THE ILLINOIS AGRICULTURAL EXPERIMENT STATION RECOMMENDS THE FOLLOWING TREATMENT FOR THE PREVENTION OF SMUT:

1. Thoroly fan and screen the oats.

2. Mix one pint of formalin with 10 gallons of water for each 80 bushels of seed to be treated. 
   Keep this solution covered so as to prevent the formaldehyde gas from escaping.

3. Sprinkle the solution over the oats, using one pint to each bushel, and mix thoroly.

4. Pile the oats up and cover with blankets, canvas, or sacks.

5. After two hours uncover the oats. If they have been thoroly mixed they will have absorbed the moisture so thoroly that they will be dry enough to sow at once in a broadcast seeder or drill.

6. If the oats are not to be seeded at once, they should be spread out in a thin layer and stirred occasionally to allow the escape of the formaldehyde gas.

This recommendation is based on five years' investigations planned to determine a simple, convenient method of treating oats for smut.
In 1914, this Station began an experiment to determine the efficiency of very small quantities of formalin solution of varying strengths for controlling smut. It has been a common practice to use as much as a gallon of solution to each bushel of oats treated, but in the conduct of this experiment only one pint of the various solutions was used per bushel. It was found that this amount will thoroughly moisten one bushel of oats, making them slightly sticky, but that after they have stood covered for two hours, they will have so fully absorbed the moisture that they may be sown immediately, either with an end-gate seeder or with a grain drill.

The addition of one pint of solution to one bushel of oats adds only approximately 3 percent of moisture. There is therefore little or no danger of heating. However, unless the oats are sown immediately, it is important that they should be aired thoroly in order to allow the escape of the formaldehyde gas, which might otherwise seriously affect the vitality of the seed.

METHOD OF CONDUCTING EXPERIMENT

Seed Used.—Big Four oats known to be seriously infected with smut were purchased at the beginning of the experiment. Thereafter seed was saved from the check plots, which were sown with untreated oats.

Strength of Solutions.—Solutions of formalin (containing approximately 40 percent formaldehyde) of the following strengths were prepared:

1 pint formalin to 3 gallons of water
1 pint formalin to 5 gallons of water
1 pint formalin to 10 gallons of water
1 pint formalin to 20 gallons of water
1 pint formalin to 40 gallons of water

Treatment of Seed.—One-bushel lots of the infected oats were weighed out, and each lot was placed on a square of muslin. To each lot there was applied one pint of one of the above solutions. The oats were then quickly but thoroly stirred, after which the muslin was folded over them and a second one placed on top to hold in the fumes of formaldehyde. After treating for two hours, the oats were uncovered and spread out to air.
Field Work.—The oats were sown in one-tenth acre plots. Duplicate plots were sown of the oats given each treatment. Check plots of untreated oats were placed every third plot in the series. There were four check plots in all.

The investigation was continued for five years. Each year after the oats were fully headed a careful determination of the percentage of smutty heads was made, and at harvest time an accurate record was kept of the yield. These data are given in the accompanying tables.

RESULTS OF EXPERIMENTS

Crop Yields.—Treatment with the 1-3 solution gave the lowest average yield of the treated oats for the five years. Treatment with the 1-5 solution gave a slightly increased average yield and one year (1916) gave the highest yield of any of the treatments. Both solutions seem to have slightly lowered the vitality of the seed. The seed treated with the 1-10 solution gave the highest yield of oats three out of the five years, and also the highest average yield for the five years. Treatment with the 1-20 solution gave an average yield nearly as high as treatment with the 1-10 solution. The 1-40 solution gave an average yield identical with that of the 1-5 solution, viz., 57.7 bushels per acre. The untreated oats were the least productive, yielding an average of 54.1 bushels per acre, or 5.6 bushels less than those treated with the 1-10 solution.

Percentage of Smut Present.—All of the solutions, except the weakest (1-40), when used at the rate of 1 pint per bushel of oats, practically eliminated the smut. The 1-40 solution permitted the development of an appreciable amount, ranging from 3.5 percent to a trace, or an average for the five years of 1.5 percent. The checks showed a wide range in the number of smutty heads, the range being from 27.3 percent the first year to 1.3 percent the last year of the experiment, with an average of 13.4 percent.
In another investigation conducted by one of the writers it was found that under controlled laboratory conditions, where the full effect of the formaldehyde was obtained, solutions of any of the strengths used in the above experiment, applied at the rate of 1 pint per bushel, are effective in killing all smut spores. These laboratory experiments also indicated that the fungicidal action of formaldehyde as well as its effect upon the viability of the oats depends upon the actual amount of the formaldehyde gas applied per bushel of oats rather than upon the amount of solution used. One pint of a 1-10 solution of formalin contains approximately .005 of a pound of formaldehyde gas.

**SUMMARY**

Under the condition of this experiment conducted for a period of five years, a solution of 1 pint of formalin, containing 40 percent formaldehyde, mixed with 10 gallons of water contained the most satisfactory amount of formaldehyde when used at the rate of 1 pint of solution per bushel of oats. This strength of solution permitted the development of a trace of smut two years out of the five, but this amount was insignificant and the average yield of oats was the greatest obtained in the series.

**RECOMMENDATION**

The above figures seem to clearly justify the Illinois Experiment Station in recommending the following treatment for the prevention of smut:

Mix one pint of formalin (40 percent formaldehyde) with 10 gallons of water. Use one pint of this solution per bushel of oats treated. Sprinkle this evenly over the oats and thoroly but quickly mix until every grain is slightly moistened. Cover at once with a blanket, canvas, or sacks. Allow the oats to remain covered for two hours, after which time uncover. If the oats are not sown at once, thoroly air to allow the formaldehyde gas to escape.