



RESEARCH ARTICLE

PLANT QUARANTINE: AN EFFECTIVE APPROACH FOR THE PREVENTION OF DISEASES: A REVIEW

Manoj Kumar Saini¹, Vishnu Kumar², Deo Prakash Pandey³ and Kumar Chiranjeeb⁴

1. Ph.D. Scholar, Department of Genetics and Plant Breeding, CSK HPKV, Palampur (HP), India-176062.
2. Principal Scientist, ICAR-IIWBR, Haryana, India.
3. Principal Scientist, CSK HPKV, Palampur (HP), India-176062.
4. Ph.D. Scholar, Department of Soil Science, CSK HPKV, Palampur (HP), India-176062.

Manuscript Info

Manuscript History

Received: 31 August 2022

Final Accepted: 30 September 2022

Published: October 2022

Key words:-

Exotic Diseases, Phytosanitary Measures, Prevention, Quarantine

Abstract

A major factor in the long-distance spread of diseases and insect pests that could be dangerous to the agriculture of the importing country is the interchange of germplasm and the international trade of agricultural products. Protecting nations from the unauthorized influx of novel insect pests and illnesses fall within the purview of the National Plant Protection Organizations. Combining regulatory and technical strategies that can guarantee biosecurity for a country or region can be used to achieve the exclusion. The International Standards for Phytosanitary Measures (ISPMs), which offer standards on pest prevention, detection, and eradication, are developed by the Food and Agriculture Organization's International Plant Protection Convention (IPPC). In the recent era, the import and export of plant commodities have dramatically increased, and the chance of plant diseases is also increased from their original native place to new location, where it does not exist. The new diseases have tremendous loss in India and the world. In the last decade beginning the government of India in 2003 has notification of new Plant Quarantine order (PQ order) that harmonized India's regulatory framework with the International Plant Protection Convention (IPPC) and internationally accepted standards and the tenants of the sanitary and Phytosanitary (SPS) agreement of the world trade organization. So, to prevent exotic diseases from a foreign country or within country legal restrictions are enforced commonly known as quarantine laws. Plant Quarantine measures are taken at the domestic or in time or as well as foreign Quarantine. It acts as an important tool to exclude plant diseases. Effectively implementation of Quarantine is highly emphasized for disease management.

Copy Right, IJAR, 2022.. All rights reserved.

Introduction:-

According to an assumption, imported food plants of the world are damaged approximately by 10,000 diseases caused by (viruses, bacteria, fungi, and other microorganisms) which reduce the quantity and quality of food crops. This pathogen reduces the quantity and quality of food crops. The entry of a single exotic pathogen or disease and its

Corresponding Author:- Manoj Kumar Saini

Address:- Ph.D. Scholar, Department of Genetics and Plant Breeding, CSK HPKV, Palampur (HP), India-176062.

establishment in a new environment causes great loss to the country till it cannot be brought under effective control practice. So, the responsibilities of plant protection agency also become important for addressing Phytosanitary issues conferring trade. In the previous era, many diseases were responsible for food scarcity, immigration of people, and demographic changes, because they spread terrible hunger. Some pandemic diseases cause vast loss all over the world like Late blight (*Phytophthora infestans*) of potatoes, Powdery mildew (*Erysiphe necator*), Fire blight (*Erwinia amylovora*) of pear, etc.

Therefore, reducing the plant commodity loss becomes essential, caused due to spreading diseases. There are so many approaches used for disease management avoidance, exclusion, eradication protection, therapy, host resistance, and biological control. Exclusion or keeping out is the fundamental concept of plant Quarantine. In plant Quarantine, the Term 'Quarantine' is derived from the 'Italian' word "quarantina" referring to 40 days. Quarantine is most commonly used for the period of detention for ships arriving from different countries, subject to epidemic diseases such as Cholera, Yellow fever, and Bubonic plague. The crew member and passenger used force to remain isolated and kept isolated on board for a sufficient period for disease symptom development and detection. The purpose of the health authority was to establish an adequate detention period. Plant Quarantine can be defined as a legal restriction on the movement of plant products, and living plant/living plant products for exclusion, prevention, or delay in the spread of the disease in an unaffected area, with the object to prevent the accidental introduction of exotic disease/pathogen. That is harmful or dangerous to the new environment of the agriculture sector of the nation. Plant Quarantine regulations are promulgated by nations or between inter-State governments. Exotic organisms when introduced into a new geographical area can cause devastating damage. A most common example of introduction was; the late blight of potato (*Phytophthora infestans*) was one of the most famous examples of what an introduced disease can do to change the course of history. Which occur in epidemic form in Ireland in 1845 and become the cause of the famous 'Irish famine' because it devastated the entire potato crop in Ireland, one million people died due to starvation and 1.5 million people emigrated from Ireland to Europe.

History of Plant Quarantine

It is generally accepted that the first international Quarantine measures were imposed in 1374 when the city of Venice banned the entry of traveller's suspected of being infected with Bubonic plague. The world's first-time plant Quarantine Law was promulgated in Rollen, France in 1860 to suppress and prevent the spread of common Burberry. The first few countries to establish plant Quarantine services were France, Germany, Australia, and the USA. The USA plant Quarantine, the act was enacted in 1912. Attention to quarantine actions in India was started in the early 20 century when the government of India 1906 ordered compulsory fumigation with Carbon-di-Sulphide at the port against Mexican cotton ball weevil (*Antonymous grandis*) to prevent the introduction it which came with imported cotton balls. In India legislative measure against disease and pests was started under the destructive insect pest act (DIP Act) of 1914 by the governor-general of India on 3rd February 1914.

International Plant Protection Convention (IPPC) the first effort toward an international agreement on plant protection was made in 1914 under the auspices of the International Institute of Agriculture in Rome. After passing several years the DIP act was revised and amended several times. After the Bengal famine of 1943, a Central plant protection organization was established in 1946. The Directorate of Plant Protection, Quarantine, and storage (DPPQS) was established under the ministry of food and agriculture. Plant Quarantine activity started in 1946 with the initiation of the plant introduction scheme in the botany division at IARI New Delhi and the directorate started in October 1949. In India, the first plant Quarantine and fumigation study was formally inaugurated on December 28, 1951. The national bureau of plant genetic resources was established in August 1976 in New Delhi. Division of plant Quarantine was established in 1978 with entomology, plant pathology, and nematology sections. In October 1988 the plant, fruits, and seeds regulation of import into India order 1989 popularly known as (the PFS order) came into force.

Importance of Plant Quarantine

Throughout history, the introduced pathogen /disease has played havoc on field crops, and plants of economic importance and even created famine conditions in different geographical areas in the world.

Table 1:- Worldwide losses caused by introduced plant diseases.

S.No.	Disease	Host	Introduced to	Introduced from	Losses caused
1.	Canker	citrus	USA	Japan	\$13 million, 19.5 million trees were destroyed

2.	Dutch elm	elm	USA	Holland	\$25 million
3.	Blight	Chestnut	USA	Eastern Asia	\$100-1000 million
4.	Powdery mildew	Grapevine	France	USA	80% in wine production
5.	Downy mildew	Grapevine	France	USA	\$ 50,000 million
6.	Bunchy top	Banana	India	Sri Lanka	Rs. 4 Crores
7.	Wart	Potato	India	Netherlands	2500 acres infected
8.	Blue mold	Tobacco	Europe	The UK	\$ 50 million

Table 2:- Diseased believed to have been introduced into India from foreign countries.

S. No	Diseases	Host	Date of the first record	Introduced from
1.	Coffee Leaf rust(<i>Hemileia vastarix</i>)	Coffee	1879	Sri Lanka
2.	Leaf blight (<i>Phytophthora infestans</i>)	Potato	1883	Europe
3.	Flag smut (<i>Urocystis tritici</i>)	Wheat	1906	Australia
4.	Downy mildew (<i>Plasmopara viticola</i>)	Grape	1910	Europe
5.	Downy mildew of Cucurbits (<i>Puccinia cubensis</i>)	Cucurbits	1918	Srilanka
6.	Black rot of crucifers (<i>Xanthomonas campestris</i>)	Mustard	1929	Java
7.	Foot rot of rice (<i>Fusarium moniliforme</i>)	Rice	1930	South East Asia
8.	Leaf spot of Sorghum (<i>Pseudomonas syringae</i>)	Sorghum	1934	South Africa
9.	Blank shank of tobacco (<i>Phytophthora nicotianae</i>)	Tobacco	1938	Holland
10.	Bunchy top of Banana	Banana	1940	Sri Lanka
11.	Crown gall of Apple/ Pear (<i>Agrobacterium tumefaciens</i>)	Apple	1940	England
12.	Fire blight of pear (<i>Erwinia amylovora</i>)	pomes	1940	England
13.	Potato wart (<i>Synchytrium endobioticum</i>)	Potato	1953	Netherland
14.	Bacterial blight of Paddy (<i>Xanthomonas oryzae</i>)	Rice	1959	Philippines

Irish potato famine, 1845 due to the late blight of pathogen *Phytophthora infestans* introduced from Central America II causes starvation of 1 million people and emigration of 1.5 million people. The downy mildew of grapevine (*Plasmopara viticola*) was introduced in America which almost caused economic ruinto the wine industry in France. Beginning in 1865 *Fusarium oxysporum* fungal species becomes theend of the Banana industry in Latin America. Chestnut blight disease (*Endothia parasitic*) was introduced to America from Asia in 1906, within 25 years the American chestnut was almost exterminated. In SriLanka coffee was replaced by tea as a plantation crop due to widespread epiphytotic of coffee leaf rust (*Hemileia vastatrix*) in 1868. Coffee rust introduced from Sri Lanka in India in 1879 is now widespread in all coffee-growing areas. The great Bengal famine, in 1943played a great role in the starvation of people in the rice-growing region in India. Fire blight of pear and other pomes which was introduced from England in 1940 is well established in the UP region of the country. Flag smut (*Urocystis tritici*) of wheat introduced from Australia is now well spreading in Punjab, Uttar Pradesh, Madhya Pradesh, and Rajasthan. The powdery mildew of rubber (*Oidium heavea*), which was introduced from Malaysia in 1938 is causing losses in Kerala.

The example shows the risks involved in the negligence introduction of serious diseases along with the imported planting material without any safeguard. Plant Quarantine provides such safeguards. Plant Quarantine involves preventing the entry of a single exotic insect or disease and its establishment in a new environment that has never been established. Quarantine not only helps to ward off the threats of exotic pathogens or diseases, but it also aims to eliminate and further prevent pathogens or diseases. Government offers services that are beyond the capabilities of individual beneficiaries.

Plant Quarantine Organizations in India

The legislative measures against insect pests and disease were initiated under the DIP act of 1914 which was passed by the governor-general of India in the council on 3rd February 1914 and the rules and regulations were framed from time to time by the government of India. The seed wasn't covered under the DIP act until 1984, but because of the changing situation and to meet the current situation and to meet the current requirement the government of India passed the comprehensive plants, fruits and seeds order 1984 which came into force in June 1985 with a vision to provide best planting material to the farmers which are present in the world to increase productivity and to increase the private seed industry.

In 1988 the government of India announced a new seed policy that covers the import of seeds planting material for 17 crops, paddy, cereal, oilseed coarse, pulses, vegetables, flowers, ornamental, and fruit crops stipulated in this order. This policy also states that absolutely no compromise shall be made with the requirement of plant Quarantine procedures to prevent entry into the country of exotic pathogens and diseases. It authorizes the state and Central government to prohibit or regulate the import into India or any part of the country. It also authorizes the officers of the customs to operate, as if the rules under the DIP act. It authorizes the state government to make rules for the detection, inspection, disinfestations, or infection. It imposes a penalty for persons who break the rule and regulations issued under the act.

The main feature of the existing plant Quarantine regulations in India

The seed has been brought under the purview of the DIP act. No consignment can be imported into India without a valid import permit issued by the plant protection advisor. No consignment of offside planting material can be imported into India without an official Phytosanitary certificate issued by an official gazette. Post-entry growth of the planting material or seed approved at land customs stations airport customs and other entry points in the country.

General condition for import in India

In India, there are general conditions for the import of plants including bulbs, tubers, corms, rhizomes, suckers, roots, budding, cutting, grafting, flowers, and plant material. Import permit for essential for seeds and fruits for consumption, seeds and plants for sowing/planting, soil and Earth clay for microbiology and soil mechanics investing action, pet for horticultural purpose. Planting material should be accompanied by a sanitary and Phytosanitary certificate from the country of origin. All planting material on arrival at port shall be import inspected and if necessary fumigated, disinfested /disinfected is, by an authorized plant protection advisor. Import of hay, straw, or any packing material of plant origin used for packing is prohibited. Import of soil Earth composed Sends Plant Bridge along with plants fruits and shades are prohibited. Cut flowers, garlands bouquets, fruits, and vegetables weighing less than 2 kg for personal use may be imported without a permission or Phytosanitary certificate but are subject to inspection.

Agencies involved in plant Quarantine

The authority involved in implementing the quarantine rule and regulation framed and the DIP act is linked with the Directorate of Plant Protection Quarantine and Storage (DPPQS) under the ministry of agriculture. DPPQS is the nodal agency in India for implementing plant Quarantine regulations which have recently been revised and known as the plant Quarantine regulation of import into India order 2003. The organization operates bulk import and export of seed and planting material for commercial purposes. A total of 94 entry locations, comprising 46 seaports, 24 airports, and 24 land custom stations, are designated points of entry for the import of plants and plant material.

National coordination

The government of India has also approved three other national institutions to act as special plant Quarantine agencies, especially for research material; National Bureau of Plant Genetic Resources New Delhi, Botanical Survey of India Calcutta, and Forest Research Institute Dehradun. The ICAR-National Bureau of Plant Genetic Resources in New Delhi is responsible for quarantine processing on imported germplasm materials, including transgenics. The use of certified disease-free seed and other planting supplies domestically as well as strict quarantine restrictions for imported material are all part of the tactics for biosecurity against insect pests and pathogens.

Mostly the plant material is imported into the country through air cargo or air mail parcels, mass consignments for consumption are brought by ships, and small research consignments by air parcels. Indian Council of Agricultural Research (ICAR) is responsible for Quarantine clearance of seed and plant material received from international agricultural research institutes viz., ICRISAT, ICARDA, and CIMMYT. Till July 1986 the quarantine clearance of all its exchanges was handled by the Central Plant Protection Training Institute of the Directorate of Plant Protection Quarantine and Storage (DPPQS). After August 1986 this authority was letter passed on to NBPGR, New Delhi. NBPGR undertakes the quarantine processing of all Germplasm including transgenic plant material and exchange for research purposes. NBPGR also deals with testing for the absence or presence of Terminator technology which is mandatory as per national legislation. The ultimate user of plant material is ICAR, agricultural universities, agricultural research institute, state department of agriculture, and private agencies. The custom, postal, international airport authorities, and port authorities, of India, should give quick clearance to the consignment of plant material. After clearance of consignment, the authority provides a Phytosanitary or health certificate. After accompanying this

certificate a plant or plant material or seed, which is ready for movement from one place to another place. This certificate indicates or certificates that the material under transit is free from pests and diseases.

International/ regional coordination

International Plant Protection Convention (IPPC) was constituted to secure common and effective action to prevent the introduction and spread of pests and diseases of plant material and to encourage governments to take all necessary steps to implement its prevention. The International Plant Protection Convention (IPPC) is governing body, the Commission on Phytosanitary Measures (CPM), has issued standards known as International Standards for Phytosanitary Measures (ISPMs) The Commission on Phytosanitary Measures (CPM), the governing body of the International Plant Protection Convention, adopts International Standards for Phytosanitary Measures (ISPMs) (IPPC). In 1993, the first International Standard for Phytosanitary Measures (ISPM) was established. There are 46 adopted ISPMs (ISPM 30 is being revoked), 31 Diagnostic Protocols, and 44 Phytosanitary Treatments as of April 2022. These are the international standards: [1] Maintaining sustainable agriculture and increasing global food security. [2] Safeguard the environment, forests, and biodiversity. [3] Encourage economic and trade growth.

Regional plant protection organizations are now in operation. [1] The European and Mediterranean Plant Protection Organization (EPPO). [2] The Inter-African Phytosanitary Council (IAPSC). [3] Organismo Internacional Regional de Sanidad Agropecuario (OIRSA). [4] The Plant Protection Committee for the South East Asia and Pacific region. [5] Comit'e Interamericano de Protection Agricola (CIPA). [6] The Caribbean Plant Protection Commission (CPPC). The purpose of the regional plant Quarantine station is to make an easy exchange of genetic stocks and scientific information at the regional/international level, they also provide low pest/pathogen risk seed and planting material that helps to reduce hazards of the serious and new seed-borne pathogen.

Domestic Quarantine

Under the DIP act the Directorate of Plant Protection, Quarantine, and storage have the responsibility to take the necessary steps and regulate the interstate movement of plant/ planting material under section 4A a b and d and 5. Currently, a domestic plant Quarantine exists in four diseases wart (*Synchytrium endobioticum*) of potato in the year 1959 from the state of West Bengal, bunchy top(virus) of banana in the year 1959 from the state of Assam, Orissa, Kerala, West Bengal, and Tamilnadu, mosaic (virus) of banana in the year 1961 from the state of Maharashtra and Gujarat, Apple scab (*Venturia inaequalis*) from the state of Himachal Pradesh in the year 1979.

Rescuing infected plant material

In case of Quarantine pest/ disease suspected 100 % inspection is carried out for critical assessment of the risk. Visual inspection of planting material to record live insects, infestation & contamination by soil and weed seeds, nematodes gall, sclerotia, smut/bunt, balls, etc. X-ray test to detect a hidden infestation, washing out a test for surface borne oospores of downy/ smut spores/ Bunt spores' detection, incubation test for detecting seed-borne pathogen such as fungi, grow outa test for detecting seed borne virus and bacteria, fumigation for eliminating insect infestation.

Plant Quarantine methods

There are several plants Quarantine methods are used to prevent or arrest the introduction and establishment of exotic disease/ pathogen. The components of plant Quarantine activities are: [1] Complete embargoes/prohibition: it involves the absolute prohibition of planting material import when the disease or pest risk is very high. Effective plant Quarantine treatments are in education in the country. [2] Partial embargoes: It is applied when an effectively operating internal plant Quarantine service exists and also applied when a pest or disease of quarantine importance to an importing country is well known. [3] Inspection and treatment at the point of origin: Inspection and treatment of given plant material when it originates from a country where pest /disease of Quarantine importance to importing country is known to occur. [4] Inspection and certification at point of origin: It involves the shipment inspection and treatment by the importing country in cooperation with exporting country. [5] Inspection at the point of entry: Inspection applied on plant material immediately upon arrival at the prescribed port of entry. [6] Utilization of post entry and plant Quarantine facilities: Introduced planting material is growing under isolated conditions.

Limitations and Constraints

There are many limitations to implementing plant Quarantine in India due to the vastness of the country and unrestricted movement of plant material, lack of organized services of plant Quarantine at the state level, lack of

plant Quarantine check posts at railway and road links, and lack of information regarding concernshipment between interstate government, lack of meticulous rules and regulation in reference of seed stock certification.

Conclusion:-

Despite every precaution of inspection certification and treatment, it can't provide a guarantee that a consignment is completely free from the pathogen. Plant Quarantine clears the doubt about the consignment, it is advised to subject plants to a period of growth in isolation under strict supervision in the importing country. If a new pathogen disease enters a new environment can affect the well-being of humans whether fiscal or health. A practical approach, including post-entry quarantine (PEQ), growing in PEQ greenhouses or containment facilities, electron microscopy, conventional, serological, and molecular diagnostics, has so far resulted in the interception of several pests, including 45 viruses, 19 of which have not yet been reported from India. Adopting the proper approach and method for pest detection would go a long way toward protecting Indian agriculture's biosecurity from the transboundary incursion of plant viruses.

References:-

1. Adopted Standards (ISPMs). (2022). International Plant Protection Convention, <https://www.ippc.int/en/core-activities/standards-setting/ispm/>
2. Chalam, V. C., Gupta, K., Sharma, R., Sharma, V. D., & Maurya, A. K. (2021). Pest risk analysis and plant quarantine regulations. In *Emerging Trends in Plant Pathology* (pp. 663-682). Springer, Singapore.
3. Chand, P., Singh, A., Vishwakarma, R., & Singh, C. K. (2017). Plant quarantine: an effective approach for prevention of alien pest and disease. *Bulletin of Environment, Pharmacology and Life Sciences*, 6(11), 07-12.
4. Kahn, R. P. (1977). *Plant quarantine: principles, methodology, and suggested approaches*.
5. Khetarpal, R. K., Lal, A., Varaprasad, K. S., Agarwal, P. C., Bhalla, S., Chalam, V. C., & Gupta, K. (2006). Quarantine for safe exchange of plant genetic resources. *Hundred years of plant genetic resources management in India*. National Bureau of Plant Genetic Resources, New Delhi, 83-108.
6. Lal, A., & Gupta, K. (2012). Role of plant quarantine in export and import of seed and planting material in horticultural crops. *Quality seeds and planting material in Horticultural crops*, 598
7. Maury, Y., Duby, C., Bossennec, J. M., & Boudazin, G. (1986). Group analysis using ELISA: determination of the level of transmission of soybean mosaic virus in soybean seed. *Agronomie*, 5(5), 405-415.
8. Neergaard, P. (1977a). Quarantine policy for seed in transfer of genetic resources.
9. Neergaard, P. (1977b). *Seed pathology Vols. 1 and 2*. The MacMillan Press.
10. Neergaard, P. (1977c). *Methods for detection and control of seed-borne-fungi and bacteria*.
11. Neergaard, P. (1977d). Quarantine policy for seed in transfer of genetic resources.
12. *Plant quarantine (Regulation of Import into India) Order and amendments (2003)* Department of agriculture and cooperation, Ministry of Agriculture, India, <http://www.agricoop.nic.in/gazette.htm>
13. Singh, R. S. (2017a). *Introduction to principles of plant pathology*. Oxford and IBH Publishing.
14. Singh, R. S. (2018b). *Plant diseases*. Oxford and IBH Publishing.
15. Station, A. B. R., & Cargo, A. (2003). *Plant quarantine including internal quarantine strategies in view of onslaught of diseases and insect pests*. New Delhi, India: NAAS, 1067.
16. *Strengthening & Modernisation of Plant Quarantine Facilities in India* | Directorate of Plant Protection, Quarantine & Storage | GOI, <http://ppqs.gov.in/divisions/plant-quarantine/strengthening-modernisation-plant-quarantine-facilities-india>.