## Prevention and Control of plant diseases:

**A)** Because many thousands of **fungal** species can infect a broad range of plants and because each fungal species has different characteristics, a variety of practices are available to control fungal diseases. The principal control measures include the use of disease-free seed and [propagating](https://www.merriam-webster.com/dictionary/propagating) [stock](https://www.britannica.com/topic/stock-finance), the destruction of all plant materials that may harbor pathogenic fungi, [crop rotation](https://www.britannica.com/topic/crop-rotation), the development and use of resistant plant varieties, and the use of chemical and biological fungicides.

 **B)** In general, the diseases caused by **bacteria** are relatively difficult to control. This is partly attributable to the speed of invasion as bacteria enter natural openings or wounds directly. Direct introduction also enables them to escape the toxic effects of chemical protectants. Losses from[bacterial diseases](https://www.britannica.com/science/bacterial-diseases) are reduced by the use of pathogen-free [seed](https://www.britannica.com/topic/seeding-agriculture) grown in arid regions. Examples of diseases controlled by this method include bacterial blights of beans and peas, black rot of crucifers, and bacterial spot and [canker](https://www.britannica.com/science/canker) of tomato. Seed treatment with hot water at about 50° C (120° F) is also effective for crucifers, cucurbits, carrot, eggplant, pepper, and tomato. Bactericidal seed [compounds](https://www.merriam-webster.com/dictionary/compounds) control some bacterial diseases, such as angular leaf spot of cotton, gladiolus[scab](https://www.britannica.com/science/scab-plant-disease), and soft rot of ornamentals. Rotation with nonhost crops reduces losses caused by wilt of alfalfa, blights of beans and peas, black rot of crucifers, crown gall, and bacterial spot and canker of tomato. Eradication and exclusion of host plants has been useful against citrus canker, angular leaf spot of cotton, [fire blight](https://www.britannica.com/science/fire-blight), and crown gall.

Resistant varieties of crop plants have been developed to reduce losses from wilts of alfalfa, corn, and tobacco; angular leaf spot of cotton and tobacco; and bacterial pustule of soybeans, among others. Protective insecticidal sprays help control bacterial diseases, such as wilts of sweet corn and cucurbits and soft rot of iris. Protective bactericidal sprays, paints, or drenches containing copper or antibiotics are used against bacterial blights of beans and celery, fire [blight](https://www.merriam-webster.com/dictionary/blight), crown gall, blackleg of delphinium, and filbert and walnut blights. Finally, sanitary measures—i.e., clean plow down of crop refuse, destruction of volunteer plants and weeds, sterilization of pruning and grafting tools—as well as refraining from [cultivating](https://www.merriam-webster.com/dictionary/cultivating) when foliage is wet, overhead watering and spraying of indoor plants, and late cutting or grazing of alfalfa and other crops, are useful in reducing the [incidence](https://www.britannica.com/science/incidence-epidemiology) of bacterial diseases.

**C)** After a plant is infected with a **virus**/viroid, little can be done to restore its [health](https://www.britannica.com/topic/health). Control is accomplished by several methods, such as growing resistant species and varieties of plants or obtaining virus-free seed, cuttings, or plants as a result of indexing and certification programs. Indexing is a procedure to determine the presence or absence of viruses not readily transmitted mechanically. Material from a “test” plant is grafted to an “indicator” plant that develops characteristic symptoms if affected by the [viral disease](https://www.britannica.com/science/viral-disease) in question. In addition, more drastic measures are sometimes followed, including destroying (roguing) infected crop and weed host plants and enforcing state and national quarantines or embargoes. Further control measures include controlling insect vectors by spraying plants with contact insecticides or fumigating soil to kill insects, nematodes, and other possible vectors. Growing valuable plants under fine cheesecloth or wire screening that excludes insect vectors also is done. Separation of new from virus-infected plantings of the same or closely related species is sometimes effective, and the simple practice of not [propagating](https://www.merriam-webster.com/dictionary/propagating) from plants suspected or known to harbor a virus also reduces loss.

Infected peach, apple, and rose bud wood [stock](https://www.britannica.com/topic/stock-finance) and carnations have been grown for weeks or months at temperatures about 37° to 38° C (99° to 100° F) to free new growth from viruses. Soaking some woody plant parts or virus-infected sugarcane shoots in hot water at about 50° C (120° F) for short periods also is effective. Both dry and wet heat treatments are based on the sensitivity of certain viruses to high temperatures. Rapidly growing dahlia and chrysanthemum sprouts outgrow viruses so that stem tips can be used to [propagate](https://www.merriam-webster.com/dictionary/propagate) healthy plants. With certain carnations, chrysanthemums, and potatoes, a few cells from the growing tip have been grown under sterile conditions in tissue culture; from these, whole plants have been developed free from viruses.

## Prevention and control of plant diseases:-

For control and prevention of plant diseases various methods are followed. According to the pathogen involved, symptoms and crop affected the method is selected. Prevention is always better but timely control also helps in reducing the losses.

 1) **Use of resistant varieties**: This is very useful easy and low cost method for preventing the diseases. Growing resistant varieties to particular disease is important.

2) **Use of cultural methods**: Proper ploughing, harrowing, timely sowing, balance fertilization and irrigation, crop rotation, mix cropping, proper drainage are the cultural method for protecting crops from diseases.

3) **Chemical Control**: Use of fungicides as a seed treatment and for spraying is a method of controlling various diseases. Spraying insecticides to control disease spreading insects is also essential to protect the crops from viral diseases. Fungicide - Any chemical used to kill or inhibit growth of fungi that cause economic damage to crop or ornamental plants (including rust in cereals, blight in potatoes, mildew in fruits) Most are applied as sprays or dust; seed fungicides are applied as a protective coating to seeds before germination. Copper compounds, especially copper sulfate mixed with lime and water (Bordeaux mixture), and sulfur have long been used for this purpose, but now synthetic organic compounds are commonly used. Many antifungal substances occur naturally in plant tissues.

4) **Biological methods**: Use of natural extracts and micro-organisms to protect the crops from diseases is safest method from environmental point of view.

 5) **Legislative control**: To control spread of diseases from other countries each country has its own legislation.

**Role of quarantine:**

## Introduction

Insects, mites, nematodes, fungi, bacteria, viruses, MLOs and other organisms are known to attack various crops of economic importance. These pests and pathogens not only reduce the quantity but also spoil the quality of the produce to a considerable extent. About crop losses due to the pests and diseases, legendary wheat pathologist, E.C. Stakman (1969) said, 'Weeds, insect-pests and plant diseases reduce the potential agricultural production in the U.S. by 23 percent. The potential food that has been aborted, spoiled or damaged would be enough to feed at least 75 million human beings. In Europe, it could feed Norway, Sweden, Finland, Denmark, Netherlands, Belgium, Czechoslovakia, Switzerland and Portugal or the four Scandinavian countries and the Great Britain. In Africa, it could feed Congo, Tanzania, Kenya, Ethiopia and Sudan'. Indeed, the magnitude of losses caused by various pests and diseases to our crops is frightening. The situation in most of the developing world may still be worse. All out efforts are, therefore, required to at least reduce these losses through proper management of crops and through pests and disease management.

Various methods of pest/disease control 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 eliminate a newly established pest/pathogen. Plant quarantine may, therefore, be defined as 'Rules and regulations promulgated by governments to regulate the introduction of plants, planting materials, plant products, soil, living organisms, etc. with a view to prevent inadvertent introduction of exotic pests, weeds and pathogens harmful to the agriculture or the environment of a country/region, and if introduced, to prevent their establishment and further spread'. Plant quarantine is thus designed as a safeguard against harmful pests/pathogens exotic to a country or a region.

## 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. The Ireland famine of 1845 was the result of an almost total failure of the potato crop due to the introduction of the late blight pathogen (*Phytophthora infestans*)from Central America. 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 epiphytotics 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 alongwith 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. These measures are of particular importance and relevance to countries like India whose economy is largely based on agriculture. 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 (1975), 'Government quarantine offers services which are beyond the capabilities of individual beneficiaries or that are difficult to obtain in some otherway at a lesser cost'. Thus, plant quarantine, in real sense, serves asa national service by preventing the introduction of exotic pests/pathogens/weeds and their further spread. However, such endeavors could succeed only with the active support of all-the administrators, general public, farmers, scientists, communication media, customs and others.

## Quarantine regulations:

Plant quarantine regulations are promulgated by the national and the state governments to prevent the introduction and spread of harmful pests and pathogens. Plant quarantine will be justified only when the pest has no natural means of spread and when they are based on biological considerations only, i.e., pest/pathogen introduction risks and the available safeguards.

In general, risks are more with the introduction of vegetative propagules than with true seed. In case of true seed, risks are more with deep-seated infections than with the surface borne contamination of pests/pathogens. Again, risks are far greater with pathogens like viruses, downy mildews, smuts and many bacteria carried inside the seed without any external symptoms. When vegetative propagules are introduced, rooted plants, and other underground plant parts like rhizomes, suckers, runners, etc. carry higher risks than budwood, 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 alternate or collateral hosts in the country of import and their introduction should also be taken into account.

## Complementary role of plant quarantine:

Plant genetic stocks are a global resource meant for the welfare of humanity. Plant introductions could be in the form of new crops or new varieties for crop diversification, or germplasm in the form of primitive landraces or wild/weedy relatives of crop plants. Germplasm from centres of origin and crop diversity may possess valuable genes for resistance against pests/pathogens, high yield, early maturity, cold, drought or salinity tolerance and quality traits like increased oil, protein contents, etc. Plant quarantine services are charged with the responsibility of preventing entry of hazardous pests, pathogens and weeds, but to deny entry to the valuable genetic resources would be against national interest. These activities are meant to help agricultural development and they are complementary to each other. Too much conservatism on the part of plant quarantine officials and too liberal an attitude on the part of plant introduction officials/breeders would be harmful. Plant quarantine officials must strive to provide adequate safeguards to allow smooth flow of germplasm resources in a healthy state. They should also try to ensure that the germplasm, when received in quarantine station, is processed promptly and that the delays in release, if any, are purely due to biological considerations alone. At the same time, circumvention of plant quarantine must be avoided at all cost even if it means delay in release or rejection of certain materials based on biological consideration. The two should work in unison as members of a single team. Together they should decide the type, quantity and source of the material, and also the required quarantine safeguards. The plant quarantine officials should conduct research on developing sensitive and reliable methods of detection and salvaging treatments, or find alternatives to permit introduction of even high risk genera, if introduction of such materials is in the national interest.