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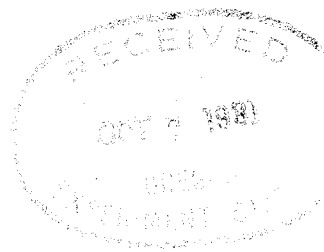
STINKING SMUT CAUSES HEAVY LOSSES

TO WHEAT GROWERS

by

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In the wheat growing areas of the Pacific Northwest, no cereal disease approaches stinking smut in economic importance. The control of stinking smut, or bunt, another name for this cereal disease, is an important and troublesome problem for farmers in every wheat growing section of the United States, but particularly important in the Northwest where it is so prevalent and so difficult to control. Government specialists, some years ago, made a survey of the smut situation in the Pacific Northwest and estimated the loss from smut at that time to be about \$10,000,000.00 annually in three northwestern states.

What Causes Smut

Smut is a fungous plant which penetrates the young wheat only in the seedling stage and grows up inside the wheat plant. It cannot be discerned without microscopic examination until after the wheat begins to mature. At that time, the smut fungus takes complete possession of kernel formation and reproduces itself by replacing the wheat kernel with its own seed or spores. Instead of wheat kernels the smut infected plant produces smut balls, each one of which may contain a million or more spores. Each of these spores is capable of germinating and producing a smut plant to again infect the wheat, and complete its life cycle.

At the time of germination the wheat plants may become infected with smut from two sources: (1) from smut spores carried on the seed and (2) from spores deposited on the soil from wind-blown smut scattered about from combines, threshing machines, and cleaners. These spores on the seed, unless killed by seed treatment, and also the spores in the soil, germinate when soil moisture and soil temperature conditions are favorable, and infect the young wheat plant before the first leaves have appeared.

Different Varieties of Smut

It has been known for a long time that there were two types, one with a smooth spore called Tilletia levis and one with a rough spore called Tilletia tritici. Both smuts are similar in behavior and are controlled in the same way. They can be distinguished only by an examination of the spores under a microscope. Recently it was discovered that in each of these species of smut there were several distinct forms or strains. No way has yet been found of distinguishing between these different forms other than observing their effect on certain wheat varieties. Some wheat varieties are immune from, or are highly resistant to certain forms of

smut and are susceptible to certain others. It is not yet known how many physiologic forms of smut there are, but experimental work at Moro and at Corvallis has proved that there are at least ten forms of bunt, six in the species T. levis and four in T. tritici. An interesting account of this experimental work and other work pertaining to wheat smut is contained in a recently published Oregon Experiment Station Bulletin No. 281 entitled "Varietal Resistance, Physiologic Specialization and Inheritance Studies in Bunt of Wheat," by Dr. E. N. Bressman.

### How Can Smut be Controlled

For many years experiment station workers have been investigating methods of controlling stinking smut in wheat. Much progress has been made, but the smut problem is yet far from being solved. There have been two general methods of attack: Seed treatment, and breeding resistant varieties.

The treating of seed with fungicides like formaldehyde and copper sulphate (bluestone) always has been practiced by eastern Oregon wheat growers. All farmers are familiar with these methods. During recent years these two methods of treating wheat have been almost entirely replaced by the dust treatment with copper carbonate, which generally gives as good smut control and much less injury to the seed germ. In some sections of Eastern Oregon none of the usual seed treatments will completely control smut; in fact, in parts of Umatilla County, seed treatment is not always effective enough to insure against smut dockage in the crop when susceptible varieties like Hybrid 128 or Federation are grown.

Seed containing considerable smut, including smut balls, was sown at the Pendleton Field Station in the fall of 1930. Based on head counts, the resulting crop contained 5.8% smut, when treated with copper carbonate containing 50% copper and 6.7% smut when treated with copper carbonate containing 18% copper. When treated with formaldehyde, one pint to 40 gallons of water, the crop contained 8.2% smut; and when treated with bluestone, one pound to 5 gallons of water, the crop contained 12.9% smut. When the seed was not treated, the resulting crop contained more than 40% smut. Twelve different seed treatments were used, and the best control was obtained from a double treatment, formaldehyde, 1 pint to 50 gallons of water, the seed dried, and then treated with copper carbonate. Notwithstanding the double treatment, the crop contained 2.6% smut. This double treatment injured the seed considerably, reducing the stand 25%, but resulted in a higher yield than from other treatments that did not control the smut so well.

From this experiment and another one in which clean, smut-free seed was sown without treatment, and practically no smut obtained in the crop, it seems that the failure to control smut this season may have been due to the ineffectiveness of seed treatment on this very smutty seed rather than to soil infestation. Further experiments are being carried on to get more definite information as to the cause or causes of so much smut being produced in the winter wheat crop in eastern Oregon even when the seed has been treated by approved methods. Using seed that is comparatively free from smut doubtless would go a long way towards reducing the amount of smut in the crop. This point frequently is overlooked by farmers. Smutty wheat never should be used for seed. Even with low wheat prices, it will pay farmers to go to considerable trouble or expense to secure seed as free from smut as possible, because smut in the crop means a yield reduction of several bushels per acre as well as a lower price per bushel.

### Smut Resistant Varieties

The production of varieties of wheat highly resistant to stinking smut gives much promise of helping to reduce the present heavy losses now being caused by this disease. It is not yet known just why some wheat varieties are attacked by

smut worse than others. A few wheat varieties have been produced that are immune from certain forms of smut and highly resistant to others. Some varieties have proved resistant to some forms and highly susceptible to others. It is quite probable that there are forms of smut in existence that have not yet been tried on these resistant varieties, but they have been inoculated with smut collected from many different localities in the Northwest, as well as from other states, and have still maintained a high degree of resistance.

To test these resistant varieties, the seed is blackened with smut spores and planted without treatment. When sown in this manner, most commercial varieties will produce a crop containing from 50 to 95% smutted heads.

#### Smut Trials at Pendleton

In this season's smut trial at the Pendleton Field Station, 27 wheat varieties were sown with seed blackened with smut spores from each of ten collections of smut originally obtained from various localities in the Pacific Northwest. The lowest average percentage of smut obtained in any variety was seven-tenths of one per cent in Hoenheimer, a late-maturing, smut-resistant variety produced by a German plant breeder. The highest percentage of smut was obtained in Hybrid 128, which had 95.2% of the heads smutted.

Following are listed the ten varieties which proved most resistant this year, with the average percentage of smut shown for each variety:

<u>Rank</u>		<u>Smut %</u>
1	Hoenheimer No. 77	0.7
2	Crimean 1532	2.8
3	Oro 8220	3.3
4	Turkey 7336	4.2
5	Argentine 10061	6.5
6	Turkey x Bd. Minn. 48	9.0
7	Turkey 1558A	11.7
8	Ridit	13.0
9	Turkey x Florence No. 935	14.0
10	Turkey x Florence No. 932	14.4

The ten varieties listed above have been tried for many years for smut resistance at several experiment stations in the western United States, and they have been uniformly high in resistance to this disease. The first eight varieties in the above list are red-kerneled wheats, and six of them were developed at the Moro Station. Of these six--all wheats of the turkey type--Oro and Argentine are the most promising varieties considering yield and smut resistance. Both varieties have been distributed to farmers and are now being grown commercially.

The variety which ranked eighth in smut resistance, Ridit, is a beardless, red-kerneled wheat produced by the Washington Experiment Station at Pullman. It is now commercially established in the Northwest.

The only white-kerneled varieties in the ten which averaged highest for smut resistance were the two Turkey x Florence hybrids. These two wheats have the same parentage as Ridit. Neither has been distributed to farmers.

#### Will it Pay to Grow Smut-Resistant Wheats

Whether it will pay a farmer to grow any of these smut-resistant varieties will depend upon (1) how difficult it is to control smut in his locality, (2) how

high they will yield in comparison with standard commercial varieties and (3) upon market price or quality.

Yield data are available on these varieties from the Moro and Pendleton Stations and from several outlying nurseries. Several farmers also are growing some of these varieties, and if they prove satisfactory in yield and quality, the acreage sown to them will increase.

There may be new smut forms in certain localities that will attack some of these varieties, as was indicated this year when a collection of smut from Craigmont, Idaho, smutted Ridit 37.6%. Oro had only 6.3% smut when smutted with this Craigmont collection. If these resistant varieties are treated, which would be the wise thing to do in areas where smut is very difficult to control, there should be little or no smut in the crop. The treating of resistant varieties may be highly desirable as a precaution against the introduction of new virulent physiologic forms of smut.

The following tables give the acre yield in bushels of some of these highly resistant varieties in comparison with Kharkof, a Turkey wheat, Hybrid 128 and Federation. Included in the tables is the variety Albit, a moderately smut-resistant club wheat which also is commercially grown in the Northwest. Albit must be carefully treated before sowing.

Field plot trials, Moro:

6 yr. average  
yield, Bu.

Hybrid 128	26.3
Kharkof	25.2
Argentine	26.2
Oro	24.9
Ridit	22.7
Federation	24.3

Nursery trials, Moro:

7 yr. average  
yield, bu.

Hybrid 128	24.1
Kharkof	20.6
Argentine	19.4
Oro	20.0
Ridit	18.9
Albit	19.6*
Federation	21.3

\* 4-yr. average; for the same 4 years Hybrid 128 averaged 22.9 bushels

Nursery trials, Kent:

5 yr. average  
yield, bu.

Hybrid 128	22.7
Kharkof	21.3
Argentine	20.0
Oro	21.4
Ridit	19.7
Albit	21.8
Federation	22.1

Nursery trials, Condon:4 year average  
yield, bu.

Hybrid 128	27.9
Kharkof	26.7
Argentine	24.2
Oro	24.0
Ridit	25.3
Albit	25.8
Federation	29.7

Nursery trials, Culver:4 yr. average  
yield, bu.

Hybrid 128	13.7
Kharkof	15.0
Argentine	14.2
Oro	14.9
Ridit	15.8
Albit	11.1
Federation	17.2

Nursery trials, Wasco Co.:5 yr. average  
yield, bu.

Hybrid 128	23.2
Kharkof	22.6
Argentine	23.5
Oro	23.6
Ridit	23.5
Albit	14.9*
Federation	21.3

\* 3-year average. Albit yielded 2.5 bushels per acre less than Hybrid 128 for the same three years.

Plot trials, Pendleton:3 yr. average  
yield, bu.

Hybrid 128	34.3
Albit	32.2
Federation	39.2

Nursery trials, Pendleton:8 yr. average  
yield, bu.

Hybrid 128	35.7
Kharkof	34.7
Argentine	34.4
Oro	34.0
Ridit	32.3
Albit	32.9*
Federation	34.4

\* 5-year average yield; Hybrid 128 for the same 5 years averaged 35.2 bu. per acre

Nursery trials, Lexington:7 yr. average  
yield, bu.

Hybrid 128	20.9
Kharkof	19.3
Argentine	19.3
Oro	19.3

Nursery trials, Lexington: (Cont'd)

7 yr. average  
yield, bu.

Ridit	19.3
Albit	21.2*
Federation	19.8

\* 5-year average yield; for the same 5 years Hybrid 128 averaged 23.5 bu. per acre

Nursery trials, Eightmile:

7 yr. average  
yield, bu.

Hybrid 128	26.2
Kharkof	23.1
Argentine	20.8
Oro	21.2
Ridit	22.4
Albit	23.0*
Federation	30.6

\* 5-year average yield; Hybrid 128 for the same 5 years averaged 24.6 bu.

The yield data in the above tables indicate that in some localities one or more of the smut-resistant varieties will yield as much as present commercial varieties. In some localities, especially at Pendleton, none of the smut-resistant wheats seems to be quite high enough in yield to replace Federation or Hybrid 128, the varieties now grown in that county.

Recommendations

From available data on methods of controlling smut, the experiment station makes the following recommendations:

1. Sow clean seed which is as free from smut as possible. The sowing of smutty seed containing very many smut balls will likely produce a smutty crop.
2. Treat seed with copper carbonate containing 50% copper, using at least two ounces per bushel, and use a treating machine that will thoroughly coat every seed with powder.
3. If clean seed of winter wheat is not available, it may be advisable to defer sowing until spring. Smut is more easily controlled in spring-sown wheat, and Federation wheat, sown early in the spring, frequently will out-yield any fall-sown wheat planted late or in dry ground.
4. Planting soon after the first fall rains increases the danger of smut infection. The delaying of seeding three to four weeks after the fall rains will lessen the danger from smut infection from smut spores in the soil; but seeding too late in the fall in some localities will reduce yields.

Comparable yields are found in this circular for four smut-resistant and three standard wheat varieties grown at several locations in the Columbia Basin of Oregon.

Albit, a moderately smut-resistant white club wheat, averaged one to three bushels per acre less in yield than Hybrid 128 at all locations.

Oro, Argentine and Ridit, highly smut resistant varieties, averaged about the same in yield as Kharkof, a Turkey wheat.