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Manage the Negative Impact of the Climate Change by Redefining the New Normal and Use of Advance Tolls and Technology in Agriculture Science – An Overview

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Abstract

In India rainfed agriculture still accounts for over 92.8 million hectare or 65 per cent of cropped area.This is a challenging task for the breeding community to improve the water usage efficiency of cultivated plant species for longer sustainability. On a positive note, climate change and cultivar developments move together as every next breeding cycle and selection fall in the changed climate. The most difficult part is climate prediction and estimate are not providing the accurate data and informationand hence farming community is left in ambiguity and often fail to initiate the planting at right time and select the right crop which had less risk in the current climatic conditions. Interestingly, large diversity of cropping systems exists under rainfed and dryland areas with an overriding practice of intercropping, due to greater risks involved in cultivating larger area under a single crop. For a longer sustainabilityout of box thinking is required, by considering socio-economic situations such as; dependency of large population on agriculture, small land-holding size, very high population pressure on land resource etc. Improving household food security has been an issue of supreme importance to millionsof farmers in India, who constitute 97.15 million total operational holdings and 56.15 million marginal holding. This lead to redefine the new normal and also important to relook at the total basic work and process of development and evaluation the new cultivars which were formulated quite long and with a little change they are still in practice. Drought,shorter monsoon spread, drought and waterlogging situation in same field are very common now a days in all the tropical and sub-tropical reasons. Shorter winter season and early high rising temperature after winter season is becoming very common which lead toreduction in the productivity.On this note, I will be covering a concept where climate changes and our socioeconomic condition need to consider on priority by plant breeding community and move as a concept from tolerance breeding to resilient breeding.

Key words : *Climate change, New normal climate cultivar development process and practice and Climate resilient cultivar.*

Introduction

Population growth and estimated high food demand are very well-known facts, the interesting part here is to estimatethechange overa periodwhere many new and old factor influence the total demography. (Roberta V. Gerpacio, 1999-2025) says a major shift in global cereal demand is underway: By 2025, demand for maize in developing countries will surpass the demand for both wheat and rice. This shift will be reflected in a 50% increase in global maize demand from its 1995 level of 558 million tons to 837 million tons by 2025. Maize requirements in the developing world alone will increase from 282 million tons in 1995 to 504 million tons in 2025 (IFPRI 2000). However world maize production is projected at consecutive peaks from 2022-23 onwards, reaching 1,177MT by the end of the forecasted period, up by 9% from the estimate for 2018-19 which is 1076 million metric tonne (International grain conceal , March 2019). Same situation is there for almost all other crops and this indicates that we need to be careful from these predictions and estimates. Another learning here is,despiteallthese negative impacts of climate change, agriculture research community has helped inproducing much more than what its estimated 15 year ago and required today. This is also a new school of thought where we can incorporate all these influencing factor (natural, climatic & socio-economic) and design the agriculture research activity which can peeve a path to supply healthy food at affordable price to everyone on this earth. I believe very strongly, that world will never go hungry if we continue to improve the productivity by genetic gain, reducing harvesting tools, improve plant nutritional use efficiency, continue improvement in food distribution system and crop diversification. In this article I have tried to cover all these aspects where we need to challenge ourselves and try to redefine our existing system process in order to increase the efficiency and help world to be out from the fear of food security

Climate Change and its influence on the product/cultivar developments : Crop growth conditions and crop productivity are interrelated issues. Basically, crop growth is affected by climate conditions,

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CO_2 concentration and technology. Concerning climate conditions, the basic variables are precipitation and air temperature that control soil moisture and water availability to plants and affect evapotranspiration. In addition, other variables such as wind velocity, the occurrence of early frosts or ice and the time occurrence of extreme phenomenon are important as they can exercise significant stress on plants and put production at risk. In Asia, where intensity, timing and duration of the rainy season is very critical and put up a very high risk on the productivity. Climate change is a very complex issue and it can be divided in two categories one which can be taken during the process of breeding and other which are very random event and cannotbe incorporated in the selection process while breeding. Increase in temperature and evapotranspiration can be taken care of very well during the breeding process as the entire breeding nursery planted in open field and generation advancement happen in natural climate. Effect of Drought and water logging condition can be taken care through screening and selection in the targeted conditions. In breeding process, it is important to develop the methodology :

For root trait selection enabling technology

Use of plant physiology in plant breeding

Screening of the early generation material under stream climatic conditions

Offseason screening.

Use of weather and climate change information for design the breeding schemes

Breeding in targeted ecology

Emphasis for designing nutrients use efficient plant architecture.

New Plant type for manging the change climate and change farming system : Breeding community always review and change their section criteria and give very high weightage to the need of farmer at present. These is a moving target and keep on changing time to time and get influenced from climate and other socioecological developments.In many crops we witness the change as an example no of percales or ear per unit area has reduced the significance of no of tiller per plant in wheat, rice and millet which is a very significant yield contributing traits.In case of corn new generation breeder start saying that, the beauty of a corn ear is not in the ear length per plant but ear length per row. All these new perspectivesshould be considered and our old books, list of traits be reviewed and realign them as per current requirement and design the plant architecture accordingly. The breeder should develop the new list for the yield contributing traits and stress management traits and align the selection accordingly.

Traits used in past for selection	Traits may become significate in future
No of tillers in Rice, wheat and millets	No of panicles per unit area
Lodging tolerance – nice to have	Lodging tolerance–Must have
Low seeding mortality–nice to have	Low seeding mortality–Must have
Skipping from droughts	Drought tolerance and /or Climate resilient
High yield / unit area	Profitability (yield /unit area /unit input/per unit times)
Early, medium or late maturity	Suitable for early , medium and late planting season
Grain yield and fodder yield	Grain yield + nutrition value + fodder yield and quality
No of bolls per plant in cotton	No. of bolls per meter square
No of fruits/plant in tomato, okra etc.	No. of fruits per meter square

Breeding v/s demands lead breeding : Variability or recombination creation, selection and use of selected variability in developing the improved cultivars the main component of plant breeding will remain unchanged. How every requirement for tailor made and demand lead plant breeder required to revisit these components of plantbreeder and see how a breeder can incorporate a commercial angle in his product design concept. It's time to think that expectation from breeding community are increasing and the science of pant breeding is evolving and hence it necessary to widen the definition of plant breeding from breeding to product designing by using a systemic and phase gate approach, where plant breeding will consider a complete project and pass through the critical evaluation at every phase to pass the gate for next phase as listed below :

Developing the product profiling and creating product concept note with define time line.

Project approval, setting the bench marking and mile stones

Translating the product profiling in to the breeding objective

Assessing the germplasm requirements / supporting breeding tools

Progressassessment or project monitoring on every mile stone

Product performance validation

Product acceptance validating

Product scale up plan and product introduction

This approach is so criticalto address the need of farmer and provide the solution to their problem which will help in increasing the productivity and profitability of farmer. Educated farmers are capable to check the label claim by product provider and this approach increase the precision in performance. Here it's very critical to see if our existing varietal release systems are still strong enough to evaluate the performance of product in the way farmers are looking for.

Excellence in Plant breeding to enhance the genetic gain/breeding cycle : Summer, rainy and winter season are getting shorter, but severities of the effects areincreasing every year. Drought and waterlogging in the same field, winter and heat stress in the same field in same crop/field isnormal nowadays. To handle this new climatic definition our old breeding system and approach will have some limitation and hence excellence in plant breeding is so critical whichwill enable to handle the current challenges and prepare ourselvesforthe future challenges. Here it is necessary to widen the scope of plant breeding to :

Increase the speed in plant breeding by shorting the breeding cycle

Increasing the pre-season in selection

Increasing the cost effectiveness in the breeding process

Increase the heat rate or success rate in product acceptance.

Integration of supporting sciences like genomics, gene-editing, double haploid and biotechnology in plant breeding are essential in to manage the complex traits, increase the pre-season and speed in plant breeding. Use of high throughput phonemics, use of artificial intelligence in data gathering and management and advance statistical tools are required for increasing cost effectiveness and improving the label claim.