

## Study on soil treatment for plant disease control

### Soil treatment

Soil treatment is the process by which soil are treated with the mixing of soil treating chemical substances up to depth of 10-15 cm soil surface for killing or controlling soil-borne pathogens.

### Objectives

To destroy the soil-borne phyto-pathogenic fungi, bacteria and nematodes without disturbing the natural balance.

### Methods of soil treatment:

#### A. Physical methods

i) Heat treatment ii) Hot water treatment iii) Vapor treatment iv) Electric heat treatment

The above mentioned methods are not practiced in our country but the following practices are commonly used by our farmers:

- Summer ploughing/ Solar heating: Deep ploughing during summer periods buries the inocula of fungi of soil borne nature. Fungal propagules, sclerotia and different types of spores conidia on plant refuses die when exposed to sunlight due to the higher temperature prevailing during the summer.

- Solar heating: When the soil is covered with white polythene sheets during hot seasons, soil temperature increases. Increased soil temperature eliminates wilt pathogens like *Fusarium oxysporum* f. sp. *lycopersici*, *Rhizoctonia solani*, *Sclerotium rolfsii* etc.

- Burning of stubbles and crop residues: Burning of plant wastes, crop residues, stubbles, etc., in the areas selected for raising nurseries for vegetable crops, tobacco, chillies and forest trees etc. heats the soil and kills the inoculum of the pathogens present in the top layer of the soil.

#### B. Chemical methods

i) Soil drenching ii) Furrow application iii) Broadcast iv) Fumigation v) Ball placement

The chemical methods that are practiced in our country are as follows:

##### 1. Soil drenching:

Fungicides are made up with water at the definite concentration and applied to the soil surface either before or after seeds emerge. Certain quantity of fungicide suspension is applied with a sprinkler per unit area so that the fungicide in general reaches a depth of a least 10-15 cm. This method is followed for controlling damping off, root rots, or any kind of infections at the ground level.

##### 2. Furrow application

Fungicides are applied either as dusts, granules or with water to the furrow at the time of planting following this method. This method requires less quantity of fungicides per hectare than the broadcast method. Special equipment must be required for such application since manual

application is never uniform. This method is suitable for the crops planted in furrows such as potato and sugarcane.

### 3. Broadcast

Non-volatile fungicides are mixed with soil or fertilizers and broadcast on the soil surface. Dust, powdery or granular fungicides are generally applied by this method. Light ploughing or harrowing is applied to mix the chemical in sufficient depth after broadcasting. In this method involves consumption of greater quantity of fungicides than other methods and is applicable where suitable implement/equipment for proper application of fungicides are not available.

### 4. Fumigation

Soil fumigation, is usually done to control soil-borne fungi and plant parasitic nematodes. The chemicals used for this purpose are usually volatile and in contact with soil moisture releases gases which diffuse in the soil and kill the larvae of the nematodes and fungi. Some impervious cover like thin polythene sheet which confined the gas into the soil for a limited period of time. Application of these highly toxic volatile substances is recommended some days or weeks before actual planting of the crop. This method is usually restricted to small areas and high value crops. Since the diffusion is restricted to certain distance the chemicals are injected into soil at regular distance (12-15 inches) all over the field and the depth of application is kept at 6-9 inches.

Some soil treating chemicals

A. Volatile chemicals: Chloropicrin, Methyl bromide, Vapona and Formaldehyde etc.

B. Non-volatile chemicals: Copper fungicides, ZnO, PCNB, Dithio carbamate, salt of Ca and Chestnut compound.

Types of soil treating chemicals

a. Pre-emergence chemical: There are chemicals which are phytotoxic and can be used as pre-emergence drenches e.g. Formaldehyde, Methyl bromide (MB), Chloropicrin, Vapam, Ethylene dibromide(EDB), D-D (Dichloropropane-Dichloropropane).

b. Post-emergence chemicals: There chemicals which are less phytotoxic and can be used after emergence e.g. Copper fungicides, Organomercurials, Dithiocarbamates, PCNB, nemagon etc.

### **Soil treatment with formalin solution**

The Formaldehyde chemical is used to Soil Fumigation. Formaldehyde is marketed as Formalin, an aqueous solution, which contains 37-40% formaldehyde, which has a poor penetration and diffusion ability.

Formalin is a widely used chemical for soil and compost disinfection. It is normally diluted with water 1:50–100, at a rate of 10 liters/m<sup>2</sup> (depth 10-15 cm) for the control of bacteria and fungi. After watering, the soil is covered with polyethylene films for a day or two in such a way that formalin vapours may be retained in the soil. The new crop is planted 10–15 days after its application.

Treatment of small seed bed

Small sized seed beds (4 x 2.5 m<sup>2</sup>) should be prepared on the surface of the soil at equal distance. Then the chemical apply / drench on the soil surface and mixed with soil properly.

Then compress by hand press and cover by a polythene paper for 48 hours. Then the polythene sheet will be turned out and spading the soil. The soils loos and expose soil to the environment helps for the removal of toxic bases. After 7 days, the seed beds are ready for sowing seeds.

#### Treatment of pot soil

For experimental purpose, sometimes soil is treated by autoclaving. Another alternate way for treatment of pot soil is to use the formalin. Soil to be collected from the field. The clods should be broken and removed stables. Then the soil spread on a brown paper and the approximate volume of the soil determine by measuring tape. Then, formalin solution @ 6-10 liters/m<sup>2</sup> (1:50-100 ratio, depth 10-15 cm) should be mixed with soil uniformly. Finally the soil will be kept in the pot and covered with a plastic sheet for 48 hrs to retain the gases within the soil. After 7-15 days, the treated soil will be ready for use.

### C. Biological method

This method consists of the use of microorganisms or derived products from living organisms, aiming at total or partial suppression of soil phytopathogens. The fungus *Trichoderma harzianum* and *Trichoderma viride* is most important bio control agent which mainly used for the control of root rot diseases of pulses, oil seeds, vegetables and tuber crops. *Trichoderma* sp. produces chitinases and  $\beta$ -1, 3 glucanases which lyses the cell wall of *Rhizoctonia solani* and *Sclerotium rolfsii*. *Pseudomonas fluorescens* and *Bacillus subtilis* bacteria also very popular and tremendously use as bio-control agents.

#### Preparation of *Trichoderma* Inoculum

Inoculum of the *Trichoderma* should be prepared on autoclaved moist wheat grains in 500 ml Erlenmeyer flask. Before using, wheat grains soak in water for 12 hours. After soaking excess water drain out and water soaked grains pour into 500 ml Erlenmeyer flask. Five-millimeter diameter mycelial discs cut from the edge of three days old PDA cultures in petri dishes. Then, add to autoclaved wheat grains in the flasks and incubate at 25 °C for 21 days. It should be shaken by hand at 2-3 days interval for proper colonization. Finally, wheat grain colonized *Trichoderma* will be mixed thoroughly with the soil at the rate of 90 g/m<sup>2</sup> soil.