*Indian J. Plant Genet. Resour. 29(3): 410-413 (2016)*
DOI 10.5958/0976-1926.2016.00087.5

# Plant Quarantine System for PGR in India

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Exchange of plant genetic resources (PGR) has contributed significantly towards crop improvement and increased crop production in the country. However, many pests have also moved across the countries along with planting material. Plant quarantine is a government endeavour enforced through legislative measures to regulate the introduction of planting material, plant products, soil and living organisms, etc. in order to prevent inadvertent introduction of pests (including fungi, bacteria, viruses, nematodes, insects and weeds) harmful to the agriculture of a country/state/region, and if introduced, prevent their establishment and further spread.

The historical Irish famine of 1845, caused by late blight of potato (*Phytophthora infestans*) introduced from Central America; powdery mildew (*Uncinula nacator*), root eating aphid (*Phylloxera vitifolia*) and downy mildew (*Plasmopara viticola*) of grapes into France in quick succession in mid19$^{th}$ Century from America; coffee rust into Sri Lanka in 1875 and its subsequent introduction into India in 1876 are prominent examples that clearly demonstrate that introduction and establishment of quarantine pests into new areas can severely damage the crop production and economy of a region/ country. Like-wise, in India also, a number of exotic pests got introduced along with imported planting material causing serious crop losses from time to time. These include the recently introduced tomato pin worm *Tuta absoluta* in 2014, Jackbeardsley mealybug (*Pseudococcus jackbeardsleyi*) in 2012, papaya mealy bug (*Paracoccus marginatus*) in 2007, fluted scale on citrus introduced from Sri Lanka in 1928; San Jose scale in apple in 1930s; bunchy top of banana introduced from Sri Lanka in 1943; the golden nematode infesting potatoes introduced in 1960s from UK and the noxious weed, *Lantana camara* introduced in 1809 from Central America are glaring examples that clearly demonstrate that introduction and establishment of quarantine pests including weeds into new areas can severely damage the crop production and economy of a region/country. These introductions highlighted the fact that increased international travel and trade had exposed the country to the danger of infiltration of exotic pests harmful to our agriculture.

With the liberalization of trade under World Trade Organization (WTO), the quarantine set-up including legislation and infrastructure of the country has been reviewed. As far as legislation is concerned, the Destructive Insects and Pests (DIP) Act was legislated by the British government ruling India in 1914 which was retained revising it as per requirements over the years through various amendments. However, after the WTO came into force, India legislated the Plant Quarantine (Regulation of Import into India) Order in 2003, henceforth referred to as the PQ Order. The Directorate of Plant Protection Quarantine and Storage (DPPQS) of the Ministry of Agriculture and Farmers Welfare is the nodal agency for implementation of PQ Order. ICAR-National Bureau of Plant Genetic Resources (ICAR-NBPGR is the nodal agency for PGR management in the country, has been empowered under the PQ Order for issuance of Import Permit and to undertake quarantine processing of all imported PGR including transgenics and trial material meant for research. Besides, NBPGR also tests samples of bulk imports sent by DPPQS for presence of exotic pests.

ICAR-NBPGR is well equipped with most modern quarantine facilities including a Containment Facility of Level 4 (CL- 4) for quarantine processing of transgenic germplasm in a risk-free manner. ICAR-NBPGR also has a well-equipped quarantine station at Hyderabad, which mainly deals with the quarantine processing of PGR meant for Southern India including State Agricultural Universities, ICAR institutes, private industry and international institutes *viz*., International Crop Research Institute for Semi-arid Tropics (ICRISAT), CIMMYT, AVRDC and CIP, Peru.

## Procedure for Import of PGR

Research institutions of public and private sector interested in importing plants or planting material should request ICAR-NBPGR for Import Permit (IP), which

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is not transferable. Phytosanitary Certificate is also a statutory requirement issued by the country of export and is a proof that the consignment has been examined according to the requirements of the importing country and found to be free from the quarantine pests. On arrival of the plant material, they are carefully processed. In case material is found to be infected/ infested with pests, all efforts are made to salvage the material. Only in rare cases, when the material cannot be salvaged it is incinerated. In case post-entry quarantine (PEQ) examination of the imported material is required, it is done at PEQ greenhouse facilities, at NBPGR, New Delhi, its Regional Station, Hyderabad and ICRISAT and also at the indenter's PEQ growing facility.

## Quarantine Processing of PGR

In case of PGR including transgenics, the samples size is generally small and the entire sample is examined for presence of pests and transgenics are also tested for ensuring the absence of terminator gene technology (embryogenesis deactivator gene) which is a mandatory requirement. During quarantine processing, seeds and plant material are examined for the presence of unwanted weed seeds, plant debris, soil clods, insect and mite pests, plant parasitic nematodes and pathogens including fungi, bacteria, viruses, etc. The external feeders and other incidental insect pests infesting the planting material are easily detected visually either by the naked eye or with the help of magnifying glass or stereoscopic binocular microscope. Presence of nematodes is indicated during visual examination by the observation of galls or swellings on roots, tubers and rhizomes; white, yellow or brown pinhead sized round bodies adhering to roots; swollen or malformed leaf, stem or other tissues or root lesions or unusual root proliferation. Fungal infection is indicated by the presence of sclerotia, smut balls, malformed seeds and fungal fructifications on seed surface. Presence of yellow discolouration around the hilum is suggestive of bacterial infection. The discoloured, deformed and shriveled seeds are removed during dry seed examination as these seeds may carry seed transmitted pathogens. The seeds of quarantine weeds for India also need to be detected in imports. Specialized tests used for detection of different groups of pests and all efforts are made to salvage the infected/ infested material before release

## Interceptions in Imported Material

Over the years, during quarantine processing, a large number of pests have been intercepted in germplasm and other research material. Over the years, during quarantine processing, a large number of pests have been intercepted in imported PGR and other research material. The significant interceptions made which are yet not reported from India include fungi like *Claviceps purpurea* in seeds of wheat, barley, *Peronospora manshurica* on soybean from several countries, *Fusarium nivale* on wheat, and barley from Germany, Italy, Hungary, Sweden and UK, *Uromyces betae* on sugarbeet from Belgium, Germany, Italy, UK and USA, *Phoma lingam* on *Brassica* from several countries, *Phomopsis longicolla* on *Glycine max* from USA, bacteria like *Xanthomonas campestris* pv. *campestris* on *Brassica* spp. from Canada, France, Pakistan, Sweden, Taiwan, UK and USA, viruses like *Barley stripe mosaic virus* on wheat from USA, *Broad bean stain virus* on *Pisum sativum* from Spain and *Vicia faba* from Syria and Bulgaria, *Cowpea mottle virus* on *V. subterranea* from Ghana and *V. unguiculata* from Philippines, *Raspberry ring-spot virus* on soybean from AVRDC (Taiwan), Sri Lanka, Thailand, USA, etc. and *Cherry leaf roll virus* on *Glycine max* from Taiwan, Sri Lanka, Thailand and USA and *Phaseolus vulgaris* from Colombia. Insects like *Acanthoscelides obtectus* in *Cajanus cajan* and *Phaseolus vulgaris* from Brazil, Colombia, Italy and Nigeria, *Anthonomus grandis* in *Gossypium* spp. from USA, *Ephestia elutella* in *Macadamia* nuts and *Vigna* spp. from USA, *Quadrastichodella eucalyptii* in *Eucalyptus* from Australia and nematodes like *Heterodera schachtii* from Denmark, Germany and Italy, *Ditylenchus dipsaci, D. destructor, Rhadinaphelenchus cocophilus*, etc. in soil clods and plant debris, and weeds like *Cichorium spinosum* and *Echinochloa crus-pavonis*, which are not yet reported from India.

The pests intercepted can be categorised as (i) many that are not known to occur in India; (ii) have different races/biotypes/strains not known to occur in India; (iii) are present on a new host or are from a country from where they were never reported before; (iv) an entirely new pest species hitherto unreported in science or (v) are reported to be present in India but with a wide host range. Interceptions, especially of pests and their variability not yet reported from India signify the importance of

quarantine in preventing the introduction of destructive exotic pests. The third and fourth category of pests are not expected in the sample as per the risk analysis which is literature-based and since no records are available on the pest/host their presence is unexpected and important from quarantine view point. The last category - pests with a wide host range are critical and could become invasive in case they find suitable biotic and abiotic environment. Such interceptions signify the success of quarantine, otherwise, these pests would have entered the country and played havoc with the plant biodiversity and agriculture.

## Issues in International Exchange of PGR

There are a number of issues related to quarantine in exchange of plant germplasm both legislative and quarantine methodology. The national quarantine legislation has classified all imports as:

- Prohibited plant species (Schedule IV);
- Restricted plant species where import is permitted only by authorized institutions (Schedule V);
- Restricted plant species permitted only with additional declarations of freedom from quarantine/ regulated pests and subject to specified treatment certifications (Schedule VI) and;
- Plant material imported for consumption/ industrial processing permitted with normal Phytosanitary Certificate (Schedule VII).

Under the PQ order, PRA has been made mandatory for all material being imported into the country other than those present in Schedules V, VI and VII. The various schedules V, VI and VII of the PQ Order give lists of crops for which a generic PRA is given and detailed PRA is not required. In case of PGR, a large number of species of cultivated crops (and their wild relatives/ land races) with useful traits are imported. Such wild relatives, land races of germplasm whose pest profile is not adequately recorded hampers PRA preparation and consequently their import. However, in 2007 the legislation has been amended whereby ICAR-NBPGR is empowered to undertake PRA for germplasm material for pest free import. This is more relevant in the present context when access to germplasm is becoming more and more difficult under the Convention on Biological Diversity, 1992.

Another difficulty, which is faced during import of certain material, is the additional declarations being sought under the Schedule VI. Many countries from where a pest is not reported are unable to certify in the phytosanitary certificate the freedom from those pests. The recent amendments of the PQ Order have resolved this problem to an extent by giving country specific requirements under additional declarations. This would greatly help the indentors in procuring germplasm of their interest from varied sources. Besides, NBPGR has also been empowered to relax certain conditions for import in specific cases where the material being imported is of utmost importance for the country.

The technical issues include issues pertaining to quarantine processing are as follows:

- Sample size based non-destructive procedures are required for detection
- A repository of antisera needs to be established as diagnostic reagents such as antisera for viruses/ bacteria are often not available for exotic pests.
- Expertise is also required in the field of taxonomy and biosystematics to identify unknown/new pests or strains.
- Highly sensitive and practically feasible molecular techniques are required for the detection of new pests/ races/ biotypes/strains/pathotypes etc.
- Need to consolidate the taxonomic information and prepare digitized keys for quick and reliable identification of insect pests is reference collections for exotic insect pests and identification keys are not readily available.
- Non-destructive and eco-friendly salvaging techniques are required.
- Post-entry quarantine testing at NBPGR and release from indexed virus-free plants may take one crop season.
- Strengthening of post-entry quarantine facilities at public and private stakeholders.

Websites like http://www.plantquarantineindia.nic.in, consisting of national database on legislation, quarantine procedures, methodologies, plant quarantine alerts, etc. designed by Directorate of Plant Protection, Quarantine and Storage (DPPQS) are available. However, an internet-based portal mechanism for exchange of official information to facilitate communication among countries needs to be developed. Also, availability of databases on quarantine pests and endemic pests would

simplify the work of the quarantine personnel. Such lists of potential quarantine and endemic pests of different crop groups are being compiled at ICAR-NBPGR which would act as a ready reckoner.

It is clear that under the present international scenario, the quarantine specialists have a major role to play not only in promoting and facilitating the export and import in the interest of their respective nations but also in protecting the environment from the onslaughts of invasive alien species. The importance of quarantine has increased manifold in the WTO regime and adopting not only the appropriate technique but also the right strategy for pest detection and diagnosis would go a long way in ensuring pest-free exchange of germplasm and transparency in international exchange, and is considered the best strategy for managing transboundary movement of pests.