



Plant Quarantine: An Effective approach for prevention of alien pest and disease

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ABSTRACT

The important of import and export of plant commodities have been increased during the recent era; there is a distinct possibility of moving insect pests and diseases from their original native habitation to new location. The government of India in 2003 has notification of a new plant Quarantine Order (PQ Order) to harmonized India's regulatory frame work with the International Plant protection Convention (IPPC) and internationally accepted standard and the tenets of the SPS agreement of the World Trade Organization (WTO). Cottony cushion scale, woolly aphid, San Jose scale, golden cyst nematode of potatoes, the giant African snail are some exotic pest introduced into India and cause extensive damage before the PQ Order 2003. So to prevent the introduction of exotic pests, diseases and weeds from foreign countries or within country, legal restrictions are enforced commonly known as Quarantine. Plant Quarantine regulatory measures are taken at the Domestic Quarantine as well as Foreign Quarantine. The enforcement of the quarantine measures is supported by legal enactments, called quarantine laws. It acts as an important tool in excluding pests from the crop. Effective implementation of quarantine is highly emphasized for manage of pests, which in turn helps in maintaining the productivity of crops.

Keyword- Exotic pests, Quarantine, Phytosanitary measures

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INTRODUCTION

Food plants of the world are damaged by more than 10,000 species of insects, 30,000 species of weeds, 100,000 diseases (caused by fungi, viruses, bacteria and other microorganisms) and 1000 species of nematodes [4, 2]. These pests and pathogens not only reduce the quantity but also spoil the quality of the produce to a considerable extent. The responsibility of plant protection addressing phytosanitary issues concerning trade. In the past many diseases are responsible for food scarcities including famines. In addition to endemic problems there are many crop pests which are entered India from other countries because in earlier years India did not have an effective control measure (plant quarantine) system to stop the introduction of exotic pests, diseases and weeds. Cottony cushion scale, woolly aphid, San Jose scale, golden cyst nematode of potatoes, the giant African snail are some exotic pest introduced into India and cause extensive damage.

Therefore, require reducing the losses of commodities damaged by pests and disease. Several approaches of pest/disease management are: exclusion, eradication, protection, therapy, resistance, and biological control. Exclusion or 'keeping out' is fundamental to the concept of plant quarantine while eradication methods are employed to abolish a newly established pest/pathogen. Quarantine can be defined "as a legal restriction on the movement of Agricultural commodities for the purpose of exclusion, prevention or delay in the spread of plant pests and diseases in uninfected areas [3] with a view to prevent accidental introduction of exotic pests, weeds and pathogens dangerous to the agriculture or environment of a country/region, and if introduced, to prevent their establishment and further spread. Plant quarantine is thus designed as safe guard against harmful pests/pathogens exotic to a country or a region. Plant Quarantine regulations are promulgated by the national and the state governments to prevent the introduction and spread of harmful pests and pathogens. Protection of the plant and plant products by

quarantine however only become the governments at the turn of this century, following a series of catastrophic pest and diseases epidemics in different parts of the world. Exotic organisms when introduced have caused extensive damage classical examples of introductions of late blight of potato (*Phytophthora infestans*) was one of the famous examples for what an introduced disease can do to change to course of history, which occur in epidemic form in 1845 devastated entire potato crop in Irish leads to millions of people died due to starvation.

History of Plant Quarantine in India

The consciousness to quarantine actions in India started in early 20th century when the Indian Government in 1906, ordered compulsory fumigation of imported cotton bales to prevent the introduction of the dreaded Mexican cotton boll weevil (*Antonymous grandis*). Destructive Insects and Pests Act, (DIP Act) was developed on February 3, 1914. Over the years the DIP Act was revised and amended several times. However it needs to be periodically reviewed and amended to meet the growing requirements of liberalized trade under the WTO. Directorate of Plant Protection, Quarantine and Storage, under the ministry of Food and Agriculture were setup in 1946 and Plant quarantine activity started in 1946 with the initiation of plant introduction scheme in the Botany Division at Indian Agricultural Research Institute (IARI) New Delhi. Directorate started in October 1949 its quarantine activities at Bombay seaport. First plant Quarantine and Fumigation station in India was formally inaugurated on December 25, 1951. National Bureau of Plant Genetic Resource (NBPGR) was created in August, 1976. Division of Plant Quarantine was created in 1978, with Entomology, Plant Pathology and Nematology sections. In October, 1988, the Plants, Fruits and seeds (Regulation of Import into India) order, 1989 popularly known as PFS order came into force.

Plant quarantine as a national service

From time to time, the introduced pests/pathogens have devastated crops and even created famine conditions in different parts of the world (Table-1).

Table-1 Examples of Pests and Diseases introduced in India from other countries

S. No.	Pests	Scientific name	Year	Native Place
1	Coffee rust	<i>Hemileia vastatrix</i>	1879	Srilanka
2	Late blight of potato	<i>Phytophthora infestans</i>	1883	England
3	Flag smut of wheat	<i>Urocystis tritici</i>	1906	Australia
4	Downey mildew of grapes	<i>Plasmopara viticola.</i>	1910	Europe
5	Rust of chrysanthemum	<i>Puccinia carthami</i>	1904	Japan/Europe
6	Downey mildew of cucurbits	<i>Puccinia cubensis</i>	1918	Srilanka
7	Downey mildew of maize	<i>Perenosclerospora philippensis</i>	1912	Java
8	Foot rot of Rice	<i>Fusarium moniliforme</i>	1930	South East Asia
9	Black rot of crucifers	<i>Xanthomonas campestris</i>	1929	Java
10	Leaf spot of sorghum	<i>Pseudomonas syringae</i>	1934	South Africa
11	Powdery mildew of rubber	<i>Oidiumheveae</i>	1938	Malaya
12	Blank Shank of Tobacco	<i>Phytophthora nicotianae</i>	1938	Holland
13	Fire blight of pear	<i>Erwinia amylovora</i>	1940	England
14	Crown gall of Apple/pear	<i>Agrobacterium tumefaciens</i>	1940	England
15	Bunchy top virus	<i>Pentalonia nigronervosa</i>	1940	Srilanka
16	Canker of apple	<i>Sphaeropsis spp.</i>	1943	Australia
17	Wart of potato	<i>Synchytrium endobioticum</i>	1953	Netherlands
18	Bacterial blight of paddy	<i>Xanthomonas oryzae</i>	1959	Philippine
19	Golden Nematode of potato	<i>Globodera pallida</i>	1961	Europe
20	San Jose scale of apple	<i>Quadraspidio tusperniciosus</i>	1900	Italy
21	Woolly aphid of apple	<i>Eriosoma lanigerum</i>	1928	Australia
22	Sunflower downy mildew	<i>Plasmopara halstedii</i>	1985	Australia

Ireland famine 1845, the late blight pathogen (*Phytophthora infestans*) introduced in Ireland from Central America and resulted almost total failure of the potato crop. Introduction of powdery mildew (*Uncinula necator*), Phylloxera and the downy mildew (*Plasmopara viticola*) in quick succession about the middle of 19th century from America virtually annihilated the grape vine industry of France. The chestnut blight (*Endothia parasitica*) was introduced into the US on the nursery stocks imported from the Orient about 1906. Within 25 years; the American chestnut was almost exterminated as a forest tree causing an estimated loss of 1000 million US dollars. In Sri Lanka, coffee was replaced by tea as a plantation crop because of the widespread epiphytotic of coffee leaf rust (*Hemileia vastatrix*) in 1868. Also, about 20,000 hectares of coconut plantation was devastated by the introduced coconut leaf minor (*Promecotheca cumingi*) during the late 1960s. In India also, several pests and diseases got introduced from time to time, some of which, like late blight of potato, banana bunchy top, bacterial blight and streak diseases of paddy,

have since become widespread. Some others like golden nematode and wart disease of potato and downy mildew of onion are still localized in certain parts of the country. The above examples only highlight the risks involved in inadvertent introduction of serious pests/diseases along with the planting material imported without adequate safeguards. Plant quarantine can provide such safeguards. Plant quarantine measures aim at providing protection to the agriculture of a country or region against the likely ravages of alien pests/pathogens should they get introduced and established. Quarantine not only helps to ward off the threats of exotic pests, but also aim to eliminate and prevent further spread of pests/pathogens (both indigenous and introduced) with restricted distribution within the country (domestic quarantine). According to Mathys [7], Government quarantine offers services which are beyond the capabilities of individual beneficiaries.

PLANT QUARANTINE SYSTEM IN INDIA

Plant quarantine activities in India are carried out under the Destructive Insects and Pests Act (DIP Act) of 1914, and the rules and regulations framed from time to time there under by the Govt. of India. Seed was not covered under the DIP Act until 1984, when the Govt. of India brought forward a comprehensive 'Plants, Fruits and Seeds (Regulation of Import into India) Order, 1984' which came into force in June 1985. With a View to provide the farmers the best planting materials available in the world for maximizing productivity per unit area and to encourage the private seed industry in India not only to meet the internal requirements but also to develop export potential for high quality planting materials. The Government of India announced a new policy on seed development in September 1988.

The new policy covers the import of seeds/planting materials of wheat, paddy, coarse cereals, oilseeds, pulses, vegetables, flowers, ornamentals and fruit crops; Procedures for their import and the related plant quarantine procedures/requirements. This policy also states that absolutely no compromise shall be made with the requirements of plant quarantine procedures to prevent entry into the country of exotic pests, diseases and weeds detrimental to Indian agriculture. Therefore, to meet the plant quarantine requirements in respect to the provisions of the new seed policy, the Govt. of India brought forward, through Gazette Notification, the updated Plants, Fruits and Seeds (Regulation of Import into India) Order, 1989.

The main features of the existing plant quarantine regulations in India are as follows:

(1) No consignment of seeds/planting materials shall be imported into India without a valid 'Import Permit', which is to be issued by a competent authority, to be notified by the Central Government from time to time in the Official Gazette. (2) No consignment of seeds/planting materials shall be imported into India unless accompanied by a 'Phytosanitary Certificate' issued by the official Plant Quarantine Service of the source country. (3) All consignments of plants and seeds for sowing/propagation/planting purposes shall be imported into India through land customs station, seaport, airport at Amritsar, Bombay, Calcutta, Delhi and Madras, and such other entry points as may be specifically notified by the Central Government from time to time, where these shall be inspected and, if necessary, fumigated, disinfested/disinfected by authorized plant quarantine officials, before quarantine clearance. (4) Seeds/planting materials requiring isolation growing under detention, shall be grown in post entry quarantine facility approved and certified by the Designated Inspection Authority (DIA) to conform to the conditions laid down by the Plant Protection Adviser to the Govt. of India. (5) Hay, straw or any other materials of plant origin shall not be used as packing material. (6) Import of soil, earth, sand, compost, and plant debris accompanying seeds/planting materials shall not be permitted. However, soil can be imported for research purposes under a special permit issued by the Plant Protection Adviser to the Govt. of India.

The DIP Act empowers the Central Government to make rules for regulating the import of seeds/planting materials into India and also the movement of the materials from one State to another within the country. The State Governments are also empowered to enact rules/regulations to regulate the movement of materials from one region/area to another within a State. The Directorate of Plant Protection, Quarantine & Storage, headed by the Plant Protection Adviser to the Govt. of India, is primarily responsible for enforcing the quarantine rules and regulations framed under the DIP Act in the country. For this purpose, plant quarantine and fumigation stations have been established at various international airports, seaports and land custom stations where the incoming consignments are inspected, fumigated or otherwise disinfested/disinfected before release to indenters. Consignments of plants/seeds for sowing/planting/propagation purposes, however, can only be imported through Amritsar, Bombay, Calcutta, Delhi and Madras quarantine stations, where facilities in respect to well-equipped laboratories, quarantine green houses and trained scientific and technical manpower are being strengthened to adequately meet the quarantine needs. Quarantine and fumigation stations under the Directorate of Plant Protection, Quarantine & Storage handle bulk imports for commerce and for planting.

Assistances involved in Plant Quarantine

The authority to implement the quarantine rules and regulation formed under DIP Act rest basically with the Directorate of Plant Protection, Quarantine and Storage, under the ministry of Agriculture. The organization handles bulk import and export of seed and planting material for Commercial purposes. Presently there are total '26' different quarantine stations located 10 at Airports (Amritsar, Bombay, Kolkata, Hyderabad, Chennai, New Delhi, Patna, Tiruchirpally, Trivandrum, Varanasi), 9 at Seaports (Bhavnagar, Mumbai, Kolkata, Cochin, Nagapatnam, Rameshwaram, Tuticorin, Vishakapatnam) and 7 at Land Frontiers (Amritsar Railway station, Attari-Wagha Border, Attari-Railway station, Bongaon-Benapol border, Gede Road, railway station, Panitanki, Kalimpong).

National coordination

Most of the plant material enters in the country through air cargo or air mail parcels. The New Seed Policy now permits private enterprises to introduce more material in certain cases under Open General Licence. Mass consignments for consumption or sowing are brought by ships, and small research consignments through air freight or by post, a variety of research institutes under the Indian Council of Agricultural Research (ICAR) and the Council of Scientific & Industrial Research (CSIR) systems, agricultural universities, state departments of agriculture and the private individuals/agencies are the ultimate users of the introduced germplasm material in crop improvement programmes.

The customs, postal, International Airport Authority and Port Authority of India should ensure that the consignments/post parcels containing seeds/planting materials are cleared quickly and are sent compulsorily to the plant quarantine services. The consignments should never be released directly to the users. All international airports/seaports/international post offices should have plant quarantine counters along with the customs counters: Various research institutes and agricultural universities can also contribute a great deal in this respect. The users of the introduced material, whether they are from the research institutes, universities, agriculture departments or private individuals/agencies, could also contribute a lot in the smooth flow of planting material. They should require for import permit, phytosanitary certificates.

International/regional cooperation

Plant quarantine, while being state in completing, is international in character. Therefore, international/regional cooperation is very necessary for achieving the objectives since plant genetic resources are a world resource meant for the welfare of the human race as a whole. Cooperation on the following lines would greatly help in safe exchange of germplasm materials.

1. Association of plant quarantine stations proposed by Kahn [5] to make easy the exchange of genetic stocks and scientific information at international/regional level. Material passing through a plant quarantine station will have very low pest/pathogen risk.
2. At present, thousands of seed samples of a variety of crops are being exchanged by different countries for breeding purposes. This has exposed many countries to the hazards of serious and new seed borne pests/pathogens.

Inspection Procedures in quarantine station

Visual inspection, X-ray test, washing test, Sedimentation test, Incubation test, Grow out test, Serological methods: (a) ELISA (Enzyme Linked Immunosorbant Assay) (b) DIBA (Dot Immuno-binding Assay) (c) ISEM (Immuno-sorbant Electron Micro Scopy) (d) Latex agglutination test, Nucleic acid hybridization and Polymerase chain reaction (PCR).

Domestic Quarantine Regulations

Central government function the domestic quarantine regulations through powers vested under section 4A, B & D and section 5 authorizes the state governments to enact similar regulations and section 5A provides for the penalties. The central, government-issued first domestic quarantine notification against fluted scale (*Icerya purchasi*) and San Jose scale (*Quadraspidiotu perniciosus*) in the year 1944 and 1953, respectively. Govt. of India issued notification to prevent the spread of Banana bunchy top virus disease from Assam, Kerala, Orissa and Tamil Nadu, potato wart (*Synchytrium endobioticum*) from West Bengal and apple scab (*Venturia inaequalis*) from Himachal Pradesh in year of 1951, 1959 and 1977, respectively [1].

Salvaging of infected materials

Once a pest, pathogen or a weed has been detected in the introduced planting material, quarantine officials must make all efforts to disinfect/decontaminate the material and make it available for further exploitation in the country without undue delay. The mechanical cleaning approaches used for salvaging are, hot water treatment, X-ray, radiography, fumigation chemical treatments and growing in isolation of chemically treated seed material [12].

Pest Risk Analysis (PRA) in Plant Quarantine/Quarantine regulations

The Central and the state government to prevent the introduction and spread of dangerous pests and pathogens in view of various rise in the significant of import and export of the plant commodities during the recent years, the current plant quarantine procedure seem to be far from being satisfactorily equipped. To cope with these difficulties, there hamper free market accessibility to the plant commodities and the quarantine should be based on the PRA6. Risk can be defined as expected magnitude of loss. Analysis of pest risk while introducing seeds planting materials is essential to determine the potential of a pest to cause damage. In common, risks are more with the introduction vegetative propagules than true seed. Further, pathogens risks like viruses, downy mildews, smuts and many bacteria carried inside the seed without any external symptoms *etc.* [3, 8, 9]. When vegetative propagules are introduced, rooted plants, and other underground plant parts like rhizomes, suckers, runners, etc. carry higher risks than bud wood, scions and unrooted cuttings. In any case, bulk introductions are always risky as thorough examination and treatment in such cases is very difficult and planting area is far too large to prevent the establishment and spread of the introduced pest/disease.

Based on these factors, plant quarantine regulates the introductions as follows:

1. *Complete embargo/prohibition*: When the pest risk is very high, the safeguards available in the country are not adequate and, therefore, import is prohibited.
2. *Post-entry quarantine*: The risk is very high but adequate safeguards in the form of post-entry isolation growing facilities are available.
3. *Restricted*: Pest risk is not high and import permit is required stipulating conditions for entry, inspection and treatment.
4. *Unrestricted*: Import permit is not required, and material may enter without restriction. While formulating quarantine regulations, local conditions like crop spectrum and environmental conditions are also to be considered. Since quarantine regulations are designed to break the life cycle of the pest/pathogen involved, the presence of alternator collateral hosts in the country of import and their introduction should also be taken into account.

Pest investigation in Plant Quarantine

Since the plant quarantine introduced as legal approach to restrict the entry of any exotic pests and made such as barrier free border etc. Leaf curl virus of cotton has entered in Rajasthan and Punjab bordering Pakistan during early nineties. Pest surveillance should be an integral component of plant quarantine services to make them useful and effective. Pest surveillance is essential to detect occurrence of exotic pest/disease in the early stages of their introduction so as to adopted and enforce domestic quarantine regulation to ward off their further spread or to check the movement of seed and seed material to other areas [1,2, 11, 12].

LIMITATIONS AND CONSTRAINTS

- i. Lack of organized services of PQ at state level, ii. Lack of inert state border PQ check posts at railway and road links, iii. Lack of concerned and coercive action at the state Govt. level, iv. Lack of rigorous seed/stack certificates or nursery infection.

CONCLUSION

The adding of new species (pest and disease) to an environment can affect the well-being of people, whether through fiscal or health. The PQ processes acts as an important device in excluding pests from the crop. Current implementation of quarantine is greatly emphasized for managing of pests, which in turn helps in conserving the productivity of crops.

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