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Department of Bacteriology.

OREGON AGRICULTURAL EXPERIMENT STATION,

CORVALLIS, OREGON.

A PRELIMINARY BULLETIN

ON THE

PREVENTION OF SMUT ON OATS.

By E. F. PERNOT.

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A Preliminary Bulletin on the Prevention of Smut on Oats.

One of the most discouraging features of farming is the partial loss of a crop through agencies which can not be detected or remedied after it has begun growing. A field of oats, which promises such good returns just before heading, frequently turn out to be a failure at the time of harvesting. The oat head which should contain the plump, nutritious kernel, is but a withered husk, filled with a noxious black powder, which are the spores of a parasitic fungus, (*Ustilago Avenæ.*) These spores are carried in a great many different ways to kernels of oats which are subsequently used for seeding. When such oats are planted, the fungus spores germinate at the same time as the oats and the mycelium enters the young sprout from which it derives its nourishment. It is unnecessary here, to go into the detail or life history of this parasitic fungus, let it suffice to state that it is not a contageous disease transmitted from plant to plant, but one which is produced by spores which are present on the seed grain, or in the soil, at the time of sowing. When they occur only in the seed oats, they may readily be destroyed, but when they are in the soil, other crops should be grown to eradicate them, as treatment of the soil is impracticable.

Many methods have been tried for the purpose of killing the spores which are attached to the seed oats and while some have been found good, others are almost worthless.

An experiment in testing the best and simplest method of sterilizing seed oats, to destroy smut spores, was conducted this year. Seed which was known to produce smutted oats, was treated in the following manner and sown in experimental plats.

The seed sown in plat A was dipped for ten minutes into a solution of copper sulfate in the proportion of two ounces to the gallon of water.

Plat B. The seed was soaked in a solution of zinc sulfate, two ounces to one gallon of water for ten minutes.

Plat C. The seed was soaked in a solution of copper sulfate, four ounces to one gallon of water for ten minutes.

Plat D. The seed was soaked in a solution of zinc sulfate, four ounces to one gallon of water for ten minutes.

Plat E. The seed was soaked in water at a temperature of 132° F. for ten minutes.

Plat F. The seed was soaked in a solution of formalin, one part to ten thousand parts of water for ten minutes.

Plat G. The seed was soaked in a solution of formalin, one part to five thousand parts of water for ten minutes.

Plat H. The seed was heated in a hot air sterilizer at a temperature of 200° F. for ten minutes.

On the 21st of July all the oat heads which showed any signs of smut were carefully removed and counted, with the following results:

Plat A contained 14 heads affected with smut.
Plat B contained 46 heads affected with smut.
Plat C contained 64 heads affected with smut.
Plat D contained 77 heads affected with smut.
Plat E contained 0 heads affected with smut.
Plat F contained 274 heads affected with smut.
Plat G contained 244 heads affected with smut.
Plat H contained 1 head affected with smut.

One hundred kernels from each sample of oats treated were tested for their germinating qualities with the following results:

Sample A germinated 100%. Sample E germinated 92%.
Sample B germinated 100%. Sample F germinated 100%.
Sample C germinated 89%. Sample G germinated 100%.
Sample D germinated 100%. Sample H germinated 90%.
Sample I germinated 95%, not treated.

In order to determine the effects of different temperatures on the germinating qualities of the oats, one thousand grains divided into 10 lots of one hundred each, were heated at different temperatures, and germinated with the results as seen in the following table:

SAMPLE I.

One hundred grains dipped in water at 132° F. for ten minutes. Placed in germinating pans May 12th, 3 P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9 o'clock a. m.	5
16	9 o'clock a. m.	24
16	3.30 o'clock p. m.	9
17	9 o'clock a. m.	20
17	3.30 o'clock p. m.	4
18	9 o'clock a. m.	8
18	3.30 o'clock p. m.	3
19	9.00 o'clock a. m.	5
19	3.30 o'clock p. m.	0
20	9.00 o'clock a. m.	0
20	3.30 o'clock p. m.	2
Total number germinated		80

SAMPLE II.

One hundred grains heated to 132° F. for ten minutes. Placed in germinating pans, May 12th, 3 o'clock P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9.00 o'clock a. m.	15
16	9.00 o'clock a. m.	38
16	3.30 o'clock p. m.	8
17	9.00 o'clock a. m.	21
17	3.30 o'clock p. m.	3
18	9.00 o'clock a. m.	8
18	3.30 o'clock p. m.	0
19	9.00 o'clock a. m.	0
19	3.30 o'clock p. m.	0
20	9.00 o'clock a. m.	0
20	3 30 o'clock p. m.	1
Total number germinated		94

SAMPLE III.

One hundred grains heated to 140° F. for ten minutes. Placed in germinating pans, May 12th, 3 o'clock P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9.00 o'clock a. m.	7
16	9.00 o'clock a. m.	36
16	3.30 o'clock p. m.	16
17	9.00 o'clock a. m.	32
17	3.30 o'clock p. m.	2
18	9.00 o'clock a. m.	5
Total number germinated		98

SAMPLE IV.

One hundred grains heated to 150° F. for ten minutes. Placed in germinating pans, May 12th, 3 o'clock P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9.00 o'clock a. m.	27
16	9.00 o'clock a. m.	43
16	3.30 o'clock p. m.	13
17	9.00 o'clock a. m.	14
17	3.30 o'clock p. m.	0
18	9.00 o'clock a. m.	3
Total number germinated		100

SAMPLE V.

One hundred grains heated to 160° F. for ten minutes. Placed in germinating pans, May 12th, 3 o'clock P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9.00 o'clock a. m.	16
16	9.00 o'clock a. m.	32
16	3.30 o'clock p. m.	13
17	9.00 o'clock a. m.	33
17	3.30 o'clock p. m.	3
18	9.00 o'clock a. m.	3
Total number germinated		100

SAMPLE VI.

One hundred grains heated to 170° F. for ten minutes. Placed in germinating pans, May 12th, 3 o'clock P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9.00 o'clock a. m.	3
16	9.00 o'clock a. m.	28
16	3.30 o'clock p. m.	12
17	9.00 o'clock a. m.	32
17	3.30 o'clock p. m.	9
18	9.00 o'clock a. m.	12
18	3.30 o'clock p. m.	2
Total number germinated		98

SAMPLE VII.

One hundred grains heated to 180° F. for ten minutes. Placed in germinating pans, May 12th, 3 o'clock P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9.00 o'clock a. m.	0
16	9.00 o'clock a. m.	2
16	3.30 o'clock p. m.	0
17	9.00 o'clock a. m.	25
17	3.30 o'clock p. m.	6
18	9.00 o'clock a. m.	28
18	3.30 o'clock p. m.	7
19	9.00 o'clock a. m.	16
19	3.30 o'clock p. m.	0
20	9.00 o'clock a. m.	5
20	3.30 o'clock p. m.	0
21	9.00 o'clock a. m.	3
Total number germinated		92

SAMPLE VIII.

One hundred grains heated to 190° F. for ten minutes. Placed in germinating pans, May 12th, 3 o'clock P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9.00 o'clock a. m.	0
16	9.00 o'clock a. m.	1
16	3.30 o'clock p. m.	0
17	9.00 o'clock a. m.	8
17	3.30 o'clock p. m.	7
18	9.00 o'clock a. m.	28
18	3.30 o'clock p. m.	8
19	9.00 o'clock a. m.	37
19	3.30 o'clock p. m.	5
20	9.00 o'clock a. m.	5
20	3.30 o'clock p. m.	0
Total number germinated		99

SAMPLE IX.

One hundred grains heated to 200° F. for ten minutes. Placed in germinating pans, May 12, 3 o'clock P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9 00 o'clock a. m.	0
16	9.00 o'clock a. m.	0
16	3.30 o'clock p. m.	0
17	9.00 o'clock a. m.	0
17	3.30 o'clock p. m.	4
18	9.00 o'clock a. m.	31
18	3.30 o'clock p. m.	9
19	9.00 o'clock a. m.	30
19	3.30 o'clock p. m.	5
20	9 00 o'clock a. m.	11
Total number germinated		90

SAMPLE X.

One hundred grains not treated. Placed in germinating pans, May 12, 3 o'clock P. M.

Date of germinating.	Time when counted.	No. germinated.
May 15	9.00 o'clock a. m.	59
16	9.00 o'clock a. m.	33
16	3.30 o'clock p. m.	8
Total number germinated		100

This germinating test, although made on a small scale, would indicate that the hot air process admits of a wide range without injuring the germinating quality of the seed.

The treatment of seed oats for smut with sulfate of copper, sulfate of zinc, formaldehyde, and hot water, have long been known and practiced, but there is a serious drawback in using a treatment which requires a liquid, for several reasons.

First. The oat kernel is enclosed in a husk, and beneath this husk it is covered with small hairs. Either one or both of these prevents the liquid from coming in contact with the minute spores of the fungus, which may be lodged among the hairs, or beneath the husks, so that there are more or less spores which escape being destroyed.

Second. Oats which are dipped into a solution are difficult to dry, especially in rainy or damp weather, and they are liable to germinate or become mouldy before being sown.

Third. It requires a large floor space to dry them and considerable time and apparatus to perform the operation of dipping successfully, especially in the hot water treatment, where barrels, kettles, thermometers, furnaces, and other appliances are needed.

The hot water method, if properly performed, is very effective, but if improperly or carelessly done there is danger of simply attenuating the spores instead of destroying them. The water in this method is simply a vehicle to convey heat, it has no other virtue, so in order to obviate the necessity of so much apparatus and trouble in drying the seed, one sample was treated with hot air in a laboratory hot air sterilizer. The temperature was raised to 200° F. and maintained for ten minutes; although this temperature was too high, the table shows that sample H germinated 90% of the seed. The plat sown with this seed contained only one head of smut, which may have come from one kernel of accidentally untreated seed. In the Willamette valley there are many hop and fruit dryers, which could be used for treating seed grain by this hot air method, with good advantage and at a slight cost. The seed could be treated at any time and stored until seeding season, but it must be remembered that seed which is treated for smut, should not be returned to the sacks again without their having been treated in like manner, because the meshes of the fabric offer an excellent place for spores to lodge, so that if the sacks were not treated, reinfection of the grain would occur.

In treating the oats, they should be spread in thin layers on the dryer trays, in order that all may receive the same exposure to the heat. If they were placed in the heater in sacks full, those in the center would receive little or no heating; or, if they were placed in the heater in large piles, it would be necessary to stir them continually, as in roasting coffee or peanuts, in order that they receive equal exposure to the heat.

It is a well recognized fact in all bacteriological work that there is nothing known to be more efficient in destroying germs and spores than dry heat, so that the advantages of the hot air methods are:

First. That it completely destroys spores.

Second. That it penetrates to all parts of the grain.

Third. That the seed is ready for sowing immediately after treatment.

Fourth. That there is no danger of injuring the seed through germination, mould, or decay, as in the wet method.

Next year an extensive experiment with different seed grains will be conducted to test more fully the virtue of hot air as a preventive of smut.

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