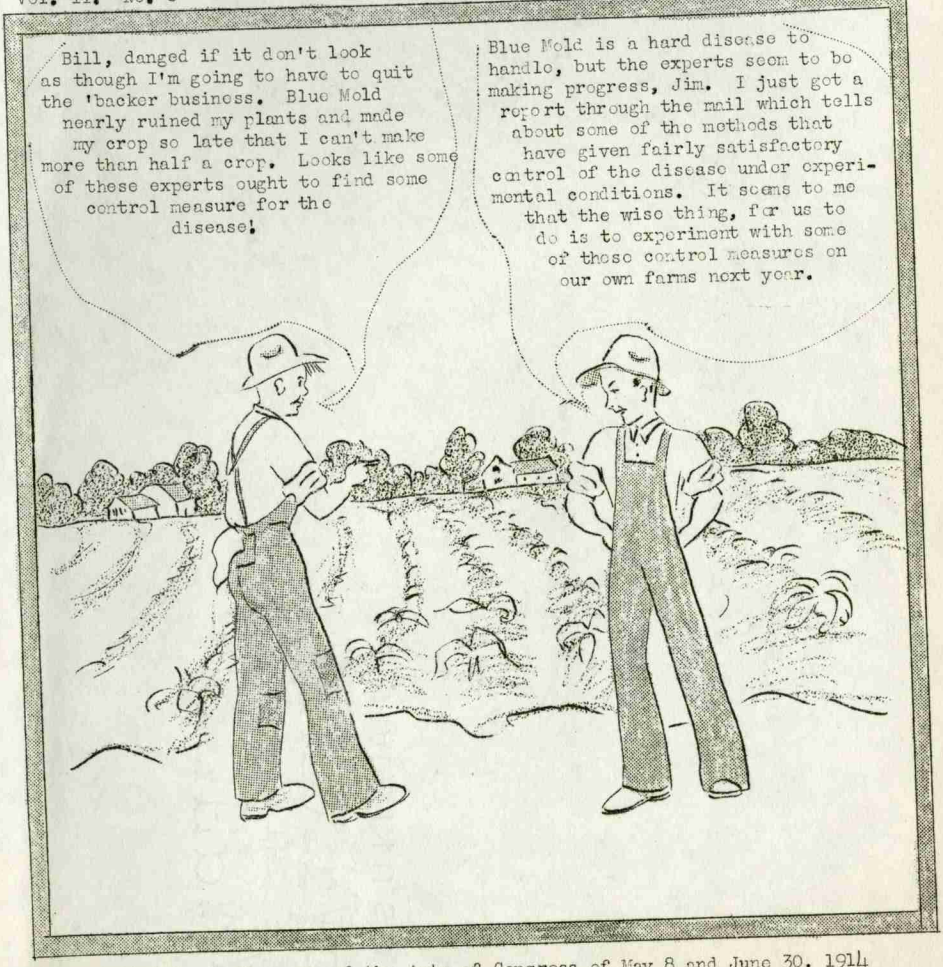
North Carolina Agricultural Extension Service
and U. S. Department of Agriculture Cooperating
I. O. Schaub, Director

Luther Shaw
Extension Plant
Pathologist

PLANT DISEASE NOTES

Vol. II. No. 8 August 1937



Distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914

METHODS OF CONTROL OF TOBACCO DOWNY MILDEW (BLUE MOLD)

Introduction

Methods of control of the downy mildew (blue mold) disease of tobacco have been the subject of intensive study by a large number of plant pathologists in the United States since the first general outbreak of the disease in 1931. Although the problem is not yet solved, substantial progress has been made in the development of control measures for the disease, and it seems wise at this time to give to the farmers of North Carolina a report of the progress that has been made.

At the outset it should be clearly understood that none of the control measures described is fool-proof. Mechanical difficulties arise in the application of all of them. Furthermore, the chemical methods of control, have been tested under severe blue mold conditions but one season in North Carolina (1937). Since weather conditions have a very decided influence on the effectiveness of this means of control especially the one involving spraying, satisfactory control cannot be guaranteed under all conditions. It is obvious, therefore, that further research and demonstrational work on these methods of control will have to be done before definite recommendations can be made. It is hoped that a presentation of the methods which have proven most effective in experimental tests will encourage testing of the methods by farmers in order to determine if their practical application is feasible. The importance of exactness and thoroughness in the application of these measures cannot be over-emphasized. Following are outlines of the best control measures known at the present time. At the present writing these control measures appear to have essentially equal value. Superiority of any one method, if such exists, must be demonstrated through further research and practical use by farmers.

The Sanitary Method

The sanitary method requires the following procedures:

(a) Locate seed beds on new sites in order to avoid centers of early outbreaks. An average of one-quarter to one-third of all beds sown on old sites can be expected to be centers of early outbreaks. The plants are small when such outbreaks occur and the losses of seedlings is great. If plants approach the size for transplanting before mildew appears, their chances of survival are increased.

(b) Locate the beds in such places as will provide (1) good soil drainage, (2) good ventilation, and (3) sunshine during the entire day. The reasons for so doing are obvious to all growers.

(c) Sow a larger area of seed beds than is needed to set the crop. Usually two to three times as much seed bed area is sown as would be required if downy mildew were absent. This increased seed bed area is necessary because no one can prophesy the severity of losses. Sometimes 25% or less of the seedlings are killed, sometimes 90% or more. In the past many growers have been able to set their crop only because they had provided these additional seed beds.

(d) Remove the seed bed covers and allow direct sunlight on the plants beginning about three weeks prior to transplanting. This procedure makes the plants grow more slowly and they are, in consequence, more hardy and less subject to serious injury. It has the disadvantage of encouraging injury from flea beetles.

(e) Moderate and judicious applications of nitrate of soda appear materially to aid in the recovery of the diseased plants.

(f) Diseased plants should not be set until recovery has advanced to the stage that new leaves and new roots have formed:

Disadvantages

(a) All of the extra labor and expense involved in the use of the sanitary method is utilized in the preparation of additional seed beds. It should be borne in mind that the cost of making tobacco seed beds varies from twelve to fifteen dollars per 100 square yards.

(b) The disease appears in all seed beds and as a result the crop must be set 10 to 14 days later. Such delay may lessen the returns from the crop.

Note: The practices outlined under this method of control have been widely adopted by tobacco farmers in North Carolina. The tremendous value of seeding excess bed space and waiting until the plants recovered from mold before transplanting was clearly demonstrated in North Carolina during the season of 1937. It is firmly believed that the adoption of these practices made it possible for North Carolina farmers as a group to set out a satisfactory acreage of tobacco in spite of the severe blue mold epidemic. Adoption of these precautionary measures are recommended for the season of 1938, even if the use of a chemical control measure is anticipated. During years when blue mold attacks are light the sanitary method of control seems to be highly effective.

Chemical Methods

Experimental work involving the use of chemicals has been conducted along two lines. One involves the use of certain chemicals as vapors or gases, and the other as liquids or sprays. Further experimentation with both is necessary.

1. Vapor Treatment

The use of vapors could be expected to be effective for the reason that vapors could envelope all above-ground parts of the seedlings and thus give complete protection. Many substances that evaporate and are toxic or poisonous to plant life have been tested. The one best suited is known as benzol. This substance can be depended upon to give complete protection against downy mildew if it is properly applied. Proper application depends upon giving strict attention to all of the following factor:

(a) The frames of the beds must be tight. The beds should be long and narrow, preferably 5 or 10 feet wide, rather than the usual shape. This is necessary to make it easier to apply the benzol and to avoid trampling on the beds during treatment. (See Figure 1)

(b) The beds should be covered during the period of treatment with a cloth of the texture of unbleached sheeting. Covers of this sort when wet with dew or rain are essentially vapor tight and will therefore permit the building up of a concentration of benzol vapor inside the bed that is toxic to the mold. Such covers let rain through readily. Covers should be removed during clear days to give the seedlings enough sunshine for their sturdy growth. The normal cover should be removed and stored when the heavier is put on at the start of treatments.

(c) The exposed surface of the evaporators should have an area about one-seventy-second of that of the seed bed. Hence, 12.5 sq. ft. of evaporating surface would be required for each 100 sq. yds. of bed. These evaporators may be pans or troughs. They should be placed throughout the bed on stands or racks, be suspended along the borders, across the beds, or else along the middles. The evaporators shoul be covered to keep the rains from splashing out the benzol. (See Figure 1).

(d) Treatment should be started about 10 days after the first outbreak in that vicinity and should be given every night and on rainy days. Benzol should be put into the evaporators about sunset. From one-half to two-thirds gallon of benzol is required each night for every 100 square yards of seed bed. The cost for labor, equipment, and materials varies from fifteen to twenty-five dollars per 100 square yards for 30 treatments. Treatments should be continued until the danger of blue mold is over. Hence the number of treatments necessary will vary in different localities and seasons.

Advantages

(a) Vapors of benzol completely prevent downy mildew.

(b) Benzol treatment can be made in rainy weather.

(c) The advantages in yield and quality to be gained by setting plants at the best time rather than 10 to 14 days later, as is usually necessary after an attack of downy mildew, is known to all growers.

(d) Vapor treated beds have been free from flea beetle injury in experimental tests.

Disadvantages

(a) Vapor treatment is expensive and laborious.

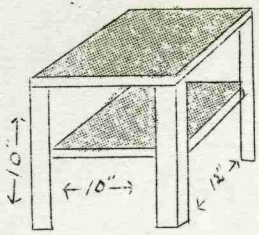
(b) Benzol is poisonous both to the mold and to the tobacco seedlings. The mold is much more sensitive to benzol vapors, however, than the seedlings, and no injury to seedlings results unless the nights are very warm. Benzol evaporates more rapidly during hot nights. In order to make the use of benzol absolutely safe no matter what weather conditions prevail, the benzol should be mixed with lubricating oil, either fresh oil or waste oil. The mixture should consist of 1 part of benzol to 5 parts of oil. The oil can be used over and over again.

(c) Benzol is highly inflammable and should be kept away from fire, matches, lighted cigarettes, etc.

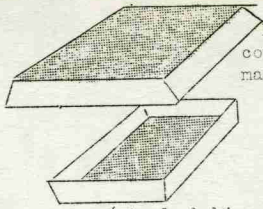
(d) Oil or benzol, spilled on seedlings, will kill them.

Note: Complete control of blue mold with benzol vapor has been obtained in experimental tests for several years in both Australia and the United States. The fact that 100 per cent control of the disease has been obtained by this method gives it a prestige which none of the others tested have approached. The mechanics involved in the application of this measure are still cumbersome; however, it is hoped that further research will soon solve this difficulty.

FIGURE 1. Materials and Methods Used in Treating Tobacco Plant Beds with Benzol Vapor for Blue Mold Control

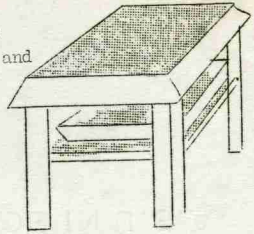


Evaporator Stand (constructed of wood)



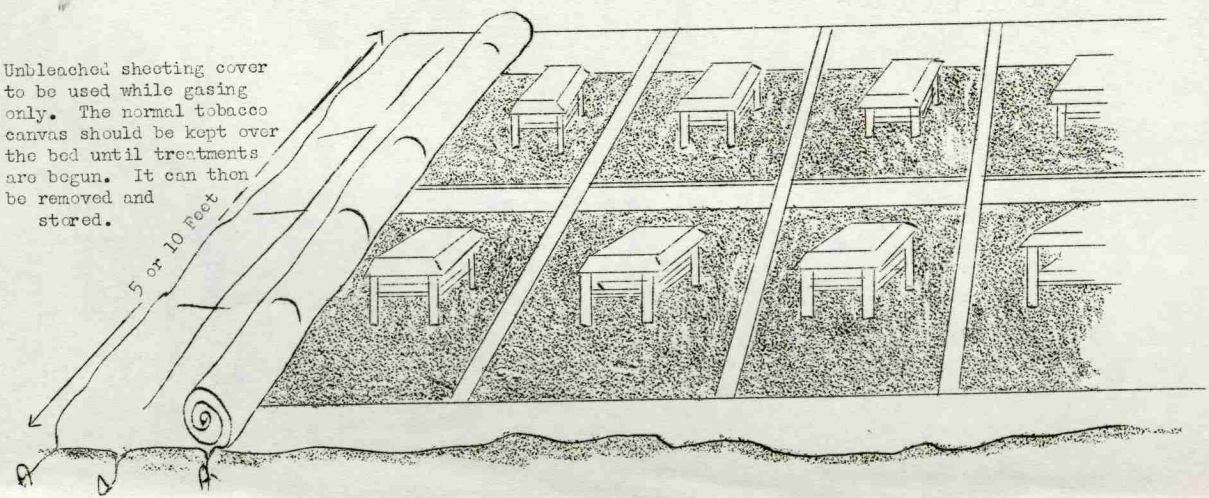
Evaporator stand cover (Can be cut and made of tin on farm

Evaporator (simple baking pan about 5" X 9", necessitating a total of 40 evaporators for 100 sq. yds. of bed)



Complete Evaporator

Diagram of Plant Bed prepared for gasing. The surface area of the evaporators should equal approximately 1/72 of bed area. Hence 12.5 sq. ft. of evaporating surface would be required in the treatment of 100 sq. yds. of bed area. The evaporators should be distributed evenly over the bed.



2. Spray Treatment

One of the most promising sprays that has been tested thus far consists of a mixture of cuprous oxide, lethane spreader, cottonseed oil, and water.

(a) Materials for mixing 50 gallons of spray mixture: One-half pound of cuprous oxide (red copper oxide), one quart of lethane spreader, and one-half gallon cottonseed oil.

(b) How to mix: Moisten the cuprous oxide with just enough lethane spreader to make a paste. Mix the quart of lethane spreader and a half gallon of oil by stirring thoroughly. Add two or three gallons of water. By the use of a bucket pump with nozzle attached, pump the contents of the pail into another container. This process breaks up the oil into fine particles and stabilizes the emulsion. When properly emulsified the oil is milky white in appearance. Add water and the copper oxide suspension to the spray tank containing about 25 gallons of water, then add water to bring the total volume to 50 gallons. (See Figure 2 for illustrations on how to mix the spray).

(c) How to spray: Make up only enough for one application and use immediately. A barrel sprayer capable of maintaining over 100 pounds pressure is preferable to hand sprayer (See Figure 3). If this is not available use a bucket pump. Do not pour on the spray with a bucket or sprinkling pot. Apply the spray through a nozzle capable of throwing a fine mist or fog, and use enough to wet or moisten the foliage. Turn the nozzle sideways, alternating from side to side, so as to cover as much of the lower leaf surface as possible. About 2.5 gallons will cover 100 yards of bed one time when the plants are small. Large plants will require from 5 to 7.5 gallons per 100 yards.

(d) When and how often to spray: Begin spraying before mildew (blue mold) develops in the bed and continue twice a week until the danger from the disease is past or until the plants are ready to set. Spray small plants only once a week in cold weather; and also avoid heavy applications to small plants in cool weather, as this may cause injury. Continue spraying through the blue mold outbreak. Best results have been obtained where the plants were sprayed twice a week during periods when the plants were growing rapidly. Apply the spray only when the foliage is dry and the cover removed. (Spray apparently can be applied satisfactorily without removing cover when plants are small.)

Advantages

(a) Sprayed plants have usually lived better when set than those not aprayed.

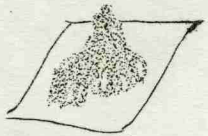
(b) Spraying lessens the severity of the disease and consequently makes it possible for the plants to be transplanted earlier than non-sprayed plants.

(c) Spraying is inexpensive, the cost being three to four dollars per 100 square yards of seed bed.

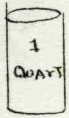
(d) The spray appears to stimulate slightly the growth of plants.

FIGURE 2. How to Mix 50 Gallons of Cuprous Oxide Spray (Smaller or larger Quantities Should Be Prepared in exactly the same manner)

First Step



½ lb. cuprous oxide

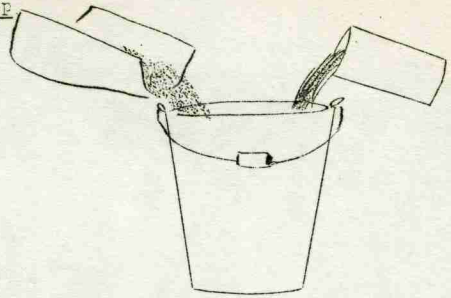


1 qt. lethane spreader

½ gal. cotton seed oil

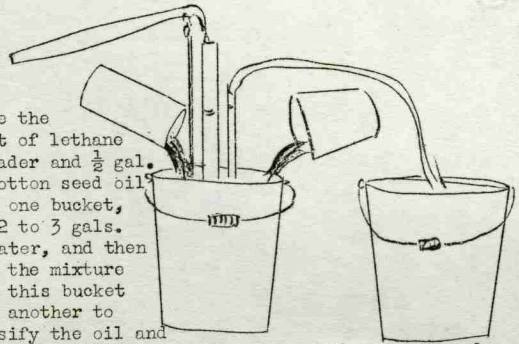
Measure out the indicated quantities of cuprous oxide, lethane spreader, and cotton seed oil.

Second Step



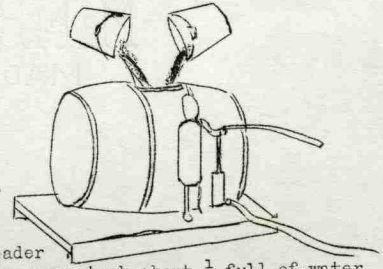
Place cuprous oxide in bucket. Add small amount of lethane spreader and stir into paste.

Third Step



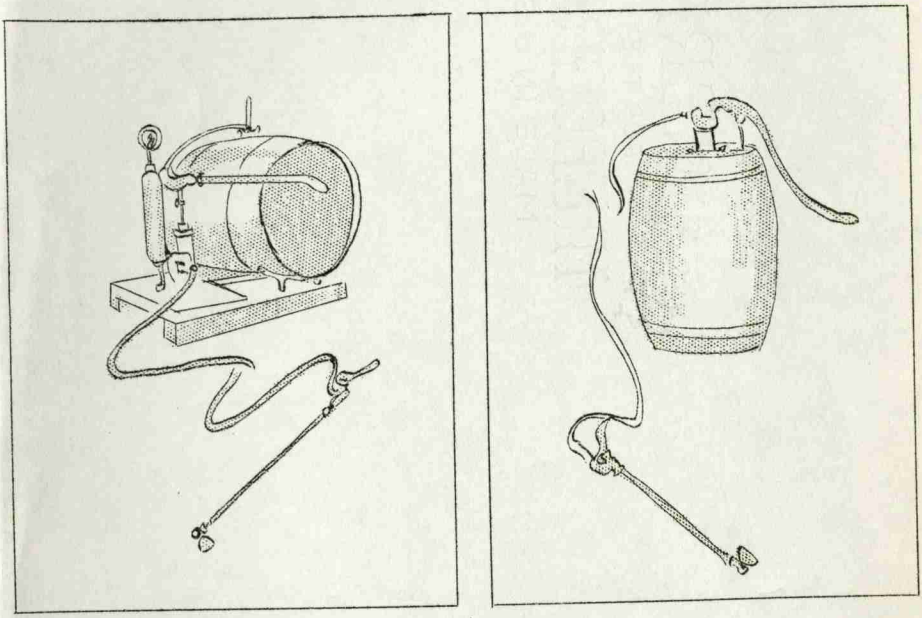
Place the quart of lethane spreader and ½ gal. of cotton seed oil into one bucket, add 2 to 3 gals. of water, and then pump the mixture from this bucket into another to emulsify the oil and spreader. Unless the oil and spreader are properly emulsified the spray is ineffective.

Fourth Step



Pour the moistened cuprous oxide and the emulsified spreader and oil into the spray tank about ½ full of water. Then add water to bring the total volume up to 50 gallons.

FIGURE 3. Suitable Equipment for Spraying Tobacco Plant Beds



For the most part it is believed that the barrel types of spray machines, as illustrated above, will prove to be best suited for spraying tobacco plant beds. The pump should be capable of maintaining from 100 to 200 pounds of pressure. The outfit should be equipped with at least 50 feet of hose and a nozzel that will break the spray into a fine mist. Constant agitation of the spray material should be maintained during the spraying operation.

It is possible that smaller spray machines such as the bucket pump and knapsack types may be satisfactory where only small areas of beds are to be sprayed. However, these types of equipment have been used in only a limited way in experimental tests in the control of blue mold, consequently their adaptability has not been determined.

The importance of using adequate spray equipment cannot be over-emphasized. Certain failure will result from attempts to apply the spray material with sprinking cans, or by splashing it onto the beds with the hands, brooms, or brushes.

Disadvantages

(a) Since it is impossible completely to cover both the upper and lower sides of the leaves with spray, sprayed seedlings become diseased. If the period is rainy when downy mildew is developing, the sprays cannot be applied. At such times sprays are largely washed off by rains. The grower who depends upon sprays to protect the seedlings during rainy, cool weather will be disappointed because the seedlings will be attached, but in experimental tests these attacks have not resulted in the death of so large a proportion of the plants as in the non-sprayed beds.

(b) Affected plants whether sprayed or not sprayed cannot be safely set until they have sufficiently recovered, thus delaying transplanting a week or two weeks.

(c) Little is yet known about poisoning tobacco seedlings with copper. It is known, however, to be toxic to them. Injury to seedlings from spray burn does not appear to be permanent.

Note: Cuprous oxide is a standard chemical manufactured and sold by several chemical concerns. The compound should contain at least 95 percent cuprous oxide and should be red in color.

General Statement

Adoption of either of the chemical control measures suggested above for blue mold control will necessitate an investment in equipment by most farmers. As already stated, the comparative values of the gas and spray treatments as farm practices are not yet determined. Therefore, it should be understood at the outset that, on the one hand, those who invest in equipment for applying the gas treatment may find it desirable to abandon it and purchase spray equipment in a few years; and on the other hand, those who purchase spray equipment may, in a few years, wish to abandon it and purchase gas equipment. Hence, farmers are advised to club together as much as possible in the purchase and use of equipment, in order that excessive losses will be avoided in the event that any of the equipment has to be abandoned. Widespread purchase of equipment by farmers in North Carolina in 1938 is not advised unless the blue mold disease starts development in epidemic proportions in regions to the South.

ACKNOWLEDGMENT

Experimental work toward the development of effective and practical control measures for the blue mold disease of tobacco has been, and still is being sponsored by practically all institutions engaged in research work in the tobacco belts of the United States, involving the following states: Florida, Georgia, South Carolina, North Carolina, Tennessee, Virginia, Kentucky, Pennsylvania, Maryland, and Connecticut. In most of the States the work has been sponsored cooperatively by the State Agricultural Experiment Stations and Extension Services and the U. S. Department of Agriculture. In North Carolina the following institutions have contributed to the cooperative program: Duke University, U. S. Department of Agriculture, North Carolina Agricultural Experiment Station, North Carolina Agricultural Extension Service, and the State Department of Agriculture. More than 50 technical and research men connected with these institutions have contributed both time and thought to the program of work. Therefore, credit for any progress that has been made must be given to the group of people who have done the work and the institutions they represent rather than to any one individual or any one institution.