

September
2021



Project Coordinator

.... a monthly update



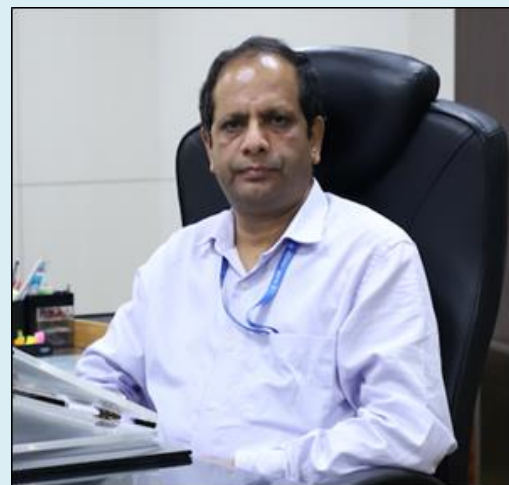
ICAR-National Institute of Abiotic Stress Management
Baramati, Pune, Maharashtra 413115

From Director's Desk

Greetings from ICAR-NIASM...

The current issue on Project Coordinator highlights the progress made under all the ICAR-NIASM projects during September, 2021 and targets for October, 2021. We made progress in research and development efforts particularly in 1) developing geo-spatial maps of soil fertility index and soil nutrient stress for Haryana, 2) assessing canopy temperature and canopy greenness in soybean genotypes under drought stress, 3) field evaluation of different accessions of foxtail millet, finger millet, pigeon pea, ground nut and soybean, 4) recording physical and chemical parameters of dragon fruit, 5) recording of comparative status of hematological status in different breeds of goat for the month, 6) Conducting quantitative IAA production assay for bacterial isolates under high salt concentration (3.5% NaCl, w/v), 7) procurement and sowing of drought tolerant desi crop varieties in CIFS, 8) evaluating effect of coating materials and storage temperatures on shelf life of custard apple (*Annona squamosa* L.) fruits, 9) Planting of sandalwood saplings in tamarind orchard, 10) recording of effects of bioformulation application on sorghum and black gram at various growth stages under field conditions, and 11) assessing effect of agrotain treated urea on nitrogen use efficiency in sugarcane at pre-growth stage. The current issue also features an article on role of silicon in abiotic stress management in plants.

The Institute organized a program on the occasion of "Poshan Vatika Maha Abhiyan & Tree Plantation" on 17th September, 2021 where around 200 participants including scientist, administrative, SRF, JRF, YP, students and contractual staff participated in the program in virtual mode. Extension activities such as awareness on herbal medicine and medicinal plants distribution and on-campus demonstration on "Supplementary and Hand Pollination in Dragon Fruit" was also organized by the institute on 25th and 28th September, 2021 respectively. I thank Dr. Aliza Pradhan and her team for their dedication and sincerity in bringing out this publication and wish that the issue would be received well by readers across all domains.



Aliza

(Himanshu Pathak)

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Poshan Vatika Maha Abhiyan & Tree Plantation at ICAR-NIASM

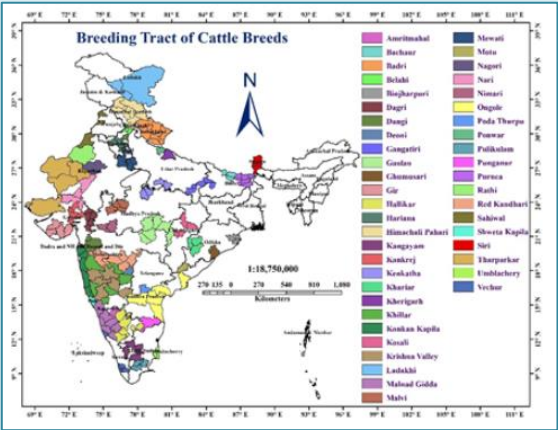


Awareness on herbal medicine and medicinal plants distribution

UP 1. Abiotic Stress Information System (ASIS)

Geo-spatial digital maps of multiple abiotic stresses, management options and future scenarios

PI: Bhaskar B Gaikwad; **Co-PI(s):** Amresh Choudhary, Ram N Singh, Dhananjay D Nangare, Nitin P Kurade, Sachinkumar S Pawar, Mukeshkumar P Bhendarkar, Gopalakrishnan B, Sunil V Potekar and Pravin H More



Breeding tract of cattle

- Outputs
- Compilation and processing of datasets on soil, water, fertilizer, crop and livestock for the state of Haryana, soil chemical properties for the state of Maharashtra, livestock breeding tracts of India and gridded meteorological parameters from IMD.
 - Geo-spatial maps on soil fertility index, soil nutrient stress (Haryana-district wise).
 - Geo-spatial maps on breeding tracts of livestock for climate analogues (India basis).
- Targets for next month
- Preparing Climate analogues for Livestock and crops (India basis).
 - Continue with dataset collection across web-resource.

UP 2. Germplasm Conservation and Management (GCM)

Genetic garden and gene bank for abiotic stress tolerant plants, animals and fisheries for food security and sustainability

PI: Boraiah K M; **Co-PI(s):** Ajay K Singh, Basavaraj P S, Mahesh Kumar, Satish Kumar, Rajkumar, N Karthikeyan, Paritosh Kumar, Sanjeev K Kochewad, Mukesh Kumar P Bhendarkar, Harisha C B, Pratapsingh Khapte, Jagadish Rane, Neeraj Kulakshetran, Bhojaraja Naik, Gurumurthy S, Pravin B Taware, Aniket More, Rushikesh Gophane and Lalit Kumar Aher

- Outputs
- Top dressing of urea in foxtail millet (118 accessions) and finger millet (77 accessions).
 - Sowing of germplasm/promising varieties of groundnut (174 accessions), finger millet (30) and soybean (30) for multiplication and maintenance.
 - Sowing of different varieties of groundnut, pigeon pea, cow pea, soybean, finger millet, sorghum, fenugreek and coriander in crop cafeteria for demonstration purpose.
- Targets for next month
- Recording of agro-morphological and physiological traits of sown crops.
 - Identification of drought responsive genes using GenBank database for gene expression profiling study in promising, wild-relative/land races of brinjal.



Field view of foxtail millet accessions

UP 3. Model Green Farm (MGF)

Environment-friendly, economically viable, state-of-the-art model farm for abiotic stressed regions

PI: Dhananjay D Nangare; **Co-PI(s):** Himanshu Pathak, Goraksha C Wakchaure, Bhaskar B Gaikwad, Vanita Salunkhe, Rajkumar, Paritosh Kumar, Aliza Pradhan, Amresh Chaudhary, Mukesh kumar P Bhendarkar, Sangram B Chavan, Vijaysinha D Kakade, Pratapsingh S Khapte, Pravin B Taware, Rushikesh Gophane, Noshin Shaikh, Santosh Pawar and Avinash V Nirmale

- Outputs
- Recording of growth & physiological parameters in guava and sapota planted with different planting techniques and filling mixtures.
 - Planting of sandalwood saplings in tamarind orchard.
 - Sequence analysis of pathogenic fungi in dragon fruit.
 - Recording of flowering, fruit set (%), fruit drop (%), number of fruits per plant, phenological stages and time required for different sub-principal growth stages of dragon fruit.
 - It was observed that as the flowering flushes proceed, flower and fruit numbers increased whereas fruit set and its size decreased.
 - Recording of physical and chemical parameters (fruit weight, pulp and peel weight, fruit dimensions, TSS) of dragon fruit under different soil filling mixtures.
- Targets for next month
- Fruit quality analysis of guava (K6 plot).
 - Growth and physiological observations in sapota.
 - Molecular characterization of remaining samples for sequence analysis of pathogenic fungi in dragon fruit.

UP 4. Climate-smart IFS (CIFS)

Climate resilient integrated farming system in semi-arid region

PI: Sanjiv A Kochewad; **Co-PI(s):** Goraksha C Wakchaure, Vanita Salunkhe, Rajkumar, Mukeshkumar P Bhendarkar, Aliza Pradhan, Vijaysinha D Kakade, Sangram B Chavan, Rajagopal V, N Subash, Laxman R Meena, Pravin B Taware and Patwaru Chahande



Application of FYM in orchard crops

- Outputs
- Harvesting of green gram.
 - FYM application in orchard crops.
 - Procurement of *desi* drought tolerant seeds from local farmers and sowing in multilayer plots.
- Targets next month
- Harvesting of bajra and black gram and threshing of green gram.
 - Painting of fencing of multilayer plot, cow and goat shed.
 - Value addition products from surplus cow milk.

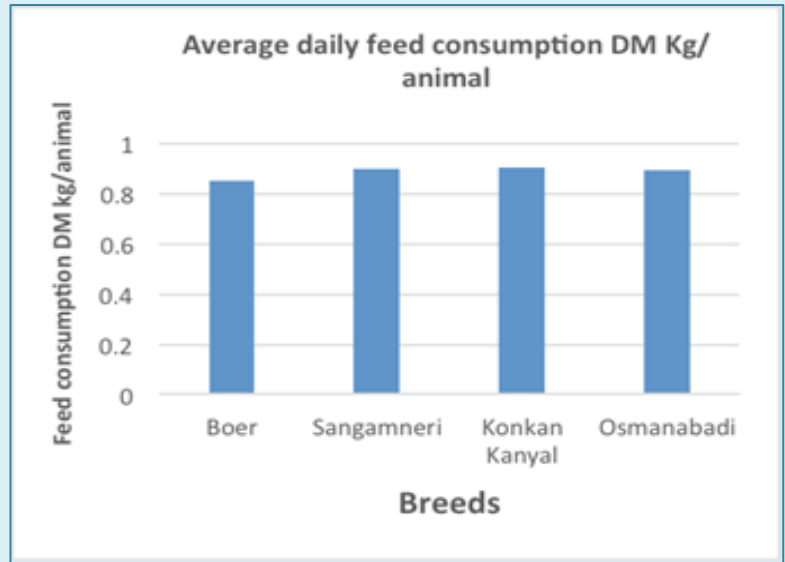


Harvesting of green gram

FP 1. Atmospheric Stress Management

Adaptation and mitigation of atmospheric stress in crops, livestock, poultry and fishes for sustainable productivity and profitability

PI: Nitin P Kurade; **Co-PI(s):** Sachinkumar S Pawar, Sanjiv A Kochewad, Bhaskar B Gaikwad, Rajkumar, Mukeshkumar P Bhendarkar, Ram N Singh, Dhananjay D Nangre, Gopalakrishnan B, Avinash V Nirmale and Sunil V Potekar



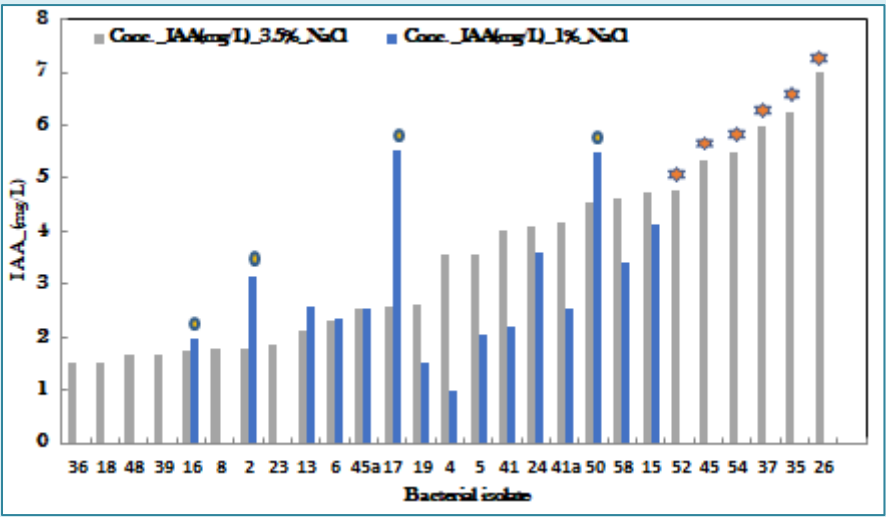
- Outputs
- Recording of comparative status of growth, physiological and haematological parameters in different breeds of goat for August.
 - Assessment of thermal stress in poultry and goat.
 - Amplification of HSP-70 polymorphic region in Vanaraja poultry birds.
 - Experiment on salinity stress levels in GIFT tilapia.
 - Procurement of set up for mass culturing of black soldier fly (BSF).
 - Programming of microcontrollers and sensors.
- Targets for next month
- Evaluation of stress parameters & parasitic prevalence in different breeds of goat.
 - DNA isolation from four goat breeds for further polymorphism analysis.
 - Continuation of research on IPM of fall army worm in maize.
 - Biophysical analysis of salinity stress in GIFT tilapia.
 - Carrying out trial checks of microcontroller and sensors.
 - Establishment and preparations of breeding unit of BSF; procurement of BSF.

FP 2. Bio-saline Agriculture

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

PI: Satish Kumar; **Co-PI(s):** Ajay K Singh, Vanita Salunkhe, Sanjiv A Kochewad, Mahesh Kumar, Paritosh Kumar, Neeraj Kumar, Amresh Chaudhary and Himanshu Pathak

- Outputs
- Conducting quantitative IAA production assay for bacterial isolates under high salt concentration (3.5% NaCl, w/v).
 - Finalization of the amplicon sequencings specification followed by proposal initiation.
 - Detection of presence of *nifH* gene among the halotolerant bacterial isolates using PCR approach.
- Targets for next month
- UHPLC based characterization of biomolecules produced by candidate bacterial strains.
 - Survey and sampling of coastal halophytic plants from the Konkan area of Maharashtra.



Estimation of IAA production of halophytes associated bacterial isolates

* IAA producers exclusively under high salt conditions 3.5% NaCl
● IAA producers at lower salt concentration 1% NaCl

FP 3. Technology Targeting and Policy

Targeting prospective technologies for abiotic stress resilience in rainfed and dryland regions

PI: Dhananjay D Nangare, **Co-PI(s):** Sachinkumar S Pawar, Sanjiv A Kochewad, Bhaskar B Gaikwad, Boraiha K M, Kartikeyan N, Rajkumar, Mukeshkumar P Bhendarkar, K Ravi Kumar and Himanshu Pathak

- Outputs
- Review of research work, literature, and secondary data on indigenous technical knowledge resources available for compilation specifically on abiotic stress management.
 - Modification of questionnaire /interview schedule for field crops, horticulture crops, livestock, fishery including personal profile of farmers, social and economical variables.
 - Discussion of interview schedule with experts (Mr Rajkumar, Dr Sanjeev Kochewad, Mr Mukesh Bhendarkar, Dr Vijay Kakade) followed by modification and finalization of the schedule.
 - Visit to Ujani dam reservoir at Bhigwan for collecting data on socio-economic impact due to introduction of sucker fish in Ujani dam reservoir on Fish farmers.
 - Publication of two fortnightly agro advisories on institute website for stakeholders.
 - Coordination of visits of farmers, students and guests.
- Targets for next month
- Collection of review on methodology of impact assessment of technologies.
 - Field visit and collection of data related to abiotic stresses in fishes.
 - Survey and field visit of custard apple farmers in Saswad area for assessing impact of pheromone traps/IPM technology.
 - Collect and compile the information on ITKs related to abiotic stress.
 - Development of ATIC and initiation of activities related to Agro tourism.
 - Coordination of extension activities and visits of farmers/students to NIASM.

B) School of Water Stress Management (SWSM)

1. Mitigating water stress effects in vegetable and orchard crops

PI: Goraksha C Wakchaure; Co-PI(s): Dhananjay D Nangare, Satish Kumar, Aliza Pradhan, K M Boraiah, Pratap Singh Khapte and Jagadish Rane



Assessing post-harvest analysis of dragon fruit

- Outputs
- Evaluating effect of coating materials and storage temperatures on shelf life of custard apple (*Annona squamosa* L.) fruits.
 - Tagging of citrus and layout demarcation in citrus and guava orchard.
 - Collection of the yield data of dragon fruit, sweet orange, custard apple and guava under different field experiments.
 - Assessing the impact of foliar application of plant bio-regulators for enhancing the post-harvest quality of dragon fruit.
 - Assessing the responses of custard apple cultivars to bio-regulators during fruiting season.
 - Manuscript revision on long term effects of soil filling mixtures on dragon fruit.

- Targets for next month
- To study the custard apple cultivar responses to plant growth regulators.
 - Field layout design and planting of eggplant to study responses of water stress tolerant root stocks using LSS.
 - Collection of yield data and assessment post-harvest quality parameters of dragon fruit, citrus, guava and custard.

EXTERNALLY-AIDED PROJECTS

EAP 1. Evaluation of halotolerant rhizobium and PGPB based biomolecules for alleviation of drought and salt stress (Funded by: AMAAS, NBAIM, Mau)

PI: Satish Kumar; Co-PI: Goraksha C Wakchaure



Appearance of the black gram crop under the influence of the bio-formulation treatment (T: Bioformulation treatment; C: Control)

- Outputs
- UHPLC based resolution of active ingredients of microbially-derived bioformulation.
 - Recording of effects of bioformulation application on sorghum and black gram at various growth stages under field conditions.
- Targets for next month
- To conduct bio-formulation applications in pigeon pea and sorghum crop.
 - To monitor the crop performance under the influence of bio-formulation treatment as per schedule.
 - To collect samples for metabolomics studies in sorghum crop.

EAP 2. Conservation agriculture for enhancing resource-use efficiency, environmental quality and productivity of sugarcane cropping system (Funded by: CA Platform ICAR)

PI: Goraksha C Wakchaure Co-PI(s): Aliza Pradhan, Amresh Chaudhary, Paritosh Kumar and Himanshu Pathak

- Outputs
- Measurement of real time soil, water and growth of parameters of sugarcane cropping system.
 - Analysis of yield data of fenugreek harvested from field trial for optimizing planting geometry, intercropping and crop residue management under sub-surface drip irrigation.
- Targets for next month
- Measurement of real time soil-water-plant parameters for sugarcane trials under CA.
 - Establish field trial on efficacy of bio-regulators under CA practices towards managing water stress in sugarcane.

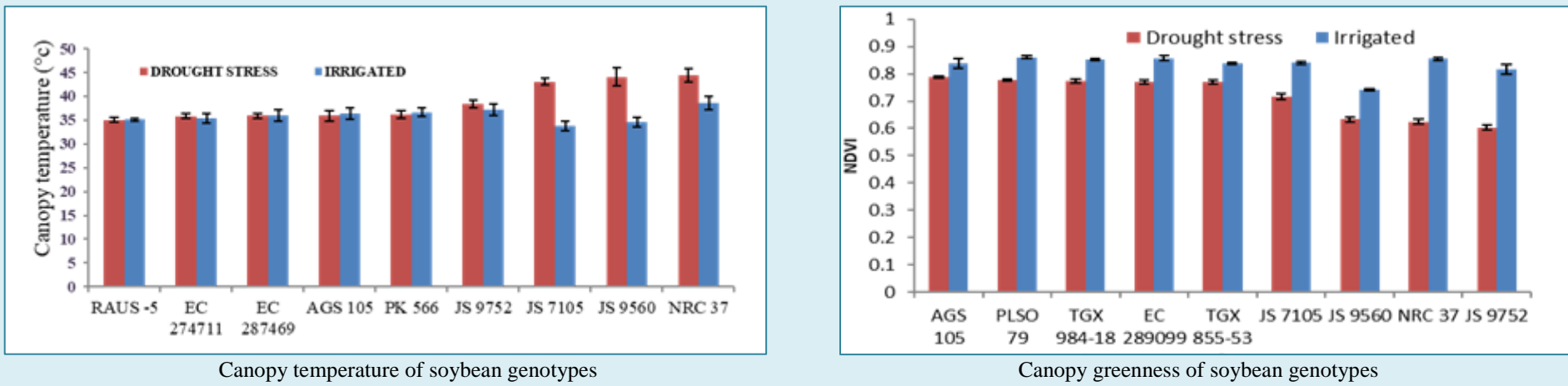


Harvesting of fenugreek in CRP-CA

EAP 3. Genomics strategies for improvement of yield and seed composition traits under drought stress conditions in soybean (Funded by: ICAR-NASF)

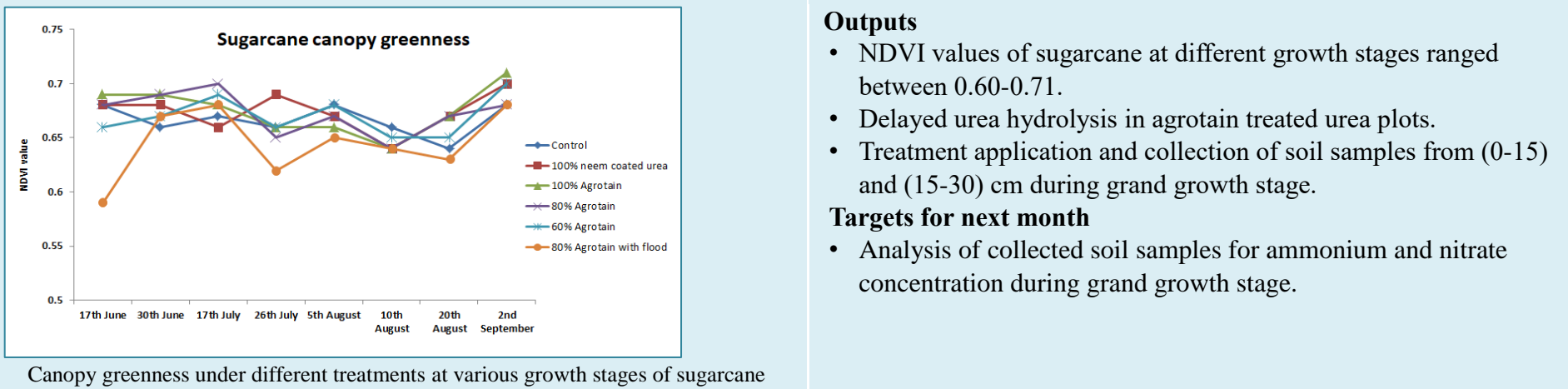
PI: Ajay Kumar Singh; Co-PI(s): Mahesh Kumar, and Jagadish Rane

- Outputs**
- Soybean genotypes RAUS-5, EC-274711 and EC-287469 showed cooler canopy under drought stress compared to check variety JS-715.
 - Soybean genotype AGS-105, PLSO-79 and TGX-984-18 showed greener canopy compared to check variety JS-9752.
- Targets for next month**
- Phenotyping of 25 promising soybean genotypes, grown under greenhouse conditions, for drought adaptive and yield related traits.
 - Root system architecture study in 50 soybean genotypes under *in vitro* conditions under PEG induced desiccation.



EAP 4. N-(n-butyl) Thiophosphoric Triamide (NBPT) as a urease inhibitor for improving nitrogen use efficiency in sugarcane cropping systems in India (Funded by: CIMMYT)

PI: Aliza Pradhan Co-PI(s): Amresh Chaudhary, Jagadish Rane, Pravin B Taware and Himanshu Pathak



EAP 5. Phenotyping of pulses for enhanced tolerance to drought and heat (Funded by ICAR-NICRA)

PI: Jagadish Rane; Co-PI(s): Mahesh Kumar, Basavaraj P S, and Boraiah K M

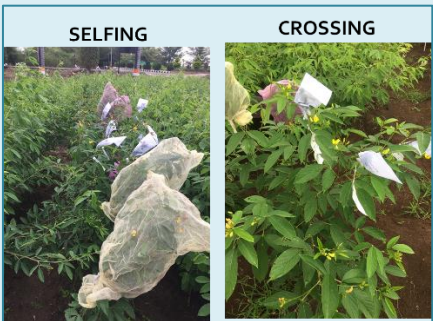
- Outputs**
- Phenotypic evaluation of 22 chickpea genotypes under drought stress condition in green house for early stage drought stress tolerance based on Shoot architectural parameters, leaf senescence, RWC and photosynthetic efficiency (Qy_Max) observed.
 - IPC (I4-16), JG 16 found to be promising genotypes under depleting soil moisture stress.
 - Evaluating performance of 170 pigeon pea cultivars including 144 mini core collections, 22 state released varieties and 4 waterlogging stress tolerant for yield and yield attributing traits under rainfed ecosystem. Selfing is also carried out to maintain purity of seed material.
 - Waterlogging tolerance of minicore collection of pigeon pea showed that among the 50 germplasms ICP-6128, ICP-7076, ICP-7507 and ICP6815 showed better survival ability in comparison to tolerant checks (ICP-5028 and MAL-15).
- Targets for next month**
- Characterization of chickpea using root architecture study using image-based techniques.
 - Developing mapping population for dissecting waterlogging tolerance in pigeonpea cultivar.



Experimental setup in Phenomics facility



Waterlogging tolerance in pigeonpea



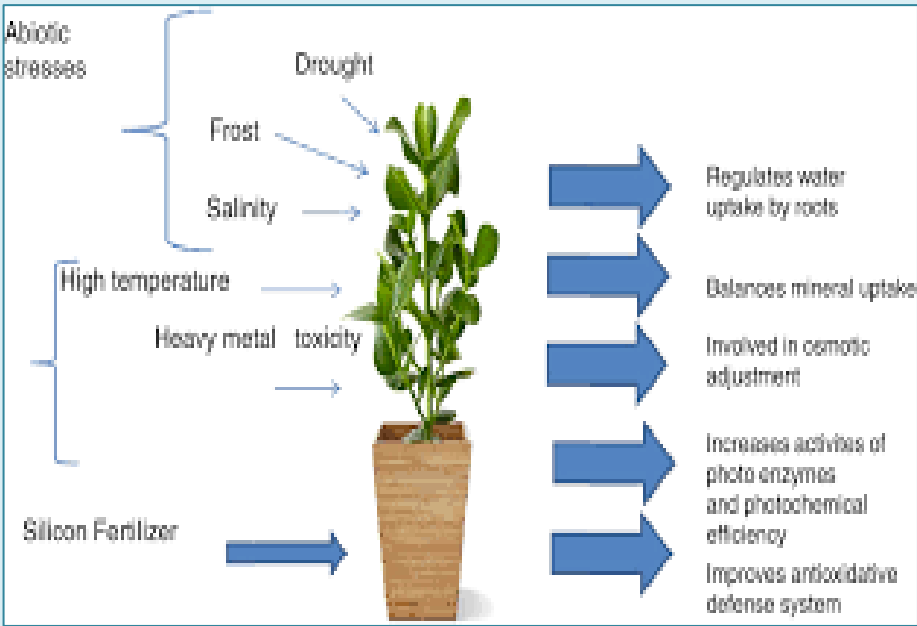
Selfing and crossing in pigeon pea at field

Silicon: a potential source imparting abiotic stress tolerance in plants

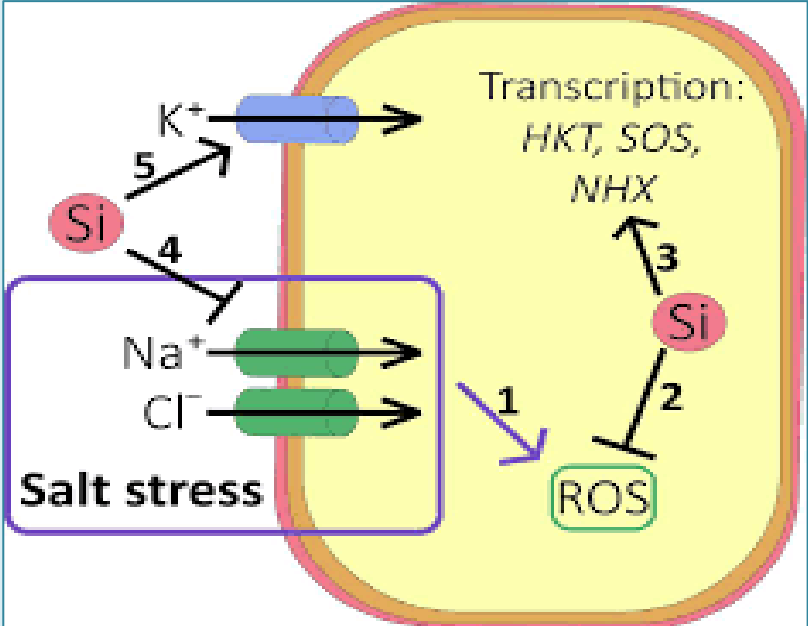
Nikhil Raskar, YP-I

A major concern across the world is the (environmental) stresses that alter growth and development of plants. Both biotic and abiotic stresses cause a huge loss in crop yield and productivity. Crop yield stability and healthy growth under stressful conditions have always been a big challenge for the plant/agricultural science researchers. On the other hand, plants have evolved several mechanisms to survive under the stress conditions; and healthy plants can sustain themselves or survive better under the stress. In other words, plant nutrition has an important role to maintain healthy growth as well as to enhance the stress tolerance.

Silicon (Si) is a beneficial element for plants. The Si supplementation to growth media mitigates abiotic and biotic stresses by regulating several physiological, biochemical and molecular mechanisms. Si has been shown to decrease drought stress in plants through different mechanisms, which include an increase in mineral nutrient uptake, modification of gas exchange attributes, osmotic adjustment, reduction in oxidative stress, modification of gene expression, and regulation of compatible solutes and phytohormone synthesis. Application of Si under drought stress might up regulates aquaporin gene (PIP; Plasma membrane Intrinsic Protein) and mitigates ROS-induced aquaporin activity inhibition in plants. Under drought stress, Si supply affected the osmo-regulation by increasing the accumulation of soluble sugars and/or amino acids in the xylem sap which increases osmotic driving force or by activating the K⁺ translocation to xylem sap by via SKOR (Stelar K⁺ Outward Rectifer) gene. Silicon application increases the photosynthetic rate, leaf and root water and osmotic potential, water use efficiency (WUE), while decreases transpiration rate, membrane permeability under water-deficit conditions. Si application can also reduce drought stress via increasing uptake of mineral nutrients by plants, altering gas exchange attributes in plants (Rizwan et al. 2015). Si supply increases both transpiration rate and net photosynthetic rate under drought stress (Rizwan et al. 2015). One of the major effects of drought stress is the disturbed uptake of essential nutrients by plants (Emam et al. 2014). In this regard, Si application in soil has been reported to increase the uptake of macronutrients (P, K, Ca and Mg) and micronutrients (Fe, Cu and Mn) in crop under water deficit stress (Gunes et al. 2008). Si supply has been widely reported to decrease oxidative damage through enhancing the antioxidant enzyme (SOD, APX, CAT and POD) activities under drought stress in wheat plants (Tale Ahmad and Haddad 2011), sunflower (Gunes et al. 2008), tomato (Shi et al. 2014), and chickpea (Gunes et al. 2007).



Benefits of Silicon fertilizers



Mechanism of SiO₂ in mitigating abiotic stress

Silicon—a multi-functional element has more advantageous role in combating both biotic and abiotic stresses than previously thought and understood. Presently, several models and mechanisms have been proposed to explain how Si provides increased protection to plants under stressed conditions. The improved Si-derived benefits in plants will be helpful to develop a more sustainable cropping system in the future.

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