EDITORIAL

COLUMN

Potential of Morpho-physiological Traits as Selection Criteria for Biotic and Abiotic Stress Resistance in Crops

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Increasing global warming associated with several abiotic stresses such as drought, salinity, heat stress etc. are affecting crop productivity drastically, thereby, threatening food security and increasing hunger. Breeding for resistance to abiotic stresses is a complicated process as it is and governed by multiple genes.In this respect very little progress has been achieved by the breeders working on different crops. On the contrary extensive literatures are documented that several morpho-anatomical and physiological traits are related to biotic and abiotic stresses. In the light of world literatures and vast experience of the author working on various field and vegetable crops, it may be suggested that selection based on these characters would surely be helpful in gaining better result in crop improvement programme against biotic and abiotic stresses.

Several suggestions are put forward to the breeders to use morpho-anatomical and physiological traits as selection criteria for improving tolerance to biotic and abiotic stresses/ Apart from germplasm, it is preferable they should work on pipe line hybrids/parents with high agronomic backgrounds. I am citing here few evidences.

Biotic stress tolerance

Crop plants are damaged by more than ten thousand insects and one million pathogens. The structural anatomy of plants plays very important role in mechanical defence or delivery of the chemicals through pores or glands. Several leaf anatomical traits such as the presence and intenisity of trichomes, leaf cuticular thickness offer non-prefence to various insects, therby imparting tolerance to these insects.

- The plant cuticle plays a major role in imparting defence against insect pests and fungal pathogens. Cuticles are formed from the outer epidermal cell layers by deposition of long chain lipids on the surface of epidermal cells. High cuticle thickness increase the resistance towards pathogen, as observed in case of charcoal rot in beans, groundnut, cotton and radish (c.o. – *Rhizoctoniasolani*), powdery mildew of roses (c.o. – *Sphaerothecapannosa*) or grey mold of grapes (c.o. – *Botrytis cinerea*).
- Plant surface waxes are hydrophobic and repel water, so pathogenic spores do not get water for germination on the plant surface. The spore structures of rust fungi do not germinate properly on wax coated leaves of wheat and barley.
- Silicification is a major defence mechanism of cereal plants against blast in rice and also against rust and powdery mildew in wheat
- Mention may be made on the role of non-glandular trichomes on shootfly (*Atherigonasoccata*) in sorghum and glandular trichomes to whitefly /virus resistance in tomato. In addition glossiness on leaf surface is related to tolerance to shootfly in sorghum. The presence of density of trichomes on lower surface of cotton leaf contributes to sucking pest resistance. Similarly the presence of trichome density imparts insect resistance in sunflower. The breeders can use these traits in mass scale screening of pipeline hybrids for insect resistance. They should also study the inheritance of these traits.

Abiotic stress tolerance

Selection for abiotic stresses often faces the problem of improper phenotyping. In crop improvement, higher efficiency of selection is most crucial to develop high yielding abiotic stress tolerant genotypes. Sufficient informationis available on the potentiality of few leaf morphological and anatomical traits for drought resistance in field and vegetable crops. A few evidences are presented below for biotic and abiotic stresses with special reference to drought and salinity in few crops.

• It has been observed that small leaves with thick cuticle. Dense trichome on leaf surface and compact palisade cells (preventing loss of transpiration) associated with thick collenchymas in the petiole contribute drought resistance in various crops such as sunflower, cotton, castor,okra and several other crops. Using these traits mass scale screening of pipe line hybrids/parents can be done for possible drought resistance. Along with these traits drought resistant cultivars show the presence oflarge sized xylem vessels for efficient movement of water from the roots to the shoots.The selected genotypes could be tested for drought resistance under drought prone areas. These selected lines can be used effectively for marker assisted selection using molecular technique.

• The rooting patter and response of root system play an important role both for drought and salinity tolerance. It has been reported in the case of cotton, sunflower, maize and rice that drought resistant crop cultivars showed robust root and deep and inclined roots compared to those of susceptible ones. Therefore, genotypes selected on the basis of morphological and anatomical could be correlated with the response of root system under drought stress. It has been confirmed that the genotypes selected on the basis of leaf morphological and anatomical showed drought resistance under drought prone areas in cotton and sunflower. Drought resistance crop varieties have particular root ideotype with profuse and inclined and deep root system. In the case of maize theroot system is in the form of inverted V.Therefore, the breeders can use these criteria in selection and incorporation in breeding program.

• In the case of salinity tolerance salt tolerant crop species such as cotton produces profuse lateral roots near soil surface and root elongation with an increase in salinity up to certain level. In the case of pearl millet, rice and maize the number of lateral roots increase in salt tolerant line which function as osmotic adjustment of root system n these crop species. With increase in salinity exposed at vegetative stage the salt tolerant varieties showed increase in root elongation unlike that in the susceptible ones.

These screening strategies are also highly helpful in developing genotypes with multiple abiotic stress resistance. Drought stress is often associated with high temperature, osmotic pressure and low availability of nutrients, while salinity stress reduces water availability and may impart physiological drought conditions in the field. Since development of effective design for creation of multiple abiotic stresses is very difficult and sometimes practically impossible the above mentioned screening techniques can be simply used to identify candidate genotypes from large germplasm set or segregating population. The evidences put forward suggest that there is a great necessity of both breeders and physiologists working together for abiotic stress tolerance. These methods are very cheap, economic, easy to replicate and can be applied to any crop species, thereby also saving huge cost otherwise invested on biotechnological researches.