Editorial

A Novel Strategy to Sustain and Improve Crop Productivity under Saline-prone Arable Lands

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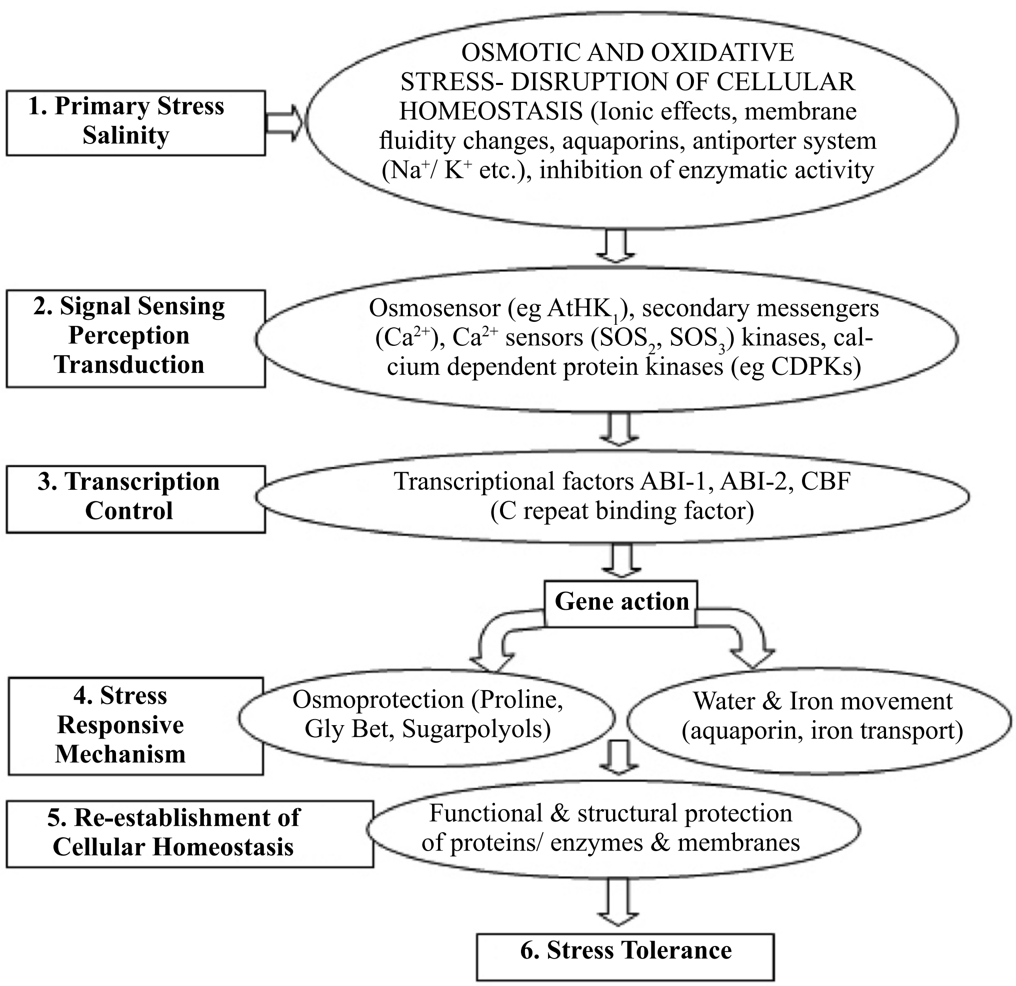
Over 800 mha land throughout the world are affected with salinity and the rest with sodicity (434 mha). Salinity is one of the major concerns with water used in irrigation. About 20% of irrigated agriculture in the world is adversely affected by salinity (Flowers and Yeo, 1995). Most of the grain crops and vegetables are highly susceptible to soil salinity even at a level of soil EC<4 ds m^{-1}. Salinity threshold values vary among species (Maas cited by Chinnusamy et al., 2005). Research have been concentrated on management strategy, progress on salinity tolerance of some crops, its effect, variation and selection and mechanism of tolerance (a review by Gonzalez-Rodriguez and Maiti, 2010). Sufficient research inputs have been directed in Salinity Research Laboratory of Vibha Seeds, Vibha Agrotech Ltd, Hyderabad, India to evaluate and select various crop species for tolerance to salinity (literatures are mentioned below). In all these studies increasing salinity levels decreased the emergence and seedling growth, but genotypic variability was found to exist showing opportunity for the selection of crop cultivars tolerant to high NaCl concentrations.

A molecular mechanism has been put forward for salinity tolerance of plants, which is shown in brief in the following diagram (Chinnusamy et al., 2005):



In general, researchers have been successful to evaluate and select crop cultivars for tolerance to salinity, but have failed to select cultivars with high yield potential probably owing to the fact that they have concentrated to evaluate germ-plasm with low yield potential. A new technique and a new strategy has been suggested for improving salinity tolerance in crops (Maiti et al., 2008).

A novel semi-hydroponic technique has been adopted to screen and select the pipe line hybrids of several field and vegetable crops with consistent results. These pipe line hybrids were tested and selected over multi-location trials (MLT) for their high yield potentials as well as for their high salinity tolerance. Adopting this new strategy the hybrids selected for high salinity tolerance have high yield potentials. This approach has not been undertaken so far by other researchers to the knowledge of the authors.

The novel technique consists of sowing the seeds at a depth of 2 cm in a plastic pot (height 85 mm, diameter 80 mm) filled with coco peat (neutral delignified coir fibers) and then applying water or required saline concentration up to two-third of the pot. Twenty seeds were sown in each pot in the upper coco peat layer at 2 cm depth which received water/solution by capillarity.

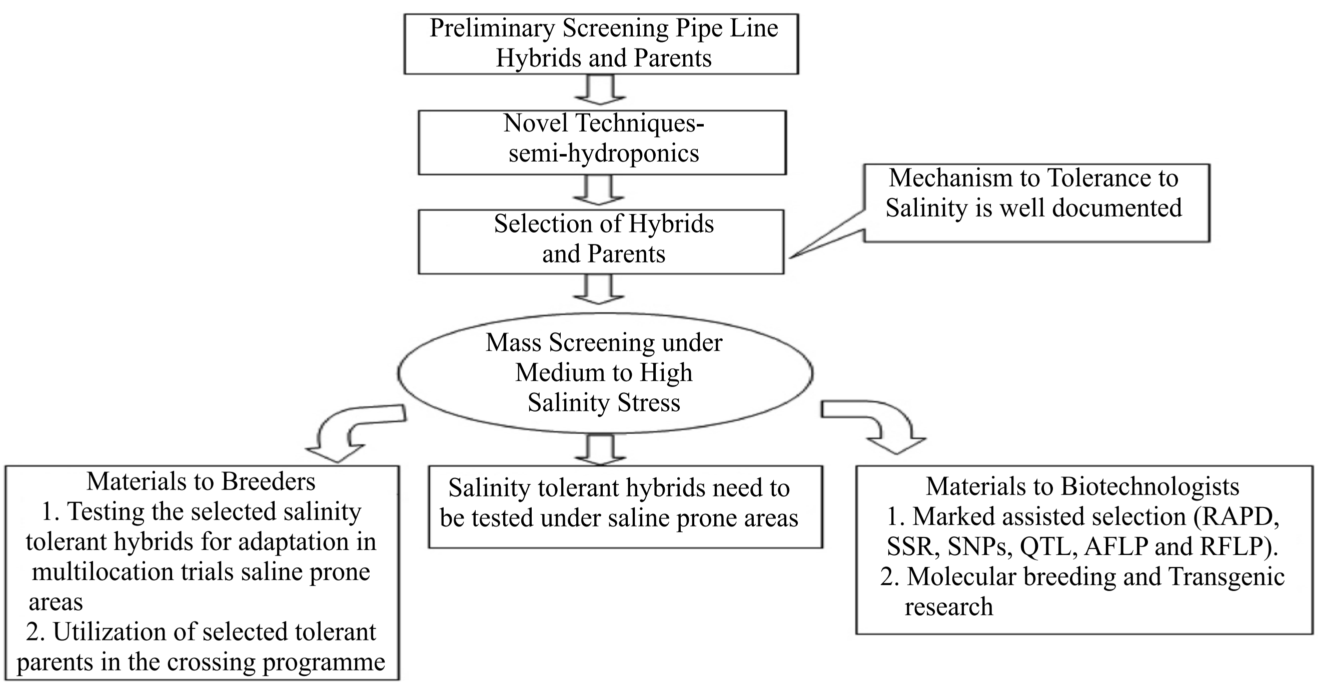
We applied the solution only one time, say water, or saline solution up to the termination of the experiment (18 days after sowing). To protect seeds from fungal attack, seeds were treated with thiram solution (5%, p/v) for 5 minutes before sowing. Seeds were sown in each pot under control (distilled water) along with 0.15 M NaCl or at higher salinity level up to 0.25 M NaCl as per specific experiment. Each of the treatments was replicated thrice for all the genotypes. This technique simulates a semi-hydroponic system where the upper layers of coco peat medium receive water/saline solution only by capillary movement, while the roots are immersed in saturated lower coco peat medium. During capillary movement there is free flow of oxygen owing to constant evapo-transpiration. Observations were recorded taking 15 days old seedlings. Data were taken on average emergence percentage, shoot length (cm), root length (cm), and seedling dry weight (g) on 15th day. The same procedure and the same variables are taken in all the experiments. The main objective of the present study was to determine the efficacy of this new technique on different sets of Bt cotton hybrids for tolerance to NaCl-salinity.

This technique has been made to detect genotypic variability of salinity tolerance of different genotypes of different Vibha field crops at the seedling stage (using distilled water as control, and 0.15, 0.20, 0.25 and 0.30 M NaCl as saline treatments). It was observed that increasing NaCl concentration significantly reduced germination, emergence, seedling shoot and root length showing considerable variations between the different genotypes. Emergence percentage and root length (root elongation) are considered as reliable selection criteria for salinity tolerance. High salinity tolerant genotypes showed greater root length (showing osmotic adjustment such as cotton, maize, pearl millet, etc.) while in the susceptible ones root length was drastically reduced.

Using the above mentioned technique we screened a large number of genotypes of different field crops (cotton, sunflower, pearl millet and maize) and vegetable crops (tomato, chilli, okra, gourds) for salinity tolerance at seedling stage (Gonzalez-Rodriguez and Maiti, 2010). Several hybrids and parents of several field and vegetable crops have been selected for high salinity tolerance in Vibha Seeds, Vibha Agrotech Ltd, Hyderabad, India.

It is confirmed that crop cultivars selected such as cotton showed good adaptation in saline zones of Gujarat, India which clearly establishes the transfer of technology from lab to land. In addition, the parents of crop cultivars selected for high salinity tolerance are being incorporated by the breeders of each crop species for improving their salinity tolerance.

Following flow diagram suggests tentative lines of research on salt tolerance of crop species (Gonzalez-Rodriguez and Maiti, 2010):



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