EDITORIAL

A Viable Strategy for Improving Crop Productivity under Sustainable Agriculture

COLUMN

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Crop breeding programmes so far have concentrated more on developing high yielding varieties of major food crops under optimal input or high input conditions. Thanks to the breeders for producing high yielding crop cultivars under high input situations, we are able to feed billions of hungry people and provide clothing.However, little progress has been made in the past fifty years to develop genotypes capable of producing good harvest under low input and adverse agricultural conditions. Essentially, the best varieties that give good yield under high input condition often fail miserably under low input conditions. It needs to be mentioned here that $1/5^{th}$of the arable land of the world is arid and semi-arid and $2/3^{rd}$of it is saline thereby affecting crop productivity severely. Besides, with ever increasing population there is an increasing demand of food and other commodities but the productivity of these crops is endangered with ever increasing global warming, heat stress, drought, salinity and other abiotic stresses, thereby threatening food security and causing starvation death especially in African countries.

In view of the gravity of the devastating stress situations, the quest for basic crop research has shifted to understand the responses of crop under stress and devise strategies to overcome these stresses employing conventional and novel frontier research technologies. Sufficient research progresses have been made to understand the problems of various stresses affecting the growth and productivity of various crops, but insignificant progress has been attained for their practical utility in the farmer's fields.Good successes have been achieved to use molecular biology such as marker assisted selection, transgenic tools, but the practical use of these techniques are beyond the reach of developing countries for this high cost technology.

Abiotic stress play important role in cultivated crops. It mainly affects the various growth stages which ultimately resulted loss in the yield. Physiological process such as flowering, grain filling and maturation was highly affected by abiotic stresses. Plant metabolisms which include photosynthesis, enzyme activity, mineral nutrition, and respiration are affected by several abiotic stress factors such as drought, salinity, heat, chilling, and UV radiation stress. Successful establishment, survival and productivity of a crop mainly depend on adaptation of the crop to environmental conditions (abiotic) in which the crop grows. Several morphological, anatomical, physiological, biochemical and molecular mechanisms play an important role in adaption of the crop to abiotic stress factors.

While looking at the research progress made so far, it may be concluded that concerted research activities are concentrated on various aspects. Excellent progress has been achieved by researchers in identification of markers linked to important characters, identification QTLs related to stress response, identification of new alleles from wild or weedy relatives as well as cloning, characterization and expression of genes tolerance to various abiotic stresses. However, poor choice of characters to be studied under abiotic stresses and unavailability of robust screening techniques are major limitations in accurate phenotyping of stress responses. Efficient screening techniques need to be developed for various abiotic stresses, and its utilization in breeding programme. Rooting pattern and depth contribute to adaptation to drought and salinity which area needs concerted research activities.Deep root system contributes to drought resistance, while profuse lateral but superficial roots contribute to salinity tolerance functioning as osmotic adjustment. In this respect, heat stress and cold stress occurring during flowering to grain filling period affect pollen viability, stigma receptivity, poor grain filling and grain abortion.

With respect to screening, germplasm being sources of resistance are evaluated for the selection of genotypes resistant to particular stress such as drought but with poor agronomic traits. Therefore, we need to adopt a viable strategy. It needs to be mentioned here that the pipe line hybrids of each crop are being selected by the seed companies/ research institutes for adaptation in various agro-climatic conditions in multi-location trials for adaptation and high agronomic performance. The crop hybrids selected for abiotic stresses such as drought, salinity and good agronomic background could be well adapted under sustainable agriculture in saline and drought prone areas. On the contrary high yielding crop cultivars may not perform well owing to lack of resistance to these traits. Adopting this approach, the productivity of crop could be enhanced under sustainable agriculture. In this context, it may be mentioned here that efficient novel techniques have been developed by Maiti and his team at Vibha Seeds, Vibha Agrotech Ltd, Hyderabad, India for the mass scale screening of the pipe line hybrids of various cereal and other crops for tolerance to drought, salinity, flooding, heat stresses, pollen viability exposed to heat stress etc. It needs to be mentioned that Bt-cotton hybrids selected for salinity and drought are confirmed for their tolerance at saline and drought prone areas thereby depicting the transfer of technology from lab to the land and vice versa. The essence of the strategies for developing high yielding stress tolerant genotypes of maize is outlined in a schematic diagram presented below, which can serve as a good approach to follow in other cereal and non-cereal crops.