PREVENTION OF CORN OATS SMUT.

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Since the admirable experiments of Jensen in Denmark, Dr. J. C. Arthur, of Indiana,[1] and Profs. Kellerman and Swingle in Kansas,[2] there is no longer any doubt as to the advisability of treating to prevent oats smut and bunt of wheat with hot water. Kellerman and Swingle[3] have shown that loose smut of wheat cannot be prevented by treating the seed. They also conducted a series of experiments to determine whether corn smut can be prevented by treating the seed. Their results show that the treated contained as much smut as the check. The same year Pammel[4] reported an experiment with corn in which the results were also of a negative character. This was in line with results of Brefeld's[5] investigations, but overlooked by the writer at that time. Brefeld's work indicates that smut of corn can enter any merismatic or growing tissue.

While these experiments do not add anything new to the experiments reported before it seems well to give the results of experiments made in 1892. These experiments are a duplicate of those made in 1891, but as corn forms such a large and important crop in Iowa, and since smut causes considerable loss every year it is well to repeat. It is never a safe plan to form conclusions from a single experiment. The results obtained this year are in harmony with those obtained in 1891.

OATS SMUT.

The following short account is from W. T. Swingle,* of the Division of Vegetable Pathology: "With oats the following slight modifications are probably advantageous: (1)

[1] Bulletin 28, Indiana Experiment Station.
Bulletin 35, Indiana Experiment Station.
[2] Bulletin No. 15 and 22, Kansas Agricultural Experiment Station.
W. T. Swingle, Farmers' Bulletin No. 5, U. S. Department of Agricultural, Division of Vegetable Pathology.
See also Hickman Bulletin I, Vol. V, second series, January, 1892, Ohio Agricultural Experiment Station.
[3] Bulletin 22, Kansas Agricultural Experiment Station.
[4] Bulletin No. 16, Iowa Experiment Station. Transactions Iowa Academy of Sciences, Vol I, Part II, p 95.
[5] Journal of Mycology, Vol. VI, p. 61.
* L. c. p. 7.

Have the water in second vessel 143½° F. and immerse the seed five minutes, cooling with cold water afterwards. Where large amounts of seed are to be treated this will prove the most speedy form of the treatment, but great care must be taken to see that every grain is thoroughly wetted. (2) Have the water in the second vessel at 132½° F.; immerse the seed ten minutes and do not cool with cold water, but spread out at once to dry. This last no doubt is the best form of the Jensen treatment for oats, since it requires a shorter time than the regular method and the warmth of the grain aids it materially in drying. Moreover, experiments have shown that seed treated in this way yields the most grain and straw."

Prof. Arthur[6] has shown that the range of temperature which will insure the death of the smut and not injure the grain is considerable. If this method will ever become of practical use the method of maintaining an exact constant temperature is almost out of the question. Prof. Arthur recommends to heat water to 145° F. at the start for both wheat and oats, and to immerse the seed with constant stirring from five to eight minutes; not allowing the temperature to drop below 130° F. No preliminary bath is required.

The copper sulphate treatment is as follows: Immerse the seed in a solution made by dissolving one pound of commercial copper sulphate in twenty-four gallons of water for twelve hours and then place the seed from five to ten minutes into lime water made by slacking one pound of lime in ten gallons of water.

OATS SMUT: FIELD EXPERIMENT.

The piece of ground used in this experiment consisted of about seven-eighths of an acre of level ground, uniform throughout. It was divided into six plots, each about seventy yards long and ten yards wide.

On April 18 each plot was sown with twelve quarts of Prize Cluster Oats, the ground cultivated and afterward harrowed.

PLOT I.

The oats sowed on this plot had been previously soaked for two hours in ferrous sulphate solution (12 grams ferrous sulphate to a liter of water).

[6] Agricultural Science, September, 1892, p. 393.;

PLOT II.

The oats sowed on this plot had been previously soaked for two hours in ammoniacal carbonate of copper solution, prepared according to the following formula:

		Which is equivalent to the formula:	
Carbonate of Copper..	1 gm.	Carbonate of copper....	3 ounces
Commercial ammonia	11.4 c. c.	Commercial ammonia..	1 quart
Water.....	1000 c. c.	Water.....	22 gallons

PLOT III.

Sowed with oats previously soaked for two hours in Bordeaux Mixture, prepared according to the following formula:

		Which is equivalent to the formula:	
Copper sulphate.....	1. 7 gms.	Copper sulphate.....	6 lbs.
Fresh lime.....	18.14 "	Lime.....	4 lbs.
Water.....	1000 c. c.	Water.....	22 gal.

PLOT IV.

Sowed with oats previously soaked for two hours in a standard disinfecting solution of corrosive sublimate, one part of the corrosive sublimate to 1000 of water.

PLOT V.

Sowed with oats previously treated with hot water as follows: Water heated in a wash boiler; then enough cold water was added to lower the temperature to 65° C. Twelve quarts of oats were next added. That reduced the temperature to 58° C. Enough hot water was then added to raise the temperature to 60° C.—140° F. This temperature was maintained for ten minutes.

PLOT VI.

Check. Untreated.

PLOT I.—FERROUS SULPHATE.

Germination.	Condition.	Amount of smut.	Remarks.
Good.	5—1 quite green. 5—3 real green.	7—11 frequent. 7—19 Covered ....9 Uncovered .0	Good condition.

PLOT II.—AMMONIACAL CARBONATE OF CARBONATE.

Poor.	5—1 nearly bare. 5—3 much greener.	7—11 few. 7—19 Covered ....0 Uncovered..0	Stooled well.

PLOT III.—BORDEAUX MIXTURE.

Good.	5—1 quite green. 5—3 real green.	7—11 some smut. 7—19 Covered ....2 Uncovered..5	

PLOT IV.—CORROSIVE SUBLIMATE.

Poor.	5—1 scarcely any. 5—3 getting green.	7—11 very little. 7—19 none.	Very late in ripening.

PLOT V.—HOT WATER.

Good.	5—1 barely up. 5—3 almost bare. less than 1-20 of a stand.	7—11 no smut. 7—19 none.	Heated too much. Recuperated later. Stooled well.

PLOT VI.—CHECK.

Good.	5—1 inferior to III. 5—3 real green.	7—11 some smut. 7—19 Covered ...11 Uncovered 5	

This experiment shows, that treating with ammoniacal carbonate of copper, corrosive sublimate and hot water are advantageous as far as the amount of smut found is concerned. The estimate above is made on three feet along the edge of the plots, but it was essentially the same in the interior. Owing to the lodging of the oats it was impossible to get results on the amount of straw and grain. The oats was also badly rusted.

PLOTS IN GARDEN.

In the following experiment a plot of ground about ten feet square was used. In this ten rows of Prize Cluster Oats were sown April 18, 125 grains planted in each row.

Row I.

The oats sowed in this row were soaked for two hours in ammoniacal carbonate of copper solution, the same as that used in Plot II of the field experiment.

Row II.

Oats soaked twenty-four hours in the ammoniacal carbonate of copper solution used in Row I.

Row III.

Oats soaked twenty-four hours in a standard solution of corrosive sublimate, the same as that used on Plot IV in the field experiment.

Row IV.

Oats soaked two hours in a standard solution of corrosive sublimate, the same as that used on Row I.

Row V.

Oats soaked two hours in a solution of ferrous sulphate (12 gm. to a liter of water), the same as used on Plot I of the field experiment.

Row VI.

Oats soaked twenty-four hours in the solution of ferrous sulphate used on Row V.

Row VII.

Oats soaked two hours in Bordeaux Mixture, same as used on Plot III of the field experiment.

Row VIII.

Oats treated as follows: Placed in an open tin vessel containing water at 65° C. The temperature lowered to 54° C. at the surface and 52° C. (125.6° F.) at the bottom. This temperature was maintained for twelve minutes.

Row IX.

Oats treated same as in Row VIII, except that they had sprouted (½ to ¾ inch long) before planting.

Row X.

Check untreated.

JULY 11.—AMOUNT OF SMUT.

Row I.	No smut.
Row II.	In this row no oats came up.
Row III.	No smut.
Row IV.	No smut.
Row V.	Three smutted heads—all from one root.
Row VI.	One smutted head.
Row VII.	Two smutted heads from the same root.
Row VIII.	No smut.
Row IX.	No smut.
Row X.	Four smutted heads.

RUST.

Leaves badly rusted below. Teleutospores of *Puccinia coronata* matured on July 11.

CORN SMUT.

The loss entailed to corn through the attacks of corn smut fungus (*Ustilago maydis*), although seemingly not large in a field, yet the aggregate loss is very consideralbe. The loss is usually less than one per cent, although in some fields it runs above this. If we take one-half of one per cent as the average loss to Iowa crops more than 500,000 dollars worth of corn are annually destroyed by this fungus, so there are sufficient reasons for making experiments. The following tables gives the results of the experiments. The soil used in this experiment had not been in corn for some years, so that it was probably reasonably free from smut.

SMUT.	Ears.	Leaf.	Staminate.	Node.	Number of the Node.	Total Smut.	Total Number of Stalks.
Ammoniacal carbonate of copper. Smutted.	3	0	1	2	2, 3.	6	33
Ammoniacal carbonate of copper. Seed rolled in germinating smut.	5	0	0	2	4, 3.	7	63
Ammoniacal carbonate of copper. Seed rolled in dry smut.	11	0	0	4	2, 3, 1, 6.	15	39
Bichloride of mercury.	2	0	0	6	2(3), 4, 12, 10, 11	8	89
Bordeaux mixture. Seed not smutted.	4	0	3	13	2(1), 3(2), 2(3), 6, 2(5), 2(4), 8.	20	96
Bordeaux mixture. Seed rolled in germinating smut.	7	0	0	11	2(2), 2(1), 5, 3, 4(4), 12.	18	102
Bordeaux mixture. Seed rolled in dry smut.	15	....	1	24	7(3), 3(1), 4(2), 6(4), 10, 11, 9,5	40	117
Eau celeste.	0	1-5th leaf	0	9	3(3), 4(2), 5, 11, 1, 8.	9	76
Modified Eau celeste. Seed not smutted.	3	0	0	5	3(3), 12, 4.	8	73
Hot water. Seed rolled in dry smut.	3	0	1	7	3(3), 6, 7, 4, 5.	11	51
Hot water. Seed rolled in germinating smut.	4	0	0	22	8(3), 6(4), 2(5), 3(12), 1(2), 2.	26	94
Hot water. Seed not smutted.	5	0	0	11	4(2), 2(3), 13, 5, 11, 12, 4.	16	84
Check. Seed not smutted.	8	0	2	4	3(2), 11.	14	57
Check. Rolled in smut.	4	0	0	9	2(4), 2(2), 10, 6, 8, 2(1).	13	71
Check. Seed rolled in germinating smut.	7	0	1	11	3(3), 4, 5, 3(2), 13, 10, 6.	19	73
Ferrous sulphate.	1	0	0	1	2.	2	40

Total number of stalks in plot	1158
" " " smut boils	232
" " " smutted ears	82
" " " leaves smutted	1
" " " staminate flowers smutted	9
Number of smut boils, first node	7
" " " " second node	14
" " " " third node	22
" " " " fourth node	30
" " " " fifth node	10
" " " " sixth node	5
" " " " seventh node	1
" " " " eighth node	3
" " " " ninth node	1
" " " " tenth node	3
" " " " eleventh node	5
" " " " twelfth node	3
" " " " thirteenth node	1

This table shows that the tendency to form smut boils increases in the lower nodes. It was also a noticeable fact that where one smut boil made its appearance on the lower nodes others appeared further up.

From these experiments we are justified in drawing the conclusion that the Jensen method of treating for oats smut is an advantage. Treating corn seed to prevent corn smut is not to be advised, for the treated seed in all cases showed smut in considerable quantity.