KEYNOTE ADDRESS

Plant Introduction in Development and Diversification of Indian Agriculture

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Major agricultural crops were domesticated over a period of thousands of years in different phtyo-geographical regions of the world, known as centres of origin and diversity. The development of trade between different civilizations, led to the dispersal of plants of economic importance to other parts of the world contributing to evolution and diversification of agriculture. The process of free movement and exchange of plant genetic resources (PGR) and its utilization in breeding continued through various regimes leading to the development of modern agriculture that feeds more than 6 billion people in the world today. For these reasons, no country is self-sufficient in genetic resources and needs genetic resources from other countries to meet the challenges of crop improvement, responding to changing global agricultural scenario with regard to food and nutritional security and/ or agro-industrial development. The dependence of different countries on non-indigenous crops varies from 63 (e.g. India, West-central Asia) to 100 percent (eg. Australia).

India is one of the major centres of diversity for a large number of indigenous and introduced crops and has immensely benefited from the introduction of crops, high yielding varieties and sources of trait specific genes. In 1960s introduction of dwarfing genes, the Norin-10 and the Dee-gee-woo-gen in wheat and rice, respectively, for developing new plant architecture brought Green Revolution and provided self-sufficiency in food. Naturally occurring male sterility led to the exploitation of opportunities for harnessing hybrid vigour to increase production in many field and horticultural crops. As a result of recent plant introductions, soybean and sunflower became major field crops in India, while several new species, such as hops, simarouba, jojoba, guayule, kiwi, tree tomato, seabuckthorn, oil palm, rambuttan, mangosteen and some others have been adopted by Indian farmers and consumers. Trait-specific introduction in a large number of crops such as oilseeds (groundnut, soybean, sunflower, brassica, oil palm), vegetables (potato, tomato, chilli, onion, cabbage, cauliflower, capsicum) and fruits (apple, pear, peach, apricot, almond, walnut, plum) has been used for enhancing yield and other traits. Some examples of utilisation of exotic germplasm in resistance breeding are nematode resistant varieties, such as NRT 3, NRT 8 and NRT 12, using Nematex, and H 86 and H 88 with resistance to early blight using *L. pimpinellifolium* and *L. hirsutum* respectively in tomato; bacterial wilt resistant varieties IIHR 110, IIHR 121-2 and IIHR 85 using Black Beauty in brinjal; downy mildew resistant variety, Phule Shubhangi using Poinsette in cucumber and black rot resistance variety Pusa Mukta using EC 24855 and EC 10109 in cabbage. The opportunities opened by the molecular biology for moving genes across sexual barriers during 1980s has further enhanced the interest in exchange and use of diverse genetic resources globally, including India.

National Bureau of Plant Genetic Resources, New Delhi, since its inception in 1976 has procured over 2 million accessions/ samples of diverse varieties, genetic stocks, breeding lines, wild relatives of crop plants from 113 countries and 8 International Agriculture Research Centres. A large number of these have been utilized in breeding programmes. A few varieties have been directly introduced to commercial cultivation in crops like wheat (Ridley, Lerma Rojo 64, Sonara 63 & 64); rice (IR 8, 20, 36 and 50); barley (BG105, 108 and DL70); oat (Kent and Rapida); sunflower (Peredovik, Armavirskii); soybean (Clark 63, Bragg and Lee); pea (Arkel, Bonneville, Early Badger and EC 33866); cowpea (EC 50000); French bean (Kentucky wonder, Contender, Jamapa); tomato (Siuox, La Bonita, Fire ball, Dwarf Money Maker and Molakai); onion (Pusa Ratnar and Early Grano); radish (China Red) and water melon (Asahi Yamoto, Sugar Baby).

However, the enforcement of Convention on Biological Diversity in 1993 and the new regimes of intellectual property rights (IPR) as per the provisions of Trade-Related Aspects of Intellectual Property Rights Agreement of 1995 and the International Treaty on Plant Genetic Resources for Food and Agriculture of 2004 have caused a major paradigm shift for exchange and access to PGR. Whilst free-flow of germplasm has benefited agriculture for all countries, apprehensions about such unrestricted access have risen due to major advances in molecular biology, biotechnology and information technology along with the use of intellectual property regimes in these fields. Nevertheless, the search for new genes is an endless effort. In view of ever-changing world scenario, a country like India needs to have a balanced approach to harness the benefit of rich global agro-biodiversity through its technological competence in the larger interest of the nation. Recognising this, concerted efforts are needed on introduction of trait and crop specific germplasm, such as better malting quality germplasm in barley, better wine quality germplasm in grapes, resistant root stocks in fruits, diverse and wild germplasm in oil palm and temperate fruits, and sources of resistance to biotic and abiotic stresses and genetic stocks with specific desirable traits in various agricultural and horticultural crops.

INVITED PAPERS

Plant Introduction and Rice Improvement for South Asia

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Rice is the single most important food crop and 90 percent of it is grown and consumed in Asia. During 1960s there were widespread concerns about the impending food crisis in Asia as rice yields were stagnant and population growth rates were accelerating. International Rice Research Institute (IRRI) was established in 1960 to apply science to problems of rice production. Germplasm conservation, evaluation and utilization received top priority from the beginning of the institute's research programmes.

Rice germplasm bank was established in 1961 through contacting national and international agencies in major rice producing countries. The international conferences held at IRRI and at Hyderabad, India in 1970 led the start of International Rice Collection and Evaluation Project (IRCEP). The outcome of these conferences was the agreement to coordinate and strengthen national efforts on field collection, evaluation and conservation on a systematic and international basis. By early 1980s the number of accessions in IRRI genebank rose to 49,027. The Assam Rice Collection from the Indian programme was a valuable addition to the IRRI genebank. Germplasm in IRRI genebank was continuously augmented and it has now 85,997 accessions of which 27,861 accessions are from South Asia. During 1980s IRRI undertook several exploration missions in Asia, Africa and Papua New Guinea to collect wild relatives of rice. IRRI genebank now contains 3,696 accessions of 21 wild species of *Oryza* besides 1,333 accessions of African cultivated rice *O. glabberima*.

Systematic characterisation of rice germplasm for a range of morphological and agronomic traits including resistance/ tolerance to biotic/ abiotic stresses was undertaken at IRRI. Similarly, the wild species have also been characterised and evaluated. IRRI germplasm is freely accessible and no IPR protection applies to germplasm held in the genebank in trust. A Material Transfer Agreement is used for exchange of germplasm from the collection under which recipients must also certify that they will not apply IPR to the germplasm accessions. Major resources have been devoted to develop improved germplasm with high yield potential, superior grain quality, disease and insect resistance and abiotic stress tolerance. Many donors from South Asia have been utilized in the genetic enhancement programme. Major improvement in the genetic yield potential of rice occurred through reduction in plant height by incorporation of a gene of short nature. The improved varieties are lodging resistant and responsive to fertilizers and have maximum yield potential of 9-9.5 tons per ha. Photoperiod insensitivity was the other important trait inherited mainly from Indian variety TKM6 that contributed in increasing the adaptability and yield stability in new varieties developed at IRRI. These short duration varieties have led to increased cropping intensity.

In the wet and humid tropics, the rice plant is subject to attack by diseases such as blast, bacterial blight,