November
2020

Project Coordinator

.... a monthly update

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

Project Coordinator

.... a monthly update

Issue 5 | November 2020 | 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 November, 2020 and targets for December, 2020. During the last month, project activities comprised of harvesting of *kharif* crops as well as field preparation and planning for *rabi*. In addition, data collection and analyses regarding effect of abiotic stress factors on crops, animals, fish and poultry, installation of automation systems, analysis of weather parameters,, evaluation of germplasm traits to certain abiotic stresses, communications for institutional collaborations, preparation/ submission/publication of agro-advisory, technical bulletin, popular articles and research papers, etc. were completed. The 'Insights from global research' section is encompassing information on Shade Avoidance Syndrome Modulated Abiotic and Biotic Stress Responses in Plants. 'A leaf from history' features Plant Growth-Promoting Rhizobacteria: the redeemer of plants. I sincerely hope that this issue will help the scientists and the farm personnel of NIASM and other research Institutes for better coordination among project staff while implementing the planned activities. I thank Dr. Aliza Pradhan and 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

Contributors
Principal Investigators of all the projects

Compiled & Edited by
Dr. Aliza Pradhan, Scientist

Technical Assistance
Mr. Pravin Hari More

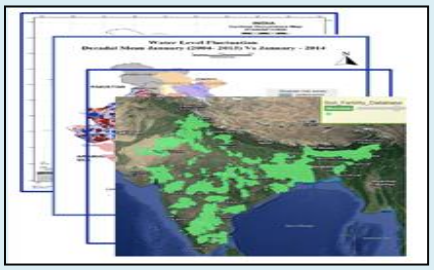
Published by
Dr. Himanshu Pathak, Director
ICAR-National Institute of Abiotic Stress Management, Baramati, Pune, Maharashtra 413115

When tillage begins, other arts follow. The farmers, therefore, are the founders of human civilization."

— Daniel Webster

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, Madhukar L Gubbala, Sunil V Potekar, Pravin H More



Concept of ASIS

Outputs
- Data pertaining to livestock census for last 25 years was collected.
- Identified indicators/factors affecting farm pond based aquaculture and cage culture site selection.
- Spatio-temporal variations of rainfall data of met sub divisions of india using parametric and non parametric methods.

Targets for next month
- Collection of livestock disease outbreak data from NADRES.
- Vulnerability analysis for meteorological parameters.
- Identification of edaphic stress indicators for preparing vulnerability index.
- Webapp of farm pond based aquaculture for abiotic stress conditions..
- Technical Draft on Methodology for Geospatial stress mapping (Continuing activity) .

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, Jagadish Rane, Neeraj Kulakshetran, Pravin B Taware, Aniket More, Rushikesh Gophane, Lalitkumar Aher

The list germplasm/genotypes/accessions of different crops collected

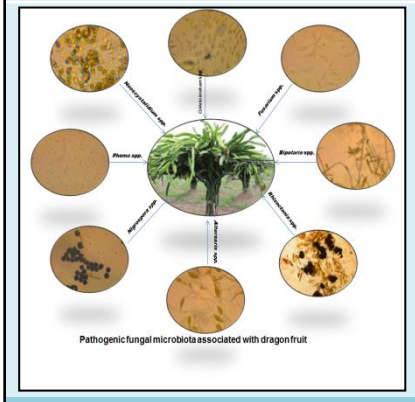
Sl. No.	Crops	Germplasm/ genotypes	Source
1	Safflower	NARI-6, NARI-96 & GMU-2369	NARI, Phaltan
2	Sorghum	Madhura-2, Madhura-3 & Revati	
3	Stylo	Stylo hamata & Stylo sebrana	
4	Subabul	Wonder graze & Taramba	
5	Wheat	KRL 210, KRL 213, KRL 283, KRL 3-4, KRL 99, KRL 19, KRL 1-4 & Karchia 65 (Kh 65)	ICAR-CSSRI, Karnal
6	Chickpea	72 genotypes	ICAR-IIPR, Kanpur & SWSM, NIASM, Baramati
7	Lentil	32 genotypes	ICAR-IIPR, Kanpur
8	Fenugreek	17 genotypes	NRCSS, Ajmeer
9	Pigeon pea	4 genotypes	ICRISAT
10	Quinoa	14 genotypes	MPKV, Rahuri (13) ICAR-IISS, RS, Bengaluru (1)

Outputs
- Collection and sowing of germplasms/genotypes/ of Quinoa, Chia, Wheat, safflower, Sweet sorghum, Stylo, Subabul.

Targets for next month
- Physiological and morphological characterization of turmeric lines for drought.
- Transplanting different genotypes of tomato and Brinzal genotypes including wild and subsequently their evaluation/characterization under Genetic garden for abiotic stress tolerance.

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 Wackchaure, 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, Avinash V Nirmale



Pathogenic fungal microbiota associated with dragon fruit

Outputs
- Data collection on heavy rain events occurred in a day in last 15 years at Baramati
- Recording of fruit yield of Guava planted with different planting techniques for assessment of long term impact of planting techniques on fruit yield, quality and carbon sequestration potential.
- Recording of plant growth data of tamarind.
- Isolation and purification of the pathogenic fungi from dragon fruit.
- Monitoring the progress of work of LIS and installation of automation system at farm.

Targets for next month
- Installation of drip system for sandalwood plants.
- Record plant growth (girth and canopy) data in guava planted with different planting techniques.
- Survey of dragon fruit orchards on the farmer's field.
- Assessment of temperature requirement of fungal pathogens in dragon fruit
- Monitoring the progress of work of automation system to be installed in the field.

UP 4. Climate-smart IFS (CIFS):
Climate resilient integrated farming system in semi-arid region

PI: Sanjiv A Kochewad; **Co-PI(s):** Kamlesh K Meena, Goraksha C Wackchaure, Vanita Salunkhe, Rajkumar, Mukeshkumar P Bhendarkar, Aliza Pradhan, Amresh Chaudhary, N Subash, Laxman R Meena, Pravin B Taware, Patwaru Chahande

Calving process in indigenous dairy cow

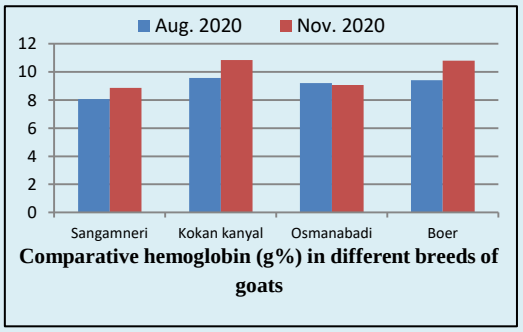
Outputs
- Submittion of quotations and report by local purchase committee for procurement and laying of geo-membrane HDPE sheet in fish pond.
- Field preparation and procurement of seeds and fertilizers for *Rabi* season.
- Collection of quotations by local purchase committee for construction of structure in CIFS.
- Laying of drip irrigation in multilayer farming in IFS model.
- Calving process in indigenous dairy cow.
- Planting of some of the agroforestry tree species on boundary.
- Preparation and application of 'Dashparni ark' on groundnut for leaf spot management.

Targets next month
- Crop sowing as well as weeding in already sown crops.
- Laying of HDPE sheet in farm pond.
- Construction of multilayer structure.

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):** Manoj P Brahmane, Sachinkumar S Pawar, Sanjiv A Kochewad, Bhaskar B Gaikwad, Rajkumar, Mukeshkumar P Bhendarkar, Ram N Singh, Dhananjay D Nangre, Avinash V Nirmale, Sunil V Potekar



Comparative hemoglobin (g%) in different breeds of goats

Outputs

- Comparative improvement in status of anaemia was observec in all the goat breeds.
- Recording of other physiological parameters *viz.* body temperature, heart rate and respiratory rate in different breeds of goat.
- Collection of environmental parameters to access stress levels in poultry birds and assessment of thermal stress risks in poultry for November month.
- Stocking of GIFT tilapia.
- Experiment on IPM of fall armyworm in maize.
- Study of rainfall trends by preparation of seasonal and annual rainfall maps of 34 main land meteorological sub-divisions of India.
- Meteorological data collection and compilation.

Targets next month

- Evaluation of stress parameters and parasitic prevalence in different breeds of goat.
- Amplification of Heat Shock Protein polymorphic region.
- Procurement of Vanaraja poultry birds for experimentation.
- Survey on fall armyworm in and around Baramati in maize..
- Collection and analysis of Meteorological data of MH will continue.
- Initiation of experiment on impact of salinity stress in GIFT Tilapia.
- Development of Live fish feed culture unit will continue.

FP 2. New Crops:

Exploiting Underutilised Crops (ex. quinoa) for Augmenting Income in Water Scarce Regions

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

Germination study in quinoa

Outputs

- To create genetic variability in Quinoa and Chia through mutation the seeds of Quinoa and Chia (Black and white) were sent to ICAR-IIHR, Bengaluru for irradiation with 3 doses in each crop *viz.*, in Quinoa: Radiation intensity (Gy) of 150, 250 & 350 & in Chia, 400, 500 & 600, respectively).
- The irradiated seeds sown in the field on 20.11.2020.
- Study on germination and physiological effects/ damage on seedlings is under progress.

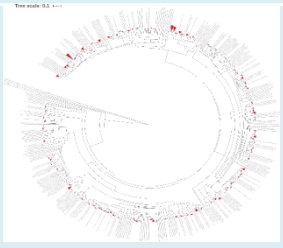
Targets for next month

- Sowing of Quinoa (different date and method of sowing).
- Observation/ data on Germination and other physiological effects on seedlings to be recorded in mutated seeds of Quinoa and Chia in field and lab/greenhouse conditions.

FP 3. Bio-saline Agriculture:

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

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



Halophytic culturable bacteria

Outputs

- Literature compilation underway to formulate a comprehensive review article on halophytes and their agro-ecological significance on a global scale.

Targets for next month

- Preparation of technical bulletin on the halophytes and associated microbiome for ameliorating the saline soil of semi-arid region of the country.
- To explore naturally occurring halophytes in nearby areas of Baramati.

FP 4. Technology Ttargeting and Policy:

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

Team: Dhananjay D Nangare, Sachinkumar S Pawar, Sanjiv A Kochewad, Bhaskar B Gaikwad, Boraiha K M, Kartikeyan N, Rajkumar, Mukeshkumar P Bhendarkar, Himanshu Pathak

Outputs

- Analyzed data on perceptions of fisheries businesses, conducted through online survey during Covid Lockdown.
- Two fortnightly agro advisories published on the Institute's website for stakeholders (English & Marathi versions).
- Published ICAR-NIASM Newsletter (April to September 2020).

Targets for next month

- Preparation for Krushak 2021.
- Development of ATIC.
- Compilation of ITK's for abiotic stress resilience in agriculture, livestock and fisheries.

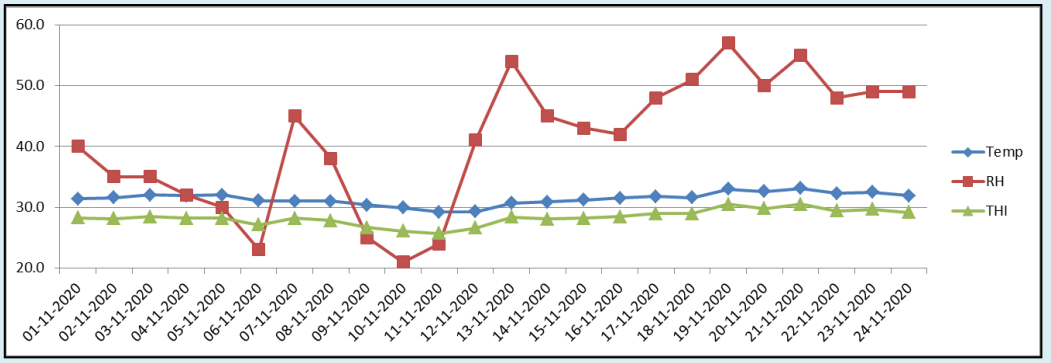
A) School of Atmospheric Stress Management (SASM)

1. Study of immune response and HSP genes polymorphism in relation to heat stress in poultry

PI: Sachinkumar S. Pawar; **Co-PI:** N P Kurade

Outputs

- Environmental parameters to access stress levels in poultry birds collected and assessed thermal stress risks in poultry for November month.
- The poultry shed prepared for next batch of birds and order placed for experimental birds.



Targets next month

- Procurement of Vanaraja birds for experimentation.
- Amplification of Heat Shock Protein polymorphic region.
- Recording of environmental parameters to access stress levels in poultry.

B) School of Drought Stress Management (SDSM)

1. Mitigating water stress effects in vegetable and orchard crops

PI: Goraksha C Wackchaure; **Co-PI(s):** Dhananjay D Nangare, Satish Kumar, Aliza Pradhan, K M Boraiah, Karthikeyan N, Jagadish Rane

Effect of different storage temperature on dragon fruit grown Under different soils

Outputs

- Storage behaviour of dragon fruits grown in three different soils viz., native (N), black (B) and mixed (N: B =1: 1) at four temperatures 4, 8, 16 and 28 ° C ambient was studied.
- Minimum fruit weight loss of 12.6% was noted in mixed soil followed by 14.4% and18.6% in native and black soil, respectively.
- Further, minimum fruit weight loss of 6.2% was noted at 4° C, followed by 8.5, 20.5 and 24.5% at 8, 16 and ambient temp (28° C) respectively.
- TSS exhibited initial decrease in up to 8 days which subsequently increased thereafter.
- Overall, storage temperature of 4° C and mixed soil treatment found more suitable for the storage of dragon fruit.

Targets for next month

- Design, layout and seedling transplantation under field trial of studying the interactive effect of different sulphur sources and water stress on onion using LSS.

2. Exploring cropping system approaches for enhanced water productivity and income: Evaluating performance of soybean based cropping systems in response to deficit irrigation

PI: Aliza Pradhan; **Co-PI(s):** Jagadish Rane, Amresh Chaudhary, Karthikeyan N

Sowing of Sunflower

Outputs

- Harvesting of soybean and maize.
- Field preparation and sowing of sunflower.

Targets next month

- Weeding in sunflower
- Data analysis of harvested soybean and maize.

EAP 1. 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, Jagadish Rane

Soybean genotypes in greenhouse

Outputs

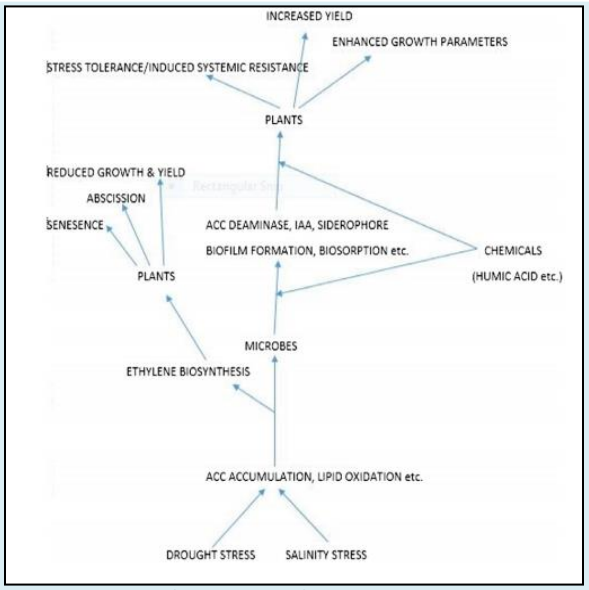
- Soybean genotypes (Nos 50) grown in greenhouse were evaluated in phenomics for traits such as canopy temperature, biomass and water status of plants. These genotypes were also screened for traits such photosystem –II efficiency and canopy greenness under greenhouse conditions.
- Fifty soybean genotypes were also evaluated for waterlogging stress tolerance in greenhouse.
- Genomic DNA was isolated from 50 soybean genotypes for GBS to conduct Genome wide association studies.

Targets for next month

- Screening of another 75 soybean genotypes in greenhouse for canopy temperature, NDVI, PS-II efficiency and water status.
- Root system architecture study in 50 soybean genotypes under hydroponic/*in vitro* conditions.
- Gene expression profiling (20 drought responsive genes) of 40 soybean genotypes under water stress and no stress conditions.

A leaf from History: Plant Growth-Promoting Rhizobacteria: the redeemer of plants

- Pooja A. Kadam, YP-1, SWSM



The Interaction of microbes, useful chemicals, and their overall influence in plant stress tolerance, growth, and productivity

Plant growth-promoting rhizobacteria are those indispensable microbes possessing the unique abilities of supporting directly and indirectly the wellbeing of plants. These microbes, in order to survive in the rhizosphere, expanded their biological activities that influence the survival and growth of plants. A number of these microbes with the enzyme machinery necessary for the breakdown of the exudates of plants are able to protect the plant from stress arising from water scarcity and salt pollution. They produce a variety of substances such as deaminase enzyme, plant hormone–indole acetic acid, siderophore, $PO4^{2-}$ solubilizing enzyme, salicylic acid, and microbiocidal/biostatic enzyme. Some of these microbes contribute to plants nutritionally by trapping and integrating nitrogen into the plant via nitrogen fixation. However, as a means of surviving the stiff competition for existence and dominance at the root environment, some microbes devise a means of burrowing/penetrating the tissues of plants and establish themselves as endophytes within the plant, contributing not only to the nutrition of the plant but also to enhancing plants' survival rate and adaptation to their environment.

PGPR contribute to sustaining the intrinsic resistance of plant to pathogenic and environmental challenges. Some of these organisms are excellent in biofilm formation and secretion of polysaccharide substances which confer stability to plants during stress. Their presence can contribute to the reduction in metal stress on plants when applied to them as bioinoculants. The growth and survival of plants will not be possible without the help of these "farmers' friends" living both within and around the plant surfaces. The classes of microbes belonging to these group/genera are *Micrococcaceae HW-2, Bradyrhizobium, Bacillus, Microbacterium, Pseudomonas, Curtobacterium, Variovorax, Paenibacillus, Pantoea* and many others.

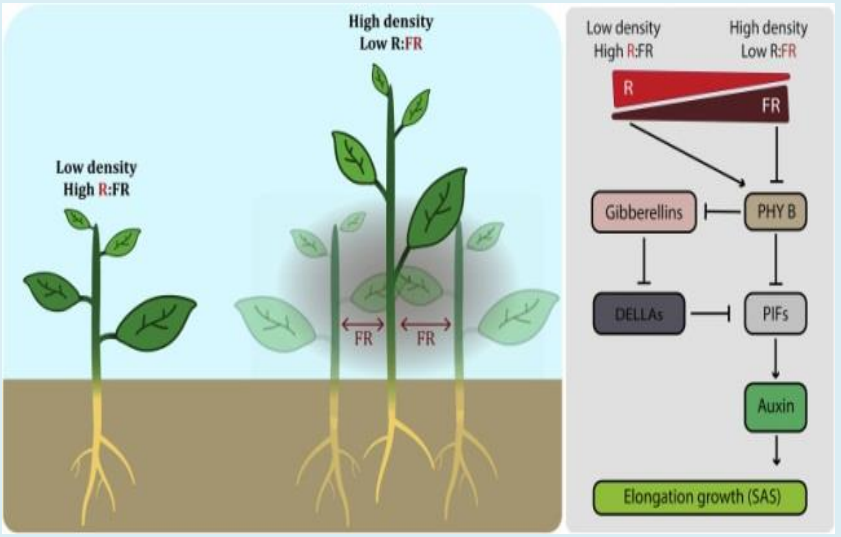
A healthy plant is a product of a healthy relationship between the plants and the growth-promoting microbes, while an unhealthy relationship could be observed in the degradation of the physical and physiological wellbeing of the plant. PGPR are the key players in the fight for sustainable plant development amidst stress conditions arising from climatic as well as manmade activities.

References:

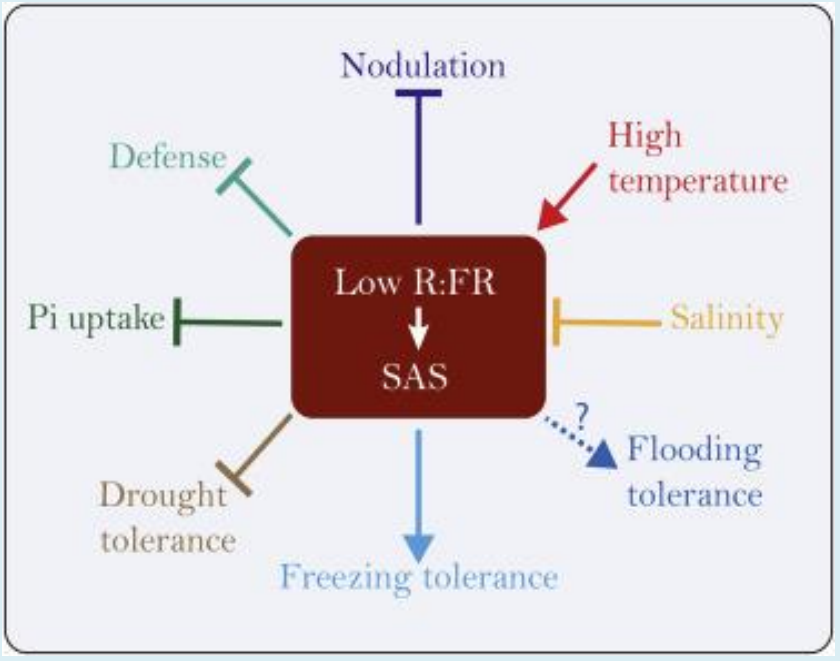
- Babalola OO (2010) Beneficial bacteria of agricultural importance. Biotechnol Lett 32(11):1559–1570.
- Gujral MS, Agrawal P, Khetmalas MB, Pandey R (2013) Colonization and plant growth promotion of sorghum seedling by endorhizospheric Serratia sp. Acta Biologica Indica 2(1):343–352.
- Moustaine M, Elkahkahi R, Benbouazza A, Benkirane R, Achbani EH (2017) Effect of plant growth promoting rhizobacterial (PGPR) inoculation on growth in tomato (Solanum lycopersicum L) and characterization for direct PGP abilities in Morocco. Int J Environ Agric Biotechnol 2(2):590–596.
- Saleem AR, Bangash N, Mahmood T, Khalid A, Centritto M, Siddique MT (2015) Rhizobacteria capable of producing ACC deaminase promote growth of velvet bean (Mucuna pruriens) under water stress condition. Int J Agric Biol 17:663–667.

Shade Avoidance Syndrome Modulated Abiotic and Biotic Stress Responses in Plants

Pravin B. Taware , Sr. Technical Officer (Farm)



Simplified Overview of the Shade Avoidance Syndrome (Courbier and Pierik 2019)



Summary of the Effect of Low R:FR Light Conditions on Other Stresses (Courbier and Pierik 2019)

References:

- Courbier, S., Pierik R. Canopy Light Quality Modulates Stress Responses in Plants. *iScience* 2019, 22, 441-452 doi.10.1016/j.isci.2019.11.035
- Wang, X., Gao, X., Liu, Y., Fan, S., Ma, Q. Progress of Research on the Regulatory Pathway of the Plant Shade-Avoidance Syndrome. *Front. Pl. Sci.* 2020, 11, 439 doi.10.3389/fpls.2020.00439

As world population increases, food security is threatened by limited resources in terms of arable land area. Therefore, it needs to grow plants at higher densities while maintaining individual plant productivity. Consequently the competition for light between individual plants, leads to growth reductions. However, plants employ a suite of developmental adjustments to increase their competitive ability, known as the "shade avoidance syndrome (SAS)". The current knowledge on how light mediated density responses interact with plant responses to abiotic and biotic stresses have been reviewed by Courbier and Pierik 2019. Integration of the signalling mechanisms that link photoreceptors with multiple hormone signalling pathways were presented while reviewing the progress of research in regulatory pathway of the plant SAS by Wang *et al*. 2020. The summary points out of these reviews are as follows;

- The molecular and physiological mechanisms that plants deploy to control shade avoidance phenotypes have been discussed.
- The altered ratio of red to far-red wavelengths (low R:FR) and low blue light ratio (LBL) in plants due to vegetation shading is predominantly detected by phytochromes and cryptochromes, respectively.
- By integrating multiple signals, plants generate a suite of responses, such as elongation of a variety of organs, accelerated flowering, and reduced branching.
- A number of transcription factor families and phytohormones, especially auxin, gibberellins, ethylene, and brassinosteroids, are involved in the SAS processes.
- The impact of SAS on responses to abiotic stresses such as salinity, drought, temperature and submergence had been elaborated.
- Response to biotic stresses, covering both pathogenic and beneficial plant microbe interactions, are modulated by density light signals.
- Concluded with new research perspectives and directions towards a better understanding of plant responses to combined stresses in order to target breeding efforts and increase plant resilience to stresses at high planting density.

Plants growing at high density are in constant competition for light with each other. The shade avoidance syndrome (SAS) is an effective way to escape neighbouring vegetation. Under natural conditions, plants deal with multiple stresses simultaneously. It is; therefore, key to identify commonalities, distinctions, and interactions between plant responses to different environmental cues. Understanding plant responses to multiple stimuli, factoring in the dominance of light for plant life, is essential to generate crops with increased resilience against climate change.

"Agriculture was the first occupation of man, and as it embraces the whole earth, it is the foundation of all other industries".

-E. W. Stewart