Ancient Introductions of Crops and Related Taxa into India and Export out of Indian Subcontinent: Some Facutal Data and Gaps in Our Knowledge

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Indian Sub-continent with its tremendous eco-geographical, climatic, pedological and floristic variations has been a wonderful field cum natural laboratory for testing various hypotheses regarding introduction of crop plants, their putative ancestors and related taxa of plants as well as animals since prehistoric times, at the hands of Man. This has been a land of innovation, absorption, amalgamation, improvements and donations (exportations) since antiquity. In cultural terms, Mahatma Gandhi, Pandit Jawaharlal Nehru and scholars from various fields have aptly described it as "Unity in Diversity".

The author tries to visualize the botanical evidences in the form of carbonized and phosphatised grains, husks, fruits, impressions, etc. From scores of archaeological sites to know the time and place of exploitation of botanical wild germ plasm resources along with brief reference to animal wealth. The paper reviews broad phases of initiation of plant domestication in the Indian sub-continent, introduction of foreign crops around *c.* 6000 B.P., *c.* 4000 B.P., *c.* 2000 B.P. and *c.* 400 B.P.; their adoption, assimilation, improvement and exportation of indigenous crops to other regions of the world in antiquity. The rich modern farming system of Indian sub-continent has evolved through historical and archaeological processes and the author tries to present factual palae-bio-geographical indicators for appreciating chronology, region of acceptance, improvements, reflections of cultivated species and wild food produces in historical texts and hints at harnessing of rich biodiversity of potentially useful agricultural plants. The author proposes that such integrated and fundamental studies will also be useful to science-policy makers for duly establishing intellectual property rights of the Indian people with reference to various indigenous arable, tree crops, tuber crops, etc. being exploited since times immemorial.

Plant Quarantine Issues for Germplasm Exchange and Scope for Networking in South Asia

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Plant quarantine plays an important role in preventing introduction of pests and their subsequent establishment along with the exchange of germplasm material in a new geographical area. It is motivated by the philosophy that it is better to endure some inconvenience and expense in an effort to exclude the exotic pests, rather than submit to losses involved following their entry and establishment.

The South Asian countries have a lot of commonalities with respect to agro-ecological conditions, cropping systems and crop spectra. Most of them have contiguous land borders without any natural barriers. The land races and wild relatives of many crops are distributed across national boundaries. Exchange of plant genetic resources (PGR) has contributed significantly towards crop improvement and increased crop production in the region. However, a number of pests have also moved across the countries along with planting material. For example, *Hemiliea vestatrix* causing coffee rust, bunchy

top of banana and coffee berry borer *Hypothenemus hampei* have moved from Sri Lanka to India in 1876, 1940 and 1993, respectively. Now, with the liberalization of trade under World Trade Organization (WTO), the quarantine set-up of all the countries in the region needs to be reviewed. In India, National Bureau of Plant Genetic Resources (NBPGR) is the nodal agency for exchange of germplasm including transgenics. There are a number of issues related to quarantine in germplasm exchange. The legislative issues are country specific where as those of quarantine processing and methodology are applicable to all.

The national quarantine legislation needs to be in harmony with the international norms laid down by International Plant Protection Convention, and India has attempted to do so by bringing out the new Plant Quarantine (Regulation of Import into India) Order, 2003. However, the legislation has been drafted more for facilitating bulk imports than for exchange of germplasm. Under this order a pest risk analysis (PRA) has been made mandatory. The various schedules V, VI and VII of the Order give lists of crops for which a generic PRA is given and detailed PRA is not required. In case of germplasm, a large number of species of cultivated crops (and their wild relatives/ land races) with useful traits are imported but do not find mention in any of the schedules. Hence, a detailed PRA becomes obligatory for them which, in fact, is elaborate and modalities of its preparation are still not clear. Also, the presence of wild relatives, land races of germplasm whose pest profile is not recorded is likely to hamper PRA preparation. There is a need to decentralize the power to waive off the requirement of having a detailed PRA in specific case of germplasm of species not mentioned in any of the aforesaid schedules.

The amount/ size of the germplasm sample is very crucial from quarantine processing point of view, as sampling procedures meant for bulk material cannot be adopted. Also, the technique applied should enable detection of miniscule amounts of pest in the samples drawn and also be non-destructive. The sample size may not be enough for direct testing of seed and post-entry quarantine testing and release from indexed virus-free plants may take one crop season. Diagnostic reagents such as antisera for viruses/ bacteria and the reference collection for insect pests are often not available for exotic pests. Also, the quarantine processing of transgenic plant material needs a containment facility for taking care of the biosafety requirements. Research needs to be intensified on the development of sensitive and non-destructive detection and salvaging techniques, alternatives to methyl bromide, molecular techniques for detection of races/ biotypes/ strains and also low levels of infections. A database on potential quarantine pests and list of endemic pests of different crop species is essential for quarantine personnel as a ready reckoner. A repository of antisera etc. needs to be established, as one has to deal with exotic pests in quarantine.

There is a need to establish a regional plant quarantine network through harmonization of plant quarantine regulations in South Asia on the lines of the Association of South East Asian Nations (ASEAN) and the European and Mediterranean Plant Protection Organization. The plant health related standards of the Region also need to be harmonized to facilitate smooth flow of planting material/ plant products within and outside the region. Common pests present in all the countries could be listed to enable the waiver of additional declarations in the issue of import permit. This would imply a compilation of information on pests present or absent all over the region, or a part of the region. Such a data would also facilitate development of PRA for crops/ pests and trade related plant safety standards of common interest to prevent their use as non-tariff barriers in international trade. Countries with expertise for undertaking quarantine of special crops/ pests could take up that task on behalf of other member countries. Also, movement of plant pests recently introduced in any of the South Asian countries such as *Bemisia tabaci* (B biotype) introduced in India, a polyphagous pest with a wide host range of > 600 plants introduced in India requires immediate attention. Pests like sunflower downy mildew introduced into India and which have yet not spread to other sunflower growing countries like Bangladesh in the region, needs to be carefully monitored especially since we have contiguous land borders. Multidisciplinary collaborative research needs to be taken up, particularly in view of scarcity of resources in many parts of the region.

International Plant Genetic Resources Institute (IPGRI), South Asian Network on PGR (SANPGR), Committee on Sanitary and Phytosanitary Measures of SAARC and Asia and Pacific Plant Protection Commission (APPPC) enhance their efforts in developing a strategy at regional level to identify areas of collaboration, streamline the technical and policy issues and network for safe exchange and quarantine.