April
2022

भाकृअनुप
ICAR

राअस्ट्रैप्रसं
NIASM

Project Coordinator

.... a monthly update

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

Project Coordinator

.... a monthly update

Issue 22 **April 2022** **Page 02**

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 April, 2022 and targets for May, 2022. We made progress in research and development efforts particularly in 1) preparation of sub-district level Geo-spatial maps of soil fertility index for India as apart of soil information system, 2) collection and conservation of different stress tolerant crop germplasms, 3) recording of various trait observations in mutant lines of quinoa and chia, 4) recording of physical and chemical parameters of sapota, guava and grapes 5) sunburn and canopy management in dragon fruit, 6) recording of comparative hematological status in different breeds of goat for the month, 7) molecular characterization of stem canker (*Neoscytalidium dimidiatum*) pathogen in dragon fruit,8) harvest of sugarcane with measurement of cane and trash yield and other yield attributes as well as soil sample collection for chemical and biological analysis, 9) calculation of soil fertility indices of all the states of India, 10) measurement of yield and its attributes for okra and eggplants, 11) study of drought adaptive traits of soybean genotypes, 12) organization of various training cum frontline demonstrations under different projects, and 13) acclimatization study of cold water fish Mahaseer in fisheries wet laboratory.

Besides the research activities, some important events and extension activities were organized during the month of April. A workshop on AGROTAIN Incorporated Urea Produced with N-TEGRATION Technology to address fertilizer use efficiency in major cropping systems of India during 27-28 April, 2022 at ICAR-NIASM. Around 150 participants including scientist, technical and administration staff, students and research scholars attended the plenary session in a hybrid mode. Hon'ble DDG (NRM), ICAR, Dr SK Chaudhari visited the institute on April 28, 2022 where he visited NIASM fields, institute facilities and infrastructures followed by an interaction meeting with all the NIASM staff where he appreciated the ongoing activities of the institute in the area of abiotic stress management.

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.

(Himanshu Pathak)

Contents

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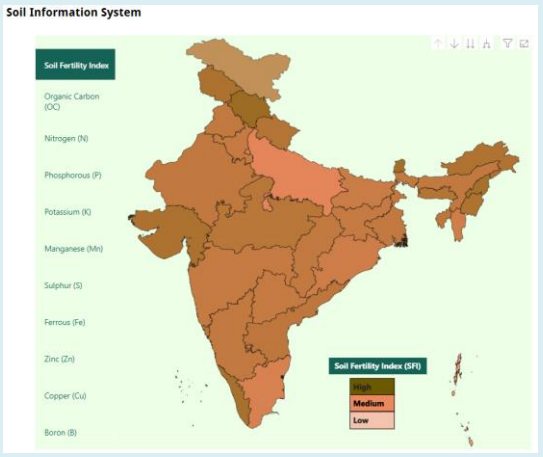
Organization of workshop on AGROTAIN Incorporated Urea Produced with N-TEGRATION Technology to address fertilizer use efficiency in major cropping systems of India during 27-28 April, 2022 at ICAR-NIASM

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):** Himanshu Pathak**,** Amresh Choudhary, Ram N Singh, Dhananjay D Nangare, Nitin P Kurade, Sachinkumar S Pawar, Mukeshkumar P Bhendarkar, Gopalakrishnan B, Sunil V Potekar, Pravin H More



Soil information System for India

Outputs

- Preparation of sub-district level Geo-spatial maps of soil fertility index for India as apart of soil information system of ASIS.

Targets for next month

- Update soil nutrient and SFI maps for India based on curated datasets using geo-referencing criteria.
- Continue with work on finding Soil stress indices for all states of India.
- Continue with dataset collection across web-resources.

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

- Threshing & post-harvest observations of accessions of foxtail millet (118), finger millet (77), & ground nut accessions (181).
- General crop management practices like thinning, weeding, irrigation in wheat, chia and quinoa.
- Collection & conservation of different citrus rootstocks.

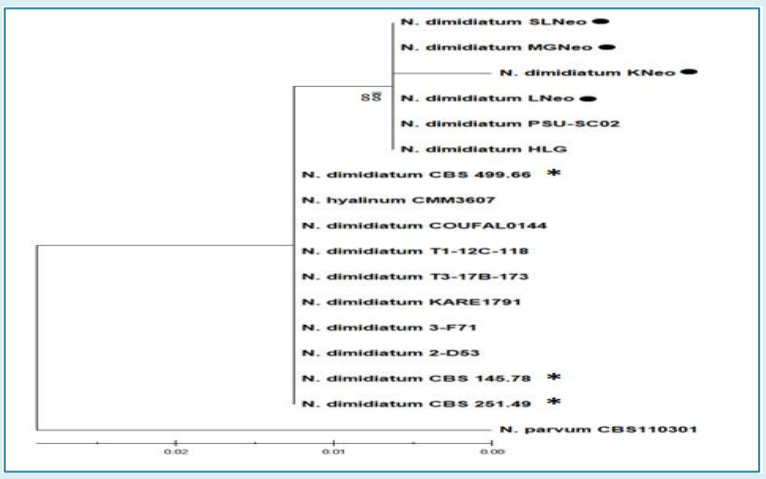
Targets for next month

- Agronomic crop management practices in wheat and quinoa germplasm.
- Recording of growth rate in different Citrus rootstocks.

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, Hanamant M Halli, Pravin B Taware, Rushikesh Gophane, Noshin Shaikh, Santosh Pawar and Avinash V Nirmale



Molecular characterization of stem canker in dragon fruit

Outputs

- Irrigation scheduling as per deficit irrigation treatments in pomegranate.
- Removal of unwanted cladodes and tying of cladodes to the support system was done to promote proper growth of plants in dragon fruit.
- Molecular characterization of stem canker (*Neoscytalidium dimidiatum*) pathogen in dragon fruit.

Targets for next month

- Post-harvest fruit quality analysis of sapota, grapes and guava; irrigation scheduling in pomegranate as per deficit irrigation treatments.
- Sunburn and canopy management experiment in dragon fruit.
- Evaluation of antifungal potential of essential oils (EOs) against *Neoscytalidium dimidiatum.*

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

Outputs

- Sugarcane trash used for mulching in horticultural and agroforestry trees.
- Quadrat wise yield data recording from ground nut and safflower.
- Sowing of fodder maize with lobia; weekly harvesting of cluster bean.

Targets next month

- Ploughing and harrowing followed by FYM application in black soil plots.

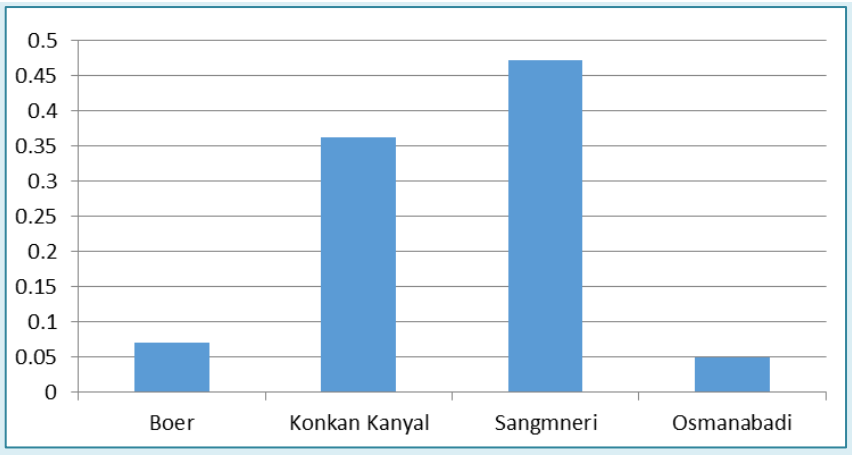
Harvesting of cluster bean

Organic mulching in fruit tress

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, Gopalakrishnan B, Rajkumar, Mukeshkumar P Bhendarkar, Ram N Singh, Dhananjay D Nangre, Avinash V Nirmale



Growth rate (kg/week) of kids of different goat breeds during April, 2022

Outputs

- Recording of comparative status of growth, feed & water intake, physiological and haematological parameters in four breeds of goat for April, 2022.
- Evaluation of biochemical parameters in different breeds of goats using commercially available human kit.
- Continuation of mass culturing of BSF as novel protein for poultry& fish.
- Assessment of thermal stress in poultry and goat for April.
- Survey of goat farmers and haematological analysis of field goats for Jalgaon (Supe).
- Adaptation and rearing of cold water fish Mahaseer in fisheries wet laboratory.

Targets for next month

- Evaluation of stress parameters & parasitic prevalence in goat breeds; survey of goat farmers and haematological analysis of field and experimental goats; amplification of HSP genes from poultry; improvement of breeding unit of BSF & mass culturing; evaluation of Azolla & Duckweed production performance per unit area

FP 2. New Crops

Augmenting farm income in water scarce regions with alternative crops

PI: Jagadish Rane ;**Co-PI(s):** Ajay K Singh, Dhananjay D Nangre, Goraksha C Wackchaure, Mahesh Kumar, Satish Kumar, Karthikeyan N, Boraiah K M, Sanjiv A Kochewad, Aliza Pradhan, Amresh Chaudhary, Ram N Singh, Basavraj P

Outputs

- Harvesting and threshing of quinoa.
- Monitoring Quinoa and Chia M2 populations to identify the desirable mutant types for flowering, branching, foliage color etc.
- Labelling the identified lines to observe modifications at post flowering stage

Targets for next month

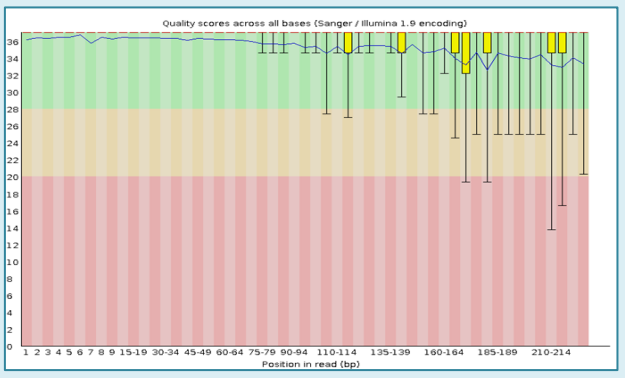
- Recording of yield attributes in quinoa.
- Observation at maturity stage in M_2 mutant lines of quinoa &chia.

Monitoring Quinoa and Chia M2 populations

FP 3. 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



Representative Phred quality scores of NGS sequence data from root

Outputs

- Generation of pair-end Illumina NGS sequencing reads (0.1 Million reads R1 and R2 reads) from three halophytic plants for study of uncultured endophytic microbes from root, stem and leaves.
- Configuration of QIIME2 bio-informatic analysis pipeline for amplicon microbiome data analysis on NIASM server.

Targets for next month

- Multiplication of halophytic plants.
- Morphological and physiological analysis of halophytic plants under different salinity levels.

FP 4. 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

- Organization of training as well as distribution of inputs to beneficiaries under TSP and SCSP program.
- Co-ordination of visit of farmers, state departments, students and FPO's (313 visitors) to ATIC/museum, research fields of ICAR, NIASM.

Targets for next month

- Field survey and data collection of farmers regarding bio-physical and socio-economic constraints.
- Procurement and distribution of critical inputs to farmers under TSP and SCSP program.
- Coordination of extension activities and visits of farmers/students at/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

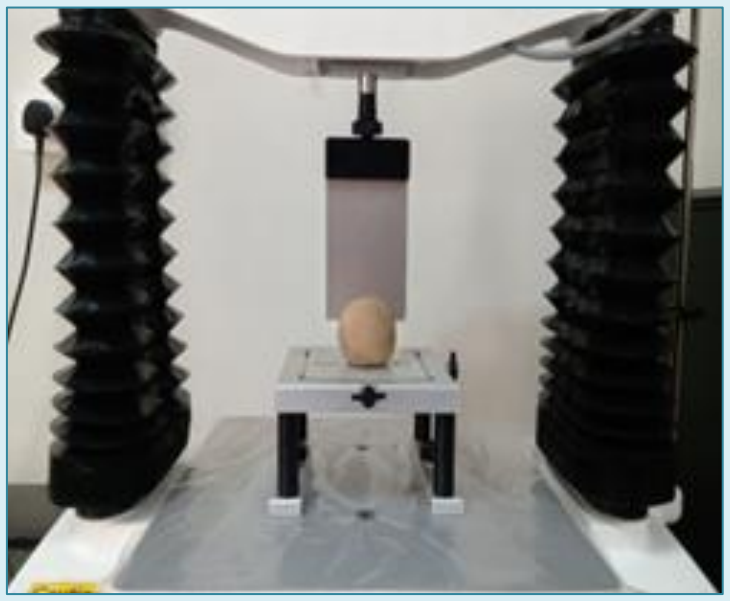
Outputs

- Measurement of real time canopy, yield and physical quality attributes of sapota.
- Measurement of yield and its attributes for okra and eggplants.
- Submission of revised draft of MS on the onion responses to PGRs under transient waterlogging situations.

Targets for next month

- Estimation of biochemical traits of okra, eggplant, and sapota.
- Data analysis of two years yield data of okra and PGRs under LSS.

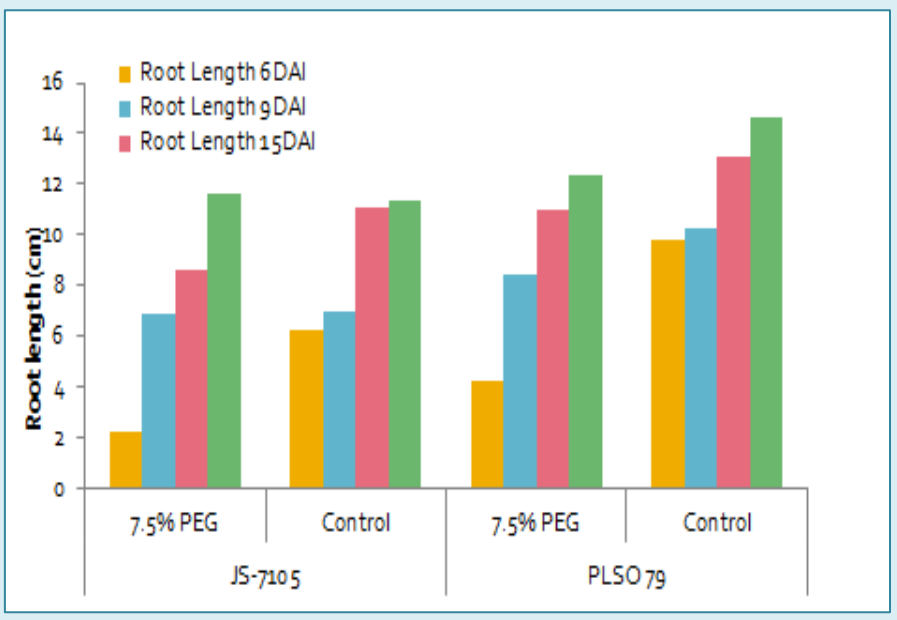
Post-harvest quality parameters of sapota



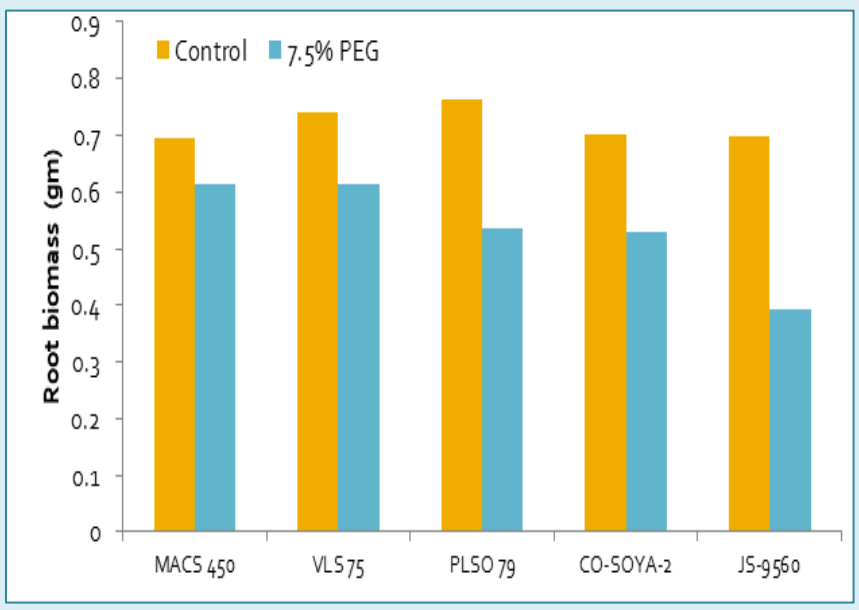
Post-harvest quality parameters of sapota

2. Genomics, genetic and molecular approaches to improve water stress tolerance in soybean and wheat

PI: Ajay Kumar Singh



Screening of soybean genotypes for root traits



Screening of soybean genotypes for root biomass

Outputs

- Soybean genotype PLSO-79 revealed longer roots under PEG induced desiccation and also without PEG (Control conditions) as compared to check variety JS-7015.
- Soybean genotypes MACS450, VLS75, PLSO-79, CO-Soyba-2 revealed higher root biomass under PEG induced desiccation and also without PEG (Control conditions) as compared to check variety JS-9560.

Targets for next month

- Morphological, physiological and biochemical analyses of EIN2, FNSL and WRKY silenced soybean plants under no stress, drought and salinity stress conditions.
- Stomatal function of EIN2, FNSL and WRKY silenced soybean plants under no stress, drought and salinity stress conditions.

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

Extraction of microbial DNA for its integrity on 0.8% agarose gel

Outputs

- Extraction of the high quality DNA from exo-polysaccharide secreting microbial stain for whole genome sequencing. Finalization and execution of the proposals for whole genome sequencing of the WGS.
- Compilation of the information for AMAAS annual report and submission to nodal Centre.
  Continuation of global metabolome data analysis.

Targets for next month

- Genome assembly and annotation of the Whole genome sequencing NGS data.
- 2- Deciphering the genomic basis of hyper-secretion of exo-polysaccharide by the microbial strain.

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

- Analysis of N, P, and K of soil and plant samples under different treatments in CRPCA trials.
- Organization of one day field training cum frontline demonstration of intercropping using MRD machine in ratoon sugarcane at farmers' fields on 20th April, 2022.

Targets for next month

- Analysis of growth, yield and soil fertility parameters of different field trials under CRPCA.
- Recording of real time morpho-physiological parameters (plant height, plant tillers, NDVI, PS-II, Hyper spectral, RWC etc) of standing sugarcane crop under CA.

Organization of one day training cum demonstration under CRPCA

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

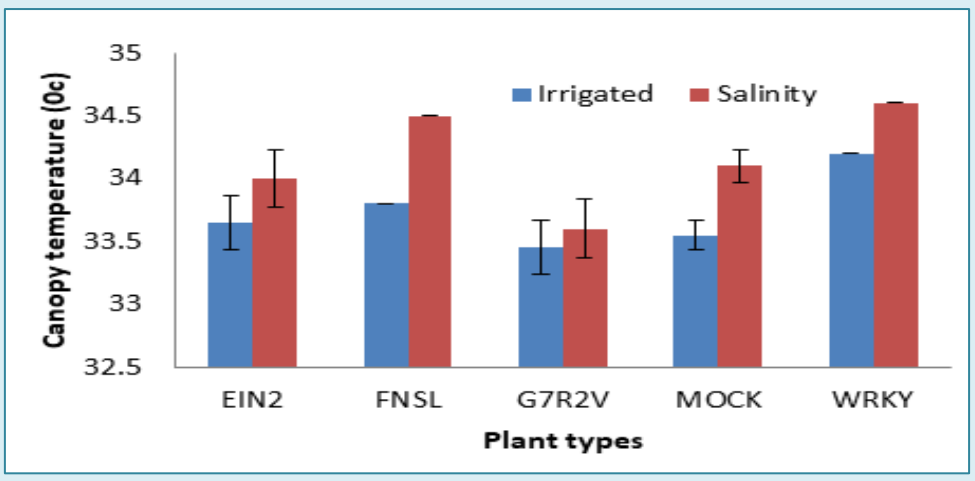
PI: Ajay K Singh; **Co-PI(s):** Mahesh Kumar and Jagadish Rane

Outputs

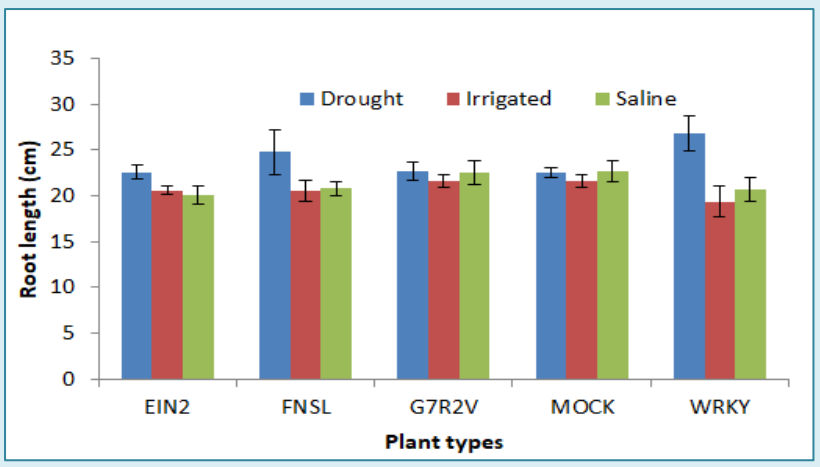
- EIN2-silenced, Farnesyltransferase-silenced and WRKY-silenced plants along with vector-infected and mock-inoculated plants were assessed for canopy temperature depression and root length.
- Gene silenced soybean plants exhibited elevated canopy temperature as compared to vector-infected and mock-inoculated soybean plants under irrigated as well as salinity stress (200 mM NaCl) conditions.
- Gene silenced soybean plants exhibited longer roots as compared to vector-infected and mock-inoculated soybean plants under drought stress conditions. Drought stress was imposed by withholding watering for 4 days. Root length was almost similar under irrigated and salinity stress condition (200 mM NaCl).

Targets for next month

- Expression profiling for EIN2 gene in in 18 promising soybean genotypes under no stress and water deficit conditions.
- Morphological, physiological and biochemical analyses of 18 promising soybean genotypes under no stress and water deficit conditions.



Evaluation of soybean genotypes for canopy temperature



Evaluation of soybean genotypes for root length

Exploring new avenues of managing abiotic stresses in agriculture

Aliza Pradhan and Jagadish Rane

The doubts about predicted climate change effects are rapidly diminishing as the adverse climate have been increasingly witnessed with amplified versions of abiotic stresses such as soil moisture deficit or excess, extreme high ambient temperature, and salinity extremes. These stresses can induce and aggravate other stresses such as nutrient deficit or toxicity. Hence, exploring new avenues of managing abiotic stresses will continue to be a major challenge for food security missions. The present food security challenge has added dimensions due to the increasing population, with limited scope to overexploit natural resources and with no provision for indiscriminate human intervention into the agro-ecology, particularly when adverse effects of climate change are looming large due to unprecedented carbon load in the atmosphere. The recent paradigm shift in strategies for crop improvement towards "G x E x M" from the conventional "G X E" largely implies the current reorientation of scientific approaches to appropriately integrate “the genetic improvement of crops" and "the novel management practices" to make "the crop climate resilient" and “climate smart” respectively. It is now imperative to meticulously address abiotic stresses as they are predominant in agro-ecologically unfavorable regions where gains during the green revolution were minimal relative to the favorable and resource-rich regions. Abiotic stresses span all the nonliving factors that can be traced to atmosphere, soil or water. These factors create crop stress when exist or occur at a level above or below optimum for crop growth and development. Abiotic stresses are largely due to soil moisture deficit or excess during drought and flood respectively; extremely high or low ambient temperatures; low or high radiation, excess salts in soil; low or high level of soil nutrients, etc. Since these stresses can cause more than 50% to 100% losses depending on intensity and magnitude (Vision 2050, NIASM), there is a lot of scope for improving the productivity of crops through appropriate agro-ecology and crop specific management practices to meet the additional demand for food arising out of ever-increasing population.

Managing water stress

Management to deal with extreme rain events that include both the deficit and the excess is critical for making the agriculture climate-smart. Under rainfed conditions, resource management practices should appropriately address major concerns due to prolonged and sporadic dry spells. There will be significant contributions from several soil moisture conservation practices that have emerged from a series of studies in the past. There is a need for precision in applying irrigation for every crop, irrespective of their seasonal specificity and annual or perennial nature. In addition to the hardware component such as drips, the software component for smart irrigation will play a significant role in this mission by managing the time and interval of application. Such practices will have to be driven by scientific information generated to understand stress-sensitive stages of the crop in every agro-ecology-specific context.

Managing extreme temperatures

Recent IPCC report reveals that despite desperate deliberations to reduce atmospheric carbon load at the global level, the ambient temperature will increase by 1.5^{o}C in this century. It implies that there will be more events of extreme temperatures and that even nights will be warmer in the near future than ever before. Crop plants, which cannot escape such circumstances, have to reduce the growth duration or minimize the grains per spike and to continue their generation. It can lead to a considerable reduction in food production. Early sowing of the crop to escape the terminal heat stress may become increasingly necessary. Since access to sufficient soil moisture can enable efficient transpirational cooling, the water management practice needs to be tuned to reduce the adverse impact of supra optimal temperature during the season and specifically during the grain development stages of crops. It indicates that the modern and automatic tools such as infrared thermography that are emerging for precision agriculture should consider both the soil moisture and ambient temperature regimes. Crop surveillance through the drone-loaded sensors can add a new dimension. Further, intercropping aimed to reduce the heat load on temperature-sensitive crops can demand additional functionalities in modern tools to distribute water across the time and space during crop growth.

Managing excess salts in soil

Much of the salty agricultural lands are the unintended gifts of the green revolution for the farmland that witnessed indiscriminate water use, particularly in command areas. It can be logical to assume that excess precipitation can periodically wash away the salts and reduce the salt load to get a better crop. However, the location-specific irrigation application through drips can add new dimensions to the salt problem and demand novel management practices that involve reducing salts in the irrigation water or designing crop sowing methods to permit drainage of salts. Cropping systems that involve salt removers, including forage grasses, can be alternative or complementary practices to achieve the task.

Other abiotic stresses

The three major abiotic stresses mentioned above can create or enhance other stresses caused by nutrient deficit or toxicity and extreme radiation levels during crop growth. They tend to add a new dimension to management practices, including integrated nutrient management with greater precision facilitated by emerging software tools driven by machine learning algorithms and artificial intelligence.

Conclusion

The emerging GxExM concepts will increasingly help integrate modern technologies for climate-resilient crops and climate-smart resource management practices. Expected success in ensuring future food security can largely emerge from improved stress-tolerant cultivars and precision agriculture tools designed to manage the resources and to create a suitable growth environment. Bioformulations developed based on stress physiology investigations can be an integral part of abiotic stress management in the future. The location-specific management of abiotic stress for climate-smart villages has to be guided by robust weather models in addition to appropriate crop models. It needs a massive set of scientific data on crop responses to depleting soil moisture, extreme temperatures, and level of salts and nutrients for fine-tuning crop models to suit the smallest possible area of agricultural land. All these modern tools have great potential to provide new vistas for food production under harsh environments.

“The earth is what we all have in common.”

-Wendell Berry