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UTAH AGRICULTURAL COLLEGE

UTAH AGRICULTURAL EXPERIMENT STATION

Control of Stinking Smut of Wheat With Copper Carbonate

By

B. L. RICHARDS and A. F. BRACKEN

Stinking smut or bunt of wheat is an ever-present and destructive disease in the wheat fields of Utah. During the past season (1925) this disease was especially prevalent, causing losses in certain fields of from 25 to 50 per cent, not counting the loss to the grower in reduced grade of grain. In the threshing of smutty wheat there is also the risk of loss from smut explosion. Almost every season cases of this sort are reported. In addition of all of the wheat tested by the U. S. Grain Inspector at Logan for Northern Utah and Southern Idaho 30 per cent showed smut infection in 1925. The average reduction for smut is near ten cents a bushel with a variation from five to twenty cents. The cost of producing a smutted crop may equal or even exceed the cost of producing a clean crop. Loss occurring from this disease, since it is preventable, can hardly be considered attached to the total gross returns; it is a subtraction from the net profit. Effective methods for the prevention of these losses by smut are now available to every grain grower.

Nature and Cause of Stinking Smut

Stinking or covered smut is caused by a minute plant parasite which normally grows in the tissue of the wheat plant. This little plant produces its seed or spores entirely within the wheat kernel. Such smutted kernels are known to the farmers as "smut balls", and when broken open expose the "stinking", dark, powdery mass of spores so characteristic of the disease. During threshing and subsequent handling of the grain, the myriads of small spores are scattered to the sound kernels to which they adhere ready to be planted with the wheat in the autumn or following spring. When wheat so covered with smut is sown without treatment, the small spores germinate and enter the growing seedling. Once inside the host, the young parasites grow upward with the growing wheat plant and finally produce spores in the developing kernels, ready to be disseminated as in the previous year.

Dipping Methods Are Effective But May Be Dangerous

Copper sulfate ("blue vitriol" or "bluestone") and formaldehyde treatments when properly applied are both effective in the control of stinking smut. These chemicals, however, endanger the germinating power of the wheat. In some instances almost complete crop failure has resulted from the use of formalin, especially in arid regions where formalin-treated wheat has been sown in dry soil. However, if formaldehyde is properly applied, and if the grain is seeded immediately in a damp soil, control of smut is assured, and but little injury need be expected.

In the use of formalin, one must be sure that it is of proper strength—40 per cent formaldehyde. The treating solution is prepared by accurately measuring one pint of 40 per cent formalin to forty gallons of water—no more and no less of either. The wheat may then be sprinkled with or dipped in this solution. It is likely that dipping is surer to kill smut under ordinary conditions. When more water is added to the barrel it also must have the same strength of formalin as that first used. Wheat treated with formalin should stand no longer than forty-eight hours after treatment before it is sown.

Copper sulfate is also destructive of the germinating power of seed. This compound may not be so disastrous in reducing stands as formalin, but the reduction even tho small is more general every year. In many wheat-growing districts the injurious effect of this compound is offset by dipping the grain in a lime solution. This combined treatment is both costly and time-consuming. With this method usually one pound of copper sulfate is dissolved in five to seven gallons of water. Because this compound goes into solution very slowly in water, the mixture is heated, and since copper sulfate will react on most ordinary metals an earthen crock is best for this purpose. The treating process is the same as for formalin.

Copper Carbonate an Effective Substitute for Wet Methods

Agricultural investigators have searched long for a chemical that would control smut and not injure the seed. This search has resulted in the introduction of copper carbonate as a safe substitute for the two dipping methods. The discovery that copper carbonate has germicidal properties was made by Darnell-Smith in 1915.¹ Besides being an effective germicide, non-injurious to the seed, copper carbonate has the following advantages when properly applied:

¹Darnell-Smith, G. B.—"Fungicidal Dusts for the Control of Smut". *In* AGR. GAZ. New South Wales (Australia), 32: 796-98 (1921)

1. It destroys the smut spores on the kernel and aids materially in protecting the grain against infection from this and other fungous organisms which may be in the soil.

2. Germination is always found to be higher in seed treated with copper carbonate than in untreated seed or in that treated with either formaldehyde or copper sulfate. As an example, tests made in 1923 at the Utah Agricultural Experiment Station gave results as follows:

| | | |
|---|-----|-------------|
| Standard treatment with formaldehyde..... | 83% | germination |
| Standard treatment with copper sulfate..... | 82% | germination |
| Standard treatment with copper carbonate..... | 95% | germination |
| No treatment (clean seed)..... | 92% | germination |

3. Copper carbonate may be applied safely at any time prior to seeding and the treated wheat stored indefinitely. This is a decided advantage since it allows a grain grower the opportunity to treat his wheat before the rush of the season's work, such as drilling and seedbed preparation.

4. Copper carbonate protects grain against weevil injury.

5. With proper machinery the labor and economy of treatment is reduced to a minimum.

6. There is no wetting of the seed and consequently no swelling. It is not necessary, therefore, to change the drill to compensate for swelling. The drill once set for proper rate of seeding requires no further adjustment.

7. Copper carbonate is as cheap as either the copper sulfate or the formaldehyde, costing from three to seven cents a bushel of wheat treated.

8. When seed is sown in dry soil, copper carbonate does not reduce yields. During the seasons of 1924 and 1925 a test was conducted at the Nephi Substation to determine the comparative effect of various treatments for smut on yield. The results are tabulated below:

| Treatment | 1924 | 1925 |
|-----------------------|----------|----------|
| No treatment..... | 22.4 bu. | 42.1 bu. |
| Copper carbonate..... | 23.7 bu. | 40.2 bu. |
| Formalin | 20.2 bu. | 39.4 bu. |
| Copper sulfate..... | 19.6 bu. | 40.6 bu. |

The fall of 1923 was dry at time of seeding and remained dry until near December. As a result, the 1924 crop did not emerge for several weeks after drilling. Under such conditions, copper carbonate gave significant higher yields than either the formalin or copper sulfate treatments, as indicated by the data given above. On the other hand, sufficient moisture fell in the fall of 1924 to allow the crop to emerge soon after sowing. Under such conditions no significant differences occurred, as the results indicate. From this it would seem evident that when seed is sown in wet soil, either on irrigated or dry-land, no danger

need be feared from either formalin or blue vitriol, provided care and accuracy have been observed in the treating process. When the soil is dry, however, there is a chance of loss in yield. This confirms the results obtained from almost all other stations on this problem.

High Quality Copper Carbonate Must Be Used

Only copper carbonate especially manufactured for seed treatment ought to be considered. This should be guaranteed with a standard purity of 50 to 60 per cent metal copper and so finely powdered as to pass thru a 200-mesh sieve. Coarse and poorly prepared dust with a low copper content is of little value and should never be used for seed-treating purposes.

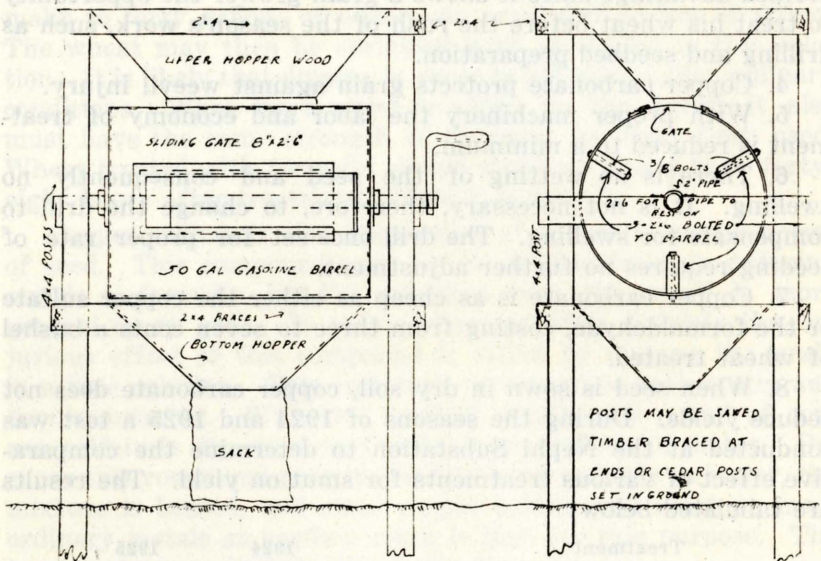


FIG. 1.—Drawing illustrating homemade machine for copper-carbonate treatment of wheat

Proper Machinery Must Be Used

Since copper carbonate is a dust and since each kernel of wheat must be thoroly covered with the disinfectant, some type of almost air-tight rotating container is necessary in the treating operation. Simply stirring in an open box or can will not suffice, and mixing wheat with the dust in a cream can cannot be recommended. The machines used for this purpose may be small or large, made on the farm or bought from manufacturers. The small types are designed for individual farms, while the large plants would serve one or more communities.

Homemade Machines.—Any man who can use tools will find little difficulty in making a machine. One type may be made by taking a 54-gallon gas barrel and cutting out a strip about six to ten inches wide the full length of the barrel. This

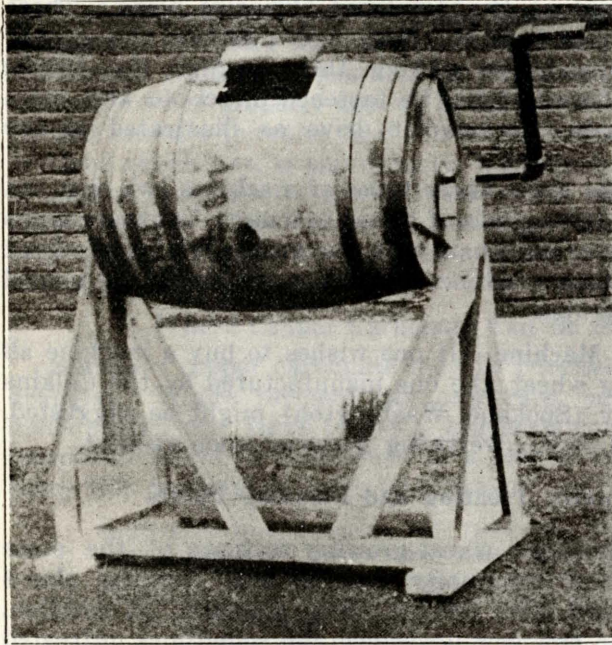


FIG 2.—Barrel for treating wheat with copper carbonate
(From California Exp. Sta. Bul. 391)

opening is then covered with a sliding gate held firmly in place by flanges on each side and across the end opposite the end thru which the gate slides backward and forward. On the inside of the barrel, three 6-inch boards are nailed lengthwise to the outer edge and equal distances from each other. A piece of pipe (two inches in diameter) can be used as an axis after drilling the necessary holes thru the center of each end. The axis must be firmly bolted to the barrel so that when the axis is turned by a handle, the barrel will also turn. The barrel needs to be placed about four feet above the ground, supported on a framework or on posts so braced as to allow no forward and backward movement when the barrel is turned. A hopper should be made above the barrel so that when the hole is turned upright, the wheat can be poured in without loss; another hopper should be placed below for catching the wheat and directing it into a sack. Each batch of wheat treated should not fill the barrel to more than one-fourth to one-third of its total capacity.

Another machine which any farmer can make is that shown in Figure 2. With this machine all that is required is a 50-gallon barrel and the necessary framework, as indicated in the illustration. For thoro mixing of the copper carbonate with

opening is then covered with a sliding gate held firmly in place by flanges on each side and across the end opposite the end thru which the gate slides backward and forward. On the inside of the barrel, three 6-inch boards are nailed lengthwise to the outer edge and equal distances from each other. A piece of pipe (two inches in di-

the wheat, three 1-inch boards about four to six inches wide should be fitted lengthwise of the barrel to the outer edge of the inside.

Another treating machine which almost any wheat grower can make is that for which the State College of Washington (Pullman, Washington) has developed blueprint plans. These plans can be obtained from the Washington Station at a cost of twenty-five cents each. In making this machine the handle which turns the barrel should be fastened direct to the main shaft rather than to the indirect drive as illustrated in the blueprint.

With any of the above three types of machines two men can treat from 100 to 150 bushels of wheat in a day. To insure thoro mixing of the copper carbonate with the grain each lot of wheat put into any of these machines for treatment should be turned slowly for two minutes.

Manufactured Machine.—If one wishes to buy a machine all ready for treating wheat, the one manufactured by the Calkins Machine Company (Spokane, Washington) might be suggested. This concern will send advertising material upon request.

Community Treating and Cleaning Plants

In some of the larger wheat-growing sections of the state the establishment of community treating and cleaning plants would save time and labor for the wheat growers. In addition, some farmers who now sow uncleaned and sometimes untreated grain might correct such poor practice if these operations could be accomplished promptly, at small cost, and with greater efficiency. Two combined treating and cleaning plants are now located in Utah—one at Nephi and the other at Hyrum.

The plant at Nephi operated for the first time in 1924. In spite of the fact that considerable smut was reported in other parts of the state in 1925, the Levan Ridge (in the Nephi district) seeded with grain run thru this plant was almost smut-free. The cleaning plant is a large Clipper machine. The treating attachment was made from an old scalper at one time used in a flour mill. As fast as the wheat is cleaned it is carried by an elevator to the treating unit. The whole plant, including the cleaning and treating units, cost approximately \$1200 and has a capacity of about 35 to 40 bushels of wheat an hour. A charge of five cents a bushel is made for cleaning and four cents for treating.

The plant located at Hyrum has a small Clipper machine for cleaning and a copper carbonate dust-treating machine manufactured by the Calkins Company. The cleaning machine cost

\$150 and the treating attachment \$86. A charge of four cents is made for treating and five cents for cleaning. The capacity of this plant is claimed to be about the same as the one at Nephi.

The dusting treatment of wheat with either copper carbonate or some other dust disinfectant has come to stay. The results of smut-control tests at both Logan and at the Nephi Substation, the yield tests at Nephi, and the data from various experiment stations in neighboring states indicate that copper carbonate when properly applied is thoroly reliable. The results further indicate that the yield of wheat, especially under certain dry-land conditions, is significantly higher when this compound is used as compared to grain treated with either formalin or copper sulfate ("blue vitriol"). Because of this, wheat farmers need not fear putting the necessary money into such a cooperative enterprise.

Where Copper Carbonate Can Be Secured

Standard copper carbonate may be purchased thru any local druggist. Where farmers can cooperate, purchases may be made sufficiently large to get a wholesale rate. The following companies might be mentioned as a few of the concerns which carry this material in large quantities:

Smith-Faus Drug Company, Salt Lake City, Utah
Denver Fire Clay Company, Salt Lake City, Utah
California Spray Chemical Company, Watsonville, California
Pittsburgh Plate Glass Company, Corona Chemical Division, Box
1575, Milwaukee, Wisconsin
F. H. Lengfelt and Company, 350-356 Woodward Street, Jersey
City, New Jersey.
The Bayer Company, Inc., 80 Varick Street, Box 56, New York City

The price of copper carbonate varies from fifteen to forty cents a pound, depending on the quality and amount purchased.

Amount of Copper Carbonate to Be Used for Treating Wheat

Ordinarily, a bushel of wheat when thoroly covered with copper carbonate will not carry more than two ounces of dust. If the treating machine is almost dust-tight and if the inside of the container is made as directed two ounces is sufficient, but if there is uncertainty about the efficiency of the treating apparatus three ounces would add safety to smut prevention. In other words, two ounces is the minimum amount for treatment. In measuring the desired amount of copper carbonate it is not necessary that a pair of scales be used for each two ounces. By cutting a small tin can to the exact size so as to hold two ounces or more of the dust, the measuring process can be done easily and safely.

WITH COPPER CARBONATE OBSERVE THE FOLLOWING PRECAUTIONS

Use the wheat variety adapted for your locality.

Use wheat which is free from trash, weed seed, and smut, if possible.

Use copper carbonate of good quality and fineness.

In treating use some reliable device which thoroly coats each seed with dust.

Do NOT attempt to treat in an open trough, bin, or wagon-box. It is dangerous to the operator and may not be effective in controlling the smut.

In treating with copper carbonate keep to the windward side in the open so as not to fill the lungs with dust. To be safe use a simple respirator made by tying a damp cloth over your nose and mouth or secure a manufactured respirator from the drug store.

For oats and barley the wet treatments are still recommended. Copper carbonate has not proved to be effective in controlling smut of these cereals.

Treat wheat every year for smut even tho you are fairly certain it is smut-free.

One must realize the ever-present danger of seed contamination. Severe losses from smut have occurred on the assumption that if smut were not noticeable treatment need not be given.