May 2021

Project Coordinator

.... a monthly update

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

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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 May, 2021 and targets for June, 2021. Even under the continued COVID-19 pandemic situation, we were able to make progress in research and development efforts particularly in 1) genomics, genetic and molecular approaches to improve water stress tolerance in soybean and wheat, 2) optimization of a HPLC mobile-phase combination from the newly developed bio-formulation, 3) recording of yield data of different fruits, 4) preparatory tillage for upcoming *kharif* season, 5) recording of comparative status of water consumption in different breeds of goat for the month and 6) measurement of the real time post-harvest quality parameters of onion, screening of soybean & chick pea genotypes.

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 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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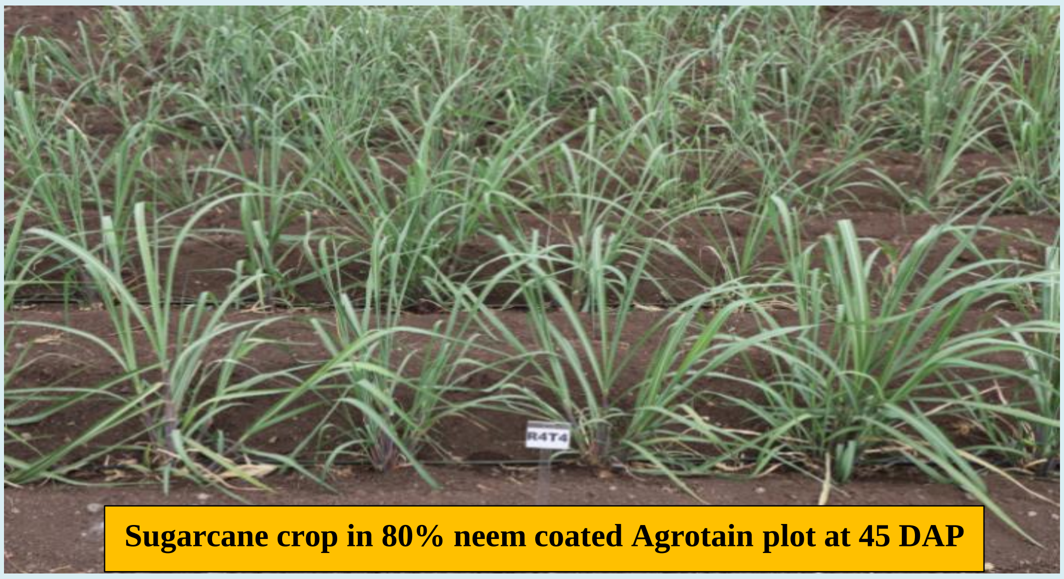
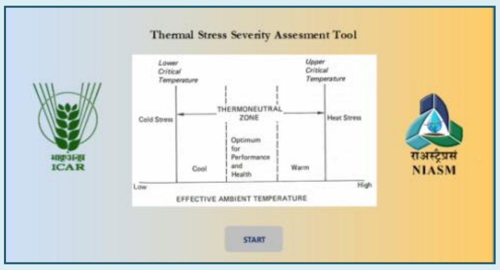
Sugarcane crop in control plot (no fertilizer) at 45 DAP



Sugarcane crop in 80% neem coated Agrotain plot at 45 DAP

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, Sunil V Potekar, Pravin H More



Thermal stress severity assessment tool

Outputs
- Spreadsheet model "Thermal Stress Severity Assessment Tool For Livestock" with management options based on forecasted values and 10 year historic data of the selected geo location.
- The Thermal Severity was assessed based on five days forecasted values of selected geo-location.

Targets for next month
- Web app for suggesting management options based on forecasted values.

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, Pravin B Taware, Aniket More, Rushikesh Gophane, Lalitkumar Aher

Outputs
- Nomination of Dr. Bhojaraja Naik, Scientist (Plant Breeding), ICAR-IISS, Mau as a Co-PI.
- Delivered talk on "Abiotic stress tolerant crop varieties: Status and way forward".

Targets for next month
- Planting germplasm of different crops
- Crop calendar preparation for Kharif, 2021.

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

Outputs
- Setting up of methyl eugenol para-pheromone traps in mango orchard for monitoring and management of fruit flies.
- Collection of the fruit yield data of Sapota in different treatments
- Recording of flowering and fruit set in guava orchard (K7 plot) under different planting treatments.
- Collection of baseline data of growth of tamarind trees after 6 years which attains average plant height 3.2 m and stem diameter 12.3 cm and crown spread 3.4 m^2.
- Compilation of information on recommendations for fruit crops and future research study.
- DNA extraction of *Colletotrichum spp*. & its *in vitro* pathogenicity study in dragon fruit.
- Collection and compilation of the information on crop details, irrigation system, no. of irrigations required in order to calculate water budgeting in north and south farm.

Targets for next month
- Water budgeting of whole NIASM farm.
- Soil analysis and recording of tamarind yield data.
- DNA extraction of *Colletotrichum* spp.
- Collect and compile the initial information of each fruit crops/plots in the north block.

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


Plantation of cucurbits in multilayer farming

Outputs
- Land preparation for sowing of mungbean and bajra.
- Plantation of cucurbits in multilayer farming system.
- Harvesting and threshing of safflower.
- Management of crops, livestock and horticulture crops.
- Harvesting of maize fodder crop.

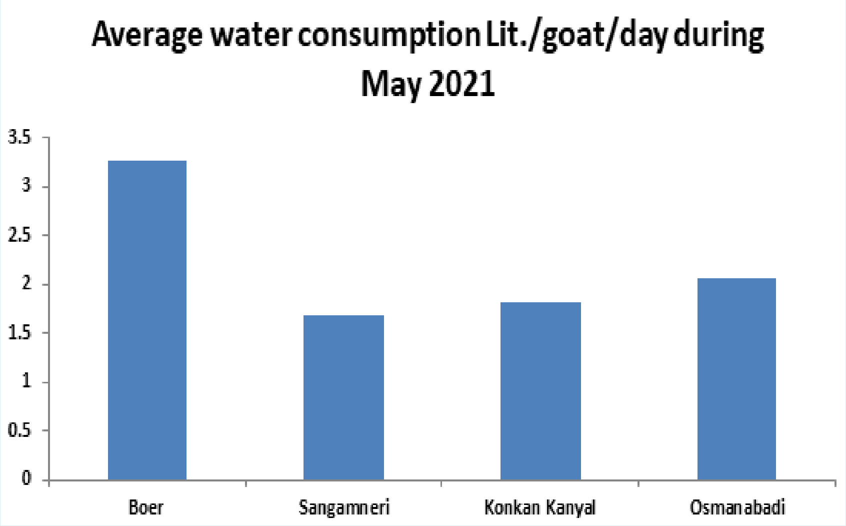
Targets next month
- Procurement of seed material and fertilizers for *kharif* season.
- Sowing of bajra and mungbean crops.
- Border plantation of perennial fodder crops.


Germination of ridge gourd in multilayer farming

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, Avinash V Nirmale, Sunil V Potekar



Outputs

- Recording of comparative status of growth, DM and water consumption in different breeds of goat for May.
- The experiment on salinity stress temporarily suspended due to unavailability of saline water.
- Collection and culturing of black soldier fly larvae for its mass multiplication.

Targets for next month

- Evaluation of comparative DM digestibility in different breeds of goats in addition to recording different growth, physiological, haemato-biochemical parameters.
- Mass Culture of BSF work.
- Experiment on impact of salinity stress in GIFT Tilapia.
- Analysis of data collected for pre-monsoon season.

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 S, Harisha C B

Outputs

- Writing of review paper /book chapter on prospects of new crops in abiotic Stress Management.

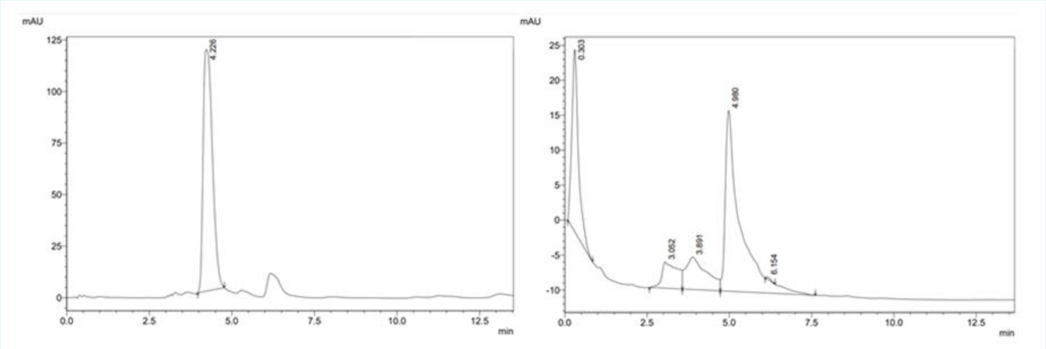
Targets for next month

- Seed germination test and storage experiments in quinoa and chia.

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, Aliza Pradhan, Amresh Chaudhary, Himanshu Pathak



IAA standard-100 ppm (left); HPLC chromatogram of the methanolic extracts of rhizospheric soil of *Cullen plicata* (right).

Outputs

- Detection of IAA in HPLC profiles of the *Cullen plicata*-rhizosphere extracts.

Targets for next month

- To measure the siderophore production by the halotolerant bacterial morphotypes using semi-quantitative approach.

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, Himanshu Pathak

Outputs

- Distribution of inputs (diary kit) to SC beneficiaries.
- Review of research work, literature, and secondary data on indigenous technical knowledge resources available for compilation specifically on Abiotic stress management.
- Publication of two fortnightly agro advisories on institute website for stakeholders.
- Rearing of fish in different small ponds.

Targets for next month

- Preparation of questionnaire for data collection on abiotic stress management of crops.
- Development of ATIC; coordination of extension activities.
- Collection of information on ITKs related to abiotic stress management.
- Writing of review paper /book chapter on abiotic Stress Management and role of extension and policy

B) School of Water Stress Management (SWSM)

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, Pratap Singh Khapte, Jagadish Rane

Post-harvest quality estimation (a) onion and (b) sapota

Outputs

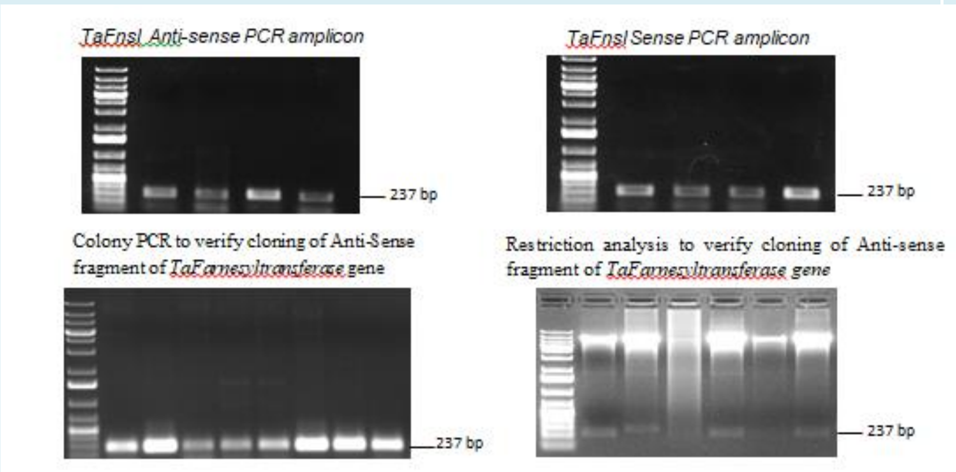
- Measurement of total above biomass of okra (Cv. Singham) for evaluating interactive effect plant bio-regulators under water stress.
- Measurement of the yield and physical quality attributes of sapota.
- Measurement of the real time post-harvest quality parameters of onion for evaluating impact of sulphur sources under water stress.

Targets for next month

- To study the interactive effect of Sulphur and water stress on post-harvest storage quality of onion.
- To measure yield and physical quality parameters of sapota.

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

PI: Ajay Kumar Singh



Outputs

- A 237 bp sense and antisense fragment of wheat Farnesyltransferase gene were PCR amplified and cloned into RNAi vector. Cloning of antisense fragment was verified by colony PCR and also by restriction digestion.

Targets for next month

- Evaluation of 50 soybean genotypes for traits associated with water stress tolerance.
- Sowing of 320 soybean genotypes along with check varieties for evaluation of drought adaptive traits under field conditions.
- Cloning of Sense-Antisense fragment of wheat Farnesyltransferase (TaFnsl) gene in pCAMBIA1301 vector to design RNAi vector.

EAP 1. Genomics strategies for improvement of yield and seed composition traits under drought stress conditions in soybean (Funded by: ICAR-NASF)

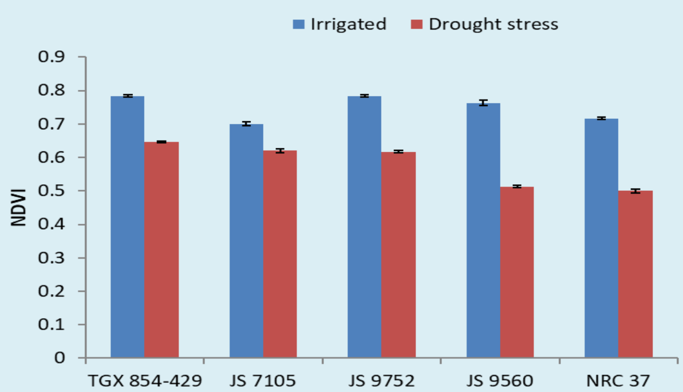
PI: Ajay Kumar Singh; **Co-PI(s):** Mahesh Kumar, Jagadish Rane

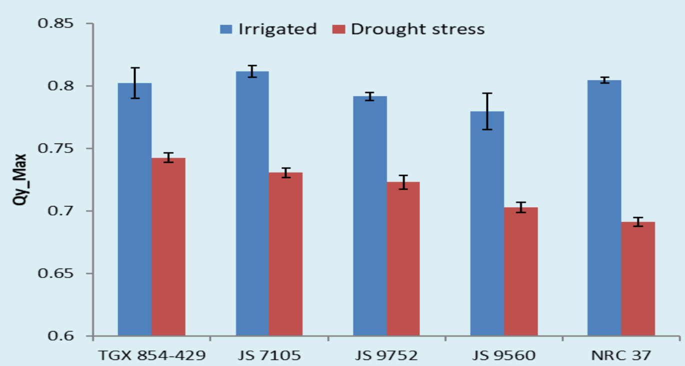
Outputs

- Soybean genotypes TGX-854-429 had higher PS-II efficiency and canopy greenness as compared to check varieties JS-7105, JS-9752 and NRC-37. This promising genotype showed enhanced water stress tolerance.

Targets for next month

- Evaluation of 15 promising soybean genotypes for drought adaptive traits.
- Root system architecture study in 25 soybean genotypes.
- Insertion of Sense-Antisense fragment of soybean Farnesyltransferase (GmFnsl) gene in pCAMBIA1301 vector to design RNAi vector.





EAP 2. Evaluation of halotolerant rhizobium and PGPB based biomolecules for alleviation of drought and salt stress (Funded by: AMAAS, NBAIM, Mau)

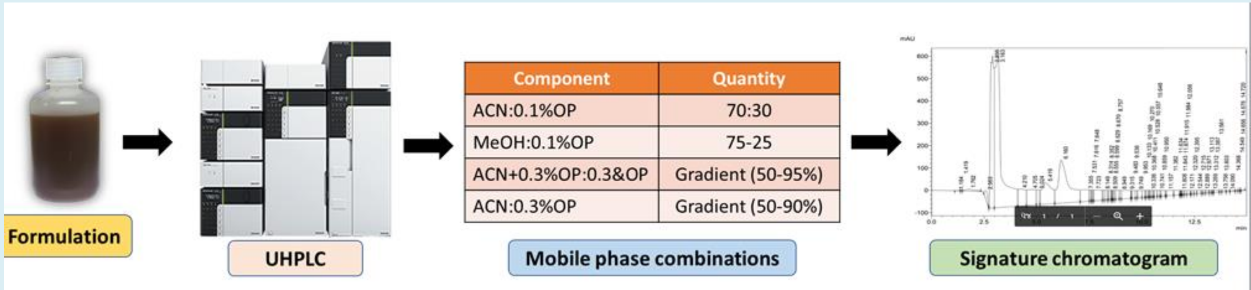
PI: Satish Kumar; **Co-PI:** Goraksha C Wackchaure

Outputs

- Optimization of a HPLC mobile-phase combination consisting of acetonitrile + OP: water + OP for resolution of multiple phenolic compounds from the newly developed bio-formulation.

Targets for next month

- To standardize HPLC gradient-elusion conditions for newly developed mobile phase combination for developing HPLC signature of the newly developed bio-formulation.



Process-overview of the mobile phase standardization for developing HPLC signatures of the newly developed bio-formulation. However, the gradient conditions need to be more finely optimized for better resolution of the closely related compounds originating from natural ingredients within the bio-formulation.

EAP 3. 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, Himanshu Pathak

Overview of tillage system, irrigation and trash management field experiment

Outputs

- Measurement of real time data of soil-water-crop parameters viz., plant height, number of tillers, NDVI, length of internodes and chlorophyll index in tillage system and planting geometry field trials of sugarcane.
- Recording of real time data in sugarcane- groundnut field trials for optimizing planting geometry, micro irrigation and residue management practices.

Targets for next month

- Analysis of the fraction of organic carbon, nitrogen, phosphorus and potassium in soil samples.
- Recording of real time growth parameters of sugarcane field experiments.
- Publication of the bulletin on conservation agriculture for sugarcane.

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 Taware, Himanshu Pathak

Overview of sugarcane field experiment

Outputs

- Weeding and gap filling in sugarcane plots.
- Application of fertilizers followed by soil sample collection and analysis for ammonical and nitrate nitrogen.
- Progress update to project team through online meeting.

Targets for next month

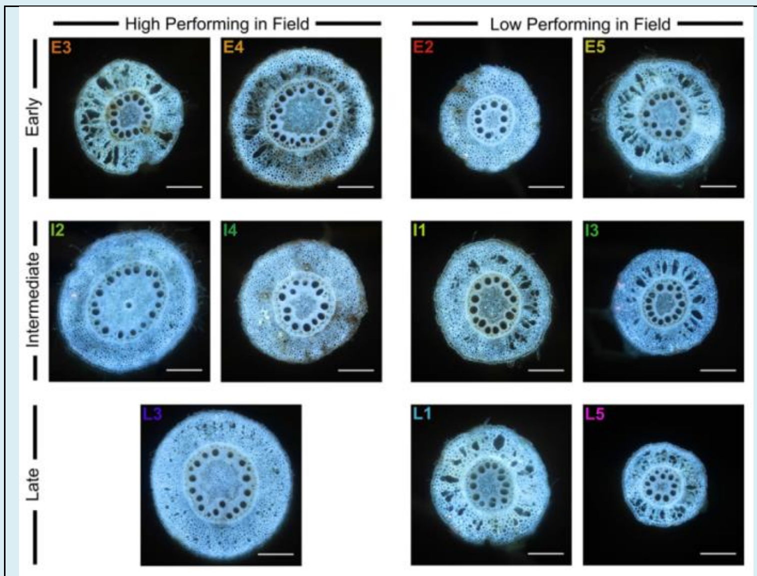
- Recording of real time growth parameters of sugarcane field experiments.

Root System Architecture in Sustainable Crop Production under Abiotic Stress Conditions

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

Roots are essential organs for capturing water and nutrients from the soil. In particular, root system architecture (RSA) determines the extent of the soil where water and nutrients can be gathered. As global climate change accelerates, it will be important to improve belowground plant parts, as well as aboveground ones, because roots are front-line organs in response to abiotic stresses such as drought, flooding, and salinity stress. Elevated temperatures driven by climate change affect developmental and physiological plant processes that, ultimately, impact on crop yield and quality. Plant roots are responsible for water and nutrients uptake, but changes in soil temperatures alters this process limiting crop growth. With the predicted variable climatic forecast, the development of an efficient RSA better adapted to changing soil and environmental conditions is crucial for enhancing crop productivity.

Calleja-Cabrera et al. (2020) reviewed the current knowledge about the effect of increasing temperatures on root growth and their impact on crop yield. Wherein, they described the main alterations in RSA that different crops undergo in response to warmer soils. They outlined the main coordinated physiological and metabolic changes taking place in roots and aerial parts that modulate the global response of the plant to increased temperatures. They discussed some of the main regulatory mechanisms controlling root adaptation to warmer soils, including the activation of heat and oxidative pathways to prevent damage of root cells and disruption of root growth; the interplay between hormonal regulatory pathways and the global changes on gene expression and protein homeostasis. It has been considered that in the field, increasing temperatures are usually associated with other abiotic and biotic stresses such as drought, salinity, nutrient deficiencies, and pathogen infections. They presented recent advances on how the root system is able to integrate and respond to complex and different stimuli in order to adapt to an increasingly changing environment. Klein et al. 2020 proved that multiple integrated root phenotypes would co-optimize drought tolerance, by phenotyping the root anatomy and architecture of 400 mature maize (*Zea mays*) genotypes under well-watered and water-stressed conditions in the field. A phenotypic bulked segregant analysis revealed that bulks representing the best and worst performers in the field displayed distinct root phenotypes. In contrast to the worst bulk, the root phenotype of the best bulk under drought consisted of greater cortical aerenchyma formation, more numerous and narrower metaxylem vessels, and thicker nodal roots. Partition-against-medians clustering revealed several clusters of unique root phenotypes related to plant performance under water stress. Clusters associated with improved drought tolerance consisted of phene states that likely enable greater soil exploration by reallocating internal resources to greater root construction (increased aerenchyma content, larger cortical cells, fewer cortical cell files), restrict uptake of water to conserve soil moisture (reduced hydraulic conductance, narrow metaxylem vessels), and improve penetrability of hard, dry soils (thick roots with a larger proportion of stele, and smaller distal cortical cells). They proposed that the most drought-tolerant–integrated phenotypes merit consideration as breeding ideotypes. Ober et al. (2021) argued that it is important to know more about the ‘hidden half’ of crop plants and hypothesize that crop improvement could be further enhanced using approaches that directly target selection for root system architecture. They reviewed the tools available for root phenotyping under controlled and field conditions and the use of these platforms alongside modern genetics and genomics resources to dissect the genetic architecture controlling the wheat root system. To contextualize these advances for applied wheat breeding, they explored questions surrounding which RSA should be selected for, which agricultural environments and genetic trait configurations of breeding populations are these best suited to, and how might direct selection for these root ideotypes be implemented in practice.



Root anatomy cross-section images of the medoid phenotype for the five best and six worst performing clusters of maize. Scale bars = 0.5 mm (Klein et al. 2020)

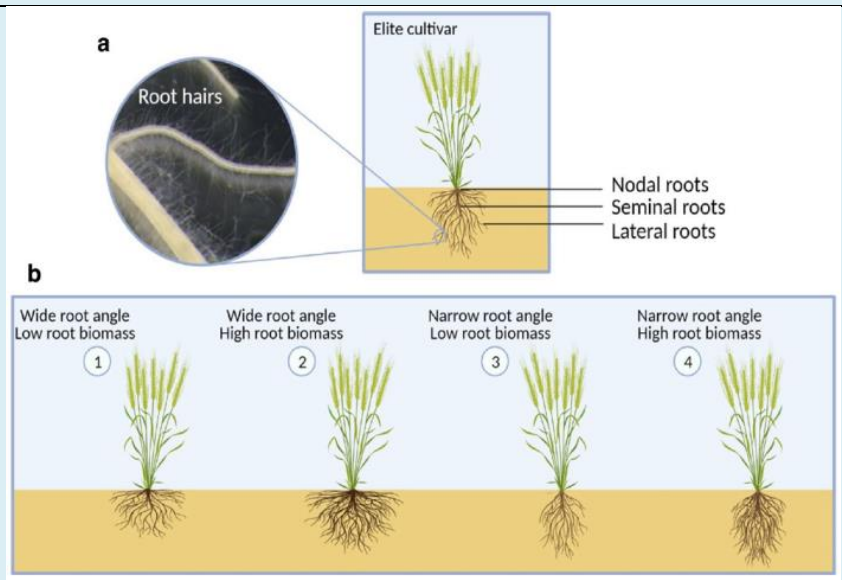


Illustration of root system architectures of wheat, (a) principal features of the wheat root architecture, (b) an example of different root ideotypes (Ober et al. 2021)

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