

THE EFFECT OF HYDROGEN PEROXIDE IN PREVENTING
THE SMUT OF WHEAT AND OATS.

F. J. PIPAL.

In order to determine the efficiency of hydrogen peroxide in preventing the stinking smut of wheat and the loose smut of oats, a series of field tests were made on Purdue Farm, during the seasons of 1913-1914 and 1914-1915.

Nineteen lots of winter seed wheat (Egyptian Red) and nineteen of seed oats (Great Dakota), used in these tests, were mixed with spores of *Tilletia foetans* and *Ustilago Avenae*, respectively, to insure abundant infections. They were loosely wrapped in cheese cloth packets and soaked in the variously proportioned solutions of hydrogen peroxide as shown in the accompanying tables. In addition to the above samples two lots of wheat and two of oats were treated with formaldehyde solution, to compare the effect of the latter with that of hydrogen peroxide. Two checks were left in the wheat and one in the oat tests.

All treated samples were dried, at least partially, immediately after soaking, and then sown in the field. The amount of treated grain was sufficient, in each case, to seed about 300 square feet of ground. When the grain headed out, careful counts were made to determine the per cent. of smut on each plat.

The results of the first season's treatment, recorded in table 1, indicate that the weaker solutions of hydrogen peroxide increase the infection of the stinking smut of wheat to a considerable extent. In all cases, except two, where the treating solution ranged in the proportion of hydrogen peroxide to water from 1 to 100 to 1 to 25, the per cent. of smut was higher than the average of the two check plats. The average per cent. of smut of the first twelve treated plats was 18.5, as compared with 16.0 per cent. of the untreated plats. The stronger solutions and pure hydrogen peroxide effected a considerable decrease in the amount of smut but in no case was it eliminated entirely.

Further tests, made in the season of 1914-1915, in which the time of soaking was prolonged to five hours, similar negative results were obtained. The plats on which seed wheat was treated with 1 to 100, 1 to 75, 1 to 50, and 1 to 25 hydrogen peroxide solutions produced 14.6 per cent. of smutted heads, as compared with 12.1 per cent. on the check plat. No stronger solutions were used in these tests than those indicated above. The object of these trials was to use solutions of such proportions as could be employed within reasonable cost limits, in actual farm practice, in case they proved effective against the smut disease.

Table 2 shows the results of the treatment of oats in the season of 1914. The effect of hydrogen peroxide in these tests was positive in every case. Although smut was eliminated entirely only in one case (plat 19), there was a considerable reduction of it on practically every plat, especially where the seed was treated with stronger solutions (plats 13 to 19). According to the tabulated results the average per cent. of smut on nineteen plats treated with hydrogen peroxide solution was 4.9, and 11.0 per cent. on the check plat.

The tests made in the season of 1915, in which only four different strengths of solution (1 to 100, 1 to 75, 1 to 50, 1 to 25) were used and the time of soaking was increased to five hours, showed practically the same results as the tests of the preceding season. Although the percentage of smut in this crop was only two per cent., the effect of the hydrogen peroxide treatment was quite apparent in all but one case. While the plat treated with 1 to 100 solution produced two per cent. of smutted stalks the other plats showed almost a uniform decrease in the amount of smut from two per cent. to six-tenths of one per cent.

In summarizing the results of these tests it may be stated that weaker solutions of hydrogen peroxide, varying in proportion from 1 to 100 to 1 to 25, not only had no effect in preventing the stinking smut of wheat but even seemed to stimulate its development and considerably increase its quantity in the crop. Stronger solutions, however, varying in strength from 1 to 15 to pure hydrogen peroxide, had perceptibly decreased the amount of wheat smut, the pure solution reducing it from sixteen per cent. to three and one-tenth per cent. In the case of oats, however, there was a gradual reduction of the smut disease in most cases, and a complete elimination of it when seed oats were soaked thirty minutes in full strength hydrogen peroxide.

The five-hour period of soaking the seed apparently had no more preventative effect on the development of smut than the one-hour period. The one-hour period was more effective in most cases than the thirty-minute period; and the latter produced better results than the fifteen-minute period.

Hydrogen peroxide had no retarding but rather stimulating effect on the germination of both wheat and oats.

Inasmuch as only pure hydrogen peroxide will materially reduce the stinking smut of wheat and entirely eliminate the smut of oats, as indicated by the results of these tests, the high cost of the treatment makes its practical application prohibitive. Formaldehyde furnishes not only a more effective but also the cheapest seed grain disinfectant.

All hydrogen peroxide used in this work was furnished by the Commercial Company, Clearing, Illinois, at whose suggestion the tests were made.

A brief reference to this work has been made in the twenty-seventh and the twenty-eighth Annual Reports (pp. 32-33, and p. 30, respectively) of the Purdue University Agricultural Experiment Station.

TABLE 1.

Treatment of seed wheat with solutions of hydrogen peroxide and formaldehyde.

Plat	TREATMENT		
	Parts of Peroxide to water	Time of soaking Minutes	Plants smutted Per cent.
1	1 to 100	15	23.3
2	1 to 100	30	13.0
3	1 to 100	60	13.5
4	1 to 60	15	21.3
5	1 to 60	30	18.3
6	1 to 60	60	18.6
7	1 to 40	15	20.3
8	1 to 40	30	19.1
9	1 to 40	60	16.5
10	1 to 25	15	21.3
11	1 to 25	30	20.0
12	1 to 25	60	17.5
13	1 to 15	15	14.5
14	1 to 15	30	14.4
15	1 to 15	60	8.6
16	1 to 10	15	7.7
17	1 to 10	30	6.9
18	Pure hydrogen peroxide.	15	5.4
19	Pure hydrogen peroxide.	30	3.1
20	Sprinkled with 1 to 30 formaldehyde solution.	.....	.0
21	Sprinkled with 1 to 50 formaldehyde solution.	.....	.0
22	Check—soaked in pure water 30 minutes.	.....	17.0
23	Check—dry.	.....	15.0

TABLE 2.

Treatment of seed oats with solutions of hydrogen peroxide and formaldehyde.

Plat	TREATMENT		
	Parts of peroxide to water	Time of soaking Minutes	Plants smutted Per cent.
1	1 to 100	15	9.2
2	1 to 100	30	9.8
3	1 to 100	60	6.0
4	1 to 60	15	9.4
5	1 to 60	30	9.8
6	1 to 60	60	4.0
7	1 to 40	15	7.5
8	1 to 40	30	3.1
9	1 to 40	60	3.6
10	1 to 25	15	7.0
11	1 to 25	30	7.0
12	1 to 25	60	4.9
13	1 to 15	15	4.0
14	1 to 15	30	3.5
15	1 to 15	60	3.9
16	1 to 10	15	1.7
17	1 to 10	30	.8
18	Pure hydrogen peroxide.	15	.9
19	Pure hydrogen peroxide.	30	.0
20	Sprinkled with 1 to 30 formaldehyde solution.	.....	.0
21	Sprinkled with 1 to 50 formaldehyde solution.	.....	.0
22	Cheek—dry.	.....	11.0