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CHEMICAL SEED TREATMENT for FIELD CROPS

EXTENSION SERVICE - UNIVERSITY OF NEBRASKA
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OF AGRICULTURE COOPERATING W. V. Lambert, Director

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Facts about Chemical Seed Treatment for Field Crops

JOHN L. WEIHING

WHY TREAT CROP SEEDS?

For Protection of Food Reserves of the Seed . . .

Within each seed is an undeveloped plant. All of the food material needed for the growth of this plant until it becomes established and able to maintain itself is stored in the seed. A seed that is placed in moist soil takes up moisture. This starts a series of reactions that change the stored food into substances for growth, energy and development of the undeveloped plant. On the outside of the seed there are thousands of microscopic soil organisms, many of which can thrive on these stored food materials. Ordinarily the organisms cannot get to this food supply because of the protective seed coat, but cracks in the seed coat favor their entrance. If the organisms do enter the seed, they may prevent germination by destroying a major portion of the food reserve (fig. 1).

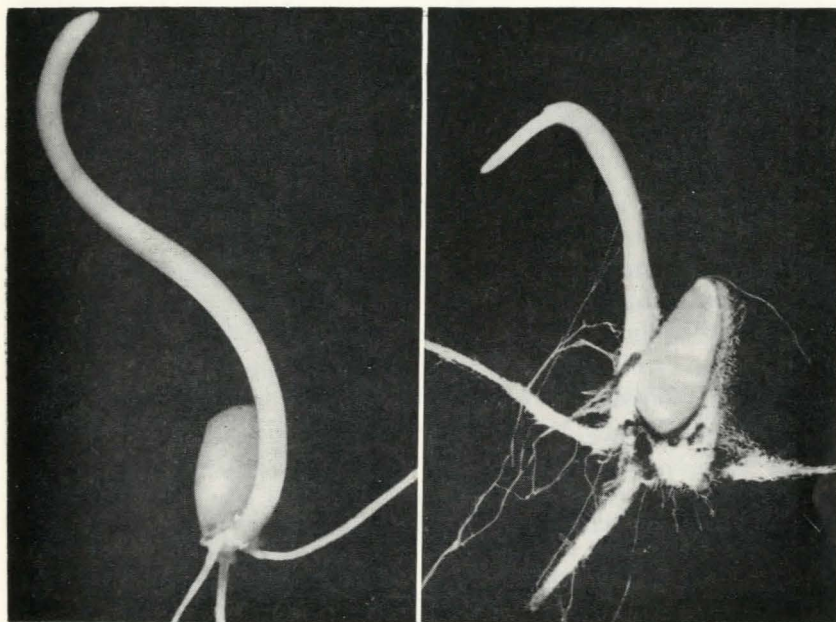


Fig. 1. The wheat kernel on the left has been treated with a chemical which is protecting it from parasitic microorganisms. The kernel on the right was not treated. Molds have gotten inside the seed and are destroying the food reserves and also have invaded rootlets, causing them to die.

For Protection Against Seedling Blights . . .

There are other microscopic organisms which attack the very young seedling and cause it to blight. They may be found either on the surface of the seed or in the soil. The moisture which activates seed germination also initiates growth of these organisms and results in infection.

Protection from infection is obtained by coating the seed with a chemical which will kill the microorganisms but not harm the seed. A seed treated with the proper chemical will thus retain its food reserves and the young seedling will be protected against attack by microorganisms. The result is rapid establishment of a vigorous seedling.

For Protection Against Certain Smuts . . .

Every farmer who has grown the cereal grains has seen the smut diseases. He has noted that some of them are controlled by chemical seed treatment, while others are not. The reason is that in one case the smut disease germ is carried on the surface of the seed where chemicals can contact and kill it. In the other case, the smut organism lives inside the seed and cannot be reached by a seed treatment chemical.

Smut diseases which are controlled by chemical seed treatment are:

Covered smut of barley	Loose smut of oats
Covered smut of oats	Loose smut of sorghum
Covered smut of sorghum	
Covered smut of wheat	

Smut diseases which are not controlled by chemical seed treatment are:

Loose smut of barley
Loose smut of wheat
Smut of corn

GENERAL DISCUSSION OF THE SMUTS OF SMALL GRAINS

Symptoms of covered smut.—In the case of covered smuts, only the kernel is destroyed while the chaff is left unharmed. The interior of the smutted kernel is composed of a dusty black powder. The individual dust particles are spores (spores are fungus seed) of the smut fungus.

Symptoms of loose smut.—The heads of a plant which has loose smut emerge as a black column (fig. 2). All of the seed and chaff are replaced with a black, sooty material. The individual particles of this material are spores of the smut fungus. All of the sooty material breaks free, and a few days after heading only a barren stock remains.

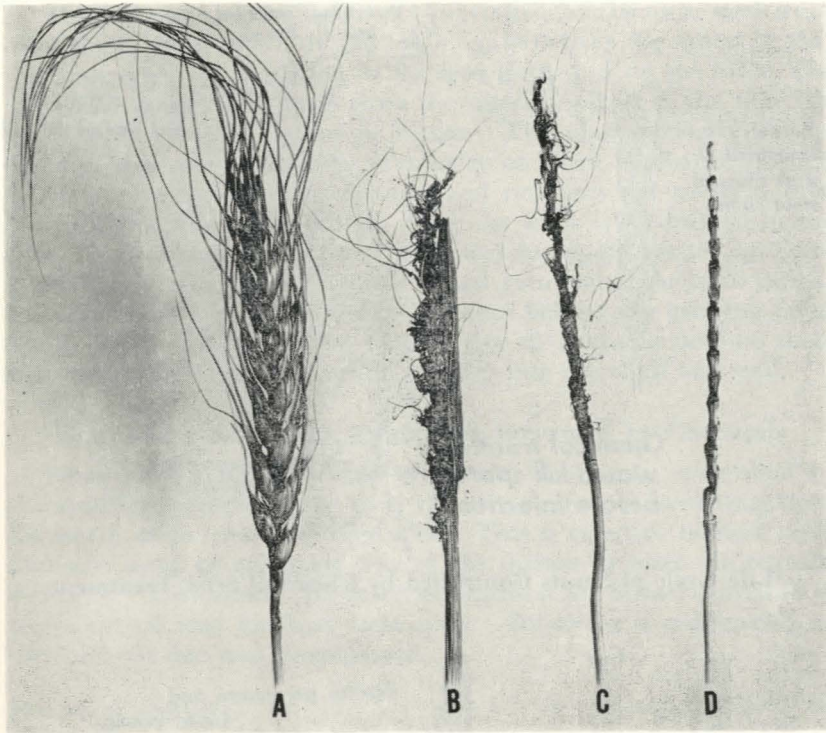
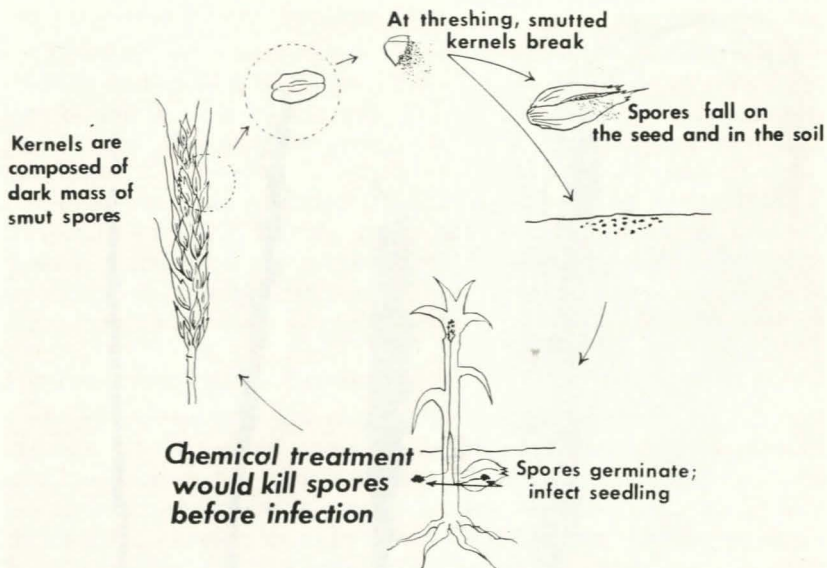


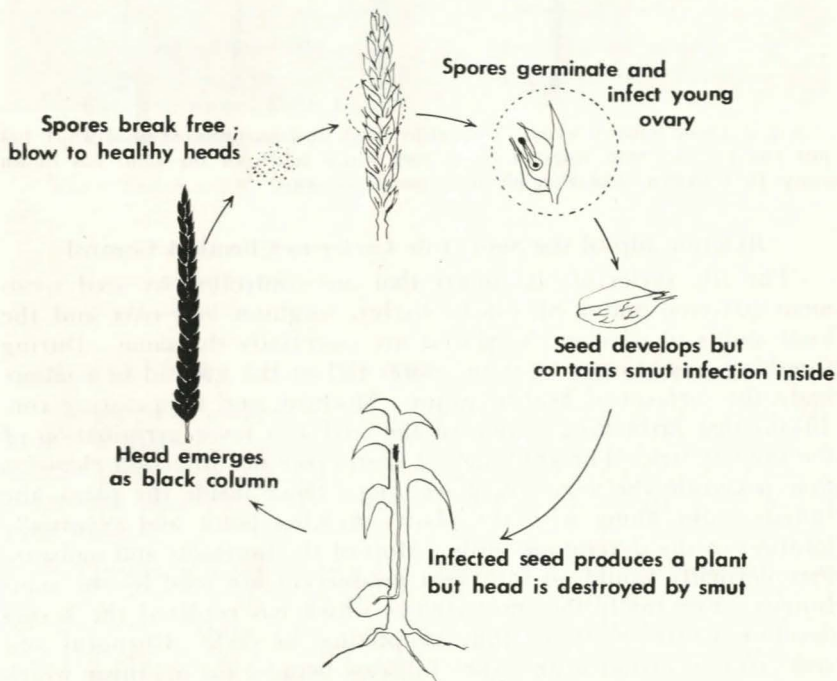
Fig. 2. Loose smut of wheat. A. Healthy head; B. Smut-infected head which has just emerged; C. Smut-infected head from which much of the smut has blown away; D. A barren head after all of the smut has gone.

Relationship of the Smut Life Cycles to Chemical Control

The life cycles of the smuts that are controlled by seed treatment (covered smuts of wheat, barley, sorghum and oats and the loose smuts of oats and sorghum) are essentially the same. During threshing operations, the smut spores fall to the ground or contaminate the surfaces of healthy grain. Moisture and temperature conditions that favor germination of the seed also favor germination of the smut spores. The germinating spores produce infection elements that penetrate the very young seedling. Once inside the plant, the fungus grows along with the plant's growing point and eventually localizes in the developing seeds. Most of the nutrients and moisture that normally would go into seed production are used by the smut fungus. Eventually the smut fungus which has replaced the kernel develops a mass of spores, thus completing the cycle. Chemical seed treatment will control this type of disease because the organism which causes the disease is carried on the surface of the seed.



Life Cycle of Smuts Controlled by Chemical Seed Treatment



Life Cycle of Smuts Not Controlled by Chemical Seed Treatment

The life cycle of the smuts not controlled by chemical seed treatment (loose smuts of wheat and barley) differs from the others in that the smut organism is carried *in* the seed instead of *on* the seed. The loose smut spores are blown from the infected plants at the time the heads of healthy plants are in bloom. The plant's ovaries are exposed at this time and spores may lodge on them by chance. When this happens, the spore germinates and produces an infection tube that penetrates into the ovary. After the smut is established in the ovary, it becomes dormant and a normal-appearing kernel develops. When the infected kernel is planted and germinates, the smut fungus becomes active and grows a slight distance behind the growing point of the plant. Eventually the smut fungus invades and destroys those structures which normally would develop into the chaff and seed.

Controlling Smuts that Cannot Be Prevented by Chemicals

Since loose smut of wheat and barley cannot be controlled by chemical seed treatment, the most effective method of combating these diseases is to purchase certified seed. This is effective because certified seed must be relatively free of the disease to meet the requirements for certification. However, on occasion the farmer may wish to free a special seed lot from loose smut. Following is a discussion of two methods that may be employed.

Hot-water method

1. Place barley or wheat seed-grain ($\frac{1}{2}$ bushel lots) into loose-meshed sacks and soak for 4 hours in a water bath held at room temperature.
2. Soak them for 5 minutes in a water bath held at 120° F.
3. Soak them in a hot-water bath held at 129° F., 10 minutes for wheat and 13 minutes for barley.
4. Dip into cold water, drain off the water, and spread out to dry.
5. Treat and plant double the normal amount because of possible injury to germination, and in a plot isolated from other grain of the same kind.

Long water-soak method

Wheat.—Soak wheat in open containers for 50 to 60 hours at 61° F. or 38 to 48 hours at 72-77° F. Remove and dry.

Barley.—Soak barley seed for 35 hours at 86° F. or 55 hours at 76° F. in open containers; or soak the barley in water at room temperature for 2 hours, then drain and hold the wet seed in a closed air-tight container for 42 hours at temperatures between 76° and 85° F. Remove, dry and treat.

KINDS OF SEED TREATING MATERIALS AVAILABLE

Seed treatment materials are commonly classed as to whether or not they contain mercury. In general, the mercury-containing compounds are the most effective. The non-mercurials, however, are less injurious to the seed and less dangerous to humans. Both kinds of materials have their place as good seed treatments. The mercury-containing compounds are commonly used on barley, oats, wheat and sorghum. Non-mercurials are used on corn, sorghum, grass, vegetable, legume and flower seed.

The table below lists the commercial seed treatment materials commonly sold for use on cereal crops in Nebraska. This list will change as chemical companies continue to improve their products. An up-to-date list will be supplied to county agents each year. The recommended amounts to be applied are always listed on the manufacturer's label and should always be closely followed.

Seed treatment materials that are commonly sold in Nebraska for control of seed-borne and seedling blight diseases of cereals.

<i>Crop</i>	<i>Dust Treatments</i>	<i>Slurry Treatments</i>	<i>Liquid</i>
Barley, Oats, Wheat and Rye	Ceresan-M (m)	Ceresan M-2X (m)	Panogen (m)
	Agrox (m)	Ceresan 100 (m)	Ceresan 75 (m)
		Ceresan 200 (m)	Ceresan 100 (m)
		Agrox (m)	MEMA RM (m)
		MEMA (m)	
		MEMAsol (m)	
		Gy-trete (m)	
Sorghum	Ceresan M (m)	Ceresan M-2X (m)	Panogen (m)
	Agrox (m)	Ceresan 100 (m)	MEMA RM (m)
	Spergon	Ceresan 200 (m)	Ceresan 75 (m)
	Arasan	Agrox (m)	Ceresan 100 (m)
	Orthocide 75 (Captan)	MEMA (m)	
	Phygon	Gy-trete (m)	
		Spergon SL	
		Arasan SF-X	
		Arasan SF-M	
Corn	Arasan	Arasan SF-X	
	Spergon	Arasan SF-M	
	Orthocide 75 (Captan)	Spergon SL	
	Phygon	Orthocide 75	
		Phygon	

(m) A mercury-containing compound. Those without designation are non-mercury compounds.

METHODS OF CHEMICAL APPLICATION

In order for a seed treatment chemical to do a fully effective job, it must be well distributed throughout the entire seed lot. Following are several methods by which this is accomplished.

Dust.—The seed treatment chemical is applied in the dust form, usually in a chemical mixer at rates ranging from $\frac{1}{2}$ to 4 ounces or more per bushel, depending on the product.

Slurry.—The seed treatment chemical is applied to the seed as a soup-like water suspension of the disinfectant powder, which is mixed with the seed in a special slurry treater. The seed requires no drying but may be bagged immediately for sowing or storage. Certain liquid seed disinfectants may also be diluted for use in slurry treaters.

Liquid.—This method is used for direct application (undiluted) of liquid seed treatment chemicals. A concentrated solution may be applied to the seed and thoroughly mixed with it. The dosage may range from $\frac{1}{2}$ to 5 fluid ounces to a bushel.

A seed treatment that can be applied as either dust or slurry does not have its efficiency increased by either method of application when done properly. The slurry method does have the advantage that it prevents the air from becoming filled with a toxic dust during treating operations.

CAUTION: Treated Seed Is Poisonous

All seed-treatment fungicides should be regarded as poisonous. Do not inhale the dust or fumes. Treat seed in a well-ventilated place or outdoors. Wear an approved dust mask when applying or handling dusted or slurry-treated seed.

Avoid getting fungicides on the skin, as burns or blisters may result. Wash hands frequently and keep them dry. Do not use treated seed for food or feed.

Sacks or other containers that have been used for treated seed should be cleaned thoroughly before they are used for other purposes.

Treated seed should not be fed to livestock. It is subject to seizure by the Food and Drug Administration when sold for feed or food in interstate commerce.

SEED TREATERS

Many seed processing concerns have large dust, slurry or liquid seed treaters where the farmer can have his seed cleaned and treated. However, farmers who find it difficult to deliver seed to processing concerns may prefer to treat seed on the farm. There are a number of small, inexpensive commercially built treaters for farm use. Some of these are made so that they can be combined with farm seed cleaners. Also available are seed treating attachments for the grain auger that make it possible to treat grain as it is put into the storage bin.

Seed treaters can be made at home. Figure 3 is a diagram of a treater for dust chemicals and the dimensions for building it. The oil drum treater shown in figure 4 can be used for either dust or slurry.

First cut all the parts shown in figure 3 from standard 1- by 10-inch boards, planed on both sides and edges. Nail up the mixing chute as shown, leaving the placing of the baffle boards until last. The sides *a* and *c* and the door must overlap the front and back, *b* and *d*. Accurate cutting and placing of the baffles is of the very greatest importance. The upper edges of these are beveled to 45 degrees to fit snugly inside the chute. A 2-inch hole is bored in each baffle, 2 inches from the top of the longer side and $\frac{3}{4}$ inch from the right-hand edge as one faces the longer side.

Baffle 1 (fig. 3) is placed with its beveled edge against side *a*, 17½ inches from the top of the chute, with the hole under the opening

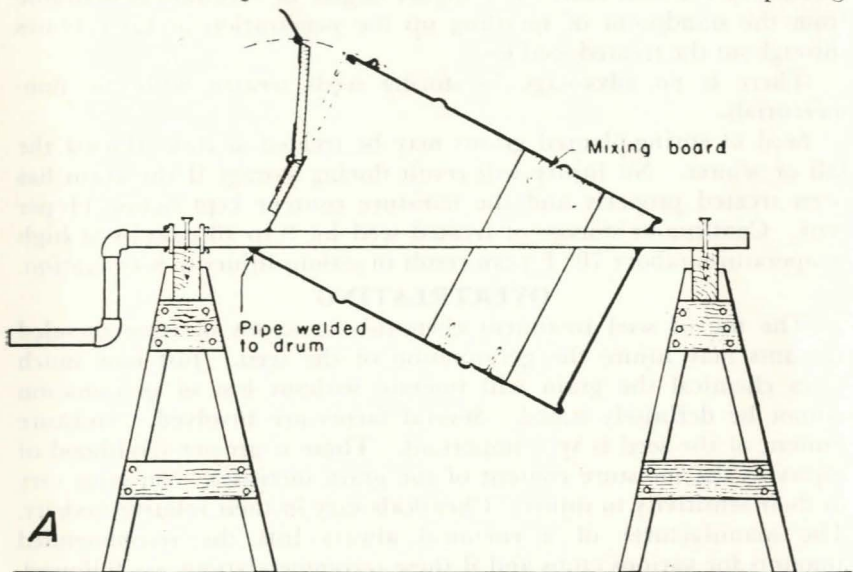


Fig. 4. An oil-drum seed treater.

that will be made by raising the trough. Baffle 2 is placed against side *b*, 24 inches from the top of the chute; 3 against side *c*, 29½ inches from the top, 4 against side *d*, 36 inches from the top and 5 against side *a*, 41½ inches from the top.

When the mixing chute is complete, study the way the proportioning trough will fit into it and how the two will fit together (fig. 3). Nail up the trough, being careful to overlap the boards as shown. The two long side boards overlap the bottom board, and the two short beveled side boards overlap the long ones and rest on top of the bottom boards. Finally, put the trough and chute together, pushing the trough clear into the front of the chute so that no opening is left in the chute unless the trough is raised. The trough holds 2½ bushels and is designed to treat 2 bushels of grain at a time.

A bushel of grain is distributed at an even depth along the mixing chute. The seed treatment chemical is sprinkled over the surface of the grain. A second bushel of grain is then distributed in the trough. The mixing chute is then tipped forward, allowing the grain to pass through the baffle arrangement and in so doing becomes well mixed with the seed treatment chemical.

STORAGE BEFORE PLANTING

Seed treatment with an organic mercury product should be stored for two to seven days, depending upon the products. The mercurials vary in their degree of volatility and storage time permits the disinfecting fumes to penetrate throughout the seed and into the cracks and crevices of the seed coat. The higher degree of volatility is desirable from the standpoint of speeding up the penetration of toxic fumes throughout the treated seed lot.

There is no advantage in storing seeds treated with the non-mercurials.

Seed of spring-planted grains may be treated anytime during the fall or winter. No injury will result during storage if the grain has been treated properly and the moisture content kept below 14 per cent. Continuous storage of treated seed for 8 to 10 months at high temperatures (above 70° F.) can result in serious injury to germination.

OVERTREATING

The use of seed treatment chemicals in excess of recommended amounts may injure the germination of the seed. Just how much extra chemical the grain will tolerate without loss of germination cannot be definitely stated. Several factors are involved. Moisture content of the seed is very important. There is greater likelihood of injury as the moisture content of the grain increases. Varieties vary in their sensitivity to injury. Chemicals vary in their relative toxicity. The manufacturer of a chemical always lists the recommended amounts for various crops and if these recommendations are followed, chemical injury will be avoided.

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