



अजैविक स्ट्रेस प्रबंधन समाचार

Abiotic Stress Management News

January to June 2026



भाकृअनुप- राष्ट्रीय अजैविक स्ट्रेस प्रबंधन संस्थान

बारामती, पुणे, महाराष्ट्र 413 115

ICAR-National Institute of Abiotic Stress Management
Baramati, Pune, Maharashtra 413 115



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SEMINAR/WORKSHOP/TRAINING

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PERSONALIA

Editorial Committee

Dr. Sudhir Kumar Mishra

Dr. Mahesh Gupta

Dr. Naveenkumar A.

Dr. Nilesh Joshi

Dr. Prabhat Kumar

Dr. Sayantani Karmakar

Layout & Typesetting

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Published By

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From the Director's Desk

Greetings from ICAR-NIASM

It is with great pleasure that I present the latest issue of the Institute's newsletter, Abiotic Stress Management News. This issue highlights the progress, achievements, and continuing efforts of the ICAR-National Institute of Abiotic Stress Management (ICAR-NIASM), Baramati, in advancing science and innovation for managing abiotic stresses in agriculture. Our Institute remains committed to strengthen the resilience and sustainability of farming systems in the face of emerging environmental challenges.

Agriculture today is increasingly exposed to extreme temperature fluctuations, erratic water availability, both excess and scarcity, and other environmental stressors that adversely affect crop growth, productivity, and sustainability. ICAR-NIASM plays a pivotal role in advancing scientific understanding of these stresses on crops, livestock, and aquatic species, while translating scientific knowledge into innovative technologies and practical solutions for climate-resilient agriculture.

Our interdisciplinary teams are engaged in a wide range of research activities, including the identification, evaluation, and advancement of crop varieties with enhanced tolerance to drought, heat, and salinity; development of novel indicators for assessing plant health and stress responses; and advanced spatiotemporal analyses of rainfall variability and drought patterns. This newsletter highlights these initiatives, along with key findings from ongoing research projects and major activities undertaken during the past six months. I would like to express my sincere appreciation to our dedicated scientists, research partners, and support staff, whose commitment and collective efforts advance the Institute's mission.

I also commend the Editorial Board for its meticulous efforts in timely compiling this issue. I am confident that this issue will provide valuable insights into the Institute's ongoing efforts and further strengthen our commitment to science-based solutions for a resilient and sustainable agricultural future.



K Sammi Reddy

(K Sammi Reddy)

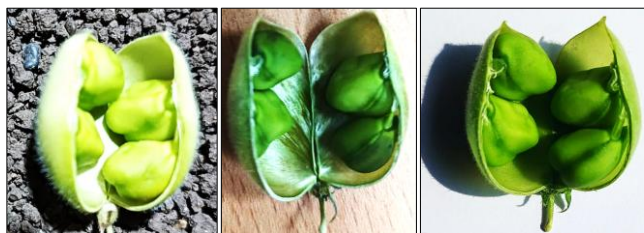
June 30, 2026

RESEARCH HIGHLIGHTS

A Rare Spectacle in Chickpea: Discovery of Four-Seeded Pods in ICC 4958

Pal K K, Changan S, Dey R, Bitla U, Jadhav T, Babar R, Aher L, Drub Kumar, Boraiah K M, Basavaraj P S, Sultana R, and Reddy K S

Scientific research often rewards patience with unexpected discoveries. One such rare and fascinating observation was made while investigating the possibility of a facultative transition from C3 photosynthesis to Crassulacean Acid Metabolism (CAM) in drought-stressed chickpea genotype ICC 4958. During late-night physiological observations involving measurements of nocturnal carboxylation rates and inverted stomatal behaviour, an unusual phenomenon caught our attention—a chickpea pod containing four fully developed seeds. The observation gains additional significance because ICC 4958 is a widely studied drought-tolerant chickpea genotype that has served as a valuable genetic resource in several physiological and molecular studies worldwide.



Four seeded pods obtained from ICC 4956

Chickpea (*Cicer arietinum* L.) is a cleistogamous, predominantly self-pollinated, cool-season C3 grain legume that typically bears one to two seeds per pod though flowers possess upto four ovules, while three-seeded pods are occasionally encountered in some genotypes. However, the occurrence of four seeds in a single pod is exceptionally rare. What made the observation even more remarkable was that two separate pods on the same plant were found to contain four seeds each, representing an extremely rare phenotypic occurrence in chickpea.

Ordinarily, the pod cavity of chickpea is not large enough to accommodate four developing seeds. In the present case, the pod size and internal cavity were conspicuously large, suggesting the possibility of a spontaneous genetic mutation, altered ovule development, or developmental modification affecting pod architecture and seed set. Such a change may have enabled the pod to successfully accommodate and

support the development of four seeds, a phenomenon rarely reported in chickpea.

Interestingly, three-seeded pods have also been observed quite frequently in the material under study (Figure 2), indicating the presence of inherent genetic variability for increased seed number per pod. Efforts are now underway to evaluate the stability and heritability of this unusual trait through advancement of the identified material into subsequent generations.



Three seeded pods in ICC 4958

If the trait proves to be genetically stable and can be incorporated into breeding programmes, it may open exciting opportunities for increasing sink capacity and significantly enhancing chickpea productivity. Even a modest increase in average seed number per pod could translate into substantial yield gains at the crop level. This unexpected discovery serves as a reminder that nature often conceals extraordinary possibilities within seemingly ordinary observations. What began as an investigation into the facultative transition from C3 to CAM photosynthesis in chickpea may eventually uncover a novel genetic avenue for enhancing seed yield. Future studies will determine whether the four-seeded pod trait is heritable and stable across environments. If successfully harnessed through breeding, this rare phenotype could contribute to the development of next-generation high-yielding chickpea cultivars for climate-resilient and nutrition-secure agriculture.

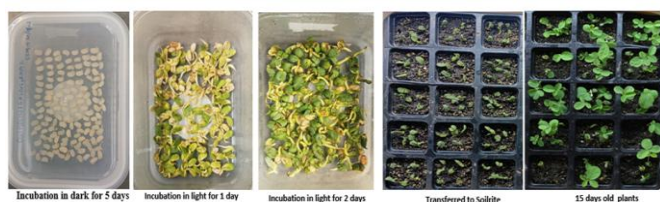
Genome Editing for Improvement of Abiotic Stress Tolerance in Soybean through Targeted Knockout of Negative Regulators

Singh A K, Boraiah K M, Basavaraj P S, Khapte P S, Changan S, Pradhan A, Wakchaure G C, Awaji S, and Reddy K S

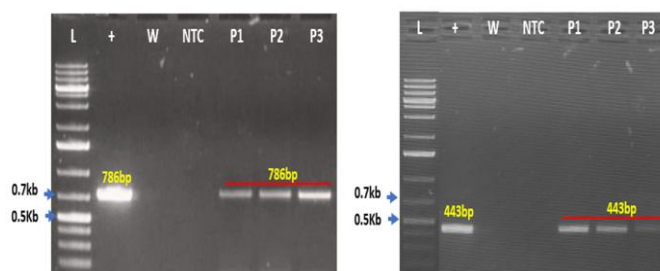
Precise genome editing offers a promising approach for enhancing abiotic stress tolerance. The CRISPR/Cas9-based genome editing is being employed to develop climate-resilient, non-GM soybean lines with improved drought and salinity tolerance. Validated guide RNAs targeting key stress-responsive genes were designed, verified through *in vitro* Cas9 cleavage assays, and cloned into CRISPR/ Cas9 expression vectors. These

constructs were introduced into soybean using both *Agrobacterium*-mediated transformation and an *in-planta* transformation approach. In the *in-planta* method, *Agrobacterium*-infected cotyledons were incubated in the dark for five days before being transferred to Soilrite under greenhouse conditions. Several *agrobacterium* transformation batches progressed successfully through co-cultivation, shoot induction, elongation under glufosinate selection, and rooting. Molecular characterization by PCR amplification of the Cas9 and PAT genes confirmed the successful integration of genome-editing constructs in multiple plants. Three plants transformed with pCas9MDC123:PARP1A1BE2gRNA1, three plants carrying pCas9MDC123:ERA1BE2gRNA, and 4 plants harbouring pCas9MDC123:ERA1BE2gRNA2 were confirmed as PCR-positive using Cas9- and PAT-specific primers.

Constructs	Batches	Cotyledons with Radicle	Agro-Infected Cotyledons Transferred to Soilrite	Greenhouse-grown Plants	PCR screening using Cas9 and PAT specific primers	Cas9 positive plants
Cas9MDC123:PARP1A1BE2gRNA1 and gRNA2	2 Batches (110 seeds/batch)	103	67	51 plants	19 plants	5 plants
Cas9 MDC123:ERA1BE2gRNA and gRNA2	1-Batches (150 seeds/batch)	90	45	33 plants	16 plants	4 plants
Cas9 MDC123: EIN2E2gRNA1	2-Batches (120 seeds/batch)	201	83	13 plants	-	-



In Planta soybean transformation

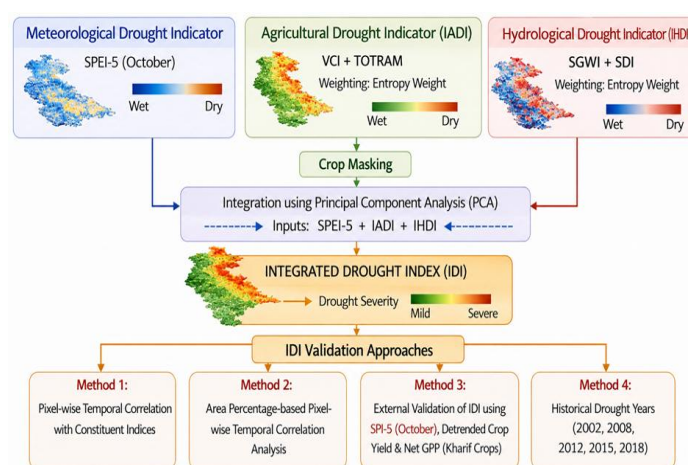


Agarose gel electrophoresis images showing PCR screening using Cas9 specific primers.

Integrated Drought Index Development and Declaration with a Crop Yield Loss Assessment and Mapping Framework for Western Maharashtra

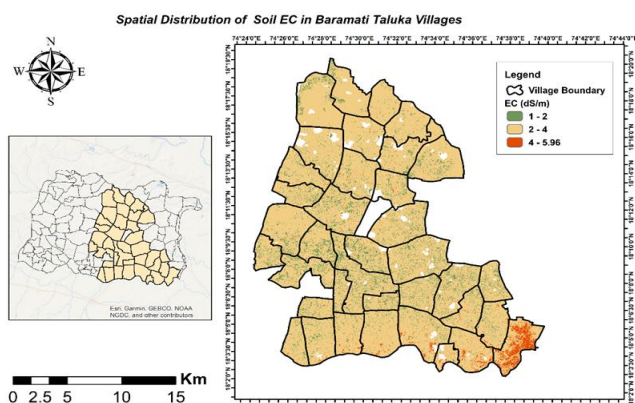
Paul N C, Ponnaganti N, Gaikwad B B, Kumar K R, Khapte P S and Nangare, D D

A novel Integrated Drought Index (IDI) framework was developed for *Kharif* season drought monitoring in Western Maharashtra using meteorological, agricultural and hydrological indicators for 2002-2024. The analysis identified 2002-03, 2012-13, 2015 and 2018 as major drought years, with 2003 and 2015 showing the most spatially extensive drought conditions, while 2014, 2016, 2020 and 2022 were predominantly non-drought years. The first principal component explained 44-66% of the total variance, demonstrating strong integration among drought dimensions. A three-indicator drought declaration framework based on P10 IDI, Moderate+ Drought Area (%) and Dominant Drought Class, supported by IDI-guided spatial ground verification, was developed for taluka-level drought declaration.



The IDI framework for western Maharashtra.

The Knowledge, Attitude and Practice (KAP) questionnaires were developed to assess onion and sugarcane farmers understanding and management practices related to drought and salinity stresses. A total of 550 farmers (167 onion+ 383 sugarcane) from Nashik, Ahilyanagar and Pune districts were surveyed. For crop-loss assessment, an integrated onion yield-gap framework using KAP, machine learning (ML) and statistical modelling showed an average total yield gap of 23.2 t / ha, of which 61% (14.2 t / ha) was attributable to the extension/adoption gap. Random Forest modelling identified soil moisture (% *IncMSE* = 32.37) and KAP score (% *IncMSE* = 29.90) as the most important predictors. To support spatial assessment, soil salinity and soil pH maps have been prepared for selected villages of Baramati taluka using remote sensing and ML techniques. Crop-wise yield-gap assessment, provide an integrated basis for improving drought and salinity resilience and supporting evidence-based agricultural planning in Western Maharashtra.



Spatial Distribution of soil EC for selected villages of Baramati Taluka.

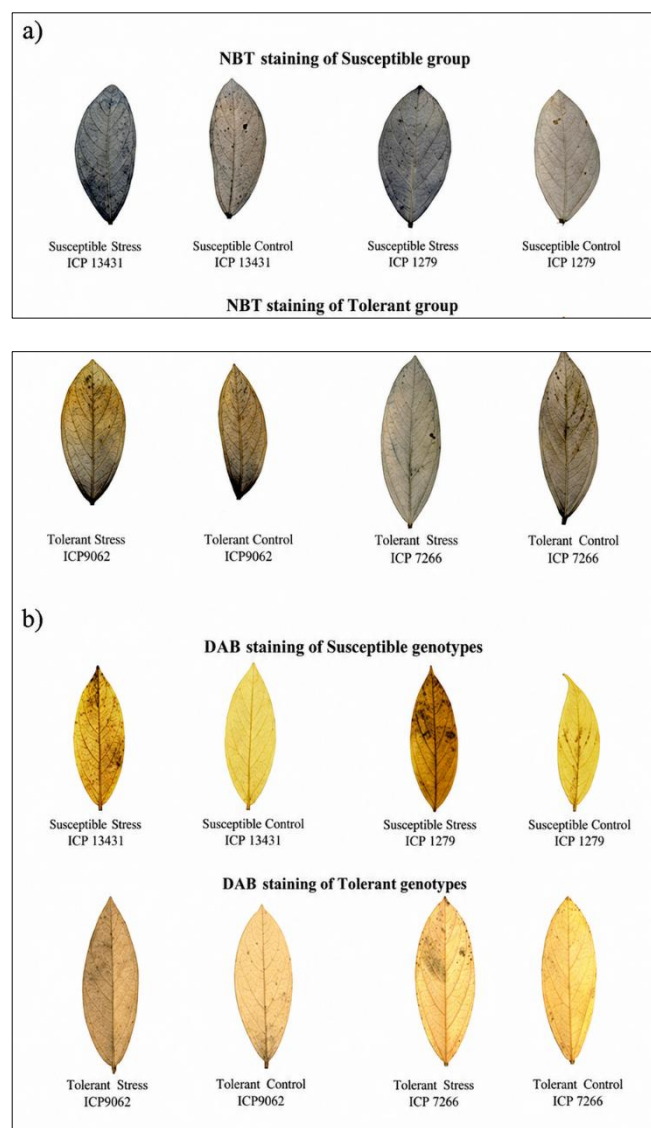
Identifying drought stress tolerant pigeon pea genotypes at reproductive stage

Hanjagi P S, Singh A K, Gaikwad B, Awaji S M and Naik S

In Kharif 2025, 280 diverse pigeon pea genotypes (193 whole genome re-sequenced panel and 87 early panel) were phenotyped for reproductive stage drought stress tolerance in field conditions. The drought susceptibility index (DSI) analysis showed that genotypes such as ICP 2405, ICP 10613, ICP 8152, ICP 8255, ICP 8194, ICP 15382, ICP 8949, ICP 11354, ICP 7266, ICP 1126, ICP 9062, and ICP 6739 recorded low DSI (0.43 to 0.49), indicating high drought tolerance. In contrast, genotypes ICPL 19664, ICP 13662, ICP 2746, ICP 13906, ICP 348, ICP 6971, ICP 14868, ICP 6123, ICP 6929, ICP 14341, ICP 6922, and ICP 1279 showed higher DSI (1.11 to 1.54), indicating greater susceptibility to drought.

The tolerant genotypes showed higher relative water content, membrane integrity, and stomatal conductance, along with better chlorophyll retention, carotenoid levels, and photosynthetic efficiency. They also had stronger antioxidant activity, with higher SOD, CAT, POD, and proline, and lower oxidative damage indicators such as MDA and H_2O_2 . The histochemical assays showed clear differences between susceptible and tolerant pigeon pea genotypes under stress. Nitro Blue Tetrazolium (NBT) staining indicated stronger superoxide accumulation in susceptible leaves, while tolerant genotypes showed comparatively lower staining, suggesting better control of reactive oxygen species. The 3,3'-Diaminobenzidine (DAB) staining revealed higher hydrogen peroxide accumulation in susceptible genotypes and weaker staining in tolerant genotypes indicating less oxidative damage and better cellular protection under stress. The tolerant genotypes also recorded improved yield-related traits such as

flower retention, pod set, pod weight, seed pod ratio, and grain yield under stress.

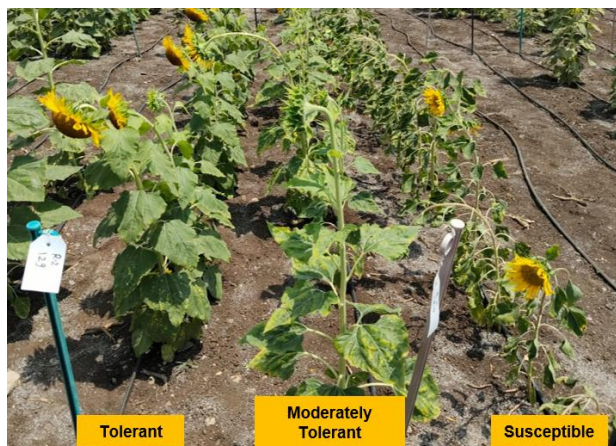


Histochemical Assay: NBT (Nitro Blue Tetrazolium) for the detection of superoxide radicals ($O_2^{\bullet-}$) in contrasting pigeon pea genotypes (a); DAB (3,3'-Diaminobenzidine) staining for the detection of H_2O_2 (b).

Screening of existing and new inbreds and hybrids of sunflower for high temperature stresses.

Hanjagi P S and Basavaraj T

For developing thermotolerant parental lines in sunflower, 140 genotypes were screened during summer 2026 for heat-stress response under field conditions. The experiment was carried out to identify tolerant, moderately tolerant, and susceptible sunflower genotypes based on physiological performance and visible field response under high temperature stress.



Field-based morphological characterization of sunflower genotypes's response to high-temperature stress

The study revealed wide variation in physiological performance, enabling classification of genotypes into tolerant, moderately tolerant, and susceptible groups. Based on the effective quantum yield of Photosystem II (PhiPS2), chlorophyll content and leaf rolling/curling characters of 140 genotypes, 22 genotypes identified as tolerant, 56 genotypes as moderately tolerant and 62 genotypes as susceptible to heat stress under field conditions.

Development of a Plasmid-Free CRISPR/Cas9 RNP Transfection System in Soybean Protoplasts

Awaji S M, Hanjagi P S and Singh A K

Following the successful standardization of an efficient protoplast isolation protocol from immature soybean cotyledons, progress has been made to establish a plasmid-free CRISPR/Cas9 genome editing workflow. The isolated protoplasts were utilized as a transient system to evaluate the delivery of pre-assembled Cas9-gRNA ribonucleoprotein (RNP) complexes for targeted genome editing. Guide RNA (gRNA) targeting the selected genes (*GmPARP1A* and *GmPARP1B*) was assembled *in vitro* with Cas9 nuclease using the GeneArt™ CRISPR-Cas9 Genome Editing Kit to produce functional RNP complexes. The purified soybean protoplasts were transfected with the pre-assembled Cas9-gRNA RNPs under optimized conditions to facilitate targeted genome editing without the integration of foreign DNA. Following transfection, the protoplasts were cultured on an optimized callus induction medium to evaluate their regeneration potential and support the development of genome-edited tissues. In parallel, genomic DNA was isolated from the transfected protoplasts for molecular analysis to verify

CRISPR/Cas9-mediated target-site cleavage. This work establishes an integrated workflow encompassing efficient protoplast isolation, RNP-mediated DNA-free genome editing, callus induction, and preliminary molecular validation, providing a robust platform for the development of transgene-free, genome-edited soybean plants and advancing functional genomics and precision crop improvement.



Development of callus from CRISPR/Cas9 RNP-transfected soybean protoplasts.



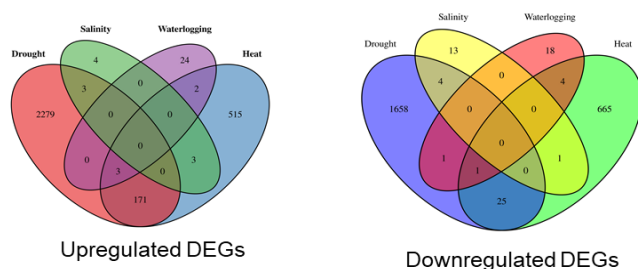
Agarose gel electrophoresis of PCR amplification of PARP1A and PARP1B genes.

Abiotic stress-responsive genes and candidate transcription factors in Pigeon pea (*Cajanus cajan* L.)

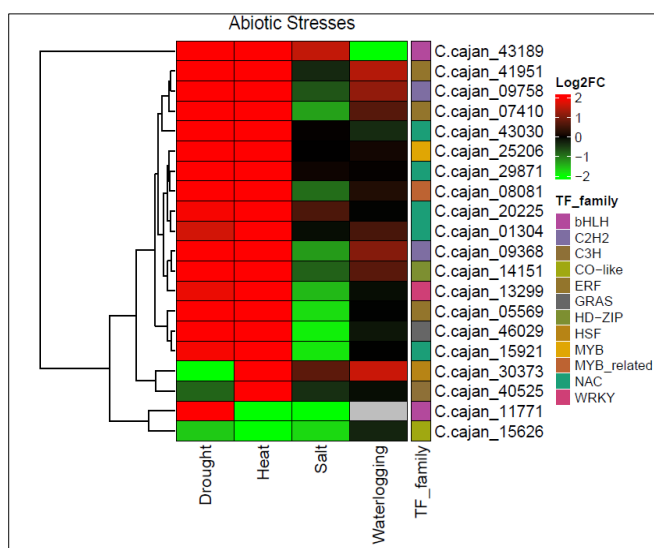
Awaji S M, Hanjagi P S and Singh A K

Pigeon pea is an important grain legume crop in semi-arid tropical and subtropical regions. The drought, heat, salinity, and waterlogging are major abiotic stresses for a pigeon pea crop. Differentially expressed genes were identified independently for each stress condition such as drought 2375; heat 1390; salinity 28; waterlogging 53). Notably, transcription factors viz., *C. cajan_43189*, *C. cajan_41951*, *C. cajan_01304*, and *C. cajan_25206* belonging to major stress-responsive TF families, including bHLH, NAC, WRKY, DREB/ERF, bZIP, MYB, and HSF, and downstream functional genes viz *C.*

cajan_15925, C. cajan_43164 and C. cajan_00889 were consistently upregulated under at least 3 stress conditions. Gene Ontology and pathway enrichment analyses indicated significant enrichment of genes associated with response to stimulus, ABA signaling, transcriptional regulation, antioxidant activity, and cellular homeostasis. Identified candidate TFs and stress responsive functional genes may serve as promising targets for functional validation, marker-assisted selection, and genome editing approaches for improving multi-stress tolerance in Pigeon pea. This study provides valuable insights into conserved stress-responsive regulatory networks and establishes a foundational resource for climate-resilient legume improvement programs.



Four-way Venn diagram showing the number of genes with conserved and non-conserved upregulated and down regulated genes, respectively



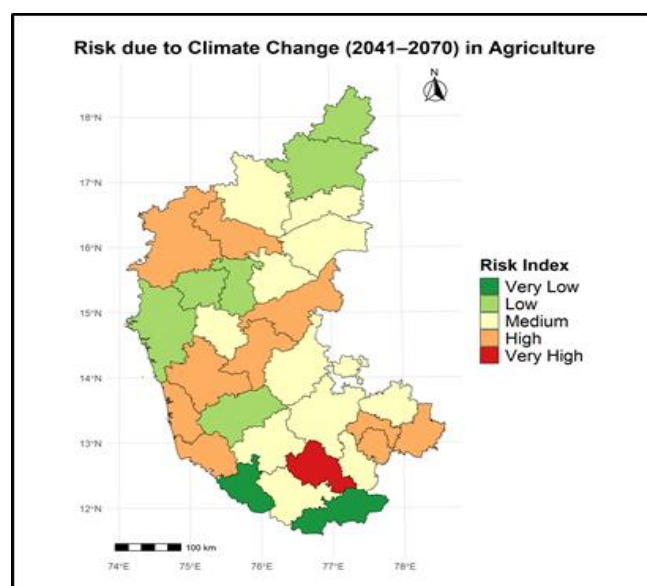
Expression analysis of candidate TF genes under abiotic stresses. The heatmap summarizes the log₂ fold-change pattern of selected TF genes across four stress conditions: drought, heat, salinity, and waterlogging. Red indicates upregulation, green indicates downregulation, and black suggests little or no change relative to control.

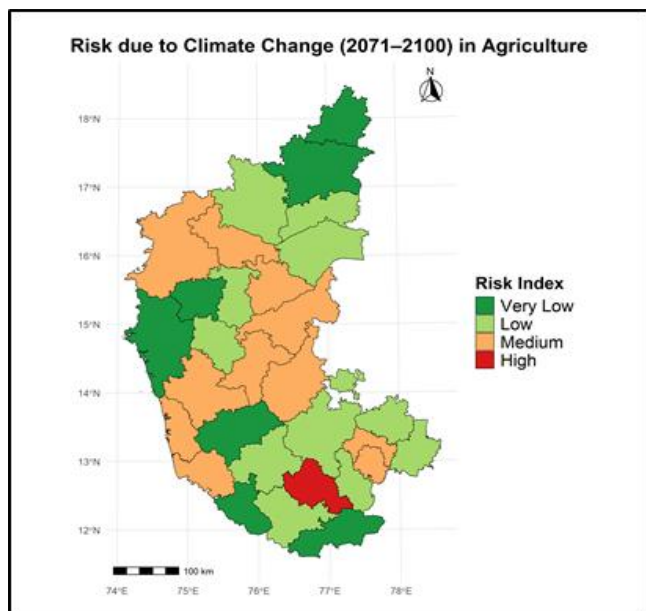
District-level climate risk mapping of Karnataka for climate-resilient agricultural planning

Karmakar S, Reddy K S, Raju B M K and Paul N C

To support climate-resilient agricultural planning in Karnataka, a comprehensive district-level climate risk assessment was carried out by integrating hazard, exposure, and vulnerability indicators under present and future climate scenarios. These indicators have been combined to construct composite indices for deriving overall risk index. Future hazard indicators were derived using India Meteorological Department (IMD) datasets as the baseline and an ensemble of eight CMIP6 climate models under the SSP2-4.5 scenario for the near-future (2041-2070) and far-future (2071-2100).

Exposure and vulnerability indicators were compiled from multiple government datasets. All indicators were normalized, and Principal Component Analysis was used to derive objective weights for constructing composite hazard, exposure, and vulnerability indices, which were subsequently integrated to develop a district-level climate risk index. These resulting indices were used to generate district-level climate risk maps, depicting present and future climate risk across Karnataka. The study integrates climate hazards, socio-economic exposure and adaptive capacity into a single district-level climate risk framework, enabling objective prioritization of vulnerable districts which, in turn can serve as a decision-support tool for policymakers to prioritize adaptation investments and strengthen climate-resilient agricultural development.





Climate risk map using for near future (2071–100)

Potassium Metaphosphate Dimer Enhances Drought Stress Tolerance in Chickpea

Changan S S, Khapte P S, Pradhan A and Pal K K

The potassium Metaphosphate Dimer (PMPD) is a novel foliar nutrient formulation combining phosphorus and potassium that shows promise in enhancing crop stress tolerance, though its underlying physiological and biochemical mechanisms remain largely unexplored. A pot-culture experiment was conducted on chickpea (cv. Digvijay) to evaluate PMPD (4 g L^{-1}) applied at different growth stages viz. vegetative (V), vegetative + flowering (VF), flowering + pod initiation (FP), and vegetative + flowering + pod initiation (VFP) under control, drought (50% field capacity), nutrient-deficient (50% P and K of RDF), and combined drought + nutrient-deficiency stress conditions. Foliar PMPD application, particularly the three-spray VFP schedule, significantly improved plant performance across all stress regimes. Relative water content increased by 17% under drought and 27% under combined drought + nutrient deficiency compared to unsprayed plants, while membrane stability index improved by 11% and 18%, respectively, indicating reduced membrane damage. Chlorophyll a, b, and total chlorophyll content were significantly elevated in PMPD-treated plants under both stress and non-stress conditions. Proline accumulation was markedly lower in PMPD-treated plants, suggesting reduced stress severity, while antioxidant enzyme activities (SOD, CAT, POX) were substantially enhanced; SOD activity was 58% higher in VFP-treated plants than unsprayed controls under drought stress. Histochemical staining (DAB and

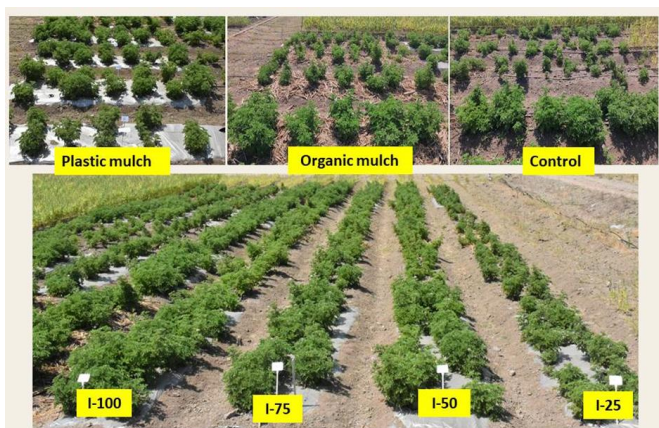
NBT) confirmed reduced accumulation of H_2O_2 and superoxide radicals in PMPD-treated leaves. Morphologically, PMPD improved shoot length, root length, root architecture, branch number, and pod number. Yield increased by 17.6% under normal conditions and 18.27% under drought stress with VFP application. These findings demonstrate that PMPD, applied across vegetative, flowering, and pod-initiation stages, effectively alleviates drought and nutrient-deficiency stress in chickpea by strengthening antioxidant defence, membrane stability, and water relations, offering a scientifically validated, sustainable approach to improving stress resilience and productivity in pulse crops

Irrigation regime and mulching improves herb yield, oil yield and water use efficiency of geranium

Harisha C B, Halli H M, Basavaraj P S and Boraiah K M

Rose-scented geranium (*Pelargonium graveolens*) oil is one of the important traded essential oils worldwide and is extensively used in the perfumery and cosmetic industries. As a perennial, cool-season aromatic crop, geranium requires adequate irrigation to achieve optimum growth and oil production. In shallow basaltic soils of semi-arid regions, efficient irrigation and moisture conservation practices are therefore essential for improving water productivity. The present study was conducted to evaluate the effects of different irrigation levels and mulching practices on herb yield, essential oil yield, and water-use efficiency of geranium. Fresh herb and essential oil yields increased with increasing irrigation levels; however, plastic mulch consistently resulted in higher yields than straw mulch and no-mulch treatments. The highest fresh herb yield (15.24 t ha^{-1}) and oil yield (37.70 kg ha^{-1}) were recorded under 100% irrigation combined with plastic mulching, which remained statistically at par with 75% irrigation combined with plastic mulching, producing 14.78 t ha^{-1} fresh herb and 36.59 kg ha^{-1} oil. The highest water-use efficiency for oil production ($0.097 \text{ L ha}^{-1} \text{ mm}^{-1}$) was recorded with 25% irrigation combined with plastic mulching. However, 75% irrigation with plastic mulching provided a better balance between oil yield and water-use efficiency, maintaining high oil productivity while reducing irrigation water use. The results indicated that geranium can be successfully cultivated with 25% irrigation-water saving under plastic mulch without a significant reduction in herb and oil yield, compared

with full irrigation under plastic mulch. Thus, 75% irrigation based on evapotranspiration combined with plastic mulching can be recommended as an efficient water-management strategy for geranium cultivation in shallow basaltic soils of semi-arid regions.



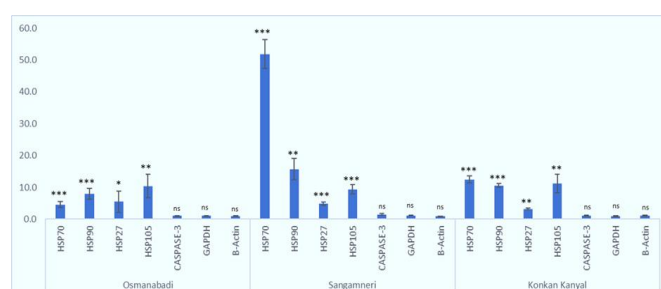
General field view of rose scented geranium grown in shallow basaltic soils with drip and mulching

Expression Pattern of Heat Shock Proteins and Apoptosis-Related Genes under Heat Stress in Indigenous goats

Pawar S S, Kurade N P, Gupta M, Kochewad S A, Nirmale A V

To understand the molecular basis of breed-specific heat-stress responses, the expression of HSP27, HSP70, HSP90, HSP105 and Caspase-3 was evaluated in PBMCs of Osmanabadi, Sangamneri and Konkan Kanyal goats subjected to heat stress. GAPDH and β -actin were used as reference genes for qPCR normalization. The results showed significant upregulation ($p < 0.05$) of HSP27, HSP70, HSP90 and HSP105 in all three breeds, confirming activation of the cellular heat-shock response. HSP70 showed particularly strong induction, highlighting its importance in maintaining protein homeostasis during heat stress. The magnitude of the response varied among breeds. Sangamneri exhibited the highest induction of HSP70 and HSP90, indicating a stronger cellular heat-shock response and potentially greater capacity to protect cells from thermal damage. Caspase-3 expression remained unchanged in all breeds, suggesting that the heat challenge primarily activated cytoprotective mechanisms without detectable transcriptional activation of the apoptotic pathway. The molecular findings were consistent with the physiological observations. Sangamneri showed the least seasonal variation in respiration rate, heart rate and rectal temperature, indicating better physiological stability under increasing THI. The combination of strong HSP

induction and stable physiological responses suggests a more efficient heat-adaptation mechanism. Konkan Kanyal showed an intermediate response, whereas Osmanabadi exhibited greater physiological changes and comparatively lower HSP induction. The study highlights HSP70 and HSP90 as potential molecular indicators of cellular thermotolerance and demonstrates that breed differences in heat tolerance are associated with differences in both physiological stability and cellular heat-shock responses.



Relative expression of different heat shock protein genes among three heat stressed goat breeds.

Trends and associations of climate variables with sesame yield in Bundelkhand, India.

Singh R N, Sonam, Vishnoi L, Singh A K and Reddy K S

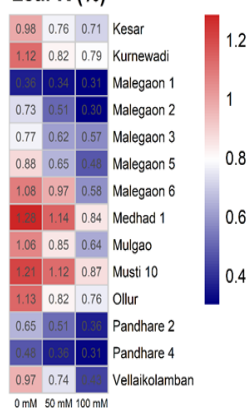
Long-term assessment of climatic variability and its influence on sesame and soybean productivity was carried out using historical district-level yield and weather datasets. For sesame, yield data (1966–2022) from nine districts of the Bundelkhand region were integrated with daily meteorological variables, and correlation analysis together with stepwise multiple regression to identify the key weather parameters governing crop productivity. The results revealed a warming trend of 0.9–2.2 °C per 100 years, accompanied by a decline in monsoon and annual rainfall of 1.03–1.51 mm per year. Sesame yield showed positive associations with temperature and heat accumulation during August–September ($r = 0.28$ – 0.48), whereas rainfall amount, rainy days, heavy rainfall events and prolonged wet spells showed negative associations ($r = -0.26$ to -0.47). The regression models explained 29–78% of the variability in sesame yield ($R^2 = 0.29$ – 0.78). The findings indicate that moderate warming may favour sesame productivity, while excessive and poorly distributed rainfall remains a major climatic constraint, particularly during sensitive crop-growth stages. The identified climate risk windows provide a basis for stage-specific weather advisories, improved crop planning and climate-resilient sesame production in Bundelkhand.

Screening and Characterization of Salinity and Drought Tolerance in Mango (*Mangifera indica* L.)

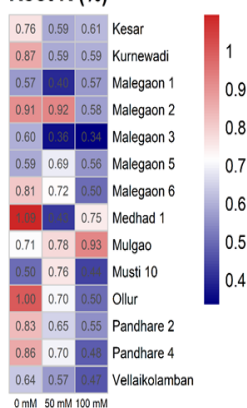
Morade A S, Kakade V D, Boraiah K M, Changan S S, Chavan S B, and Kumar N

Salinity and drought stresses are major constraints to mango production, particularly in areas affected by limited water availability and increasing soil salinity. To identify suitable planting material, mango genotypes were evaluated for their physiological, nutritional, and biochemical responses to salinity stress. The screening exhibited key traits associated with salinity tolerance. Leaf and root potassium concentration found to decrease with higher salinity levels. Local mango genotypes were able to retain higher leaf potassium under 50 and 10 mM saline irrigation i.e. Medhad 1 (1.14 and 0.84%) and Musti 10 (1.12 and 0.87%). The leaf K showed strong positive correlations with membrane stability index (MSI; $r = 0.57^*$) and relative water content (RWC; $r = 0.54^{***}$), indicating its positive association with membrane integrity and plant water status. In contrast, leaf Na showed negative correlations with MSI ($r = -0.22$), RWC ($r = -0.37$) and chlorophyll content ($r = -0.37$), suggesting that Na accumulation was associated with poorer physiological performance under salinity stress. Flavonoid content was positively correlated with chlorophyll ($r = 0.27^{***}$), whereas FRAP showed only a weak negative association with chlorophyll ($r = -0.12$), indicating that the relationship between antioxidant capacity and chlorophyll retention was not consistent across the measured parameters. Fruits from tolerant genotypes were collected for grafting studies, and seedlings are being raised for further evaluation and propagation.

Leaf K (%)



Root K (%)

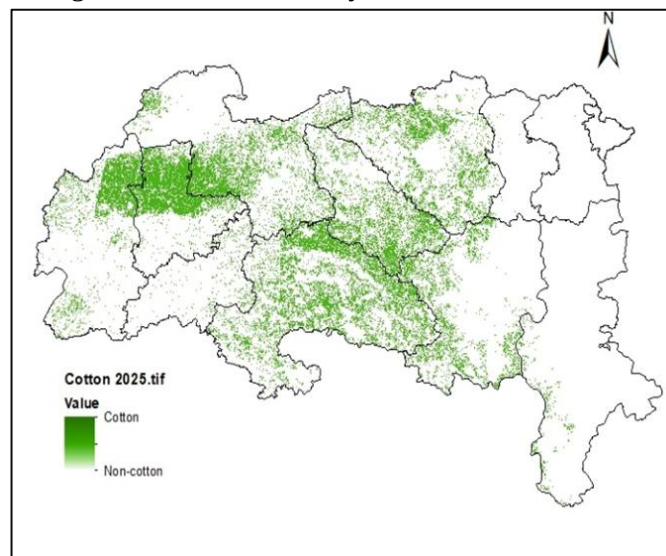


Leaf and root potassium concentration in local mango genotypes under three saline irrigation regimes

Spatial Mapping of cotton growing areas in Vidarbha region of Maharashtra

Sonam, Singh R N, Das B, Tayade A, Pal K K, and Reddy K S

A robust multi-temporal cotton acreage estimation methodology was developed by integrating Sentinel-1 SAR and Sentinel-2 optical satellite time-series data with a Random Forest machine learning classifier and resulted in cotton crop mapping at 30m spatial resolution. It utilized SAR backscatter and vegetation/moisture indices together with a large georeferenced training database comprising around 7,000 cotton and 10,000 non-cotton samples. The optimized feature combinations and training sample sets were implemented in Google Earth Engine for cotton crop mapping, resulting in high classification performance (Overall Accuracy >0.8). The developed framework produced near-accurate district-wise cotton acreage estimates which may be extended for operational acreage estimation with freely available satellite data.



Cotton mask area in Vidarbha region, Maharashtra

Characterization of the novel mutant lines in chia

Boraiah K M, Harisha C B, Basavaraj P S, Hanamant M Halli, Santosh H B, and Bhojaraja NK

Characterization of the mutant lines was carried out at four locations, viz., ICAR-NIASM, Baramati; ICAR-CRIDA, Hyderabad; ICAR-NISST, RS, Bengaluru; and UAS, Raichur, to assess the stability and distinctiveness of their morphological and phenological traits. The stable mutant lines exhibited substantial and distinct phenotypic variation compared with the wild types. Important unique traits included early and extra-early (100-105 days) maturity (11-1-3/4-2 and 141-1-1), with

141-1-1 showing a putative photoperiod-insensitive response; distinct pigmentation on the stem, petiole and florets (94-1 and 125-1); bold seeds (1.6-2.0 g/1000 seeds) with two ovules per floret (125-1); a distinctive conical (Kulfi-shaped) panicle in 125-1; crinkled leaf lamina with light-green foliage (148-1-2); whole-plant chlorosis (31-1-1); extreme dwarf (25-30 cm) and sturdy plant architecture (52-3); very tall (120-130 cm) plants with long and loose panicles (75-1); and a compact, round panicle (204-1 and 80-1-1). These novel traits represent valuable genetic resources of morphological, phenological and potentially adaptive genetic variation for chia improvement and the development of diverse breeding material.

MAJOR EVENTS

Organization of 21-day training

A 21-day ICAR-sponsored Winter School on “Recent Advances in Abiotic Stress Management for Enhancing Productivity, Quality and Farmers’ Income” held from January 28, 2026 to February 17, 2026. Dr. A. K. Nayak, Deputy Director General (NRM), ICAR, New Delhi, graced the occasion as Chief Guest, while Dr. A. Velmurugan, Assistant Director General (SWM), ICAR, was the Guest of Honour. Dr. K. Sammi Reddy, Director, ICAR–NIASM, stressed the importance of cross-learning and collaborative approaches to address emerging abiotic stress challenges. A total of 25 participants including 7 Female + 18 Male from 13 states attended this programme. The Winter School aimed to strengthen technical competencies and facilitate the development and adoption of crop-, animal and engineering-based interventions for effective abiotic stress management across diverse agro-ecological regions.



Organization of 1-month training

An online training programme was organized by ICAR–NIASM, Baramati, Pune in collaboration with the

human resource management unit, ICAR during January 02 – 30, 2026. The programme was conducted to prepare candidates for the Limited Departmental Competitive Examination (LDCE) for the post of Assistant in the ICAR. A total of 33 participants from 22 ICAR institutes/centres across 10 states participated in the training programme. Programme was organized with the support of Dr. S. K. Sharma, ADG (HRM), ICAR. A total of 16 online sessions were successfully conducted by 12 resource persons from ICAR and other organizations.



Fishery Training and Feed Distribution Programme organized at Kolhapur

The ICAR–NIASM, Baramati organized a one-day fishery training and outreach programme on ‘Modern Fisheries Management and Sustainable Aquaculture’ in Kolhapur under the Development Action Plan for Scheduled Castes (DAPSC) 2025–26. The programme empowered 40 marginalized Scheduled Caste beneficiaries (including five women), by introducing modern and sustainable fish farming practices. The programme coordinator Dr. Bhendarkar highlighted the institute’s ongoing research on the impacts of climate change on aquaculture and discussed opportunities available to fishers in Maharashtra.



Development Action Plan (DAPSC) for Scheduled Castes Outreach Programme at Nagpur

The ICAR–NIASM, Baramati, organized a community outreach programme under DAPSC 2025–26 to support marginalized Scheduled Caste families and promote inclusive development. A socio-economic survey of 150 SC families in Rahate Toli, Nagpur, was conducted with

the support of BARTI to identify household needs. The programme coordinated by Dr. Mukesh Bhendarkar and Dr. N.P. Kurade, which was attended by 398 participants, including 243 women, 150 beneficiaries and their family members. Based on the findings, 150 home utensil kits and essential household items were distributed to selected beneficiaries on March 6, 2026.



Conservation Agriculture Awareness Programme

ICAR–NIASM organized a Conservation Agriculture Awareness Programme and Input Distribution on March 25, 2026 under the ICAR-sponsored CRPCA project. About 95 SCSP beneficiaries, including women farmers from five villages of Baramati tehsil, participated. Dr. K. Sammi Reddy, Director, ICAR–NIASM, inaugurated the programme and highlighted the importance of conservation agriculture in sugarcane. Experts discussions held on minimum tillage, trash management, intercropping, residue and nutrient management, soil health, productivity, and reduction of greenhouse gas emissions. Agricultural inputs and household kits were distributed to beneficiaries.



Hands-on Training on Climate-Resilient Fodder Systems at Beed

ICAR–NIASM, Baramati, organized a hands-on training programme on “Climate-Resilient Fodder Systems for Drought and Heat-Stressed Farmers” on April 28, 2026 in Beed district sponsored by NABARD-WDF. Farmers gained practical exposure on silvipasture, multi-tier fodder systems, boundary plantations, and goat feeding

practices. The Leucaena + Lucerne + grasses model demonstration resulting in improved fodder availability, livestock productivity, and reduced feed costs under low-rainfall conditions. The programme strengthened farmers’ capacity to adopt sustainable fodder systems for enhanced livelihood resilience.



Annual Sports Meet 2026

The Annual Sports Meet 2026 was organized at ICAR–NIASM, Baramati between June 4, 2026 and June 6, 2026, to promote physical fitness, team spirit, camaraderie, and a healthy work–life balance among the institute community. The Sports Meet was inaugurated by the Director, ICAR–NIASM, Baramati. This three-day events witnessed enthusiastic participation from students, permanent staff, and contractual staff, who competed in various sporting disciplines. Different indoor and outdoor games were played by different teams. The major outdoor events included volleyball and cricket, while a range of indoor games provided opportunities for wider participation. The enthusiastic participation and sportsman spirit among the teams made the Annual Sports Meet 2026 a successful and engaging institute-level event.



Khet Bachao Abhiyan

Khet Bachao Abhiyan was implemented by ICAR–NIASM, Baramati. A total 41 scientists of this institute grouped into 13 teams were engaged to meet the objectives of the Abhiyan. The campaign focused on creating awareness among farmers about balanced fertilizer use, soil-test-based nutrient management,

integrated nutrient management, organic and biological inputs, green manuring, natural farming practices, etc.

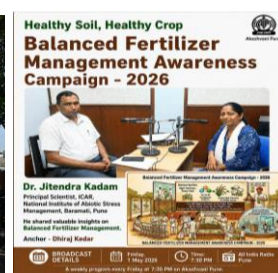


Additionally, a total of 508 field level demonstrations were conducted on natural farming, green manure, PSB/ biofertilizers, PMDS, mulching and other sustainable technologies. Special emphasis was given to reducing chemical fertilizers and improving nutrient-use efficiency. Under this campaign, a total of 2,673 farmers (2,247 male + 426 female) from 75 villages were strengthened.

Intensive Campaign on Balanced Use of Fertilizers

The Intensive Campaign on Balanced Use of Fertilizers was undertaken by ICAR–NIASM during April 7, 2026 to May 31, 2026 to promote the balanced and judicious use of fertilizers for improving soil health, enhancing crop productivity, reducing input costs, and promoting sustainable agricultural practices. The farmers of 32 villages were encouraged to use organic manures, green manure, and promote biofertilizers and biomass recycling for long-term soil sustainability. They were also educated about negative impacts of excessive use of fertilizers on soil fertility, microbial activity, crop productivity, cultivation cost and the environment. The regular soil testing, Soil Health Cards and crop-specific fertilizer recommendations were popularized among the farming community. The farmers were encouraged for adopting integrated nutrient supply approach of 45–55%

chemical fertilizers, 25–35% organic manures and 20–25% biofertilizers.



Under the Intensive Campaign on Balanced Use of Fertilizers, an interaction with input dealers and a Sarpanch Sammelan was organized at Tal. Baramati on May 26, 2026.



The programme focused on promoting the balanced and judicious use of fertilizers among farmers. Discussions emphasized soil-test-based fertilizer application, efficient nutrient management, and reducing unnecessary fertilizer use. The interaction also strengthened coordination among farmers, local representatives, and agricultural input dealers for promoting sustainable crop production.



MoU Signed with Maharashtra Gene Bank for eDNA-based Fish Biodiversity Assessment

ICAR-NIASM, Baramati signed a Memorandum of Understanding (MoU) with the Maharashtra Gene Bank (MGB) for collaborative research on fish biodiversity assessment and conservation in the Eastern Vidarbha region of Maharashtra. The collaboration aims to utilize advanced environmental DNA (eDNA) tools for non-invasive monitoring of aquatic biodiversity and generation of scientific baseline data for conservation planning and sustainable fisheries management.



Celebration of 18th Foundation Day of ICAR–NIASM, Baramati

The 18th Foundation Day of ICAR–NIASM, Baramati, was celebrated on February 21, 2026. The programme was graced by Dr. Vilas Kharche, Hon'ble Vice-Chancellor, MPKV, Rahuri, as the Chief Guest, and Dr. Subhash Puri, former Vice-Chancellor, CAU, Imphal, as the Special Guest. Dr. K. Sammi Reddy, Director, ICAR–NIASM, presided over the programme. The programme commenced with a field visit, during which the dignitaries reviewed various experiments. They appreciated NIASM's unique research environment and experiments on emerging crops such as quinoa and chia. The one-hectare integrated farming model was also recognized as a potential model for farmers facing water scarcity. Subsequently, the tree plantation at the Nakshatra Garden symbolized the institute's commitment to environmental conservation. Dr. K. Sammi Reddy, Director, ICAR–NIASM, presented the institute's achievements, ongoing externally funded projects, and future research directions. Dr. S. N. Puri, former Vice-Chancellor, encouraged young researchers to pursue emerging opportunities, strengthen extension services, and focus on improving farmers' income. The Chief Guest, Dr. Vilas Kharche, Vice-Chancellor, MPKV, Rahuri, delivered a lecture on "Soil Carbon Management in the Context of Climate Change." The ICAR-NIASM's Hindi magazine 'Sufalam 2025' was also released followed by technology certificates distribution. The programme was ended with vote of thanks delivered by Dr. J. H. Kadam, Principal Scientist.



Visit of the Union Minister of State for Agriculture and Farmer's Welfare

Hon'ble Union Minister of State for Agriculture and Farmers Welfare, Government of India, Shri Ram Nath Thakur, visited ICAR–NIASM, Baramati, on June 27, 2026. The Hon'ble Minister planted a Peepal sapling on the campus and visited the Natural Farming Project demonstration farm, where he was briefed about natural farming practices and input production. He also visited the Water Treatment Plant and reviewed the Institute's water management and recycling systems.



The Hon'ble Minister appreciated the Institute's need-based research and encouraged scientists to strengthen their engagement with farmers, expand technology demonstrations, and develop practical solutions for improving agricultural productivity, profitability, and sustainability. He also encouraged students to promote scientific farming practices in their respective villages. During the programme, Hon'ble Minister released the

ICAR–NIASM Annual Report 2025, Technologies for Mitigation of Abiotic Stress in Agriculture, and a booklet on Fish Rearing in Farm Ponds. Programme concluded with a vote of thanks by Dr. N. P. Kurade, Head, School of Social Science and Policy Research, ICAR–NIASM.



Professional Attachment Training for new ICAR scientists

The 3-month Professional Attachment Training for the following newly appointed scientists in ICAR has been conducted at the ICAR-NIASM Baramati during December 1, 2025 to February 27, 2026.

Name of the scientist	Supervisor
Dr. Jagadhesan B. (Scientist, Plant Physiology)	Dr. Prashantkumar S. Hanjagi, (Senior Scientist, Plant Physiology)
Dr. Dipankar Barman (Scientist, Plant Physiology)	Dr. Sushmma M. Awaji (Scientist, Plant Physiology)
Dr. Bijoy Chanda (Scientist, Agricultural Statistics)	Dr. Santosha Rathod (Senior Scientist, Agricultural Statistics)

PERSONALIA

Resource Person in Invited Lectures

1. Dr. Santosha Rathod delivered an invited lecture on "Analysis of Genomic Data Using R Software" during the ICAR-sponsored Winter School organized by Rani Lakshmi Bai Central Agricultural University (RLBCAU), Jhansi on January 18, 2026.
2. Dr. Nintu Mandal delivered an invited lecture on "Safety Measures in Chemical Laboratories" during the Safety Day Programme organized at ICAR-NIASM, Baramati on January 24, 2026.
3. Dr. Santosha Rathod delivered lectures and hands-on practical sessions on "Spatio-Temporal Models" during the ICAR-sponsored 21-Day Winter School at UBKV, West Bengal on January 28, 2026.
4. Dr. Santosha Rathod delivered lectures and hands-on practical on "Analysis of Horticultural Data Using R"

during the ICAR-sponsored 21-Day Winter School organized by ICAR-Central Institute for Arid Horticulture (CIAH), Bikaner on February 11, 2026.

5. Dr. Rinku Dey also delivered two lectures on 'Strategies for isolation and selection of abiotic stress mitigating microorganisms in agriculture', and 'Abiotic stress adaptation/mitigation strategies in microorganisms' on February 20, 2026 at ICAR-IARI, New Delhi in 21 days ICAR Sponsored Winter School.
6. Dr. Nintu Mandal delivered a technical lecture on "Scientific Use of Soil Health Cards and Soil-Test-Based Nutrient Management" during the Sarpanch Sammelan on Balanced Use of Fertilizers organized at ICAR-NIASM, Baramati held on May 26, 2026.
7. Dr. Santosha Rathod delivered a lecture on "research funding and innovative technologies for teaching and research in agriculture" at CAU, Imphal on May 21, 2026.

Awards/Recognitions

1. Dr. Santosha Rathod served as Moderator for the session "Laying Shared Digital Foundations for AI4ARN" under the AI4ARN track at AI4Agri 2026, held in Mumbai on February 22–23, 2026.
2. Dr. Mahesh Gupta Co-chaired a scientific session in International Symposium and 33rd Annual Conference of Society of Animal Physiologists SAPI 2025 on "Emerging Horizons to Animal Physiology: Redefining Innovations and Sustainability" during February 25-27, 2026 organised RIVER, Puducherry.
3. Dr. Mukesh Bhendarkar acted as Expert Panellist for the national event on "Livelihood-based Aquatic Ecosystem Adaptation" organized by Jaljeevika under the UNDP-GCF supported ECRICC project during June 15-17, 2026.
4. Dr. Santosha Rathod is serving as Editor (AI-ML in Agrometeorological Applications) for the Journal of Agrometeorology

Trainings/Seminar/Workshop/Symposia/Conference organized

SN	Training	Beneficiaries	Course Director / Coordinators
1.	One-month online training programme during January 02 - 30, 2026	33	Dr. S. K. Das
2.	ICAR-sponsored 21-days Winter School on Recent Advances in Abiotic Stress Management for Enhancing Productivity, Quality and Farmers Income' during January 28, 2026 to February 17, 2026	25	Dr. G. C. Wakchaure, Dr. P. S. Hanjagi, Dr. S. A. Kochewad
3.	Community outreach programme to support marginalized Scheduled Caste (SC) families on March 6, 2026	398	Dr. N. P. Kurade, Dr. S. S. Pawar, Dr. M. P. Bhendarkar, Dr. D. D. Nangare, Dr. A. V. Nirmale, Dr. B. B. Gaikwad, Mr. Rajkumar, Dr. V. Kakade, Dr. A. Pradhan, Dr. S. B. Chavan, Mr. K. Ravi Kumar
4.	One-day fishery training and outreach programme on Modern Fisheries Management and Sustainable Aquaculture in Kolhapur district on March 17, 2026	40	Dr. Mukesh Bhendarkar
5.	Conservation Agriculture Awareness Programme and Input Distribution on March 25, 2026	95	Dr. G. C. Wakchaure,
6.	Hands-on training programme on Climate-Resilient Fodder Systems for Drought and Heat-Stressed Farmers on April 28, 2026 in Beed district.	15	Dr. Sangram B. Chavan
7.	Interaction Workshop on Abiotic Stress Management: Comprehensive Outlook on May 25, 2026	35	Dr. Nintu Mandal

Workshops/Seminar/Symposia/Conference/Training attended

Name of staff	Title	Venue	Organised by	Duration
Dr. Mukesh Bhendarkar	Training Programme on DNA Barcoding and Biodiversity Studies	Dr. BAMU, Chhatrapati Sambhajinagar	Dr. BAMU Chhatrapati Sambhajinagar	January 05–15, 2026
Dr. R. Dey	Provisions of the POSH Act 2023 and its effective utilization for officials of ICAR headquarters and ICAR institutes	Virtual	ICAR	February 11, 2026
Nobin C. Paul	AI Impact Summit 2026	New Delhi	Govt. of India	February 16-20, 2026
Dr. Santosha Rathod	AI4Agri – Global Conference & Investor Summit	Mumbai	Govt. of Maharashtra	February 22–23, 2026

Name of staff	Title	Venue	Organised by	Duration
Dr. Mahesh Gupta	International Symposium and 33 rd Annual Conference on Emerging Horizons to Animal Physiology: Redefining Innovations and Sustainability	Puducherry	RIVER Puducherry	February 25-27, 2026
Dr. Prashantkumar S Hanjagi	Mass Spectrometry Based Metabolomics (NCL_SDP86_2026)	CSIR-NCL, Pune	CSIR-NCL, Pune	March 23-25, 2026
Dr. Nintu Mandal	13 th Biennial Convention and National Seminar of the Society for Fertilizers and Environment (SFE)	Visva-Bharati, Santiniketan, West Bengal	Visva-Bharati, Santiniketan, West Bengal	March 14-15, 2026
Dr. Nobin C. Paul	AI/ML for Agriculture	Indian Institute of Remote Sensing Dehradun	IIRS-ISRO	April 20-24, 2026
Dr. R. Dey	Strengthening Agriculture Research with Gender Perspective for Sustainable Agri-Food System for Nodal & Co-Nodal Officers- Gender Research in Agriculture (NO-GRA).	ICAR-CIWA, Bhubaneswar	ICAR-Central Institute for Women in Agriculture, Bhubaneswar	May 18-22, 2026

Promotion, Joining and Transfer of Staff

Name of the staff	Effective Date	Details
PROMOTIONS		
Mrs. Purnima Gadge, AAO	March 09, 2026	Promoted to AO
JOININGS		
Shri T.D.S. Prakash, CFAO	April 30, 2026	Transferred from ICAR-NAARM, Hyderabad
Shri Deepak Kumar Meena, Assistant	February 20, 2026	New Joining
TRANSFERS		
Dr. S.K. Das, CFAO	April 30, 2026	Transferred to ICAR-NAARM, Hyderabad
Mrs. Purnima Gadge, AAO	April 30, 2026	Transferred to ICAR-CICR, Nagpur (AO)



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