Physical Methods – Heat treatments, soil solarization, hot water treatment, hot air treatment, control by refrigeration and radiation

As early as 1832, Sinclair suggested that hot air treatment in an oven might control smuts of oats and barley. Gardeners in Scotland while treating the bulbs of different ornamental plants first employed hot water therapy.

The scientific principle involved in heat therapy is that the pathogen present in seed material is selectively inactivated or eliminated at temperatures that are non lethal to the host tissues.

Following physical methods are employed for reduction or elimination of primary inoculums that may be present in seed, soil or planting material.

i. Hot water treatment (HWT)

The seeds are soaked in cold water at 20-300C for 5 hrs to induce the dormant mycelium to grow. Then the seeds are immersed in hot water at 50-540C for 10 minutes to kill the mycelium. It is very effectively used to eliminate loose smut of wheat. The setts of sugarcane can be treated at 500C for 2 hrs to eliminate grassy shoot pathogen. The main drawback in the hot water treatment is that the seeds may be killed or loose its germinability, if the period of treatment exceeds the specified time. So this method is replaced by other physical methods like Hot air and Aerated steam treatment wherein the seeds are exposed only to hot air/aerated steam.

ii. Hot air treatment (HAT)

Sugarcane setts are treated with hot air at 500C for 2 hrs to eliminate mosaic virus.

iii. Aerated steam therapy (AST)

Sugarcane setts are also exposed to aerated steam at 500C for 3 hrs to eliminate mosaic virus.

iv. Moist hot air treatment (MHAT)

This method is effectively used in sugarcane to eliminate grassy shoot disease. Initially the setts are exposed to hot air at 540C for 8 hrs, then exposed to aerated steam at 500C for 1 hr and finally to moist hot air at 540C for 2 hours.

v. Solar heat treatment (SHT)

A simplest treatment has been devised in India to eliminate the pathogen of loose smut of wheat. Previously the hot water treatment was followed to eliminate loose smut. As the termal

death point of the fungus and the embry are very close. The extensive care should be taken to avoid killing of the embryo. Luthra in 1953 devised a method to eliminate the deep seated infection of *ustilago nuda.* The method is popularly known as solar heat or solar energy treatment.

Luthras solar energy treatment: The seeds are soaked in cold water for 4 hours in the forenoon on a bright summer day followed by spreading and drying the seeds in hot sun for four hours in the afternoon. Then, the seeds are again treated with carboxin or carbendazin at 2g/kg and stored. This method is highly useful for treating large quantities of the seed lots.

vi. Soil Solarization

Soil solarization is generally used for controlling soil-borne pathogens like *Pythium, Verticillium, Rhizoctonia, Fusarium* etc. and nematodes in small areas like nurseries. Irrigate the nursery bed to moisten the soil to a depth of 10cm. Cover the bed after 2 days with thin transparent polythylene sheets for 4-6 weeks and then irrigate the beds once in a week. The purpose of irrigation is to increase the thermal sensitivity of resting structures of fungi and to improve heat conduction.

vii. Steam Sterilization

Steam is passed through perforated pipes at a depth of 15 cm to sterilize the upper layers of soil. It is mostly practiced under glass house and green house conditions.

viii. Hot air Sterilization

Hot air is also passed through pipelines to sterilize the soils in the nursery areas.

ix. Hot water treatment

It is mainly done in pot culture studies to kill the fungi and nematodes. The pots containing soil are immersed in boiling water at 980C for 5 minutes or drenching boiling water @ 20 litres/ Sq.m.

Refrigeration

It is an accepted fact that the low temperature at or slightly above the freezing point checks the growth and activities of all such pathogens that cause a variety of post harvest diseases of vegetables and fruits. Therefore most perishable fruits and vegetables should be transported and stored in refrigerated vehicles and stores. Cool chains refrigerated space from field to consumer table is becoming very popular. Regular refrigeration is sometimes preceded

by a quick hydro cooling or air cooling to remove the excess heat carried in them from the field to prevent development of new or latent infections.

Radiation

Electromagnetic radiations such as ultraviolet (UV) light, x rays and y rays as well as particulate radiations have been studied in relation to management of post harvest diseases of horticultural crops. Y rays controlled post harvest fungal infections in peaches, straw berries and tomatoes but doses of radiation required to kill pathogens, were found injurious to host tissues. Some plant pathogenic fungi sporulate only when they receive light in the ultraviolet range. It has been possible to control diseases on green house vegetables caused by species of these fungi by covering or constructing the green house with a special UV absorbing vinyl film that blocks transmission of light wavelengths below 390 nm.