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## Seed Treatment for Prevention of Plant Disease

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Seed treatment is the process of applying different substances or techniques to seeds before sowing to control or eliminate disease-causing organisms. It functions as a preventive measure, protecting seeds and emerging seedlings during their most sensitive stages. Unlike curative approaches used after diseases appear, seed treatment serves as an early protective barrier, helping ensure proper crop establishment. This practice is widely used to minimize losses caused by pathogens that are either carried on the seed or present in the soil. These organisms may be associated with seeds in various forms, such as sclerotia, smut balls, nematode galls, or infected plant debris. In some cases, pathogens may be located on the seed surface or even inside the seed. Treating infected seeds with chemicals or heat can significantly reduce the presence of many seed-borne pathogens. Additionally, seed treatment helps protect healthy seeds from soil-borne pathogens such as *Pythium*, *Fusarium*, and *Rhizoctonia*, which are responsible for seed rot, pre-emergence damping-off, and seedling blight in many crops. Some treatments eliminate pathogens present on or with the seed, others target those inside the seed, while certain methods suppress or inhibit harmful organisms in the surrounding soil near the germinating seed.

### Objects of seed treatment

- To reduce the chances of poor germination and protect seedlings from early infection
- To eliminate both external and internal seed-borne pathogens
- To create a protective barrier around the seed that shields the germinating seed or seedling from attack by soil-borne pathogens

### Methods of seed treatment

- A. Physical methods
- B. Chemical methods
- C. Biological method

#### A. Physical Methods or Procedures

##### 1. Hot Water Treatment:

Hot water treatment is an effective method to ensure that seeds are free from pathogens. The temperature of the water generally ranges from 48°C to 52°C (118–125°F), depending on the crop, and the duration of treatment varies between 10 and 20 minutes. It is essential to follow crop-specific protocols to eliminate pathogens without damaging the seed. Although this method can be performed using simple heating equipment, the use of a controlled water bath

and a precise thermometer is recommended for accuracy. When properly applied, hot water treatment can effectively kill most seed-borne fungi and bacteria without affecting seed viability. However, seeds of low quality or those stored for more than a year may show reduced germination after treatment. Therefore, it is advisable to test a small seed sample before treating the entire batch. Careful control of temperature is critical, as even slight deviations may either fail to eliminate pathogens or cause damage to the seed.

## 2. Cold Water Treatment:

In this method, seeds are first placed in loosely tied bags and soaked in water for about 30 minutes. After soaking, they are stored in airtight containers for a specific duration depending on temperature conditions—approximately 80 hours at 68°F, 70 hours at 70°F, 60 hours at 75°F, or 40 hours at 80°F. After the treatment period, the seeds are drained, dried on a clean surface, and stored at an appropriate moisture content of 10–18%.

## 3. Anaerobic Water Treatment:

This technique involves soaking seeds in water and maintaining them under oxygen-deficient (anaerobic) conditions for a specific period. For example, loose smut in barley can be effectively controlled by soaking seeds at 24–28°C for about 6 hours, followed by storage in airtight containers for 42 hours. This method minimizes the risk of seed damage that may occur due to overheating.

## 4. Dry Air Treatment:

Although not widely practiced, dry air treatment has shown promising results against certain pathogens under specific temperature conditions. For instance, it has been effective against *Colletotrichum gossypii* in cotton. Treating tomato seeds at 70°C for 3–4 days can partially control tobacco mosaic virus (TMV), while lettuce seeds infected with lettuce mosaic virus can be treated at 55°C for 80–120 days for virus inactivation.

## 5. Solar Heat Treatment (Solar Energy Method):

In this method, seeds are first soaked in water for 4–5 hours at room temperature or in the shade, then drained and dried under direct sunlight for 4–8 hours. In many regions, practices such as drying paddy grains on concrete surfaces under sunlight act as a form of solar heat treatment. This method has proven effective against diseases like loose smut in barley and wheat.

## 6. Aerated Steam Treatment:

This method involves exposing dry seeds to moving steam under controlled pressure. For example, cabbage seeds can be treated at 56°C for about 30 minutes to eliminate *Alternaria brassicae*. This approach ensures effective pathogen control without harming the seed.

## B. Chemical Methods of Seed Treatment

**1. Steep Treatment:** Seeds are immersed in a fungicidal solution or suspension for a specified period, after which they are drained and dried.

**2. Sprinkle Treatment:** A liquid fungicide is applied to the seeds, which are then kept moist for a certain duration before drying.

**3. Dust Treatment:** Seeds are mixed with a dry fungicide (usually at 2 g per kg of seed) in a closed container and shaken thoroughly to achieve uniform coating.

**4. Slurry Treatment:** A paste is prepared by mixing a fungicide with water, and seeds are coated with this mixture. The treated seeds are then dried before sowing.

**5. Wet Treatment:** Seeds are treated with a small quantity of concentrated liquid (approximately 100–300 ml per kg of seed). Drying is necessary after treatment, and the liquid is not recovered.

**6. Fumigation:** Seeds are exposed to volatile chemicals in airtight containers for a fixed duration to control pathogens.

**7. Pelleting:** Seeds are first coated with an adhesive substance, such as Tween-20, and then covered with fungicidal dust to form a protective outer layer.

Commonly used chemicals include Thiram or Captan (0.25% or 2.5 g/kg seed), Provax-200 (0.25%), Bavistin (0.25%), Panocline (0.1–0.4% depending on dosage), and Benomyl or Homai (0.3%).

### C. Biological Method

Biological seed treatment involves the application of beneficial microorganisms to seeds. These organisms remain dormant initially but become active under favorable conditions, colonizing the seed surface and protecting it from pathogens. They control diseases by competing with harmful organisms or producing antibiotic substances. Common biocontrol agents include *Bacillus subtilis*, *Streptomyces griseoviridis*, and *Trichoderma harzianum*. The general application rates are 2.5-3.0% of seed weight for seed treatment, 2% solution for soil drenching, and 2% solution for foliar spraying.

### Precautions

- Treated seeds should not be used for consumption.
- Seed treatment should always be carried out in a well-ventilated area.
- Protective gear such as gloves and face masks must be used during handling and application.

### Conclusion

Seed treatment is a crucial practice in modern agriculture for preventing plant diseases and ensuring healthy crop establishment. By protecting seeds at the earliest stage, it not only improves germination and plant growth but also reduces the dependence on chemical pesticides. A balanced approach that integrates chemical, biological, and natural methods will be essential for achieving sustainable and productive agricultural systems in the future.