

Crop Breeding for Low Input Farming Systems and Appropriate Breeding Strategies

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Abstract : More than 1.4 billion people in the world, mostly in developing nations, rely on crops grown in low-input farming systems. And yet, there have been no focused breeding programs so far addressing this system; the conventional high input system appears to have failed to adequately meet the needs and requirements of 'difficult' environments operating under this system. Moreover, the unavailability of resources for crop production is getting to its peak, the environment is maltreated by the excessive use of agrochemicals, crop productivity reaches its plateau stage, particularly in the developed nations, the world population is increasing, and food shortage continues to persist for poor societies. In various parts of the world, genetic gain at the farmers' level remains low, which could be associated with low adoption of crop varieties that have been developed under a high input system. Farmers usually use their local varieties and apply minimum inputs as a risk-avoiding and cost-minimizing strategy. This evidence indicates that the conventional high-input plant breeding system has failed to feed the world population, and the world is moving further away from the United Nations' goals of ending hunger, food insecurity and malnutrition. In this review, we discussed the rationality of focused breeding programs for low-input farming systems, the technical aspect of crop breeding that accommodates future food needs and its significance for developing countries in the decreasing scenario of resources required for crop production. To this end, the application of exotic introgression techniques like polyploidization, Pan-genomics, comparative genomics, and De novo domestication as a pre-breeding technique have been comprised in the review to exploit the untapped genetic diversity of the crop wild relatives (CWRs). Desired recombinants developed at the pre-breeding stage are exploited through appropriate evolutionary plant breeding approaches (EPB). Populations advanced through evolutionary breeding, like composite cross populations (CCPs), are heterogeneous populations and have greater intra- and inter-varietal diversity within the agricultural system and ensure a wider adaptation capacity for crop varieties. Overall, findings and conclusions indicated that low input farming system is a huge farming system that requires distinctive breeding approaches, and exotic pre-breeding introgression techniques and EPB methods, which deploy the skills and knowledge of both breeders and farmers to develop heterogeneous landrace populations, are an effective breeding method for all farmers practicing low input farming across the world.

Keywords : low input farming, evolutionary plant breeding, composite cross populations, participatory breeding

Conference Title : ICAACS 2024 : International Conference on Agriculture, Agronomy and Crop Sciences

Conference Location : Toronto, Canada

Conference Dates : November 25-26, 2024