

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

¹ Contribution from the Botanical Department (Extension Division) of Purdue University Experiment Station.

shrinkage in storage of the onions grown in infested fields is very much greater than in those from uninfested fields or from formaldehyde treated seed.

It has been proven beyond a doubt that the formaldehyde "drip" method of treatment will control the onion smut very effectively but the method was designed to apply to onions that are sown at the rate of five to seven pounds per acre. In Lake County, where the seed is sown at the rate of about 60 pounds per acre, the problem is somewhat different. Under these conditions the control is never 100 per cent but it has been sufficiently effective to secure its adoption by the majority of growers. The probable explanation of the control by the formaldehyde treatment is that the gas evolved disinfects the soil in the immediate vicinity of the seed through which the seedlings must grow thus killing the spores or the saprophytic mycelium. This disinfecting action does not seem to extend over a sufficient area to permit the large number of seedlings developed in the row to grow in disinfected soil and as a result a small proportion of the plants may be diseased. This may possibly be explained by the fact that the formaldehyde does not wet an area more than three-quarters of an inch wide, though the gas may spread somewhat beyond this, whereas the row of onion seedlings is about an inch and a quarter wide.

Aside from the failure of the formaldehyde to completely disinfect the soil there are other factors that seem to affect the efficiency of the treatment. The growers believe that spring plowing so loosens the soil that the formaldehyde penetrates too deeply for proper or sufficient disinfection. The amount of rain at planting time and immediately following is very important. In 1921 the heavy continuous rains at the time of treatment, and during the week following, practically nullified all the beneficial effects. The probable explanation of this fact is that the rain diluted the disinfectant so that it lost its potency, or else the presence of the water in the soil prevented uniform penetration.

The usual recommendation for dilution is one pint of 40 per cent formaldehyde in 16 gallons of water, to be used at the rate of 200 gallons per acre.

The treated onions had about five per cent of smut while the untreated parts of the beds averaged about 50 per cent. Increases in yields of 100 bushels per acre were obtained.

The growers at Munster found that they were usually applying only 140 to 160 gallons so it was decided to dilute the formaldehyde, one pint in 10, 12, and 14 gallons of water. This was done in 1922 with somewhat better control of the smut and without causing any injury to the seedlings. Rather peculiar results were obtained, however, from the treatment. The soil at the time of sowing was dry and the weather very favorable for the treatment. An examination of the fields in June showed the treated rows had less than five per cent of smut while the untreated rows had as much as 95 per cent in some cases. In one field where the grower did not use the treatment, over half of the plants were being destroyed by the smut. During the summer there were no effective rains and the temperature was generally above normal. These

abnormal conditions had a particularly harmful effect in the treated rows while the untreated rows were apparently not so seriously affected. The results of some of the growers are as follows: Joe Munster, who treated all his seed, reports that he did not harvest the crop because it was a complete failure. John DeVries did not get any difference in yield between his treated and untreated fields. Andrew Krooswyk states that his treated seed was somewhat better than the untreated but neither was worth much. In other words, the treatment did not seem to have had the beneficial effects obtained in previous years.

The explanation of this trouble seems to be that the treatment permitted a heavy growth of onions whereas the untreated areas were very much thinned by the smut. The continued dry weather so depleted the soil of water that in the heavy, normal stands the plants were unable to make any growth and as a result most of the bulbs did not develop. On the other hand, there was not so much competition among the plants of the diseased (untreated) rows and the few that remained were able to get sufficient moisture to develop small bulbs which were just the right size for sets. This resulted in approximately the same yields in the treated and untreated onions. Viewed in connection with previous experiences and from all angles, this peculiar and unexpected effect is really an argument for the treatment since it shows that smut control permits a much thicker stand which in normal years would produce an almost perfect yield.