत बीएससी एग्रीकल्चर की पढ़ाई सुरू कर एक अन्य महत्वपूर्ण मील का पार किया।

महत्वपूर्ण अनुसंधान परिणाम जैसे, अजैविक तनाव सूचना प्रणाली को संकलित और विकसित करना, अजैविक तनाव सहिष्णुता के लिए जर्मप्लाज्म की जांच करना, सहनशील रूटस्टॉक्स की पहचान करना, फसल, फल, औषधीय और वन प्रजातियों के साथ-साथ मछली, मवेशी और मुर्गी पालन के लिए टिकाऊ प्रबंधन के लिए पैकेज और प्रथाओं का विकास करना जैसे काम किए। इस वार्षिक रिपोर्ट में प्राकृतिक संसाधनों का संरक्षण, संसाधन उपयोग दक्षता में सुधार, एंडोफाइट्स का अलगाव और अजैविक तनाव शमन के लिए उनके संभावित अनुप्रयोग, अजैविक और जैविक तनाव इंटरैक्शन पर प्रकाश डाला गया है। यह वार्षिक रिपोर्ट २०२३ के दौरान बहु-विषयक शोधकर्ताओं के कार्य, शिक्षण, विस्तार, संस्थागत निर्माण और अन्य सहायक गतिविधियों पर प्रकाश डालती है, जिसमें प्रमुख अनुसंधान कार्यक्रमों के तहत की गई अनुसंधान गतिविधियों का विवरण शामिल है। संस्थान ने इस वर्ष १०० शोध पत्र, ५ समीक्षा पत्र, २९ तकनीकी लेख, ४ पुस्तक, २२ पुस्तक अध्याय, ४ तकनीकी बुलेटिन, २९ तकनीकी/विस्तार फोल्डर एवं ४ सॉफ्टवेर पैकेज प्रकाशित किए हैं।

मैं आभारी हूँ डॉ हिमांशु पाठक, सचिव (कृषि४ अनुसंधान एवं शिक्षा विभाग) एवं महानिदेशक (भाकृअनुप); श्री संजय गर्ग, अतिरिक्त सचिव (कृषि अनुसंधान एवं शिक्षा विभाग) एवं सचिव (भाकृअनुप), शुश्री अलका नांगिया अरोड़ा, अतिरिक्त सचिव (कृषि अनुसंधान एवं शिक्षा विभाग) एवं वित्त सलाहकार (भाकृअनुप), डॉ ए वेलमुरुगन, उप महानिदेशक (प्राकृतिक संसाधन प्रबन्धन) और डॉ. राजबीर सिंह, सहायक महानिदेशक (कृषि विज्ञान, कृषि-वानिकी और जलवायु परिवर्तन) इनका उनके निरंतर समर्थन और मार्गदर्शन के लिए। मैं आभारी हूँ संस्थान की संस्थान प्रबंधन समिति (आईएमसी) और संस्थान अनुसंधान परिषद (आईआरसी) के सदस्य। राज्य कृषि विभागों, किसानों, केवीके और फंडिंग एजेंसियों के समर्थन को कृतज्ञतापूर्वक स्वीकार किया जाता है। मैं संस्थान की गतिविधियों को अंजाम देने के लिए स्कूलों के प्रमुख, वैज्ञानिक, तकनीकी, प्रशासन और वित्त कर्मचारियों को उनके पूरे दिल से प्रयास और समर्पण के लिए दिल से धन्यवाद देता हूं। मैं इस दस्तावेज़ को संकलित करने में प्रकाशन समिति के सदस्यों द्वारा किए गए प्रयासों की भी सराहना करता हूं।

ksreddy

दिनांक : ३१-१२-२०२३
बारामती

(के सम्मी रेड्डी)
निदेशक

Executive Summary/ कार्यकारी सारांश

During the year 2023, various experiments were conducted under the Institute, Umbrella and Flagship projects and also under externally funded projects. The outreach programmes were also carried under Development Action Plan for Schedule Caste (DAPSC) and Tribal Sub-Plan (TSP). The achievements of all the above activities and others are briefly highlighted below.

वर्ष 2023 के दौरान संस्थान, अंब्रेला और फ्लैगशिप परियोजनाओं के तहत और बाह्य वित्तपोषित परियोजनाओं के तहत भी विभिन्न प्रयोग किए गए। आउटरीच कार्यक्रम भी अनुसूचित जाति के लिए विकास कार्य योजना (डीएपीएससी) और जनजातीय उप-योजना (टीएसपी) के तहत किए गए थे। उपरोक्त सभी गतिविधियों की उपलब्धियों और अन्य को संक्षेप में नीचे हाइलाइट किया गया है।

- The prototype of Ambience Monitor v1.0 developed to monitor the ambient temperature, relative humidity, wind speed, and solar radiation showed 95% statistical limits of agreement with measurement of standard instruments.

- परिवेश के तापमान, सापेक्ष आर्द्रता, हवा की गति और सौर विकिरण की निगरानी के लिए विकसित परिवेश मॉनिटर v 1.0 का प्रोटोटाइप माप के मानक उपकरणों की तुलना में 95% सहमती की सांख्यिकीय सीमाएं दिखाता है।

- In an investigation carried to assess the function role of the *Omega-3 Fatty Acid Desaturase gene from Glycine max*, it was found that GmFAD3A over-expressing soybean plants exhibited tolerance while GmFAD3-silenced plants were vulnerable to drought and salinity stresses

- ग्लाइसिन मैक्स (GmFAD3) से ओमेगा-3 फैटी एसिड डेसाचुरेज़ जीन की कार्य भूमिका का आकलन करने के लिए की गई एक जांच में यह पाया गया कि सोयाबीन के पौधों को अधिक व्यक्त करते हुए सहयता का प्रदर्शित की, जबकि GmFAD3 साइलेंट पौधे सूखे और लवणता के तनाव के प्रति संवेदनशील थे।

- In an investigation, it was found that the presence of anaemia is indicative of multiple stress in goats. An herbal formulation has been prepared for the treatment of anaemia in goats and is being evaluated for its efficacy in mitigating impact of multiple abiotic stressors in goats.

- एक जांच में, यह पाया गया कि एनीमिया (खून की कमी) से पीड़ित बकरियों में कई प्रकार के तनाव की उपस्थिती है। बकरियों में एनीमिया के इलाज के लिए एक हर्बल फार्मूलेशन तैयार किया गया है और बकरियों में कई अजैविक तनावों के प्रभाव को कम करने में इसकी प्रभावकारिता के लिए मूल्यांकन किया जा रहा है।

- An assessment of fodder scenario and sugarcane tops (STs) utility in Maharashtra revealed potential of STs use as green fodder (during Oct-Mar) or as mixed silage with 50% composition (across the year), in feeding about 50-70% of livestock population across Kolhapur, Pune, Satara & Solapur; 30-50% in Sangli, Ahmednagar &

- महाराष्ट्र में चारे के परिदृश्य और गन्ने के शीर्ष (एससीटी) की उपयोगिता के आकलन से पता चला कि एससीटी द्वारा हरे चारे (अक्टूबर-मार्च के दौरान) या 50% संरचना (वर्ष भर) के साथ मिश्रित साइलेज के रूप में उपयोग की संभावना है। इससे कोल्हापुर, पुणे, सातारा और सोलापुर में लगभग 50-70% पशुधन आबादी को खिलाने में मदद मिल सकती है; तथा सांगली, अहमदनगर और लातूर में 30-50%, 7

Latur, 10-30% in 7 districts and less than 10% in remaining 15 districts producing sugarcane.

जिलों में 10-30% और शेष 15 जिलों में 10% से कम तक चारा खिला सकते है।

- A soil chemical quality index that classifies the soil into four levels of fertility classes was developed. The approach can be used for getting insights into fertility status at sampled and unsampled locations of Haryana.
- मृदा रासायनिक गुणवत्ता सूचकांक विकसित किया गया जो मिट्टी को उर्वरता वर्गों के चार स्तरों में वर्गीकृत करता है। इस दृष्टिकोण का उपयोग हरियाणा राज्य के नमूनाकृत और अप्रतिदर्शित स्थानों पर मिट्टी की उर्वरता स्थिति की जानकारी प्राप्त करने के लिए किया जा सकता है।
- Trench planting with a soil mixture of clay black soil and sandy loam native soil at a 1:1 ratio exhibited higher yield of more than 9.3 t ha^{-1} from 8 year old pomegranate trees.
- 1:1 के अनुपात में चिकनी काली मिट्टी और रेतीली दोमट मिट्टी के मिश्रण के साथ खाई में रोपण से आठ साल पुराने अनार के पेड़ों से 9.3 टन प्रति हेक्टेयर से अधिक की उच्च उपज देखी गई।
- Overall cost of cultivation, gross income, net returns and B:C ratio in the Climate-resilient integrated farming model of one hectare for semi-arid regions was Rs. 282262, 379109, 96845 and 1.34, respectively.
- अर्ध-शुष्क क्षेत्रों के लिए एक हेक्टेयर के जलवायु-लचीला एकीकृत कृषि मॉडल में खेती की कुल लागत (रु 282262), सकल आय (379109), शुद्ध लाभ (96845) और लाभ लागत अनुपात, (1.34) मिला है।
- The carbon footprints calculations of wheat and rabi sorghum cultivation in problematic soils using online ‘Cool farm tool’ revealed increase in Total GHG emissions and its intensity with increasing fertilizer applications, and fertilizer doses.
- ऑनलाइन 'कूल फार्म टूल' का उपयोग करके समस्याग्रस्त मिट्टी में गेहूं और रबी ज्वार की खेती की कार्बन पदचिह्न गणना से कुल जीएचजी उत्सर्जन में वृद्धि और उर्वरक अनुप्रयोगों और उर्वरक खुराक में वृद्धि के साथ इसकी तीव्रता का पता चला।
- Net income of Rs. 10779 and B:C ratio of 1.15 was obtained for multilayer integrated farming system model of 0.12 ha.
- बहुस्तरीय एकीकृत कृषि प्रणाली मॉडल से रु 10779 शुद्ध आय और 1.15 का लाभ लागत अनुपात 0.12 हेक्टेयर से प्राप्त किया गया।
- B:C ratio of 2.52, was obtained along with gross water productivity of 9.07 Rs. m-3 for the self-sustaining goat farming model for small and marginal farmers.
- छोटे और सीमांत किसानों के लिए आत्मनिर्भर बकरी पालन मॉडल से 2.52 का लाभ लागत अनुपात और रु 9.07 प्रति घन मिटर की सकल जल उत्पादकता के साथ प्राप्त किया गया था।
- Maintaining 100 cm cutting height for intercropped Leucaena across cutting cycles, enhances overall fodder production per plant as compared to sole Leucaena cultivation or maintaining 50 cm cutting height across cutting cycles.
- कटाई चक्रों में अंतरफसल ल्यूकेना के लिए 100 सेमी कटाई की ऊंचाई पर काटने से प्रति पौधे समग्र चारा उत्पादन को एकमात्र ल्यूकेना खेती और 50 सेमी कटाई की ऊंचाई से अधिक बढ़ाता है
- Optimization studies on sowing time for Chia revealed that early sowing at ICAR-NIASM from July produced more biomass and took a longer duration for flowering and maturity. High temperatures and
- चिया के लिए बुआई के समय पर अनुकूलन अध्ययन से पता चला कि जुलाई से आईसीएआर-एनआईएएसएम में शुरुआती बुआई से अधिक बायोमास पैदा हुआ और फूल आने और पकने में लंबी अवधि लगी।

bright sunshine hours delayed flowering while sowing Chia beyond 15th December is uneconomical due to partial flowering and low yield.

- उच्च तापमान और तेज़ धूप के घंटों के कारण फूल आने में देरी होती है जबकि आंशिक फूल आने और कम उपज के कारण 15 दिसंबर के बाद चिया की बुआई करना अलाभकारी है।

- The Constructed wetland and integrated aquaponics system designed system showed removal capacity of >95% for pathogenic microbial loads (viz. faecal coliform and E.coli), >90% for heavy metals (viz. Fe, Mn, Zn, Cu, Ni, Cd), >80% in organic loads (BOD) and for salts in saline groundwater EC 25%, sodium 38%, Ca+Mg 34%, bicarbonate 83%, chloride 43% and nitrate 74% in 48 hrs of hydraulic retention time and with 5-10% evapotranspiration losses of water.

- निर्मित आर्द्रभूमि और एकीकृत एक्वापोनिक्स प्रणाली द्वारा डिज़ाइन की गई प्रणाली ने रोगजनक माइक्रोबियल भार (जैसे मल कोलीफॉर्म और ई.कोली) के लिए >95%, भारी धातुओं (जैसे Fe, Mn, Zn, Cu, Ni,Cd) के लिए >90%, >80% कार्बनिक भार (बीओडी) में और खारे भूजल में लवण के लिए 25% ईसी, 38% सोडियम, 34% कैल्सियम +मैग्नीशियम, 83% बाइकार्बोनेट, 43% क्लोराइड और 74% नाइट्रेट हाइड्रोलिक प्रतिधारण समय के 48 घंटे में और 5-10% वाष्पीकरण-उत्सर्जन हटाने की क्षमता दिखाई।

- Zn-containing diet at 10 mg kg^{-1} diet improved the regulation of the stress-related genes, enhancing resilience of fish to multiple stressors and infections in fish.

- 10 मिलीग्राम प्रति किलोग्राम जिंक युक्त आहार से तनाव से संबंधित जीन के नियमन में सुधार हुआ, जिससे मछली में कई तनावों और संक्रमणों के प्रति मछली की प्रतिरोधक क्षमता बढ़ गई।

- Nickel alone and concurrent with high temperature (34 °C) leads to dysfunctional gene and metabolic regulation affecting physiology and genotoxicity in *Pangasianodon hypophthalmus*.

- निकेल के एकल अथवा उच्च तापमान (34° सेल्सियस) के साथ समकालिक संपर्क से पांगासियानोडॉन हाइफोफथाल्मस में निष्क्रिय जीन और उपादात्मक नियंत्रण में कमी होती है, जिससे शारीरिकता और जीनोटॉक्सिसिटी प्रभावित होती है।

- The manganese nanoparticles (Mn-NPs) enriched diet helps in downregulation of cortisol and HSP 70 gene expression, indicating their potential to mitigate stress responses in *Pangasianodon hypophthalmus*.

- मैंगनीज नैनोपार्टिकल्स (एमएन-एनपी) समृद्ध आहार कोर्टिसोल और एचएसपी 70 जीन अभिव्यक्ति को कम करने में मदद करता है, जो पैंगासियानोडॉन हाइपोफ्थल्मस में तनाव प्रतिक्रियाओं को कम करने की क्षमता को दर्शाता है।

- Replacing 25% of fish meal with quinoa husk was found to improve the gene regulation of *P. hypophthalmus* involved in mitigating ammonia, arsenic, and high-temperature stress in fish.

- मछली के आहार का 25% क्विनोआ हस्क के साथ परिवर्तन से पाया गया कि पैंगासियानोडॉन हाइपोफ्थल्मस की जीन नियंत्रण में सुधार हुआ, जो मछली में अमोनिया, आर्सेनिक, और उच्च तापमान की स्थिति को कम करने में शामिल है।

- Soybean intercropping with sugarcane in spring season is a potential strategy to expand the soybean area under cultivation without much loss in the sugarcane yield and also to bring climate resilience to soybean production

- वसंत ऋतु में गन्ने के साथ सोयाबीन की खेती एक संभावनात्मक रणनीति है जिससे सोयाबीन क्षेत्र को विस्तारित करने का कोई अधिक हानि नहीं होती है और साथ ही साथ गन्ने की पैदावार में भी कमी नहीं होती है, और सोयाबीन उत्पादन में जलवायु सहिष्णुता भी लाई जा सकती है।

- Higher chia seed yield of 635-658 kg ha^{-1} can be optimaly produced at spacing (50 ×

- 635-658 किलोग्राम हेक्टेयर-1 की उच्च चिया बीज उपज उथली बेसाल्टिक मिट्टी पर अंतर (50 × 30

30 cm) and nutrient application (110:75:95 kg NPK ha^{-1}) on shallow basaltic soils.

सेमी) और पोषक तत्व अनुप्रयोग (110:75:95 किलोग्राम एनपीके/हेक्टेयर) पर इष्टतम रूप से उत्पादित की जा सकती है।

- A survey of dragon fruit orchards from various districts of Maharashtra revealed that stem canker is a prevalent fungal disease in dragon fruit cultivation in Maharashtra, primarily affecting *H. undatus*, *H. polyrhizhus*, and *H. megalanthus*

- महाराष्ट्र के विभिन्न जिलों के ड्रैगन फ्रूट उद्यानों का सर्वेक्षण ने दिखाया कि स्टेम कैंकर ड्रैगन फ्रूट के खेती में एक प्रमुख कवक रोग है, जो मुख्य रूप से एच. अंडेटस, एच. पॉलीराइजस, और एच. मेगालैंथस को प्रभावित करता है।

- Pigeonpea genotypes ICP-16309, ICP-7148, ICP-8255, ICP-6845, ICP-6815, ICP-10228, ICP-6370, ICP-10397, ICP-4903, ICP-7869, ICP-7507, NAM-2282 and NAM-314 were found waterlogging tolerant at seed and early seedling stage and better than check genotype MAL15.

- अरहर के जीनोटाइप ICP-16309, ICP-7148, ICP-8255, ICP-6845, ICP-6815, ICP-10228, ICP-6370, ICP-10397, ICP-4903, ICP-7869, ICP-7507, NAM-2282 और NAM-314 को बीज और प्रारंभिक अंकुर अवस्था में जल भराव के प्रति सहनशील और चेक जीनोटाइप MAL15 से बेहतर पाया गया।

- Among 48 pigeonpea genotypes screened for deficit moisture stress at the early vegetative stage, ICPX140203-B-2 recorded significantly higher biomass, while IC73959 could retain higher tissue water content.

- प्रारंभिक वनस्पति चरण में नमी की कमी के तनाव के लिए जांचे गए अरहर के 48 जीनोटाइपों में से, ICPX140203-B-2 में काफी अधिक बायोमास दर्ज किया गया, जबकि IC73959 उच्च ऊतक जल सामग्री को बनाए रख सकता है।

- High-temperature stress tolerant germplasms of cowpea were identified for specific traits among the 250 cowpea germplasm collections compared with five checks during two year screening trials at ICAR-NIASM and ICAR-NBPGR RS Jodhpur.

- आईसीएआर-एनआईएएसएम और आईसीएआर-एनबीपीजीआर आरएस जोधपुर में दो साल के स्क्रीनिंग परीक्षणों के दौरान पांच जांचों की तुलना में 250 लोबिया जर्मप्लाज्म संग्रहों के बीच विशिष्ट लक्षणों के लिए लोबिया के उच्च तापमान तनाव सहिष्णु जर्मप्लाज्म की पहचान की गई।

- Among 50 diverse cowpea germplasm selected from minicore collections and screened for tolerance to deficit moisture stress at seedling stage, genotype EC240861 maintained higher biomass and IC488240 retained higher tissue water content.

- मिनीकोर संग्रहों से चुने गए 50 विविध लोबिया जर्मप्लाज्म में से और अंकुर चरण में नमी की कमी के तनाव के प्रति सहनशीलता के लिए जांच की गई, जीनोटाइप EC240861 ने उच्च बायोमास बनाए रखा और IC488240 ने उच्च ऊतक जल सामग्री बरकरार रखी।

- Three significant QTLs on chromosome 7 (qNIR30-7.8) associated with tissue water content and qDA25-9.2, qDA30-9.3 on chromosome 9 associated with higher digital plant area of rice were identified under weed competition conditions.

- ऊतक जल सामग्री से जुड़े गुणसूत्र 7 (qNIR30-7.8) पर तीन महत्वपूर्ण क्यूटीएल और चावल के उच्च डिजिटल संयंत्र क्षेत्र से जुड़े गुणसूत्र 9 पर qDA25-9.2, qDA30-9.3 की पहचान खरपतवार प्रतिस्पर्धा स्थितियों के तहत की गई थी।

- Potential, unique mutants in chia were identified and segregated in M4 generation across four multi-location trials to confirm

- चिया में संभावित, अद्वितीय उत्परिवर्तकों की पहचान की गई और संबंधित पहचाने गए लक्षणों की स्थिर

the stable expression of respective identified traits.

अभिव्यक्ति की पुष्टि करने के लिए चार बहु-स्थान परीक्षणों में एम-4 पीढ़ी में अलग किया गया।

- Differential floral morphological and behavioural traits were found to be linked to delayed and partial pollination in dragon fruit, particularly in white fleshed varieties.

- विभेदक पुष्प आकृति विज्ञान और व्यवहार संबंधी लक्षणों को ड्रैगन फल में विलंबित और आंशिक परागण से जोड़ा गया था, विशेष रूप से सफेद मांसल किस्मों में।

- Among 118 accessions of foxtail millet evaluated under low N shallow basaltic gravelly soils at ICAR-NIASM, for physiological and phenotypic responses, FXM 70, FXM 74, FXM 21, FXM 6, FXM 34, and FXM 39 (NIASM codes) were found to be better performing genotypes across multiple traits and therefore yield under nitrogen stress.

- आईसीएआर-एनआईएएसएम में, शारीरिक और फेनोटाइपिक प्रतिक्रियाओं के लिए कम नाइट्रोजन वाली उथली बेसाल्टिक बजरी वाली मिट्टी के तहत कंगनी के 118 संयोजनों का मूल्यांकन किया गया, जिनमें एफएक्सएम 70, एफएक्सएम 74, एफएक्सएम 21, एफएक्सएम 6, एफएक्सएम 34 और एफएक्सएम 39 (एनआईएएसएम कोड) शामिल हैं। ये जीनोटाइप कई लक्षणों में उत्कृष्ट प्रदर्शन करने के लिए पहचाने गए हैं और इसलिए नाइट्रोजन तनाव के तहत उपजने के लिए उपयुक्त हैं

- Among 48 groundnut genotypes evaluated for drought tolerance at pre- and post-flowering stages, ICG – 4543, ICG - 3673, ICG – 3102, ICG - 3584, ICG - 1519, ICG - 6703, ICG – 11249, ICG – 14127 and ICG – 4684 were found to be tolerant.

- फूलों से पहले और बाद के चरणों में सूखा सहिष्णुता के लिए मूल्यांकन किए गए मूंगफली के 48 जीनोटाइप में आईसीजी-4543, आईसीजी-3673, आईसीजी-3102, आईसीजी-3584, आईसीजी-1519, आईसीजी-6703, आईसीजी-11249, आईसीजी-14127 और आईसीजी-4684 सहिष्णु पाए गए।

- Drought and heat stress were found to have the most detrimental impact on overall plant growth, development and yield of chia, specifically during the grain filling stage in the pot experiment conditions.

- सूखा और गर्मी के तनाव का चिया के समग्र पौधे की वृद्धि, विकास और उपज पर सबसे हानिकारक प्रभाव पाया गया, विशेष रूप से पॉट प्रयोग स्थितियों में अनाज भरने के चरण के दौरान।

- Candidate microorganisms (endophytes and mineral (Zn, K, Mn and P) solubilizing microbes) for management of moisture deficit and nutrient stress in different crops (Quinoa, Chia, Dragon fruit and Sugarcane) of arid and semi-arid tropics were isolated and evaluated both in potted and field conditions.

- शुष्क और अर्ध-शुष्क उष्णकटिबंधीय की विभिन्न फसलों (क्विनोआ, चिया, ड्रैगन फ्रूट और गन्ना) में नमी की कमी और पोषक तत्वों के तनाव के प्रबंधन के लिए उम्मीदवार सूक्ष्मजीवों (एंडोफाइट्स और खनिज जैसे की ज़िंक, पॉटेशियम, मंगेनीज अँड फोसपोरस के, घुलनशील रोगाणु) को अलग किया गया और नर्सरी और क्षेत्रीय स्थितियों में मूल्यांकन किया गया।

- Among five different wild eggplant species, used as rootstock compared to non-grafted eggplants, the eggplant grafted on *S. sisymbriifolium* rootstock gave 40% higher and *S. torvum* rootstocks gave 21% higher yield under water deficit stress (0.6 ETc); while *S. macrocarpon* and *S. torvum* rootstocks under ECiw 6 ds m^{-1} exhibited a

- गैर-ग्राफ्टेड बैंगन की तुलना में रूटस्टॉक के रूप में उपयोग की जाने वाली पांच अलग-अलग जंगली बैंगन प्रजातियों में से, एस. सिसिम्ब्रीफोलियम रूटस्टॉक पर ग्राफ्ट किए गए बैंगन ने 40% अधिक उपज दी और एस. टोर्वम रूटस्टॉक्स ने पानी की कमी के तनाव (0.6 ईटीसी) के तहत 21% अधिक उपज दी; जबकि ईसीआईडब्ल्यू 6 डीएस एम-1 के तहत एस. मैक्रोकार्पोन और एस. टोर्वम रूटस्टॉक्स ने गंभीर

twofold higher K:Na ratio under severe salinity stress.

लवणता तनाव के तहत दो गुना अधिक K:Na अनुपात प्रदर्शित किया।

- Among the eight promising early maturing genotypes of chickpea, IPC 06-11, MNK-1, JG-14 and ICE 15654-A exhibited early maturity in a temperature range of 41.4/9.3 °C with photoperiods of 13.1/10.9 h in all seasons throughout the year along with heritability of 60%, therefore can be used as donor aids in developing early maturing, drought stress tolerant and photothermo-insensitive chickpeas.

- चने की आठ आशाजनक शीघ्र परिपक्व होने वाली जीनोटाइप में से आईपीसी 06-11, एमएनके-1, जेजी-14 और आईसीई 15654-ए ने सभी मौसमों में 13.1/10.9 घंटे की फोटो अवधि के साथ 41.4/9.3 डिग्री सेल्सियस के तापमान रेंज में प्रारंभिक परिपक्वता प्रदर्शित की। 60% की आनुवंशिकता के साथ पूरे वर्ष भर, इसलिए इसे जल्दी पकने वाले, सूखा तनाव सहिष्णु और फोटोथर्मो-असंवेदनशील चने के विकास में दाता सहायता के रूप में उपयोग किया जा सकता है।

- Genotypes EC932021, IPR8-21, IPR6-21, and IPR236-20 of common bean exhibited stable performance across all seasons of during 2022, demonstrating shorter duration and higher yield, regardless of the varying climatic conditions.

- सामान्य बीन के जीनोटाइप EC932021, IPR8-21, IPR6-21, और IPR236-20 ने 2022 के सभी मौसमों में स्थिर प्रदर्शन प्रदर्शित किया है, जो अलग-अलग जलवायु परिस्थितियों की परवाह किए बिना कम अवधि और उच्च उपज का प्रदर्शन करता है।

- Silver nanoparticles (AgNPs) were synthesized through a green method utilizing a plant extract derived from Parthenium hysterophorus and characterized using TEM, SEM, FTIR techniques.

- सिल्वर नैनोकणों (एजीएनपी) को पार्थेनियम हिस्टेरोफोरस से प्राप्त पौधे के अर्क का उपयोग करके हरित विधि के माध्यम से संश्लेषित किया गया और टीईएम, एसईएम, एफटीआईआर तकनीकों का उपयोग करके चित्रित किया गया।

- Among garlic cultivars Cv. Godavari, Cv. Phule Baswant, Cv. Local–1, Cv. Bhima Purple, Cv. GG–4, and Cv. Local– 2, Cv. Godavari showed higher tolerance to water deficit stress along with improvement in physiological and functional quality traits, and therefore suggested for cultivation in water deficit regions.

- लहसुन की गोदावरी, फुले बसवंत, लोकल-1, भीमा पर्पल, जीजी-4, और लोकल-2 किस्मों में गोदावरी ने शारीरिक और कार्यात्मक गुणवत्ता लक्षणों में सुधार के साथ-साथ पानी की कमी के तनाव के प्रति उच्च सहनशीलता दिखाई, और इसलिए पानी की कमी वाले क्षेत्रों में खेती का सुझाव दिया गया।

- Highest cane yields of 157.1 t ha^{-1} was obtained in reduced tillage under 75% ETc with live trash mulching and exogenous application irradiated chitosan (5 ml L^{-1}) for first harvest of C0-86032 in experimental plots of ICAR-NIASM.

- आईसीएआर-एनआईएएसएम के प्रायोगिक क्षेत्रो में को-86032 की पहली फसल के लिए लाइव ट्रैश मल्चिंग और एक्सोजेनस एप्लीकेशन इरेडिएटेड चिटोसन (5 एमएल प्रति लीटर) के साथ 75% ईटीसी के तहत कम जुताई में 157.1 टन प्रति हेक्टेयर की गन्ने की उच्चतम पैदावार प्राप्त की गई।

- For sustained sugarcane productivity, higher cane yield, soil C retention and soil microbial activity, reduced tillage, residue retention and 50-75 % recommended dose of fertilizer as basal is recommended.

- निरंतर गन्ना उत्पादकता, उच्च गन्ना उपज, मिट्टी कार्बन प्रतिधारण और मिट्टी माइक्रोबियल गतिविधि, कम जुताई, अवशेष प्रतिधारण और बेसल के रूप में उर्वरक की 50-75% अनुशंसित मात्रा की सिफारिश की जाती है।

- Among the different zigzag paired row (ZPR) with sub-surface drip irrigation (SSDI) and crop residue retention (S) practices, the treatments M6S1 i.e. ZPR–225 cm × 75 cm + SSDI (M6) resulted in higher cane yields (20.4%) and groundnut yield (18%) as compared to PSR (150 cm) + surface irrigation (SI) methods (M1) i.e. farmer's practice.
- उप-सतह ड्रिप सिंचाई (एसएसडीआई) और फसल अवशेष प्रतिधारण (एस) प्रथाओं के साथ विभिन्न ज़िगज़ैग युग्मित पंक्ति (जेडपीआर) के बीच, उपचार M6S1 जेडपीआर-225 सेमी × 75 सेमी + एसएसडीआई (एम 6) के परिणामस्वरूप पीएसआर (150 सेमी) + सतह सिंचाई (एसआई) विधियों (एम 1) की तुलना में अधिक गन्ना पैदावार (20.4%) और मूंगफली की पैदावार (18%) हुई। किसान का अभ्यास।
- Custard apple harvested at A50 (50% areoles opening) stage was found to be best when considering physicochemical and surface temperature of fruits.
- फलों के भौतिक-रासायनिक और सतह के तापमान पर विचार करते समय ए 50 (50% एरोल ओपनिंग) चरण में काटा गया सीताफल सबसे अच्छा पाया गया।
- The B:C ratio for dragon fruit cultivation from the 4th year onwards was around 2.38, for the farmers surveyed from Pune, Solapur, Satara and Sangli districts of western Maharashtra. These farmers perceived high capital costs, yield loss due to extreme weather conditions and poor linkage with the processing industry as the major constraints.
- पश्चिमी महाराष्ट्र के पुणे, सोलापुर, सातारा और सांगली जिलों के सर्वेक्षण में शामिल किसानों के लिए चौथे वर्ष से ड्रैगन फ्रूट की खेती के लिए बी:सी अनुपात लगभग 2.38 था। इन किसानों ने उच्च पूंजीगत लागत, अत्यधिक मौसम की स्थिति के कारण उपज में कमी और प्रसंस्करण उद्योग के साथ खराब जुड़ाव को प्रमुख बाधाओं के रूप में माना।
- A total of 2272 visitors including farmers (385), students (1719) and several organizations (168) visited ICAR-NIASM during 2023.
- 2023 के दौरान किसानों (385) छात्रों (1719) और कई संगठनों (168) सहित कुल 2272 आगंतुकों ने आईसीएआर-एनआईएएसएम का दौरा किया।
- About 1041 farmers and two self-help groups (SHG) from about 48 villages were benefitted through 5 training/ demonstration/awareness/input distribution programmes and Interaction meet carried under DAPSC programme of ICAR-NIASM during year 2023.
- वर्ष 2023 के दौरान आईसीएआर-एनआईएएसएम के डीएपीएससी कार्यक्रम के तहत आयोजित 5 प्रशिक्षण/प्रदर्शन/जागरूकता/ निविष्टि वितरण कार्यक्रमों और बातचीत बैठकों के माध्यम से लगभग 48 गांवों के लगभग 1041 किसान और दो स्वयं सहायता समूह (एसएचजी) लाभान्वित हुए।
- About 1637 beneficiaries were benefitted through training/demonstration/input distribution programmes carried under TSP of ICAR-NIASM during year 2023.
- वर्ष 2023 के दौरान आईसीएआर-एनआईएएसएम के टीएसपी के तहत किए गए प्रशिक्षण/प्रदर्शन/ निविष्टि वितरण वितरण कार्यक्रमों के माध्यम से लगभग 1637 लाभार्थी लाभान्वित हुए।

Abbreviations

CIFS	Climate resilient Integrated Farming System
DAPSC	Development Action Plan for Scheduled Castes
ETc	Crop Evapotranspiration
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GmFAD3	Fatty Acid Desaturase gene from Glycine max
HSD	Honestly Significant Difference
HSP	Heat Shock Protein
ICT	Information and Communications Technology
IMD	Indian Meteorological Department
kmph	Kilometre per hour
LMT	Local Mean Time
LoA	Limits of Agreement
MRL	Maximum Residue Limit
NATP	National Agricultural Technology Project
NCBI	National Center for Biotechnology Information
NDVI	Normalized Difference Vegetation Index
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PS II	Photosystem II
QTL	Quantitative Trait Locus
RH	Relative Humidity
RMSE	Root Mean Square Error
rRNA	Ribosomal Ribonucleic acid
RWC	Relative Water Content
SHG	Self-Help Group
SOC	Soil Organic Carbon
THI	Temperature-Humidity Index
TSP	Tribal Sub-Plan
TSS	Total Soluble Solids
WHO	World Health Organization
WUE	Water Use Efficiency

Contents

1. Introduction

As stated in the sixth assessment report of the Intergovernmental Panel on Climate Change (IPCC), "Climate change is a long-term challenge, but the need for urgent action now is clear," and we couldn't agree more. The detrimental effects of climate change, in particular the increased frequency and severity of extreme weather events, have a negative influence on the security of food, nutrition, and water, which in turn hinders efforts to attain sustainable development goals. Climate change has reduced the growth of agricultural output around the world over the past fifty years, despite the fact that overall agricultural productivity has increased. Our country has been witnessing losses in agricultural productivity due to episodic and frequent droughts, floods, degradation of land, extremes of temperature, and pest and disease outbreaks. These issues are anticipated to make the climate change much more severe, which poses a significant risk to the nation's ability to provide enough food supplies in the coming century. It would be a difficult effort to raise agricultural output with minimal inputs without compromising the sustainability of the agro-ecosystems, given the present estimates of population, national economy, and climate change. This would be a challenge because it would be difficult to improve agricultural production. Therefore, the most important task that lies ahead is to ensure that the efficiency of the agroecosystem is preserved over the long term. This is something that can be addressed by a variety of methods, including those that aim to bridge the knowledge gaps in the systems that underlie tolerance to abiotic stresses in fishes, animals, and plants. In light of this, the Indian Council of Agricultural Research (ICAR) established the ICAR-National Institute of Abiotic Stress Management (ICAR-NIASM) on 21st February 2009. It's mission is to develop an understanding of the fundamental causes, strategies for mitigating the effects, opportunities for adaptation, and gaps in agricultural policies and education. The ultimate objective is to improve the income and quality of life of farmers who are residing in abiotically stressed ecosystems. There is an urgent need for incremental scientific research that aim to create insights and sustainable management solutions. This is because there is a renewed emphasis on limiting global warming to 1.5 degrees Celsius in order to develop a world that is fair, equitable, and sustainable. At the same time as it was discovered that there are limitations to adaptation and that there is a requirement for focused and collaborative efforts in both adaptation and mitigation, it was also found that there are various realistic and successful adaptation solutions that can lower hazards to both people and nature. With any additional delay in this regard, we will miss a brief window of opportunity that is rapidly closing, which will allow us to ensure that everyone will have a future that is both livable and sustainable.

Role of the Institute

Through approaches that include both conventional and innovative methods for crop improvement, resource management, and policy development, the institute is focussed on stresses that are brought on by an excess or deficit of soil moisture, soil salinity, sodicity, acidity, water logging, declining water quality, heat stress, cold wave, floods, seawater inundation, and other similar factors. In order to fulfill its mission, the institute has thematically undertaken significant research programs through four schools, namely Atmospheric Stress Management, Water Stress Management, Soil Stress Management and Policy Support Research. Through participation in networking with both national and international institutes, the institute intends to build strategic human resources for the purpose of controlling abiotic stressors over the long term. The institute has been making efforts to support the ongoing research and development project that is being carried out under the National Agricultural Research and Education System (NARES), while simultaneously concentrating on abiotic stressors. Additional objectives of the institute include the production of intermediate goods for tolerance to many abiotic stresses, such as gene constructs and stress-induced promoters. These products will be utilized by other institutes in order to obtain end products such as crops, animals, fisheries, and so on.

Mission

Managing abiotic stresses for sustainable agriculture.

Mandate

1. Basic and strategic research to manage abiotic stresses in crops, livestock and fisheries.
2. Repository of information on abiotic and biotic stresses, adaptation and mitigation strategies and policies.
3. Building sustainable agriculture in multi-stressed agro-ecosystems.
4. Serve as Center of Academic Excellence in managing multiple stresses in agriculture.

Objectives of the Institute

1. Assess the vulnerability of crops, horticulture, livestock, fisheries and microbes to abiotic stresses.
2. Develop technologies and policies for adaptation and mitigation of atmospheric, water and soil stresses with frontier science.
3. Develop repository of information on abiotic stress management for climate-smart agriculture.
4. Establish Center of Academic Excellence for human resource development to manage multiple stresses in agriculture.

Objectives of the Schools

A) School of Atmospheric Stress Management

1. Assessing vulnerability of crops, livestock and fisheries to atmospheric stressors.
2. Unravelling the mechanisms and traits for atmospheric stress tolerance in crops and animals.
3. Developing adaptation and mitigation strategies for atmospheric stress management.
4. Developing decision support systems for optimizing input use and climate proofing.

B) School of Water Stress Management

1. Unravelling the mechanisms and traits contributing to water stress tolerance in plants.
2. Optimizing novel genetic improvement approaches for enhancing resilience of crops to water stress.
3. Exploring alternative crops and cropping systems for alleviating water stress.
4. Developing precision agriculture for higher water productivity in crop, horticulture, livestock and aquaculture.

C) School of Soil Stress Management

1. Exploring mechanisms and traits of soil stress response in crop, livestock and fisheries.
2. Developing adaptation and mitigation strategies for soil stress management.
3. Mitigating the adverse impacts of nutrient imbalance and pollution in agriculture.
4. Developing integrated farming systems for abiotic-stressed regions.

D) School of Social Science and Policy Support

1. Assessing impacts of abiotic stressors on agricultural income, market and trade.
2. Evaluating techno-economic feasibilities of multiple stress tolerant adaptation and mitigation technologies.
3. Harnessing information and communication technologies for assessment and dissemination of technologies.
4. Evolving model capacity building programmes for abiotic stress management.

Strategy

A six-point hexagonal interlinked strategy is adopted to enhance the effectiveness of research, extension and academic activities (Fig. 1.1). It includes defining target environments, adaptive techniques, mitigation strategies, policy support and synergies through networking. The operational strategy of the institute is to focus on basic research on abiotic stresses faced by the country, strategic human resource development, robust databases and amelioration approaches using frontier technologies with the participation of a wide network of national and international centres. The comprehensive strategy of the institute prioritizes characterization of the occurrence and magnitude of various abiotic stresses impacting the agriculture sector. This will provide a rationale for basic and strategic research that aims at agro-ecology specific stress mitigation and adaptation technologies for crops, horticulture, livestock and fisheries. This will be facilitated by continuing efforts for development of world-class infrastructures and scientific manpower necessary for center of excellence in abiotic stress management. Assessment of available inputs and their use synergistically, preventing losses, judicious allocation of inputs among the competing demands for maximizing returns and development of site-specific technologies are the means of achieving high resource use efficiencies for sustainable agriculture. Joint adaptation and mitigation actions against climate change that can be implemented today across a wide range of land and water resource management solutions should provide both adaptation benefits in the short-term and mitigation strategies on a long-term basis.

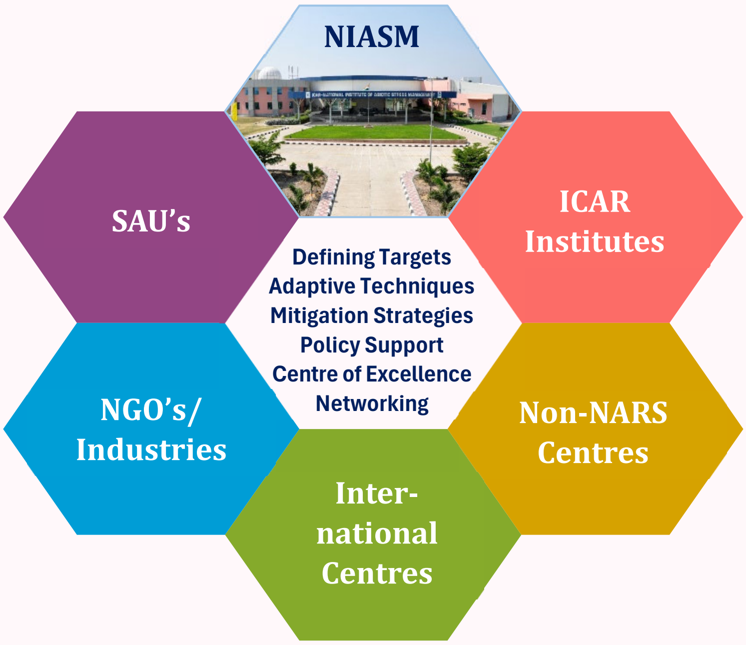


Fig. 1.1: Institute's strategy for achieving the mandate

Status of the Institute

In the XI Five Year Plan, the Union Cabinet approved the proposal of the Ministry of Agriculture, Govt. of India to establish "National Institute of Abiotic Stress Management (NIASM)" with a legal status of Deemed-to-be-University under the Indian Council of Agricultural Research at Gat No. 35, Malegaon Khurd, Baramati, Pune, Maharashtra. After being established as a new institute for abiotic stress management in 2009, NIASM initiated its activities at the camp office at KVK, Sharadanagar, Baramati. The office was then shifted to Gat No. 35, Malegaon, Khurd, on 1st November 2010 after the inauguration of the Engineering Workshop by the Hon'ble Union Minister of Agriculture and Food Processing Industries. Till January 2015, the office and laboratories were housed in this workshop and specialized cabins, which subsequently shifted to the newly constructed Office-cum-Admin block and two school buildings. At the same time, substantial efforts have been made to strengthen its human resources for carrying out research and administrative and technical activities. The current year's scientific, technical, and administrative staff strengths are 35, 10, and 6, respectively. Thus, the total filled-up cadre strength is 52 against 118 sanctioned posts (Table 1.1). The institute has initiated research through four schools with multidisciplinary approach (Fig. 1.2).

Table 1.1: Cadre strength of the Institute as on 31st December 2023.

Cadre	Sanctioned	Filled	Vacant
RMP	01	01	0
Scientific	50	35	15 (30%)
Technical	35	10	25 (71%)
Administrative	32	06	26 (81%)
Grand Total	**118**	**52**	**64 (60.7%)**

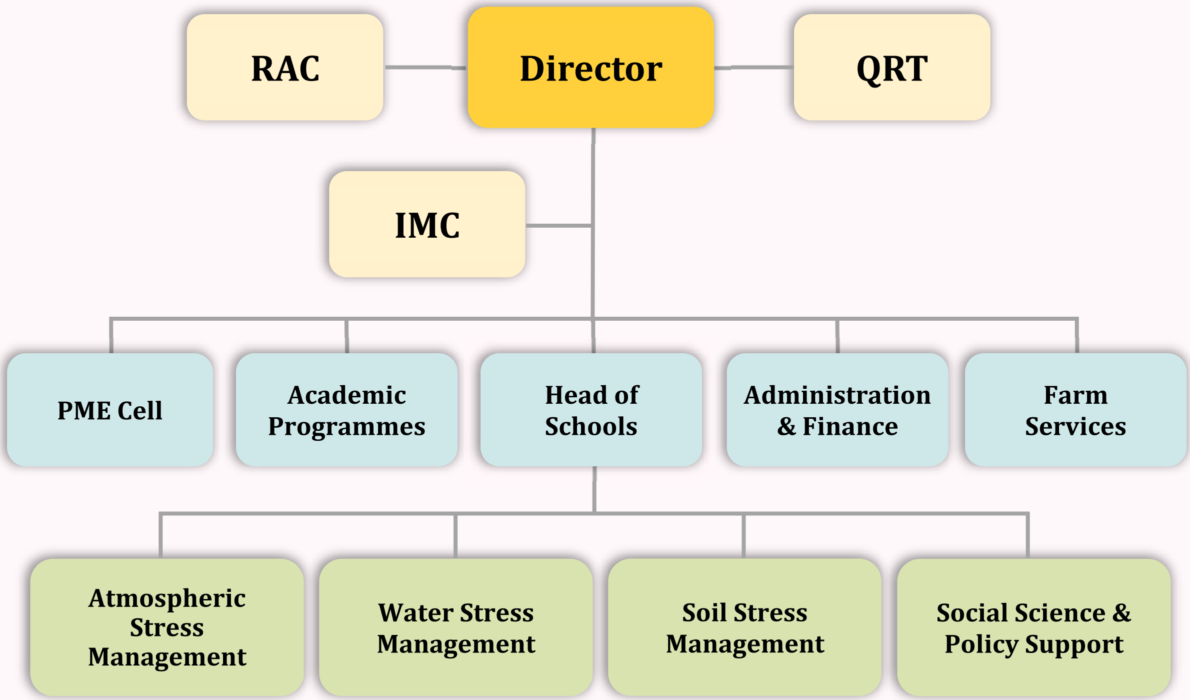


Fig. 1.2: Organogram of the Institute

Infrastructure for Research and Academics

Office-cum Administrative Building

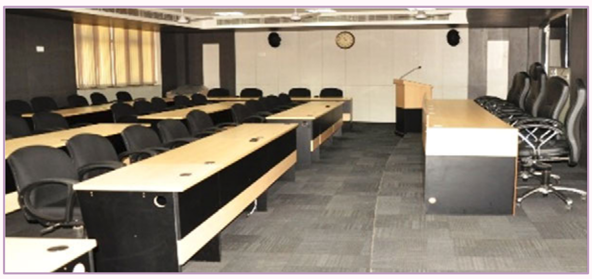
Office-common administration building has centralized air-conditioning system and centrally located open-air amphitheatre with a public address system. For safety, the building has a fire detection and alarm system

Auditorium

Institute has a full-fledged auditorium named "Sardar Vallabhbhai Patel Auditorium" with a capacity of 230 seats. It is well equipped with an audio-visual facility, a centralized air condition facility and a spacious stage used to conduct various events at the Institute.

Conference Rooms

The Institute has four conference rooms equipped with audio-visual systems for conducting parallel sessions of conferences, trainings, meetings, etc.

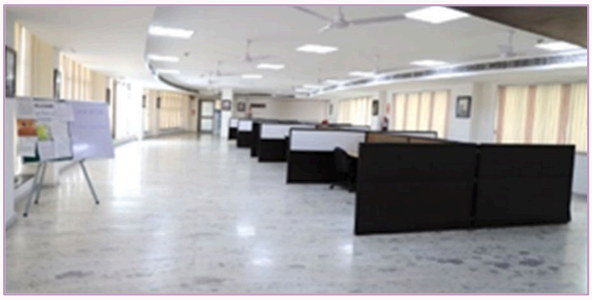


School Buildings

Two schools buildings of School of Water Stress Management (SWSM) and School of Soil Stress Management (SSSM) have been built presently. They have reception hallway, two laboratories with a storage room, one HoD room, 12 scientific and 02 technical staff rooms, one class room, one reading room, a pantry, and a record room.

Library

Institute library has a good collection of books with areas related to agriculture, animal husbandry and basic science subjects as per the mandate of the Institute. Scientists, technical personnel, research associates, students and trainees are regular users of the library. Library maintained its designated services and activities of acquisition of books, exchange of literature, circulation, reference services and documentation. Present library acquisitions have more than 2500 books in addition to other documents like newsletters of NAAS/ICAR institutes and other open-source articles and documents



Guest House

The institute has a well-furnished 'Nira Guest House' which has 18 double bed rooms and three VIP Suites which in total can accommodate about 40 guests at a time. The guest house has a well-equipped kitchen and well-furnished dining halls.

Hostels

Well maintained hostel facility comprising of two hostels (boys and girls). Each hostel has with 36 rooms with attached toilet for the students in institute. There is also a common room for recreational activity in each hostel. Each room of the hostel has attached toilet and bathrooms and also has requisite furniture for students along with 24 hours water supply, provision of solar water heater and electricity backup. The dining block of these hostels is equipped with modular commercial kitchen with a seating capacity of around 100 person.

Staff Quarters

The institute has well-constructed quarters, namely, Director Residence (Type VII quarter), and Type-IV quarters (6 nos.) built on the Institute campus. Residential complex of Type VI (4 nos.), Type V (6 nos.), Type IV (8 nos.) and Type III (8 nos.) have been constructed at MIDC, Baramati. The area is a peripheral plantation, garden, road, street lights and an electric substation.

Director residence

Staff quarter (on-campus)

Type V Quarter, MIDC, Baramati

Type VI Quarter, MIDC, Baramati

State-of-the-Art Research Facilities

Plant Phenomics Facility

Established under National Innovations on Climate Resilient Agriculture (NICRA) programme, Plant Phenomics facility has capacity of 225 pots, is equipped with three imaging sensors viz., Infra-Red (IR), Visible (VIS) and Near-Infra Red (NIR); automated weighing; precise watering stations and conveyor belt system to move the plants within the facility to and fro from growth chambers. The entire facility is computer operated through Lemna Control Software.

Genetic Engineering, Molecular Biology and Microbiology Laboratories

Institute has a state of-the-art laboratories with sophisticated equipment's such as Inductively Coupled Plasma Mass Spectrometry (ICP-MS), Stereo zoom Microscope Portable Photosynthesis System, Hyperspectral Spectroradiometer, Atomic Absorption Spectrophotometer (AAS), Microwave Digestion System, Real time Chlorophyll Fluorescence Imaging System, Infrared Thermal Imaging System, CO_2 incubator, Gas Chromatography, High-performance liquid chromatography, Nanodrop, Root scanner, Automatic Nitrogen analyzer, Fluorescent microscope and light microscope, etc. Plant Genetic Engineering Laboratory has been developed to carry out basic and strategic research to address plants response to various abiotic stresses. Molecular Biology Laboratories have been developed to carry out basic and strategic research to address plant/fish/animal(s) response to various abiotic stresses. These laboratories have facilities for genomics and proteomics studies. The laboratory is well equipped with PCR cycler, Real-time PCR, Lyophilizer, Ultra-high-speed centrifuge, Bio-safety cabinets, Chemiluminescence imaging system, Multimode reader for DNA, RNA and protein quantification. The ROS generated due to various kinds of stresses can also be quantified and measured by multimode reader. Institute also has Plant Tissue Culture having automated horizontal sterilizers, small growth chambers, walk-in growth chambers for growing and maintaining transgenic/ Genetically modified/cisgenic/VIGS and RNAi silenced plants. The animal Cell Culture facility is equipped with CO_2 incubator, biosafety cabinet and Inverted microscope.






Greenhouse Facility

There are four Hi-tech greenhouses with the total area spanning 240 m^2. Each Greenhouse is having three chambers of 10 m x 8 m of size. Greenhouses are equipped with cooling pad and axial exhaust fan system with a platform for growing plants. These greenhouses have provision for controlling temperature, photoperiod and humidity.

Research Farm

South and North Block Research Farm

About 150 acres research farm is divided in to four blocks. The south side farm is divided into six blocks, which have been further sub-divided into 37 rectangular/trapezoidal plots including agro-met observatory. Experiments related to atmospheric, edaphic and drought stresses are being carried out

with crops like soybean, guar, green gram, etc. during kharif ason and with wheat, jowar, chickpea, sorghum and sugarcane in rabi season.Additionally, eight new plots have been developed and put under rainfed forages like marvel grass, stylo, anjan grass and irrigated Napier grass. The northeast side farm was terraced and put under various orchards to evaluate the impact of edaphic and drought stresses on horticultural crops. About four hectare of northwest side farm includes a water balancing tank and a playground has been developed. The farm is further subdivided into two blocks with seven experimental plots. A water storage tank of 80 lakh liters has also been constructed for providing drip irrigation to the orchard crops.

Malad Research Farm

About 16 acres of land is rented from the Government of Maharashtra to cater to the needs of diversified research activities. The farm is located at Malad Village, about 12 km from the main campus. A farm pond (50m x 50 m size) has been built to facilitate field experiments at the site.

Model Herbal Garden

institute has a model herbal medicinal garden named as 'Sanjeevani Garden' that was developed under the financial assistance of NMPB, New Delhi. Medicinal plant species are Bonduc, Bael, Coral tree, Neem, Palash, Simaruba, Skikakayi, Putranjeeva, Soap nut, Shami, Shivan, Terminalia species, Wood apple, Mahua, Hirda, Behda, Curry leaf, Lime, Kutaj, Sesbania, Nirgudi, Henna, Guggal, Eucalyptus, Red Sanders, Parijatha, Jasmine, Gunj, Mapia foetida, Nagkesar, Surangi and aromatic grasses.

Nakshatra Udyan

Nakshatra Udyan (Constellation Park) was established at the institute. This has 42 different species of plants representing 27 Nakshatras that are planted in the central triangle of the institute. The Udyan has Vat-vriksha i.e., 'Ficus religosa' plant, Areca Palm and Golden Shower plants apart from other plants.

Experimental Livestock Research Facility

Institute has an experimental livestock facility for conducting experiments related on abiotic stress management in livestock. The facility consists of cattle, goat and poultry sheds. The Committee for Control and Supervision of Experiments on Animals (CCSEA) has approved the registration of the institute's animal house facility for the purpose of research and in-house breeding of small animals and large animals.




Fisheries Research Farm

Institute has a modern fisheries facility consisting of glass aquarium, plastic rectangular tank, FRP tank and other facilities. The wet laboratories have facilities to conduct experiments in both ornamental and food fishes. There is a dissection unit for sample collection. Institute has three farm ponds for fish rearing fish brood stock.

Institute Technology Management Unit (ITMU)

ICAR-NIASM has an ITMC wing, which includes the ITMU unit. The ITMU unit held the meeting for various activities such as institute technology promotion, technology certification, patent, copyright and trademark submission. In the last year 2023, the ITMU incharge has presented the institute ITMU progress three times under review meetings conducted by IPTM Unit ICAR. ITMU's publications have ISSN and ISBN for wider distribution. ICAR-NIASM. ITMU has done various activities during the year 2023. ITMU's publications have ISSN and ISBN for wider distribution.

Table 1. Patents, RNI and ISBN registration details.

Name of Innovation/ Technology/ Product/ Variety (Application/ Registration No.)	Date of Filing/ Registration	Progress
Patent: Development of Novel Antiparasitic and Immune-Modulating Nano-Botanical Formulations for Aquaculture. (Inventors: Neeraj Kumar, K Sammi Reddy, SA Kochewad, KK Krishnani, AK Singh and Paritosh Kumar)	04.07.2023	Application filed
Patent: Novel Microstimulant and Stress Alleviator for Aquaculture. (Inventors: Neeraj Kumar, KK Krishnani and Himanshu Pathak)	04.07.2023	Examination requested
Patent: A Process for The Development of Nanoscaled Metallic Formulations for Aquaculture. (Inventors: Neeraj Kumar, KK Krishnani and Himanshu Pathak)	04.07.2023	Examination requested
ISBN registration: Postharvest Technology of Dragon Fruit	ISBN: 978-81-949091-2-5	

Budget Utilization

The financial statement (budget) and the revenue generated during financial year 2022-23 are given in respective tables 1.2 and 1.3.

Table 1.2: Budget utilization during the financial year 2022–2023

Head/Sub-head	Allocation (in lakh)	Expenditure (in lakh)
Grants in aid-Capital	91.01	
Office Building		15.78
Works		9.3
Equipment		49.45
Information Technology		10.95
Furniture and Fixtures		5.53
Sub Total-1	**91.01**	**91.01**
Grants in aid-Salary		
a) Establishment Charges	796.41	796.41
Sub Total-2	**796.41**	**796.41**
Grants in aid-General		
Pension and other retirement Benefits	0.00	
Travelling allowance	510.95	8.68
Research and Operational Expenses		279.13
Administrative Expenses		207.30
Miscellaneous Expenses		15.77
Sub Total-3	**510.95**	**510.88**
Tribal Sub-Plan		
Grants in aid-Capital	5.50	5.49
Grants in aid-General	25.00	25.00
Sub Total-4	**30.50**	**30.49**
Scheduled Castes Sub-Plan		
Grants in aid-Capital	26.00	26.00
Grants in aid-General	26.00	26.00
Sub Total-5	**52.00**	**52.00**
Grand Total	**1480.87**	**1480.79**

Table 1.3: Revenue generated during the financial year 2022–2023

Particulars	Amount (in lakh)
Sale of farm produce	12.13
License fee	10.03
Unspent Balance of Grants of Previous Year	51.82
Interest earned on loans and advances	0.00
Interest on short term deposits	0.20
Income generated from internal resource generation	0.00
Recoveries from loans and advances	2.18
Miscellaneous receipts	6.88
Grand Total	**83.24**

2. Research Highlights

2.1 SCHOOL OF ATMOSPHERIC STRESS MANAGEMENT

The production and productivity of crops and livestock are directly impacted by weather anomalies, mostly caused by atmospheric shifts. Its monitoring and unravelling of underlying adaptive mechanisms are important for making production systems resilient. Accordingly, the research programme on atmospheric stress management has largely concentrated on comprehending the effects of atmospheric stress and developing assessment and management strategies in crops and livestock using monitoring approaches and fundamental research investigations in areas focusing on heat and drought stress. This includes creating tools for mapping abiotic stresses; developing hardware for monitoring ambience for livestock; risk characterization using systematic literature review; using gene-silencing approaches; examining heat tolerance in goats, and deriving herbal products for abiotic stress mitigation. The major research findings emerging out and the progress made under this programme during the past year are summarized below.

Weather conditions at ICAR-NIASM Research Farm

Information on weather is of paramount importance for agriculture production. Observations of weather parameters are being recorded at Institute on regular basis. Observations recorded during January to December 2023 are discussed below.

Temperature

The Long Period Average (LPA) of annual mean temperature of Baramati is 26.3 °C. The monthly mean temperature during different months recorded at ICAR-NIASM is presented in Fig. 2.1.1. During this year, annual mean temperature was 25.5 °C and the monthly mean temperatures varied between 21.6 °C (January) to 29.7°C (May). The monthly mean temperature increased linearly from February to May followed by reduction during June to August due to cooling effect of the monsoon winds, after which it started decreasing and attained a value of 21.3°C in December. Monthly maximum temperature reached its peak in May (37.3°C) and dipped to 28.8°C in December. For minimum daily temperatures, June recorded the maximum (22.3°C) and February recorded the minimum (12.8°C) values (Table 2.1.1).

Relative humidity

Relative humidity measured, at standard hours in the morning (0700 LMT) and afternoon (1400 LMT), during the year 2023 were used for computation of monthly statistics. Monthly mean relative humidity during the different months has been depicted in Fig. 2.1.1. Relative humidity at morning varied between 69% (April) and 89% (July, September and December). On the other hand, variation in afternoon relative humidity was between 21% (February) to 63% (July). The mean morning and afternoon relative humidity was found to be decreasing from January to April, which is due to the effect of increasing temperature, and then it reaches to its highest value during monsoon months, and again decreased in post monsoon months. Annual mean relative humidity averaged over the entire year stood at 61% and ranged between 47% to 76%. Higher diurnal ranges (more than 50%) in RH were observed in January to March. The lowest diurnal range was observed in July (25%).

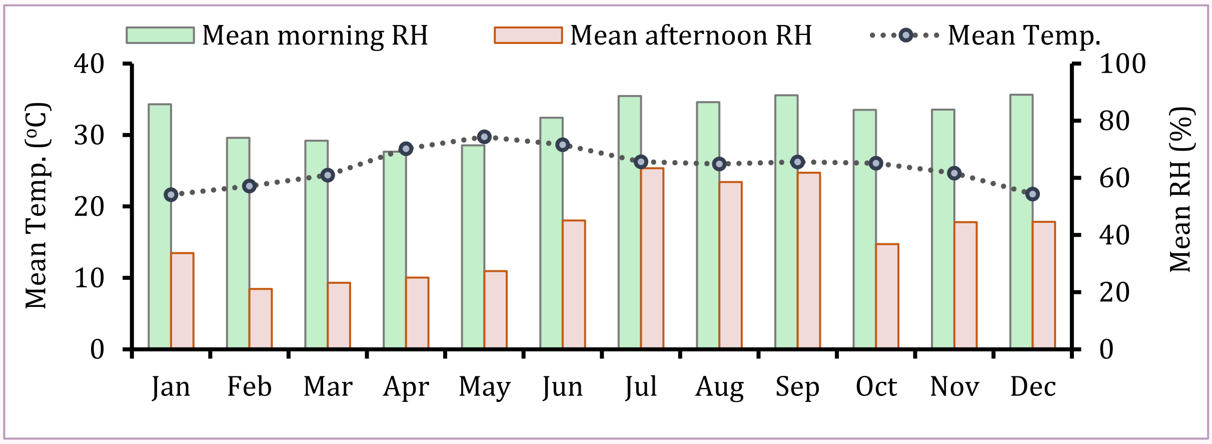


Fig. 2.1.1: Variations of monthly mean temperature mean morning and afternoon relative humidity during 2023 at ICAR-NIASM Baramati.

Rainfall

The Long Period Average (LPA) annual total rainfall of Baramati is 596.9 mm with an average of 34 rainy days per year. This year, Baramati received about 77% of its average annual rainfall, distributed among 29 meteorological rainy days, which yielded 461.4 mm of total rainfall in 2023. The monthly cumulative rainfall during different months recorded at ICAR-NIASM, Baramati has been given in Fig. 2.1.2. During the monsoon season the maximum rainfall was received in September (219.8 mm), followed by June (Table 2.1.1). In the monsoon season, there were 19 rainy days with total rainfall of 326.8 mm, which is 82% of normal rainfall of the region. Withdrawal of monsoon resulted in incessant rains during October. In the post-monsoon season, highest rainfall occurred in October (32.2 mm) and during the summer season, 75.2 mm of rainfall was received (Fig. 2.1.2.).

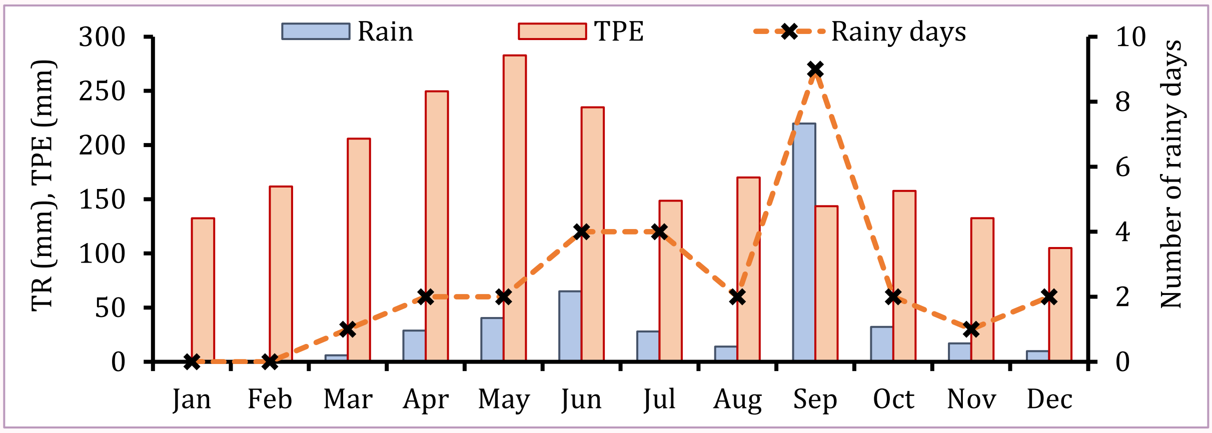


Fig. 2.1.2: Variations of monthly total rainfall (TR), total pan evaporation (TPE) and number of rainy days during 2023 at ICAR-NIASM Baramati.

Wind speed, Pan Evaporation and Sunshine duration

Monthly averages of the wind speed, pan evaporation and bright sunshine hours recorded in this year at ICAR-NIASM are presented in Table 2.1.1. Monthly average wind speed values have been found to vary from 3.6 (February) to 13.0 kmph (July), and the annual average for the daily wind speed stood at 7.1 kmph. It is observed that wind velocity was higher during June-August (>10.0 kmph) compared to the rest of the months (Table 2.1.1). Annual total open pan evaporation (TPE) aggregates to 2124 mm, which was around 4 times of the total rainfall of this year. The evaporative demand increased from January and achieved its highest value in May (9.1 mm d^{-1}). It declined thereafter to 7.8 mm d^{-1} in June and from July to December average daily pan evaporation varied between 3.4 to 45.5 mm d^{-1}. The lowest evaporation rate was recorded in December (3.4 mm d^{-1}). The annual average of daily PE was 5.7 mm. During the year, the daily average of bright sunshine duration remained 6.6 hrs and monthly average values have been found to vary between 1.2 hrs (July) and 9.4 hrs (February) (Fig. 2.1.3).

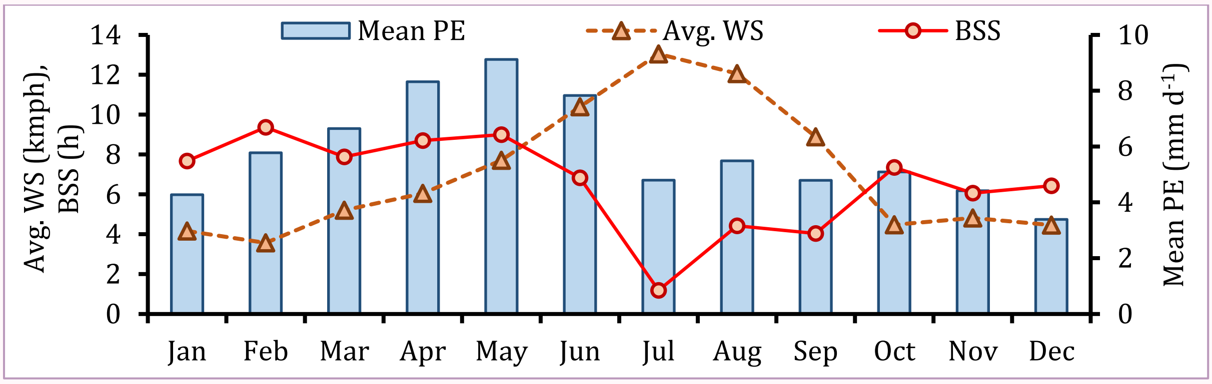


Fig. 2.1.3: Variations of monthly mean pan evaporation (PE), average wind speed (WS) and mean bright sunshine hours (BSS) during 2023 at ICAR-NIASM Baramati.

Table 2.1.1: Mean monthly weather parameters recorded at ICAR-NIASM from Jan to Dec, 2023

Parameter	Months											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tmax (°C)	30.3	32.9	33.3	36.3	37.3	34.9	30.3	30.8	30.8	32.6	31.1	28.8
Tmin (°C)	13.0	12.8	15.4	19.9	22.2	22.3	22.2	21.1	21.6	19.5	18.2	14.6
RH I (%)	86	74	73	69	71	81	89	86	89	84	84	89
RH II (%)	34	21	23	25	27	45	63	59	62	37	45	45
Avg. WS (kmph)	4.2	3.6	5.2	6.0	7.7	10.4	13.0	12.1	8.9	4.5	4.8	4.5
BSS (h)	7.7	9.4	7.9	8.7	9.0	6.8	1.2	4.4	4.0	7.4	6.1	6.4
Total rain (mm)	0.4	0.0	6.0	28.8	40.4	65.0	28.0	14.0	219.8	32.2	17.0	9.8
Total rainy days	0	0	1	2	2	4	4	2	9	2	1	2
Mean PE (mm d^{-1})	4.3	5.8	6.6	8.3	9.1	7.8	4.8	5.5	4.8	5.1	4.4	3.4

Extreme weather observation recorded in 2023

The warmest and coldest days in the entire year were obtained based on daily mean temperature data, and it was found that 23rd May (32.3°C) and 10th Jan (18.6°C), were the warmest and coldest days, respectively (Table 2.1.2). Daily maximum temperature reached 40.2°C (13th and 20th May), while lowest daily minimum temperature dipped to 8.2°C (10th Jan.). The warmest and coldest months were calculated based on monthly mean maximum and minimum temperatures, respectively. May (29.7°C) was the warmest and Jan (21.6°C) was the coldest month during this year (Table 2.1.1). The cumulative monthly rainfall was highest in September (219.8 mm). The highest rainfall, pan evaporation and wind speed events were reported on 29th September (63.8 mm), 17th May (12.4 mm d^{-1}) and 2nd August (17.7 kmph), respectively.

Table 2.1.2: Important meteorological events of the year 2023

Particulars of weather parameter	Value	Date
Highest daily mean temperature	32.3 °C	23 May 2023
Lowest daily mean temperature	18.6 °C	10 Jan 2023
Highest daily maximum temperature	40.2 °C	13 & 20 May 2023
Lowest daily minimum temperature	8.2 °C	10 Jan 2023
Highest monthly mean temperature	29.7 °C	May 2023
Lowest monthly mean temperature	21.6 °C	Jan 2023
Highest daily rainfall	63.8 mm	29 Sep 2023
Highest monthly cumulative rainfall	219.8 mm	Sep 2023
Highest monthly cumulative PE	282.7 mm	May 2023
Highest rate of daily PE	12.4 mm	17 May 2023
Highest daily wind speed	17.7 kmph	2 Aug 2023

Prototype of Ambience Monitor v1.0

The developed prototype of ambience monitor v1.0 monitors the ambient temperature, relative humidity, wind speed, and solar radiation. The onboard display module displays these pańrameters in real time, and the data is synced once every 15 minutes to a third-party IoT cloud platform. The stored data can be visualized and exported from to Excel spreadsheet format.

Fig. 2.1.4: Ambience Monitor v1.0

The data acquired during the 12-hour trial run was used to calibrate sensors using data sets from analogous times and places using standard instruments. After calibration, the data generated after repeated trial for 12 hrs, and compared with standard instruments observed to have 95% statistical limits of agreement. The current system is a promising solution for real-time monitoring of ambient conditions in livestock sheds, which can aid in carrying out precautionary measures at an appropriate time to prevent abiotic stress-related loss in animals.

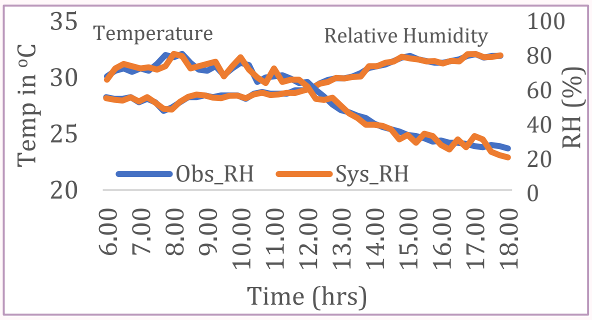


Fig. 2.1.5: Comparison of temperature and RH data with reference data

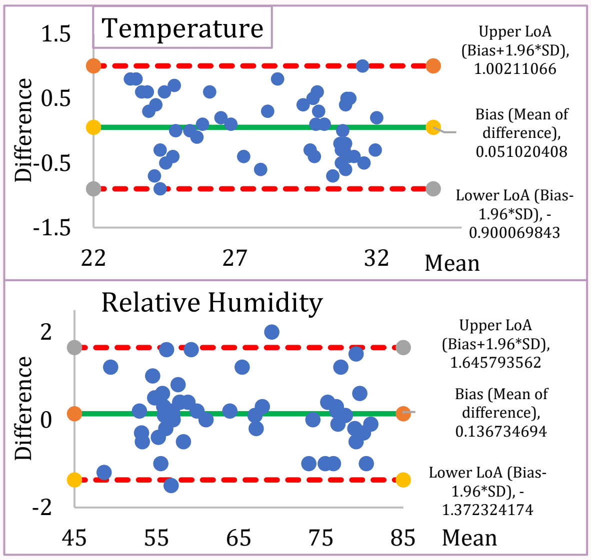


Fig. 2.1.6: Bland-Altman plots revealing 95% statistical LoA

Risk characterization through Systematic Literature Review (SLR) for soybean

The major indicators for climatic hazards, exposure, sensitivity and adaptive capacity for soybean crop concerning the South Asian region (Table 2.1.3) were identified through an initial desk review.

These indicators served as keywords for the Systematic Literature Review (SLR) search string from databases like Web of Science, Scopus, Krishi portal, Indian journals, and local literature from other South Asian countries. After removing duplicates, screening was done using exclusion criteria, and the reviewed literature on hazards, impacts and adaptation options was presented using a PRISMA chart. The reviewed literature was also used to perform bibliometric analysis, including co-occurrence analysis, to arrive at detailed information necessary for meta-analysis and to arrive at commodity-specific key adaptation options for various climatic hazards.

Table 2.1.3: H-E-V indicators identified for Soybean crop

Hazards	Exposure	Sensitivity	Adaptive capacity
Delayed monsoon	Total soybean growing area	Average rural household size	Groundwater availability
Drought	Cultivators employed in soybean production	Total population under poverty	Irrigation availability
Extreme temperature	Rural population density in soybean growing areas	Avg. size of land holding	Soil organic carbon
Extreme precipitation	Agricultural labourers	Soybean yield volatility	Soil water holding capacity
Waterlogging	-	Sector share in GDP	Fertilizer use/ Machinery
Heatwaves	-	Gender pay gap	Income
	-	Land degradation	Work participation rate
Damaging wind speed	-	Land Slope	Availability of credit
Floods	-	-	Access to ICT

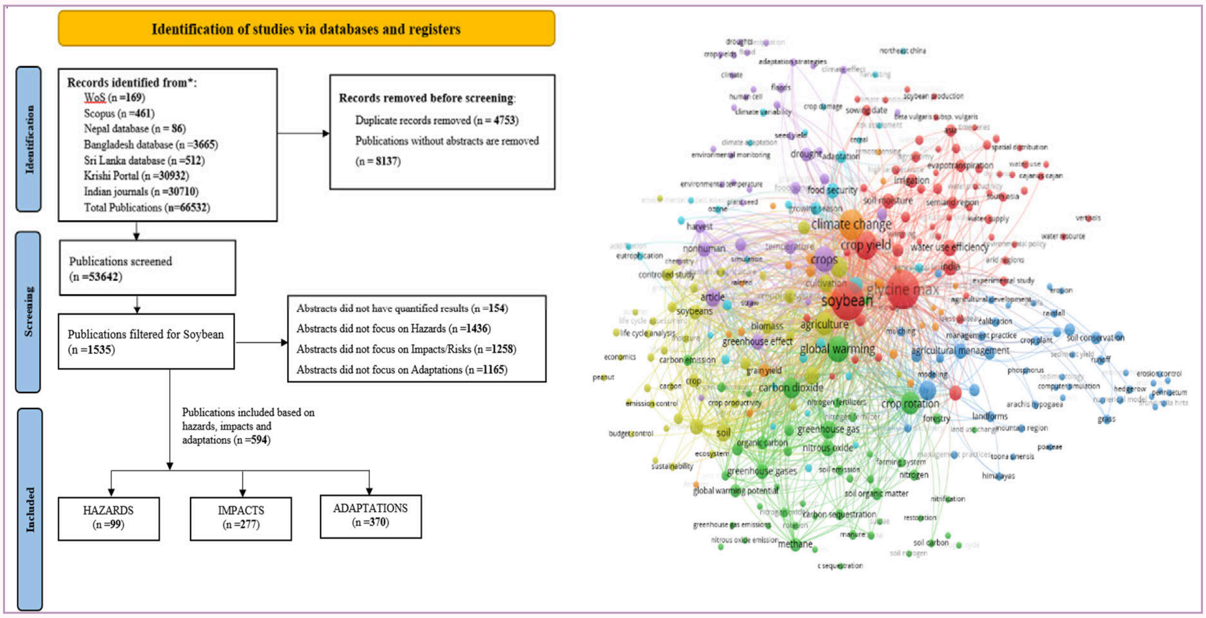


Fig. 2.1.7: PRISMA chart and co-occurrence analysis for compiled database

Response of GmFAD3 overexpressing and silenced plants to drought and salinity stress tolerance

Fatty acid desaturases (FADs) mediate the desaturation of fatty acids and play an essential role in response to various abiotic stresses. Bean Pod Mottle Virus (BPMV)-based vector was used for achieving rapid and efficient overexpression as well as downregulation of Omega-3 Fatty Acid Desaturase gene from *Glycine max (GmFAD3)* for assessing its functional role in drought and salinity stress responses in soybean. Higher levels of recombinant BPMV-GmFAD3A transcripts were detected in overexpressing soybean plants. Over-expression of GmFAD3A in soybean resulted in higher expression of GmWRKY54 than in mock-inoculated, vector-infected and FAD3-silenced soybean plants under drought and salinity stress conditions. The GmFAD3A-overexpressing plants showed higher levels of chlorophyll content, efficient photo-system-II, relative water content, transpiration rate, stomatal conductance, proline content and also cooler canopy under drought and salinity stress conditions as compared to mock-inoculated, vector-infected and GmFAD3-silenced soybean plants. It was concluded that GmFAD3A over-expressing soybean (GOES) plants exhibited tolerance while GmFAD3-silenced plants were vulnerable to drought and salinity stresses.

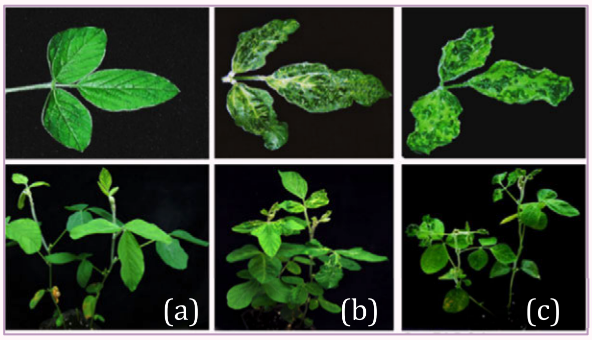


Fig. 2.1.8: Morphology of (a)vector-infected, (b) GmFAD3-silenced, and (c) GOES plants

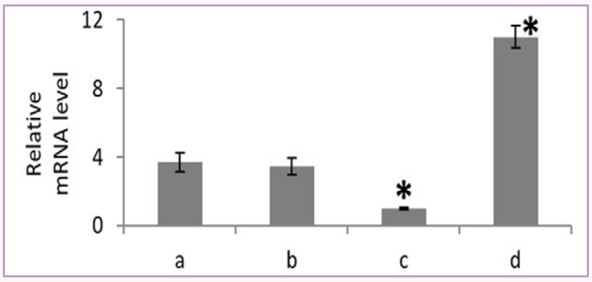


Fig. 2.1.9: Expression of GmFAD3 gene in leaves of (a) mock-inoculated, (b) vector-infected, (c) FAD3-silenced and (d) GOES plants

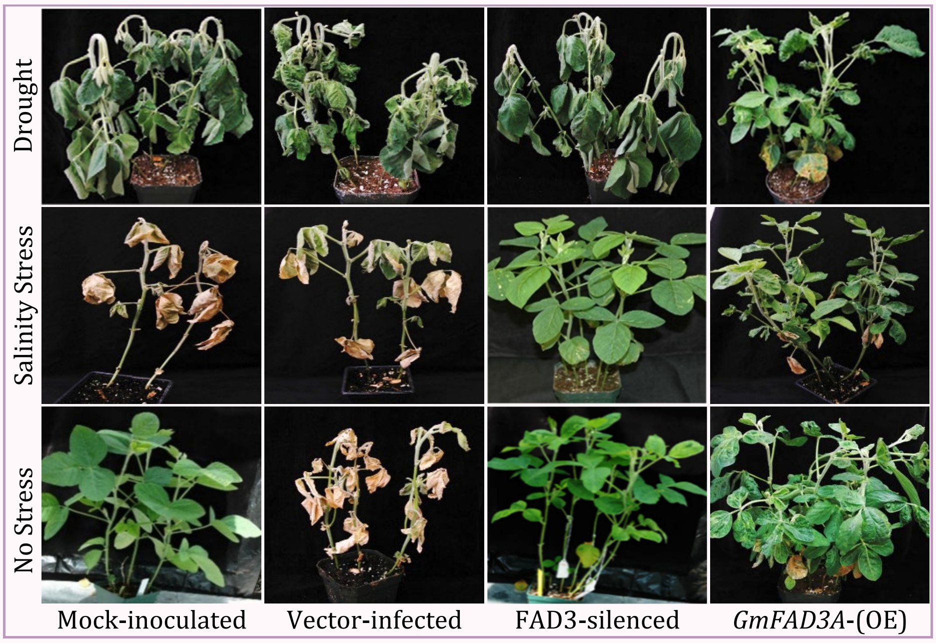


Fig:2.1.10: Response of vector-infected, GmFAD3-silenced, and Gm FAD3 overexpressing soybean plants to drought and salinity stresses

Exploitation of halophytic plant and associated microbiome for amelioration of saline agricultural land of arid and semiarid regions

Halophyte *Sesuvium portulacastrum* was grown in the greenhouse under no-stress and saline stress conditions at 3, 4 and 5% salinity levels maintained with NaCl and evaluated for canopy coolness, photosystem II efficiency, chlorophyll, and proline content. Halophyte *S. portulacastrum* showed higher Photosystem II (PS-II) efficiency in terms of quantum yield at 3 and 4% salinity levels as compared to no saline conditions. Meanwhile, at 5% salinity level, PS II efficiency drastically decreased as compared to no-stress conditions. There was no significant difference in chlorophyll content in *S. portulacastrum* under saline and no-stress conditions. Canopy temperature increased under saline conditions compared to no-stress conditions in S. *portulacastrum.*

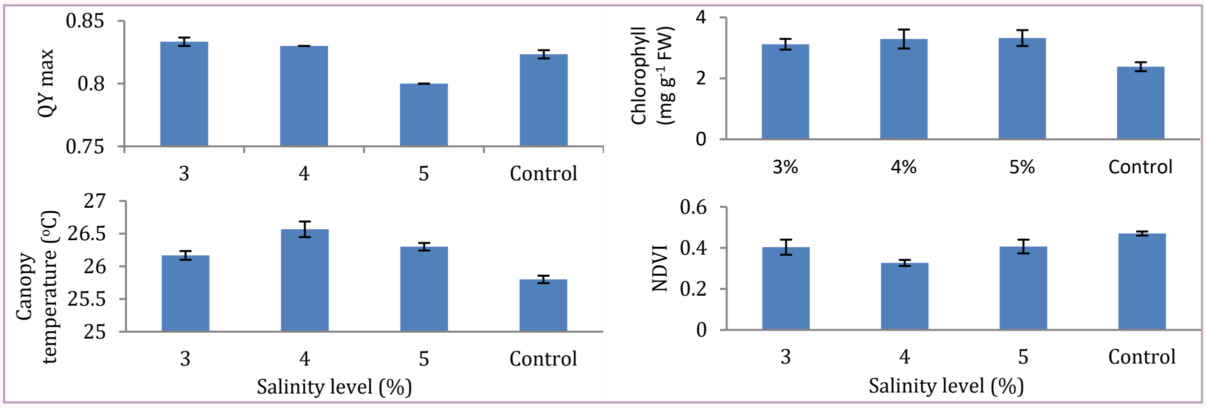


Fig. 2.1.11: Quantum yield (PS-II efficiency), canopy temperature, canopy greenness and chlorophyll content in halophyte *S. portulacastrum* under under 3% NaCl

Determination of seasonal heat stress variations in poultry bird

Elevated ambient temperatures represent the primary factor contributing to heat stress in chickens. The optimal temperature range for laying hens and growing broilers is between 19-22°C and 18-22°C, respectively. It is projected that any environmental temperature surpassing 25°C will induce heat stress in poultry. Due to the concentration of the poultry industry mainly in hot climate regions like Asia and South America, heat stress has emerged as a significant issue in poultry farming. This can detrimentally impact the productivity and health of chickens, consequently posing challenges to human food security. An experiment was conducted to assess the degree of thermal stress exposure experienced by poultry throughout the year at the institute's experimental farm. The thermal stress experienced by the poultry throughout the study period was assessed using Temperature Humidity Index (THI) by monitoring temperature and relative humidity. As per previous studies, the stress thresholds for very severe, severe, moderate and no heat stress are ≥30, 28.9-29.9, 27.8-28.8, and ≤27.8, THI respectively. During the experiment except in winter months, the poultry birds, experienced heat stress throughout the year with THI levels ranging from 26.8 to 33.2 (Fig. 2.1.12).

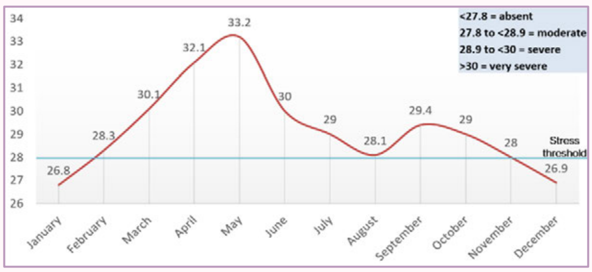


Fig. 2.1.12: Thermal stress levels in experimental poultry birds

Study on multiple abiotic stress indicators in goats from scarcity areas and its mitigation

A study conducted on a survey of abiotic stresses in the goat population (>400 goat farmers) from the scarcity/rainfed region of western Maharashtra revealed that goats are exposed to multiple abiotic stresses. Heat stress is a common problem in the area, and goats are exposed to varied levels of heat stress (Mild to severe). Shrinking of grazing areas, scarce vegetation, exposure to toxic plants, and absence of concentrated feeding are other abiotic situations leading to multiple stress situations in goats. Heat, nutrition (deficiency and toxicity), and walking/transport stress were major stressors. During summer seasons, inadequate nutritional availability in addition to heat stress was observed to be having a highly adverse impact on goat production. The hematological and fecal examinations on 126 goat samples revealed the prevalence of anaemia in almost 66% of goats. 46% of anaemic goats revealed parasitic infestations and 54% had other causes mostly nutritional deficiencies. These findings suggest that anaemia is the indicator of multiple stress in goats. Therefore, a herbal formulation for the treatment of anaemia in goats using 10 plants with medicinal properties has been prepared and is being evaluated for mitigation of the impact of multiple abiotic stressors in goats.

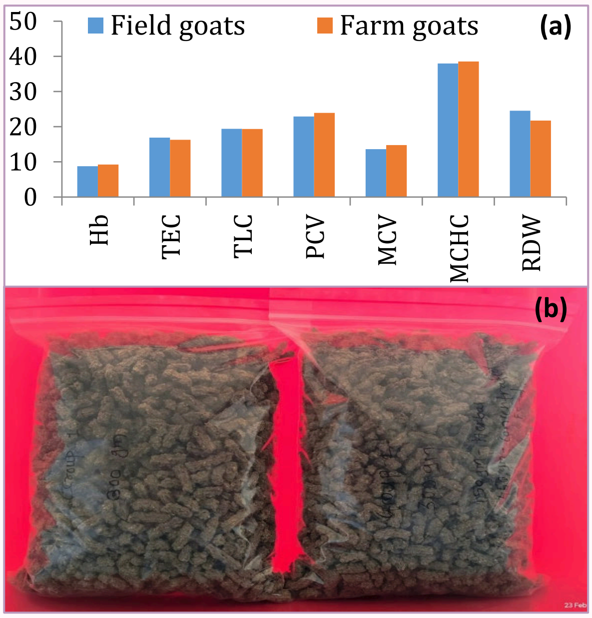


Fig. 2.1.13: a. Comparison of hematological parameters in field and farm goats, b. Pelleted herbal formulation.

Assessment of fodder scenario and sugarcane tops utility in Maharashtra

The area under fodder crops being significantly less (3.06% of the cultivated area), necessitates reliance on crop residues or alternate fodder sources. Maharashtra recorded 1,320.31 lakh tonnes of sugarcane production in 2022 with estimated sugarcane tops (STs) of more than 225 lakh tonnes. Though STs are not a better feed option for livestock, feed conversion efficiency was high at 20% and low at 30% sugarcane top feeding through total mixed ration in calves, which suggests that even 50% of available STs if used for mixed silage production, may fulfil the 15% requirement of green fodder for livestock. Currently, STs are mostly fed directly to livestock or may be used in lesser proportion for silage preparation. Particularly during water scarcity periods, the immature sugarcane crop is also fed as livestock fodder. The analysis carried out for the districts of Maharashtra state revealed that STs used either as green fodder (during Oct-Mar) or as mixed silage with 50% composition (across the year), can feed about 50-70% of livestock population across four districts (Kolhapur, Pune, Satara & Solapur); 30-50% in three districts (Sangli, Ahmednagar & Latur), 10-30% in 7 districts and less than 10% in remaining 15 districts producing sugarcane (Fig. 2.1.14). This provides an insight that silage production and consumption will therefore be largely local rather than transported across districts. However, by bringing more area under cultivation of short duration fast growing fodder species during water availability period either exclusively or by replacing partly the long duration crops like sugarcane will help reduce green fodder shortage during scarcity period. This strategy would be more beneficial for sugarcane growers rearing livestock, owing to the faster biomass production rates and nutritional quality of fodder crops compared to sugarcane. This grown fodder can also be utilized in mixed silage production. Furthermore, by popularizing mechanized shredding/cutting practices of STs and other green fodder for mixed silage preparation either through fixed or mobile machines and making arrangements for silage bags/pits can help timely conversion of all available STs into fodder silage. Mechanized mixed silage making through suitable small farmer groups, thus has potential to improve the availability of better forage options for sustaining livestock production in addition to generating employment opportunities in the drought prone areas of tropical regions.

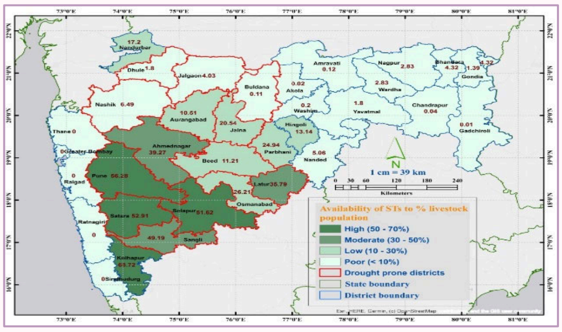


Fig. 2.1.14: Availability of STs either as green fodder (during Oct-Mar) or mixed silage (across the year) to the per cent of livestock

District level estimation of fodder demand and milk production

The district level fodder demand (green and dry) was mapped using conversion coefficient from NATP database and livestock population (20th livestock census, 2019). The green fodder demand (63.09%) was higher than dry fodder (36.91%) and highest for cattle followed by buffalo, goat and sheep. Similarly, the district level milk production for various livestock categories was also estimated using conversion coefficients from Integrated Sample Survey Report, 2019. The highest milk production was from indigenous buffaloes, followed by exotic cows, indigenous cows and goats.

Table 2.1.4: Fodder demand (t day $^{-1}$)

Livestock	Green Fodder	Dry Fodder
Cattle	995201	775564
Buffalo	840533	465365
Goat	223327	29777
Sheep	141131	16251
Total	2200193	1286957

Table 2.1.5: Average milk yield (AMY 000t day $^{-1}$)

Livestock	AMY	% of total
Exotic cows	229.84	27.10
Indigenous cows	205.57	24.24
Indigenous buffaloes	370.14	43.64
Goats	42.66	5.03
Total	848.21	100

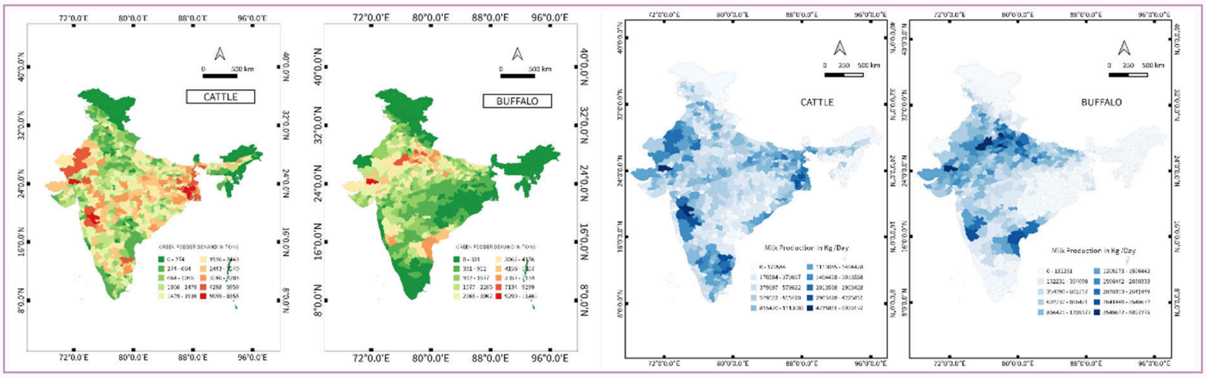


Fig. 2.1.15: Geo-spatial map of district-level fodder demand and milk production of livestock

Soil Chemical Quality Index

The Soil Chemical Quality Index was calculated for the village level for India using the weighted sum approach. In this approach, each of the 12 nutrients was given a weight based on expert opinion for its categorization into low, medium, and high levels and accumulated to calculate the Soil Chemical Quality Index. Further refining the methodology, particularly for Haryana State, the farmer-level geo-referenced datasets were first curated by removing duplicates, imposing threshold limits, and using a geofencing approach. Further Machine learning models were developed for the amputation of missing values. Among the several Interpolation techniques used, those exhibiting the lowest RMSE (Root Mean Square Error) were used to develop interpolated Raster maps of each nutrient. Further, these raster maps were used to calculate the soil nutrient scoring based on linear and non-linear scoring functions and integrated into a single soil chemical quality index using numero, additive, and weighted approaches. This Index classifies the soil into four levels of fertility classes that can be used for getting insights into fertility status at sampled and unsampled locations.

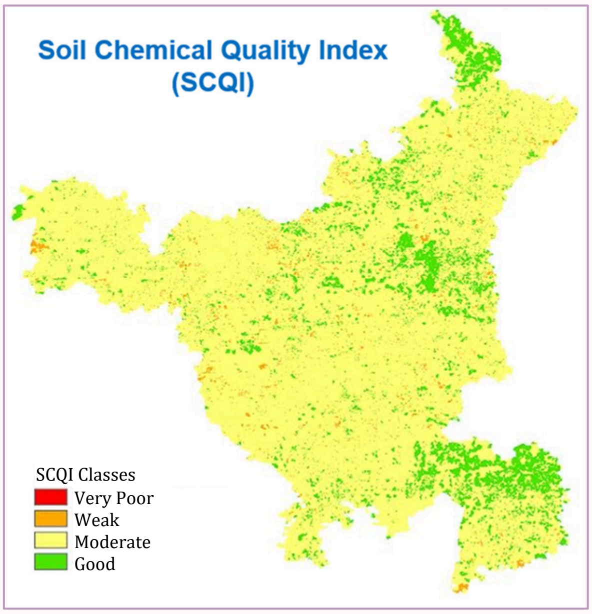


Fig. 2.1.16: Raster map depicting SCQI for Haryana State

2.2 SCHOOL OF EDAPHIC STRESS MANAGEMENT

Salinity, mineral toxicity, and nutrient shortage are three significant soil stresses that have been identified as important hazards to the production of crops, cattle, fisheries, and other commodities. The school of edaphic stress management has focused on conducting basic and strategic research on soil-related stresses in crop plants, animals, and fisheries in order to manage these stresses. The work in the areas of planting systems in shallow gravelly lands, climate resilient integrated farming systems, agroforestry systems, purification of waste water/air and abiotic stress mitigation in fishes have generated a significant amount of basic understanding of the underlying processes. The research activities and findings of the school progressed over the pastyear are outlined here.

Effect of planting techniques on growth, nutrient and quality parameters of pomegranate tree under shallow and gravelly land

Twenty-six treatments of planting techniques comprising pits with varying dimensions and soil types were imposed to study growth and development, nutrient concentration, and quality parameters of 8-year-old pomegranates under the shallow skeletal soil situation. The trench planting with a soil mixture of clay black soil and sandy loam native soil at a 1:1 ratio exhibited a higher yield of more than 9.3 t ha^{-1} from the eight-year-old pomegranate trees. It is mainly for higher P (0.28%) and K (1.8%) contents, juice content (48.5%), and total soluble solids content (16.05). Moreover, the trench had a higher soil volume (3 m^3), which can hold a higher amount of water and nutrients, and the black soil also had a higher capacity to retain plant available water, which can be recommended to the shallow skeletal soil situation of the Deccan plateau region as it promises about 67% more yield to the contemporize planting approach of 45cm x 45cm x 45cm pits of the native murrum soil situation.

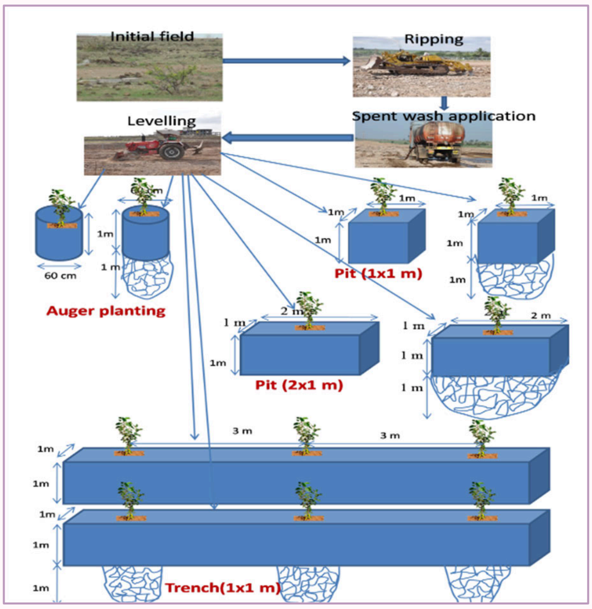


Fig. 2.2.1: Planting approaches for shallow and skeletal soil situations

Climate resilient integrated farming system for semi-arid regions

A climate-resilient integrated farming system developed at ICAR-NIASM, Baramati, involves the diversification of farming system components both within and across components, optimizing their size, and utilizing climate-smart technologies to minimize risks and achieve sustainable production and income in changing climatic conditions. The components of CIFS are as below: Crop: 6250 m^{-2}.; Horticulture: 3000 m^{-2}.; Livestock: Indigenous cows (02), goats (10), native poultry birds (50), fisheries (400 m^{-2}), and agroforestry (boundary plantations). The performance of different components of the model is presented below. In the crop component, the highest net return (Rs. 7047) was obtained from was from Redgram+Sorghum-

Clusterbean cropping system (0.1 ha) The highest B:C ratio was observed in Black gram-Groundnut Cropping system (0.1 hectare). The total cost of cultivation in crop components was Rs. 38017, gross income generated was Rs. 51699, and net income was Rs. 13681. The overall B:C ratio of crop components was 1.35 in the livestock component, the cost of rearing dairy animals (Gir cow) was Rs. 165832, gross income generated was Rs. 177957, and net income was Rs.12125. The B:C ratio was 1.07. The cost of rearing in goat component was Rs. 33600, gross income was Rs. 84689, and net return was Rs. 51089. The B:C ratio was 2.52. The cost of rearing in poultry components was Rs. 36425, gross income was Rs. 46832, and net return was Rs. 10407. The B:C ratio was 1.28. The Overall cost of rearing in the livestock component was Rs. 235857, gross income was Rs. 309478, and net return was Rs. 73621. The B:C ratio was 1.31. In the horticulture component, the cost of cultivation was Rs. 8388, the gross income generated was Rs. 17932, and the net return was Rs. 9543. The B:C ratio was 2.13. The overall cost of cultivation, gross income and net returns in the CIFS model were Rs. 282262, 379109 and 96845, respectively. The overall B:C ratio of the CIFS Model was 1.34. The economics of different components of CIFS are presented in Table 2.2.1.

Table 2.2.1: Economics of components of CIFS

Components	Gross Income (Rs.)	Cost of cultivation/ rearing (Rs.)	Net Income (Rs.)	B:C Ratio
Cropping systems (0.1 ha each)				
Pearl millet-Chickpea	7605	7836	-231	0.97
Green gram-Sorghum	7400	7152	247	1.03
Sorghum- Safflower	6094	6100	-6.04	0.99
Black gram-Groundnut	14728	8104	6623	1.81
Redgram+Sorghum-Cluster bean	15872	8824	7047	1.79
Sub-Total	51699	38017	13681	1.35
Livestock				
Gir cow (2 cows)	177957	165832	12125	1.07
Goat (10 goats)	84689	33600	51089	2.52
Poultry (100 no.s)	46832	36425	10407	1.28
Sub-Total	309478	235857	73621	1.31
Horticulture				
Fruit crops (0.3 ha)	17932	8388	9543	2.13
Total	379109	282262	96845	1.34

Water footprints in CIFS

Cropping systems: The water footprints calculated for cropping systems of CIFS revealed footprints ranging between (0.7 to 3.9) kg m^{-3} among different cropping systems. The blue water footprint for cropping systems increased in the order redgram+ sorghum-cluster bean (CS5) < blackgram-ground nut (CS4) < pearl millet-chick pea (CS1) < Green gram-Sorghum (CS2) < Hybrid sorghum-safflower (CS3). Redgram+ sorghum followed by cluster bean had minimum water footprint with the highest system productivity and was profitable, followed by blackgram–ground nut.

Livestock: The water productivity of livestock was worked out, where water required for different routine activities such as drinking water, water required for the cultivation of feed and fodder, water required for cleaning of animal shed and animals are taken into account. The water utilized is divided by the gross income and net income to calculate the gross and net water productivity. The gross water productivity (Rs m^{-3}) in cattle, goats, and poultry was 11.29, 9.07, and 14.97, respectively. The water productivity (unit m^{-3}) for milk, meat and eggs was 0.093, 0.0235 and 1.61, respectively. The biomass and carbon stock of various fruit crops and agroforestry plants planted in CIFS is presented in Table 2.2.3. The total carbon stock was maximum in teak trees. The total biomass (kg) and carbon stock (kg) of the CIFS model were 2512.55 and 1197, respectively.

Table 2.2.2: Livestock water productivity

Livestock water productivity	Cattle	Goat	Poultry
Gross water productivity (Rs m^{-3})	11.29	9.07	42.68
Net water productivity (Rs m^{-3})	0.76	5.47	9.48
Water productivity/milk (L);/meat, egg (unit m^{-3})	0.09	0.023	1.61

Table 2.2.3: Biomass and carbon stock of CIFS

Sr. No.	Species	No. of plants	Age	Biomass		Carbon stock	
				(kg tree^{-1})	Total	(kg tree^{-1})	Total
1	Teak (B)	36	2	17.49	629.59	8.39	302.20
2	Mango (Road)	32	2	9.09	290.83	4.36	139.60
3	Citrus (Multilayer)	31	2	6.00	185.96	2.88	89.27
4	Pomegranate (H)	48	2	7.78	373.39	3.73	179.23
5	Custard Apple (H)	53	2	5.96	316.06	2.86	151.71
6	Sapota (H)	20	2	2.11	42.27	1.01	20.29
7	Ber (b)	5	2	6.00	29.99	2.88	1.20
8	Papaya (Boundary)	9	2	3.19	28.68	1.53	13.77
9	Papaya (Multilayer)	31	2	12.64	391.69	6.07	188.02
10	Drumstick (Silvi-pasture)	5	2	44.51	222.53	21.36	106.81
11	Citrus (B)	5	2	0.30	1.49	0.14	5.45
	Total				2512.55	55.23	1197.56

Biomass and carbon stock of fruit and agroforestry systems

Perennial fruit and agroforestry tree species were established in the CIFS model to enhance the carbon sequestration potential with other tangible benefits (Fig. 2.2.2 a). After the establishment of various components, about 2.52 tonnes of biomass and 1.19 tonnes of carbon were stored in the perennial tree components of the CIFS.

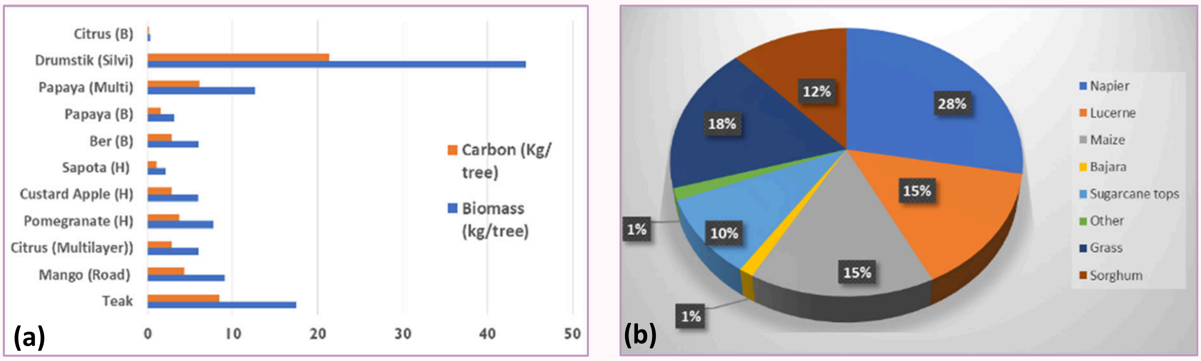


Fig. 2.2.2: (a) Biomass and carbon stock of perennial components in CIFS and (b)contribution of fodder availability of different components

The boundary plantations of teak added the highest quantity of carbon, followed by pomegranate. A comprehensive evaluation of cattle and goat fodder requirements revealed a total consumption of 20.9 metric tons and 10.4 metric tons, respectively. Notably, the NB Hybrid variety accounted for approximately 28% of the total fodder production within the CIFS system (Fig. 2.2.2 b).

Appraisal of carbon footprints under the problematic soil over the fertilizer levels for wheat and rabi sorghum crops

The greenhouse gas emissions based on secondary data collected from experimental plots at different locations in the Deccan plateau region were calculated using the online 'Cool farm tool', which allows estimations of house gas emissions based on soil and crop management practices. The estimates revealed that the nitrous oxide emission and greenhouse emission intensity varied significantly for soil type. The normal soil had a higher N_2O emission but low greenhouse emission intensity. The high emission intensity was higher under the sodic soil due to poor crop performance. Similarly, The N_2O, CO_2 and total GHG emissions were higher under higher fertilizer application of 25% more than the recommended dose of fertilizer at 4.2 kg N_2O ha^{-1}, 2512.8 kg CO_2 ha^{-1}, and 3663.3 kg CO_2 eq ha^{-1}, respectively. The GHGS emission intensity was at par for fertilizer application and significantly higher than the control treatment. The GHG emission intensity increased with fertilizer doses (Table 2.2.4).

Table 2.2.4: Effect of nutrient management systems (NMS) on GHG emission and emission intensity under wheat and sorghum crops in normal, calcareous and sodic soil types

	Parameters	N_2O (kg ha^{-1})	Total CO_2 emission (kg ha^{-1})	Total GHGs emission (kg CO_2 eq ha^{-1})	GHGs emission intensity (kg kg^{-1})
Wheat					
Soil type	Normal	3.6±1.2ᵃ	2274.1±221.6ᵃ	3267.5±525.3ᵃ	1.78±0.82ᶜ
	Calcareous	2.8±0.9ᶜ	2274.1±221.6ᵃ	3026.0±448.3ᵃ	2.14±0.66ᵇ
	Sodic	3.2±1.0ᵇ	2296.1±221.9ᵃ	3173.5±490.0ᵃ	2.89±0.73ᵃ
NMS	Control	1.8±0.4ᵈ	1935.2±13.0ᵈ	2434.0±107.6ᵈ	3.36±0.58ᵇ
	25% less RDF (90:45:30)*	3.1±0.6ᶜ	2281.6±13.0ᶜ	3135.3±163.4ᶜ	2.00±0.48ᵃ
	RDF (120:60:40)	3.6±0.7ᵇ	2395.9±13.0ᵇ	3390.0±189.5ᵇ	1.89±0.63ᵃ
	25%> RDF (150:75:50)	4.2±0.8ᵃ	2512.8±13.0ᵃ	3663.3±218.8ᵃ	1.83±0.67ᵃ
Sorghum					
Soil type	Normal	3.1±0.8ᵃ	1505.2±150.7ᵃ	2342.5±349.2ᵃ	2.74±1.0ᵇ
	Calcareous	2.3±0.6ᶜ	1507.2±150.6ᵃ	2137.5±299.2ᵃ	2.01±0.3ᶜ
	Sodic	2.7±0.7ᵇ	1523.2±150.9ᵃ	2261.5±326.2ᵃ	3.74±2.5ᵃ
NMS	Control	1.8±0.4ᵃ	1276.5±11.9ᵈ	1775.3±107.0ᵇ	5.0±2.4ᵇ
	25% less RDF (60:30:30)*	2.7±0.5ᵇ	1511.9±11.9ᶜ	2240.0±141.5ᵃ	2.1±0.3ᵃ
	RDF (80:40:40)	3.0±0.6bᶜ	1590.5±11.9ᵇ	2404.0±156.1ᵃ	2.1±0.3ᵃ
	25%> RDF (100:50:50)	3.3±0.6ᶜ	1668.6±11.9ᵃ	2569.3±172.7ᵃ	2.1±0.4ᵃ

Multilayer integrated farming system (MLIFS) for livelihood improvement in multiple abiotic stress regions

This system involves cultivating and managing various components of Integrated Farming System (IFS) at distinct levels. These components were strategically combined to address multiple challenges, including shallow basaltic soils, limited land size with inadequate irrigation resources, and the goal of creating a sustainable agricultural income in degraded lands. In this model (0.12 ha), seasonal vegetables and fruit cultivation were integrated alongside the raising of backyard poultry. Micro-irrigation systems were used for crop irrigation, and poultry birds were allowed to scavenge for food, producing eggs and poultry. This approach aimed to reduce the cost of feeding poultry while enhancing soil quality over time, resulting in a sustainable and steady income stream. In Multilayer farming system the crop water productivity (54.0 Rs. m^{-3}), water productivity for eggs (1.61 Nos m^{-3}), system water productivity (36.71 Rs. m^{-3}) and land equivalent ratio (1.89 LER) were calculated.

Table 2.2.5: Economics of multilayer IFS

Components	Gross income (Rs.)	Cost of cultivation (Rs.)	Net income (Rs.)	B:C ratio
Vegetables and fruits	13794	13421	372	1.02
Poultry	46832	36425	10407	1.28
System (MLIFS)	60626	49846	10779	1.15

The cost of cultivation (CoC) for vegetables and fruit component was Rs. 13,421, resulting in a gross income (GI) of Rs. 13,794, a net income (NI) of Rs. 372, and B:C ratio of 1.02. For the poultry CoC was Rs. 36,425, with a GI of Rs. 46,832, a NI of Rs. 10,407, and a B:C ratio of 1.28. When considering the entire Multilayer integrated farming system, the overall CoC was Rs. 49,846, resulting in a GI of Rs. 60,626, a NI of Rs. 10,779, and a B:C ratio of 1.15 in 0.12 ha.

Effect of Multilayer integrated farming system on soil properties

The soil samples were taken at the start of the experiment i.e. from the original site and then during the time period when different fruit crops, vegetables and grasses were growing as a multilayer farming system. The soil begins to develop as it was amended with organic materials such as compost, vermicompost and FYM. The pH of soil at the beginning was 8.31 (0-15 cm) and 8.43 (15-30), which get reduced to 8.01 (0-15 cm) and 7.93 (15-30 cm). Initially, EC was 0.29 dS m^{-1}(0-15 cm) and 0.28 dS m^{-1} (15-30 cm) and now it is 0.24 dS m^{-1} (0-15 cm) and 0.17 dS m^{-1} (15-30 cm). OC was recorded as 0.29 % (0-15 cm) and 0.27 % (15-30 cm) at the original site and now increased up to 0.33% (0-15 cm) and 0.32% (15-30 cm). The original site recorded 118.2 kg ha^{-1} N at 0-15 cm depth and 111.4 kg ha^{-1} N at 15-30 cm depth. It was increased up to 130.5 kg ha^{-1} (0-15 cm) and 122.9 kg ha^{-1} (15-30 cm). Similar results were observed in available P and K content. At original site available P was 7.24 kg ha^{-1} (0-15 cm) and 6.71 kg ha^{-1} (15-30 cm), and available K was 251.3 Kg ha^{-1} (0-15 cm) and 243.8 kg ha^{-1} (15-30 cm). P and K were increased as 8.69 kg ha^{-1} (0-15 cm), 8.15 kg ha^{-1} (15-30 cm) and 267.6 kg ha^{-1} (0-15 cm), 259.6 kg ha^{-1} (15-30 cm) respectively. Bulk density was 1.53 Mg m^{-3} (0-15 cm) and 1.72 Mg m^{-3} (15-30 cm), which get reduced up to 1.48 Mg m^{-3} (0-15 cm) and 1.63 Mg m^{-3} (15-30 cm) showing increase in soil porosity. Water holding capacity is also improved. It was 32.8 % (0-15 cm) and 30.8% (15-30 cm) at the original site and increased up to 36.8% (0-15 cm) and 35.8% (15-30 cm) at current site.

Self-sustaining goat farming model for livelihood improvement of small and marginal farmers

In the changing climatic and socio-economic situations, there is a need to develop new livestock production systems to obtain sustainable income for small and marginal farmers from decreasing land and water resources. Goat meat has high demand in the local and international markets and gets high prices in the local market. Farmers and rural youth are interested in goat farming, but constraints such as the decrease in grazing resources in terms of quality and quantity, increase in grazing pressure, unavailability of labourers for grazing of animals, and high rates of labourers discourage goat farming. A self-sustaining goat farming model has been developed by integrating a locally adapted goat breed (Osmanabadi) with a climate-smart loose housing system and growing different types of fodder shrubs on the boundaries of cropland with a micro-irrigation. In this system, a sufficient amount of fodder is produced from well-established fodder shrubs that can be fed to a goat. The labor requirement for managing the animals is less, and it is also easy to manage them in this system. The behavioural needs of the animals are also satisfied in a loose housing system, which helps the animals perform better with limited fodder resources. This goat farming model has the potential to generate employment for rural youth and landless farmers sustainably and can earn sustainable income with less land and limited water resources.

The total recurring cost of production of goat unit was Rs. 33600, and the gross income was Rs. 84689 with a B:C ratio of 2.52, without supplementation of concentrate feed. The goat is one of the important livestock species that can be reared in dry lands and limited irrigation conditions. The major portion of water was used in growing fodder for the goats. The net water productivity in this model was Rs. 5.47 m^{-3}. The water productivity for the production of live weight of goat (23 g m^{-3}) and gross water productivy (9.07 Rs. m^{-3}) were calculated.

Fig. 2.2.3: Boundary plantation of various fodder shrubs and goats feeding on fodder shrubs

Impact of Leucaena-based silvipasture systems on fodder productivity in degraded soil environments

An experiment was conducted to investigate the impact of Leucaena-based silvipasture systems on fodder productivity in degraded soil environments. Four different intercrops (*Medicago sativa, Desmanthus virgatus, Cenchrus ciliaris, and Cenchrus setigerus*) were intercropped alongside two different cutting height treatments for Leucaena leucocephala, specifically at 50 and 100 cm. The results indicated that the 100 cm cutting height for Leucaena, when intercropped, resulted in significantly higher yield of green fodder biomass than the sole Leucaena or the 50 cm cutting height treatment (Fig 2.2.4 a). This trend was also observed in the green fodder yield of the intercrops, where the 100 cm cutting height treatment exhibited the least reduction in biomass.

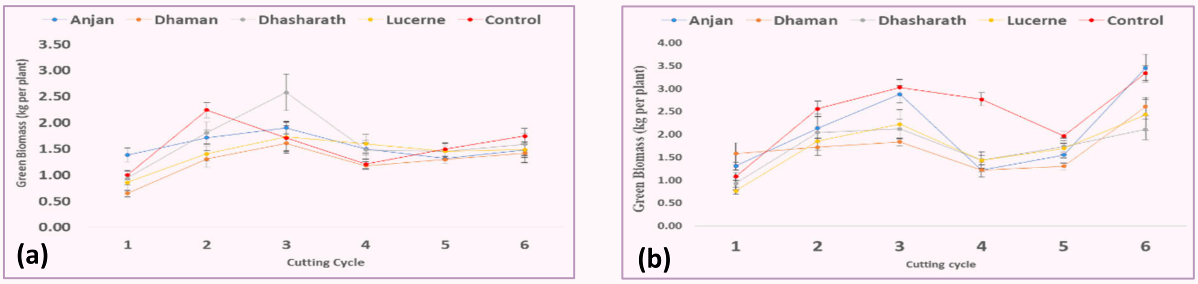


Fig. 2.2.4: Green Biomass across cutting cycles

Overall, the intercropping systems produced between 11 to 27 tonnes of green fodder biomass, regardless of the type of crops or cutting height. These findings emphasize the potential benefits of intercropping with Leucaena at a greater cutting height to enhance fodder production.

Flowering phenology and yield of Chia in relation to various sowing dates and prevailing weather

The sowing of Chia (*Salvia hispanica*) was taken up from 1st July 2022 to 1st February 2023 at fortnightly intervals to standardize the ideal sowing time. The flowering behaviour and seed yield were recorded to find the suitable sowing window. Flowering stages were recorded per the BBCH scale suggested by Brandan et al. (2019). The results showed that early sowing from July produced more biomass production and took a longer duration for flowering and maturity (130-140 days). This also affects the sowing of regular kharif crops. It was observed that sowing from 15th September to 30th November made the crop mature in less than 100 days.

Further, sowing of Chia from the first week of August to the first week of September realizes a higher seed yield of 793-811 kg ha^{-1}. If sowing beyond 15th December, it is uneconomical due to partial flowering and low yield. If the sowing is delayed, the flower parts were converted to vegetative parts due to the prevalence of long-day situations. However, for genetic improvement, two generations of the crop could be achieved if sowing 1st generation on 1-15 July and 2nd sowing on 15-30 November.

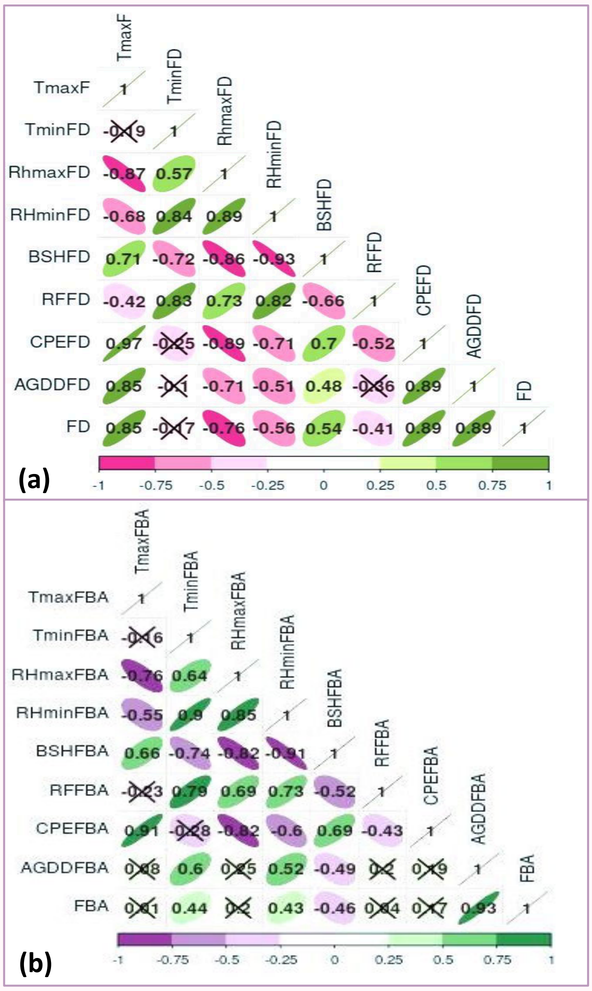


Fig. 2.2.5.: Correlation of a) flower bud appearance and b) flowering duration in Chia with weather parameters

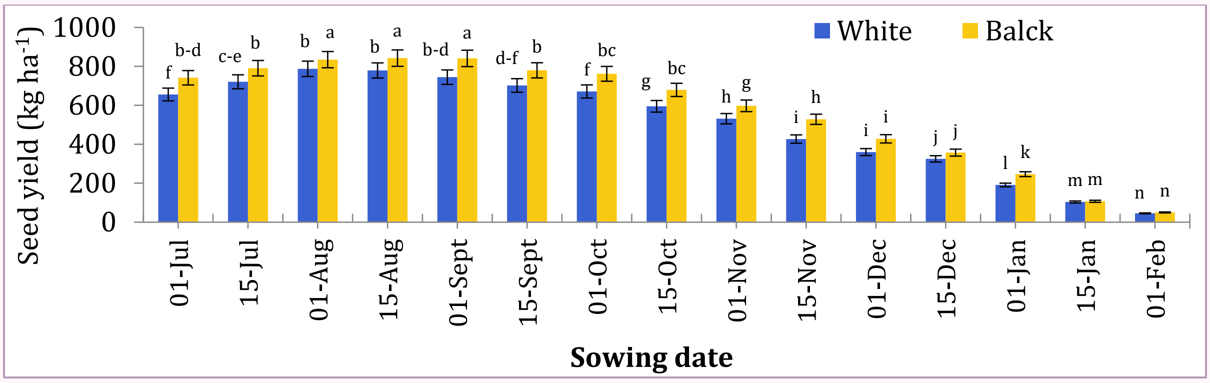


Fig. 2.2.6: Effect of different sowing dates on seed yield of Chia

The positive and significant correlation between growing degree days (AGDD) for flower bud appearance (FBA) and Flowering duration (FD) was observed in chia. The FD was positively and significantly correlated with T_{max}, bright sunshine hours (BSH) and pan evaporation (CPE), whereas negatively correlated with relative humidity (RH) and rainfall (RF) between FBA and completion of flowering. Similarly, the FBA was positively and significantly correlated with T_{min}, RH_{min} and AGDD, whereas negatively correlated with BSH prevailed during sowing to FBA. These results highlighted that high temperature and BSH delay flowering in Chia.

Wastewater treatment synergizing with the integrated approach of constructed wetland and aquaponics

A Constructed wetland and integrated aquaponics system has been designed with locally available media mixture and naturally inhabited microbial consortia/ biofilm for simultaneous treatment of wastewater to grow commercial floriculture, leafy vegetables and fish in an integrated manner. The designed system has shown removal capacity of >95% for pathogenic microbial loads (*viz.* faecal coliform and E.coli), >90% for heavy metals (*viz.* Fe, Mn, Zn, Cu, Ni, Cd), >80% in organic loads (BOD) and for salts in saline groundwater EC 25%, sodium 38%, Ca+Mg 34%, bicarbonate 83%, chloride 43% and nitrate 74% in 48 hrs of Hydraulic retention time and with 5-10% evapotranspiration losses of water. Among various commercial flowering crops screened (Marigold, Chrysanthemum, Gladiolas, Tuberose, Aster, Jasmine, gerbera) on the wetland system, marigold has performed the best and is able to tolerate water logging, metal pollution, organic load as well as microbial pollution efficiently and also shown pollutant removal capacity to some extent and could be a potential crop for integration with wastewater treatment under constructed wetland system. In the mild climate of Maharashtra, four crops of African marigolds can be taken in a year with flower yields of up to 500g flower/plant and about 10 cm diameter. Among various vegetable crops tested in the aquaponics system (Spinach, Lettuce, Cucumber, Tomato, Coriander, Cabbage, Cauliflower, Chilli) and

Fig. 2.2.7: Constructed wetland and integrated aquaponics system

fish (Pangasius, Carp, Gift Tilapia); Spinach + Pangasius has performed the best with yield of up to 100g spinach/plant and 100% increase in pangasius fish body weight in 3 months. Treated water was found safe for agricultural reuse as per WHO/ FAO/Indian Standards, harvested marigolds were safe for human use, and spinach and fish were safe for human consumption. System set-up cost was estimated at Rs. 2000 each for a 100-litre constructed wetland and aquaponics system, while electricity consumption in their operation was 0.06 unit/100-litre water. This filtration System can operate at various scales (small, medium and large) and has a system life of more than ten years if a treatment unit is made with cement and more than 5 years if it is made of PVC material. The system can be run by a less skilled person with no sludge disposal problem. This NIASM Subsurface-flow Constructed wetland and integrated Aquaponics system has been prepared in two designs: (a) horizontal and (b) vertical. Horizontal systems occupy more area to grow more number of plants for commercial floriculture but produce less volume of treated water due to evapotranspiration loss (10-20%), while vertical systems occupy less area with less evapotranspiration losses of water (5-10%), i.e. filter more water in less area. This wastewater treatment and reuse strategy has the potential to mitigate the water scarcity problem by providing additional water sources in water scare regions and reducing the burden of wastewater treatment on CETP and STPs. It can emerge as a business model in urban and peri-urban village areas. reducing greenhouse gas emissions from wastewater mismanagement and providing sanitation and hygiene in developing countries for achieving sustainable development goals.

Vermicomposting of farm waste using Red wiggler worm (*Eisenia fetida*) and African night crawlers

Crop residue generated from the institute campus were collected and composted at the Vermicomposting unit of ICAR-NIASM using two earthworm species Red wiggler worm (*Eisenia fetida*) and African night crawlers (*Eudrilus eugenia*), without using animal waste or cow dung and their compost quality, composting time, and recovery percentage were assessed. In 2022 about 2100 kg and in 2023 1800 kg vermicompost was prepared from Farm weed (600 kg), and thrash of Sugarcane (300 kg), Soyabean (350 kg), Ragi (200 kg), Groundnut (300 kg), Coconut leaf (100 kg), Quinoa (64.3 kg), Chia (55. 5kg), Wheat straw (50 kg), Sunflower (40 kg), Bamboo (20 kg), Turmeric (18 kg), Typha (3.5 kg), Bajra (3.6 kg) and Chickpea (4.7 kg). The average quality of the prepared vermicompost was found to have pH 7-8, EC 2.06dS m^{-1}, nitrate 81.92 mg kg^{-1}, phosphate 52.98 mg kg^{-1}, sodium 81.04 mg kg^{-1} and potassium 621.43 mg kg^{-1}. The farm weed had dormant seeds, and the sodium content was found to be the highest (410.5 mg kg^{-1}). Composting time varied from 10 months (Sugarcane) to 2 months (Farm weed), and the recovery percentage varied from 95% (Farm weed) to 35% (Sugarcane leaf). The chemical analysis of compost prepared from the harvest of 2023 comprising farm weed (1600 kg) sunflower (25 kg), sugarcane (70 kg), quinoa (25 kg), foxtail millet (10 kg), geranium (25 kg), typha & vetiver (20 kg), marigold waste (5 kg) is being carried out.

Fig. 2.2.8: Vermicomposting setup

Collection of indoor air-purifying plant species

Indoor air pollution is a significant problem in modern houses, and it can be up to ten times worse than outdoor air pollution since contained areas enable potential pollutants to build up more than open spaces due to poor ventilation and limited air circulation. Controlling indoor air pollution is difficult and costly as pollutants vary in many types. Plants are used as an efficient environmental cleaning system in a process known as "Phytoremediation". More than 70 types of indoor air purifying plants were collected and classified for their light requirement, water requirement and type of pollutants removing capabilities *viz.* Areca palm, Raphis palm, Rubber plant, Peace lily, Snake Plant, Money Plant, Dieffenbachia, Philodendron Xanadu, Philodendron Selloum 'Green Princess', Philodendron Burle Marx, Dracaena compacta, Dracaena, Dracaena, Angel dracaena, Fern morpankhi, Satavari plumosa Fern, Calathea Sanderiana, Calanthea zebrine, Peacock plant, Syngonium podophyllum, Syngonium pink, Syngonium White Butterfly, Tradescantia pallida, Tradescantia bicolor, Aloe barbadensis, Aloe Vera Star, Jade plant, Fittonia Pink Plant, Tradescantia Spathacea, Tradescantia zebrina, ZZ plant, Pilea microphylla, Spider plant, Chlirophytum spider plant, Homalomena Plant, Anthurium Red Mini, Cordyline fruticosa chocklate queen, Croton petra, Kalanchoe etc.

Evaluation of new soybean genotypes as off-season intercrop in sugarcane

ICAR-IISR evaluated new soybean genotypes as an intercrop in sugarcane for its off-season suitability (January to April) and yield potential at multiple locations (Uttar Pradesh, Karnataka and Maharashtra (at ICAR-NIASM)). Five soybean genotypes were sown as intercrop in farmers' sugarcane fields (Malegaon, Baramati, Pune, Maharashtra) on 15th February 2023 in medium-deep black soils. Results revealed that all the soybean varieties performed comparatively superior during the off-season without much yield loss. Grain yield was recorded in the descending order of genotypes: NRC-131 (22.75 q ha^{-1}) > NRC-130 (20.99 q ha^{-1}) > NRC-136 (20.03 q ha^{-1}) > YMV-11 (13.34 q ha^{-1}) > JS-20-34 (10.86 q ha^{-1}). Therefore, these tested areas would be the potential option for climate-resilient soybean cultivation expansion without causing significant loss in sugarcane yield.

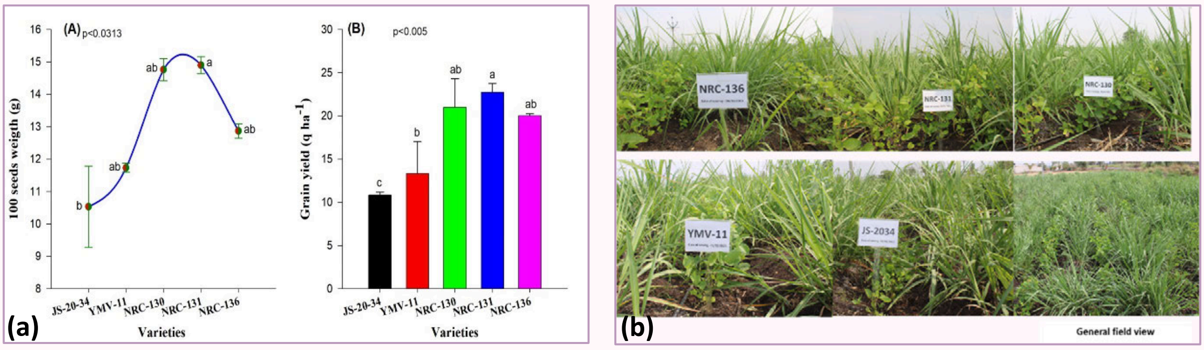


Fig. 2.2.9: a) 100 seed weight and seed yield b) field plots of soybean varieties as intercrops with sugarcane

Prevelance of dragon fruit stem canker (*Neoscytalidium dimidiatum*) in various districts of Maharashtra

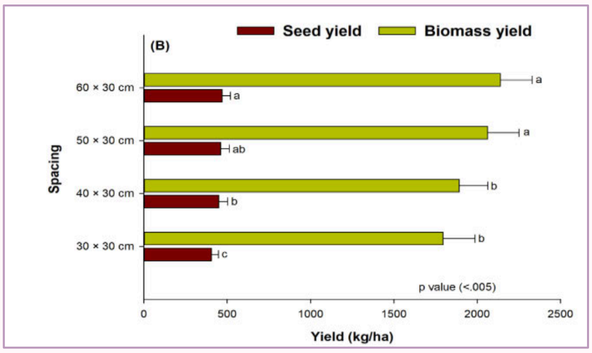
The survey of Dragon fruit orchards in Pune, Satara, Solapur, Ahmednagar, Latur, Beed, Parbhani, Nanded, and Jalgaon districts of Maharashtra, revealed prevelance of stem canker fungal disease primarily affecting *H. undatus, H. polyrhizhus,* and *H. megalanthus* (Table 2.2.6). The disease was observed consistently throughout all three seasons, with varying levels of severity. Initial symptoms involved small circular chlorotic spots with occasional brick red flecks, which later developed into raised lesions. These lesions turned necrotic, resulting in the formation of black, raised pycnidia. Over time, the necrotic tissues containing pycnidial masses detached from healthy tissues, giving the infected cladodes a shot hole appearance. Additionally, yellowing and rotting of infected cladodes occurred prior to the pathogen's advancement. Fruits infected by pathogen showed sunken, chlorotic lesions with subsequent rotting. The presence of the pathogen was confirmed through molecular and morphological characterization after isolating it from infected plant parts. On molecular confirmation of submitted sequences post comparision with NCBI database sequences, accession numbers were given (Table 2.2.6).

Table 2.2.6: Occurrence of stem canker (*Neoscytalidium dimidiatum*) species in various districts of Maharashtra

Isolate	Host	Location	GenBank accession number		
			ITS	BT2	TEF-1α
SLNeo	*H. polyrhizus*	Solapur	OM884028	OM927962	OM927965
LNeo	*H. polyrhizus*	Loni, Pune	OM884029	ON099066	OM927966
MGneo	*H. undatus*	Malegaon, Pune	OM884030	OM927963	OM927964
Kneo	*H. undatus*	Khatav, Satara	OM899800	OQ349385	OM984744
LH1Neo	*H. undatus*	Harangul, Laur	OQ318538	-	OQ332859
LH2Neo	*H. undatus*	Harangul, Laur	OQ318539	-	OQ332860
GT2Neo	*H. undatus*	Gotondi, Pune	OQ318540	OQ349386	OQ332861
J1Neo	*H. polyrhizus*	Jalgaon	OQ318541	-	OQ332862
BW1Neo	*H. polyrhizus*	Bhalawani, Solapur	OQ318542	-	OQ332863
BW4Neo	*H. polyrhizus*	Bhalawani, Solapur	OQ318543	OQ349387	OQ332864
YellowD1Neo	*H. megalanthus*	Sangola, Solapur	OQ318544	-	OQ332865
YellowD2Neo	*H. megalanthus*	Sangola, Solapur	OQ318545	OQ349388	OQ332866
Bd1Neo	*H. polyrhizus*	Beed	OQ318546	-	OQ332867
BABNeo	*H. polyrhizus*	Bardapur, Beed	OQ318547	OQ349389	OQ332868
NKNeo	*H. polyrhizus*	Nanded	OQ318548	OQ349390	OQ332869
PANeo	*H. polyrhizus*	Parbhani	OQ318549	OQ349391	OQ332870

Optimization of plant population for efficient utilization of space and nutrients in chia

The field trial conducted for optimizing the chia plant population for efficient utilization of space and nutrients during 15th September to February 2023 at ICAR-NIASM in shallow basaltic soils resulted in higher and comparable seed yield (610-650 kg ha^{-1}) at plant spacing of 50 × 30 cm or 60 × 30 cm. Application of NPK at 90:60:75 kg ha^{-1} and 110:75:95 kg ha^{-1} recorded greater and at par seed yield of chia (635-658 kg ha^{-1}). The improvement in the seed yield might be associated with greater leaf area that could enable plants to utilize maximum resources such as water, nutrient and space.



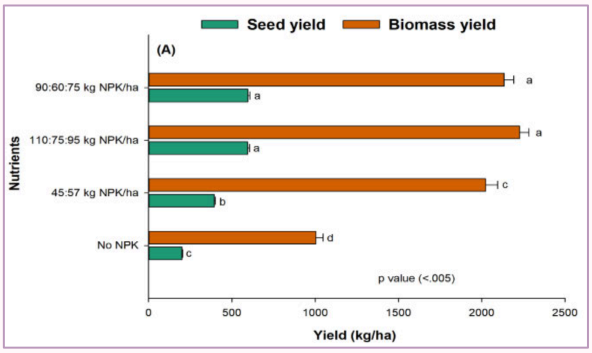


Fig. 2.2.10: Seed yield of Chia in response to spacing and nutrients

Studies on horticultural crops

Sunburn management in Dragon fruit: Evaluation of colour shade nets of shade factor 35 and 50% for sunburn management in dragon fruit at ICAR-NIASM resulted in significant reduction of sunburn, disease incidence and maximum chlorophyll content (3.34–3.91 µg ml^{-1}) and NDVI across dragon fruit genotypes compared to open field growing conditions. Maximum membrane stability index (63.53%) was observed in 50% white shade net. Dark colour shade net, specifically 50% green, reduced light intensity to 44.83 klux. 35% white shade net led to highest new sprouts in white fleshed genotypes. Effective cladode percentages were highest (18.80 and 18.59%) in green and white 50% shade nets. Shading reduced time of flower bud initiation compared to plants grown in open. However, highest yield White 50% shadenet treatment gave yield of 11.96 kg $pole^{-1}$ (1.91 t ha^{-1}) in white fleshed dragon fruit. Highest TSS (27.46%), total phenols (83.56 mg per 100g) and fruit firmness (0.46 kg cm^{-2}) was observed in plants grown in open conditions. Red fleshed dragon fruit taken in white 50% shadenet treatment exhibited highest acidity (3.97%) and ascorbic acid content (18.30 mg per100g). Thus white 50% shade net exhibited positive effects on sunburn management, disease incidence and overall yield of dragon fruit genotypes.

Fig. 2.2.11: Sunburn management in Dragon fruit (*Hylocereus spp.*) through artificial shading

Canopy management in Dragon fruit for maximizing productivity: To optimize canopy management practices and identify number of cladodes per fruit, plants with different cladode numbers were categorized and observed for growth, flowering, fruiting, sunburn and disease incidence. It was observed that, sun burn and disease incidence in dragon fruit was more in plants with higher percentage of old cladodes or sparse canopy. The results indicated that canopy treatments significantly reduced sunburn and disease incidence over control or un-pruned canopy. Moreover, pruning treatments improved chlorophyll (5.62 µg ml^{-1}) and NDVI (0.67-0.69) in dragon fruit over control. Canopy treatment T5 (121-140 cladodes) had significantly higher effective cladodes (46.75 %) and yield (17.77 t ha^{-1}) and lower disease incidence (7.59%). Therefore, pruning or canopy treatment T5 (121-140 cladodes) can be maintained at base pruning to have good canopy renewal, higher flowering, fruiting and yield with reduced sunburn and disease incidence.

GHG and energy budgeting in fruit crops: In Guava and pomegranate, highest GHG emissions were attributed to use of electricity followed by fertilizer, diesel and herbicide use. GHG budgeting estimated net mitigation of 31.81 and 28.81 ton CO_2 eq. ha^1 from Guava (5^{th} year rotation) and Pomegranate (7^{th} year rotation) cultivation.

Comparative evaluation of natural, organic and conventional farming systems in fruit crops: These studies in Dragon fruit and Custard apple were continued during 2023 in rocky lands of semi-arid regions of Maharashtra. Preparation of Jeevamrit (mixture of dal flour, jaggery, cow urine, healthy soil and cow dung in water) and application of different inputs under these three systems is underway as per standard protocols.

Potential role of dietary zinc on gene regulation of growth performance and immunity in *Pangasianodon hypophthalmus* against multiple stresses

This study investigates dietary zinc (Zn) to mitigate arsenic, ammonia and high-temperature stress on *Pangasianodon hypophthalmus.* The fish were exposed to different combinations of arsenic (2.68 mg L^{-1}), ammonia (NH3, 2.0 mg L^{-1}) pollution and high temperature (34 °C) stress for 105 days. The treatments include control, As, NH_3, As+NH_3, NH_3+T, As+NH_3+T, Zn-5 mg kg^{-1}, Zn-10 mg kg^{-1}, Zn-15 mg kg^{-1}, Zn-5 mg kg^{1}As+NH_3+T, Zn-10 mg kg^{-1}As+NH_3+T and Zn-15 mg kg^{-1}As+NH_3+T. The genes related to apoptosis, cytokines, chemokines, immunity and growth, particularly nuclear factor kappa B (*NFkB*), were studied in liver and gill tissues. Diets containing zinc were prepared with graded levels of 0, 5, 10 and 15 mg kg^{-1} diet. Cortisol, inducible nitric oxide synthase (*iNOS*), heat shock protein (*HSP70*), metallothionine (*MT*), catalase (*CAT*), superoxide dismutase (*SOD*), and glutathione peroxidase (*GPx*), were upregulated by arsenic (As), ammonia (NH_3) and high temperature (34 °C) stress, but downregulated with dietary Zn at 10 mg kg^{-1} diet. The NFkB pathway genes, including caspase 3a (*CAS 3a*), tumor necrosis factor (*TNFα*), interleukin (*IL*), and toll-like receptors (*TLR*), were noticeably upregulated due to stressors. However, Zn supplementation downregulated these genes and mitigated stress in the fish exposed to As+NH_3+T. Genes related to growth hormone (*GH*), growth hormone regulator 1 and β (*GHR1 and GHRβ*), were noticeably downregulated in response to stressors. Conversely, Zn-containing diets significantly upregulated *GH*, *GHR1*, and *GHRβ*, while myostatin (*MYST*) and somatostatin (*SMT*) results differed from other growth-related genes. control or arsenic, ammonia and temperature stress for 105 days. The liver and kidney tissues showed the highest arsenic bioaccumulation. Notably, Zn-containing diet was observed to protect fish from *Aeromonas hydrophila* infection. Overall, the results indicate that Zn-containing diet at 10 mg kg^{-1} diet improved the regulation of the stress-related genes, enhancing the resilience of fish to multiple stressors and infections in fish.

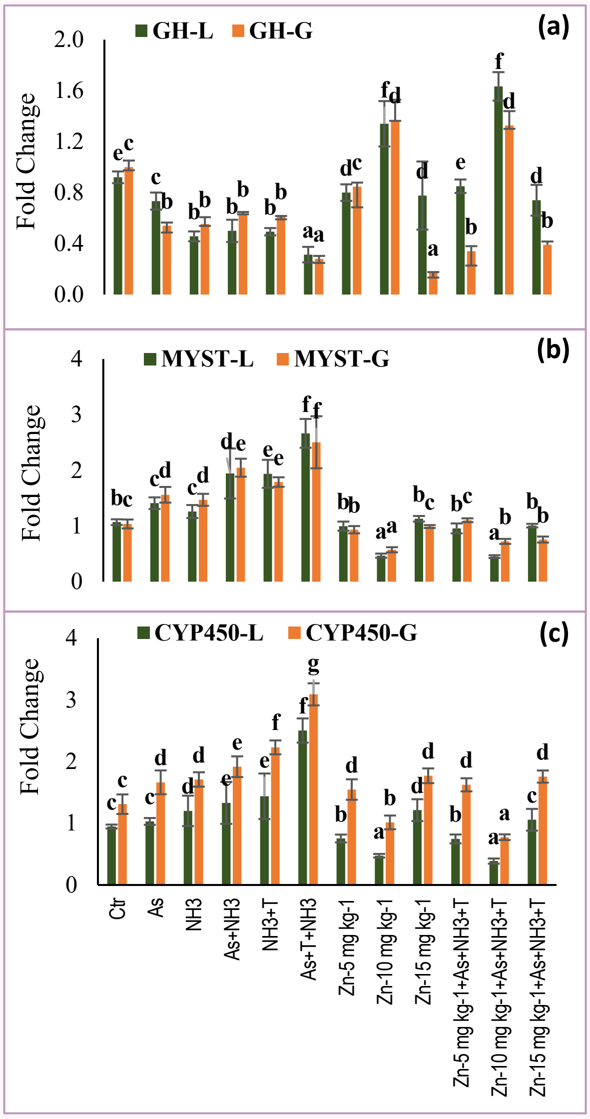


Fig. 2.2.12: Mitigating role of zinc on a) growth hormone (*GH*), b) myostatin (*MYST*) and c) *CYP 450* genes expressions in liver and gill tissues of *P. hypophthalmus*

Synergistic effect of nickel and temperature on gene expression, multiple stress markers and depuration

The present investigation aimed to determine the median lethal concentration (96h-LC_{50}) of nickel alone and concurrent with high temperature (34 °C) (Ni+T) using static non-renewable bioassay toxicity test in *Pangasianodon hypophthalmus*. The groups treated under exposure to Ni reared under 25-28.9 °C and Ni+T exposure group reread under 34°C. The median lethal concentration of Ni and Ni+T was determined as 19.38 and 18.75 mg L^{-1}, respectively at 96 h. Oxidative stress viz. catalase (CAT), superoxide dismutase (SOD), glutathione-s-transferase (GST), and glutathione peroxidase (GPx) in liver, gill and kidney were noticeably elevated with Ni and Ni+T during 96 hr. Whereas the CAT, GPx and SOD gene expression were significantly upregulated with Ni and Ni+T. Trilox equivalent antioxidant capacity (TEAC), cupric reducing antioxidant capacity (CUPRIC), ferric reducing ability of plasma (FRAP) and ethoxyresorufin-O-deethylase (EROD) and acetylcholine esterase (AChE) were reduced due to exposure to Ni and Ni+T. Cellular metabolic stress and lipid peroxidation were highly affected due to Ni and Ni+T exposure.

Moreover, the gene expression of interleukin (IL), tumor necrosis factor (TNFα), toll-like receptor (TLR), and total immunoglobulin (Ig) was remarkably downregulated following exposure to Ni and Ni+T. HSP 70, iNOS expression, ATPase, Na+/K+-ATPase and cortisol, blood glucose was significantly elevated with Ni and Ni+T in *P. hypophthalmus*. The kidney and liver tissues were highly accumulated with Ni, whereas DNA damage was reported in gill tissue. Interestingly, the depuration study revealed that at 28th days, the Ni bioaccumulation was below the Maximum residue limit (MRL) level. Therefore, the present study revealed that Ni and Ni+T led to dysfunctional gene and metabolic regulation affecting physiology and genotoxicity.

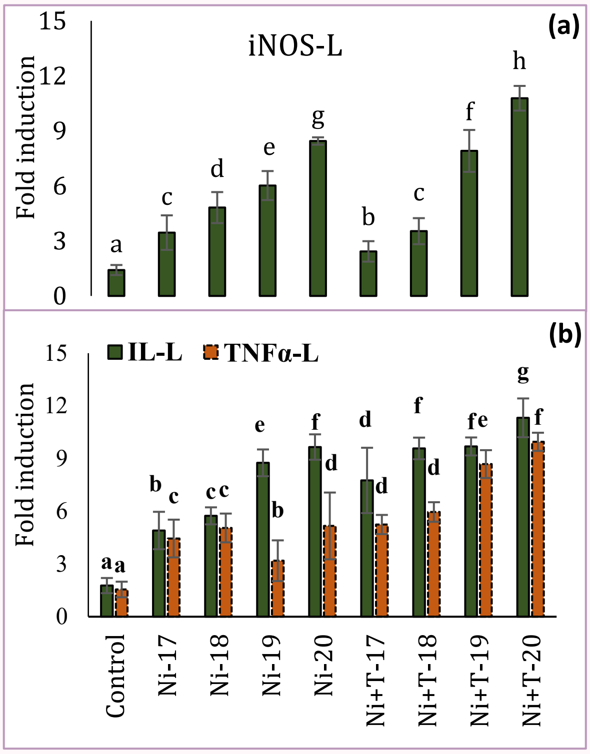


Fig. 2.2.13: Effect of nickel alone and concurrent with high temperature exposure on (a) iNOS b) interleukin (IL), and tumour necrosis factor (TNFα), in liver during 96 hr acute toxicity test of *P. hypophthalmus*

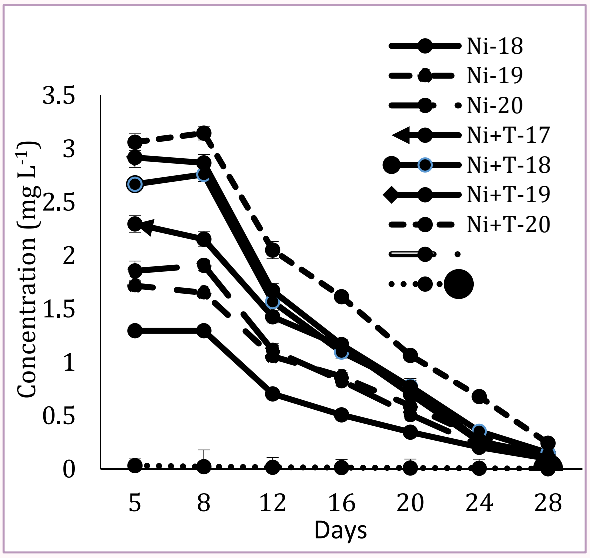


Fig.2.2.14: Depuration of Ni in muscle tissues and detoxification in exposure to nickel and high temperature during acute toxicity test in *P. hypophthalmus*

Manganese nano-particles control the gene regulations against multiple stresses in *Pangasianodon hypophthalmus*

An experiment was conducted to delineate the potential of manganese nanoparticles (Mn-NPs) to mitigate arsenic and ammonia pollution as well as high-temperature stress in *Pangasianodon hypophthalmus*. The fish were exposed to different combinations of arsenic and ammonia pollution and high-temperature stress while incorporating diets enriched with Mn-NPs. Including Mn-NPs at 3 mg kg^{-1} in the diet led to a noteworthy downregulation of cortisol and HSP 70 gene expression, indicating their potential to mitigate stress responses. Furthermore, immune-related gene expressions were markedly altered in response to the stressors but demonstrated improvement with the Mn-NPs diet. Interestingly, the expression of inducible nitric oxide synthase (iNOS), caspase (CAS), metallothionine (MT) and cytochrome P450 (CYP450) genes expression were prominently upregulated, signifying a stress response. The growth-related gene expressions such as growth hormone (GH), growth hormone regulator 1 (GHR1 and GHRβ), Insulin-like growth factor (IGF1 and IGF2) were significantly upregulated. In contrast, myostatin, somatostatin was downregulated upon the supplementation of dietary Mn-NPs with or without stressors in fish. The gene expression of DNA damage-inducible protein and DNA damage in response to head DNA % and tail DNA % was protected by Mn-NPs diets. Furthermore, Mn-NPs demonstrated a capacity to enhance the detoxification of arsenic in different fish tissues. Our study aimed to comprehensively examine dietary Mn-NPs' role in mitigating the multiple stressors using gene regulation mechanisms, enhancing the productive performance of *P. hypophthalmus*.

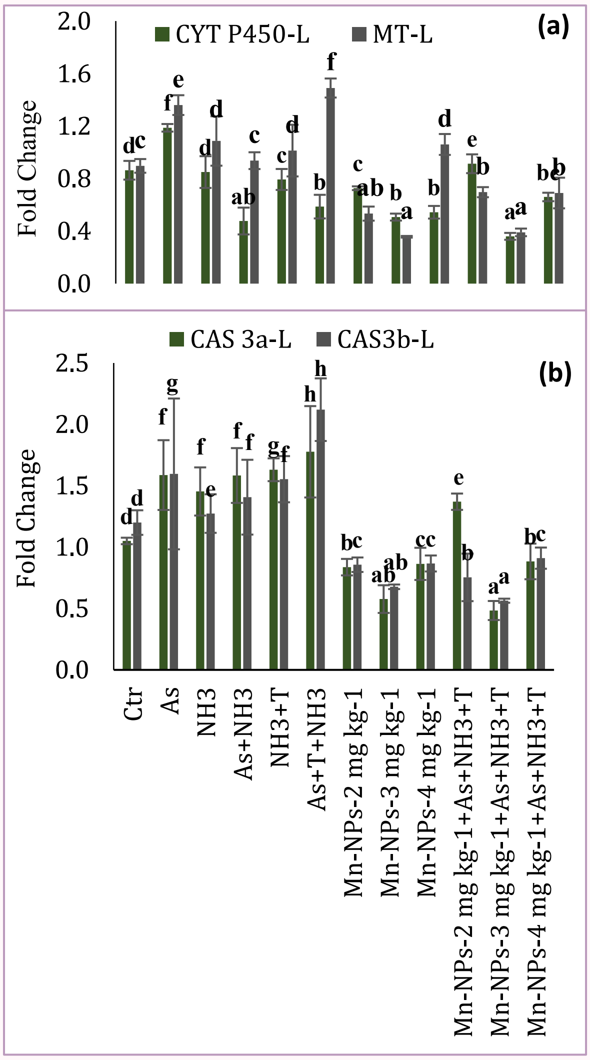


Fig. 2.2.15: Effect of Mn-NPs on mitigation of As, NH_3 & high temperature stress on gene expression of a) CYP 450, metallotheonine (MT), & b) Caspase (Cas 3a, 3b) in fish liver.

Role of dietary quinoa husk (*Chenopodium quinoa*) for gene regulations for growth and immunity against multiple stresses in *Pangasianodon hypophthalmus*

The quinoa (*Chenopodium quinoa*) husk (the waste material of quinoa) was used to prepare fish feed by replacing fish meal. Six isonitrogenous diets (30%) and isocaloric diets were prepared by replacing fish meal with quinoa husk (containing 25% protein) at different percentages: 0% quinoa (control), 15%, 20%, 25%, 30%, and 35%.

The formulated feed was also assessed for gene regulation related to antioxidative status, immunity, stress proteins, growth regulation, and stress markers. The gene regulation of sod, cat, and gpx in the liver was noticeably upregulated with concurrent exposure to ammonia, arsenic, and high-temperature (NH_3+As+T) stress. However, quinoa husk at 25% downregulated sod, cat, and gpx expression compared to the control group. Moreover, genes related to stress proteins HSP70 and DNA damage-inducible protein (DDIP) were significantly upregulated in response to stressors (NH_3+As+T), but quinoa husk at 25% considerably downregulated HSP70 and DDIP to mitigate the impact of stressors.

Growth-responsive genes such as myostatin (MYST) and somatostatin (SMT) were remarkably downregulated, whereas growth hormone receptor (GHR1 and GHRβ), insulin-like growth factors (IGF1X, IGF2X), and growth hormone gene were significantly upregulated with quinoa husk at 25%. The gene expression of apoptosis (Caspase 3a and Caspase 3b) and nitric oxide synthase (iNOS) were also noticeably downregulated with quinoa husk (25%) when reared under stressful conditions. Immune-related gene expression, including immunoglobulin (Ig), toll-like receptor (TLR), tumor necrosis factor (TNFα), and interleukin (IL), also strengthened fish immunity with quinoa husk feed. Interestingly, the results of the present study revealed that replacing 25% of fish meal with quinoa husk could improve the gene regulation of *P. hypophthalmus* involved in mitigating ammonia, arsenic, and high-temperature stress in fish.

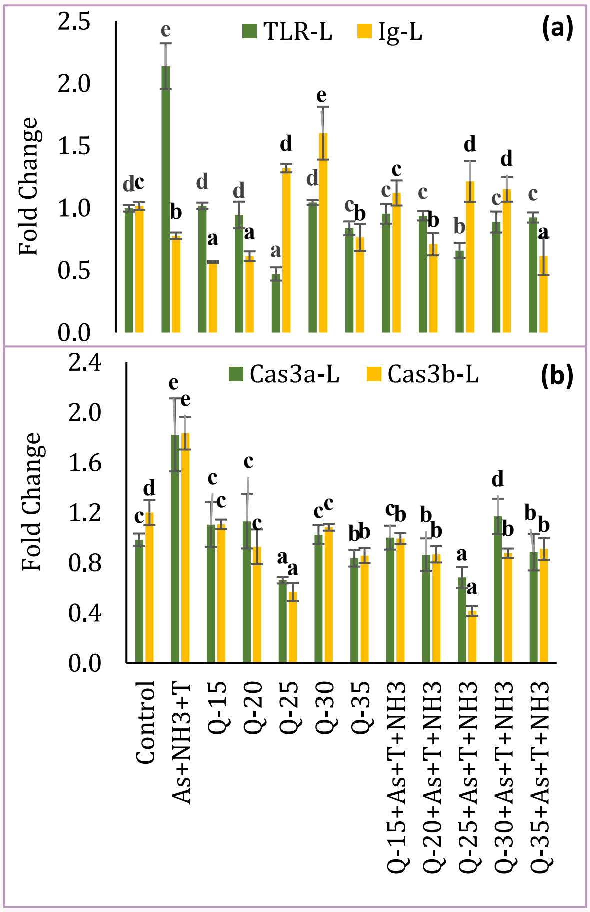


Fig.2.2.16: Effect of quinoa husk on a) TLR, IG and b) Caspase gene expression in fish liver reared under arsenic, high temperature and ammonia

2.3 SCHOOL OF WATER STRESS MANAGEMENT

One of the most significant abiotic stresses in Indian agriculture is water stress, which requires a multifaceted strategy to address. In order to develop adaptation and mitigation alternatives for the management of water-related abiotic stresses, the school of water stress management has extensively concentrated its operations. These include investigations pertaining to crops namely pigeonpea, cowpea, chickpea, rice, groundnut, garlic, common bean, sugarcane, quinoa, chia, chilli, dragon fruit, foxtail millet, eggplant, mango, and custard apple using multi-prong and multi-disciplinary approaches. The major research findings emerging out and the progress made under this programme during the past one year are summarized below.

Screening and identification of waterlogging tolerant pigeonpea genotypes

Seed Screening: All the 210 pigeonpea genotypes, including germplasm, breeding lines and checks, were screened for waterlogging tolerance at the seed stage following the procedure of seed submergence. Two seeds of each genotype were sown in pots (replicated four times); immediately after sowing, pots were submerged under water (water level was maintained 3 cm above of pots) in a cement pot for 96 hrs. After stress treatment for 96 hours, pots were well-drained, kept in the greenhouse and allowed for germination. Of the total screened genotypes, ICP-16309, ICP-7148, ICP-8255, ICP-6845, ICP-6815, ICP-10228, ICP-6370, ICP-10397, ICP-4903, ICP-7869, ICP-7507, NAM-2282 and NAM-314 germinated in all the replications and were found tolerant.

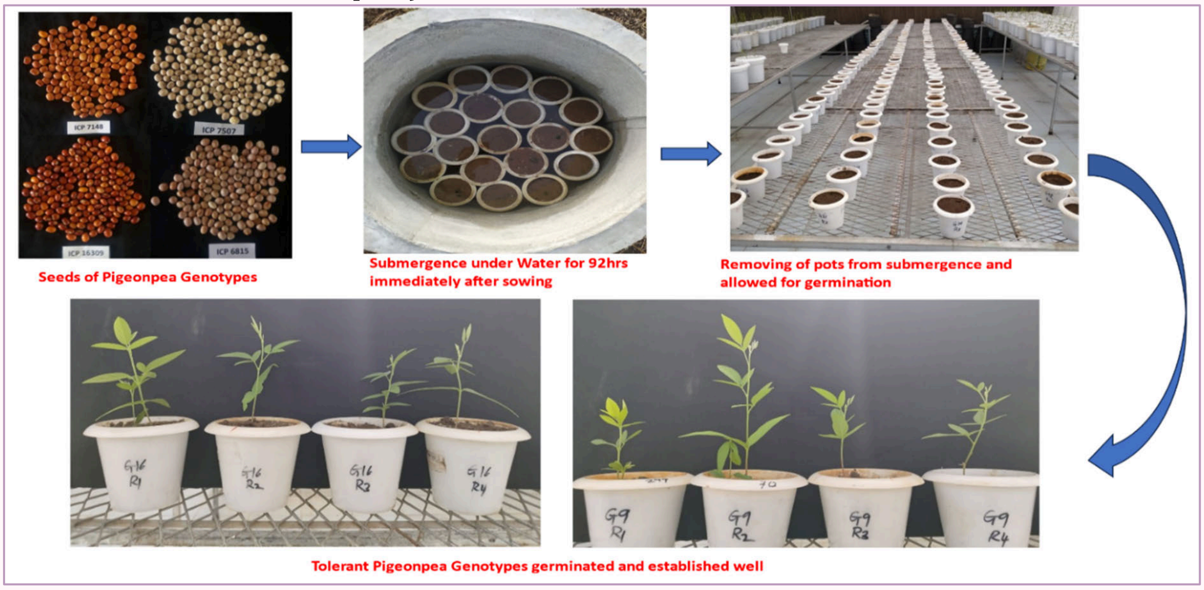


Fig. 2.3.1: Screening of pigeonpea at seed stage

Screening at the early seedling stage: The same set of genotypes were screened for waterlogging tolerance at the early seedling stage (21 days after emergence) for about ten days of waterlogging following standard protocol. Genotypes viz., ICP-16309, ICP-7148, ICP-8255, ICP-6845, ICP-6815, ICP-10228, ICP-6370, ICP-10397, ICP-4903, ICP-7869, ICP-7507, NAM-2282 and NAM-314 found tolerant and better than waterlogging tolerant check MAL15.

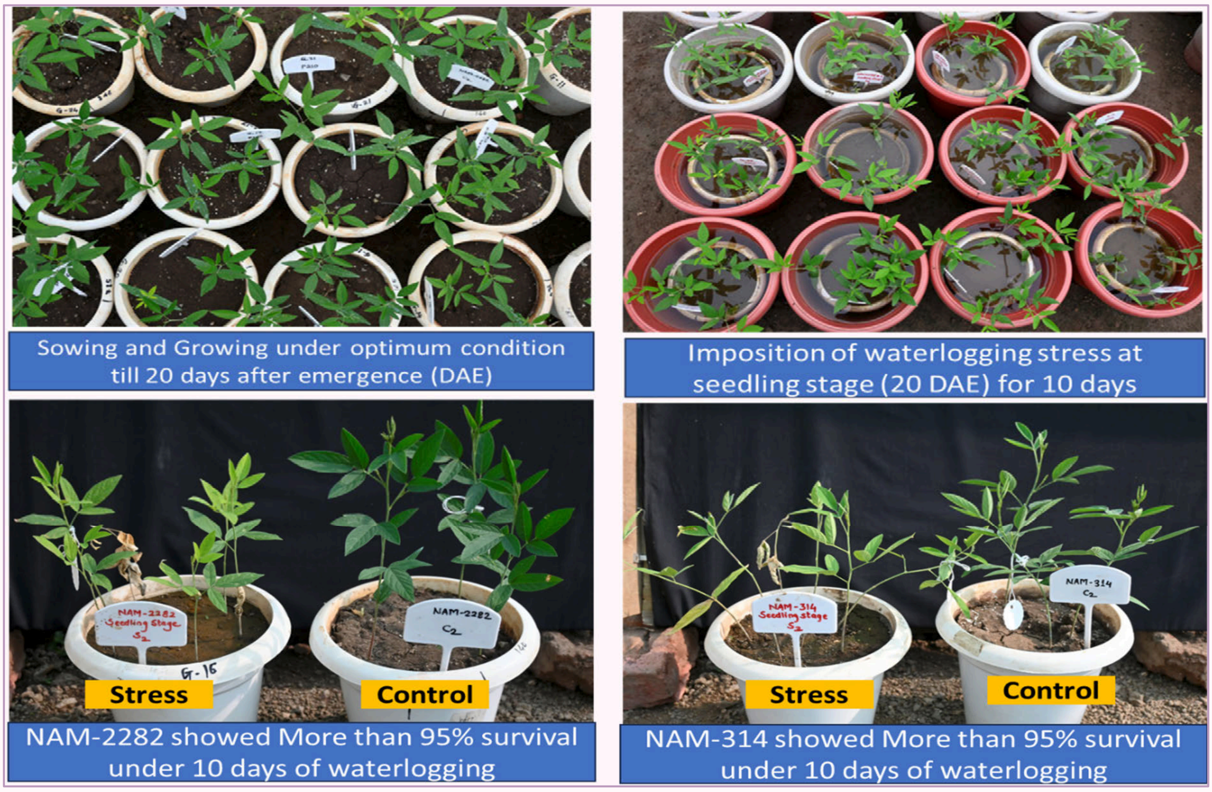


Fig.2.3.2: Waterlogging tolerance in pigeonpea genotypes at early seedling stage

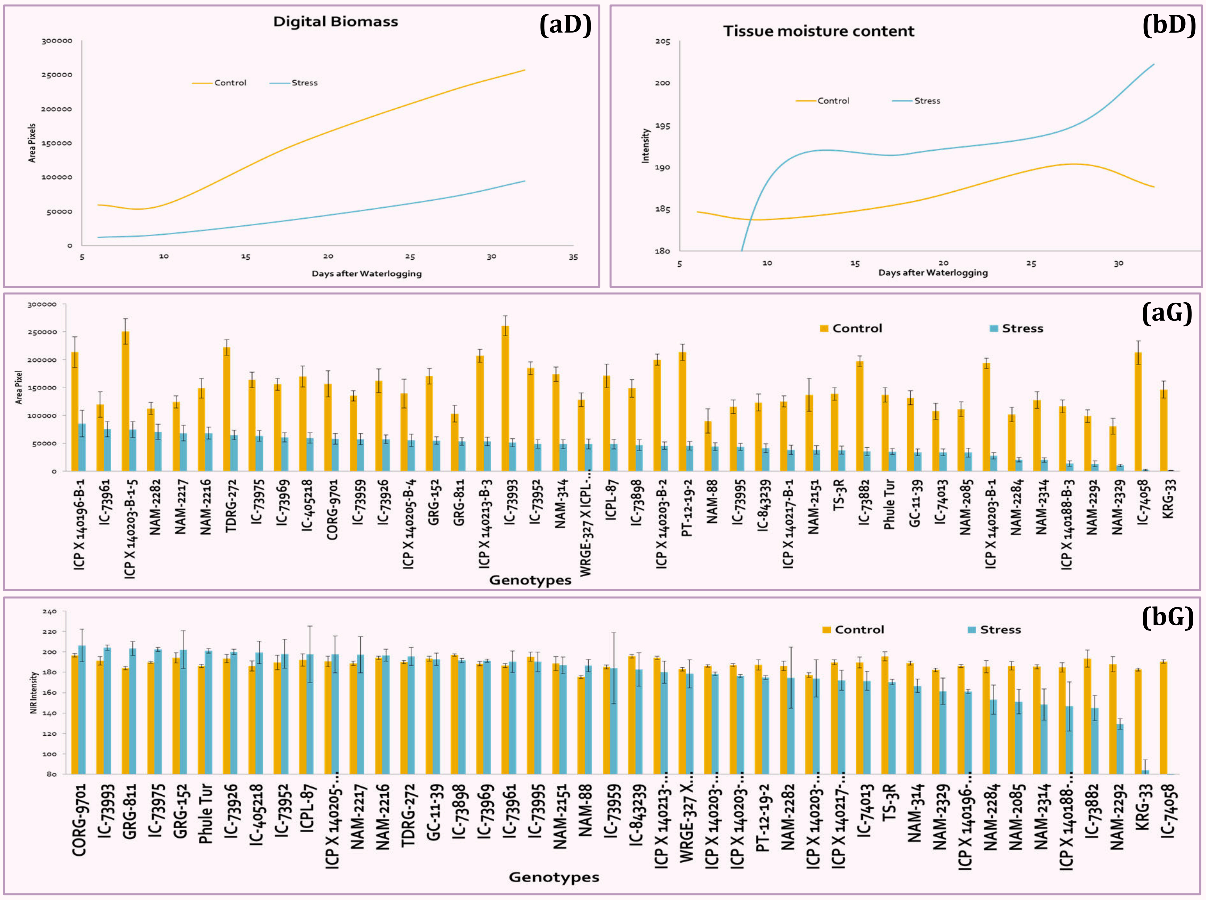


Fig. 2.3.3: Genetic variation among pigeonpea genotypes for (a) digital biomass (b) tissue water content across days (D) and genotypes (G) under control waterlogging stress

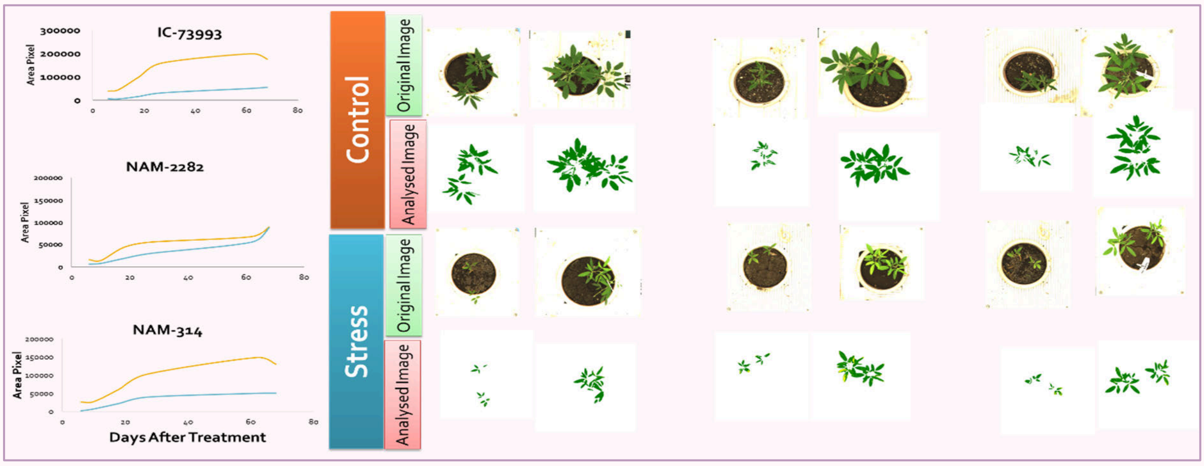


Fig. 2.3.4: Rate of recovery of waterlogging tolerant pigeonpea genotypes after stress

Identification of deficit moisture-tolerant pigeonpea germplasm accessions using the phenomics approach

Forty-eight pigeonpea genotypes, including advanced breeding lines, previously identified tolerant lines, and germplasms, were screened for deficit moisture stress at the early vegetative stage (45 days after stress) using the plant phenomics facility of ICAR-NIASM. There were significant differences between irrigation (control and drought stress), genotypes and Genotypes x Treatment for phenomic parameters such as digital biomass and tissue water content.

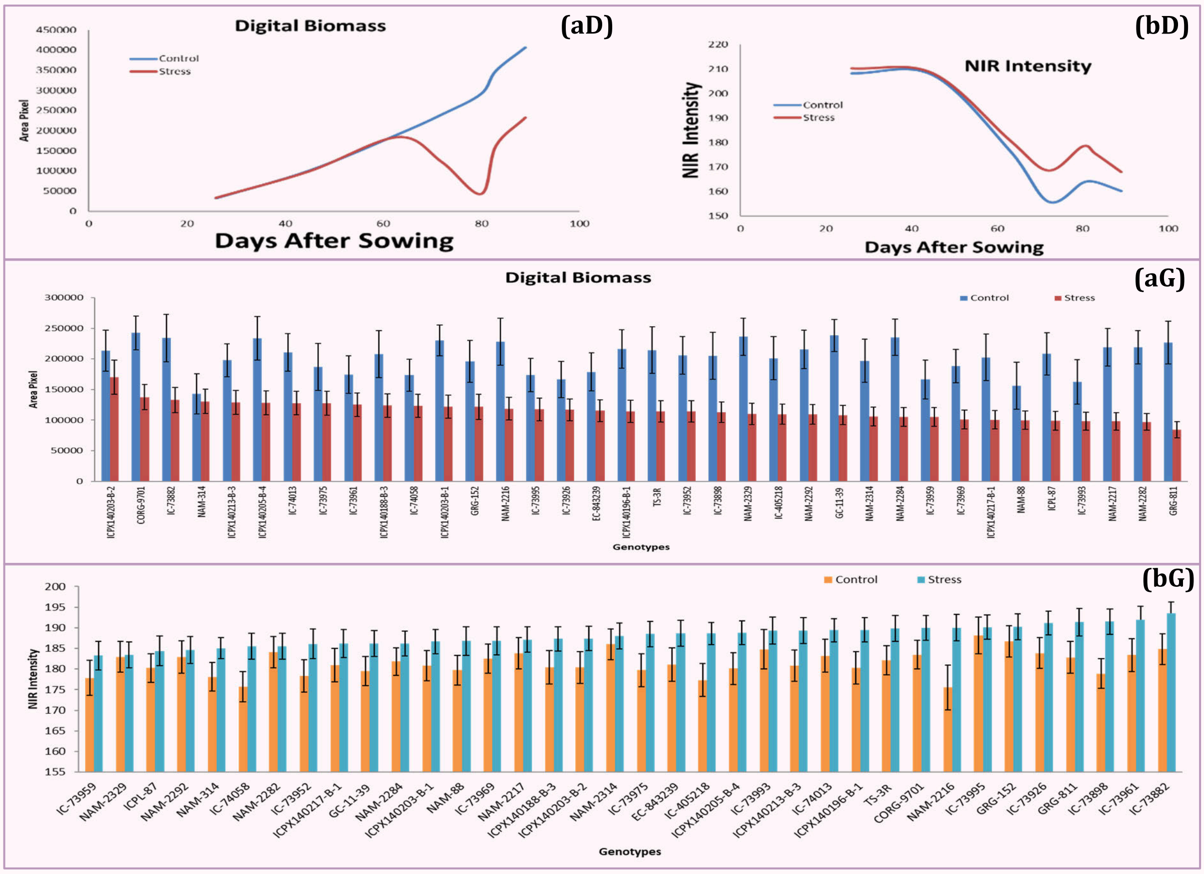


Fig. 2.3.5: Genetic variation among pigeonpea genotypes for (a) digital biomass (b) tissue water content across days (D) and genotypes (G) under deficit moisture stress treatment

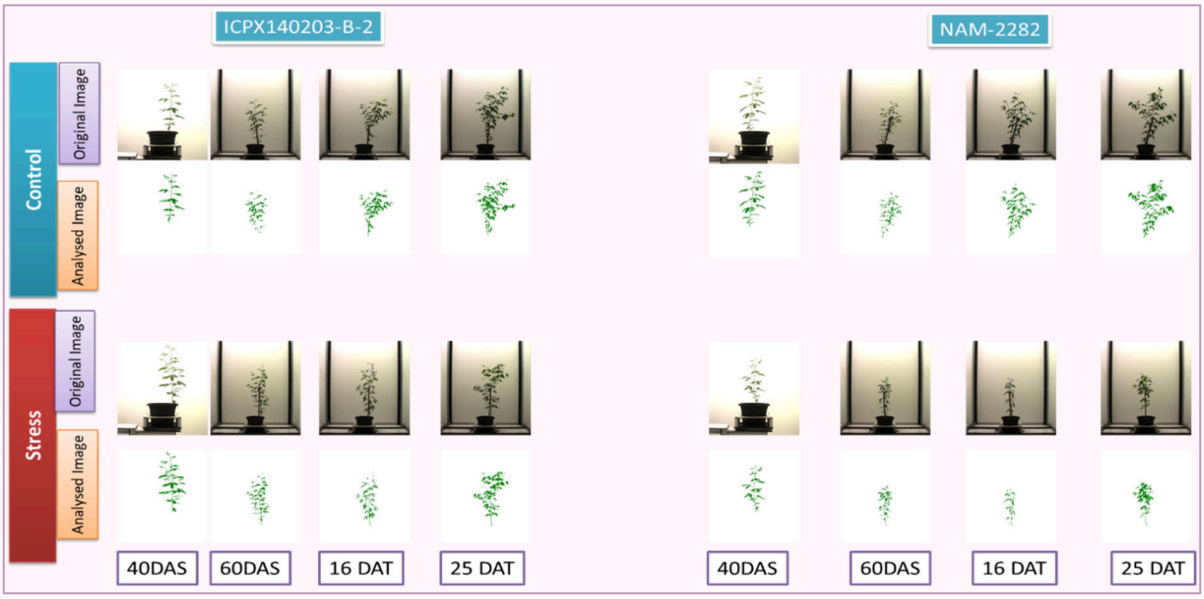


Fig. 2.3.6: Variation in digital biomass among tolerant pigeonpea genotypes

Among the genotypes, ICPX140203-B-2 recorded significantly higher biomass under stress than checks GRG811, 152 and TS3R. However, genotype IC73959 could retain higher tissue water content than all other tested genotypes.

Adventitious root formation contributed tolerance to waterlogging in Cowpea varieties

Five elite and popular cowpea varieties, *viz*., DC15, PL3, PL4, GC3 and RC101, were screened for waterlogging tolerance at the V4 stage (21 days after emergence) for ten days of waterlogging following standard screening protocol. Among the varieties, DC15 and PL4 were found to be tolerant to waterlogging. Waterlogging tolerance exhibited was associated with the rapid formation and an increased number of adventitious roots under ten days of waterlogging stress compared to other varieties.

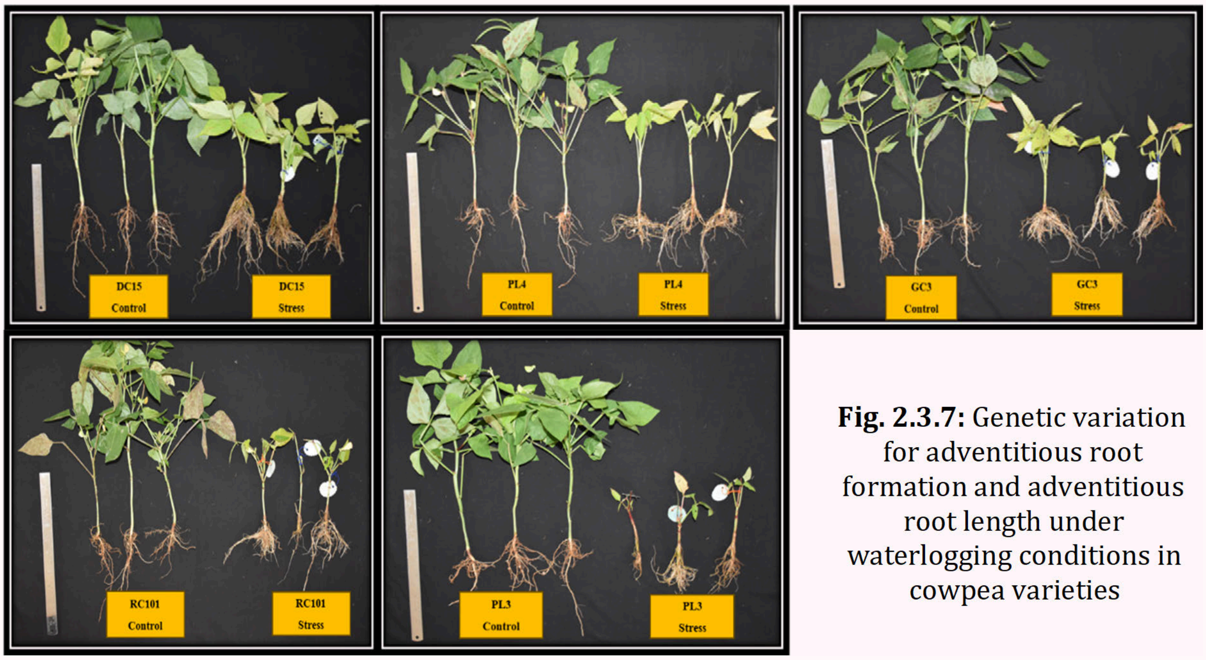


Fig. 2.3.7: Genetic variation for adventitious root formation and adventitious root length under waterlogging conditions in cowpea varieties

Identification of traits specific to high-temperature stress-tolerant Cowpea germplasm accessions

A two-year screening of 250 cowpea germplasm collections along with five checks (DC15, RC101, GC3, PL4 and PL3) at two locations (ICAR-NIASM & NBPGR, RS, Jodhpur) led to the identification of the following trait specific high-temperature stress tolerant germplasms of cowpea, which can be used for the development of high-temperature stress tolerant cowpea varieties for commercial cultivation.

Table 2.3.1: Trait specific identified genotypes

Type of Germplasm	Traits	Genotypes
Vegetable type	Very early (Escape Mechanism), 15 days earlier than checks (PL3, RC101, GC-3 and DC-15)	EC-724484, EC-724740, EC724484, EC-723684, IC-488084, IC488077, EC-243999, IC-259159, IC410043, IC554414
Fodder type	Higher fodder yield under stress and control (>23 q ha^{-1})	EC 240891, EC 107182, EC 240917, EC 240875, EC 240890, EC 240801, IC 488112, IC 488119, IC 488131, IC 488085,
Dual purpose grain type	High grain (>45g/plant) and fodder yield (>21-23 q ha^{-1})	IC 488095
	High leaf PS-II (Fv/Fm) (>0.79-0.8), high pod fluorescence (>0.79-0.8), high yield under both conditions (>43.5 g/plant)	EC 724764-B, IC 560916, IC 548288, EC 240966-A, EC 724905, EC 724484, EC 240989-A, EC 241058, IC 402097, EC 240868, IC 548860, IC 507157, EC 724805, IC 488185, IC 418505, IC-402161

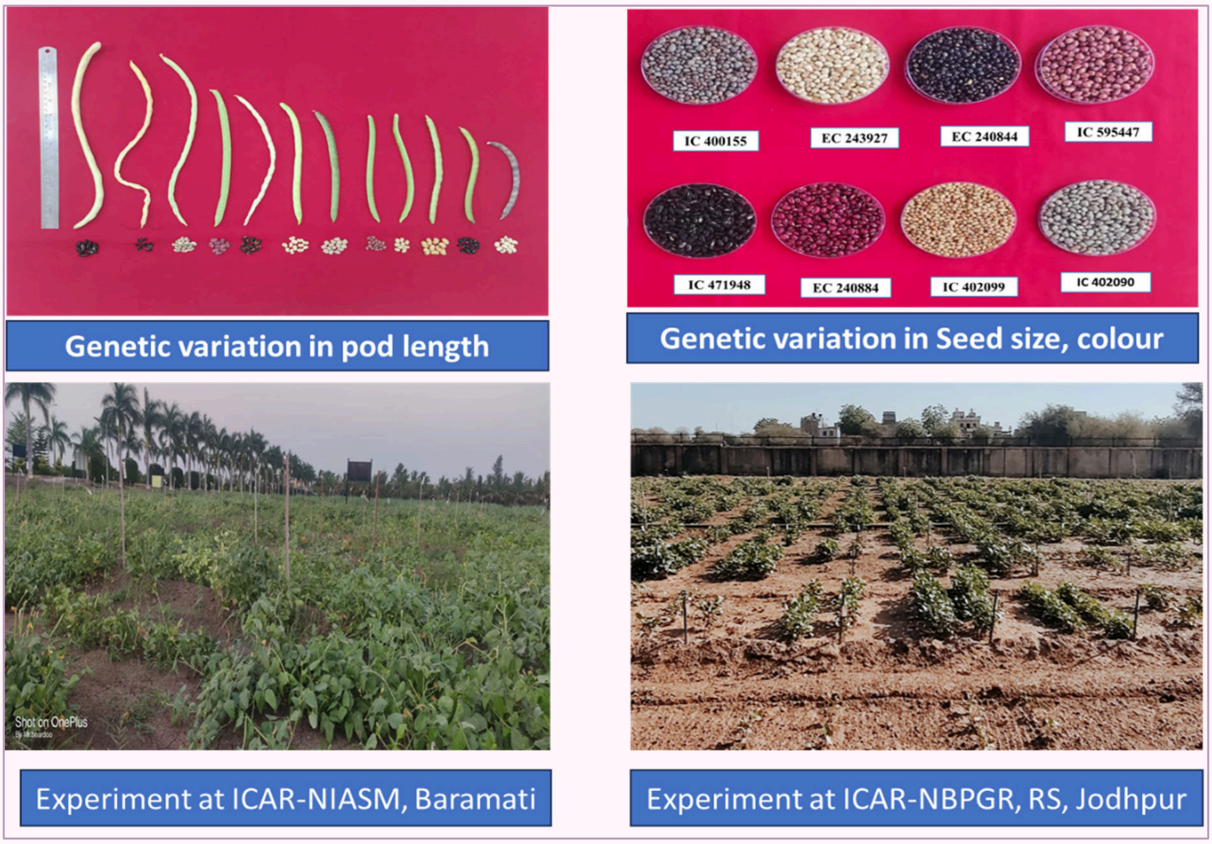


Fig. 2.3.8: Experiment at two locations and variation in pod length, seed colour and size

Identification of deficit moisture-tolerant Cowpea germplasm accessions using the phenomics approach

Fifty diverse cowpea germplasm were selected from minicore collections for screening them for tolerance to deficit moisture stress at seedling stage. 20 days after watering was stopped to induce deficit moisture stress for stress treatment (<20% of field capacity (FC)), whereas optimum condition (>80% FC) was maintained in control treatment using automated irrigation system at Lemna tech platform for about 30 days. Each accession was regularly monitored for biomass accumulation and tissue water content throughout the stress period and 20 days post stress period. Genotype EC240861 could able to maintain higher biomass and IC488240 retained higher tissue water content under stress conditions.

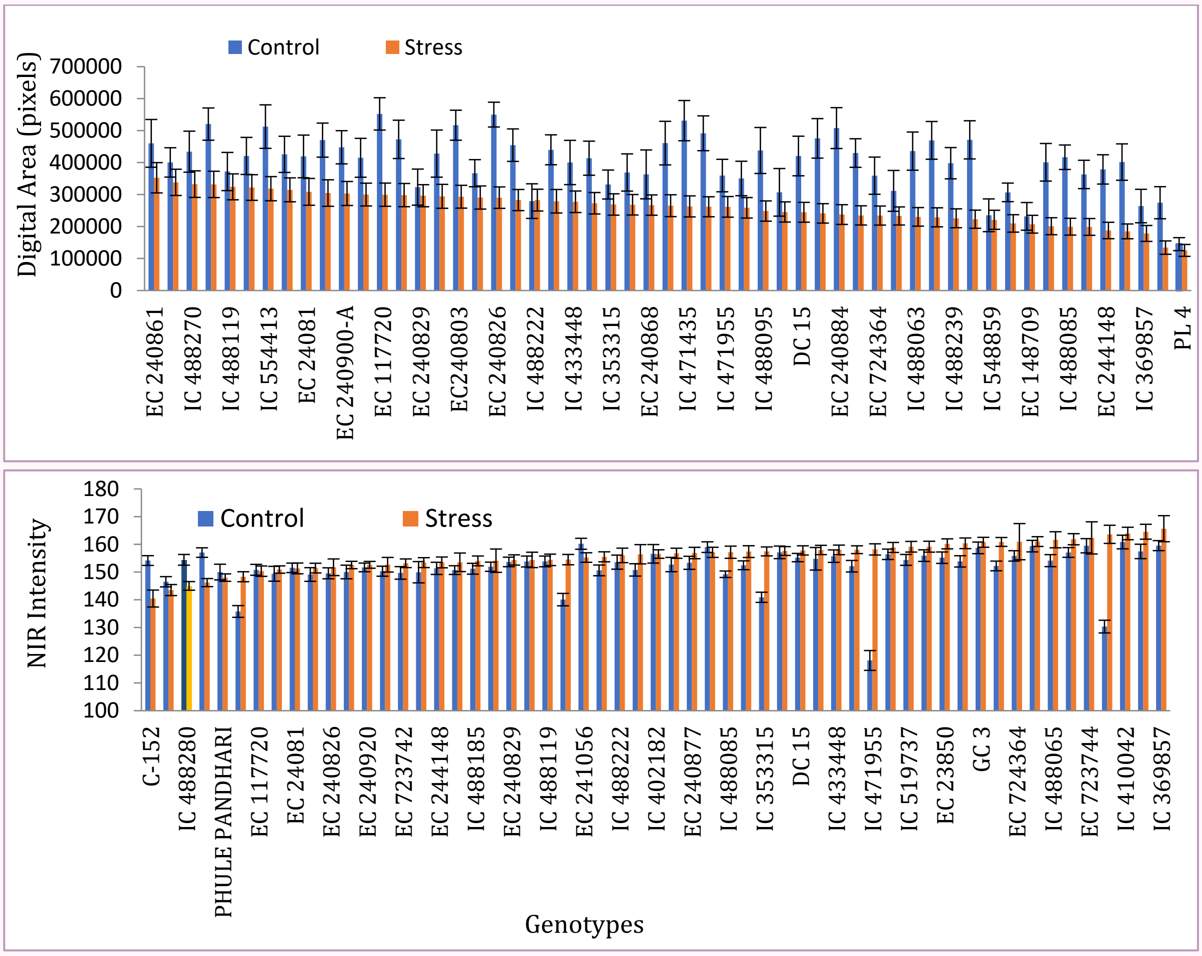


Fig. 2.3.9: Genetic variation among cowpea germplasms as (a) digital biomass (b) tissue water content across genotypes under control deficit moisture.

Genetic variation for desiccation tolerance among *Cicer* Accessions

Photosynthesis is the primary process leading to biomass production and then the formation of grains. The tolerance of this process is critical for productivity under water stress that leads to leaf desiccation. Therefore, in the present study, 15 Cicer accessions belonging to different Cicer species were evaluated for drought tolerance based on photosystem-II (PS-II) efficiency of the leaf subjected to gradual loss of its moisture content for 30 hours. A significant (33.26%) reduction was observed in the maximum quantum efficiency of PS-II (QYmax) of Cicer accessions leaves with a decrease in absolute leaf moisture content (ALMC) to the extent of 67.79%. Chlorophyll fluorescence-based imaging tools have been proven to be highly robust in screening many genotypes for drought tolerance, with PS-II tolerance to tissue dehydration as an indicator. Cicer accession viz., WC-02 (ICC17126), WC-08 (ICC17141), and CH-05 (ICC2580) were found to be more tolerant than others by their high ALMC and high proline content.

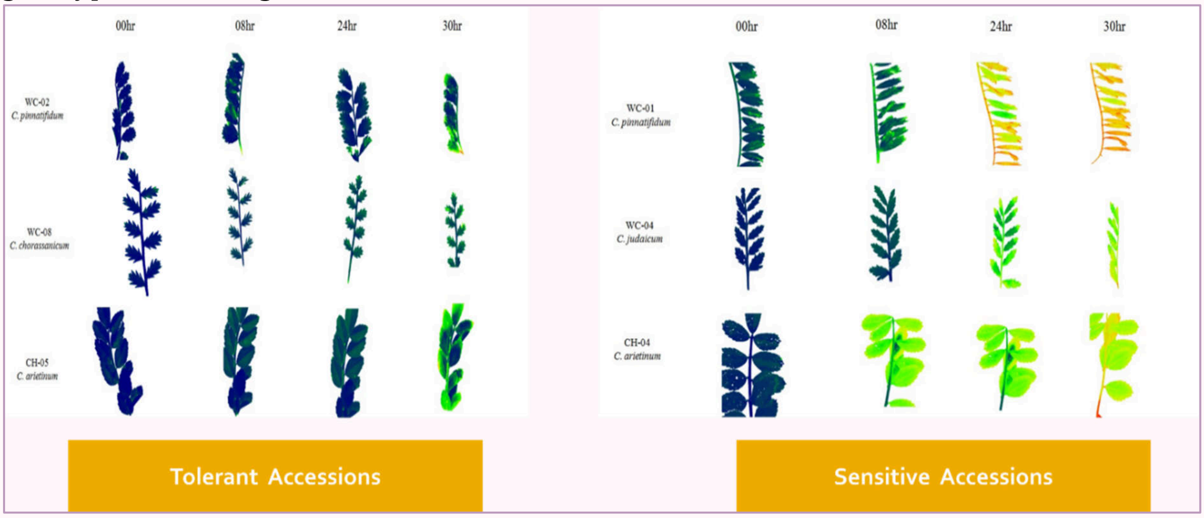


Fig. 2.3.10: Desiccation tolerance of Cicer Accessions

Identification of genomic region associated with weed competitive traits under simulated DSR conditions using high-throughput phenotyping approach

A total of 192 backcross inbred lines mapping population along with parents were developed and genotyped at IIRR, Hyderabad and phenotyped at ICAR-NIASM, Baramati, to identify QTLs associated with weed competitive traits using plant phenomics approach. The study identified three significant QTLs on chromosome 7 (qNIR30-7.8) associated with tissue water content and qDA25-9.2, qDA30-9.3 on chromosome 9 associated with higher digital plant area of rice under weed competition.

Potential promising and unique mutants in Chia identified

Black (local variety) and white (var. Champion) seeded chia genotypes were subjected to irradiation with gamma rays of three different doses viz., 400, 500 and 600 Gy during 2020. The irradiated seeds were evaluated for germination in the lab to know the effects of mutation on seedling growth and establishment. The germination and seedling growth (root and shoot length) was reduced as dose increases. Similarly, observed delayed emergence of seedling and slow growth at initial stage in seeds irradtaed with 600 Gy. More than 1000 plants (M_1) were selected during 2020 and planted them in plant to row (M_2) method during 2021. All these lines/rows (M_2) were observed at different stage of crop for morpholgical varaitions to identify macro mutants. More than 25000 macro mutant plants in M_2 generation showing variation for chlorosis, shape of cotyledon, flowering (early and late), leaf shape and color, branching pattern, seed color etc were selected follwing pedigree method during rabi 2021. The seeds from selected plants sown in plant to row method and observed for repeatability of traits and also expression of novel traits in M_3 generation during 2022.

It was found that besides expression of traits which were observed in M_2, some of the novel traits viz. purple pigmentation on different part plants, bold seed, round pancle shape, entire plant chorosis (light green color) were observed in M_3 plants indicating recessive gene expression. Each of selected macro mutants with morphological variations and micro mutants without morphological variations were planted in double rows for confirmation, stable expression of the traits and also advancing M_4 generation during late kharif, 2023.

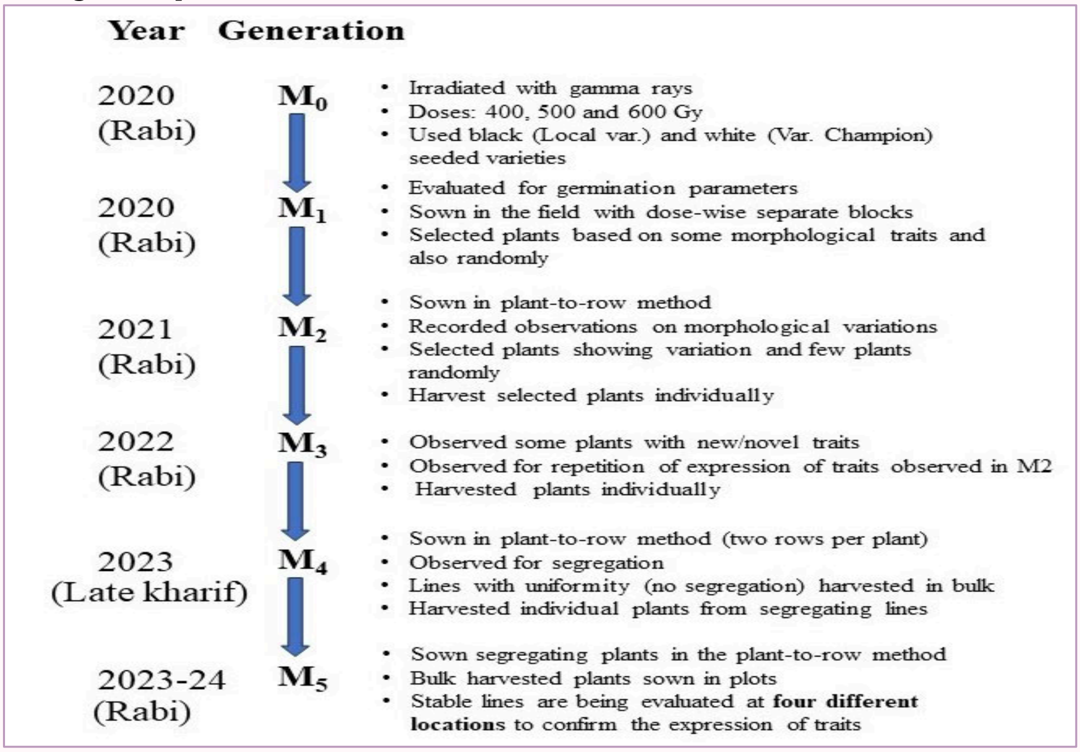


Fig. 2.3.11: Procedural flow chart of mutant lines development in Chia (*Salvia hispanica* L.)

In the M_4 generation, the expression of the novel traits and the stability of the lines (for traits expressed during M2) was confirmed. The traits include phyllotaxy/ Rosset type and dense and compact panicle-shaped. Few stable (90%) mutant lines with complete (31-1-2 to 25) and partial chlorosis, cup-shaped cotyledon/ curly leaf (148-1-1 to 15 and 148-2-1 to 12), early flowering, pigmented plants with bold seeded lines (three rows 125 line and three rows of 94 line) were identified, few of which can be registered as genetic stocks within one or two years. The seed weight of mutant lines 125 and 94 (bold-seeded) was higher compared to the wild type (Fig. 12a). Within these lines, plant-wise seed weight variation was observed, indicating the scope for the selection of extra-bold types (Fig. 12b). Hence, individual plant selection and plant to row sowing was adopted in M_3 and subsequent generations. In M_4, most of the lines with similar pedigree were stable, showing very little or no segregation for morphological traits (Table 2.3.2 & Fig. 2.3.13) expressed in the previous generation. Hence, the uniform and stable lines were harvested in bulk, while the segregating lines were harvested as individual plants separately. The promising stable mutant lines (M_5), including four morphologically (pedigree with line numbers of 31, 148, 94 and 125) different and one early line (11-1) were identified as potential lines for registration and sent for multilocation trials at Regional Station, ICAR-IISS, Bengaluru, ICAR-CRIDA, Hyderabad and College of Agriculture, Bhemarayanagudi, UAS, Raichur for confirmation of traits expression. The segregation ratio of promising lines in M_4 generation (Table 2.3.2) indicating the confirmation of expression traits and gradual stabilization of lines. Further, early observation at seedling stage (in M_5 generation) during late rabi, 2023-24 at all four locations (Fig. 2.3.14) including ICAR-NIASM, Baramati confirming the stable expression of respective traits of the promising mutant lines.

Table 2.3.2 :. Segregation in M_4 generation of promising chia mutants at ICAR-NIASM, Baramati.

Mutant line	Characters	Segregation# (Avg of all lines) in M_4	Trait confirmation at seedling stage in M_5
400WW 31-1-1	Multiple and increasing leaves: Chlorosis (Chl): Normal* green (NG)	0:77:69 (1)	-
400WW 31-1-2 to 7*	Chlorosis (Chl): Normal green (NG)	137:72 (7)	Fig. 2.3.13B
400WW 74-1-1 to 6	Light green/yellow: Normal green (NG)	65:58 (9)	
400WW 148-1-1 to 3*	Cup shaped cotyledon and curly leaves with basal leaf chlorosis: Normal	180:6 (5)	Fig. 2.3.13A
600WW 80-1-1 to 20	Round panicle: Normal long panicle	85:41 (13)	Fig. 2.3.13H
600WW 75-1 to 14*	Longer loose with phyllody type panicle: Normal panicle	125:8 (11)	Fig. 2.3.13I
500B 94-1-1 to 5	Purple pigmented stem, leaf petiole	119:44 (5)	Fig. 2.3.13E,
500B 94-2-1 to 5	and florets (slightly bold seeded):	131:43 (5)	Fig. 2.3.13F &
500B 94-3-1 to 5	Normal type (Wild)	173:64 (5)	Fig. 2.3.13G
Over all 94th lines*		142:50 (15)	
500B 125-1-1 to 9	Purple pigmented stem, leaf petiole	105:6 (9)	
500B 125-2-1 to 9	and florets and bold seeds with two	60:1 (9)	
500B 125-3-1 to 9	per flower instead of four in wild type	41:2 (9)	
Over all 125th lines*		69:3 (27)	
52-3-3**	Triple leaf and branching at each nodes: Normal	1:75	-
52-3-2**	Dwarf, thick, curly and dark green	60:6	Fig. 2.3.13C
52-3-6**	foliage: Normal	25:8	

*The almost stable lines (more than 95 % uniform with similar traits) are being validated at four locations including ICAR-NIASM, Baramati; # based on average number of each trait plant type and normal denotes wild type. **observed expression of novel trait in M4.

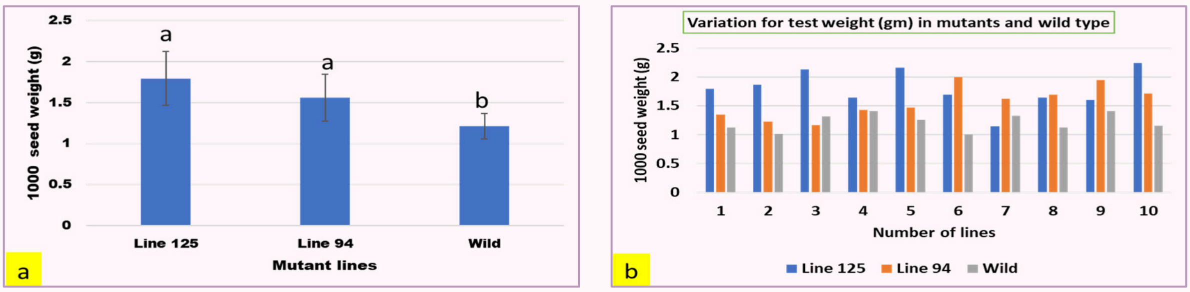


Fig. 2.3.12: Variation for seed weight in mutants and wild type in M_3 generation. Seed weight variation across (a) and within family/line (b) in mutant lines and wild type

Fig. 2.3.13: Phenotypic variation of promising mutant lines (M_4) of chia. Dawrf plant (line 148) with cup shaped cotyledon during intital growth (inset) with curly foliage and chlorosis in apical buds/leaves (A); Entire plant (line 31) chlorotic foliage (B); thick and dwarf and dark green curly (D) foliage plant (line 52); Pigmented plant type (line 94 and 125) with purple pigment on stem (E&F), petiole (G&H) and panicle (I&J); round panicle type (K) (muatnt lines 80, 86 and 122) and pyhyllody panicle (L) type (line 75) and wild type plant (D) & panicle (M).

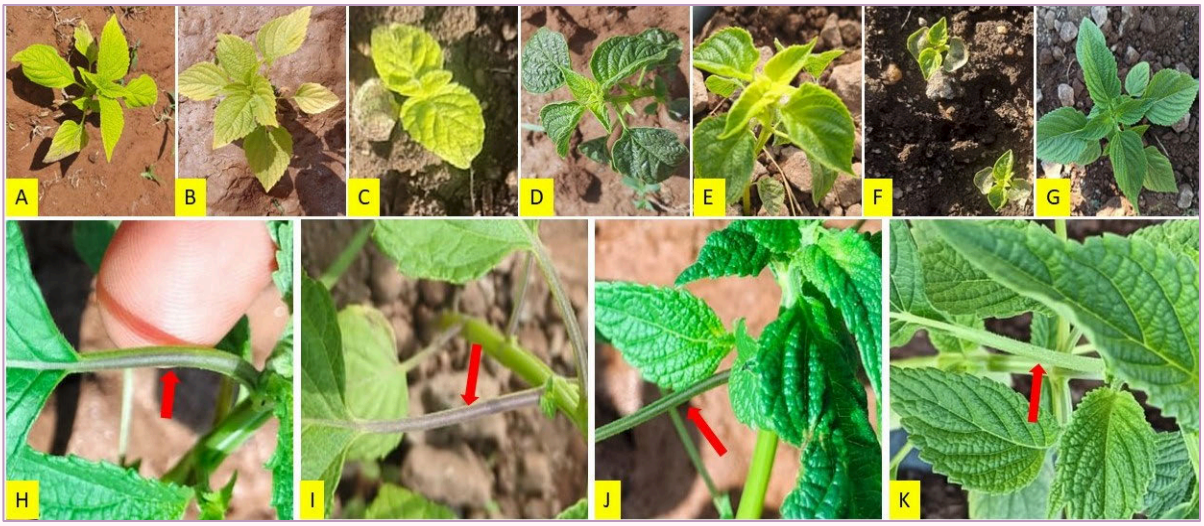


Fig. 2.3.14: Expression of different morpho-pysiolgical traits at different locations in M_5 generation. Chlorotic (A, B & C) foliage in mutant line 31, curly foliage type (D,E &F) in mutant line148 and pigmented petiole (H,I &J) in in mutant line 125/94 at seedling stage during late rabi (2023-24) at ICAR-IISS, Bengaluru, ICAR-CRIDA, Hyderabad and College of Agriculture, Bhemarayanagudi respectively, with sequence under each trait. G and K represents plant type and petiole of wild type maintained at ICAR-NIASM, Baramati.

Identified floral traits and mechanisms associated with delayed and partial pollination in Dragon fruit

The extensive cultivation of white-fleshed varieties in India during the initial commercial expansion has led to lower productivity in dragon fruit. Field observations and surveys have revealed that this particular white-fleshed varieties tends to yield a higher proportion of smaller fruits, despite occasional instances of larger-sized fruits. The formation of greater proportion of smaller fruits was associated with delayed and partial pollination. A series of experiments on floral and pollination biology were conducted to unravel the traits and mechanisms contributing for delayed and partial pollination in dragon fruit. The data on fruit set, fruit weight, and number of seeds per fruit in different varieties upon stigma isolation at different time intervals after anthesis (Table 2.3.3) indicating the delayed and insufficient (due to less number of viable pollen) pollination in white varieties. In the white variety, though a significant fruit set was observed in the flowers exposed for 12 hrs after anthesis, and then onwards fruit set was continuously increased in all the sets of flowers whose stigma was isolated at later hours of anthesis till 24 hrs after anthesis. However, there was no significant difference between the fruit set of flowers isolated at 21 and 24 hrs after anthesis and not observed 100% fruit set even at 24 hrs after anthesis. Whereas almost all the flowers isolated at 9 hrs were set into fruits. Differential floral morphological and behavioral traits are linked to the cause of delayed and partial pollination in dragon fruit.

Table 2.3.3: Fruit set, fruit weight, and number of seeds per fruit in white, red, and Jumbo red dragon fruit varieties upon stigma isolation at different time intervals after anthesis

SITAA	Fruit Set (%)			Fruit Weight (g)			Seed per fruit		
	RW	RR	JR	RW	RR	JR	RW	RR	JR
0 hrs	0 .00^{a}	0.00^{a}	0.00^{a}	NFS	NFS	NFS	NFS	NFS	NFS
3 hrs	0.00^{a}	40.00^{c}	46.67^{c}	NFS	98.91^{c}	111.42^{c}	NFS	174^{c}	314.10^{c}
6 hrs	6.67^{a}	70.00^{d}	80.00^{d}	54.00^{a}	193.33^{ac}	213.70^{cd}	78.50$^{a\#}$	416.50^{ac}	592.30^{c}
9 hrs	10.00^{ac}	96.70^{b}	100.00^{b}	74.33^{a}	222.27^{a}	321.23^{ad}	118.66$^{a@}$	523.90^{a}	1040.90^{ac}
12 hrs	33.33^{bc}	100.00^{b}	100.00^{b}	95.70^{a}	243.00^{a}	382.10^{a}	170.50^{a}	631.10^{a}	1611.10^{a}
15 hrs	46.67^{bd}	100.00^{b}	100.00^{b}	120.43^{ab}	369.70^{b}	515.13^{b}	324.20^{ab}	1458.40^{b}	2689.20^{b}
18 hrs	60.00^{de}	100.00^{b}	100.00^{b}	158.44^{bc}	377.76^{b}	520.80^{b}	551.80^{bc}	1536.30^{b}	2621.00^{b}
21 hrs	83.33^{ef}	100.00^{b}	100.00^{b}	211.96^{cd}	381.70^{b}	514.60^{b}	722.70^{cd}	1726.90^{b}	2797.20^{b}
24 hrs	96.67^{f}	100.00^{b}	100.00^{b}	226.41^{b}	382.80^{b}	520.16^{b}	993.70^{d}	1785.00^{b}	2795.80^{b}
N	30			2 to 30 (depending on the fruit set)			10 except 6 and 9 hr AA in RW; #=2 & @=3		

SITAA- Stigma isolation time after anthesis
Letter with the same alphabet indicates no significant difference; NFS: No fruit set;
N-number of flowers or fruit samples subjected for taking observation

The short and sturdy flower in white variety less prone to shaking which is very crucial for natural pollination in heterostyly nature flowers. Further, though all the varieties exhibit heterostyly, distance between stigma and anthers was more in white varieties compared to red varieties and make further difficult for natural self-pollination. Additionally, continuous opening of flower for longer time and absence of complete unclasping of shorter stigma lobes in white varieties also contributed for delayed and partial pollination. However, bending of flowers at 2.00 PM in the next day of anthesis (i.e. 18 hrs after anthesis) favors pollination in white fleshed dragon fruit (*Hylocereus* *undatus*) varieties, so that by that time pollen viability reduced to below 50%. Therefore, the deviation of floral morphological and behavioral traits during the course of evolution was linked to the cause of delayed and partial pollination in dragon fruit particularly in white fleshed varieties.

Evaluation of yield traits and tolerance indices of Foxtail millet accessions under low soil nitrogen conditions in the shallow basaltic gravelly soils

About 118 accessions of foxtail millet were evaluated under low N soils of native soils at ICAR-NIASM, Baramati for physiological and phenotypic responses. All the accessions showed a reduction in plant height, no. of leaves, leaf and panicle length, and yield. Over all 23% of chlorophyll reduction was observed during early vegetative growth. These cumulative effects on plant growth and physiological traits attributed 58% yield reduction (Fig. 2.3.16). Based on high frequency among the top 10 genotypes under each index and overall ranking - FXM 70, FXM 74, FXM 21, FXM 6, FXM 34, and FXM 39 (NIASM codes) were considered as best genotypes. The superior traits like better root architecture (lateral growth, wider angle, root hairs), profuse tillering with dark foliage in tolerant lines may be contributed for better growth and yield compared sensitive/susceptible lines under low N (RDF-N) conditions (Fig. 2.3.15) where in the RDF is NPK (40:20:20) and RDF-N is Without N (0:20:20).

Fig. 2.3.15: Phenotypic responses of contrasting accessions under RDF and RDF-N

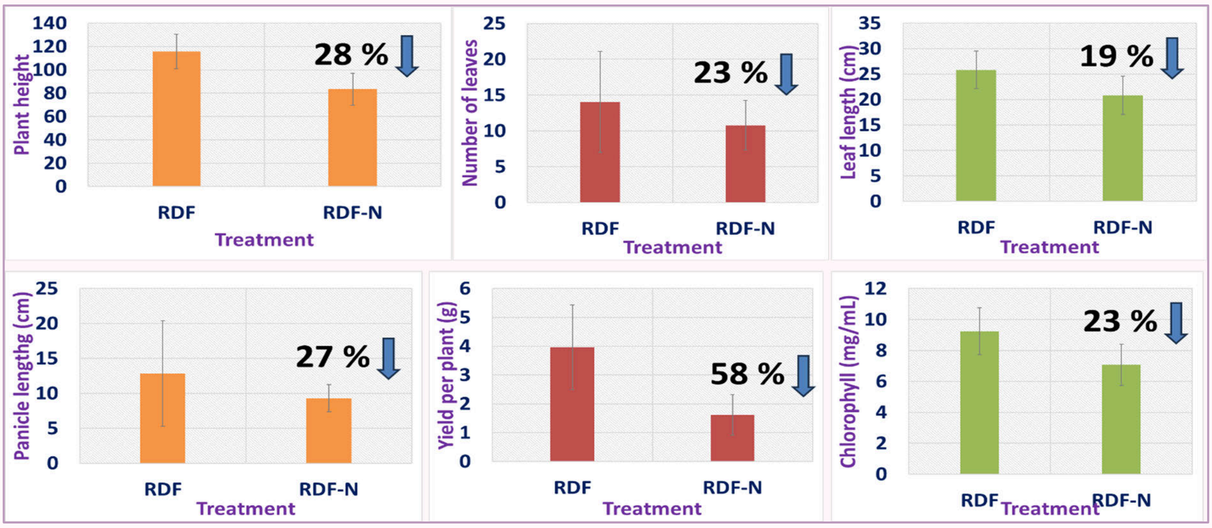


Fig. 2.3.16: Response of yield and its attributing traits under N stress

Identification of Groundnut genotypes tolerant to pre- and post-flowering drought stress

Forty-eight genotypes comprising 44 accessions (from ICRISAT) and 4 released varieties as Checks (Kadiri Lepakshi, Phule Unnati, DH-257, R-2001-2) were evaluated for drought tolerance at pre- and post-flowering stages during rabi-summer 2022-23. Based on high frequency and overall ranking of stress indices (considering some of the efficient indices) identified tolerant accessions viz. ICG – 4543, ICG - 3673, ICG –

3102, ICG - 3584, ICG - 1519, ICG - 6703, ICG – 11249, ICG – 14127 and ICG – 4684 for pre- and post-flowering drought. Whereas, the accessions viz. ICG-3421, ICG-297, and ICG-11249 were considered as susceptible for drought. Among varieties Kadiri Lepakshi and Phule Unnati were highly drought tolerant.

Combined effect of drought and heat stress on Quinoa (*Chenopodium quinoa*) morphology, physiology and yield

Climate change significantly threatens crop production and food security, particularly in marginal environments characterized by drought, heat, and challenges such as rapid population growth and limited resources. Quinoa (*Chenopodium quinoa*) is emerging as a promising alternative crop that can adapt to these harsh conditions, offering a solution for climate change adaptation. However, quinoa plants often face simultaneous exposure to multiple abiotic stresses, including water deficit and heat stress, which can severely impact their growth, physiology, and productivity. To address these challenges, a pot experiment was conducted with four treatments: Control (100% FC, 32/20°C), Drought (50% FC, 32/20°C), Heat (100% FC, 36/24°C), and Drought + Heat (50% FC, 36/24°C), each replicated eight times. These stresses were applied at different growth stages (vegetative, flowering, and grain-filling) to assess their impact on quinoa morphology, physiology and yield. Results revealed that drought and heat stress had the most detrimental impact on overall plant growth, development and yield. Morphological parameters *viz.,* plant height, stem girth, leaf area, shoot and root biomass were most affected by stress at the flowering stage and decreased substantially by 33.7, 44.8, 57.3, 65.8 and 73.7%, respectively under drought + heat stress as compared to control. Similarly, physiological parameters drought + heat stress was more detrimental at grain filling stage and reduced NDVI, membrane stability index (MSI), relative water content (RWC), chlorophyll content and PS-II efficiency by 51.30, 25, 33, 47 and 57%, respectively as compared to control (Table 2.3.4). The stages of flowering and grain filling were crucial for predicting quinoa yield. The most significant reductions in yield measures were observed during the grain filling stage under drought + heat stress. Panicle length, panicle weight, the number of panicles per plant, and the number of branches per plant all experienced successive reductions of up to 75%, 64.14%, 53.38%, and 49%, respectively, compared to the control. The control group achieved the highest 1000 seed weight of 3.2g among all treatments. However, during the grain filling stage, drought and heat stress combined exhibited the most significant decline (43%) in the 1000 seed weight parameter. Seed yield was substantially reduced under stress conditions, with the combination of drought and heat stress during the grain filling stage leading to a 94% reduction compared to the control (Fig. 2.3.17).

Table 2.3.4: Treatment effects on PS II efficiency of quinoa

Crop growth stages	Treatments					
	Control	*Drought*	*Heat*	*Drought + Heat*	*S.E (m)±*	*C.D at 5%*
Vegetative	0.76	0.44	0.43	0.34	0.01	0.04
Flowering	0.79	0.46	0.45	0.35	0.02	0.05
Grain filling	0.75	0.42	0.34	0.31	0.01	0.03

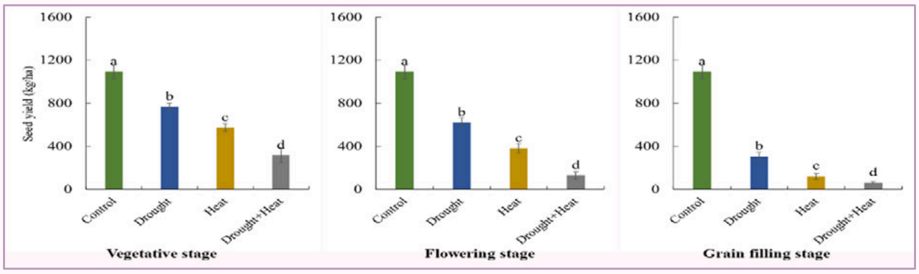


Fig. 2.3.17: Effect of treatments on quinoa seed yield (kg ha^{-1})

Isolation of candidate microorganisms for management of moisture deficit and nutrient stress in different crops of arid and semi-arid tropics

To alleviate moisture deficit and nutrient-stress in potential (Quinoa, Chia and Dragon fruit) and other major crops like Sugarcane, candidate microorganisms ((endophytes and mineral (Zn, K, Mn and P) solubilizing microbes)) were isolated (Table 2.3.5, Fig. 2.3.18), characterized for plant growth promoting traits and are being evaluated both in potted and field conditions. Based on *in vitro* Tri-calcium phosphate (TCP) solubilization capacity and seedling bioassay, twenty-seven and five phosphate solubilizing bacteria (PSB) are under evaluation in potted and field condition, respectively, in quinoa (Fig. 2.3.19).

Table 2.3.5: Microbial isolates for characterization and evaluation

Crop	Nutrient solubilizers				Endophytes		
	Phosph-ate	K	Zn	Mn	Root	Stem/cladod	Seed
Quinoa	26	11	28	7	22	13	11
Chia	35	36	18	10	10	13	16
Dragon fruit	49	16	22	25	19	36	-
Sugarcane	15	18	21	23	311	34	-

16S rRNA is also being catalogued to understand the diversity of the associated microorganisms with different crops.

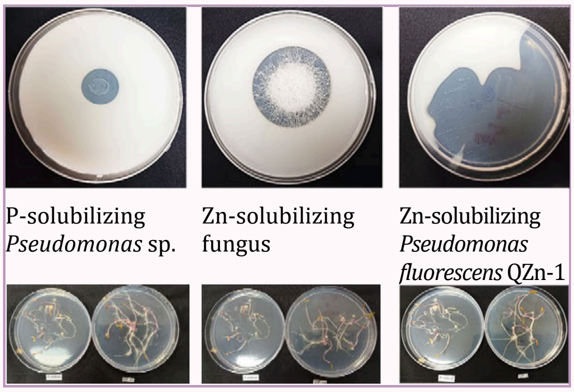


Fig. 2.3.18: *In vitro* germinating seedling bioassay with PSB in quinoa

Fig. 2.3.19: Evaluation of PSB in quinoa in potted condition. Effect of inoculation of potential isolate QP-4, QP-8, QP-64

Fig. 2.3.20: Evaluation of potential PSB in quinoa. Effect of inoculation of *Pseudomonas fluorescens* QZn-1 (PSB3) in field condition with 40 and 60 kg P_2O_5. ha^{-1}

Rootstock identified for drought tolerance in Eggplant

Eggplant cv. Suraj (SUR) was grafted onto five different wild eggplant species: *S. gilo* (GIL), *S. indicum* (IND), *S. macrocarpon* (MAC), *S. sisymbriifolium* (SIS), and *S. torvum* (TOR). The performance of these five rootstocks along with non-grafted control were evaluated for under three levels (100%, 80%, and 60% ETc)of deficit irrigation based on crop evapotranspiration from November to May 2021-22. The eggplant grafted on these rootstocks exhibited better growth and improved physiological traits, such as leaf RWC, PS II efficiency, chlorophyll content, NDVI, and cooler canopy, indicating their sturdy and tolerant nature. The grafted plants maintained a higher root-to-shoot ratio under water deficit conditions than non-grafted plants (Fig. 2.3.21). The eggplant grafted on *S. sisymbriifolium* rootstock gave 40% higher and *S. torvum* rootstocks gave 21% higher yield under water deficit stress (0.6 ETc) over non-grafted in field evaluation (Table 2.3.6). Grafting eggplant on these rootstocks positively enhances the scion variety growth, yield, and water use efficiency in the semi-arid Deccan plateau of India.

Table 2.3.6: Effect of irrigation levels and graft combinations on eggplant yield attributes

Treatment	Fruit number (plant^{-1})	Fruit weight (g)	Fruit yield (kg plant^{-1})
Irrigation levels (I)			
100%ETc (WW)	101a	39.01a	4.08a
80%ETc (MD)	97.47b	38.26a	3.65b
60%ETc (SD)	94.38c	36.59b	3.40c
Significance (I)	***	**	***
Graft combinations (G)			
SUR/GIL	77.16d	37.36bc	2.86f
SUR/IND	106.27	35.17c	3.72c
SUR/MAC	81.33d	39.25ab	3.20e
SUR/SIS	120.72a	40.27a	4.84a
SUR/TOR	108.11b	38.73ab	4.20b
SUR	77.16d	36.93bc	3.44d
Significance (G)	***	**	***
I x G	**	***	**

Mean values of three replicates followed by the same letter for each factor within each column are not significantly different according to LSD (p ≤ 0.05). Significance *, ** and *** at p ≤ 0.05, 0.01 and 0.001, respectively.

Fig. 2.3.21:. Comparative performance of grafted and non-grafted plants under control (Well-watered) and water deficit conditions in greenhouse conditions

Identification of rootstocks for salinity tolerance in Eggplant

Eggplant cv. Suraj (SUR) was grafted onto five different wild eggplant species: *S. gilo* (GIL), *S. indicum* (IND), *S. macrocarpon* (MAC), *S. sisymbriifolium* (SIS), and *S. torvum* (TOR). These graft combinations and non-grafted control seedlings were planted in pots containing 4 kg of soil. The grafted plant was allowed to establish for fifteen days after transplanting. Following this, salinity treatments were applied at three different levels of saline water concentration (ds m^{-1}) of ECiw0 (S_1), ECiw3 (S_2), and ECiw6 (S_3). The growth and physio-biochemical parameters were assessed every two weeks. Shoot and root ion uptake and partitioning were studied after 45 days of transplanting. The impact of salinity stress significantly affected the growth and physiology of non-grafted eggplants. Notably, eggplants grafted onto *S. macrocarpon* (MAC) rootstock exhibited less ion toxicity at ECiw6.0 ds m^{-1} compared to non-grafted eggplants (Fig. 2.3.22). Those grafted onto *S. macrocarpon* rootstock maintained higher PS II efficiency, showing reduced chloride uptake by 60% in shoots and 38% in roots compared to non-grafted plants. Additionally, these grafted plants displayed higher K uptake, with 52% higher in shoots and 39% higher in roots over non-grafted plants. Consequently, a significantly higher K:Na ratio was maintained in eggplants grafted onto *S. macrocarpon* and *S. torvum* rootstocks under ECiw 6 ds m^{-1} (Fig. 2.3.23). *S. macrocarpon* and *S. torvum* rootstocks exhibited a twofold higher K:Na ratio compared to non-grafted eggplants under severe salinity stress (ECiw6). These wild species show potential as rootstocks for enhancing salinity tolerance in eggplants.

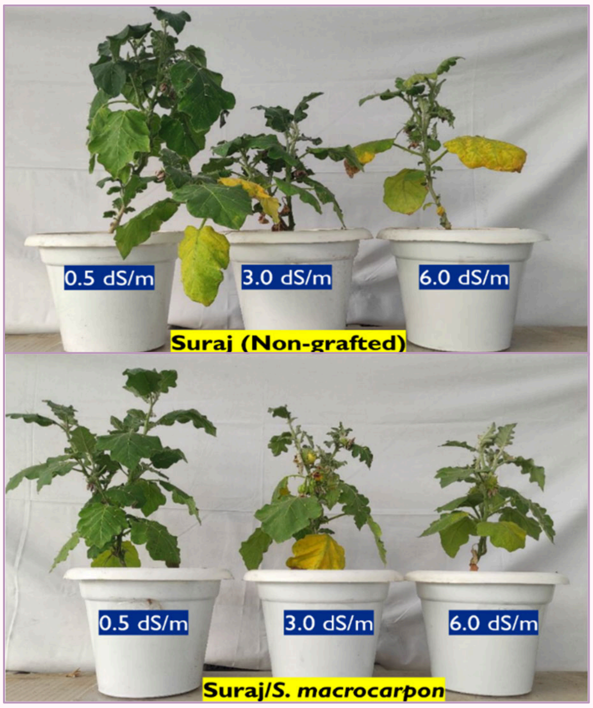


Fig. 2.3.22: Grafted and non-grafted eggplant in different levels of salinity stress treatment

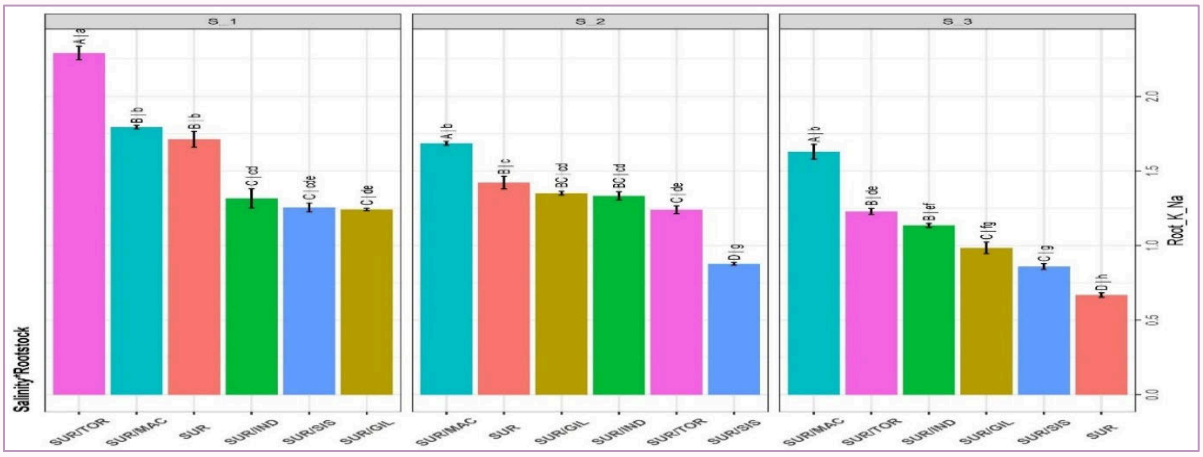


Fig. 2.3.23:. K:Na ion ratio in roots of graft combinations in different levels of salinity stress treatment. The values followed by the same letter are not significantly different at p≤0.01 according to Tukey HSD.

Collection, conservation and maintenance of vegetable germplasm

The germplasm of tomatoes, eggplants, and chillies was collected from international and national institutes and the local area during 2020-2023 (Fig. 2.3.24). The collected germplasm was purified through self-pollination and maintained in field and greenhouse conditions. The collected germplasm includes wild species of fruiting solanaceous vegetable crops. And will be screened for multiple stresses

Fig. 2.3.24: Diversity is tomato and chilli fruit shape and size of the evaluated germplasm

Identification of photothermo-insensitive with climate-smart early maturing Chickpea genotypes

Chickpea is a cool season, photothermo-sensitive crop that is adversely affected by high temperatures (>35 ^{0}C) and whose flowering is promoted by long-day conditions (>12h). This prevents horizontal crop spread under various agro-climatic conditions and the development of insensitive genotypes that perform well in all seasons. Therefore, a study was conducted to identify genotypes that mature early, are insensitive to photoperiod, have high temperatures, and are drought-tolerant. The set of 74 genotypes was evaluated under rainfed conditions in Kharif 2021 (off-season) to select eight promising early maturing genotypes with high yielding capacity. Then, further investigations were conducted in five different seasons, viz., Late Kharif 2021, rabi 2021, summer 2022, early Kharif 2022 and Kharif 2022, to identify the genotypes with photothermal-insensitivity among the selected eight genotypes.

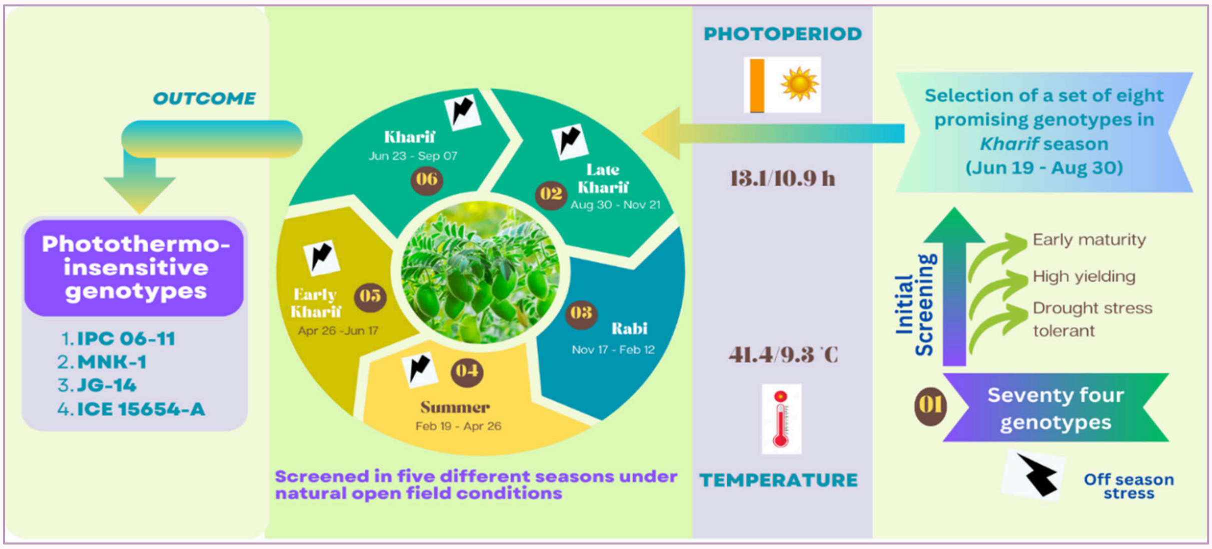


Fig. 2.3.25: Diagrammatic depiction of the complete six season field experiment from screening to selection of four photothermo-insensitive chickpea genotypes. Number indicates seasons

Except for rabi 2021, each of these seasons was distinct from the chickpea's typical growing season. Among these eight, the stable genotypes which performed better in all the seasons, especially under summer were considered, such as IPC 06-11, MNK-1, JG-14 and ICE 15654-A as a photothermo-insensitive, were able to flower and set pods with higher seed yield and, resulting in early maturity in a temperature range of 41.4/9.3 °C with photoperiods of 13.1/10.9 h to reach in all seasons throughout the year. The heritability was more than 60%. Hence, these genotypes can be used as donor aids in developing early maturing, drought stress tolerant and photothermo-insensitive chickpeas.

Accelerating genetic gain in Common bean (*Phaseolus vulgaris* L.): Performance evaluation of genotypes across three seasons or generations

To expedite genetic gain and reduce varietal improvement time in common bean, evaluating the performance of different genotypes across multiple seasons or generations is crucial. This study aimed to assess the performance of common bean genotypes across three distinct seasons or generations, enabling the identification of superior genotypes that consistently exhibit desirable traits under varying environmental conditions. The genotypes were investigated for their reproductive behaviours, phenological changes of plants, and variation in grain yield attributes.

The study analysed the influence of maximum temperature range and photo-period length on days to early flowering, podding, and maturity. The results revealed that all genotypes flowered, set pods, and produced yields across the three seasons, albeit with variations in flowering time and yield levels. Among these genotypes, EC932021, IPR8-21, IPR6-21, and IPR236-20 exhibited stable performance across all seasons, demonstrating shorter duration and higher yield, regardless of the varying climatic conditions. This investigation identified promising common bean genotypes of high-yielding and short-duration with consistent performance across seasons.

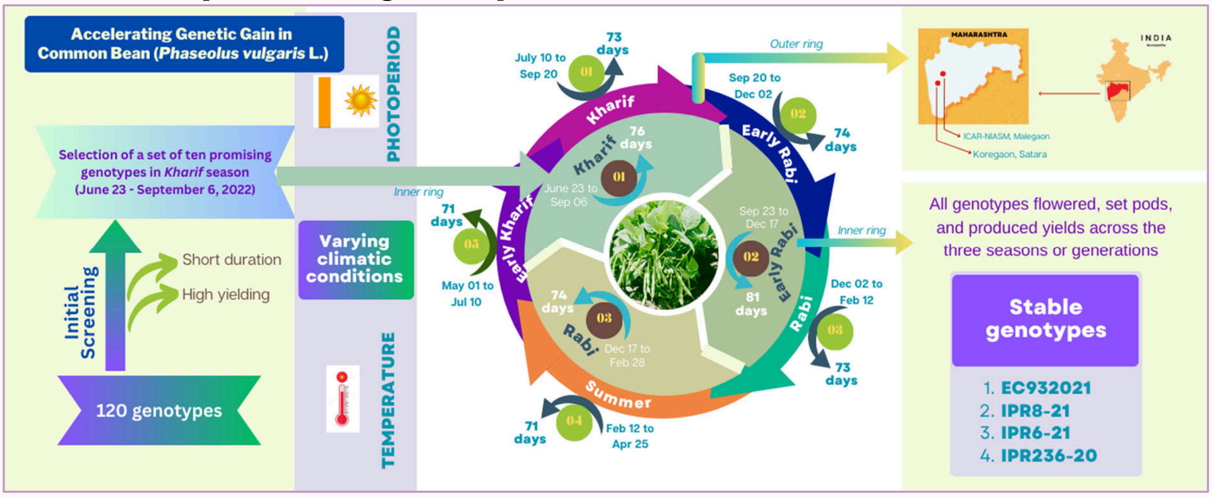
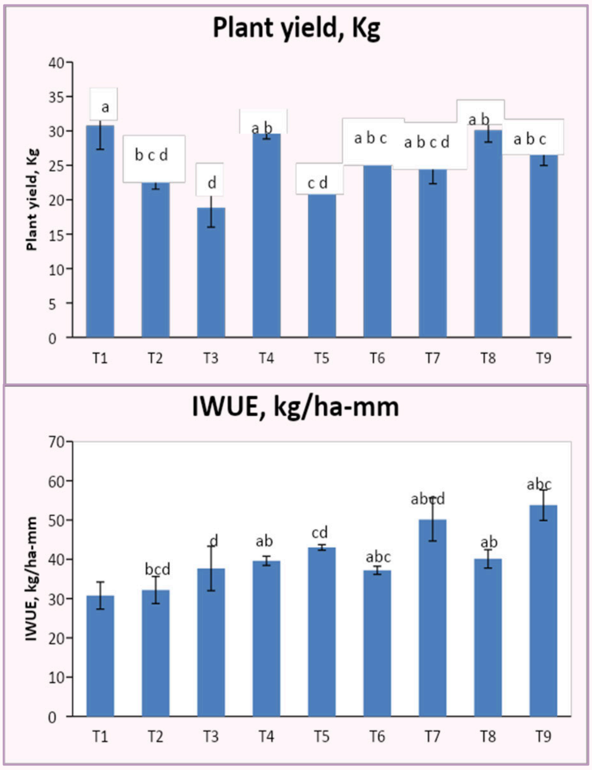


Fig. 2.3.26: Diagrammatic depiction of the complete six season field experiment from screening to selection of four stable common bean genotypes. ***Inner Circle:*** Depicts three annual generation cycles achieved from fully matured seeds. ***Outer Circle:*** Depicts proposed method to achieve five generation cycles per year from physiologically matured seeds of common bean genotypes under natural open field conditions. *Numbers in the diagram indicate the season/generation.*

Further, based on data from three generations, a method was proposed to achieve five generation cycles per year in natural open field conditions, facilitating rapid advancement. The study provides valuable insights into identifying superior genotypes with desirable traits and their potential for varietal improvement. The proposed method offers a practical solution to enhance breeding program efficiency and reduce varietal development time in common bean.

Studies on deficit irrigation strategies along with plant growth regulator on yield and WUE of mango (Variety: Keshar)

The experiment was conducted to study the effect of deficit irrigation strategies with growth regulators on yield, WUE and quality of mango (Variety: Keshar) during 2022-2023. The growth regulators NAA (45 ppm) and SA (550 ppm) were applied during the growth stages of mango. The deficit irrigation of 25 and 50 % was applied after flowering to harvesting. It was observed that the plant yield was found to be maximum in 100% ETc followed by 75 and 50% ETc. With the application of PRD deficit irrigation strategies for 75 and 50%, the average plant yield was increased by 19.6% compared to the average plant yield under DI at 75 and 50 % ETc. With application growth regulators, a spray of NAA and SA at different growth stages increased the plant yield by 16.9 per cent compared to the average plant yield under DI and PRD strategies at 75 and 50 % ETc. Treatment 100% ETc is significantly different from Treatment PRD 75% ETc +Spray of NAA and SA, and both differ from Treatment DI 50% ETc.



The total irrigation water applied, excluding rainfall in different treatments, varied from 41.6 cm (50% ETc), 62.5 (75% ETc) and 83.3 cm (100% ETc). Irrigation Water use efficiency (IWUE) varied from 30.7 to 53.8 $kg.ha^{-1}.mm$. IWUE in PRD 50% ETc with spray of NAA and SA is significantly higher than DI 50% ETc with spray, which is statistically different from PRD 50% ETc. Similarly, Treatment of PRD 75% ETc with or without spray indicates no significant difference between them. The IWUE under treatments 100% ETc and 75% ETc with and without spray are not significantly different. But they are different from DI with 50% ETc. The average plant yield under PRD 75% ETc with the application of NAA and SA is at par with control 100% ETc with water saving of 25%.

Green synthesis of silver nanoparticles (AgNPs) from *Parthenium hysterophorus* weed and its application in drought stress

Silver nanoparticles (AgNPs) were synthesized through a green method utilizing a plant extract derived from *Parthenium hysterophorus*. The Parthenium plants were collected from the ICAR-NIASM campus for the experiment. Silver nitrate

($AgNO_3$) sourced from Himedia was used in the synthesis of AgNPs. The water-soluble phenolics such as caffeic acid, ferulic acid, vanillic acid, anisic acid, fumaric acid and sesquiterpene lactones, predominantly parthenin and/or hymenin, present in the plant, acted as the reducing agents. Initially, these AgNPs were characterized using a UV-VIS Spectrophotometer and a zeta/particle size analyzer (Fig. 2.3.27). Further characterization will be conducted through techniques like TEM, SEM, FTIR, etc., and their potential for drought stress tolerance will be evaluated.

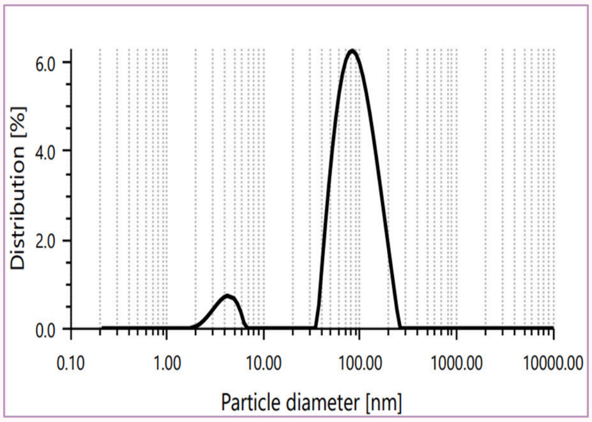


Fig. 2.3.27. Particle size distribution of silver nanoparticles

Effect of deficits irrigation on stress tolerant garlic cultivars

A field experiment was initiated in year 2022–23 to evaluate the interactive effect of garlic cultivars (Cv. Godavari, Cv. Phule Baswant, Cv. Local–1, Cv. Bhima Purple, Cv. GG–4, and Cv. Local– 2) and deficit irrigation levels (100, 75, 50 and 25% ET) applied based on crop evapotranspiration using line source sprinkler (LSS) system. Both total bulb yield (TBY) and above ground biomass (AGB) production of garlic cultivars were limited by water deficits and varied significantly in different garlic cultivars. The maximum total bulb yield (TBY) of 12.7 Mg ha^{-1} was obtained at full irrigation (100% ET) and declined to 10.7, 7.1 and 3.2 Mg ha^{-1} at low (75% ET), medium (50% ET) and severe (25% ET) water deficits, respectively. Cv. Godavari also shows its higher tolerance to alleviate water deficit stress owing to its better growth, canopy and physiological traits (Fig. 2.3.28). The physiological and functional quality traits such as dry matter (DM), rehydration ratio (RR), total phenol content (TPC) and total flavonoids content (TFC) were improved with water deficits in all cultivars. Shifting to stress-tolerant cultivars such as Cv. Godavari is suggested for region-specific cultivation because it saves significant water, allows for more efficient use of water resources, and increases bulb yield and quality of garlic in semi-arid regions.

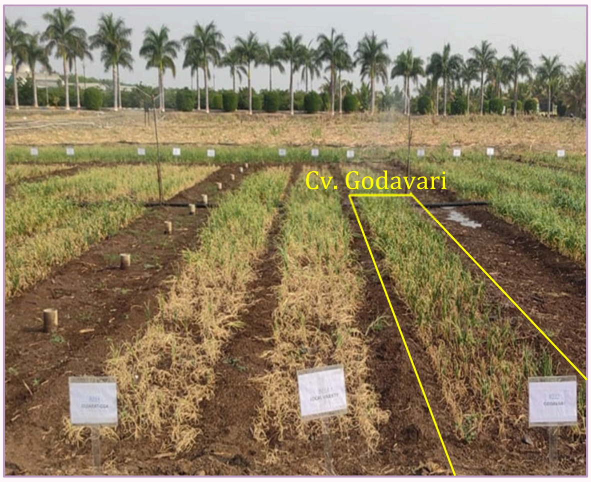


Fig. 2.3.28:. Performance of Cv. Godavari under varied deficit irrigation levels

Garlic responses to plant growth regulators (PGRs) under water deficit regimes

A field experiment was initiated in 2022-23 to elucidate the effects of plant growth regulators (PGRs) under variable deficit irrigation (DI) levels on garlic in the semi–arid region of peninsular India. Treatments included combinations of the foliar sprays with PGRs i.e. irradiated chitosan (IC, 5 ml L^{-1}), sea weed extracts (SWE, 5 ml L^{-1}), nano urea (NU, 2.5 ml), thio–urea (TU, 800 ppm), salicylic acid (30 µM L^{-1}) along with control (no PGR) and four deficit irrigation (DI) levels equaling 100%, 75%, 50% and 25% of the crop evapotranspiration (ETc). DI levels were maintained using line source sprinkler (LSS) system. Preliminary results showed that foliar application PGR improved bulb yield (7-28%), water productivity (4.09-5.01 kg m^{-3}) and water saving (18-45%) over control. (Fig. 2.3.29)

Fig. 2.3.29:. Garlic responses PGRs under varied deficit irrigation regimes

Effect of deficit irrigation (DI), foliar plant growth regulators (PGRs) and surface trash retention on sugarcane yields in semi-arid regions

In the year 2023, a field experiment was conducted to evaluate the interactive effect of deficit irrigation (DI), surface trash retention and foliar application of PGRs on plant crop of sugarcane (Co-86032). The experiment was replicated thrice with three levels of deficit irrigation viz., I_1: 50% ETc; I_2: 75% ETc and I_3: 100% ETc (full irrigation) were applied using drip irrigation system in main plots and two soil surface trash retention practices (S_1: live trash covering and S_2: without trash covering) in subplots. Further, PGRs namely thiourea (TU, 1800 ppm), irradiated chitosan (IC, 5 ml L^{-1}), nano-urea (NU, 4 ml L^{-1}), salicylic acid (SA, 25 µM) and no PGRs (control) were applied exogenously with interval of one month after crop establishment (60 DAT) as sub-sub plot treatments. The highest cane yields of 157.1 t ha^{-1} was obtained in I_2+S_1+IC i.e. reduced tillage under 75% ETc with live trash mulching and exogenous application irradiated chitosan (5 ml L^{-1}) (Fig. 2.3.30). Surface trash retention (S_1) improved cane yields by 8.1, 17.2, and 23.1% in full (100% ETc), 75% ETc and 50% ETc when compared control (S_2). PGRs improved main crop cane yields by 4.0-7.2%, 8.3-18.7% and 11.7-22.4% under full (100%), 75%ETc and 50% ETc, water deficit level, respectively. Field trials on 1st ratoon crop with same treatments are on-going.

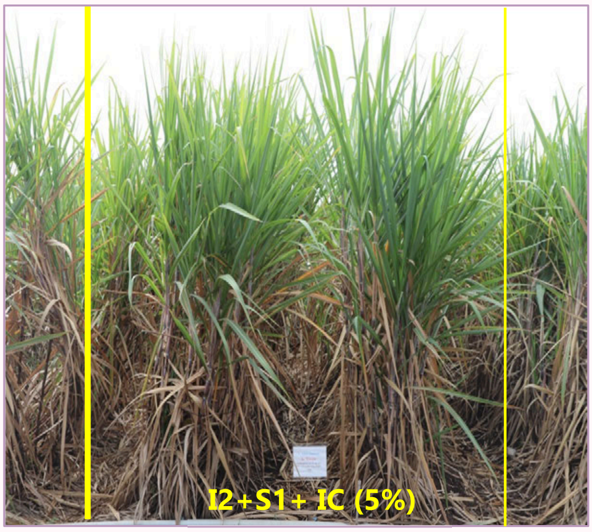


Fig. 2.3.30:. Sugarcane responses to deficit irrigation, surface mulch and irradiated chitosan

Effect of tillage, residue and nutrient management on soil organic carbon, biology and yield under multi-ratooning sugarcane system in basaltic soils of semi-arid tropics

Sequestration of carbon in arable cropping systems is considered as one of the potential climate change mitigation strategies. Hence, the impacts of minimum soil disturbance, residue retention and nutrient management practices on change in total soil organic carbon (SOC), its pools, soil microbes, enzyme activities and yield under multi-ratooning sugarcane system in black soils of semi-arid tropics was evaluated. A field experiment was conducted in split-split plot design with conventional tillage (CT) and reduced tillage (RT) as main plot treatments with residue burning (RB) and residue retention (RR) in sub plot and three sub-sub plot nutrient management practices; 25% of recommended dose of fertilizer (RDF) as basal and 75% through fertigation (N1); 50% of RDF as basal and 50% through fertigation (N2) and 75% of RDF as basal and 25% through fertigation (N3) in ratoon sugarcane. Soil samples were collected from 0-15 and 15-30 cm soil depth after multi-ratooning (one plant and four ratoon crops) for six years. Results indicated that plots with RR had 17% higher total SOC with 63, 34 and 15% higher labile, less labile and non-labile C pools, respectively than RB plots ($P \leq 0.05$). Of total SOC stock, contribution of passive pools was higher 72-78% than active pools. RT, RB and N2 plots showed higher microbial and enzymatic activities at both the soil layers. RT coupled with RR reported highest net SOC enrichment of 5.23 Mg C ha^{-1}. In four seasons, the maximum average ratoon cane yields of 153 t ha^{-1} and 137 t ha^{-1} were obtained in RT with RR and RB, respectively. While, their corresponding values in CT were 113 and 95 t ha^{-1}, respectively. The highest improvement in cane yield by 30.7% and 37.1% was observed in RT with 50% application RDF as basal in band placement and remaining through fertigation with RR and RB, respectively over farmers practice. Overall RT, residue retention (RR) and 50-75 % RDF as basal is recommended for higher cane yield, soil C retention and soil microbial activity for sustained sugarcane productivity.

Optimizing planting geometry and crop residue management using subsurface drip irrigation system

Another field trial on optimizing planting geometry and surface trash management for groundnut-sugarcane cropping system using a subsurface drip irrigation system was evaluated for 2nd ratoon crop during the year 2023 for reconfirmation of the previous year's results. Among the different zigzag paired row (ZPR) with sub-surface drip irrigation (SSDI) and crop residue retention (S) practices, the treatments M6S1 i.e. ZPR–225 cm × 75 cm + SSDI (M6) resulted in higher cane yields (20.4%) and groundnut yield (18%) as compared to PSR (150 cm) + surface irrigation (SI) methods (M1) i.e. farmer's practice.

Fig. 2.3.31:. Experimental plot showing impact of planting geometry and crop residue management using subsurface drip irrigation system

Development of valorized products from dragon fruit

Different parts of the dragon fruit, including the pulp, peel, seeds, flower buds, dried flowers, and stems, provide significant nutritional benefits such as vitamins, minerals, dietary fibers, and antioxidants. These parts can be processed into dried form, canning, and value-added products for longer shelf life and off-season availability. Considering the multi-health benefits, experiments for processes optimization for producing valorized products from peel/pulp, such as pulp juice, pulp jam, peel candy, and peel jelly were conducted (Fig. 2.3.32). Further, evaluation of these products for enhancing storage quality is under process.

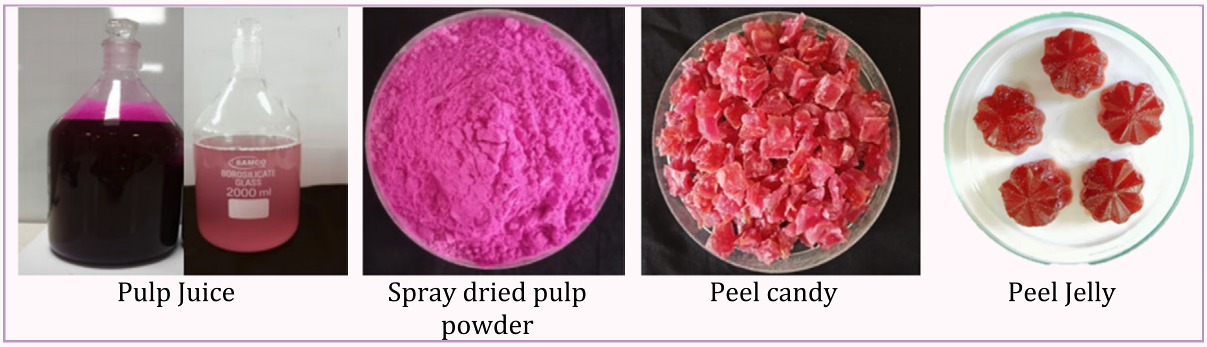


Fig. 2.3.32:. Valorized products of pulp and peel of dragon fruit developed by ICAR-NIASM

Physicochemical and thermal characteristics of custard apple fruit during ripening

A lab experiment was conducted to investigate the changes in the physicochemical and thermal characteristics of custard apple fruit during ripening, with objective of how those can be utilized in identifying the appropriate maturity stage. For this freshly harvested fruit at different areoles opening (AO) stages (0, 10, 25, 50, 75 and 100% denoted as A0, A10, A25, A50, A75 and A100) were stored for 9 days at ambient conditions (28 °C) and analyzed for changes in physicochemical properties. Surface temperature was recorded using infrared camera (Fig. 2.3.33).

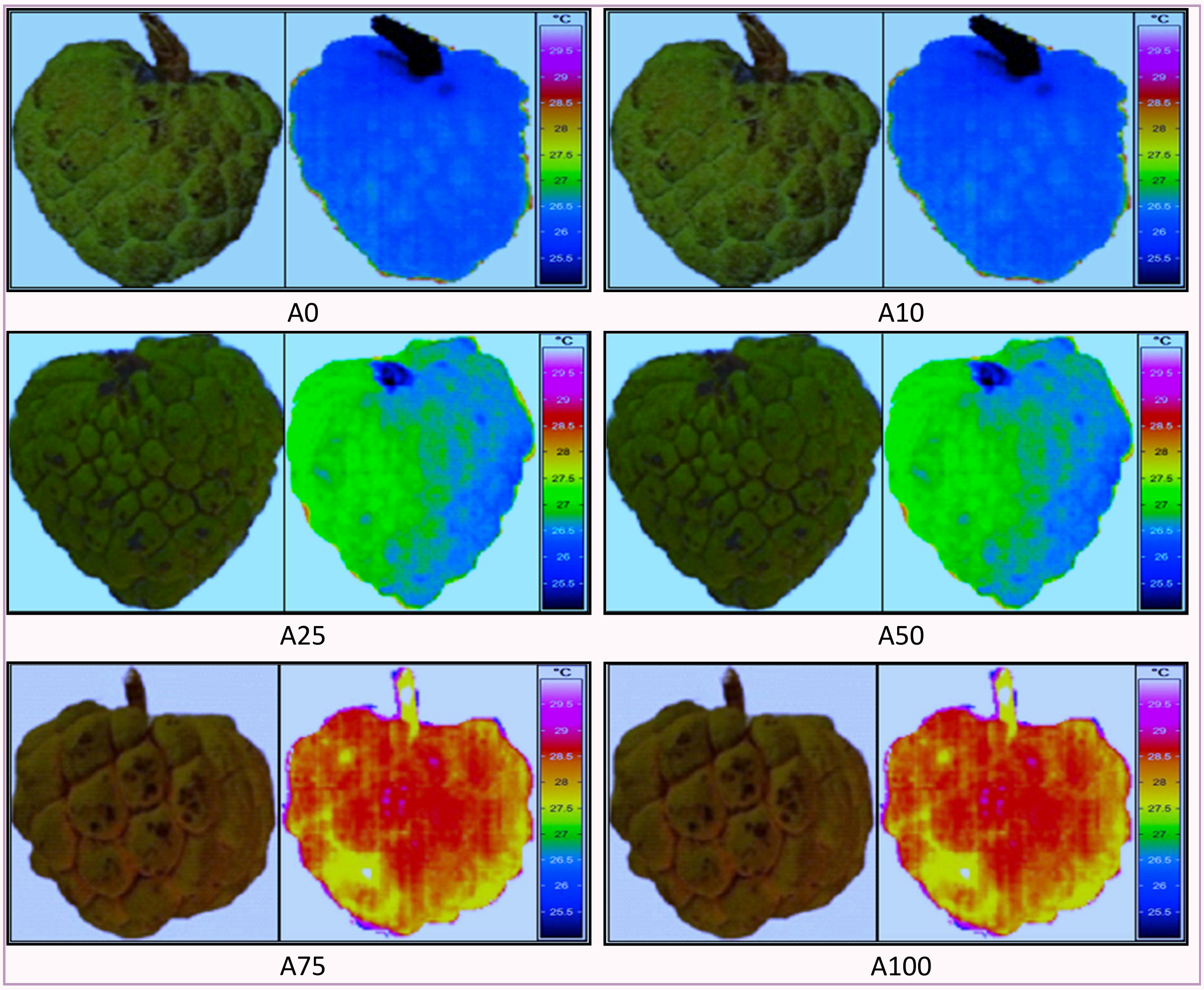


Fig. 2.3.33:. Thermal imaging of custard apple fruits

Correlations between different properties and surface temperature of custard apple fruit is expressed using Pearson's correlation matrix (Table 2.3.7). Mean values of physicochemical property changes throughout storage were significantly correlated at both ($p<0.05$) and ($p < 0.01$ levels,) except Physiological loss in weight (PLW). There were significantly positive correlations between AO and TD (True density) (r=0.99), PSR (Pulp/seed Ratio) (r=0.94), FST (Fruit surface temperature) (r=0.82), TSS (Total soluble solids) (r=0.95), TS (Total Sugar) (r=0.96) and MC (Moisture content)(r=0.98). However, there negative correlations between AO and PF (r=- 0.98), CF (Cutting Force) (r=-0.96), TA (r=-1) respectively. FST represents the internal characteristics of fruit, as heat releases from physicochemical activities during ripening. Higher TSS, TS and MC in fruit pulp lead to high chemical activities, resulting in a positive correlation with FST. While TA, PF (Penetration Force), CF (Cutting Force) correlated negatively with FST. These correlations of quality attributes with FST could provide insights into the internal quality of fruit non-destructively during ripening about internal quality of fruit non-destructively during ripening. Overall, fruit harvested at A50 were found to be the best when considering physico-chemical and surface temperature of fruits.

Table 2.3.7: Pearson's correlation matrix between quality attributes of custard apple fruit

Quality attributes	AO (%)	PLW (%)	TD (g cc^{-1})	PF (g)	CF (g)	PSR	FST (°C)	TSS (°B)	TS (%)	TA (%)	MC (% wb)
AO (%)	1.00**										
PLW (%)	-0.37ns	1.00**									
TD (g cc^{-1})	0.99**	-0.40 ns	1.00**								
PF (g)	-0.98**	0.17 ns	-0.96**	1.00**							
CF (g)	-0.96**	0.12 ns	-0.94**	0.99**	1.00**						
PSR	0.94**	-0.29 ns	0.97**	-0.93**	-0.90*	1.00**					
FST (°C)	0.82*	-0.10 ns	0.83*	-0.83*	-0.79ns	0.93**	1.00**				
TSS (°B)	0.95**	-0.20 ns	0.97**	-0.97**	-0.94**	0.99**	0.91*	1.00**			
TS (%)	0.96**	-0.28 ns	0.98**	-0.95**	-0.92**	1.00**	0.92*	0.99**	1.00**		
TA (%)	-1.00**	0.33 ns	-0.99**	0.98**	0.97**	-0.94**	-0.82*	-0.95**	-0.95*	1.00**	
MC (% wb)	0.98**	-0.39 ns	0.99**	-0.95**	-0.92**	0.98**	0.89*	0.97**	0.99**	-0.98**	1.00**

2.4 School of Social Science and Policy Support

The School of Social Science and Policy Support's research, education and extension activities are carried out through flagship research project, teaching extension education courses and extension and capacity-building programmes in line with the institute's mandate. The major activities of the school were farmer-oriented research focusing demonstration, capacity building, information sharing, and frontline extension activities along with developmental programmes of DAPSC and TSP as summarized below.

Economic analysis of dragon fruit cultivation

As part of the research project, a detailed economic analysis of dragon fruit cultivation was studied through farmers' survey questionnaires in the Western Maharashtra regions of Pune, Satara, and Sangli districts. A total of 27 villages were surveyed to understand and identify the bio-physical and socio-economic constraints in dragon fruit cultivation and address the abiotic stresses through capacity building, training and demonstration of resilient technologies for dragon fruit.

Economic analysis of Dragon fruit cultivation was calculated by surveying farmers from Pune, Solapur, Satara and Sangli districts of western Maharashtra. The findings were that the total capital cost for establishing a dragon fruit orchard, including land preparation, planting material, orchard supporting system, implements, etc., is estimated to be approximately Rs. 10,92,084 ha^{-1}. Whereas, the annual cost of cultivation, such as labour charge for various intercultural operations, machinery charges, input which includes fertilizer, pesticides, etc, and maintenance and transport charges, the total working capital was found to be Rs. 1,86,390 ha^{-1}. The average yield of dragon fruit in farmers' fields is around 15 tonnes ha^{-1}, and farmers are selling at an average price of Rs. 70,000 per tonne; thus, the average income of farmers is Rs. 10,50,000 ha^{-1}. The benefit-cost analysis of dragon fruit cultivation was calculated considering the components of cost-benefit analysis, i.e., fixed capital cost, annual cost, interest on working capital, depreciation, rental value of land, interest on fixed capital, family labour contribution in monetary terms etc. and selling price received by the farmers. The B:C ratio for dragon fruit from the 4th year onwards is around 2.38, as per responses collected during the farmers' survey. However, there were variations in total yield and income among dragon fruit farmers due to variations in soil type, age of orchard, cultivar and impact of socio-economic and bio-physical factors. As dragon fruit is mostly grown in soil- and water-stressed conditions, adopting appropriate resilient practices by farmers will likely help enhance their production and income. The farmers perceived high capital costs, yield loss due to extreme weather conditions and poor linkage with the processing industry as the major constraints to be addressed.

Extension Activities

ICAR- NIASM, as a part of extension activity, have coordinated visits of various stakeholders (farmers, students, organizations) to showcase institute technologies and research field demonstrations. Total 2272 visitors including farmers (385), students (1719) and several organizations (168) visited the institute. ICAR-NIASM also participated in the Agricultural Science Congress organized during 10-13, October 2023, to showcase the institute's technologies to various stakeholders.

Fig. 2.4.1: Visitors to ICAR-NIASM

DAPSC interventions 2023

As a part of the extension and developmental activities of the institute, DAPSC (Developmental Action Plan for scheduled caste) programmes were carried out to enhance the livelihood and income of farmers. Under this scheme, various activities were undertaken, such as the distribution of critical agricultural inputs and capacity-building programmes.

Under the DAPSC programmes, various interventions were planned, which included crops, orchards, livestock, and fisheries. Besides these, some interventions were targeted to improve living standards, promote health and nutrition, etc. A total of 1041 farmers and two self-help groups (SHG) from about 48 villages (from 11 tehsils viz Baramati, Daund, Purandar, Indapur, Malashiras, Karjat, Jamkhed, and Phaltan) were included based on a survey of their status and requirements for the upliftment of livelihood. Other inputs, namely, poultry cages (60), utensil kits (150) with stainless steel water filters (50), sewing machines (100), flour mills (50), dairy kits consisting of milk cans, SS buckets, milk measure, plastic baskets, mineral mixture, deworming tablets (100) were provided. Also, Bicycles (70) were distributed to landless beneficiaries. A total of 2 SHGs were provided with capital inputs/livelihood support for income generation viz - nonwoven bag-making machine (1) and onion transplanter (1). To promote seed production activities in a few selected villages, ICAR-National Institute of Abiotic Stress Management, Baramati, and Krishi Vigyan Kendra, Baramati jointly organized a Field Day-cum-Farmers'-Scientists'-Interaction Meet on "Kharif onion seed production" under DAPSC 2022-23 at Halgaon of Jamkhed Tehsil and Shinde, Nandgaon of Karjat Tehsil on 27th August 2022. About 35 farmers from Halgaon (Jamkhed) and 93 farmers from Shinde and Nandagaon participated in the interaction meet. Various training programmes on "Upliftment of livelihood of SC Beneficiaries" were also organized during the period under the Development Action Plan for Scheduled Castes (DAPSC) at different villages 1. Visapur and 2. Sangvi village of Satara District, 3. Karanje and 4. Malegaon from

Pune district Maharashtra. It was followed by the distribution of inputs like sewing machines, domestic flour mills, bicycles, utensil kits, and dairy kits to the identified beneficiaries of selected villages.

Fig. 2.4.2: Dr Himanshu Pathak, DG, ICAR handing over the onion transplanter to SC women's SHG

Fig. 2.4.3: Dr K Sammi Reddy, Director, handing over the Nonwoven bag making machine to SC SHG

Fig. 2.4.4: Field Day-cum-Farmers'-Scientists'-Interaction Meet

About 80 beneficiaries benefitted from this training programme. Grampanchayat sarpanch and the members/social workers from the village actively participated in the training programme. The training programme was followed by the distribution of dairy kits to SC livestock farmers

Fig. 2.4.5: Distribution of Sewing machines at Sangavi

Fig. 2.4.6: Distribution of poultry cages to SC beneficiaries

Fig. 2.4.7: Distribution of Bicycles to SC beneficiaries

Fig. 2.4.8: Distribution of Dairy kits to SC beneficiaries

Fig. 2.4.9: Field Day-cum-Farmers'-Scientists'-Interaction Meet

Financial achievement/Total Budget (2022-23) received and utilized:

The total budget (Rs. 52,00,000) was received under Capital: (Rs. 26,00,000) and General (Rs. 26,00,000) budget heads for the financial year 2022-2023 for expenditure towards conducting DAPSC activities. The expenditure incurred under capital and general budget heads are summarized under Table 2.4.1.

Table 2.4.1: Expenditure incurred under Capital and General heads

Sr. No.	Name of capital item (Capital Head)	Quan -tity	Amount (Rs.)	Sr. No.	Name of capital item (General Head)	Quan -tity	Amount (Rs.)
1	Backyard poultry cages	60	480000	1	SS milk cans	100	97000
2	Domestic Flour mill	50	497500	2	Utensil Kit	150	1098750
3	Bag preparing machine	1	289999	3	Deworming tablets	500	21000
4	Bicycles	70	342230	4	Mineral Mixture	100	94800
5	Sewing machine	100	550000	5	Cattle feed	100	154800
6	SS Filter	50	88750	6	Onion seeds	105	500000
7	Onion Transplanter	1	351000	7	Liquid fertilizers	100	100000
				8	Plastic Ghamella	100	89000
				9	SS bucket/milk measure	100	175580
				10	Transport	-	8064
				11	Manpower	-	183286
				12	Imprest for DAPSC	-	15285

TSP interventions 2023

The Tribal Sub Plan (TSP) activities of ICAR-NIASM are implemented in ten villages in the Nandurbar district of Maharashtra. Farmers are provided with training, field demonstrations, and awareness programmes on improved agricultural technologies. The selected farmers receive improved inputs related to agriculture production, livestock production, fish production, horticulture crops, etc. Total 1637 tribal farmers from 16 villages were given inputs for improved agricultural practices. Seven farmer interaction meetings (Kisan Gosti) involving farmers from 16 villages in the Navapur and Dhadgaon Tehsils of the Nandurbar district were conducted, along with training sessions and field demonstrations in following areas of

- Field demonstration of fish feeding method
- Backyard poultry practices
- Improved livestock management practices
- Crop-animal-fish.Integrated culture practices
- Waste water management at TSP village

The villages include Bedki, Dapur, Pati, Piprana, Borpadha, Kamod, Khokasa, Kotkhab, Nagchari, Nangipadha, Motekadwan, Keli, Vadphali, Vadsatra, Vadhda, and Nagare. The Director, ICAR-NIASM interacted with the Sarpanchs of villages and advised them on the implementation of Good agricultural practices.

Fig. 2.4.10: Distribution of agriculture input among the farmers

Fig. 2.4.11: Distribution of agriculture inputs to farmers

Fig. 2.4.12: Distribution of Mini Dall mill to Women SHG

Table 2.4.2: Details of Items distributed In TSP Programme

Sr. No.	Name of the items	Quantity	Benefi-ciaries (Nos.)	Sr. No.	Name of the items	Quantity	Benefi-ciaries (Nos.)
1	Paddy seed	5000 kg	400	9	Power weeder	04 nos.	20
2	Maize seed	1000 kg	46	10	Sickle	230 nos.	115
3	Mango plants	1000 nos.	100	11	Secateur	80 nos.	80
4	Guava plants	1000 nos.	100	13	Spade	95 nos.	95
5	Fish-feed (4 mm)	-	49	13	DAP	6000 kg	120
6	Fish feed (2 mm)	-	49	14	Cattle feed	200 bags	200
7	Fish-seed (Pangasius)	100000	200	15	Moringa Harvester	03 nos.	03
8	Mini Dal mill (1 Unit/Women SHG)	02 nos.	40	16	Post hole auger digger	10 nos.	20
Total number of farmers : 1637							

Fig. 2.4.13: Addressing farmers on Climate smart agriculture technologies

Fig. 2.4.14: Interaction meeting with Farmers at Navapur and Dhadgaon Tehsil at Nandurbar District

Fig. 2.4.15: Distribution of fish feed to farmers

Fig. 2.4.16: Demo on fish feeding method, culture practice integrated agri-aqaculture

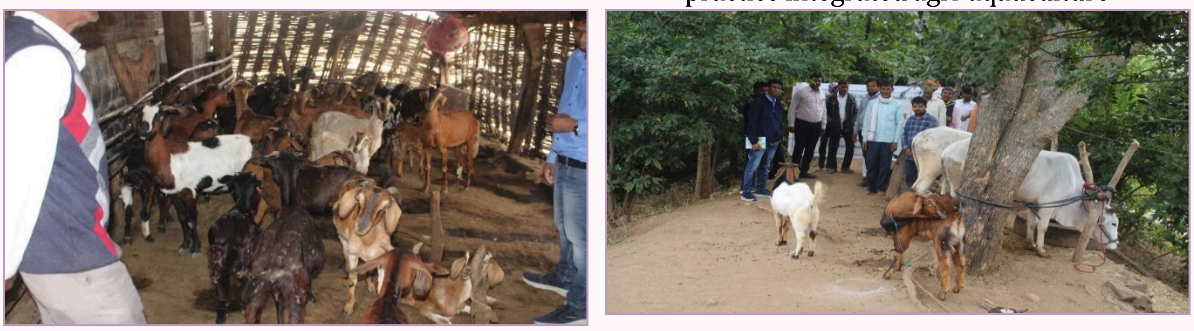


Fig. 2.4.17: Training on Improved livestock management practices

3. Training & Capacity Building

ICAR-IARI BSc (Hons) Agri. students admitted to IARI-NIASM Baramati Hub

SN.	Name of student	Roll No.
1.	Sushain Padmaraj	IARIBAR20233001
2.	Jonah Peter Manoj	IARIBAR20233002
3.	Thaliyaparambil Nandhana Shankar	IARIBAR20233003
4.	Errala Aravind	IARIBAR20233004
5.	Palak Thakur	IARIBAR20233005
6.	Ahmed Ziyan T	IARIBAR20233006
7.	Harshita Parihar	IARIBAR20233007
8.	Eslavath Sravanthi	IARIBAR20233008
9.	Ayaskanta Behera	IARIBAR20233009
10.	Arnab Das	IARIBAR20233010
11.	Karthik S S	IARIBAR20233011
12.	Sanjana Barman	IARIBAR20233012
13.	Virbhadra Kumar	IARIBAR20233013
14.	Mahima Kumari Shah	IARIBAR20233014
15.	S Kumar	IARIBAR20233015
16.	Umashankar Kumar	IARIBAR20233016
17.	Hrishikesh Vinod	IARIBAR20233018
18.	Sujal Sahajpal	IARIBAR20233019
19.	Neha S	IARIBAR20233020
20.	Raser Panyang	IARIBAR20233021
21.	Ajay Sharma	IARIBAR20233022
22.	Jitendra Singh	IARIBAR20233023

ICAR-IARI MSc/MTech/PhD students who joined IARI-NIASM Hub for research

SN	Student	Roll No.	Discipline	Degree
1.	Navodhaya JV	IARIBAR20232003	Plant Physiology	MSc
2.	Harimadhav C	IARIBAR20232006	Plant Physiology	MSc
3.	Bhavani Vuggumoodi	IARIBAR20232008	Environmental Science	MSc
4.	Ramakrishna Bantu	IARIBAR20232001	Soil & Water Conserve. Eng.	MTech
5.	Megha PP	IARIBAR20232002	Soil & Water Conserve. Eng.	MTech
6.	Swapnil Jain	IARIBAR20232009	Agri. Struct. & Process Eng.	MTech
7.	Eram Fatma	IARIBAR20232004	Agri. Struct. & Process Eng.	MTech
8.	Shambhavi Singh	IARIBAR20232005	Environmental Science	PhD
9.	Diwakar Tiwari	IARIBAR20232010	Agri. Struct. & Process Eng.	PhD

MSc/MTech students graduated from IARI-NIASM Baramati Hub (2023-24)

SN.	Name of student	Roll No.	Discipline	Research Guide	Thesis title
1.	Ashok Subodhi	70011	Environmental Science	AK Singh	Combined effect of drought and heat stress on quinoa in marginal environments
2.	N Charishma	70012	Environmental Science	AK Singh	Elevated carbon dioxide responsiveness of soybean genotypes differing in tolerance to soil moisture deficit conditions
3.	Prerna Kumari	70013	Environmental Science	AK Singh	Pb responsiveness of soybean genotypes differing in tolerance to soil moisture deficit
4.	Chanmolu Hari Gopala Krishna	70016	Plant Physiology	J Rane	Optimization of phenotyping protocol to assess waterlogging induced roots in cowpea
5.	Bhavani	70008	Soil and Water Conservation	GC Wakchaure	Effect of Deficit Irrigation on Garlic (*Allium sativum L.*) Cultivars in Deccan Plateau of India

MSc/PhD Students of SAU's/Private Universities joined ICAR-NIASM for research work (2023-24)

SN	Student	Discipline	Guide/ Co-guide / SAC member	University/College
	M.Sc. students			
1.	Sanket Navle	Soil Science & Agril. Chemistry	V Rajagopal	MPKV, Rahuri
2.	Rupali Singh	Agroforestry	SB Chavan	ICFRE-ECO Rehabilitation Centre, Prayagraj
3.	Renuka Nagale	Forestry	SB Chavan	Dr BSKKV, Dapoli
4.	Girish Chopde	Genetics & Pl. Breeding	PS Basavaraj	MPKV, Rahuri
5.	More Krushna Vitthal	Entomology	Rajkumar	VNMKV, Parbhani
6.	Dhore Anjali Kailas	Agronomy	HM Halli	UAS, Bengaluru
7.	Vankalas Chaitanya Nihalkumar	Horticulture	PS Khapte	College of Agriculture, Baramati
8.	Sadakal Omkar Uttam	Horticulture	AS Morade	College of Agriculture, Baramati
9.	Kokani Nishigandha Kiran	Horticulture	VD Kakade	College of Agriculture, Baramati
10.	Kalbhor Shashianand Uttam	Entomology	Rajkumar	College of Agriculture, Baramati
11.	Arshiya Pathan	Biotechnology	SA Kochewad	VP Arts, Science and Commerce College, Baramati
12.	Anupama Shinde	Biotechnology	Neeraj Kumar	VP Arts, Science and Commerce College, Baramati
13.	Pranita Ganeshkar	Biotechnology	Neeraj Kumar	VP Arts, Science and Commerce College, Baramati
14.	Bhavana Ahiwale	Biotechnology	SS Pawar	VP Arts, Science and Commerce College, Baramati

SN	Student	Discipline	Guide/ Co-guide/ SAC member	University/College
15.	Shreya Kamble	Biotechnology	SS Pawar	VP Arts, Science and Commerce College, Baramati
16.	Bharati B Misal	Fruit Science	VD Kakade	College of Agriculture, Baramati
17.	Gayatri S Waghmore	Fruit Science	VD Kakade	College of Agriculture, Baramati
18.	Namrata K Kote	Fruit Science	AS Morade	College of Agriculture, Baramati
19.	Shruti S Sarode	Vegetable science	PS Khapte	College of Agriculture, Baramati
20.	Priti K Mote	Vegetable science	PS Khapte	College of Agriculture, Baramati
	Ph.D. Students			
1.	Sagar Karande	Plant Pathology	VN Salunkhe	MPKV, Rahuri
2.	Rutuja D Labade	Plant Pathology	VN Salunkhe	VNMKV, Parbhani
3.	Vishnu B Gore	Biochemistry	SS Changan	MPKV, Rahuri
4.	Rutuja S Pisal	Fruit science	SA Morade	MPKV, Rahuri
5.	Ashutosh Kumar	Fruit science	KM Boraiah	MPKV, Rahuri
6.	Sonal D Jadhav	Fruit science	DD Nangare	VNMKV, Parabhani
7.	Suraj Gund	Agril. Botany	PS Basavaraj	MPKV, Rahuri
8.	Sonal Nikam	Engineering	GC Wakchaure	College of Engg., Malegaon
9.	Amol P Solanke	Agril. Botany	Gurumurthy	MPKV, Rahuri

Trainings/Seminar/Workshop/Symposia/Conference organized by ICAR-NIASM *(CD: Course Director, CCD: Co-Course Directors, CC: Course coordinators)*

SN.	Training (Period)	Beneficiaries details (Numbers)	Organizers
1.	ICAR Sponsored Winter school on "Climate Change & Abiotic stresses Management Solutions for Enhancing Water Productivity, Production Quality and Doubling Farmers Income in Scarcity Zone" (05-25 Jan. 2023)	Scientists/ researchers, academicians and extension faculties from ICAR, SAUs and KVK across the countries. (25)	CD: GC Wakchaure, CC: AK Singh, Aliza Pradhan
2.	National conference on "Globalization of India's Crop Improvement Research (19-21 Jan. 2023)	Scientists, Professors, Students, research scholars	KM Boraiah
3.	Quality control in laboratory analysis and exposure to advanced analytical instruments for B Voc. Quality control in Industry (30 Jan. -17 Feb. 2023)	Students (13)	Karthikeyan N, Rajkumar
4.	Non-phenotyping for abiotic stress tolerance in crops and Agroforestry (6-15 Feb. 2023)	Postgraduate students of JNKVV Jabalpur, MP (25)	S Gurumurthy, SB Chavan & VD Kakade
5.	Climate Resilient Agriculture and Livelihoods for NGOs and FPOs (13-17 Feb. 2023)	NGOs and FPOs (26)	CD: SB Chavan, Aliza Pradhan, VD Kakade CCD: VN Salunkhe, Harisha CB, Rajkumar, PS Khapate, Ravi Kure, HM Halli

6.	Bankable models for mainstreaming climate financing for bankers (with special reference to agroforestry, dragon fruit medicinal plants & New Crops) (15-17 Feb. 2023)	Bank officials of national, private & co-operative (30)	CD: SB Chavan, Aliza Pradhan VD Kakade
7.	State Level Workshop on 'Emerging Technologies for Enhancing the Productivity and Quality of Dragon Fruit in Water Scarce and Degraded Areas' (20 Feb. 2023)	Farmers (>400)	VD Kakade, DD Nangare, VN Salunkhe, SB Chavan, GC Wakchaure, Aliza Pradhan, KM Boraiah
8.	Toolified Approach for Competency Development of Government Officials for Developing Climate Projects (13-17 March, 2023)	Government officials & Academic staff of colleges (31)	CD: SB Chavan, VD Kakade
9.	State Level Workshop on "Commercial Dragon Fruit Cultivation (20 May, 2023)	Farmers (30-40)	GC Wakchaure, KM Boraiah, VD Kakade
10.	Blended Learning Programme (Concept Development, Appraisal & Monitoring) Phase II & III of Climate Change Projects(12-17 June, 2023)	NABARD officials (18)	CD: SB Chavan, VD Kakde & Aliza Pradhan
11.	Abiotic Stress Management in Agriculture for Enhancing the Farmers Income with Special Reference to Natural Resource Management(01-06 Aug. 2023)	Faculty from ICAR institutes, SAU, KVKs and other research organizations, SAMETIs and NGOs across the country. (135)	CD: Harisha CB, SB Chavan, HM Halli, AS Morade
12.	Abiotic Stress Management for Sustainable Millet based Production Systems(22-23 Aug. 2023)	Scientists, Professors, Students, research scholars (>300)	SB Chavan & Arjun Tayade (Organizing Secretary)
13.	Inplant Training Programme on "Abiotic Stresses in Agriculture, Management Strategies and Engineering Interventions" (4 Sep.- 3 Oct. 2023)	Students (UG, PG, and PhD) (22)	CD: GC Wakchaure Aliza Pradhan, VD Kakade, RN Singh
14.	Swachhta Hi Seva and Special Campaign 3.0(15 Sep. -2 Oct. & 2-31 Oct. 2023)	NIASM Staff (60)	KM Boraiah
15.	State Level Joint Workshop on "Commercial Dragon Fruit Farming(19 Oct. 2023)	Farmers government, and Sakal media group officials (65)	GC Wakchaure, KM Boraiah, VD Kakade, VN Salunkhe, SB Chavan
16.	RAWE Programme orientation for B.Pharma (27 Oct.-06 Nov. 2023)	B.Pharma Students of SVPM'S College of Pharmacy, Malegoan, Baramati (03)	CB Harisha
17.	One day special lecture on Pension & Retirement Benefits and National Pension System (NPS) at ICAR-NIASM (26 May, 2023)	Scientific, Technical & Administrative Staff members of NIASM & all the Pune based ICAR Institutes (100)	SK Das, HM Halli
18.	Schedule for Pre-Examination Training for Limited Departmental Audit & Accounts Examination (LDA&A Exam.) (20 July-06 Oct. 2023)	Administrative Staff members of different ICAR institutes of the country (313)	SK Das
19.	5 days Student Ready-RAWE Training Programme (Biotechnology) at ICAR-NIASM (4-8 Oct. 2023)	Students of Sharadchandraji Pawar College of Agriculture, Baramati (07)	AK Singh

20.	3 months internship program on "Entrepreneurial Development in Biotechnology specially in Plant Molecular Technique" during at ICAR-NIASM (15 Feb- 15 May 2023)	K. K. Wagh College of Agricultural Biotechnology, Nashik (MH) (05)	KM Boraiah
21.	One month training on "Molecular technique in plant disease diagnosis" at ICAR-NIASM (01-30 June 2023)	Student of IISER Thiruvananthapuram, Kerela (02)	VN Salunkhe
22.	7 days RAWE training programme (30 Jan.- 07 Feb. 2023)	3rd year students of B. Voc. (Quality control in industries) Sharadha Bhai Pawar Mahavidhyala, Baramati (13)	Rajkumar Karthikeyan N
23.	Unit attachment under STUDENT READY programme (09-15 Jan. 2023)	Final year B.Sc. (Agri) students from Dr. Sharadchandra Pawar College of Agriculture, Baramati (07)	Rajkumar
24.	15 days RAWE training programme on Quality control in industries (30 Jan.- 17 Feb. 2023)	2nd year students of B. Voc., Sharadha Bhai Pawar Mahavidhyala, Baramati (11)	Gopalkrishnan B, Harisha CB, Halli HM.
25.	Training on "HPLC Technique" at ICAR-NIASM, (25 Mar-04. Apr. 2023)	Vidya Prathisthan's College of Agricultural Biotechnology Baramati, (03)	Karthikeyan N
26.	Swachhta Pakhwada(16-31 Dec. 2023)	NIASM Staff and students (80)	KM Boraiah
27.	International Webinar on "Technological Advances and Innovations for Abiotic Stress Management (27 Dec. 2023)	National and international scientists and officials in the field of agriculture. (75)	KM Boraiah
28.	NIASM Associates course (NAC-3) on "Agriculture and Abiotic Stress Management" (5 July-2 Nov. 2023)	ICAR-NIASM, Baramati (20)	HM Halli
29.	Training programme on "Quality control in laboratory analysis and exposure to advanced analytical instruments" (30 Jan- 17 Feb 2023)	2rd year students of B Voc. (Quality control in Industries), Sharadha Bhai Pawar Mahavidyalaya, Baramati (11)	GopalakrishnanB, CB Harisha, HM Halli
30.	Training programme on "Quality control in laboratory analysis and exposure to advanced analytical instruments" (30 Jan- 07 Feb 2023)	3rd year students of B Voc. (Quality control in Industries), Sharadha Bhai Pawar Mahavidyalaya, Baramati (13)	Rajkumar, Karthikeyan
31.	Unit attachment training under student ready programme (9-15 Jan 2023)	Final year BSc (Agri) students from Dr. Sharadchandra Pawar College of Agriculture, Baramati (07)	Rajkumar, GopalakrishnanB, CB Harisha

4. Awards & Recognition

- Dr K Sammi Reddy, received Dhiru Morarji Memorial Award (2022-23) of Fertilizer Association of India (FAI), New Delhi by the hands of Sri Mansukh Mandaviya, Union Minister of Health and Family Welfare and Chemicals and Fertilizers of India.

- Dr Aliza Pradhan, received Best oral presentation at XXII National Symposium of the Indian Society of Agronomy on "Climate-smart agronomy for resilient production systems and livelihood security" at ICAR-CCARI, Goa.

- Dr Aliza Pradhan, recognised as research guide for P.G. programme (Environmental science) by graduate school of ICAR-IARI, New Delhi.
- Dr Aliza Pradhan, received "NIASM Hindi Puraskar-2023" during Hindi Pakhwada-2023.
- Dr Aliza Pradhan, recognised as University teacher of BSKKV, Dapoli, Maharashtra.
- Dr Basavaraj PS, received Young Scientist award from Mother Terasa College of Agriculture & All India Agricultural Student Association during International Conference on Climate Resilient Agriculture for Sustainable Agricultural Productivity.
- Dr BB Gaikawad, Dr Sangram Chavan and Sh Sunil Potekar, recognized as "Drone (Rotor Craft) Pilot" for small and medium category drone by DGCA.
- Dr DD Nangare, received ICAR-NIASM Best Senior & Principal Scientist award on occasion of 15th foundation day.

- Dr DD Nangare, recognized as External subject expert member for selection committee, Dept. of Applied Engg., VIGNAN'S Foundation for Science and Technology, Vadalamudi, Guntur (AP).
- Dr DD Nangare, invited as subject expert for CAS of Professors in Agricultural Engineering discipline conducted by Maharashtra Council of Agriculture, Education Research (MCAER), Pune.
- Dr DD Nangare, invited as subject expert member for state level paper presentation competition (Techno spark 2023) held at Shriram College of Agricultural Engg., Paniv.

- Wakchaure GC, Gawhale BJ, Bhavani, Pal KK, K Sammi Reddy received Best Poster Award at National Seminar on 'Abiotic Stress Management for Sustainable Millet based Production Systems' at ICAR-NIASM.

- Choudhari JD, Wakchaure GC, Gawhale BJ, Aliza Pradhan, Amresh Chaudhary, Singh RN received Best Poster Award at National Seminar on 'Abiotic Stress Management for Sustainable Millet based Production Systems' held at ICAR-NIASM.

- Dr Gopalakrishnan B, received "Best Oral Presentation" award at International Conference on "Feeding the future through Sustainable Eco-Friendly Innovations in Rangeland, Forages and Animal Science" held at UAS, Bangalore.

- Dr Gurumurthy S, won third prize at the Plant Biology 2023 Hackathon on "The role of science communication in enhancing the adoption of innovative technologies in agriculture" organized by the American Society of Plant Biologists in Savannah, Georgia, USA.

- Dr Gurumurthy S, received Best poster presentation award for the poster entitled "Accelerating Genetic Gain in Common Bean (Phaseolus vulgaris L.): Performance Evaluation of Genotypes Across Three Seasons or Generations" held at ICAR-IARI, New Delhi.
- Dr Gurumurthy S, presented in the KRITAGYA: A National level hackathon on Speed breeding for crop improvement at New Delhi.
- Dr Gurumurthy S, has been offered three months visiting post-doctoral fellowship (International Exchange Fellowship) at Kansas State University, Kansas, USA.
- Dr Gurumurthy S, has recognized as University faculty and guide of IARI, New Delhi.
- Dr Gurumurthy S, has recognized as university teacher of BSKKV, Dapoli, Maharashtra.
- Dr Gurumurthy S, has recognized as University teacher of UAS, Dharwad, Karnataka.
- Dr Gurumurthy S, has recognized as University teacher of UAS, Raichur, Karnataka.
- Dr Gurumurthy S, recognized as nominated member of the Board of Studies (BOS), Tuljaram Chaturchand College, Baramati, Pune.
- Dr HM Halli, awarded scholarship for accommodation and registration to

attend the XXV International Grassland Congress at Covington, KY USA by Grassland Congress Organizing Committee and International Grassland Congress.

- Dr HM Halli, received 'ICAR-NIASM Highest rated publication award' on the occasion of 15th Foundation day.
- Dr HM Halli, received an International Travel Support grant and Registration support from Science and Engineering Research Board (SERB), India to attend XXV International Grassland Congress, at Kentucky, USA.
- Dr HM Halli, recognised as research guide for PG programmes (Environmental science) by graduate school of ICAR-IARI, New Delhi.
- Dr HM Halli, recognised as University teacher of BSKKV, Dapoli, Maharashtra on 02.03.2023.
- Dr HM Halli, won Silver medal in Badminton at ICAR- Western Zone Sports Meet at ICAR- IGFRI, Jhansi, UP.
- Dr PS Khapte, received DST-SERB International Travel Support to attend International Plant Phenotyping Symposium–PhenoVeg 2023, at Taiwan.
- Dr PS Khapte, recognized as a research guide for PG programmes of ICAR-IARI, New Delhi in the discipline of Vegetable Science.
- Dr PS Khapte, recognized as a research guide MPKV, Rahuri in the discipline of Horticulture.
- Dr Rajagopal, recognized as a research guide MPKV, Rahuri in Soil Science & Agriculture Chemistry discipline.
- Mr R Rajkumar, recognized as "Mentor" in State Inter-University Research Convention for Post Graduate Students level at "AAVISHKAR-2023" under "Agriculture and Animal Husbandry" category held at "Savitribai Phule Pune University".
- Mr Rajkumar, received "Budding Innovators Award" in a National Level Krishi Vigyan Vidhi 1.0 Conclave organized by Krishna Vishwa Vidyapeeth, Karad; Jaywantrao Bhosale Krishna College of Agriculture Rethare Bk. & SPPU-Research Park Foundation, SPPU, Pune in Association with IIT Ropar, Punjab.
- Dr SB Chavan, received the ISAF Gold Medal 2022 for outstanding contribution to agroforestry research and development from the Indian Society of Agroforestry, Jhansi at the event held at PJTSAU Hyderabad.
- Dr SB Chavan, recognized as a Research

Guide IARI, New Delhi in Environmental Science discipline.
- Dr SS Changan, received Best Paper Award by Indian Potato Association (IPA).
- Dr SS Changan, recognized as ICAR-IARI PG faculty, New Delhi in Plant Biochemistry discipline.
- Dr Vanita Salunkhe, received 'High Rated Publication of ICAR-NIASM' award on NIASM foundation day.
- Dr Vanita Salunkhe, received "Best Oral Presentation" award in the Indian Phytopathology Society (IPS) Platinum Jubilee conference held at University of Mysore, Mysuru, Karnataka.
- Dr Vanita Salunkhe, recognized as a Research Guide IARI, New Delhi in Plant Pathology discipline.

- Dr Vanita Salunkhe, recognized as a research guide MPKV, Rahuri in Plant Pathology discipline.
- Dr VD Kakade, received 'ICAR-NIASM Best Scientist award' on the occasion of NIASM foundation day.
- Dr VD Kakade, recognized as research guide (Fruit Science) by MPKV, Rahuri for MSc Horticulture.
- Mr AS Morade, recognized as Expert Member by National Horticulture Board (Pune office) for accreditation and star rating of fruit and vegetable nursery.
- Mr AS Morade, recognized as research guide by MPKV, Rahuri for MSc Horticulture.
- Uthappa AR, SB Chavan, Gopal Ramdas Mahajan, A Raizada, Parveen Kumar received Best Poster Award at National Seminar on 'Abiotic Stress Management for Sustainable Millet based Production Systems' held at ICAR-NIASM, Baramati.
- Badminton men's team (HM Halli, VD Kakade, AS Morade, SS Changan & Basavaraj) received Runner up trophy during at ICAR Zonal (West zone) sport meets at IGFRI, Jhansi.

5. Linkages & Collaborations

Academic/Research organizations having MOU with ICAR-NIASM

Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani

Maharashtra Animal & Fishery Sciences University, Nagpur

Kamdhenu University, Gandhinagar, Gujarat

University of Agricultural Sciences, GKVK, Bangalore

University of Agricultural Sciences, Dharwad

University of Agricultural Sciences, Raichur

Agharkar Research Institute, Pune

Shivnagar Vidya Prasarak Mandal, Malegaon, Baramati

University of Horticulture, Bagalkot

International Water Management Institute, New Delhi

Vasanth Dada Sugar Institute, Pune

Lovely Professional University, Punjab

NGOs, Corporate & other organizations having MOU with ICAR-NIASM

BAIF Development Research Foundation, Pune

Agriculture Tourism Development Cooperation, Pune

MITCON Consultancy & Engineering Services Ltd., Pune

Yara Fertilisers India Pvt. Ltd.

iiCARE Foundation, Navi Mumbai

Ambronics Private Limited, Parbhani

Association for Innovation Development of Entrepreneurship in Agriculture (a-IDEA), Hyderabad

Alliance Bioversity & CIAT, New Delhi

Privi Life science, Pvt Ltd, Mumbai

Novem Solutions Private Limited, Hospet, Karnataka

6. Publications

Research Papers

1. Aditi YT, Rajkumar VB, Vitthalrao BK (2023) Efficient Use of Seriwaste for the Qualitative Improvement in the Protein Contents of Black Soldier Fly (BSF), Hermetia illucens (L). International Journal of Animal Biotechnology and Applications. 9(1): 10-20. DOI:10.37628/ijaba.v9i1.839
2. Aditi YT, Rajkumar VB, Vitthalrao BK (2023) The Utilization of Seriwastes (Excreta of Silkworm Larvae, Litter of Mulberry Leaves in Rearing Bed, Dead Larvae and Dead Pupae of Silkworm) for Biomass and Protein Contents of Black Soldier Fly (BSF), Hermetia illucens (L). Research and Reviews: A Journal of Toxicology. 12(3): 7-17. DOI:10.37591/rrjot.v12i3.3036
3. Ankita AS, Aditi YT, Rajkumar VB, Vitthalrao BK (2023) Efficiency of the Zingiberene for the Qualitative Silk. Entomology and Applied Science Letters. 10(1): 1-10. DOI:10.51847/4hW3o5bgkY
4. Arunkumar D, Krishnani KK, Kumar N, Sarkar B, Upadhyay AK, Sawant PB, Chadha NK, Abisha R (2023) Mitigating abiotic stresses using natural and modified stilbites synergizing with changes in oxidative stress markers in aquaculture. Environmental Geochemistry and Health. 45: 4565–4581. DOI:10.1007/s10653-023-01507-w
5. Asangi H, Ravi Y, Ashoka N, Kavan Kumar V, Harisha CB, Verma AK (2023) Recent Advances in Ajwain (Trachyspermum ammi L.) Cultivation: A Review. International Journal of Environment and Climate Change. 13 (10): 2929-2938. DOI:10.9734/ijecc/2023/v13i102959
6. Barge KR, Kad VP, Wakchaure GC, Yenge GB (2023) Development of protocol for preservation of custard apple pulp. Journal of Agricultural Research and Technology. 48 (2): 223-229. https://www.researchgate.net/publication/374781189
7. Basavaraj B, Jayadev HM, Halli HM, Sannagoudar MS (2023) Mapping of soil test-based spatial fertilizer recommendations for paddy and maize using GIS, GPS and STCR approaches in a micro-watershed of Karnataka, India. Current Science. 124: 1160-1166. https://www.currentscience.ac.in/Volumes/124/10/1160.pdf
8. Basavaraj PS, Boraiah KM, Gupta P, Rane J, Raskar N (2023) Genetic analysis and characterization of diverse pigeonpea genotypes for yield-enhancing traits. Vegetos. DOI:10.1007/s42535-023-00646-w
9. Basavaraj PS, Rane J, Boraiah KM, Gangashetty P, Harisha CB (2023) Genetic analysis of the tolerance to transient waterlogging stress in pigeonpea (Cajanus cajan L. Millspaugh). Indian Journal of Genetics and Plant Breeding. 83(3): 316-325. DOI:10.31742/ISGPB.83.3.3
10. Basavaraja T, Tripathi A, Chandora R, Pratap A, Manjuanatha L, Gurumurthy S, Singh B (2023) Evaluation of phenological development and agronomic traits in exotic common bean germplasm across multiple environments. Plant Genetic Resources.

21(3): 195-203. DOI:10.1017/S1479262123000618

11. Bharamappanavara M, Madhyavenkatapura AS, Appaiah MC, Basavaraj PS, Ajitha V, Senguttuvel P, Maganti SM, Rathod S, Mondal TK, Lokesha R, Mathada RU, Sundaram MR, Palakolanu S, Parmar B, Kumar RM, Subba Rao LV, Channappa G (2023) Genetic analysis of early seedling vigour in Oryza glaberrima accessions under laboratory and direct-seeded rice conditions. Cereal Research Communications. 51: 991–1002. DOI:10.1007/s42976-023-00349-7
12. Bharamappanavara M, Manoj CA, Basavaraj PS, Vijjeswarapu A, Anantha M, Siddaih, Lokesha R, Jayateertha D, Nidagundi JM, Mathada UR, Talagunda SC, Guddalahalli LY, Byanna R, Rathod S, Sundaram RM, Venkata SL, Kumar RM, Channappa G (2023) Genetic analysis and identification of QTLs associated with yield-enhancing traits in Oryza sativa IR64 × Oryza glaberrima interspecific backcross populations. Crop and Pasture Science. 74: 1023-1036. DOI:10.1071/CP22105
13. Biradar B, Jayadev HM, Halli HM, Sannagoudar MS (2023) Mapping of soil test-based spatial fertilizer recommendations for paddy and maize using GIS, GPS and STCR approaches in a micro-watershed of Karnataka, India. Current Science. 124(10) DOI: 10.18520/cs/v124/i10/1160-1166
14. Boraiah KM, Basavaraj PS, Harisha CB, Kakade VD, Halli HM, Kate P, Rane J, Pathak H (2023) Supplementary manual pollination: a potential technology to enhance the yield and quality in white fleshed dragon fruit variety. National Academy Science Letters. DOI:10.1007/s40009-023-01356-2
15. Chakraborty P, Krishnani KK, Mulchandani A, Sarkar DJ, Das BK, Kurcheti PK, Sawant PB, Kumar N, Sarkar B, Poojary N, Mallik A, Pal P (2023) Toxicity assessment of poultry-waste biosynthesized nanosilver in Anabas testudineus (Bloch, 1792) for responsible and sustainable aquaculture development-A multi-biomarker approach. Environmental Research. 235:116648. DOI:10.1016/j.envres.2023.116648
16. Changan SS, Kumar V, Tyagi A (2023) Expression pattern of candidate genes and their correlation with various metabolites of abscisic acid biosynthetic pathway under drought stress in rice. Physiologia Plantarum. 175(6): 14102. DOI:10.1111/ppl.14102
17. Chavan SB, Dhillon R, Sirohi C, Uthappa AR, Jinger D, Jatav HS, Chichaghare AR, Kakade V, Paramesh V, Kumari S, Yadav DK (2023) Carbon Sequestration Potential of Commercial Agroforestry Systems in Indo-Gangetic Plains of India: Poplar and Eucalyptus-Based Agroforestry Systems. Forests. 14(3): 559. DOI:10.3390/f14030559
18. Deshmukh H, Dobriyal M, Tandel MB, Gunaga R, Sharma OP, Garde YA, Thakare U, Kunwar R, Chavan S, Salunkhe S, Thakur NS (2023) Development and Standardization of an Innovative Scale for Measuring the Socio-Economic Status of Agroforestry Farmers in South Gujarat, India. Sustainability. 15(3): 2691. DOI:10.3390/su15032691
19. Gopalakrishnan B, Sugumaran P, Kannan B, Thirunavukkarasu M, Davamani V (2023) Land suitability evaluation for cattle grazing through multi-criteria approach using remote sensing and GIS. Range Management and Agroforestry. 44: 1-9. DOI:10.59515/rma.2023.v44.i1.01
20. Govindasamy P, Muthusamy SK, Bagavathiannan M, Mowrer J, Jagannadham PT, Maity A, Halli HM, Sujayanand GK, Vadivel R, Das TK, Raj R, Pooniya V, Babu S, Rathore SS, Muralikrishnan L, Tiwari G (2023) Nitrogen use efficiency—a key to

enhance crop productivity under a changing climate. Frontiers in Plant Science. 14: 1167. DOI:10.3389/fpls.2023.1121073

21. Gurumurthy S, Arora A, Krishna H, Chinnusamy V, Hazra KK (2023) Genotypic capacity of post-anthesis stem reserve mobilization in wheat for yield sustainability under drought and heat stress in subtropical region. Frontiers in Genetics. 14: 1180941. DOI:10.3389/fgene.2023.1180941
22. Gurumurthy S, Sanjay UN, Amaregouda A, Reddy KS, Apoorva A, Kruthika S, Durga G, Jha U, Sadiah S, Reddy KS, Rane J (2023) Understanding the impact of combined heat and drought stress on the reproductive process of chickpea (*Cicer arietinum L.*). Plant Physiology Reports. DOI:10.1007/s40502-023-00749-1
23. Gurumurthy S, Soren KR, Pradhan A, Rane J, Pathak H (2022) Kharif Chickpea: A New Crop for the Western Maharashtra. National Academy Science Letters. 45: 557–559. DOI:10.1007/s40009-022-01144-4
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26. Harisha CB, Narayanpur VB, Rane J, Ganiger VM, Prasanna SM, Vishwanath YC, Reddi SG, Halli HM, Boraiah KM, Basavaraj PS (2023) Promising Bioregulators for Higher Water Productivity and Oil Quality of Chia under Deficit Irrigation in Semiarid Regions. Plants. 12: 662. DOI:10.3390/plants12030662
27. Halli HM, VK Wasnik, BG Shivakumar, AK Singh, VK Yadav, Sunil Swami, SS Manjanagouda, S Gurumurthy (2023) Influence of detopping practices on green fodder availability, seed yield and economics of fodder maize (*Zea mays L.*) in central and southern plateau regions of India. Range Management and Agroforestry. 44(2): 315-322 DOI:10.59515/rma.2023.v44.i2.13
28. Honnappa M, Gireesh C, Padmashree R, Manoj CA, Basavaraj PS, Muralidhara B, Ajita V, Barbadikar KM, Diwan JR, Santosh R, Mahantashivayogayya K, Lokesh R, Sundaram RM, Kumar RM, Senguttuvel P, Kemparaju KB, Anantha MS (2023) Dissecting the Genetic Relationship between Root Morphological Traits with Grain Yield of Introgression Lines (ILs) Derived from Wild Rice (Oryza rufipogon Griff) under Low Soil Phosphorous Condition. International Journal of Plant and Soil Science. 35(22): 57–80. DOI:10.9734/ijpss/2023/v35i224114
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30. John JE, Maheswari M, Kalaiselvi T, Prasanthrajan M, Poornachandhra C, Rakesh SS, Gopalakrishnan B, Davamani V, Kokiladevi E, Ranjith S (2023) Biomining Sesuvium portulacastrum for halotolerant PGPR and endophytes for promotion of salt tolerance in Vigna mungo L. Frontiers in Microbiology. 14: 1085787. DOI:10.3389/fmicb.2023.1085787
31. Kate GU, Krishnani KK, Kumar N, Sukhdhane K, Verma AK, Brahmane MP, Chadha NK, Kumar J (2023) Abiotic and biotic stress alleviating effects of the

medicinal and aromatic plant-derived product on striped catfish Pangasianodon hypophthalmus. Fish and Shellfish Immunology. 135: 108625. DOI:10.1016/j.fsi.2023.108625

32. Khapte PS, Ponnam KM, Reddy KM, Boraiah KM, Wakchaure GC, Gurumurthy S (2023) Evaluation of CGMS-based chilli F1 hybrids for morphometric, fruit quality and yield traits. Indian Journal of Horticulture. 80(4): 353–359. DOI:10.58993/ijh/2023.80.4.8
33. Kumar N, Chandan NK, Bhushan S, Singh DK, Kumar S (2023) Health risk assessment and metal contamination in fish, water and soil sediments in the East Kolkata Wetlands, India, Ramsar site. Scientific Reports. 13: 1546. DOI:10.1038/s41598-023-28801-y
34. Kumar N, Gismondi E, Reddy KS (2023) Copper and nanocopper toxicity using integrated biomarker response in Pangasianodon hypophthalmus. Environmental Toxicology. 1-20. DOI:10.1002/tox.24058
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7. Ongoing Projects

Umbrella Projects

SN	Projects title	Project Team
1.	Abiotic Stress Information System (ASIS): Geo-spatial digital maps of multiple abiotic stresses, management options and future scenarios (IXX15659)	BB Gaikwad, DD Nangare, NP Kurade, SS Pawar, Gopalakrishnan B, Amresh Chaudhary, RN Singh, Nobin Chandra Paul
2.	Germplasm Conservation and Management (GCM): Genetic garden and gene bank for abiotic stress tolerant plants, animals and fisheries for food security and sustainability (IXX15674)	KM Boraiah, AK Singh, Basavaraj PS, Rajkumar, Karthikeyan N, Paritosh Kumar, SA Kochewad, MP Bhendarkar (On Study leave), Harisha CB, PS Khapte, Vijaysinha Kakde, Neeraj K, H M Halli, PB Taware, Aniket More, Rushikesh Gophane, Lalitkumar Aher
3.	Model Green Farm (MGF): Environment-friendly, economically viable, state-ofthe-art model farm for abiotic stressed regions (IXX15700)	Nangare DD, GC Wakchaure, BB Gaikwad, Vanita Salunkhe, Rajkumar, Paritosh Kumar, Aliza Pradhan, MP Bhendarkar (On study leave), SB Chavan,VD Kakade, PS Khapte, H M Halli, V Rajagopal, PB Taware, Rushikesh Gophane (On study leave), Noshin Shaikh (On study Leave), Santosh Pawar (On study Leave), AV Nirmale
4.	Climate-smart IFS (CIFS): Climate resilient integrated farming system in semi-arid region (IXX15697)	Kochewad SA, GC Wakchaure, Vanita Salunkhe, Rajkumar, Aliza Pradhan, SB Chavan, VD Kakade, V Rajagopal, H M Halli, Neeraj Kumar, Gopalakrishnan B, Ravi Kumar, N Subash (IARI), Laxman Meena (ICAR-IIFSR), PB Taware, P Chahande.

Flagship Projects

SN	Projects title	Project Team
1.	Adaptation and mitigation of atmospheric stress in crops, livestock, poultry and fishes for sustainable productivity and profitability (IXX15676)	NP Kurade, SS Pawar, BB Gaikwad, SA Kochewad, Gopalkrishnan B, Rajkumar, MP Bhendarkar (On Study Leave), RN Singh, DD Nangare, AV Nirmale, SV Potekar
2.	New Crops: Exploiting under-utilized crops (ex. Quinoa) for augmenting income in water scarce regions (IXX15656)	Aliza Pradhan, AK Singh, DD Nangare, GC Wakchaure, Karthikeyan N, Boraiah KM, SA Kochewad, RN Singh, Basavaraj PS, Harisha CB, H M Halli, Paritosh Kumar, Neeraj Kumar
3.	Bio-saline Agriculture: Exploitation of halophytic plant and associated microbiome for amelioration of saline agricultural land of arid & semiarid regions (IXX15657)	AK Singh, Vanita Salunkhe, SA Kochewad, Paritosh Kumar, Neeraj Kumar, Amresh Chaudhary, Kartikeyan N, Ahmmad Shabeer

4.	Targeting prospective technologies for abiotic stress resilience in rainfed and dryland region (IXX15699)	Ravi Kumar, DD Nangare, SS Pawar, BB Gaikwad, SA Kochewad, Rakjumar, Boraiah KM, Kartikeyan N, MP Bhendarkar (On Study Leave)

Institute Projects

SN	Projects title	Project Team
1.	Wastewater treatment synergizing with integrated approach of constructed wetland and aquaponics (IXX14228)	Paritosh Kumar, Harisha CB, Neeraj Kumar
2.	Nutrient and gene interaction approaches through nutrigenomics in response to multiple stressor (IXX15014)	Neeraj Kumar, AK Singh, Satish Kumar
3.	Mitigating water stress effects in vegetable and orchard crops (IXX16553).	GC Wakchaure, Nangare DD, Aliza Pradhan, K M Boraiah, Khapte PS
4.	Genomics, genetic and molecular approaches to improve water stress tolerance in soybean and wheat (IXX15660)	AK Singh
5.	Climate resilient agriculture practices for enhancing food grain production from low soil available water storage capacity areas of Deccan Plateau region (IXX20120)	V Rajagopal, Kotha Sammi Reddy, BB Gaikwad, Aliza Pradhan and Nobin Chandra Paul
6.	Assessing the host-sandalwood interactions under abiotic stressed environment for adaptability & income generation	SB Chavan, VD Kakade, Harisha CB, SS Changan, AS Morade
7.	Marginal quality water remediation by integrated constructed wetland and aquaponics (IXX19881)	Paritosh Kumar, Harisha CB, Neeraj Kumar
8.	Exploring morpho-physiological, biochemical, and molecular traits in onion and its wild relatives for tolerance to combined waterlogging and anthracnose.	Vanita Salunkhe, PS Khapte, SS Changan, Pranjali Gedam (ICAR-DOGR)
9.	Pilot study on multiple abiotic stress mapping for Western Maharashtra (IXX20117)	BB Gaikwad, K Sammi Reddy, R N Singh, Ms Sonam, Rajagopal V, and Nobin Chandra Paul
10.	Salinity and drought tolerance studies in Mango (*Mangifera indica L.*) (IXX20121).	SA Morade, Vijaysinha Kakade, KM Boraiah, S Changan, Sangram Chavan and Neeraj Kumar
11.	Climate variability, teleconnections and their impact on selected crops of India (IXX20119)	RN Singh, Sonam, AK Singh, K Sammi Reddy
12.	Quantifying the extent of water stressed soybean and cotton area in relation to meteorological variables in Vidarbha region using remote sensing	Sonam, RN Singh, KK Pal, KS Reddy, Bappa Das
13.	Marginal quality water remediation by integrated constructed wetland and aquaponics	Paritosh Kumar, Harisha CB, Neeraj Kumar
14.	Climate resilient agriculture practices for enhancing food grain production on the low soil available water capacity area of Pune district	Rajagopal V, K Sammi Reddy, BB Gaikwad, Aliza Pradhan, Nobin Chandra, Nirmal Kumar

External Projects

SN	Projects title	Project Team
1.	Phenotyping of pulses for enhanced tolerance to drought and heat (OXX01737: ICAR-NICRA)	Basavaraj PS, Aliza Pradhan, Boraiah KM, RN Singh, KS Reddy
2.	Conservation agriculture for enhancing resource-use efficiency, environmental quality and productivity of sugarcane cropping system (OXX03355: ICAR-CRPCA)	Wakchaure GC, Aliza Pradhan, H Pathak, Amresh Kumar, KS Reddy, Paritosh Kumar
3.	Establishment of model herbal garden for medicinal and aromatic plants (OXX4927: NMPB, New Delhi)	Harisha CB, Nangare DD
4.	Climate smart management practices (OXX4928: IRRI)	Basavaraj P, J Rane, H Pathak (upto 31.07.2022), HM Halli
5.	Studies on N-(n-butyl) Thiophosphoric Triamide (NBPT) as a Urease Inhibitor for Improving Nitrogen Use Efficiency in major cropping systems in India (OXX4926: CIMMYT)	Aliza Pradhan, Amresh Chaudhary (upto 22.12. 2023), J Rane (Upto 22.1.2023), K Sammi Reddy
6.	Genomics strategies for improvement of yield and seed composition traits under drought stress conditions in soybean (OXX4929: ICAR-NASF)	AK Singh, J Rane
7.	Development of Nano-based delivery system to mitigates arsenic pollution, ammonia and temperature stress on growth and immune related gene expression in fish (OXX5181: LBS Award)	Neeraj Kumar
8.	Agri Drone Project (OXX5501: Central Sector Scheme, Ministry of Agriculture and Farmers Welfare, GOI)	Gaikwad BB, Kurade NP, Pawar SS, Gopalakrishnan B, Rajkumar, Potekar SN, Ravi Kumar K, Khapte PS, Salunkhe VN, V Rajagopal, HM Halli, Kakade VD, Chavan SB, Karthikeyan N, Taware PB
9.	Efficacy of bio-stimulants in alleviating drought stress in tomato (*Solanum lycopersicum* L.) (OXX5500: Yara Fertilizers India Pvt. Ltd.)	Khapte PS, J Rane
10.	Investigating the impact of varying nutrient composition on morphometric, physiological and yield traits in Potato. (OXX6276: Novem Solutions Pvt Ltd, Hospet, Karnataka)	Khapte PS, Changan SS, Gaikwad BB, K. Sammi Reddy
11.	Atlas of Climate Adaptation in South Asian Agriculture (ACASA): interconnections between climate risks, practices, technologies, and policies. (OXX7240: Funded by Bill and Melinda Gates Foundation, anchored by BISA-CIMMYT)	Gopalakrishnan B
12.	Development of Nano-based delivery system to mitigate arsenic pollution, ammonia and temperature stress on growth and immune related gene expression in fish (OXX5467: SERB-DST)	Neeraj Kumar
13.	Development of effective mass propagation techniques for rapid multiplication and easy transportation of quality planting material in Bajra-Napier Hybrid. (Funded by National Livestock Mission, MOFAHD, GOI)	Halli HM, Chavan SB, Basavaraj PS, K Sammi Reddy

8. Meetings

12th Institute Management Committee Meeting

The 12th Institute Management Committee meeting of ICAR-NIASM was held on May 30, 2023. The meeting was conducted under IMC Chairman Dr K Sammi Reddy, Director, NIASM. Dr R M Sundram, Director, IIRR, Hyderabad, Dr Sachine Nalawade, Head, MPKV Rahuri, members of IMC and All Head of School, NIASM were attended the meeting physically. Dr S K Das, CFAO, NIASM, Mr Charles Ekka, CAO, NIASM and Member Secretary, IMC and Mr Anirudha Basanth Pujari, Progressive farmers, Solapur member IMC were also attended the meeting. Whereas, Dr A. Velmurugan, ADG, NRM, Dr Jagadish Rane, Director, CIAH, Bikaner, Dr M Prabhakaran, Principal Scientist, CRIDA Hyderabad, Dr S Naresh Kumar, Principal Scientist, IARI, New Delhi, members of IMC were attended the meeting in virtual mode/online. The action taken report on 11th IMC recommendations and Agenda for 12th IMC were presented by Mr Charles Ekka, Member Secretary IMC. The Chairman and members IMC were agreed with the proposed agenda. The Chairman IMC, Dr Reddy was presented the achievements of the institute. The meeting was ended with vote of thanks by Mr Ekka, Member Secretary IMC.

13th Institute Research Council (IRC) Meeting

The 13th Institute Research Council (IRC) meeting of ICAR-NIASM was held in two phases as first phase (June 06-09 and June 12-14, 2023) and second phase on July 28, 2023. The Meeting was chaired by Director and Chairman IRC Dr K Sammi Reddy. In the first phase of IRC meeting all the school of Head and Scientists were attended the meeting. Whereas, in the Second phase of IRC meeting, Dr VUM Rao, Former Projector Coordinator, Agromet were invited as expert IRC on July 28, 2023. The meeting was started with opening remarks by Director and IRC Chairman with focused on research programme and activities of the institute. The Chairman IRC conveyed his remarks on various research activities such as scientists' involvement in research (55 %), Education (40%) and extension (5%) should be followed. He also urged that scientists should have at least one project as PI, CO-PI and an external project. He also conveyed that scientists should also focus on one scientist one product as emphasised by DG ICAR. The action taken report of 12th IRC recommendations was presented by Dr Neeraj Kumar. The achievements of the schools were presented by Heads of the respective schools and Principal investigators of the projects presented progress of Flagship, Umbrella, In-house projects and externally aided projects. All the scientists of the ICAR-NIASM were attended the meeting and participated in the discussion for formulation of the new project proposals. The Director, NIASM has emphasized on high quality research for abiotic stress management in crops, animal and fish. He also emphasized for technology development and high impact research publication in area of abiotic stress management.

11th Research Advisory Committee (RAC) meeting

The 11th Research Advisory Committee (RAC) meeting on October 17, 2023, chaired by Dr B Venkateshwarlu, discussed research and development activities at ICAR-NIASM. Experts including Dr C Viswanathan, Dr N Sarangi, Dr BB Barik, Dr DK Pal, and Dr A Velmurugan, along with special invitee Dr PK Neeraj Kumar presented the Action Taken Report, while school heads outlined research for 2022-23. Dr Ghosh discussed potential collaborations. The meeting highlighted the importance of basic and strategic research in abiotic stress, emphasizing collaboration and addressing knowledge gaps. The session

Ghosh, provided insights. Dr K Sammi Reddy presented NIASM's achievements, and Dr Venkateshwarlu commended progress. Dr concluded with thanks from Dr Neeraj Kumar.

National Level Pause and Reflect Meetings and Launch of Circular Bioeconomy Innovation Hub

The Nature+ initiative, a collaborative effort involving the ICAR-National Institute of Abiotic Stress Management, CGIAR institutes, International Water Management Institute, and Bioversity International, aims to address the depletion of natural resources and mitigate climate change in agriculture. Launched in August 2023, the project focuses on five work packages: Conserve, Manage, Restore, Recycle, and Engage. At the outset, Dr K Sammi Reddy, Director, NIASM welcomed Dr H Pathak, Director General, Indian Council of Agriculture Research & Secretary, Department of Agriculture Research and Education, GoI (virtual) and other delegates. The initiative, supported by Dr H Pathak, Dr AK Sikka and Dr Carlo Fadda, emphasizes nature-based solutions for sustainable agri-food systems. ICAR-NIASM's contribution involves assessing nutrient management systems in rice crops, with a focus on soil quality and resilience. Significant variations in soil properties were observed among different landscape positions in the Kalsbai watershed area. Furthermore, the project explores an agroforestry model to enhance farmers' livelihoods and environmental sustainability. Scoping studies were conducted to evaluate forest trees, fodder crops, and livestock components in the study region. Research deliverables for the period of 2023-24 were also presented, highlighting the project's progress towards transforming the agri-food system into a more resilient and vibrant food production system.

9. Seminar/Workshop/ Symposia/Conference/Trainings attended by Staff

Staff	Title of Seminar/Workshop/ Symposia/Conference/Trainings attended	Venue	Organized by	Dates
Dr K Sammi Reddy	National Seminar on Abiotic Stress Management for Sustainable Millet based Production Systems	ICAR-NIASM, Baramati	SARAS, Baramati	22-23 August 2023
	XVI Agricultural Science Congress & ASC expo	CMFRI, Kochi,	NAAS, New Delhi	10-13 October 2023
	VIII Annual Review Workshop of National Innovations in Climate Resilient Agriculture (NICRA)	NASC, New Delhi	NICRA, ICAR-CRIDA, Hyderabad	8-9 November 2023
	International Conference on Plant Health Management ICPHM 2023: Innovation and Sustainability	PJTSAU, Hyderabad	Plant Protection Association of India, Hyderabad	15-18 November, 2023
	State level Seminar on "Rejuvenating soil health for food security and agriculture sustainability"	VNMKV, Parbhani	Parbhani Chapter of Indian Society of Soil Science	21-22 December 2023
	FAI Annual Seminar- 2023	Hotel Pullman, New Delhi	FAI, New Delhi	06-07 December 2023
	Conference on Role of Journalism and Media in Promoting the Climate Smart and Digital Agriculture	Hotel Sheraton, Pune	NAHEP, MPKV, Rahuri	08 December 2023
Dr AK Singh	Training Programme on "Enhancing Pedagogical Competencies for Agricultural Education"	NASC, New Delhi	NASC, New Delhi	31 July to 05 August, 2023
Dr NP Kurade	Five days Pedagogy Development Training Program	NAAS, New Delhi	NAAS, New Delhi	20-24 November, 2023
Dr DD Nangare	51st Joint AGRESCO meeting	MPKV Rahuri	MPKV Rahuri	25 May, 2023
	Training Programme on "Enhancing Pedagogical Competencies for Agricultural Education"	NASC, New Delhi	NASC, New Delhi	31st July to 05th August, 2023
Dr SS Pawar	Workshop on 'Genome editing in farm animals for improved productivity and health'	Online mode	ICAR-NDRI, Karnal	03 March 2023
	Training Programme on "Next Generation Sequencing and Data Analysis"	Online mode	ICAR-NAARM, Hyderabad	16-20 October 2023

Dr GC Wakchaure	3rd National Symposium on 'Emerging Technologies and Trends in Sustainable Production and Value Chain Management of Onion, Garlic and Other Allium Species'	Jain Irrigation Systems Limited, Jalgaon,	Jain Irrigation Systems Limited, Jalgaon, Maharashtra	11-14 February, 2023
	57th ISAE Annual Convention and International Symposium on 'Engineering Interventions for Marking Millets a Global Food'	UAS, Raichur, Karnataka	ISAE New Delhi and UAS, Raichur	06-08 November, 2023
	National Symposium cum Industry Meet on Agri-business in Alliums: Innovation, Promotion & Sustainability,	MCCIA, Pune	ICAR-DOGR, MCCIA and ISA, Pune	20-22 December, 2023
Dr BB Gaikwad	National Training Workshop on "Big Data Analytics in Agriculture"	Virtual mode	ICAR-NAARM	09-10 March, 2023
	Design Thinking in Agricultural Research and Education	Online Mode	ICAR-NAARM Hyderabad	09-13, Oct--ober, 2023
	International Conference on Hyperspectral Imaging	Sheraton Hotel, Pune	MPKV, Rahuri	20 Decem--ber, 2023
	National Symposium cum Industry Meet (NSIM) 2023 on Agri-business in Alliums: Innovation, Promotion & Sustainability	MCCIA, Pune	ICAR-DOGR, MCCIA and ISA, Pune	21 December, 2023
Dr SA Kochewad	National conference on "Agroecology based agri-food transformation systems"	ICAR-IIFSR, Modipuram	FSRDA & ICAR-IIFSR, Modipuram	27-28 January, 2023
	Conference on Role of Journalism and Media in Promoting the Climate Smart and Digital Agriculture	Hotel Sheraton, Pune	CAASTCSAW, MPKV, Rahuri	8 December, 2023
Dr VN Salunkhe	Conference on Plant and Soil Health Management: Issues and Innovations	University of Mysore, Mysuru,	Indian Phytopathology Society	2 -4 February, 2023
	State-level workshop on "Emerging Technologies for Enhancing the Productivity and Quality of Dragon Fruit in Water-Scarce and Degraded Areas	ICAR-NIASM, Baramati	ICAR-NIASM and MSHMPB, Pune and MDFA	20 February, 2023
	Training on Biosecurity and Biosafety: Policies, Diagnostics, Phytosanitary Treatments & Issues		ICAR-NBPGR, New Delhi	4-14 September, 2023
Dr KM Boraiah	National conference on Globalization of India's Crop Improvement Research	YASHADA, Pune	Foundation for Advanced Training in Plant Breeding	19-21 January, 2023
	International Webinar on Technological Advances and Innovations for Abiotic Stress Management	Online mode	MANAGE, Hyderabad & ICAR-NIASM, Baramati	27 December, 2023
	International Seminar on Exotic and Underutilized Horticultural Crops	ICAR-IIHR, Bengaluru		17-19 Oct-ober, 2023
	Sorghum Germplasm Field Day on	ARS, Washim, PDKV	ARS Washim, PDKV, Akola.	13 March, 2023

Dr SB Chavan	10 days training program of DGCA Approved Remote Pilot training	CASR RPTO, Chennai.	CASR RPTO, Anna Univers- -ity, Chennai	22 April to 1 May, 2023
	51st Joint AGRESCO meeting	MPKV Rahuri	MPKV Rahuri	25 May, 2023
	Annual group Meet of All-India Co-ordinated Research Project on Agroforestry	AICRP on Agroforest ry	PJTSAU, Rajdendranag ar, Hyderabad	16-18, October 2023
	Five days Pedagogy Development Training Program	NAAS, New Delhi	NAAS, New Delhi	20-24 Nov- ember, 2023
Dr CB Harisha	International conference on Climate resilient agriculture for sustainable productivity	Online mode	Mother Teresa College of Agriculture, Coimbatore and AIASA	31 March, 2023
	3rd International conference cum buyers sellers meet for medicinal plants used in lifestyle products	Online mode	RCFC Eastern region, NMPB, Jadavpur Univ- -ersity, Kolkata	6-8 December, 2023
Dr Gopalakrish nan B	National Training Workshop on "Big Data Analytics in Agriculture"	Online mode	ICAR-NAARM	09-10 March, 2023
	National workshop on "Atlas of Climate Adaptation in South Asian Agriculture"	ICAR-CRIDA	ICAR-CRIDA	21-22 August, 2023
	National Conference on "Generative AI in Practice for Empowering Agricultural Research Productivity".	Online mode	ICAR-NRCG, NAAS, & SAVE	September 11-12, 2023
	International Conference on "Feeding the Future Through Sustainable Eco-Friendly Innovations in Rangeland, Forages and Animal Science"	UAS, Bangalore	RMSI, ICAR-IGFRI & UAS, Bangalore.	December 2-4, 2023
Dr Gurumurthy	Plant Biology 2023	Savannah, USA.		5-9 August, 2023
	International Conference on Pulses: Smart crops for agricultural sustainability and nutritional security	New Delhi		10-12 February, 2023
	International Conference on Biodiversity, Food Security, Sustainability & Climate Change	AAU, Jorhat, Assam		25-28 April, 2023
	Training on "Advances in Statistical techniques for Efficient Agricultural Experimentation"	ICAR-IASRI, New Delhi	ICAR-IASRI, New Delhi	11-31 January, 2023
	National Conference of Plant Physiology on Physiological and molecular approaches for climate smart agriculture	ICAR-IARI, New Delhi		09-11 December, 2023
Dr Neeraj Kumar	Institute Technology Display during Agriculture Science Congress (ASC)	ASC Kochi	ASC, Kochi	09-14 Oct- -ober, 2023
	Institute Technology Display during ICAR Foundation Days at New Delhi	ICAR, New Delhi	ICAR, New Delhi	16-19 July, 2023
Dr PS Khapte	Training on "Data Visualization using R" through online platform		ICAR-NAARM, Hyderabad	1-8 March, 2023

	International Plant Phenotyping Symposium – PhenoVeg 2023	World Vegetable Centre, Taiwan.	World Vegetable Centre, Taiwan	26 to 27 September, 2023
Mr Rajkumar	International Conference on "Plant Health Management Innovation and Sustainability"	PJTSAU, Hyderabad	ISPP, New Delhi.	15-18 November, 2023
Dr HM Halli	Five days training on Pedagogy Development Training Program	NAAS Complex, New Delhi	NAAS, New Delhi	20-24 November, 2023
Dr Aliza Pradhan	National conference on "Agro-ecology based agri-food transformation systems"	ICAR-IIFSR, Modipuram	FSRDA & ICAR-IIFSR, Modipuram	27-28 January, 2023
	Annual workshop on "AGROTAIN Incorporated Urea Produces with N-TEGRATION™ Technology for improving N Use Efficiency in Major cropping systems of India"	ICAR-IISS, Bhopal	CIMMYT, India	26-27 August, 2023
	XXII National Symposium on Climate smart agronomy for resilient production systems and livelihood security	ICAR-CCARI, Goa	Indian Society of Agronomy	22-24 November, 2023
	Conference on Role of Journalism and Media in Promoting the Climate Smart and Digital Agriculture	Hotel Sheraton, Pune	CAAST-CSAWM, MPKV, Rahuri	8 December, 2023
	12th advanced course on Conservation agriculture for Asia and North Africa: Gateway for sustainable and climate resilient agrifood systems	Delhi, MP, Ludhiana and Karnal	CIMMYT, BISA and ICAR-CSSRI, Karnal	9-24 December, 2023
Dr PS Basavaraj	Training on Genomic Tools in Plant Genetic Resource Management	ICAR-NBPGR, New Delhi	ICAR-NBPGR, New Delhi	18-19 September, 2023
	National conference on Globalization of India's Crop Improvement Research	Pune	ATPBR, Pune	19-21 Janu--ary, 2023
Dr SS Changan	Winter school on "Climate Change & Abiotic Stresses Management Solutions for Enhancing Water Productivity, Production Quality & Doubling Farmers Income in Scarcity Zones"	ICAR-NIASM, Baramati	ICAR-NIASM, Baramati	05-25 January, 2023
Dr Nobin Chandra Paul	113th Foundation Course (FOCARS)	ICAR-NAARM, Hyderabad	ICAR-NAARM, Hyderabad	18 July to 17 October, 2023
	Professional attachment training (PAT)	ICAR-NBSS&LUP Nagpur	ICAR-NBSS&LUP, Nagpur	19 Oct. 2023 - 17 Jan. 2024
Dr Sonam	Professional attachment training (PAT)	ICAR-CCARI, Goa	ICAR-CCARI, Goa	01 Sep. - 30 Nov. 2023
Ms P Navyasree	Professional attachment training (PAT)	ICAR-NAARM,	ICAR-NAARM, Hyderabad	28 Aug.- 28 Nov. 2023
Mr S Potekar	Training on "Agrometeorological data collection, analysis and management"	ICAR-CRIDA	ICAR-CRIDA	18-27 January 2023
All Scientists & Technical Staff	National Seminar on "Abiotic Stress Management for Sustainable Millet based Production Systems"	ICAR-NIASM, Baramati	SARAS, ICAR-NIASM, Agri. Dept. (GoM), KVK Baramati	22-23 August 2023

१०. राजभाषा अनुभाग

हिंदी कार्यशाला का आयोजन

राजभाषा कार्यान्वयन समिति के अध्यक्ष एवं राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान के निदेशक महोदय डॉ के सम्मि रेड्डी के मार्गदर्शन में हिंदी भाषा के रुझान हेतु संस्थान में ३० मार्च २०२३, २७ सितंबर २०२३ तथा २९ दिसंबर २०२३ को हिन्दी कार्यशाला का आयोजन किया गया।

पहली एक दिवसीय कार्यशाला में सदस्य सचिव डॉ वनिता सालूँखे ने उपस्थितों का स्वागत किया। कार्यशाला को आगे बढ़ाते हुए डॉ माधुरी दिगंबर प्रभुणे (प्राध्यापक, महिला महाविद्यालय बारामती) ने "राजभाषा हिन्दी के विविध रूपों की जानकारी' इस विषय पर उपस्थित सभी को मार्गदर्शन किया। उन्होने विश्व में तीसरे स्थान पर रही हिन्दी के बोली भाषा, मानक एवं परिनिष्ठित भाषा, राजभाषा, राष्ट्रभाषा, संपर्क भाषा, प्रयोजनमूलक हिन्दी, राष्ट्रीय चेतना हिन्दी, एकता रूप हिन्दी एवं साहित्यिक हिन्दी जैसे हिन्दी के विविध रूपों के बारे में सभी को अवगत किया। इस कार्यशाला का संस्थान के ५० कर्मचारियों ने प्रत्यक्ष रूप से लाभ लिया। कार्यशाला की उपलब्धियों पर चर्चा करते हुए डॉ प्रवीण तावरे ने धन्यवाद ज्ञापन किया। डॉ परितोष कुमार ने कार्यशाला का सूत्रसंचालन किया।

दूसरी एक दिवसीय कार्यशाला का हिंदी भाषा के रुझान हेतु २७ सितंबर २०२३ को आयोजन किया गया। इस कार्यशाला में डा प्रवीण तावरे, सहायक, मुख्य तकनीकी अधिकारी, भाकृअनुप-राअस्ट्रेप्रसं, बारामती ने "योग: समग्र व्यक्तिगत विकास का राजमार्ग" इस विषय पर उपस्थित कर्मचारियों को प्रशिक्षित किया।

निदेशक महोदय डॉ के सम्मि रेड्डी द्वारा मार्गदर्शन

मुख्य अतिथि महोदया डॉ माधुरी प्रभुणे द्वारा मार्गदर्शन

तीसरी कार्यशाला में मार्गदर्शन करते हुए निदेशक महोदय

आकाश दर्शन हेतु उपस्थित विद्यार्थी एवं प्रशिक्षक

तीसरी एक दिवसीय कार्यशाला का आयोजन दि. २९ दिसंबर २०२३, निदेशक की अध्यक्षता में बी पी पाल समिति कक्ष में हुआ। कार्यशाला का विषय "अवलोकनीय खगोल विज्ञान" था जिसमें प्रेजेंटेशन समिति कक्ष में, और आकाशदर्शन शाम ६.३० के बाद खुले मैदान में रखा गया था। कार्यशाला के प्रशिक्षक डॉ प्रविण तावरे, तकनीकी

अधिकारी ने कुल ३१ सहभागीयोंकों खगोल विज्ञान में छिपे आश्चर्यों से अवगत कराया। दूरबीन के सहायता से बृहस्पति और शनि गृहों का दर्शन कराया। बृहस्पति के चाँद और शनि के वलयोंको देखकर सभी अचम्बित हुए। कार्यशाला में आकाश स्थित ध्रुव तारा, मृगशिरा नक्षत्र, सप्तऋषि तारका समूह, आदि के बारे में जानकारी दी गई।

हिन्दी पखवाड़ा समारोह

राजभाषा हिंदी के प्रगामी प्रयोग को बढ़ावा देने हेतु भाकृअनुप-राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान द्वारा १४ सितम्बर से २९ सितम्बर के दौरान हिंदी पखवाड़ा का आयोजन किया गया। हिन्दी दिवस तथा हिन्दी पखवाड़ा का उद्घाटन राजभाषा कार्यान्वयन समिति के अध्यक्ष डा के सम्मि रेड्डी, निदेशक, राअस्ट्रैप्रसं के मार्गदर्शन में १४ सितम्बर को किया गया। उद्घाटन समारंभ में मुख्य अतिथि के रूप में डा चंदा निंबकर (निदेशक, पशुपालन विभाग, निंबकर कृषि अनुसंधान संस्थान, फलटण) मौजूद रहे। उन्होने संशोधन संस्थानों में राजभाषा हिन्दी का महत्व के बारे उपस्थित सभी को अवगत किया। इसके बाद हिन्दी पखवाड़ा में हर दिन विविध प्रतियोगिताओंका जैसे कि, हिन्दी निबंध लेखन, टिप्पण एवं प्रारूप लेखन, टंकलेखन, स्वरचित काव्यपाठ, वाद-विवाद, आशुभाषण, प्रश्नोत्तरी आदि प्रतियोगिताओंका आयोजन किया गया। जिसमे संस्थान के सभी सदस्यों ने बढ़-चढ़कर हिस्सा लिया और प्रतियोगिताए सफल बनाई। हिन्दी पखवाड़ा समारोप एवं पुरस्कार वितरण समारंभ का आयोजन २९ सितम्बर को संस्थान के सरदार पटेल सभागार में किया गया। डा के सम्मि रेड्डी, निदेशक एवं अध्यक्ष राजभाषा कार्यान्वयन समिति, राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान, बारामती, डा प्रवीण राव (कुलपति, प्रो. जयशंकर तेलंगाना राज्य कृषि विश्व विद्यालय), डॉ एस डी सावंत, (पूर्व कुलपति, बाळासाहेब सावंत कोकण कृषि विद्यापीठ, दापोली), डा जी राजेश्वर राव (पूर्व निदेशक, उष्ण कटिबंधीय वन अनुसंधान संस्थान, जबलपुर), डा ईश्वर पवार (विभागाध्यक्ष, चांदमल ताराचंद बोरा कॉलेज, शिरुर) इन्होंने कार्यक्रम की शोभा बढ़ाई। समापन समारोह में उपस्थित मान्यवरों ने प्रतियोगिता विजेताओंको पुरस्कार प्रदान करके सम्मानित किया। मुख्य अतिथि ने राजभाषा के रूप मे हिन्दी का महत्व सभी को अवगत किया। राजभाषा कार्यान्वयन समिति के अध्यक्ष डा के सम्मि रेड्डी जी ने हिंदी भाषा के रुझान के लिए किए गए उचित प्रयास पर समाधान जताया। डा वनिता सालुंखे (सदस्य सचिव, राजभाषा कार्यान्वयन समिति), डा परितोष कुमार, डा प्रवीण तावरे आदि ने कार्यक्रम का आयोजन किया एवं कार्यक्रम को सफल बनाया।

निदेशक महोदय डॉ के सम्मि रेड्डी द्वारा मार्गदर्शन

मुख्य अतिथि महोदया डा चंदा निंबकर द्वारा मार्गदर्शन

प्रतियोगिताओंका आयोजन

हिन्दी पखवाड़ा समारोह

संस्थागत राजभाषा कार्यान्वयन समिति बैठक

राजभाषा कार्यान्वयन समिति की बैठक दि. २९ दिसंबर २०२३ को संस्थान की संस्थान के राजभाषा कार्यान्वयन समिति के अध्यक्ष तथा संस्थान के निदेशक की अध्यक्षता में बी पी पाल समिति कक्ष में सम्पन्न हुयी। बैठक में संस्थान के राजभाषा कार्यान्वयन समिति की पूर्व सदस्य सचिव डॉ वनिता सालुंखे महोदया के कार्य को सहारते हुए अध्यक्ष डॉ सम्मी रेड्डी, निदेशक ने उनके योगदान पर हर्ष जताया। वर्तमान समिति को कार्य जारी रखने हेतु मार्गदर्शन किया और इस उपलक्ष्य में निम्नलिखित मुद्दों पर ध्यान देने की जरूरत जताई।

१. नगर राजभाषा कार्यान्वयन समिति, पुणे (कार्यालय - २) की सदस्यता प्राप्त होनेपर नियमित रूप से उनके संपर्क में रहना और आवश्यक रिपोर्ट बनाए रखना।

२. राजभाषा रिपोर्ट तत्परता से जारी करने हेतु रिपोर्ट संबंधीत जानकारी विविध विभागों से समय पर प्राप्त करते हुए।

३. हिन्दी में तकनीकी लेखन हेतु पुस्तक, सुफलाम वार्षिक, तथा बाकी संस्थानों के हिन्दी पत्रिकाओं में लेख प्रकाशित करने ही आवश्यकता को अधोरेखित किया।

४. नियमित कार्यशालाओं के आयोजन हेतु संभावित विषयो पर वैज्ञानिकों से विचारविमर्श करना और संपर्क करते हुए उसमें निरंतरता रखना।

५. हिन्दी तकनीकी शब्दावली (सार्थक) समृद्ध करने के प्रयास में सभीसे नए शब्दों के लिए सभी कर्मचारियों से आवाहन करना।

६. हिन्दी में तकनीकी 'औडियो बूक' का निर्माण करने हेतु, अलग अलग विषयों को सूत्रबद्ध करते हुए आवश्यक जानकारी संबन्धित विषयों के वैज्ञानिकों से प्राप्त करना।

11. Major Events

SN	Event	Date
1.	Hon'ble Shri Sharad Pawar, Former Cabinet Minister of Agriculture, GoI and MP, Rajya visits ICAR-NIASM	03.01.2023
2.	ICAR Sponsored Winter School on "Climate Change & Abiotic Stresses Management Solutions for Enhancing Water Productivity, Production Quality and Doubling Farmers Income in Scarcity Zones"	05.01.2023
3.	Visit of farmers from Sub Divisional Agricultural Office Chiplun	10.01.2023
4.	Visit of NM College of Agriculture students	11.01.2023
5.	ICAR-NIASM participated and assisted in organizing national conference on "Globalization of India's Crop Improvement Research	19.01.2023 to 21.01.2023
6.	Celebration of 74th Republic Day 2023	26.01.2023
7.	Bimonthly structured Meet of NABARD Officers & DDMs at ICAR-NIASM	04.02.2023
8.	Short-term training on "Non-destructive Phenotyping for Abiotic Stress Tolerance in Crops and Agroforestry"	06.02.2023 to 15.02.2023
9.	On-location training program on "Climate resilient agriculture & livelihood for NGOs and FPOs" at ICAR-NIASM from	13.02.2023 to 17.02.2023
10.	Training Program on Climate Financing for New Crops and Agroforestry jointly organized by ICAR-NIASM and Bankers Institute of Rural Development (BIRD), NABARD	15.02.2023 to 17.02.2023
11.	Celebration of 15th Foundation Day	21.02.2023
12.	"Field day-cum-Demonstration on Climate Resilient Dairy Production" and distribution of Dairy kits to SC beneficiaries	28.02.2023
13.	Visit of Mr. Stewart Collis of Gates foundation to National Plant Phenomics Facility	06.03.2023
14.	Field day cum farmers-scientist interaction meet on "Awareness about DAPSC programme and need assessment"	14.03.2023
15.	हिन्दी कार्यशाला वृतांत	30.03.2023
16.	Organisation of World Intellectual Property Day	26.04.2023
17.	Special lecture on Pension & Retirement Benefits and NPS	26.05.2023
18.	12th Institute Management Committee Meeting	30.05.2023

19.	Signing of MOU with Novem Solutions Private Limited & MITCON Consultancies to Manage Abiotic Stress	02.06.2023
20.	Celebration of World Environment Day	05.06.2023
21.	Field day cum farmers scientist interaction meet on distribution of items to SC beneficiaries under DAPSC	20.06.2023
22.	Visit of Dr A Vishnuvardhan Reddy, Vice Chancellor of ANGRAU Guntur, AP	23.06.2023
23.	Pre-examination Training for LDA&A Examination	20.07.2023 to 06.10.2023
24.	Distribution of Tractor to Scheduled Caste Self-help group	21.07.2023
25.	Field day cum Farmers-Scientist interaction meet on "Awareness about DAPSC programme & need assessment"	26.07.2023
26.	MANAGE and ICAR-NIASM collaborative online Training program on "Abiotic Stress Management in Agriculture for Enhancing the Farmers Income with Special Reference to Natural Resource Management	01.08.2023 to 06.08.2023
27.	Celebration of 77th Independence Day	15.08.2023
28.	Secretary, DARE and Director General, ICAR Inaugurates National Seminar on Millets at ICAR-NIASM, Baramati	22.08.2023
29.	Inauguration of Malad Farm and Shivdhara Water Treatment Plant	22.08.2023
30.	Distribution of Onion Transplanter to Scheduled Caste Self-help group	22.08.2023
31.	हिन्दी पखवाड़ा समारोह	14.09.2023
32.	Inplant Training Programme on "Abiotic Stresses in Agriculture, Management Strategies and Engineering Interventions"	04.09.2023 to 03.10.2023
33.	11th Research Advisory Committee (RAC) meeting	17.10.2023
34.	State Level Joint Workshop on Commercial Dragon Fruit Cultivation	19.10.2023
35.	Valedictory Programme of Special Campaign 3.0 and Awareness Campaign on "Solid Waste Management and Disposal"	31.10.2023
36.	Swachhta Hi Seva and Special Campaign 3.0	31.10.2023
37.	Celebrations of Ayurveda Day	29.09.2023 to 10.11.2023
38.	Vigilance awareness week	30.10.2023 to 05.11.2023
39.	Celebration of World Soil Day at Sangavi Village, Satara district	05.12.2023
40.	National Level Pause and Reflect Meetings and Launch of Circular Bioeconomy Innovation Hub	14.12.2023 to 15.12.2023
41.	Conduct of Institute Animal Ethics Committee (IAEC) Meeting and Annual Inspection of animal experimentation facility	22.12.2023
42.	International Webinar on "Technological Advances and Innovations for Abiotic Stress Management"	27.12.2023

Visit of Hon'ble Sh. Sharad Pawar

Inauguration of ICAR Sponsored Winter School

Farmers from Sub-Divisional Agri. Office Chiplun

NM College of Agriculture students visit

Closing of 21 Days ICAR Sponsored Winter School

Celebration of 74^{th} Republic Day

Bimonthly structured Meet of NABARD Officers and DDMs to ICAR-NIASM

Training on "Non-destructive Phenotyping for Abiotic Stress Tolerance in Crops and Agroforestry"

Training on "Climate resilient agriculture & livelihood for NGOs and FPOs"

Training Program on Climate Financing for New Crops and Agroforestry

Celebration of 15th Foundation Day

"Field day-cum-Demonstration on Climate Resilient Dairy Production"

Visit of Mr Stewart Collis of Gates foundation

Field day cum farmers-scientist interaction meet on "Awareness about DAPSC & need assessment"

हिन्दी कार्यशाला वृतांत

World Intellectual Property Day

Workshop on Commercial Dragon Fruit Cultivation

Lecture on Pension & Retirement Benefits and NPS

12th Institute Management Committee Meeting

MOU with Novem & MITCON

World Environment Day

Visit of Dr A Vishnuvardhan Reddy, VC, ANGRAU

Distribution of items to beneficiaries under DAPSC

Pre-examination Training for LDA&A Examination

Distribution of Tractor under DAPSC programme

Field day cum interaction meet under DAPSC

MANAGE and NIASM collaborative online training

Celebration of 77th Independence Day

Inauguration of Malad Research Farm

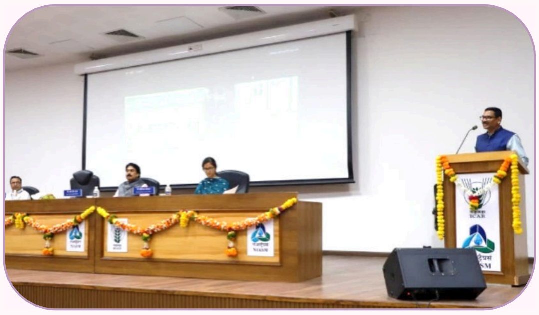
Inauguration of Shivdhara Water Treatment Plant

Inauguration of National Seminar on Millets

Distribution of Onion Transplanter under DAPSC

हिन्दी पखवाड़ा समारोह

Inplant Training Programme



Closing of Pre-examination Training for LDA&A

11th Research Advisory Committee (RAC) meeting

State Level Joint Workshop on "Commercial Dragon Fruit Cultivation"

Special Campaign 3.0 and Awareness Campaign on "Solid Waste Management and Disposal"

Swachhta Hi Seva

Ayurveda Day

Vigilance awareness Day Week

World Soil Day

हिन्दी कार्यशाला "अवलोकनीय खगोल विज्ञान"

Institutional Animal Ethical Committee Meeting

12. Distinguished Visitors

Hon'ble Shri Sharad Pawar, Former Cabinet Minister of Agriculture, GoI and Member of Parliament, Rajya Sabha

Hon'ble Shri Sharad Pawar, Former Cabinet Minister of Agriculture, GoI and MP, Rajya, accompanied by Dr Ranveer Chandra, Chief Technology Officer (CTO) of Agri Food and Executive Director at Microsoft Networking Research and Dr Ajit Jaokar, Course Director (AI) at Oxford University, visited ICAR-NIASM, Baramati on 3 January 2023. The purpose of the visit was to review the research activities focused on abiotic stress management and explore potential collaborations, especially in the application of artificial intelligence in agricultural research. During the visit, Dr K Sammi Reddy, Director, ICAR-NIASM, provided an overview of institute's research mandate and progress since its establishment in 2009. Dr J Rane, Principal Scientist and In-charge of National Plant Phenomics facility, elaborated on the utilization of machine vision and automation to understand stress responses in crop plants. He showcased the state-of-the-art facility at institute and demonstrated the cost-effective field phenomic tool developed inhouse. The event also saw the participation of Dr Prashantkumar Patil, Honorable Vice-Chancellor of MPKV, Rahuri; Dr Shankarrao Magar, Former Vice-Chancellor of DBSKKV, Dapoli; Shri Prataprao Pawar, Chairman of Sakal Media Group and Trustees of Agriculture Development Trust (ADT), along with progressive farmers who engaged in discussions about the ongoing research initiatives at the institute.

Mr Stewart Collis of Gates Foundation

Mr Stewart Collis, accompanied by the trustees of KVK Baramati, visited the National Plant Phenomics Facility 06 March 2023. Dr NP Kurade, Principal Scientist, extended a warm welcome to the guests and provided an overview of the NIASM institute, highlighting its mandates and achievements. The Heads of Schools, namely, Dr SS Pawar (SASM), Dr AK Singh (SWSM), Dr AS Tayade (SSSM) and Dr DD Nangare (SSSPS) presented the updates on ongoing activities and accomplishments within their respective schools. During the visit, Dr BB Gaikwad briefed Mr Stewart on the digital soil maps developed within the institute. Additionally, Dr Basavaraj demonstrated the functionality and research utility of the plant phenomics facility, showcasing a low-cost field phenotyping tool. Mr Stewart expressed appreciation for the strides made by the institute in the field of abiotic stress management and acknowledged institute's efforts in developing digital solutions for abiotic stress-related challenges.

Dr A Vishnuvardhan Reddy, Vice Chancellor of ANGRAU, Guntur (AP)

Dr A Vishnuvardhan Reddy, Vice Chancellor, ANGRAU, Guntur, AP, visited ICAR-NIASM alongwith the officials from his university. The main purpose of the visit was to gain insights into the activities and facilities of ICAR-NIASM and explore potential collaborations for future endeavors. During the interaction, Dr Vishnuvardhan Reddy emphasized the significance of partnering with esteemed institutions like ICAR-NIASM to enhance students' research capabilities and provide them with comprehensive knowledge. Additionally, Dr AK Singh, Head of School (SASM) shared valuable information with the visiting dignitaries about ongoing research and development initiatives. Following the meeting, a comprehensive tour of the institute's premises was arranged to showcase various laboratories and facilities across different schools. On the morning of the 24th, a field visit was organized, allowing Dr Reddy and his team to witness firsthand the impressive progress made in rehabilitating and revitalizing the lands. The team had the opportunity to explore climate-smart integrated farming systems, silvopasture, the animals experimental farm, and fruit orchards. Dr Reddy expressed his appreciation for the diligent efforts undertaken by ICAR-NIASM in the realm of research and development. These collective efforts ensured a fruitful visit and facilitated meaningful exchanges between ANGRAU Guntur University and ICAR-NIASM. The efficient coordination of this program was carried out by Dr SB Chavan, Dr Rajkumar, and Mr K Ravi Kumar.

13. Personnel

Staff of ICAR-NIASM

Director
Dr K Sammi Reddy
SCIENTIFIC STAFF
School of Atmospheric Stress Management
1. Dr Ajay K Singh, Head & Principal Scientist (Agricultural Biotechnology)
2. Dr Nitin P Kurade, Principal Scientist (Veterinary Pathology)
3. Dr Sachinkumar S Pawar, Senior Scientist (Animal Biotechnology)
4. Dr Bhaskar B Gaikwad, Senior Scientist (Farm Machinery and Power)
5. Dr Sushma M Awaji, Scientist (Plant Physiology)
6. Dr Gopalakrishnan B, Scientist (Environmental Science)
7. Mr Rajkumar, Scientist (Agricultural Entomology)
8. Mr Mukesh P Bhendarkar, Scientist (Fisheries Resource Mgmt.) (On study leave)
9. Dr Ram Narayan Singh, Scientist (Agricultural Meteorology)
School of Water Stress Management
1. Dr Kamal K Pal, Head & Principal Scientist (Microbiology)
2. Dr Dhananjay D Nangare, Principal Scientist (Soil & Water Cons. Eng.)
3. Dr Goraksha C Wakchaure, Senior Scientist (Agricultural Structure & Process Eng.)
4. Dr Boraiah KM, Scientist (Genetics and Plant Breeding)
5. Dr Prashantkumar S Hanjagi, Scientist (Plant Physiology)
6. Dr Gurumurthy S, Scientist (Plant Physiology)
7. Dr Pratapsingh S Khapte, Scientist (Vegetable Science)
8. Dr Sushil Sudhakar Changan, Scientist (Plant Biochemistry)
9. Dr Aliza Pradhan, Scientist (Agronomy)
10. Dr Basavaraj PS, Scientist (Genetic & Plant Breeding)
11. Dr Sonam, Scientist (Agricultural Meteorology)
School of Edaphic Stress Management
1. Dr Sanjivkumar A Kochewad, I/c Head & Senior Scientist (LPM)
2. Dr Rinku Dey, Principal Scientist (Microbiology)
3. Dr Vanita N Salunkhe, Senior Scientist (Plant Pathology)
4. Dr Rajagopal V, Scientist (Soil Chemistry/Fertility/Microbiology)

5. Dr Sangram B Chavan, Scientist (Agroforestry)
6. Mr Karthikeyan N, Scientist (Agricultural Microbiology)
7. Dr Harisha CB, Scientist (Spices, plantation, medicinal & aromatic plants)
8. Dr Neeraj Kumar, Scientist (Fish Nutrition)
9. Mr Amrut S Morade, Scientist (Fruit Science)
10. Dr Vijaysinha D Kakade, Scientist (Fruit Science)
11. Dr Paritosh Kumar, Scientist (Environmental Science)
12. Dr Hanamant M. Halli, Scientist (Agronomy)

School of Social Science and Policy Support

1. Dr Dhananjay D Nangare, I/c Head & Principal Scientist (Soil & Water Conserv. Eng.)
2. Dr Sachinkumar S Pawar, Senior Scientist (Animal Biotechnology)
3. Dr Bhaskar B Gaikwad, Senior Scientist (Farm Machinery and Power)
4. Dr Sanjivkumar A Kochewad, Senior Scientist (Livestock Production Management)
5. Dr Boraiah KM, Scientist (Genetics and Plant Breeding)
6. Mr Karthikeyan N, Scientist (Agricultural Microbiology)
7. Mr Ravi Kumar, Scientist (Agricultural Extension)
8. Dr Nobin Chandra Paul, Scientist (Agricultural Statistics)
9. Ms Ponnaganti Navyasree, Scientist (Agricultural Business Management)

TECHNICAL STAFF

1. Dr Avinash V Nirmale, Chief Technical Officer (Animal Science)
2. Dr Pavin B Taware, Assistant Chief Technical Officer (T 7/8) (Farm)
3. Mrs Noshin Shaikh, Technical officer (T5) (Civil) (On study leave)
4. Mr Santosh Pawar, Technical officer (T5) (Electrical) (On study leave)
5. Mr Pravin More, Technical officer (T5) (Computer) (On study leave)
6. Mr Rushikesh Gophane, Technical officer (T5) (Horticulture) (On study leave)
7. Mr Lalitkumar Aher, Technical officer (T5) (Biotechnology)
8. Mr Sunil Potekar, Technical officer (T5) (Agro-Meteorology)
9. Mr Patwaru Chahande, Technical officer (T5) (Agriculture)
10. Mr Aniket More, Technical Assistant (T3) (Field/Farm)

ADMINISTRATIVE STAFF

1. Mr Charles Ekka, Chief Administrative Officer
2. Dr Sunil Kumar Das, Chief Finance & Accounts Officer
3. Mrs Purnima S Ghadge, Assistant Administrative Officer
4. Mr Dayanand P Kharat, Assistant Administrative Officer
5. Mr Girish V Kulkarni, Assistant Administrative Officer
6. Mr Trilok Saini, Assistant Administrative Officer

Joining, Transfer and Promotion of Staff

Name of the staff	Date	Institute
Joining (from)		
Dr Sushil S Changan, Scientist (Plant Biochemistry)	06.03.2023	ICAR-CPRI, Shimla
Mr Amrut S Morade, Scientist (Fruit Science)	06.03.2023	ICAR-IISWC, Bellary
Dr Nobin Chandra Paul, Scientist (Agricultural Statistics)	11.04.2023	-NA-
Dr Ajay K Singh, Head & Principal Scientist (Agricultural Biotechnology)	16.06.2023	ICAR-NIASM, Baramati
Dr Kamal K Pal, Head & Principal Scientist (Microbiology)	03.07.2023	ICAR-DGR, Junagadh
Dr Sonam, Scientist (Agricultural Meteorology)	14.07.2023	ICAR-NAARM, Hyderabad
Miss P Navyasree, Scientist (Agricultural Business Management)	20.07.2023	ICAR-NAARM, Hyderabad
Dr Rinku Dey, Principal Scientist (Microbiology)	26.12.2023	ICAR-DGR, Junagadh
Selection (to)		
Dr Jagadish Rane, Principal Scientist (Plant Physiology)	22.01.2023	Director, ICAR-CIAH, Bikaner
Dr Ajay K Singh, Principal Scientist (Agricultural Biotechnology)	16.06.2023	Head, School of Atmospheric Stress Management, ICAR-NIASM, Baramati
Dr Arjun S Tayde, Principal Scientist (Agronomy)	18.07.2023.	Head, Division of Crop Production, ICAR-CICR, Nagpur
Transfer (to)		
Dr Amresh Chaudhary	22.12.2023	ICAR-CSSRI, Karnal
Promotion		
Dr Boraiah KM	15.09.2021	Promotion to next higher grade of PB-3 (Rs. 15,600-39,100 + RGP 8000) (Pay Level-12) as Senior Scientist
Dr Sangram B Chavan	01.01.2023	Promotion to next higher grade of PB-3 (Rs. 15,600-39,100 + RGP 8000) (Pay Level-12) as Senior Scientist
Dr Neeraj Kumar	01.01.2023	Promotion to next higher grade of PB-3 (Rs. 15,600-39,100 + RGP 8000) (Pay Level-12) as Senior Scientist
Dr Aliza Pradhan	02.07.2022	Promotion to next higher grade of PB-3 (Rs. 15,600-39,100 + RGP of Rs 7000) (Pay Level-11)

14. Major Committees

Research Advisory Committee (RAC)

Dr B Venkateswarlu; Chairman RAC & Ex-Vice Chancellor, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani

Dr SMK Naqvi; Former Director, ICAR- Central Sheep and Wool Research Institute, Avikanagar

Dr N Sarangi; Former Director, ICAR- Central Institute of Freshwater Aquaculture, Bhubaneswar

Dr DK Pal; Former Pr. Scientist, ICAR- National Bureau of Soil Survey & Land Use planning, Nagpur

Dr C Viswanathan; Head, Plant Physiology, ICAR- Indian Agricultural Research Institute, New Delhi

Dr BB Barik; Former Director, Vaikunth Mehta National Institute of Co-operative Management, Pune, Maharashtra and Former Principal, BVRI, Bichpuri, Agra

Dr PK Ghosh; Director, ICAR-National institute of Biotic Stress Management, Raipur (Special Invitee)

Dr A Velmurugan; ADG (S&WM), NRM Division, KAB-II, Pusa, New Delhi

Dr Neeraj Kumar; Scientist, ICAR-NIASM, Baramati, (Member Secretary)

Institute Management Committee (IMC)

Dr K Sammi Reddy; Chairman IMC & Director, ICAR-National Institute of Abiotic Stress Management, Baramati, Maharashtra

ADG (S&WM); NRM Division, ICAR Hqrs. New Delhi

Commissioner of Agriculture; Govt. of Madhya Pradesh, Bhopal

Dr Sachin Nalawade; Head, Dept. of Farm Machinery & Power Eng., Mahatma Phule Krishi, Vidyapeeth, Rahuri

Dr Naresh Kumar; Professor & Principal Scientist, Centre for Environment Science and Climate Resilient Agriculture, ICAR-Indian Agricultural Research Institute, New Delhi

Dr M Prabhakar; Principal Scientist & Project Investigator, NICRA, ICAR-Central Research Institute on Dryland Agriculture, Hyderabad

Dr RM Sundaram; Principal Scientist, ICAR-Indian Institute of Rice Research, Hyderabad

Sh Aniruddha Vasant Pujari; Pujari Farm, Solapur, Maharashtra

Smt Purnima S Ghadge; Asst. Administrative Officer, ICAR-NIASM, Baramati (Member Secretary)

Institute Joint Staff Council (IJSC)

Dr K Sammi Reddy, Chairman IJSC & Director

Category	**Staff Side**		**Office Side**	
Administration	Mr DP Kharat	Member CJSC	All Heads of School	Members
	Mr GV Kulkarni	Member	Chief Administrative Officer	Member
Technical	Mr Santosh Pawar	Secretary IJSC	Chief Finance & Accounts Officer	Member

15. Project Activities

Project Activities	Investigators
• Prototype of Ambience Monitor v1.0	Gopalakrishnan B, SS Pawar, NP Kurade, BB Gaikwad, Rajkumar
• Risk characterization through Systematic Literature Review (SLR) for soybean	Gopalakrishnan B
• Exploitation of halophytic plant and associated microbiome for amelioration of saline agricultural land of arid and semiarid regions	AK Singh
• Response of GmFAD3 overexpressing and silenced plants to drought and salinity stress tolerance	AK Singh
• Determination of seasonal heat stress variations in poultry bird	SS Pawar, NP Kurade, AV Nirmale
• Assessment of fodder scenario and sugarcane tops utility in Maharashtra	SS Pawar, NP Kurade, BB Gaikwad, AV Nirmale
• Study on multiple abiotic stress indicators in goats from scarcity areas and its mitigation	NP Kurade, SS Pawar, AV Nirmale
• Soil Chemical Quality Index	BB Gaikwad
• Effect of planting techniques on growth, nutrient and quality parameters of pomegranate tree under shallow and gravelly land	V Rajagopal
• Climate resilient integrated farming system for semi-arid regions	SA Kochewad
• Multilayer integrated farming system for livelihood improvement in multiple abiotic stress regions	SA Kochewad
• Self-sustaining goat farming model for livelihood improvement of small and marginal farmers	SA Kochewad
• Impact of Leucaena-based silvipasture systems on fodder productivity in degraded soil environments	SB Chavan, AV Nirmale, HM Halli
• Flowering phenology and yield of chia in relation to various sowing dates and prevailing weather	Harisha CB
• Wastewater treatment synergizing with the integrated approach of constructed wetland and aquaponics	Paritosh Kumar
• Vermicomposting of farm waste using Red wiggler worm (*Eisenia fetida*) and African night crawlers	Paritosh Kumar
• Collection of indoor air-purifying plant species	Paritosh Kumar
• Evaluation of new soybean genotypes as off-season intercrop in sugarcane	HM Halli

• Prevelance of dragon fruit stem canker (*Neoscytalidium dimidiatum*) in various districts of Maharashtra	VN Salunkhe
• Optimization of plant population for efficient utilization of space and nutrients in chia	HM Halli
• Studies on horticultural crops	VD Kakade, AS Morade
• Potential role of dietary zinc on gene regulation of growth performance and immunity in *Pangasianodon hypophthalmus* against multiple stresses	Neeraj Kumar
• Synergistic effect of nickel and temperature on gene expression, multiple stress markers and depuration: An acute toxicity in fish	Neeraj Kumar
• Manganese nano-particles control the gene regulations against multiple stresses in *Pangasianodon hypophthalmus*	Neeraj Kumar
• Role of dietary quinoa husk (*Chenopodium quinoa*) for gene regulations for growth and immunity against multiple stresses in *Pangasianodon hypophthalmus*	Neeraj Kumar
• Screening and identification of waterlogging tolerant pigeonpea genotypes	Basavaraj PS
• Identification of deficit moisture-tolerant pigeonpea germplasm accessions using the phenomics approach	Basavaraj PS
• Adventitious root formation contributed tolerance to waterlogging in cowpea varieties	Basavaraj PS
• Identification of traits specific to high-temperature stress-tolerant cowpea germplasm accessions	Basavaraj PS
• Identification of deficit moisture-tolerant cowpea germplasm accessions using the phenomics approach	Basavaraj PS
• Genetic variation for desiccation tolerance among Cicer Accessions	Basavaraj PS
• Identification of genomic region associated with weed competitive traits under simulated DSR conditions using high-throughput phenotyping approach	Basavaraj PS
• Potential promising and unique mutants in chia identified	Boraiah KM
• Identified floral traits and mechanisms associated with delayed and partial pollination in dragon fruit	Boraiah KM
• Evaluation of yield traits and tolerance indices of foxtail millet accessions under low soil nitrogen conditions in the shallow basaltic gravelly soils	Boraiah KM
• Identification of groundnut genotypes tolerant for pre- and post-flowering drought	Boraiah KM
• Combined effect of drought and heat stress on quinoa (*Chenopodium quinoa*) morphology, physiology and yield	Aliza Pradhan
• Isolation of candidate microorganisms for management of moisture deficit- and nutrient- stress in different crops of arid- and semi-arid tropics	KK Pal, Aliza Pradhan, Rinku Dey, Karthikeyan N, Basavaraj PS, Boraiah KM
• Collection, conservation and maintenance of vegetable germplasm	PS Khapte

• Rootstock identified for drought tolerance in Eggplant	PS Khapte
• Identification of rootstocks for salinity tolerance in eggplant	PS Khapte
• Identification of photothermo-insensitive with climate-smart early maturing chickpea genotypes	Gurumuthy S
• Accelerating genetic gain in Common bean (*Phaseolus vulgaris L.*): Performance evaluation of genotypes across three seasons or generations	Gurumuthy S
• Studies on deficit irrigation strategies along with plant growth regulator on yield and WUE of mango (Variety: Keshar)	Nangare DD
• Green synthesis of silver nanoparticles (AgNPs) from *Parthenium hysterophorus* weed and its application in drought stress	SS Changan
• Effect of deficits irrigation on stress tolerant garlic cultivars	GC Wakchaure
• Garlic responses to plant growth regulators (PGRs) under water deficit regimes	GC Wakchaure
• Effect of deficit irrigation (DI), foliar plant growth regulators (PGRs) and surface trash retention on sugarcane yields in semi-arid regions	GC Wakchaure
• Effect of tillage, residue and nutrient management on soil organic carbon, biology and yield under multi-ratooning sugarcane system in basaltic soils of semi-arid tropics	GC Wakchaure
• Optimizing planting geometry and crop residue management using subsurface drip irrigation system	GC Wakchaure
• Development of valorized products from dragon fruit	GC Wakchaure
• Physicochemical and thermal characteristics of custard apple fruit during ripening	GC Wakchaure
• Economic analysis of dragon fruit cultivation	Ravi Kumar
• Development action plan for Schedule Caste (DAPSC) interventions 2023	NP Kurade, Nangare DD, SS Pawar, AV Nirmale, BB Gaikwad, SB Chavan, VD Kakade, Rajkumar, Aliza Pradhan, K Ravi Kumar
• Tribal Sub Plan (TSP) interventions 2023	SA Kochewad, VN Salunkhe, Neeraj Kumar, Paritosh Kumar, Rajkumar B, K Ravikumar, HM Halli

The three symbolically interlocking radial hands represent (a) the cyclic anthropogenic pressures of livestock (blue), agriculture (green) and fisheries and other water related activities (aquamarine blue) and (b) human of various creeds and colours, under taking for livelihoods on the land scape which needs consideration not in a sectional approach but a holistic way to provide customized technologies and (c) asking for forging unrelenting extensive linkages of peers through global co-operation to pact against our surmountable problem by collective action, thus generating new material represented by emerging seedling in the centre.

Raindrop in the center indicates the driving force of life but is threatened by (a) stresses of climate change and (b) associated various anthropogenic actions reflected by symbolic hands around.

The clouds crossing raindrop are (a) like Asian Brown Clouds indicative of looming climate change (b) from greenhouse effects or pollution which needs undeviating attention.

The seedling in green colour connecting earth with raindrop expresses the efforts of the scientists to tackle all the pressures through screening and developing through biotechnology or other futuristic tools to evolve abiotic stress tolerant and or adoptable plants, animals, fishes etc. and the undying optimism towards ever regenerating life regardless of forever mounting pressures of human beings.

The central triangular open space created by hands around the raindrop institutionalizes creation of unique facility under single umbrella with growth for (a) specially focused high quality research facilities embedding frontier sciences, and (b) choicest capacity building through a cutting–edge education.

Black color text राअस्ट्रैप्रसं represents the name of the institute in Hindi 'राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान'. NIASM is acronym for 'National Institute of Abiotic Stress Management'.

The brown colour surface supporting seedling represents earth is the endangered 'nature' consequential to (a) unabated land degradation resulting in edaphic stresses like drought, floods, salinity, soil acidity pollution etc. due to the forces of varying rainfall confounded by the plaguing climate change and (b) a shrinking greenery by deforestation related activities needing attention of all dwellers of 'spaceship earth' on resource conservation.

INTERNATIONAL YEAR OF
MILLETS
2023

भाकृअनुप-राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान

ICAR-National Institute of Abiotic Stress Management

बारामती, पुणे, महाराष्ट्र ४१३ ११५

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