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Post-Harvest Diseases of Horticultural Crops and Their Management

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Loss of earned money is more painful than any other and so is the pain of postharvest loss of a crop. It is loss occurred during transportation and storage not in the field. Therefore there is an urgent need to make efforts minimizing these losses. Present article is designed with collection of the information regarding the post harvest losses of horticultural crops and their management.

Introduction

It is now well recognized that the most economically feasible and expedient means to increase the world food supply is to reduce losses in food crops that occur after they are harvested as the area for cultivation and resources are limited. In India, the diverse Agro climatic conditions permit cultivation of about fifty kinds of fruit crops. The total production of fruits in India is approximately 21 million tons. This can easily be doubled if adequate attention is given to control diseases, both in the field and in storage, which account for over 25-30 per cent loss**.** There is an urgent need for undertaking detailed studies on the various methods of controlling the diseases and to minimize the loss of fruits in the field, in transit as well as in storage. Postharvest losses are much more painful and costlier than pre harvest losses both in terms of money. Postharvest losses involve parasitic diseases caused by fungi, bacteria and viruses, environmental factors, physiological and mechanical factors.

Importance of Horticultural Crops

India is the second largest producer of fruits and vegetables next to China contributing 10.9 and 11.9 % of the total world production respectively. India is the largest producer of mango, banana and papaya. India produces 41.7% of the world mangoes and 25.7 % of the bananas. In grapes, India has recorded the highest productivity per unit area in the world. The per capita consumption of fruits has increased from 40 to 85 g/day and that of vegetables from 96 to 175 g/day within the last one decade.

Importance of Post-harvest Diseases

Post-harvest losses of perishables in developing countries have been estimated to be in the range of 5-50 % or more of the harvest. Many scientists estimate that 20 to 30% losses in fruits and vegetables are due to

post harvest diseases. In India nearly 20-50 % of perishable are lost due to post harvest diseases.

Crop	Loss	Crop	Loss
Banana	20-80 %	Sweet potato	35-95 %
Papaya	40-100 %	Onion	16-35 %
Grapes	27 %	Tomato	5-50%
Apple	14 %	Cabbage	37%
Potato	5-40 %	Cauliflower	49%

Factors Affecting Post-Harvest Diseases

Knowledge of the time and mechanism of infection is essential for the development of an effective programme for the control of post-harvest diseases. There are many causes of post-harvest losses and which can be classified as:

- Mechanical injury
- Insect and mite injury
- Physiological deterioration
- Disease due to non-infectious pathogens

Environmental Factors Affecting Post-harvest Diseases

In general the factors that play a crucial role in the maintenance of quality and incidence of post-harvest diseases are temperature and relative humidity. The microbial attack to different crops becomes very slow at low temperature. But some microbes like the species of *Botrytis, Sclerotinia, Cladosporium* can grow slowly even near freezing temperature. Reported chilling injury in some tropical fruits when stored at 10-15^{0}C. Chilling injuries are generally developed at temperatures below 12^{0}C in grape fruits and which reduce host resistance against pathogen The role of R.H. in the post-harvest environment is equally important as temperature. If the R.H. is high the decay is closely relative but if R.H. is near saturation and temperature is near 0^{0}C, it will lower decay losses.

Biochemical Changes

Fruits and vegetables are considered as the best sources of energy due to the presence of sugars, amino acids, organic acids, vitamins and other nutrients. During pathogenesis many of the fruit rot pathogens bring about a change in nutrients, cause depletion of nutrients and bring about the total loss of nutrients.

The infection of fruit and vegetables both in storage and market by diversified pathogens or by storage fungi brings about many changes in the host fruit by modifying their biochemical composition. Pectolytic and cellulolytic enzymes produced by the pathogens break down the pectic and cellulosic substances of host cell wall.

Integrated Approach for Management of Post- harvest Diseases

I. Pre-harvest Care

A. Phytosanitation

Most of the primary inoculums of much post-harvest disease are carried from the orchard, therefore pre-harvest cultural practices will influence post-harvest diseases problem, and phytosanitation would provide a simple and effective measure to keep the incidence of diseases low, fallen fruits, infected leaves and dead twigs can harbor a large quantities of inoculums. The reproductive bodies of the pathogen on the plant debris can hibernate and can perpetuate the infection cycle (e.g. Acervulus, Pycnidia, Chlamydospores,

Sclerotia etc.). e.g. Anthracnose of Guava (*Gloeosporium psidii*), Anthracnose of mango, Crown rot of banana – Colletotrichum and Botryosphaeria rot of apple.

B. Pre-harvest Chemical Treatments

The effective method to reduce infections initiated in the field, including quiescent infections, is the application of broad-spectrum protective fungicides to the developing fruit on the plant, in order to prevent the infection e.g. Copperoxychloride for citrus brown rot; Benomyl for oranges stem end rot, Carbendazim for Anthracnose and stem-end rot of mango, banana and other tropical fruit crops.

C. Resistant Cultivars

The first pre harvest factor which may affect postharvest quality is the cultivar. In fact, one of the aims of plant breeding and genetic engineering is to incorporate resistance genes in new varieties of crop plants. Differences in cultivar characteristics can markedly affect the keeping quality of the fresh produce e.g. melons with a thick skin and raspberries with a firm texture are better than others to withstand the rigors of harvesting and handling and have longer storage lives.

II. At Harvest Care

A. Maturity at Harvesting

In general the maturity at the time of harvesting is a factor which can influence the post-harvest losses. Both over mature as well as pre-mature harvesting can make the fruits more prone to post- harvest infection. Harvest the fruits at proper stage by considering the size, shape, colour, flesh firmness, sugar, starch and oil content.

B. Harvesting Technique

Choosing the most appropriate time and technique of harvesting is most important. Fruits and vegetables require a careful harvesting technique because of their delicate nature; simple manual harvesting methods however, are usually quite effective and satisfactory. For example the bamboo pole-harvester with a net attached to its top, used in India is excellent for harvesting mango fruits. Whatever harvesting method is adopted, the basic care that needs to be exercised is avoidance of causing punctures or injuries to the fruits during the process, since the tissue thus injured often becomes the focal point of infection at later stages. Harvesting by hand is the predominant method for fruits and vegetables.

III. Post-harvest Care

A. Handling and Packaging

Careful handling of fruit is the most important step that has to be taken at all post-harvest stages. Sorting and grading of the harvested fruits is good farm house practice. Eliminating the fruits showing injury or early symptoms of a disease, revealed at this stage by careful inspection can substantially reduce the intensity of disease at later stages. Packing practice has to be evolved to suit the individual consignment, aiming at the maximum perfection as well as cost effectiveness.

- Before packing remove superficial tissues from banana bunches for reducing the incidence of crown-rot disease.

- Discourage the common Indian practice of using the leaves from respective fruit plants for packaging. Instead of paddy straw, shredded paper or saw dust has been suggested.
- In modern practice corrugated boxes/ fiber board packs/molded plastic trays/ wooden, crates are findings their places.
- Use impregnated paper for wrapping individual fruits such as Mango, Papaya, Banana, Guava with paper.

B. Care during Transport

Horticultural produce may be transported by road, rail, sea or air, sometimes for many thousands of miles. A well planned schedule should be worked out for transportation of fruits according to the mode of journey, the nature of fruits and distance as well as duration of the journey. The fruits of guava and papaya are comparatively more prone to injury and hence need special care during transportation and if possible temperature and other ambient conditions may be controlled. High value perishables can be sent by air, either in wide bodied freights or in the cargo holds of passenger aircraft.

C. Storage

Low pressure storage, cold storage and modified atmosphere storage are aimed out preventing the perpetuation of pathogen and spread of the disease.

(i) Storage disinfection of warehouses: Debris from warehouses/cold storages should be removed, the walls and floors should be washed with bleaching powder, copper sulfate, etc to eradicate the pathogens which are surviving in the store structures.

(ii) Low temperature storage: Low temperature storage is less suitable for tropical fruits like mango, banana, sapota and guava which are sensitive to chilling. Papaya fruit inoculated with *Colletotrichum gloeosporiodes* and when stored at low temperature (10^0 C for 21 days) develops less anthracnose. Suitable temperature for Mango storage is more than 13^0C, temperature below 13^0 C causes chilling injury, for Guava more than 15^0 C, for Banana more than 10^0 C and for Papaya more than 6^0 C is required.

(iii) Cold storage: Storage at low temperature is the main method for reducing deterioration of harvested fruits and vegetables. Low temperature affects both the host and the pathogen simultaneously. They prevent moisture loss from the host tissues and consequent shriveling; they retard metabolic activity and delay physiological changes that lead to ripening and senescence.

(iv) Modified atmosphere storage: This method have found effective in extending the shelf life of harvested fruits. In storage maintaining a low temperature, an adequate humidity, low oxygen, low ethylene concentration are favorable. If atmosphere of Mango storage is modified as 2% CO_2, 6% O_2 and 13^0C it can be stored for longer.

D. Postharvest Treatment with Chemical

Since open wounds, created during harvesting, handling and packaging are the major sites of invasion by postharvest wound pathogens, the protection of wounds by chemicals will considerably decrease decay in storage. Many chemical compounds have been used as part of

post-harvest treatment of tropical fruits for the retardation of microbial infection. e.g. Inorganic copper or sulphur compound, Phenolic compounds, Dithiocarbamates, Antibiotics, Systemic fungicides (benomy/TBZ), Iprodine, Imazalil, Prochloraz, Fosetyl, etc. Contents of major and minor nutrients also influence on storage rots, for example higher N in apple increase the decay due to *Gloeosporium* and Boron deficiency in Aonla causes blackening of fruits.

E. Physical Methods

(i) Fruit irradiation: Radiation treatments are meant for killing or weakening the quiescent pathogen thereby improving the shelf life of the fruits. Among the ionizing radiation gamma irradiation has been most successfully used for inhibiting the growth of pathogens inside fruit tissue. Irradiation ranging between 0.3 KGY and 1.2 KGY reduces the incidence of post harvest storage disease of mango (Gloesporium & Botryodiplodia) but a dose above 0.6 KGY results in lenticels spotting and surface discoloration of the fruits. e.g. peaches, strawberries guava fruits (infected by *C. gloeosporides* to radiation at 100 Krad (1 KGY). Alternaria, Botrytis and Stemphylium can be controlled in vegetables in greenhouses with special UV-absorbing polyvinyl film.

(ii) Washing fruits: After harvest before packing/marketing individual fruits or fruit bunch should be washed in abundant flow of clean water to remove plant debris/trash/latex and pathogen which are responsible for causing diseases in transit.

(iii) Hot water treatment: Hot water treatment is promising and has been used with success in eradicating or suppressing the development of fungi/bacteria on the fruit surface as well as those situated just below the surface as a result of pre harvest infection.

(iv) Heated forced air treat/Aerated steam/hot air: Recently heated forced air treatment has gained some importance in the postharvest treatment of some fruits. e.g. Mango at 48^0 C for 15 minutes considerably reduce the anthraonose /stem end rot (*B. theobromae*) and also eradicate the infection of fruit fly.

(v) Drying fruits: Many fruits can be stored for longer time after drying and can be kept free of disease because moisture is kept below a certain level during storage e.g Grapes, plums, dates and figs, slices of fleshy fruits-apples, peaches and apricots, etc.

F. Biological Control

Employing microbial antagonism offers one of the most effective means of controlling the post-harvest diseases without any adverse effect on the environment and the consumer. Control of pathogen through employing antagonist is popularly known as bio-control. Spraying with suspensions of *T. harzinum, T. viride, Gliocladium roseum* and *Paceilomyces variotii* resulted in a partial control of Botrytis in strawberry fruits and Alternaria rot in lemons.

G. Fruit Coating with Vegetable / Edible Oil

Use of vegetable oils in plant disease control is a relatively recent development in the field of plant pathology. e.g. Castor, Linseed, Mustard, Sunflower, Safflower, Groundnut, mineral

oils, Palmarosa, red thyme / liquid paraffin, etc. coated on harvested fruits to prevent entry of pathogen as well as decreasing respiration due to their antifungal activity.

H. Homoeopathic Drugs/Growth Regulator

In recent years some homoeopathic drugs have been used for the control of post- harvest spoilage of fruits. For example, Lyeopodium 140 for *Pestalotia mangiferae*, Kaliodatum 200 for Stem-end rot and Rhizophous rot of mango fruits and Methyljasmonate-200 for Fusarium fruit rot of banana.

I. Natural Plant Products

The study of green plants of their antimicrobial activity has received little attention though such activity was known since ancient times.

Neem leaves were kept in woolly cloths and grain store houses for preventing deterioration by molds & pests and still today it is common practice. Baskets of fruits and vegetables are lined with neem leaves for their protection against microbial attacks. It is believed that toxic substance emitted by the leaves keep the air remarkably free of pathogenic microorganisms.

Conclusion

On the basis of above information it can be concluded that an appreciable amounts of harvests are lost due to the post harvest diseases in the horticultural crops but it can be reduced through their management which should be at right time and right place for more profit to the farmers as well as share to the national economy.