SEED TREATMENTS TO CONTROL PLANT DISEASES

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Seed treatments are used to prevent or reduce losses from diseases caused by organisms associated with seeds or present in the soil.

Such organisms are associated with seeds in several ways. They may be mixed with seed as sclerotia, smut balls, nematode galls, and/or infested plant parts. Pathogens may be present in or on seeds.

Treating infested seeds with chemicals or heat greatly reduces the incidence of many seed-borne pathogens. Seed treatment is used also to protect healthy seed against soil-borne organisms, such as Pythium, Fusarium, and Rhizoctonia, which cause seed rots, preemergent damping-off, and seedling blights of many crops.

Some treatments kill organisms mixed with the seed or on its surface. Some destroy pathogens within the seeds. Others kill or retard the activity of soil organisms near the planted seeds.

Mechanical, physical, and chemical methods are used.

The mechanical method is designed to remove infections materials mixed with seeds. Seeds should be thoroughly cleaned before being seeded. Mechanical treatment does not kill pathogens within a seed, remove all organisms from the surfaces of seeds, nor protect seeds from soil-borne organisms. Mechanically treated seed, therefore, often requires further treatment.

Physical methods are used primarily to kill pathogens deep in the seeds. Some pathogens, such as those that cause loose smuts of wheat and barley, can be inactivated in no other way.

Physical methods include hot-water and water-soak treatments and ultraviolet, infrared, X-ray, and other kinds of irradiation. Dry heat has been tested, but only the hot-water and water-soak treatments have been shown to be practical. Physical methods do not protect seeds against soil-borne organisms; they are effective against pathogens on or in seeds.

The hot-water treatment was the most commonly recommended physical method before 1950, but it never has been used extensively because of difficulties in exactly controlling temperature and duration of treatment. Its margin of safety is small and adequate supplies of steam or hot water, accurate thermometers, water tanks or vats, and drying facilities also are required.

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The method has been used mostly to disinfect small lots of seed and batches of small-seed crops that require low seedling rates per acre. Procedures differ with the crop and to some extent with the pathogen.

Various modifications of a water-soak method have been developed since 1950. They are safer and have less critical requirements than the hot-water treatments. They have been used mostly to control loose smuts of barley and wheat but are effective against some other pathogens.

In all water-soak treatments, the seeds must be soaked at least 2 hours and subsequently kept under anaerobic or near anaerobic conditions are one day or longer. In some instances the seeds are soaked 64 hours in water at approximately 72° F. and then dried. Sometimes the seeds are soaked only 2 hours, and then placed in air-tight containers at 80° for 48 hours before being dried.

Other effective modifications differ in temperature used and duration of treatment. The higher the temperature, the shorter is the time required. Varieties of crops differ considerably in sensitivity to injury from soaking for long periods. The possibility of injury is reduced by adding 1 percent of common salt or 0.2 percent of Vancide 51 to the water the seeds are soaked in.

Chemical treatments are the most commonly used to treat seed. Many excellent chemicals are available. They may be organic or inorganic, mercurial or nonmercurial, and metallic or nonmetallic.

Organic fungicides are used more than inorganic ones, but the latter are sometimes preferred. Fungicides may be applied as liquids, suspensions or powders. Equipment is available for all three forms. Recommended dosages vary with the fungicide, the crop, the length of the storage period after treatment, and sometimes with the method of application. Using excessive amounts of fungicides may injure the seeds, waste the chemical, and make handling and sowing treated seeds disagreeable and even dangerous. Using less than the recommended amount of fungicide hampers disease control and may reduce yields and quality.

Volatile fungicides usually are used at lower dosages than nonvolatile materials and are more effective when the treated seeds are stored at least a few days before being planted.

All dry fungicides present hazards. Special precautions are necessary. All powders harm people who inhale them over long periods or in excessive amounts. Seed fungicides are even more dangerous because all of them are poisonous. The extent of the hazard depends on the amount of powder inhaled, the toxicity of the chemical, the length of exposure, and the person's sensitivity.

When treating large quantities of seeds, particularly over a period of many days, artificial ventilation should be provided to collect and exhaust

the powder from the treating room. Workmen should wear clean filter masks over their noses and mouths. A special mask must be used against volatile chemicals. If the fungicides are applied wet, this special equipment may not be necessary, but one must not inhale the chemicals or their fumes. The chemicals should not come in contact with the skin. If a worker get the chemicals on him, he should wash promptly and thoroughly with soap and water.

Originally wet treatments involved soaking the seeds in a water solution of a fungicide for a prescribed time, then removing and drying them before using or storing them. Farmers never liked the method; it took time, much work, and extra drying space in the granary. Seeds not properly dried were damaged.

Today wet treatments are applied mostly by the slurry method or by quick-wet procedures, and no drying is necessary because the treatments add less than 1 percent of moisture to the seeds.

In the slurry method, seeds are completely coated with a thick suspension of the chemical in water. The suspension is applied by a special machine, a slurry treater. Because this method eliminates flying powder during treating, it is safer and less disagreeable for workmen. It permits more nearly accurate and uniform dosages of chemical than do other methods for most kinds of seeds.

In the quick-wet method, a concentrated solution of a volatile fungicide is added to the seeds and thoroughly mixed with them. Panogen 75 and Ceresan L are examples. Use of volatile liquid fungicides has increased greatly since 1950, especially for treating small grains, cotton, flax, and rice.

Pelleting is another way to apply chemicals. Pelleting is used mostly as a protectant against soil organisms and as a repellent against birds and rodents. It has been particularly valuable for treating seeds of pine and other conifers. It is used to some extent to treat seeds of other crops, notably onion, to control smut.

Insecticides are applied to the seeds of many crops. Insecticides increase the need for fungicides since insecticides tend to predispose seeds and young seedlings to attack by soil fungi. Compatible fungicides and insecticides, like captan-dieldrin and thiram-dieldrin, are available.

Some manufacturers package fungicide-insecticide mixtures, and the combination is applied as a single treatment. Others market insecticides and fungicides separately, and the materials are applied separately.

All seeds containing chemical powders should be placed in closely woven bags (10-ounce or heavier) to reduce chemical sifting during handling and shipping. This is particularly desirable when chemicals are applied at high rates to smooth-surface seeds. If the seed is to be sold, it must be labeled to indicate that it has been treated and is unfit for food or feed.

An ideal fungicide would be highly effective in disease control, harmless to seed even at higher than recommended dosages, economical to use, easy to apply, relatively nontoxic to people, noncorrosive to machinery, adapted to use in planting equipment without interferring materially with uniform seed flow, stable for relatively long periods, and relatively harmless to animals that might consume the treated seeds. No chemical in use in 1963 met all those requirements.

The choice of treatment depends on the crop, the nature of the disease problem, the condition of the seeds, the relative cost and availability of acceptable fungicides, the availability of treating equipment, and weather conditions expected after seeding.

Crops differ in responses to seed treatment. Some benefit more than others. Some are more sensitive to injury than others. It is essential to know which diseases are to be controlled and whether the pathogen is located in or on the seeds or in the soil.

Only high quality seeds should be planted. They should be thoroughly cleaned, cured, and dried before being treated. Cracked, damaged, and old seeds sometimes benefit more from treatment than good seeds, but treatment should not be expected to substitute for good seeds. Even good seeds may benefit from a protectant.

When soil and weather conditions after seeding are unfavorable for rapid germination and development of seedlings, treatment of seeds often will mean the difference between a good and a poor stand. When growing conditions favor the host, there may be no apparent benefit from treatment. Because weather cannot be foreseen several weeks in advance and treating costs are low, many crops are treated every year as insurance against losses. Corn and sorghum are examples.

The treatments have been standardized to a remarkable degree, and recommendations applicable over wide areas for controlling diseases in specific crops can be made. Nevertheless, a grower will do well to consult his agricultural experiment station for the best fungicides for his situation.

Corn is extensively treated. Almost all of the seed of hybrid corn is treated chemically to prevent seed rots and seedling diseases.

The monmercurial organic fungicides, principally captan and thiram, are used most. They are applied as powders or slurries. Captan is superior at low dosages and on old seed, especially when conditions after planting are unfavorable. Both chemicals, when applied at recommended rates, give adequate protection to good seed. Dieldrin can be combined with either captan or thiram if protection against soil insects is needed. Such combination treatments are commonly used in some states. Heavy insect infestations, however, can be controlled best by treating the soil.

Sorghum also is extensively treated to control kernel smuts, seed rots, and seedling blights. The nonmercurial fungicides captan and thiram are principally used. Mercurial fungicides are used to some extent.

Dieldrin often is added to the nonmercurials. Insecticides are less often combined with mercury compounds, although aldrin has been used with Panogen.

Wheat is treated to control bunt, loose smut, seed rots, and seedling blight.

Organic mercury compounds, like Ceresan (M and L), Panogen (15 and 42), Chipcote (25 and 75), and various Ortho LM Seed Protectants, are recommended generally for bunt control when the pathogen is not present in the soil. Depending on the formulation, seeds may be treated with a direct-type or a powder machine slurry.

Formulations such as Orthocide HCB and Ceresan M-DB may be used to treat seed directly in a drill-box.

If the pathogen is present in the soil, seeds should be treated with HCB, which is sold under trade names of No Bunt, Smut Go, Sanocide, and Anticari. It is a wettable powder suitable to use as a powder or slurry.

Soil surface treatments with HCB (10 pounds an acre of a 40-percent formulation) have effectively reduced dwarf bunt in the Pacific Northwest. Seed treatment does not control dwarf bunt.

Loose smut can be controlled only by a hot-water or water-soak treatment. The hot-water treatment is: Soak cleaned grain in water at 60° to 70° F. about 4 hours; preheat it in water at 120° for 1 minute; treat it in water at 129° exactly 10 minutes; plunge it into cold water immediately to cool; remove and dry it rapidly at not more than 100°.

The water-soak method has already been discussed. It is less dependable for wheat.

Seed treated with either the hot-water or the water-soak method should also be treated with a fungicide, like captan or thiram, to protect it against soil organisms.

Seed-borne pathogens that cause seed rots and seedling blights are killed by mercurials ordinarily used to control bunt, the hot-water treatment, or the water-soak method. They are not controlled by HCB.

Barley diseases that respond to seed treatment are covered smut, loose smut, intermediate loose smut, stripe, seed rot, and seedling blights. Loose smut is controlled by hot-water or water-soak treatments like those described for wheat.

The standard hot-water method for barley is: Soak the seed in water at 60° to 70° F. 5 or 6 hours; preheat it in water at 120° for 1 minute; treat it in water at 126° for 13 minutes; cool it; and dry it.

The water-soak method is effective against loose smut and is replacing the hot-water method because it is safer and easier to use. All organic mercury compounds used on wheat will control covered smut, intermediate loose smut, stripe, and seed-borne pathogens that cause seed rots and seedling blights of barley.

Oats are treated with the same organic mercury compounds recommended for wheat and barley. Those fungicides are effective against loose smut, covered smut, Helminthosporium blight, seed rots, and seedling blights.

Treating rice seeds with captan and thiram powders or slurries will improve rice stands. Those fungicides protect germinating seeds against soil-borne pathogens. Organic mercury compounds are recommended if the seed is known to be infected with Helminthosporium, Piricularia, or other seed-borne fungi.

Cotton seed is treated to protect against angular leaf spot, anthracnose, sore shin, seed rots, and seedling blights. The seed usually is delinted before it is treated. Delinting is done mechanically by reginning, or chemically by acid. The method of delinting may influence the choice of fungicide.

Organic mercurials, like Ceresan (M or L) and Panogen 15, generally have been most effective against seed-borne pathogens.

The nonmercurial captan is superior against soil organisms.

In some Cotton Belt localities, incorporating a fungicide or a mixture of fungicides as a spray or dust into the covering soil at planting time has helped to reduce preemergent and postemergent damping-off by reinforcing the effect of seed treatment and by providing a treated zone for seedlings to emerge through.

Flax seed commonly is cracked and damaged by threshing. Cracks also develop in the seedcoat of some yellow-seeded varieties while they mature. The cracks let many fungi enter that rot seeds or cause seedling blights.

Organic mercury compounds, like those used for wheat, are recommended for flax. They also kill seed-borne pathogens. They may be applied as liquids, slurries or powders. Heavier dosages are required for flax than for most field crops because fungicides do not readily adhere to smooth seedcoats and because flax seeds have more surface area per bushel. Wet treatments cause some gumming of flax seeds because their coats are mucilaginous.

Nonmercurial organics, like captan, have not been widely used for flax, but they are effective against soil organisms.

Sugar beets should be treated with a good protective fungicide like captan, thiram, Dexon, or dichlone to control seed rots and damping-off.

Organic mercury compounds are effective against seed-borne pathogens but are less satisfactory against soil organisms.

Sugar beets usually are treated with powders rather than slurries or liquids.

Yields of soybeans are rarely increased by seed treatment unless poor seeds are used or weather conditions after planting are especially unfavorable. Captan, thiram, and chloranil are the best fungicides when treatment is required. Organic mercurials are sometimes injurious.

Treating peanut seed is profitable, especially when machine-shelled seed is used. It reduces seed rotting and improves stands. Recommended chemicals include thiram, chloranil, and 2-percent Ceresan applied as powders.

Small-seeded forage legumes like alfalfa, clover, sweetclover, vetch, lespedeza, and trefoil, usually do not respond to seed treatment under field conditions. Occasionally small increases in stand are obtained, but not increased forage yields.

Treatment may be helpful on Pythium-infested muck soils and under certain other special conditions where it is hard to establish a stand. Captan and thiram are among the most effective and safest seed fungicides for those crops. Copper and mercurial fungicides may cause severe injury.

The many species of forage grasses differ in disease problems and responses to treatment. Losses from seed decay and damping-off can be reduced by using a protectant like captan or thiram. Damaged seeds usually benefit more from treatment than sound seeds.

Seed treatment also is valuable in controlling seed rots, seedling blights, and other diseases of many vegetables, fruits, ornamentals, and forest trees.

SEED TREATMENT IS GOOD, INEXPENSIVE INSURANCE.