

THE PRESENT STATUS OF THE HOT WATER
TREATMENT IN INDIANA.¹

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The first application on the farm of the hot water treatment of wheat for the control of loose smut was made in Indiana in 1917 by six men in five counties. Since that time the number has steadily increased until in 1921 there were about 850 farmers in 50 counties who treated their wheat. Moreover, the influence of the treatment has been spread by the ever increasing supply of seed from treated fields. For example, in Shelby County, where some of the pioneer work was done, there is a supply of 25,000 bushels of such seed this year (1922); Hancock County has over 2,000 bushels; Gibson County, 3,000 bushels; Posey County, 5,000 bushels; and Wayne County, 4,900 bushels. It is reported that there are 29,000 acres in Knox County planted with seed from treated fields.

As is usual when a laboratory control method is first applied on the farm many unforeseen changes were necessary to make the method entirely practical. The particular changes that have been made can best be discussed under the different phases of the treatment.

1. *Presoaking.* It has been proven that presoaking is one of the essential steps in the treatment. The early recommendation, to soak the wheat in cold water for eight hours, is perfectly proper but under farm conditions this time is too long because the treating usually begins about 9 A.M. making it necessary to begin soaking the seed at 1 A.M. Investigations showed that four hours presoaking was sufficient and that 12 hours soaking is dangerous because the seed is quite apt to germinate and thus be rendered much more susceptible to injury by the treatment to follow. A peculiar mistake in the presoaking recommendations was made in Porter County last year. The farmers thought that any four hours previous to treatment would do and they soaked the wheat during the previous afternoon. Promptly at the end of the time they removed the sacks from the water but allowed the soaked wheat to stay in the sacks until the following morning thus permitting sufficient germination to prevent successful treatment.

Not more than one bushel of dry wheat should be soaked in a two bushel burlap sack because it swells to almost twice its original bulk. If the sacks are too full the seed will soon become packed and either burst the sacks or, as sometimes occurs, the tight outer layer excludes the water and the wheat in the center is not properly soaked. Because of this propensity of the seed to swell and tightly pack, the sack should be laid on its side in the water, rather than on end.

2. *The Treatment.* At first a half bushel of wheat was treated in a barrel of hot water, the temperature being maintained by adding boiling water from time to time. In Shelby County where large amounts of wheat were treated this method was too slow and a rather ingenious

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device was made to meet the emergency. It consisted of a heavy wire drum holding five bushels of soaked wheat, which revolved in a large tank of water heated by steam. This is distinctly a field application of the treatment. However, the sack method is still frequently employed, but instead of barrels, large tanks of water heated by steam are used so that six to eight men may treat their wheat at one time.

A device which enables the operator to keep the wheat in the hot water without burning his hands consists of loops of heavy twine fastened by a slip-noose to the mouth and one corner of the sack. It has been noted that grain sacks are unsatisfactory for treating because the tightly woven cloth seems to prevent the ready passage of the water through the wheat, and burlap sacks are therefore recommended. When using the drum not more than five bushels of wheat should be treated at once and the drum should not be filled more than two-thirds full. This allows a free movement of the wheat and a quick and thorough mixing with the hot water.

The time of treating and temperature of the water have not undergone any change. Temperatures as high as 135° F. will not injure wheat, and it is also known that immersion in water at 130° F. for 15 minutes will not do any particular harm to the seed. However, these facts are only used as leeway in the treatment rather than as changes because it is necessary to speed up the treatment as much as possible and there is usually nothing to be gained in lengthening the time of treatment.

3. *Drying the seed after treatment.* Perhaps the greatest drawback to the treatment is the drying of the seed. It has been found, however, that it is only necessary to surface-dry the grain so that it will run through the drill without clogging. Allowance is made for the swollen condition of the grain by setting the drill to sow about twice as much as customary. Experiments at Washington, D.C., have shown that wheat can be dried very thoroughly in artificial dryers without injury to seed. One illuminating incident happened this year in Clinton County. Some treated wheat remained wet too long after treatment and produced sprouts that were in some cases a quarter of an inch long. A sample of this seed was dried completely over a radiator and sent to Purdue to be tested. It germinated 92.5 per cent.

Results. Usually the stand of the treated wheat is thin but the plants stool much more than the untreated wheat so that the final number of heads produced is about the same in both cases. It has been noticed generally that the heads in the treated wheat are much more uniform in size and are usually somewhat larger than in the untreated. It is possible that the thinning of the stand may have something to do with this but it is believed that the treatment kills the weak seed and that only the stronger plants survive. This belief is supported by the fact that the improvement in the crop usually maintains itself in the wheat the second and third year after treatment.

The treated wheat will usually ripen about a week later than the untreated wheat, but this is not an objectionable feature. This delay in ripening did, however, result rather disastrously in Bartholomew County two years ago. The weather was apparently unfavorable during

the time of filling and ripening and since it had a week more to act on the treated wheat the grain was considerably shrivelled and really inferior to the untreated wheat. The farmers blamed the treatment for the trouble.

It was noticed at first that certain weeds like cockle and rye would often be killed by the treatment. This led to rather false hopes for the treatment and some county agents went so far as to recommend the hot water treatment as a means of ridding the wheat of cockle. We have found, however, that this cannot always be depended upon. In Posey County it has been found that a treatment of 15 minutes at 130°F. is more effective in killing cockle and that it will not materially injure the wheat more than the ten minute treatment. Experiments in treating cockle seed have shown that one controlling factor is the length of time that it is presoaked. With the cockle seed used, it was found that after 12 to 24 hours of soaking the germination was reduced very materially by the treatment. It seems, too, that fresh cockle seed is more susceptible to injury than old seed.

Without question the treatment will control the loose smut but there are certain factors which have been found to prevent a perfect control. These are: 1. Insufficient presoaking of the seed; 2. Imperfect heating of the seed due to excessive amounts of wheat in the sack or the drum; 3. An incorrect thermometer, registering too high so that the actual temperature of the water was below 129°F. The stinking smut, however, is not always controlled. This is apparently due to the inability of the heat to kill the spores in the center of the smut-filled seed, followed by the subsequent breaking of these spore masses, which results in the distribution of viable spores over the wheat. In Porter County in 1922 there was one field where the treated wheat had 10 per cent of stinking smut and the untreated part about 12 per cent.

Changes made in the field applications. The original recommendation for eradication of loose smut, given by Freeman and Johnson in bulletin 152 of the Bureau of Plant Industry, and at first followed in Indiana, was as follows: Treat enough wheat for a small seed plot, about five bushels, and select the seed for the next year's crop from this plot. The first objection to this program came from the farmer. He could not or would not keep this small area separate from the rest of the wheat. Usually it was necessary to plant this patch in a larger field and when it came to cutting this separately and hauling it to the threshing machine separately the trouble began. The farmers who had been convinced of the value of the treatment treated enough seed for a whole field and supplies of supposedly smut-free wheat began to appear. With the advent of wheat certification, which calls for practically smut-free wheat, the treatment became more popular. It soon became evident, however, that using wheat from a smut-free field did not guarantee a smut-free crop owing to the fact that the spores could easily be blown from neighboring or even distant fields. This showed the fallacy of recommending the seed plot method or even separate fields of treated wheat and also seems to be one of the factors which has been retarding the spread of the practice. The farmers feel that it is useless to treat

a small amount of seed if the wheat produced is liable to give a badly diseased crop the next year.

Another old idea which has acted against a wider application of the treatment has been that the farmers themselves can not handle the treating because it is too complicated and dangerous. The whole treating project is being revised this year. It has been demonstrated in Knox and Shelby counties that a widespread use of treated seed will greatly reduce the dangers of the spread of the smut. In Knox County it was found last summer that wheat which had been treated last year had no smut in it; that which was one year from treatment had no smut; two years from treatment there was one-quarter per cent; and three years from treatment two per cent while in the untreated fields there was an average of eight per cent. This shows rather clearly that the best way to handle this problem is to establish smut-free areas or communities. In order to do this it is evident that the actual treating in a large area would soon become too great for one station to handle. This was solved by placing the treating stations in the hands of the farmers themselves. Five groups of farmers in Clinton County, three groups in Marion County and one group each in Henry and Wabash counties treated a total of over 800 bushels. In every case enough seed was treated to plant a whole field and so far as the treatment itself was concerned the work of these farmers was a complete success.

The steps in advance that have been made are these:

1. Enough seed is being treated for whole fields so that it will be much easier to keep this wheat separate and propagate the seed.
2. The farmers themselves are beginning to handle the treatment and in this way greatly increasing the number of centers from which the treated wheat can start.
3. Smut-free areas are being established in which it is hoped that wheat can be maintained free from loose smut for several years.

ONION SMUT IN INDIANA.¹

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A survey of all the important onion growing regions of Indiana in 1922 showed the smut disease to occur abundantly in Lake County, around Munster, and in one locality near Rensselaer in Jasper County. In the vicinity of Munster there is a considerable industry in the growing of onion sets and in these fields the disease is very severe, frequently causing losses of 50 per cent or more. The losses caused are of two types, a direct loss by the destruction of the plants and indirectly by the production of over-sized onions which are often discarded as they are not salable as sets. These over-sized onions are the result of a thinning of the stands by the disease permitting the onions that remain to grow more than is desired. In addition, it has been found that the

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