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Treatments for Control of Grain Smuts

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1.—Covered Smut of Oats. 2.—Covered Smut of Barley. 3.—Loose Smut of Wheat. 4.—Bunt of Wheat (Smut balls on left, healthy kernels on right).

COOPERATIVE EXTENSION SERVICE IN AGRICULTURE AND HOME
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PLANT PATHOLOGY SECTION

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Treatments and Procedure

SEEDLING INFECTION	TREATMENT	PROCEDURE
Bunt, Stinking, or Covered Smut of Wheat	Copper Carbonate 52 per cent Copper	2-3 oz. per bu. mixed until grain is thoroughly coated.
	Basic Copper Sul- phate 50 per cent Copper	2-3 oz. per bu. mixed until grain is thoroughly coated.
	New Improved Ceresan	½-1 oz. per bu. mixed until grain is thoroughly coated. Seed within a week after treating.
	Copper Sulphate Bluestone Blue Vitrol	Dip in a solution of 1 lb. blue- stone, 1 lb. salt—5 gal. water, followed by a dip in 1 lb. lime—10 gal. water.
Covered Smut of Barley and Intermediate (black) Loose Smut of Barley	New Improved Ceresan	Same as for Bunt of Wheat.
	Formalin	1 pt. to 40 gal. water. Dip and wet every kernel.
Covered and Loose Smut of Oats	New Improved Ceresan	Same as for Bunt of Wheat.
	Idaho Modified Formalin Spray	1 part formalin—10 parts of water. Spray grain and cover 4 hours.
Head Smut of Corn	Sanitation, Rotation, and Eradication	
Stem Smut of Rye	Copper Carbonate 52 per cent Copper	Same as for Bunt of Wheat.
	New Improved Ceresan	Same as for Bunt of Wheat.
FLORAL INFECTION		
Loose Smut of Wheat	Modified Hot Water	Soak 4-6 hrs. in cold water, dip in water 120° F., then 10 min. in water at 129° F.
Loose Smut of Bar- ley	Modified Hot Water	Soak 4-5 hrs. in cold water, dip in water 120° F., then 13 min. in water at 126° F.
LOCAL INFECTION		
Common Smut of Corn	Sanitation, Rotation, and Eradication	

Treatments for Control of Grain Smuts

Introduction

MANY of the grain smuts, particularly those of wheat, oats, and barley, with which the Idaho grower has to contend, are so easily controlled that those who are familiar with the situation seem unable to understand why the growers continue to gamble by seeding untreated lots of seed, with the hope that clean crops will result. Treating seed is neither difficult, nor expensive. It can be accomplished by the farmer, by those who are equipped to treat seed commercially, or by the elevator companies.

Several materials are used to treat grain, depending upon the smut involved, the variety of grain to be treated, and the method in which infection of the grain is accomplished. These materials are formaldehyde, copper, mercury, and hot water. Formaldehyde is used in solution as a dip or spray—or as a dust. It is a gas which can be obtained on the market in the form of an aqueous solution (37-40 per cent), known as formalin. Copper, in some form, can be used either as a dip (bluestone dip), or as a dust (copper carbonate, basic copper sulphate). Mercury is obtained on the market as ethyl mercury phosphate, otherwise known as New Improved Ceresan. This material is applied in dust form.

Classes of Smuts

A number of smuts of the different grains take their annual toll from grain crops. Although these smuts are caused by different species of fungus organisms in each case, the symptoms produced are similar in that the heads or panicles are generally involved and are replaced by a black mass of fungus spores. There are a few exceptions to this general rule.

From the standpoint of the application of the type of control measures that might be applied, the smuts can be grouped into three general classes, based upon the method of attacking their respective hosts. These classes are as follows, listed in the rank of the number of crops involved and the total damage produced:

1. *Seedling Infection:*
 - a. Bunt, Stinking Smut, or Covered Smut of Wheat.
 - b. Covered Smut of Barley.
 - c. Intermediate (black) Loose Smut of Barley.
 - d. Covered Smut of Oats.
 - e. Loose Smut of Oats.
 - f. Head Smut of Corn.
 - g. Stem Smut of Rye.
2. *Floral Infection:*
 - a. Loose Smut of Wheat.
 - b. Loose Smut of Barley.
3. *Local Infection:*
 - a. Common Smut of Corn.

The group of smuts belonging to the seedling type of infection attack their respective hosts in the seedling stage, before the developing seedling emerges from the ground. The source of infection may be either spores adhering to the seed or spores in the soil. The nature of the loci of the infecting spores is such that some type of surface sterilization is adequate for the control of this class of smuts. It is therefore advisable to use some form of formaldehyde, copper, or mercury.

The loose smuts of wheat and barley attack the plant at flowering time. The spores of the two fungi involved are blown by the wind into the developing flowers. Germination of these spores takes place and after penetrating the embryonic kernel, the fungus mycelium remains dormant inside the kernels until the latter germinate. Thus the infection is carried internally and surface sterilization of such infected kernels is of no value. To reach the internally borne fungus, heat is applied in the form of hot water.

Common corn smut infects young seedlings or is capable of infecting young tissue throughout the growing season. The source of infection is spores which have overwintered in the soil, in debris along fence rows, or from manure containing old infected corn stalks. Since the spores are not carried on the seed, it can be readily understood that seed treatment is of no value. Sanitation and crop rotation are therefore relied upon to keep the infection down.

Methods of Treatment

Previous to seed treatment, the seed to be treated should be thoroughly cleaned, by passing through a fanning mill one or more times. Such treatment will remove broken and light weight seed, dirt, and, most important, the unbroken smut balls in the case of bunt wheat seed.

Dusts

Dusts are applied by either hand- or power-driven rotary treaters or by gravity treaters, type and size depending upon amount of seed to be treated. In some parts of the country privately owned mobile units are available to treat grain on a commercial basis, and nearly all grain elevator companies are equipped to clean and treat seed grain.

The more commonly used dusts are copper carbonate, basic copper sulphate, and organic mercury (New Improved Ceresan). In applying these materials it is essential that each kernel be thoroughly coated with the material.

COPPER CARBONATE (52 per cent copper)

(For bunt, covered, or stinking smut of wheat and stem smut of rye)

This material has come to replace the older wet treatments, in which either formalin or a solution of copper sulphate and salt were used. The dust is applied at from 2 to 3 ounces per bushel of grain, depending on whether spring or fall grain is treated.

BASIC COPPER SULPHATE (50 per cent copper)

(For bunt, covered, or stinking smut of wheat only)

Of still more recent development than using copper carbonate is the use of basic copper sulphate as a dust treatment. This material is used at the rate of 2 to 3 ounces per bushel of grain. It has some advantages over copper carbonate, in that it "fogs" less and has less tendency to clog the drill if allowed to stand. It results in as good control as does copper carbonate.

NEW IMPROVED CERESAN

(For bunt of wheat, stem smut of rye, loose and covered smut of oats; covered and intermediate black loose smut of barley)

This product contains organic mercury (ethyl mercury phosphate) and is applied at the rate of $\frac{1}{2}$ to 1 ounce per bushel of grain. Its effectiveness is partly due to its volatility. Being applied in such small amounts, it "fogs" the least of any of the dusts and does not clog the drill.

Precautions to be Observed in Using Dusts

The dusts are poisonous to humans and stock. Temporary nausea is produced when the dust or fumes are inhaled in too great quantities. There is some evidence that the effects of copper are both cumulative and transitory. Great care should be taken when working with any of the materials. Treating should be accomplished in the open, or in a location where air currents will rapidly carry off the dust and fumes.

Similar ill effects result whether these substances are taken into the body by way of either the respiratory or alimentary systems. Mercury dusts, in addition, when moistened are injurious to the skin of many individuals.

None of these ill effects will result if proper precautions are taken. Some of these precautions have already been enumerated. Additional protection can be provided by the use of proper masks. An ordinary filter mask will protect its wearer from the copper dusts. Since the mercury dust is volatile, an organic filter mask will afford better protection when using this type of dust. The U. S. Bureau of Mines, Department of Interior, tests and approves masks for various manufacturers. Lists of the approved masks are published from time to time and made available to the public.

Dips

Aqueous solutions of either formaldehyde or copper, in which the grain is dipped for various lengths of time, were the first methods of seed treatment to be instituted. These wet methods have several disadvantages. Germination was generally reduced and the grain had to be dried before seeding could be accomplished. Readjustments to the drill had to be made in order to allow for the swelling of the grain. These wet treatments have

been largely superseded by the dust treatments for wheat, but in one form or another are still being used to treat oats and barley.

BLUESTONE DIP METHOD

(For bunt of wheat only)

Add 1 pound of bluestone (copper sulphate) (blue vitriol) and 1 pound of salt to each 5 gallons of water. Suspend the bluestone in a small cheesecloth bag in the water until it is dissolved. Immerse wheat in the solution until every kernel is thoroughly wet. Then dip seed at once in a lime bath made by slaking 1 pound of lime and making up to 10 gallons by adding water. Dry and sow as soon as possible. This lime bath helps to prevent seed injury.

ORDINARY FORMALDEHYDE METHOD

(For all grain smuts excepting the loose smuts of wheat and barley; head and common smuts of corn)

Add 1 pint formalin to 40 gallons of water. This equals 1 ounce to $2\frac{1}{2}$ gallons or 4 ounces to 10 gallons. About 1 gallon of the solution will be needed for each bushel of wheat and a little over a gallon for each bushel of oats or barley. Wet all grain thoroughly, either by sprinkling, or pouring loose into the solution, or by soaking 10 minutes in gunny sacks filled one-third full. If treated loose, cover the treated grain, after treatment, with disinfected sacks or canvas for 2 hours. Sacked grain should be drained and let lie spread out in the sack until sown. Sow as soon as possible; otherwise, serious injury may result.

IDAHO MODIFIED FORMALIN SPRAY METHOD

(For oat smuts only)

A promising method of treating oats with concentrated formalin was instituted a number of years ago by the Idaho Agricultural Experiment Station. This method eliminates the procedure of wetting the grain. The latter, therefore, does not swell. Oats may be treated any time before seeding.

Use 1 part of formalin in 10 parts of water. Spread the grain out on a clean floor, canvas, or wagon box. As the grain is shovelled from one pile to another, each shovelful is sprayed with a small quart hand sprayer held close to the grain. Three movements of the handle for each shovelful gives about the right amount. Use in the proportion of 1 pint of the solution to 5 bushels of oats. Cover grain with sacks or canvas which have been sprayed with the solution. Leave covered 4 hours.

Precautions:

Formaldehyde vapor acts as an irritant upon the nose and eyes, therefore:

1. Hold the sprayer close to the grain.
2. Shovel the seed onto the vapor.
3. Work from one side of the pile.
4. Provide a circulation of air where grain is being treated.

MODIFIED HOT WATER TREATMENT

(For control of loose smuts of wheat and barley)

This treatment is not recommended for general use due to the difficulties of application and the narrow range of temperature between effective control and serious seed injury. It is recommended for use on small lots of seed for a seed plot when valuable seed has become infected with loose smut.

The seed should be soaked for 4 to 6 hours in cold water, then placed in water at 120 degrees F. for a minute in order to warm the seed. The treatment then consists of soaking in water at 129 degrees F. for 10 minutes for wheat and at 126 degrees F. for 13 minutes for barley. The grain should be allowed to cool and dry before seeding. An accurate high temperature thermometer should be used and the water stirred during the operation in order to insure equal temperature throughout the bath.

There are no known methods of seed treatment which can be recommended for the control of the two corn smuts. The spores of the two fungi are not carried on or in the seed; therefore seed sterilization would be useless. Sanitation, rotation, and eradication are the only known practices which can be recommended to keep the two diseases in check.

Warning

There has recently appeared in the wheat fields of Idaho a new race of the bunt organism. It has been found in Oneida and Bannock counties of southern Idaho, and in Nez Perce, Lewis, Latah, and Benewah counties of northern Idaho. The symptoms produced by this race of the organism can be readily recognized, in that the affected plants are stunted to such an extent that in harvesting with combines the diseased plants are left standing. For this reason the smut is known under several common names, such as "short smut", "dwarf smut", or "stubble smut."

The spores of this strain of the fungus are very resistant to disinfectants, particularly so after having been deposited in the soil. No known method of disinfection will control them there. Thus the crop from well-treated seed may show a high percentage of smut. The best procedure, under such circumstances, is to thoroughly clean and treat the seed, and delay as long as possible to seed fall grain. Treatment with New Improved Ceresan will kill the spores on the seed. In those sections where fall rains can be counted on with some certainty, it would be well to wait until after the rains occur before seeding. The spores in the soil will have germinated and died before seeding takes place. In dry land wheat growing sections of southern Idaho the wheat variety Relief can be used to good advantage, in that it is highly resistant. In fact, this variety is already popular and is being grown quite widely. This variety is not adapted to northern Idaho conditions.

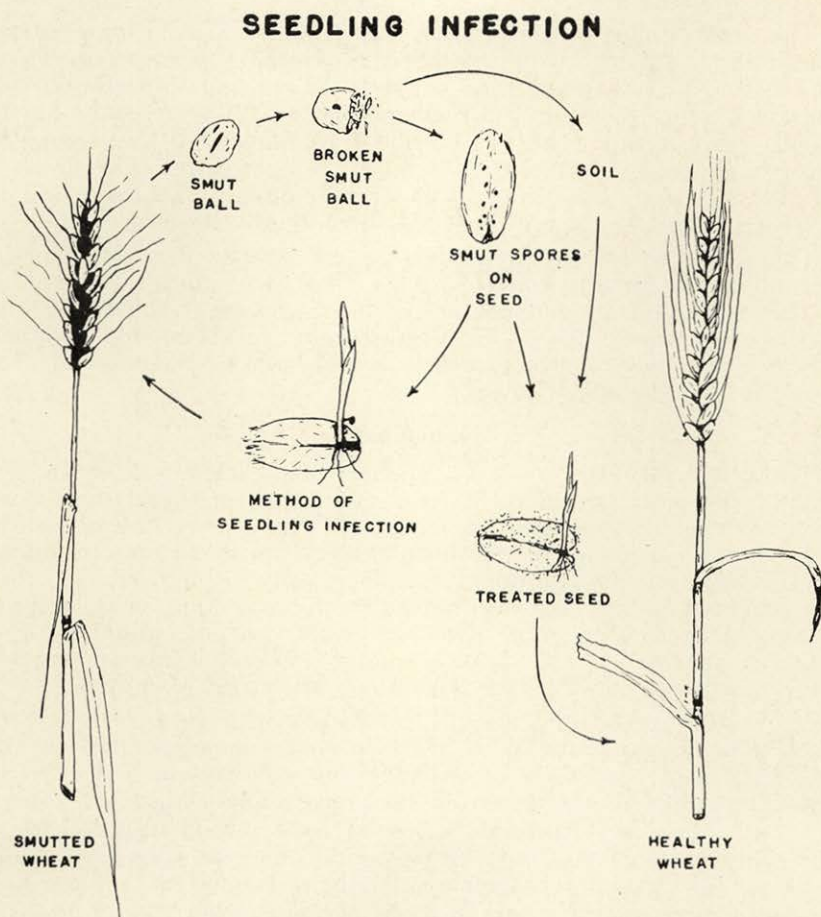


Figure 1.—Life phase of Bunt or Stinking Smut of Wheat. Typical, with a few exceptions, of all members of this group.

FLORAL INFECTION

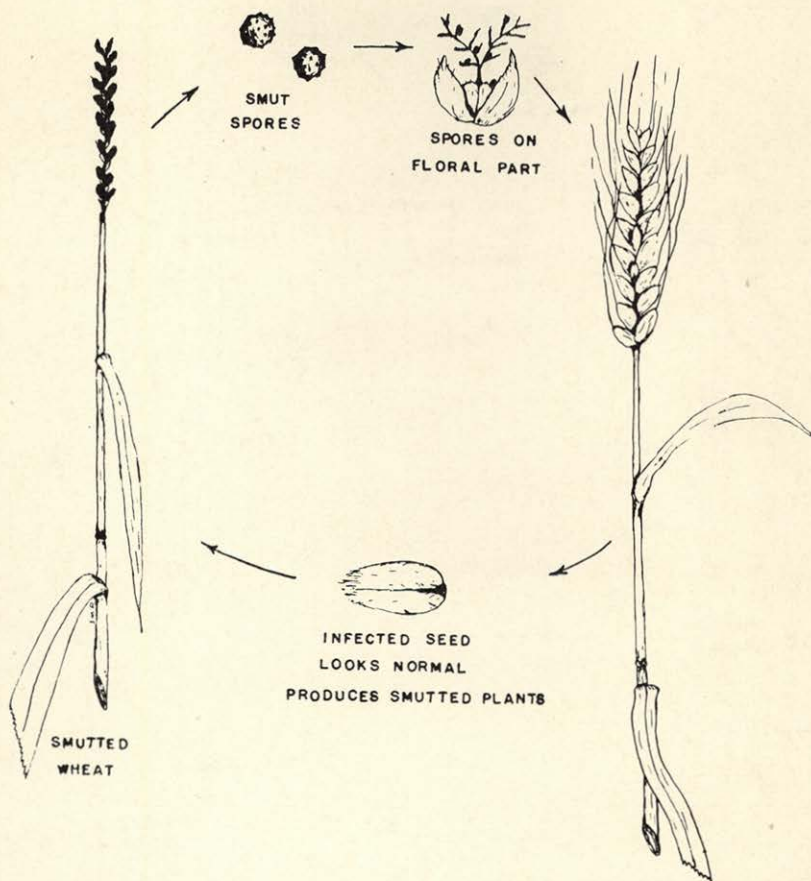


Figure 2.—Life phase of Loose Smut of Wheat. Typical of the two members belonging to this group.

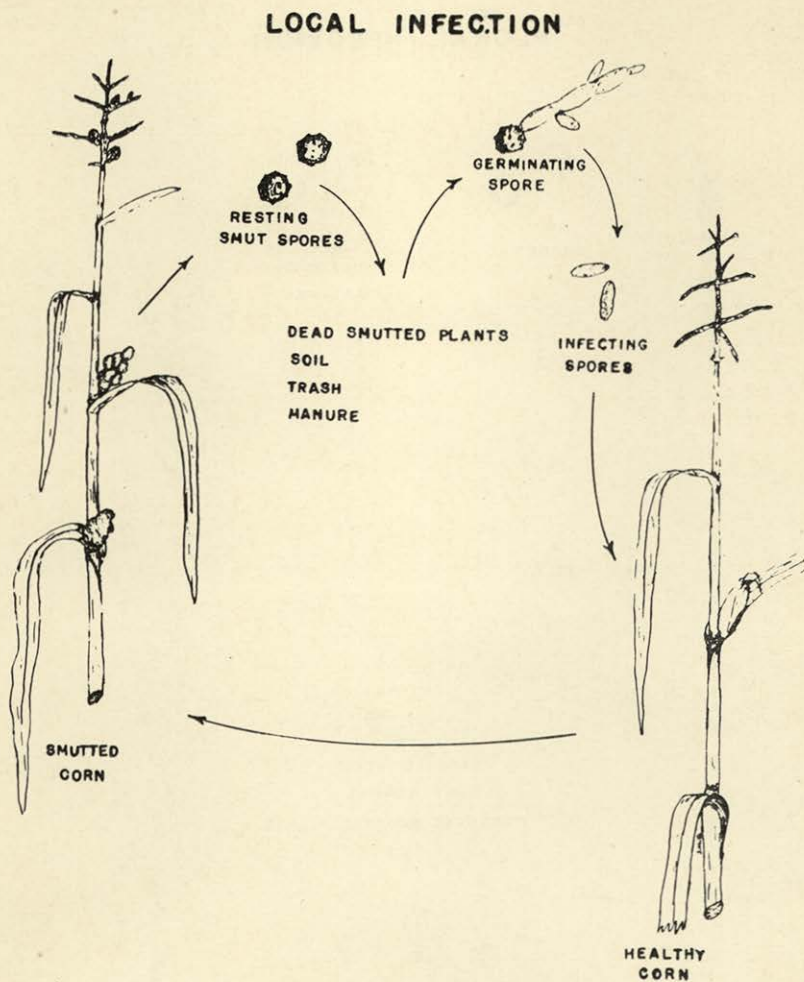


Figure 3.—Life phase of Common Smut of Corn. Common Corn Smut is the sole member of this group.

