Improved Method of Fighting Smut in Oats

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Improved Method of Fighting Smut in Oats

Abstract
Any farmer who grows oats may secure a return of from $3 to $6 or even $8 from a total investment of 7 cents, 3 cents for labor and 4 cents for formaldehyde. And this may be repeated as many times as there are acres of oats.

Extensive tests by the Farm Crops section of the Iowa Agricultural Experiment Station over a three-year period, comparing different methods or treating seed oats for the prevention of smut, show very definitely that the time and labor heretofore expended for this purpose may be greatly reduced by increasing the strength of the solution and not making the seed wet enough to necessitate drying before seeding.

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Improved Method of Fighting Smut in Oats

AGRICULTURAL EXPERIMENT STATION
IOWA STATE COLLEGE OF AGRICULTURE
AND MECHANIC ARTS

Agronomy Section
Farm Crops

Ames, Iowa
IMPROVED METHOD OF FIGHTING SMUT IN OATS

By H. D. Hughes

Any farmer who grows oats may secure a return of from $3 to $6 or even $8 from a total investment of 7 cents, 3 cents for labor and 4 cents for formaldehyde. And this may be repeated as many times as there are acres of oats.

Extensive tests by the Farm Crops section of the Iowa Agricultural Experiment Station over a three-year period, comparing different methods of treating seed oats for the prevention of smut, show very definitely that the time and labor heretofore expended for this purpose may be greatly reduced by increasing the strength of the solution and not making the seed wet enough to necessitate drying before seeding.

METHOD PREVIOUSLY USED

The method of treating seed oats for smut which has been in use over 20 years is, briefly, as follows:

1. Make a solution using one pint (1 pound) of formaldehyde and 40 gallons of water.
2. Pile 40 bushels of oats on the barn floor.
3. Sprinkle the oats with the solution, at the same time shoveling them over until every grain is thoroughly wet, using about a gallon for each bushel of oats.
4. Shovel the oats into a compact pile and cover with blankets and sacks for from six to ten hours.

40 per cent of the heads destroyed by smut
5. Uncover and shovel out into a thin layer a few inches thick to dry.

6. Shovel and turn the oats at least once, and preferably twice a day, until dry enough to seed; the time required depends upon the weather and the kind of seeder used.

7. When seeding, open up the drill to seed about one-fourth more oats to allow for the swollen condition of the grains.

NEW METHOD RECOMMENDED

While the method just outlined has been entirely satisfactory in killing the smut, two-thirds of the time and labor it requires can be eliminated by the use of a stronger solution. (A solution of one pint of formaldehyde to 10 gal. of water (instead of 40 gal.) used at the rate of only one quart (instead of one gal. of weaker solution) per bushel of grain will entirely kill the smut without injury to the oats. Since the use of so small an amount does not necessitate drying, the oats may be sacked at once and at the end of about 12 hours will run thru the drill as readily as untreated seed.

After three years of experimentation in the field, with the idea of reducing the time and labor heretofore involved, the following procedure is recommended by the Farm Crops section:

1. Make a solution using one pint of 40 per cent formaldehyde and 10 gallons of water.

2. Sprinkle the 10 gallons of solution over 40 bushels of oats, meanwhile shoveling so that the solution is uniformly distributed.

3. Sack as soon as the solution and oats have been thoroughly mixed and seed the next morning.

LABOR AND COST

Two men in from two and one-half to three hours can thus treat and sack enough seed for 40 acres, or an average of about four minutes for the seed required for each acre. Formaldehyde can be secured at any drug store at from 50 to 60 cents per pint, making the cost per acre from 4 to 6 cents.

ONLY 10 PER CENT OF SEED OATS ARE TREATED TO KILL SMUT

That there is considerable loss from smut each year is well known to everyone who grows oats, the loss in some seasons averaging as high as 8 per cent and in individual fields, 20 and even 30 per cent. Yet only about 10 per cent of the oats seeded in Iowa are treated to prevent this loss, and this in spite of the fact that the value of the relatively inexpensive and simple formaldehyde treatment has been thoroughly established and the method is well known. Undoubtedly this is true, largely because the spring months are very busy. If farmers knew of a method of treating seed oats which would not wet the oats to such a degree as to make it necessary to dry them again before seeding and thus save labor and time perhaps more seed would be treated.

COMPARISON OF DIFFERENT METHODS OF TREATMENT

In the spring of 1915 a series of trials was begun to test the value of different solutions made with one pint of formaldehyde each to 3 gallons of water, to 5, to 10, to 20, to 30, and to 40 gallons of water.*

*In these tests the author had at different times the assistance of Messrs. J. A. Krall, M. E. Olson and L. C. Burnett.
In the old method of treatment, all three steps shown above were necessary. The new method requires only the first and saves labor and time accordingly.
The amounts of these solutions used per bushel ranged from 1 to 8 pints or 1 gallon. Different lots of seeds were treated with the different solutions and covered for different periods of time ranging from 0 to 14 hours. Germination tests were made with each lot of seed treated to determine the effect of treatment on the vitality, and plots were seeded in the field to determine the direct effect of the formaldehyde in killing the smut, as well as to determine the yield of the treated seed compared with the same seed untreated. With slight variations these tests were repeated in 1916 and in 1917.

TABLE I—SHOWING YIELD IN BUSHELS PER ACRE OF DIFFERENT LOTS OF SEED OATS TREATED WITH VARIOUS AMOUNTS OF FORMALDEHYDE

<table>
<thead>
<tr>
<th>Strength of Solution</th>
<th>Pts. of solution per bu.</th>
<th>1916 yield</th>
<th>1917 yield</th>
<th>Average yield</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of plots</td>
<td>No. of plots</td>
<td>No. of plots</td>
<td>No. of plots</td>
</tr>
</tbody>
</table>

All of the treatments were effective in killing the smut in 1915 the untreated seed showed slight infection: 1.83 per cent of smut. In 1916 the untreated seed produced 12.7 per cent smutted plants. The use of the 1 to 5 solution (1 pint of formaldehyde and 5 gallons of water), also the 1 to 10 and 1 to 20 solutions, entirely killed the smut as did seven of the treatments with the 1 to 30 solution. All of the plots treated with the 1 to 40 solution showed a few heads of smut, but in no case did the number approximate 1 per cent.

In 1917 there was again some smut in each of the plots where the seed was treated with the 1 to 40 solution, but in no case did the smut reach 1 per cent of infection. The plots treated with the 1 to 5, 1 to 20 and 1 to 30 solutions in a few instances showed an occasional smutted head. The total per cent of smut in different plots amounted to .2, .4, .13, .25, and .87 per cent. Not a single smutted plant was found in the plots treated with the 1 to 10 solution. The untreated seed produced plants with 11.5 per cent smutted heads.

TABLE II—SHOWING YIELD IN BUSHELS PER ACRE OF SEED OATS TREATED WITH FORMALDEHYDE AND THEN COVERED FOR VARIOUS PERIODS OF TIME

<table>
<thead>
<tr>
<th>No. of hours covered</th>
<th>No. of plots in 1916</th>
<th>No. of plots in 1917</th>
<th>Yield in 1916</th>
<th>Yield in 1917</th>
<th>Average yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>11</td>
<td>11</td>
<td>71.7</td>
<td>59.3</td>
<td>65.5</td>
</tr>
<tr>
<td>4</td>
<td>11</td>
<td>12</td>
<td>70.9</td>
<td>64.1</td>
<td>67.5</td>
</tr>
<tr>
<td>8</td>
<td>11</td>
<td>11</td>
<td>69.6</td>
<td>62.0</td>
<td>65.8</td>
</tr>
<tr>
<td>14</td>
<td>11</td>
<td>11</td>
<td>70.0</td>
<td>62.1</td>
<td>66.0</td>
</tr>
</tbody>
</table>

The use of the 1 to 5 solution (1 pint of formaldehyde and 5 gallons of water), also the 1 to 10 and 1 to 20 solutions, entirely killed the smut as did seven of the treatments with the 1 to 30 solution. All of the plots treated with the 1 to 40 solution showed a few heads of smut, but in no case did the number approximate 1 per cent.
The solution made with 1 pint formaldehyde and 10 gallons of water is recommended for use, not primarily because the largest yield was secured from this treatment in 1916 and the next to the largest yield in 1917, but because the required amount of formaldehyde can be applied in this solution to kill the smut without wetting the oats enough to make drying necessary.

Repeated trials have shown that 12 hours after the oats are treated with the 1 to 10 solution, they will run thru the drill as rapidly as will the untreated seed, and this is secured when the oats are sacked immediately following treatment.

No relation was found to exist between the number of hours that the seed was covered and the killing of the smut or the yield in the field.

ANTI-SMUT COMPOUNDS

In the spring of 1917 certain anti-smut compounds, under various names, were placed on the market as substitutes for formaldehyde. Farmers are cautioned against the use of these, for there is no other material known which is better than formaldehyde (or formalin) for killing the smut, and the experiment station knows of none as good. Moreover, the cost of these substitutes, per bushel of seed treated, is much the greater. But, regardless of cost, the money spent for most of them may be considered wasted as they have no value whatever in killing smut, whereas the value of formaldehyde has been fully established by 20 years of satisfactory use.

THE ATOMIZER METHOD

Some work in treating oats for smut has been done at Cornell and Michigan agricultural experiment stations to determine the value of using a stronger solution of formaldehyde by applying it to the oats in the form of a fine spray. In this method one pint of 40 per cent formalin is mixed with one pint of water, the quart solution being sprayed over 50 bushels of oats while the oats are shoveled in order that the formalin may be distributed as uniformly as possible. After applying the formalin, the oats are piled and covered for five hours when they are ready for seeding. This method is reported to have completely killed the smut. While the Iowa station has made no tests with this method, it would seem that the treatment is in its essentials much like the method now recommended by this station. The choice between the two methods depends upon the convenience of operation.

WHAT IS SMUT?

Every grower of oats is familiar with the appearance of the smutted plants. Smut is a fungus plant which cannot get its own plant food from the soil and water and make it into plant tissue with the aid of sunlight, but must get its food supply from other plants; therefore smut is a parasite. The smutted heads of oats (also of barley and wheat), are the ripened seeds or spores of the smut plant. The smut seed germinates in the ground where it has been placed with the seed grain and then sends its shoots up within the tissue of the grain plant, feeding upon the juices of the latter. As the oat plant grows and its flowers develop the smut plant steals the juices intended for the developing grains and uses them to make its own seed or spores. These spores are the black masses which appear in the place of the
seed grain and will number millions. As the smut ripens these spores are blown about by the winds infecting other plants and thus continuing in the crop year after year.

**KINDS OF OAT SMUT**

Several kinds of smut attack small grains and treatments that are effective against some neither prevent nor retard the growth of others. That most commonly found in Iowa is the "loose smut of oats", and this, fortunately, may be controlled by the use of formaldehyde. This is likewise true of the "covered smut of wheat" which is of next importance; this is also known as "stinking smut" or "bunt".

The method in which the smut fungus attacks the grain plant varies greatly with the different kinds. The spores of the loose smut of oats ripen about the same time as the grain and become attached with the seed grain either within the hull or to the outside just as do dust particles. These spores may be scattered in the field by the winds or during the threshing operation. When the seed germinates in the spring, any smut spores placed in the soil with the oats also germinate, and make their way into the tissues of the oat plant.

**SMUT IN IOWA OAT FIELDS**

The actual per cent of smutted plants was determined in 5,904 Iowa oat fields in 1912 and 1913 with the results as shown in table 3. While 7.5 per cent of the plants were smutted in the fields where the seed had not been treated, the loss in some fields was over 30 per cent. The presence of 1.4 per cent of smut in the fields where the seed had been treated indicates that in some cases the formaldehyde used was not of proper strength or else that the work was not carefully done:

**TABLE III—SHOWING THE PER CENT SMUT IN IOWA OAT FIELDS 1912-1913**

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Counts</th>
<th>Per Cent Smut</th>
</tr>
</thead>
<tbody>
<tr>
<td>1912</td>
<td>3,356</td>
<td>7.3</td>
</tr>
<tr>
<td>1913</td>
<td>1,994</td>
<td>7.8</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>7.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Counts</th>
<th>Per Cent Smut</th>
</tr>
</thead>
<tbody>
<tr>
<td>1912</td>
<td>312</td>
<td>1.9</td>
</tr>
<tr>
<td>1913</td>
<td>342</td>
<td>1.0</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>1.4</td>
</tr>
</tbody>
</table>

**AMOUNT OF SMUT VARIES FROM YEAR TO YEAR**

The amount of smut found in 1912 and 1913 is nearly the same, but it is not unusual to find considerable variation from year to year. As a usual thing oats which are badly smutted one year when used for seed in the following season will produce a crop badly smutted, but this is not always the case as seed known to be badly smutted sometimes produce a crop quite free from it. Sultry weather and dashing rains, with little wind at the time the smut spores are ripening, no doubt, results in a decrease in the amount of infection, as the smut spores settle, or are washed to the ground, while clear, windy weather at this time results in an increase in smut the following season. An increase in smut infection seems also to occur when warm clear weather continues for several days in the spring immediately following oat seeding, due possibly to a difference in the optimum tempera-
ture at which the seed oats and the smut spores germinate. To infect the oat plant the smut spores must germinate at very nearly the same time as the grain, since infection can occur for only a short time following the germination of the seed.

MORE SMUT IN SOME VARIETIES THAN IN OTHERS

Of the varieties of oats commonly grown in Iowa, the Early Champion is known to be more susceptible to smut than others; this variety often contains fifteen per cent of smutted plants when most other varieties grown under the same conditions have perhaps only five per cent. There is considerable variation in the susceptibility of other varieties. In general, the earlier varieties are more badly smutted than those maturing later in the season.