

Soil Application Methods of Fungicides: Fundamental Information

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To eradicate or reduce the inoculum density of soil-borne plant pathogens.

Methods of soil treatments:

1. Soil drenching:

In this method fungicides are mixed in water and about the same Concentration as for spraying and applied to the soil surface either before or after plants emerge. The required quantity of fungicide suspension is applied with a sprinkler or rose can per unit area so that the fungicide reaches a depth of at least 10-15 cm. This method is followed for controlling damping off. Root rots or infections at the ground level.

Quantity of fungicidal solution required for soil drenching:

- For Mini plots or shallow flats: 2.5 L/m²
- Pots up to 40 cm size and propagative beds up to 10 cm in depth: 3.0 L/ m²
- Pots and propagative beds greater than 10 cm in diameter or depth: 3.5 to 6.0 L/ m²

Important fungicides used for soil drenching:

Fungicide Dosage (%) Pathogens controlled:

- Bordeaux mixture 1 % - *Pythium, Phytophthora*
- Cheshunt compound 0.3 % - *Pythium, Sclerotium.*
- Copper oxy chloride 0.2 to 0.3 % - *Pythium, Phytophthora*
- Captan 0.2 to 0.3% - *Pythium, Phytophthora*
- Captafol 0.3 % - *Macrophomina, Pythium, Rhizoctonia, Phytophthora*
- Dexon 0.1 to 0.2 % - *Pythium, Phytophthora*
- Carbendazim 0.15 % - *Fusarium, Rhizoctonia, Sclerotium*
- Benomyl 0.15% - *Fusarium, Rhizoctonia, Sclerotium*
- Fosetyl-AL 0.2% - *Phytophthora, Pythium*
- Metalaxyl (Ridomil-MZ) 0.2 % - *Pythium, Phytophthora*

- Vitavax 0.15% -*Fusarium, Rhizoctonia, Sclerotium*

2. Broadcast:

In this method fungicides are mixed with soil or fertilisers, and scattered with hand as uniformly as possible over the field and mixed with the soil with a suitable implement. This method involves greater quantity of fungicides than other methods.

For example:

Benomyl @ 12-45 kg a.i. /ha for soil treatment by broadcast controls pea root rot and *Verticillium* wilt of potato.

3. Furrow application

Fungicides are applied either as dusts or mixed with water to the furrow at the time of planting for control of diseases that occur at the base of the plant. This method 'requires' much less quantity of fungicides per hectare than broadcast method.

For example:

Captan @ 25-30 kg/ha for furrow application for the control of onion smut, Thiram @ 15-25kg/ha for furrow application for the control of smut and neck rot of onion.

4. Fumigation:

This method is usually restricted to small areas and high value crops. Fumigants are used to control soil-borne fungi and nematodes. These chemicals produce a gas that distributes itself through the soil. After application of chemicals to soil, it should be covered with a thin polythene sheet for some time.

Fumigant Pathogens controlled:

- Methyl bromide- *Rhizoctonia, Nematodes, Pythium*
- Vapam- *Pythium* and Nematodes
- Methyl isothiocyanate- *Rhizoctonia*
- Sodium azide, Potassium azide- *Sclerotium rolfsii*
- Nemagon- Nematodes, *Pythium*
- Formaldehyde (37-40 % soln)- *Pythium* and *Rhizoctonia*
- Chloropicrin- *Pythium* and *Nematodes*

Precautions:

- Soil should be in good planting conditions
- Soil should be moist enough to permit seed germination

- Manure, peat, compost and other humus material must be added before treatment, when using soil fumigants, fertilizers containing ammonia or ammonium salts should not be added to the soil at the time of treating.
- Planting should be done two to four weeks after the treatment.

Methods of Application of Fungicides-Seed and Foliar Application

a) Seed treatment:

Seeds, tubers, bulbs, setts and other propagating materials are given physical / chemical treatment for eradication of pathogens present on them and for preventing their rot in the soil after planting.

Types of seed treatment:

There are various types of seed treatment and the important ones are physical and chemical methods.

Physical methods:

1. Mechanical separation:

Healthy seed contaminated with ergot of rye, ergot of bajra, false smut of rice, ear cockle of wheat can be separated mechanically because the pathogen causes alteration in size and weight of the seed.

2. Steeping the seed in Brine Solution:

The diseased grains are removed by steeping the seed in the brine solution and the diseased grains float due to their lightweight.

Examples: Ergot of rye, ear cockle of wheat.

3. Hot water treatment:

Jensen (1887) suggested this for control of loose smut of wheat. Hot water treatment aims at destroying the infection in the seed without harming the embryo.

Examples:

- loose smut of wheat-Hot water treatment of seeds at 52°C for 10 minutes.
- Whip smut of sugarcane - hot water treatment of setts at 52°C for 30 minutes.
- Grassy shoot of sugarcane - hot water treatment of setts at 52°C for 30 minutes.

Diseases controlled by Hot Water Treatment:

Crop Disease Temperature:

- Sesamum Bacterial leaf spot Treat seeds at 44°C / 10 min.

- Mustard *Alternaria* Treat seeds at 50°C / 30 min.
- Potato Virus infection Tuber treatment at 50-56°C for 15-20 min.(or) 50°C for 10-12 min.
- Cotton Bacterial blight(black arm) Seed treatment at 52-56°C/10 to 15 min.
- Sugarcane Red rot Sett treatment at 52°C / 30 min.
- Whip smut Sett treatment at 52°C / 30 min.
- Grassy shoot Sett treatment at 50°C / 30 min.

Solar treatment:

It is a safe and convenient method than hot water treatment. J.C. Luthra (1931) suggested this method for control of loose smut of wheat. Wheat seed is pre-soaked in water for 4-5 h in the shade or in a room and then dried on ground/concrete floor in a thin layer in sun for 1 hr usually at noon.

Chemical Methods

Fungicidal seed treatment:

The treatment of seed with fungicides is commonly called seed dressing and the fungicide used is known as Seed Dressing Agent (or) Seed Dresser. Fungicidal seed treatment not only kills the pathogen present on / in the seed but also protects the germinating seeds from other soil-borne pathogens till they become established into young plants. Fungicidal seed treatment methods include wet seed dressing and dry seed dressing.

Wet seed dressing:

a) Seed dip method:

Dipping the seed or seed materials in fungicidal solution for 5-20 minutes and drying them in shade before sowing. This method is particularly useful to check externally seed borne diseases.

Fungicides / Bactericides used: Captan, carbendazim, Agrimycin-100 and 500 Aureofungin.

Concentration: 0.1 to 0.5% (2g/kg seed / L of water) Diseases controlled by wet seed treatment.

Diseases controlled by wet seed treatment

Crop Disease Procedure

- **Sugarcane** Red rot, Whip smut, Pine apple rot-Dipping of setts in carbendazim (5g/10 lit.) solution for 15 minutes.

- **Turmeric** Rhizome rot- Dipping of rhizomes in 0.3 % mancozeb solution for 30 minutes (3 g/lit.)
- **Ginger** Rhizome rot- Dipping of rhizome in 0.2 % mancozeb solution for 2 hr (2 g/lit.)
- **Betel vine** Stem rot, Leaf spot- Dipping of vines in 0.5 % Bordeaux mixture + 500 ppm streptomycin solution for 30 mts.
- **Chilli** Virus infection- Dipping of seeds in Trisodium orthophosphate solution (90 g/lit.) for 15 mts.
- **Sesamum** Bacterial leaf spot- Dipping of seeds in 200 ppm streptomycin sulphate or 250 ppm *agrimycin* solution for 1 hour.
- **Beans** Bacterial leaf spot- Dipping of seeds in 500 ppm streptomycin solution for 1 hour.
- **Cotton** Black arm -Dipping of seeds in 1000 ppm streptomycin sulphate
- **Rice** Bacterial leaf blight -Dipping of seeds in 250 ppm *agrimycin* solution for 12 Hours
- **Cabbage and Cauliflower** Black rot- Dipping of seeds in 100 ppm *agrimycin* or streptomycin solution for 30 minutes.

b) Slurry treatment:

The seed is mixed with a dust fungicide in a special treater (Slurry treater) in which small calibrated amounts of concentrated liquid (about 5-20 ml/kg seed) are added, thus forming a soap-like slurry to ensure coating without undue wetting. This treatment is common in almost all seed processing plants owned by Government as well as private producers.

Fungicides used: Thiram, Captan.

c) Sprinkle treatment:

The seed is sprinkled with a fungicidal liquid, solution or suspension, left damp with this for a definite period of time and then dried. This method is widely used in countries like USA, Europe and UK.

Dry seed dressing:

This method is simple and economical. The method consists of adding the required fungicide (usually 0.3 % to the seeds and shaking them in a closed vessel or a 'rotary drum' for 5-15 minutes to facilitate even spreading of fungicides over the surface of all seeds.

Commonly used seed dressers:

- **Sulphur group** Sulphur dust (5 g / kg seed)
- **Organic fungicides** Mancozeb, Thiride 75 SD, Captan 75 SD
- **Systemic fungicides** Vitavax, Plantvax, Benomyl, Carbendazim, Ridomil(Metalaxyl), Tricyclazole.

Diseases controlled by seed treatment with bio-control agents:**Crop Diseases Dosage:**

Cotton Wilt, root rot Treat the seed with commercial formulation of *Trichoderma viride*(or) *T. harzianum*(or) *Gliocladium virens* @ 4 g/kg seed Groundnut stem rot, crown rot Redgram greengram, blackgram and bengalgram wilt, *Phytophthora* blight *Macrophomina* root rot chilli damping off, wilt Tobacco Cabbage and cauliflower damping off.

b. Foliar Application

There are two methods of application of fungicides to foliage viz., spraying and dusting. .

(A). Spraying.

- Most commonly used method.
- Wettable powders / EC formulations are used
- Most common diluents is water
- Dispersion of spray is achieved by its passage under pressure through nozzles of sprayers.

Spraying is of three types:**1. High volume spraying**

- Spray fluid required > 400 l /ha
- Thorough spraying which causes run off
- Droplet size 0.5-3 mm
- Loss of fungicidal due to run off may be 50 % or 90 %.
- Accumulation of deposit at the tips and edges of leaves and fruits

2. Low volume spraying

- Spray fluid required 5-400 l/ha
- Spray is distributed on the surface as discrete droplets
- Drop let size 80- 1 00 urn
- No run-off of the chemical

- Labour saving method
- Dose of fungicide is reduced by 20-25 %.

3. Ultra low volume spraying

- Spray fluid required less than 5 l/ha
- Very fine spray similar to low volume spraying.
- Droplet size 30-50 urn
- Lowering cost of labour
- Drift hazard (very fine spray, a wind velocity of > 5 m/sec increase drift hazard).

Spraying equipments:

Hand sprayer, plunger sprayer, hand compression sprayer (Pneumatic knapsack sprayer), Knapsack sprayer. Foot sprayer (Pedal pump); Rocking sprayer (Gator sprayer), Power operated sprayers.

(B) Dusting

- Covers entire foliage.
- Its use is limited due to its weak tenacity.
- Carried out by emitting a blast of air in which dust particles are borne.
- Dust formulations are used.
- Require no water.
- Material is ready to use.

Dusting equipments:

Hand duster, bellows duster, rotary hand (crank) duster, power operated duster, tractor powered feed duster.

Precautions to be observed while dusting / spraying/Dusting

- Select suitable hand or power duster and ensure proper working of dusting machine.
- Fill duster to 2/3rd of its capacity.
- While dusting keep outlet as low on the crop as possible (4 to 6" above) the crop.
- Dusting should be done in the direction of wind or at right angles to it but never in opposite direction.
- Always dust in the morning or in the evening when wind is calm and dew on the leaves.

Spraying:

- Prepare spray solution by taking recommended amount of fungicide and add a little water first and make a paste, then add required quantity of water, to make a spray solution by stirring thoroughly.
- Do not use hand for stirring or mixing chemical but use a wooden stick.
- Select sprayer and check for proper working.
- Pour spray fluid in the sprayer tank using funnel to strain the solution.
- Do not still the spray solution while filling the sprayer tank.
- Build up the pressure in the spray tank.
- Spray in the direction of wind or at right angles to it.
- Keep nozzle about 6" above the crop to be sprayed.
- Cover leaf surface and other pan of the plant evenly and also in the under surface of leaf.