Smut is a fungous disease. It develops inside the growing plant and at heading time produces a dark, powdery spore mass instead of the grain. It not only reduces the yield, but also lowers the quality of the sound grain and renders it unsafe for planting until treated.

Two different groups of smut occur on the small grains. In the first group the spores cling to the outside of the seed and infect the seedling as soon as it emerges from the seed. Stinking smut (bunt) of wheat, covered smut of barley, and smut of oats are typical of this class.\(^1\) In the second group the spores do not cling to the outside of the seed, but infect the embryo of the grain at the time the parent plant is in blossom. Loose smut of wheat and loose smut of barley belong to this second class.

The heads of wheat plants affected by stinking smut are of a distinctly darker green color than normal ones. The diseased kernels are unusually large and distend the glumes, giving the heads the appearance of being better filled than sound heads. The spores are scattered widely thru the whole crop at threshing time. They cling to the outside of the seed and are planted with it. They germinate and infect the young seedling as soon as it sprouts. The fungus mycelium grows upward slowly within the young plant until the time of heading, when it develops rapidly within the ovary of the blossom, and fills the entire interior of the wheat grain with its smut spores.

The life habits of the loose smut fungus of oats are similar to those of bunt in wheat, except that in oats the smut spores are not

\(^1\) Stem smut of rye may also be included in this group.
enclosed within the seed pericarp, but are covered by a thin transparent veil. This thin covering breaks and the casual observer would hardly be aware of its existence. Practically speaking, oat smut is uncovered.

METHODS OF TREATMENT

The distribution of the spores of the first group of smuts, in which infection is carried on the outside of the seed, is dependent upon the breaking of the seed coat of the diseased grain; and since many of the smut balls (smutted seeds) are left intact, the first important measure in controlling this class of smut is to give the seed a thorough fanning to blow out all the light smut-filled grains. The next step is to kill the spores that have been distributed and are still clinging to the sound kernels. This may be done by the use of some disinfectant. Various materials and methods have been used with more or less success. The best and most practical material for this purpose is a 40-percent solution of formaldehyde, commonly sold under the name of formalin. Either the soaking or the sprinkling method may be effectively used if the fanning has been well done. If it is not known that every smut ball has been removed, the soaking method is the better since it allows the remaining smut balls to be skimmed off.

FORMALDEHYDE TREATMENT FOR THE STINKING SMUT OF WHEAT, COVERED SMUT OF BARLEY, AND SMUT OF OATS, BY THE SOAKING METHOD

1. Provide one barrel or tank, and two tubs or half barrels. Make a 2-inch hole thru the side of each in such a way that the bottom of the hole will be level with the bottom of the tub. Tack a small piece of wire screening inside the tubs over the holes in order that the wheat may not run out when the plugs are removed.

2. Place one tub on a small table or pair of horses with the plug directly above the other tub on the floor.

3. Prepare the formaldehyde solution (one pint of formalin in 35 gallons of water) in the third barrel or tank, and fill the upper tub half or two-thirds full.¹

4. Pour into this solution about a bushel of grain.

5. Stir the grain thoroughly so that all the smutted kernels may rise to the top of the solution.

6. Skim off the smut balls and light kernels that float on the surface.

7. After from five to ten minutes, or when all the smut balls have been removed, pull the plug and allow the solution to drain into the lower tub.

8. Dump the grain on a clean floor or canvas.

9. Lift the lower tub upon the table, add enough solution to replace that removed by the grain, and repeat the operation.

10. After dumping five or six batches in one pile, cover with a canvas for two hours.

11. Uncover and spread out the grain so that it will dry quickly.

¹One pint of formalin in 20 gallons of water is sometimes used.
A solution consisting of one part 40-percent formaldehyde and one part water is sprayed on the oats as the grain is shoveled from one pile to another. One quart of the solution is sufficient for fifty bushels of seed. The grain, after treatment, should be piled in a heap and covered with a blanket or canvas and allowed to remain for five hours. At the end of this period it may be seeded or stored away.

Treated grain should not be put back into used sacks or bins without first soaking the sacks, or spraying the walls and floor of the bins, with the formaldehyde solution. The wagon box and seeding machine should also be treated in a similar way before sowing the grain.

**Modified Hot-Water Treatment for Loose Smut of Wheat and Barley**

The spores of the loose smuts of wheat and barley ripen at the time the healthy plants are in bloom. These spores are blown about by the wind and many of them find their way into the flowers of the healthy plants. Here these spores give rise to smut infection within...
the very young kernels, which mature without any outward evidence of the presence of the disease. When such kernels are sown, the plants which come from them will produce smutted heads. Because the infection is internal, a method of seed treatment must be used which will have a deeper influence than formaldehyde. Experiments have shown that the smut fungus is more easily killed by heat than are the germs of the grain, and this fact has led to the use of the hot-water method of treatment, a description of which follows.

1. Soak the grain four or five hours in cold water.

2. Place about one-half peck of the grain in a bag, or basket, and immerse in water at a temperature of from 110° to 120° F. for about a minute.

3. Plunge wheat into water at 129° F., and barley into water at 126° F., and allow to remain ten minutes. Movement upward and downward while in the water will facilitate the penetration of the heat.

4. Immerse in cold water to complete the treatment.

5. Spread the grain out in order that it may dry quickly.

It is essential that the thermometer be accurate and that the time of treatment be not too long or too short. If the temperature rises above 131° F., the vitality of the grain will be seriously injured; and if it falls below 124° F., it will be ineffective for killing the smut infection.

This hot-water treatment is often injurious to the vitality of the grain. All grain so treated should be tested for germination and an increased amount sown to make up for the loss in vitality. Because of the tediousness of this process, it is commonly used to obtain smut-free seed for a small plot from which sound healthy seed may be taken for the general seeding the following year.

WHEAT SCAB

The blighting of wheat due to the scab fungus causes greater damage to Illinois wheat than any other single disease, especially to spring wheat. This disease causes the grain to shrivel and ripen pre-
maturely. The kernel is covered with a white, gray, or pink mold. The base of the affected spikelets and glumes usually show the presence of the pink fungus. The severity of the attack may vary, affecting a single spikelet or the entire head.

The use of a good fanning mill to screen and blow out all light shriveled kernels, followed by the soaking and skimming formaldehyde treatment, as for wheat and barley smut, is recommended as a precautionary measure. No absolute cure is known for scab.

CORN SMUT

The smut of corn is caused by a fungus which does not depend upon seed infection for its distribution. The spores from old, diseased corn stalks and from infected manure and soil are distributed by the wind to growing corn plants, where, if the conditions are favorable, an infection will take place and smut bodies will develop.

Seed disinfection is of no benefit in the prevention of corn smut. Rotation of crops will reduce the abundance of smut. Various sprays have been tried with some success, but they are not practical. Cutting and burning the smut bodies before they mature may reduce the source of infection for next year's crop, but this is not known to be worth while.

ERGOT

The worst disease affecting the rye crop in Illinois is ergot. It is not uncommon to find ergot on wheat, timothy, and other grasses,

\[\text{Fig. 4.—Any Actively Growing Part of the Corn Plant is Susceptible to Smut}\]
but no crop is so susceptible to this trouble as rye. Ergot man itself in large brownish-black bodies in place of the rye kernels. These bodies are very objectionable because they reduce the yield, make the grain unsafe for milling, and render it unfit for use as stock feed or seed. Grain containing ergot may be cleaned by running it thru the fanning mill and then treating it with salt brine to remove all that the fanning may have missed. This method has been used very successfully by the Wisconsin Experiment Station.

"Make a salt brine of about 20-percent strength. This can be done by dissolving 40 pounds of common salt in 25 gallons of water, or in that proportion. Have this solution in a tub, barrel, or other suitable container. When the salt is well dissolved pour in the rye slowly and stir vigorously at the same time. It is a job for two men. The ergot and light seeds will rise to the top and the sound kernels will sink to the bottom. Skim off the ergot or add rye until the solution rises and runs over the side of the tub, carrying with it the ergot, when assisted by hand or skimmer. If the ergot does not float, strengthen the solution by adding more salt and stirring until it dissolves. Grain in different stages of dryness will require a slightly different strength of solution.

"A good arrangement is to have two tubs or half-barrels, one set above the other, so that the overflow containing the ergot will fall into the lower tub. Cover this lower tub with cheesecloth to catch the ergot and let the brine run thru so that it may be used over again. With the addition of more salt to replace that which sticks to the kernels, the solution is good as long as it lasts. When vigorous stirring brings up no more ergot, pour off or drain off the solution. Then rinse at once with fresh water to remove the salt. This washing is necessary to prevent injury to germination and to allow the wet grain to dry more readily. Air drying is quickly and easily accomplished if the wet grain is spread thinly on a clean floor or canvas. The clean rye may be used for any purpose desired without any fear that it will carry the disease."