A NEW BORDEAUX POWDER.

COLUMBIA, MISSOURI.

January, 1903.
University of the State of Missouri.

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Agricultural Experiment Station.

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A NEW BORDEAUX POWDER.

FOR SPRAYING FRUIT TREES AGAINST FUNGI.

R. M. Bird, Acting Chemist.

The Department of Horticulture asked for a fine dust that might be used in place of the liquid "Bordeaux Mixture" for spraying trees against fungi. A powder which contains copper in the same chemical state that exists in properly made liquid "Bordeaux Mixture" can readily be prepared by following the directions given below:

Materials required to make seventy pounds of a stock powder:

Four pounds of copper sulphate (blue stone).

Four pounds of good quick-lime.

Two and a half gallons of water, in which to dissolve the copper sulphate.

Two and a half gallons of water, which is to be added to the quick-lime.

Sixty pounds of air-slacked lime which has been sifted through the fine sieve mentioned below.

A box, about 3 x 3 x 3 feet, into which the material is sifted. The arrangement shown in Fig. 1, will facilitate the sifting and prevent excessive flying about of the fine dust.

A wire sieve made like sketch, Fig. 2, except that it should have a cover. The bottom should be of rather
stout wire gauze having 25 or 30 meshes to the inch. This sieve fits loosely between the strips on the box (Fig. 1) and can be shaken back and forth over the opening without allowing much lime dust to escape.

A wooden frame (of 1x1 in. strips) which fits snugly inside the frame of the sifter (Fig. 2) and is covered with fine, strainer-wire gauze having 100 meshes to the inch. This makes a false bottom to the stoutly made sifter and is used to separate the fine dust of the air-slacked lime and for the final sifting.

A wooden block to rub the material through the coarse sieve, Fig. 3.

Two close-woven, cotton flour-bags—one slipped inside the other—with which the blue material is filtered.

Directions. 1. Break up into small lumps about seventy or eighty pounds of quick-lime and spread it out so that it will become air-slacked. When slacked and perfectly dry sift it through the fine sieve (100 meshes).

2. Completely dissolve four pounds of copper sulphate in two and a half gallons of water. The easiest way is to suspend the sulphate in a coarse bag just below the surface of the water until it is dissolved.

3. Pour gradually two and a half gallons of water over four pounds of good quick-lime in such a manner as to slack it to the finest powder and give a good milk of lime solution; let it cool.

4. Put sixty pounds of the sifted, air-slacked lime into a shallow box—one in which the material can be well worked with a hoe or shovel.

5. Pour the well stirred milk of lime and the cop-
per sulphate solution at the same time into a third vessel and stir until the whole is thoroughly mixed. It will have a deep blue color and be thick. This is so finely divided that it will remain in suspension for hours.

6. Pour this immediately into the double flour bag filter and squeeze out most of the water.

7. Empty this wet, blue material at once (do not let it dry) into the sixty pounds of air-slacked lime and work it up so that it will be well distributed. If the resulting mixture is too moist add more air-slacked lime.

8. Rub this through the coarse sieve while still somewhat damp, mix thoroughly and spread out to dry.

9. When perfectly dry sift it through the fine-mesh sieve, crushing all lumps. All of this can be readily made to go through the fine sieve, except the small amount of sand which may be in the four pounds of quick-lime. Mix so that the blue copper compound will be perfectly evenly distributed throughout the whole mass.
Store until needed; it will keep indefinitely.

This powder contains about three and a third times as much copper per gallon as is contained in the liquid Bordeaux mixture. It may be diluted to suit the need with powdered lime or flour, or may be used in this condition. Where large quantities are needed use multiples of the quantities given above.

If one hundred and thirty pounds of slacked lime, or an equal volume of flour is added to seventy pounds of the stock powder, the resulting mixture will have practically the same copper strength as the "four-four-fifty" liquid Bordeaux mixture. It makes no difference whether this added lime be partially or completely slacked, as no subsequent reaction takes place in the dry powder. Any other insecticide, as Paris green, for canker worms, may be added in the form of powder in the proper proportions.

The usual method of preparing dust containing copper seems to have been to slack the lime with a strong solution of copper sulphate. When made on a small scale the resulting powder contains more or less of green and blue copper compounds mixed with much of a dark brown compound. The former are probably basic sulphates of copper, or of copper and calcium (lime), and the latter a hydrated copper oxide, formed by the action of the steam in the slacking process. When made on a large scale most of the copper appears at the end in the oxide condition, and a not inconsiderable quantity of the mixture is too coarse grained to stick very well to the non-resisting leaves.

While this oxide condition of the copper undoubtedly has some fungicidal value, the opinion of experien-
menters seems to be that its value is not at all equal to the value of the copper compound contained in a properly prepared liquid Bordeaux mixture. The dry mixture here proposed is the same that exists on the leaf after the water of the liquid mixture has evaporated, except that there is present more lime relative to the copper and less calcium carbonate. As soon as the powder gets wet, calcium carbonate begins to form, of course.

Whether or not this powder when applied to the leaf wet with dew or rain will prove as effective as the liquid Bordeaux mixture, only experiment will show. It seems to have the requisite properties, chemically speaking, namely, hydroxide condition of the copper and the necessary excess of lime to prevent injury to the leaves, at the same time exposing fungus spores already upon the leaf or which may fall upon it afterwards to the toxic action of the copper. It being so extremely finely divided it seems possible to cover the wet leaf surface as effectually as when water is used as a carrier of the toxic agent. The subsequent solvent action of atmospheric water and substances produced by the leaves and germinating spores are very likely the same with either material.

In a bulletin to be issued by the Horticultural department at the close of this season the results of practical tests with the powder will be presented. If any one tries it, we shall be obliged if he will report the results to us and tell us exactly how he prepared it, the number of pounds of blue-stone, quick-lime and slacked lime he used as well as the appearance of his mixture and how he applied it to the trees.
We are endeavoring to obtain in dust form other well known toxic compounds now used in suspension in water or in solution.

Recently a large orchard was visited where the trees were being sprayed with dust. The nozzle of the dust sprayer did not seem very efficient. If instead of a stream of dust from a straight nozzle there is formed at the lower branches a dust cloud, larger than the tree, which slowly rises up through the tree, the dust is distributed more economically and the leaves are covered more effectually. A nozzle like that shown in cross-section in Fig. 5 creates a good cloud and can be made of tin at any tin shop. Fig. 4 is a pattern for cutting the tin which when folded forms the deflecting cone, C of Fig. 5, cut along the dotted lines and after bending to form a cone solder it together, curve the pieces like a a’ etc., outwards, solder the cone to the circular piece of tin, D, Fig. 5, now connect the whole to the nozzle by narrow strips of tin, S S’ etc., Fig. 5, turned edgewise to the opening. This nozzle N should fit over the straight nozzle furnished with machines.

**Fig. 4**

**Pattern for Cone.** Diameter is \( \frac{2}{3} \) times d of figure 5. Cut along dotted lines and after bending to cone shape, curve a, a’, etc., outwards. See C of Fig. 5.
Nozzle. \( d \) = outside diam. of nozzle furnished with machine; diam. at bottom of flange \( F = d \); diam. at top of flange \( F = \frac{3}{4} \) times \( d \); height, \( a \), of flange = \( \frac{1}{4} \) of \( d \); diam. of top piece, \( D = \frac{3}{4} \) times \( d \). \( N \) fits over straight nozzle. \( C \) is cone (see Fig. 4). \( F \) is flange. \( D \) and \( C \) deflect. Dust outward. \( S, S', S'' \) support deflector.

The following remarks upon powder spraying mixtures were furnished by Professor Whitten, of the department of Horticulture:

In the past few years a number of fruit growers in Missouri have become interested in using dry sprays instead of the liquid spraying mixtures that have formerly been popular. This interest has been aroused on account of the fact that dry fungicides and insecticides are much lighter to handle and can be applied much more rapidly than those which are applied in water.

Many of our fruit growers have hundreds of acres in orchards and some of them have thousands of acres.
Some of our best fruit lands are on steep hillsides where an enormous amount of power is necessary to haul the heavy liquid spraying mixtures through the orchards. In other cases spraying is done when the ground is soft in spring and hauling heavy loads through the cultivated orchards becomes very burdensome and also cuts up the ground, leaving it in an undesirable condition. In many cases, on the well drained lands, where surface ponds cannot well be made to hold water, not enough water can be had within reasonable distance to enable the grower to use the liquid spray. It also not infrequently happens that there are not enough teams in the neighborhood to spray these enormous orchards at the proper time if the heavy liquid sprays are used.

In a number of orchards where it is not feasible to use the liquid, the fruit growers have for some years been using the fungicides and insecticides in the form of dust. In some cases fairly satisfactory results have been reported from using air-slacked lime as a fungicide and mixing Paris green with it for an insecticide. In other cases a dry copper mixture has been made by dissolving the copper sulphate in water and then using this solution to partially slack the lime, which was allowed to finish the slacking process in the air and thus become dry after the copper sulphate solution was added.

One serious difficulty has been encountered however. The lime alone has not enough fungicidal value to fully meet the needs of the grower. In adding the copper sulphate by the methods usually employed by the grower its fungicidal value has been partly destroyed, thus leaving the dust less efficacious than the
liquid spray. It must be added however that the results obtained have been more satisfactory than was expected at first. Some of the dry Bordeaux mixtures have proven to have considerable fungicidal value and when Paris green has been used with air-slacked lime as an insecticide results have been fairly satisfactory.

There is great need of an efficient, dry Bordeaux mixture that may be economically made by the grower himself. The powder recommended in this circular has been designed by the acting chemist with the hope that it will meet the needs of the fruit growers, especially those who cannot use the liquid spray. This dust spray will be tested practically in the orchard of the Experiment Station during the present season and it is hoped that many orchardists will apply it and report results to the Station.

If it is desired to use an insecticide for canker worm or codlin moth one pound of Paris green may be added to twenty pounds of the dry Bordeaux mixture.

The dust sticks to the trees much better if it is applied when the dew is on the trees or while they are wet just after a rain.

Machines for applying the dust may be had from the following firms: Leggett & Brother, New York City; Kansas City Dust Sprayer Co., Kansas City, Mo.; J. J. Kaiser, Stanberry, Mo.; Hillis Bros., McFall, Mo., and Ozark Dust Sprayer Co., Springfield, Mo.