Spraying Experiments for the Control of Pecan Scab in Mississippi

By
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Pecan culture is rapidly becoming one of the most important industries of South Mississippi, especially in the counties bordering along the Gulf coast, and in recent years, extensive plantings have been made in the central and various other sections of the State. As plantings have been increased, many growers are becoming deeply interested in the various diseases and insects which attack the pecan, since these pests are of continually increasing importance as the business enlarges.

Probably the most serious disease of this important nut crop in the State is pecan scab. In view of the numerous inquiries which have been received during the last two years for information concerning this disease, active investigational work was begun on this problem in the summer of 1920 by the Department of Plant Pathology of the Mississippi Experiment Station, with the hope of being able to combat the disease by means of spraying.

Although the information given in this bulletin covers only one season of spraying experiments for the control of the disease, the results are offered to emphasize the importance of spraying, and to impress the pecan grower with the fact that it is a problem which can be partially or perhaps completely controlled, if properly handled. Again, because of the scant information on spraying for the control of the disease in other sections of the country, it was deemed best to submit these results as a preliminary report. The investigation in regard to this problem is being continued.

Before taking up the experimental phases of the work, it appears advisable to outline briefly the symptoms, cause and effects of pecan scab, as well as seasonal variations and their effects, in order that the grower may have these facts fairly well in mind.

**PECAN SCAB**
(Fusicladium effusum)

**Symptoms, Cause, Etc.—** Pecan scab is a fungous disease which affects the leaves, twigs and nuts. The disease manifests itself on the leaves in the form of small, velvety, black spots (Fig. 1). These spots, or pustules, contain the spores, or reproductive organs of the fungus, and when mature, they escape from the tissues of the infected host plant and lodge upon fresh surfaces, where in the presence of moisture, they germinate, and continue to spread the disease. As a rule, leaf infections are seldom serious or sufficiently numerous to cause much damage. Twig infection is very similar to leaf infection, but the damage done by the former may sometime cause serious injury, in that the tender shoots are frequently killed back
by the fungus. The greatest injury, of course, is where the disease attacks the nuts (Fig. 2). If infection occurs rather early in the season, very soon after the nuts are formed, the diseased nuts drop before maturity, and infection taking place later in the summer, retards their growth and development, causing many undersized and faulty nuts.

**Distributions and Prevalence.**—Pecan scab is, no doubt, fairly well distributed over the entire pecan growing sections of the South. Previous investigators (1) have stated that serious damage is confined to a limited number of varieties of pecans grown in the warmer and more humid sections. McMurran and Demaree (1) state that 150 miles inland from the Atlantic and Gulf Coasts, it is of relatively minor importance, even in the case of susceptible varieties. This observation is partly substantiated by observations of the writer in so far as it applies to Mississippi; however, during the last two years, scab has been reported as causing serious damage as far inland as 200 miles from the Gulf Coast. In other words, certain varieties have exhibited about the same degree of susceptibility in widely scattered parts of the State. The disease, in addition to its wide prevalence in the coastal counties, was reported as causing serious loss in Clarke, Hinds, Bolivar, Warren, and Lowndes counties.

**Susceptible and Immune Varieties.**—There are great differences in the susceptibility of pecans to scab. Among the varieties that are largely pro-

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**Fig. 1.** Pecan leaves infected by the scab fungus. The spots are raised, velvety, black in color, and confined largely to the leaf veins and midribs. (Afer McMurran & Demaree, U. S. Dept. of Agr., Farmers Bulletin 1129, 1920.)
pagated in Mississippi, the most susceptible are the Pabst, Van Deman, and Schley. Delmas is, of course, very susceptible, but this variety is no longer planted to any extent in the State because of its extreme susceptibility to the disease. Success, while apparently free from scab in many parts of the State, has been reported by growers and observed by the writer as scabbing rather severely in points along the Gulf coast. The Stuart, Moneymaker, Russell, Frotcher, Moore, and Alley are varieties which are very resistant and may be listed as practically immune to the disease wherever grown in the State.

SEASONAL VARIATIONS

The severity of pecan scab is, in many instances, determined by the character of the season. The disease is most serious during periods of wet weather. With frequent rainfall, the crops of susceptible varieties may

Fig. 2. A Schley pecan showing the effects of the scab fungus. This nut, although apparently mature, is undersize and faulty.

be completely destroyed. On the other hand, in very dry seasons, the fungus, as a rule, causes only a moderate amount of loss. Thus scab, like many other parasitic fungous diseases, is active and destructive in the presence of abundant moisture, whereas when the season is dry, it does not propagate and injure the host plant so readily. This fact is very important for the pecan grower if he is endeavoring to combat the disease by spraying, a subject which will be discussed later.

EFFECTS OF SCAB IN MISSISSIPPI IN 1920-21

For the past two seasons, the pecan crop, especially in the coastal counties, has been materially damaged by scab. Such susceptible varieties as Pabst, Van Deman and Schley were reduced in yield as much as 50 to 75 per cent in 1920. Reports have also been received from other inland counties, as heretofore mentioned, that the disease was becoming serious and taking a heavy toll of the crop. Although not quite as severe the past season as was the case in former years, the disease was, nevertheless, a limiting factor in production in many parts of Mississippi.
SPRAYING AS A CONTROL FOR SCAB

Previous Work.—McMurran and Demaree (1) state that pecan scab can be successfully combatted by spraying, and recommend a standard Bordeaux mixture composed of 4 pounds of bluestone (copper sulphate), 4 pounds of quicklime and 50 gallons of water as the most satisfactory fungicide. They advise the addition of 1 pound of resin-fishoil soap to each 50 gallons of the preparation, since it increases the adhesiveness of the mixture. These investigators say if the nuts are kept covered with the fungicide from the time they are formed, about the first of May, until the first of September, when growth is almost complete, scab infection will be prevented. Spooner (2) also reports successful results from the use of Bordeaux mixture for scab control in Georgia in 1914. This investigator used a maximum of 4 applications.

SPRAYING FOR SCAB CONTROL IN MISSISSIPPI IN 1921

Location of Experiments.—Realizing the seriousness of the disease in South Mississippi in some of the older established orchards, definite spraying experiments were started in March, 1921 at the orchards of Chas. E. Pabst & Sons, located 4 miles east of Ocean Springs. These trees, consisting of Pabst, Van Deman, Schley, and Success varieties, suffered severely from scab attacks the previous year. Blocks of trees, consisting of 20 Pabst, 20 Van Deman, 6 Schley, and 5 Success, were selected for the work. Suitable checks were also included in each block. The Pabst and Van Deman trees are 18 years of age, whereas, the Schley and Success are about 20 years old. These trees are uniform in size and range from 35 to 50 ft. in height (Fig. 3). It was deemed best to select trees of considerable size for the work, in order to test the practicability of spraying on a commercial scale, or in other words, an effort was made to attack the spraying problem just as it confronts the large pecan grower in orchards of considerable size.

Equipment Used and Schedules Followed.—The spraying equipment used in these experiments consisted of a high power Deming outfit. It is equipped with a 10-horsepower engine and pump of sufficient capacity to discharge 15 to 20 gallons of spray mixture per minute through two leads of hose. To each lead of hose was attached a comet spray gun, one operator spraying the tops of the trees from the tower attached to the spray tank, and the other spraying the lower portion of the tree from the ground. This outfit is capable of maintaining a pressure of between 250 and 300 lbs., and with the exception of a breakdown which occurred in July, all applications were made under the above pressures. The regular 4-4-50 standard Bordeaux mixture was used exclusively, and the first application was made on March 10th, while the trees were dormant. Other blocks of trees of two varieties were not sprayed until in full leaf, in order that comparative tests could be made of the effectiveness of the dormant applications. The first summer application was made on April 21 and 23, at which time the trees were in full leaf, and the sprayings repeated at in-
tervals of approximately 4 weeks. The last application was made on Aug. 2. The interval between applications was lengthened as much as possible, in order to reduce the cost of the operations, as well as to reduce the spraying schedule to a practical basis. This does not imply that 6 or even 7 applications are prohibitive from a standpoint of cost, even in large orchards, but it was thought that if a control of the disease could be effected with a lesser number of applications, for instance, 4 or 5, a great deal of time and some expense could be saved.

Fig. 3. A block of Pabst pecan trees in the experimental plots at Ocean Springs, Mississippi—Season 1921.
RESULTS OF EXPERIMENTS

In arriving at the effectiveness of spraying the trees with the Bordeaux mixture, as compared with the unsprayed checks, trees of each variety were selected from the sprayed and check blocks for recording the total yield per tree. Time would not permit taking yield records of all the trees in the experiment. The ones selected for recording the yields were approximately the same size and age, and uniform in every way. All the yield records were taken on October 11, 12 and 13th, and are recorded in the table below.

Total yields of sprayed and unsprayed pecan trees at orchard of Chas. E. Pabst & Sons, Ocean Springs, Mississippi, season 1921.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Tree No.</th>
<th>Spraying Dates</th>
<th>No. Applications</th>
<th>Yield in lbs per tree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Van Deman</td>
<td>1</td>
<td>Mch. 10, Apr. 20, May 24, June 29, Aug. 2</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>Van Deman</td>
<td>2</td>
<td>Ditto</td>
<td>5</td>
<td>33</td>
</tr>
<tr>
<td>Van Deman</td>
<td>3</td>
<td>Ditto</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>Van Deman</td>
<td>4</td>
<td>Ditto</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>Van Deman</td>
<td>5</td>
<td>Apr. 20, May 24, June 29, Aug. 2</td>
<td>5</td>
<td>24</td>
</tr>
<tr>
<td>Van Deman</td>
<td>6</td>
<td>Ditto</td>
<td>5</td>
<td>32</td>
</tr>
<tr>
<td>Van Deman</td>
<td>7 (check)</td>
<td>Not sprayed</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Van Deman</td>
<td>8 (check)</td>
<td>Not sprayed</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Van Deman</td>
<td>9 (check)</td>
<td>Not sprayed</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Van Deman</td>
<td>10 (check)</td>
<td>Not sprayed</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Pabst</td>
<td>1</td>
<td>Mch. 10, Apr. 20, May 24, June 29, Aug. 2</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Pabst</td>
<td>2</td>
<td>Ditto</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Pabst</td>
<td>3</td>
<td>Ditto</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>Pabst</td>
<td>4</td>
<td>Ditto</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Pabst</td>
<td>5</td>
<td>Apr. 20, May 24, June 29, Aug. 2</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>Pabst</td>
<td>6</td>
<td>Ditto</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Pabst</td>
<td>7 (check)</td>
<td>Not sprayed</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Pabst</td>
<td>8 (check)</td>
<td>Not sprayed</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Pabst</td>
<td>9 (check)</td>
<td>Not sprayed</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Pabst</td>
<td>10 (check)</td>
<td>Not sprayed</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Schley</td>
<td>1</td>
<td>Mch. 10, Apr. 20, May 24, June 29, Aug. 2</td>
<td>5</td>
<td>48</td>
</tr>
<tr>
<td>Schley</td>
<td>2</td>
<td>Ditto</td>
<td>5</td>
<td>37</td>
</tr>
<tr>
<td>Schley</td>
<td>3 (check)</td>
<td>Not sprayed</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Schley</td>
<td>4 (check)</td>
<td>Not sprayed</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>Success</td>
<td>1</td>
<td>Mch. 10, Apr. 22, May 26, June 29, July 30</td>
<td>5</td>
<td>67</td>
</tr>
<tr>
<td>Success</td>
<td>2</td>
<td>Ditto</td>
<td>5</td>
<td>152</td>
</tr>
<tr>
<td>Success</td>
<td>3 (check)</td>
<td>Not sprayed</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>Success</td>
<td>4 (check)</td>
<td>Not sprayed</td>
<td>5</td>
<td>47</td>
</tr>
</tbody>
</table>

A glance at the table shows readily the effectiveness of the spraying with the Bordeaux mixture. In the case of each of the four varieties, the sprayed trees reveal a much higher yield than the unsprayed. The total yield per tree is also the only accurate criterion of the loss resulting from diseased nuts dropping prior to maturity. The weights in the case of the
checks also reveal the undersize and faulty nuts, as illustrated in (Fig. 4). Figure 5 shows the size of a cluster of Pabst pecans taken from a tree which received 4 applications. In the case of this variety, control of the disease was difficult, but even with intervals between spraying of at least 4 weeks, the disease was held in check for a sufficient length of time to allow the sprayed trees to mature their crops. On the other hand, the yields of the unsprayed check trees of the Pabst variety were practically a complete failure (Fig. 4).

The same results of the effectiveness of the Bordeaux mixture is also observed in the case of the Van Deman (Figs. 6 and 7), the Schley (Figs. 8 and 9) and the Success varieties. In the case of the Schley, very little scab was noted on the nuts in either the sprayed or check trees, until about the middle of July. At about this time, plenty of rain occurred and the disease began to make its appearance in the Schley, as well as Success check trees. This accounts for the large size of the Schley nuts in Fig. 9. Here the fungus did not get well distributed over the trees until late in

![Fig. 4. Pabst--Checks--Not sprayed. Note scabby effect, undersize and faulty clusters. (Photographed by J. M. Beal, Miss. A. & M. College.)](image)
the summer, thus allowing the nuts to attain considerable size before attacking them. The checks (unsprayed) Schley's as illustrated by the clusters in figure 9 are large, but it will be noticed that the scab spots are numerous and these nuts are not well filled, as is the case of the clusters from the sprayed trees as illustrated in figure 8.

It is also noted that the trees which received a dormant application of Bordeaux mixture on March 10th show but little differences in the yields from those which only received the summer applications. Further investigation appears to be needed on the matter of the advantages of dormant applications of Bordeaux and other fungicides.

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**Fig. 5.** Pabst pecans sprayed 4 times. Some late scab infection is present, but nuts are sound, large and fully mature. (Photographed by J. M. Beal, Miss. A. & M. College.)

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**CONCLUSIONS AND RECOMMENDATIONS**

The results presented in this bulletin clearly indicate and corroborate the work of other investigators that pecan scab can be successfully controlled by spraying with Bordeaux mixture. Spraying to control pecan scab
and various other fungous diseases of many hosts is a preventive measure. It does not act as a cure after the disease is once established in the host. Consequently, the importance of keeping the nuts covered with the fungicide from the time they are formed and mature, to prevent the disease from developing, is very essential. A definite spraying schedule will depend upon the amount of rainfall in a given locality. If the season is very wet, the interval between applications should be shortened in order to keep the nut clusters well covered with the fungicide, whereas, if the season is moderately dry, the interval between applications may be lengthened as much as 3 or 4 weeks with every expectation of success. With an average season for Mississippi conditions, from 4 to 5 applications appear to be necessary for good control of the disease. The first spraying should begin about the time the young nuts are formed, and they should be kept covered with the poison until about Aug. 1 or 15th.

In the case of large trees which were included in these experiments, that is, those ranging in height from 40 to 50 ft. and from 18 to 20 years

Fig. 6. Van Deman pecans not sprayed. (Photographed by J. M. Beal, Miss. A. & M. College.)
of age, only power spraying outfits should be used. These should be equipped with 8 to 10-horsepower engines and pumps of sufficient capacity to discharge from 15 to 20 gallons of the liquid per minute through two leads of hose. Spray guns are also necessary, as well as specially constructed hose and connections, and pressures of at least 250 to 350 pounds must be maintained with these outfits. For smaller orchards and trees of medium height, the smaller power machines, from 3 to 4 horsepower, with extension rods and tower, may be used to advantage.

It seems hardly necessary to emphasize the importance of thorough spraying to control a disease like pecan scab. Nevertheless, any sort of spraying or merely shooting the liquid into the tree will not suffice. Every effort should be made to cover all portions of the tree and cover all the nut clusters. One man working from the tower attached to the spray tank can cover the top of the tree with a spray gun, and another working from the ground can cover the lower branches. Where the trees are planted in

![Image]

**Fig. 7.** Van Deman pecans sprayed 5 times. (Photographed by J. M. Beal, Miss. A. & M. College.)
definite rows, which is usually the case in most orchards, it is usually best to drive the sprayer on one side of the tree and spray thoroughly and then drive down the same row and repeat the spraying on the opposite side of the tree. This insures a thorough job.

The problem of spraying pecan trees for scab is being continued by the Department of Plant Pathology of the Mississippi Experiment Station. It is hoped that further progress on the effectiveness of other fungicides, dormant spraying, etc., may be available after further investigations.

Spraying should not be looked upon as the only control measure for pecan scab. For the person who is contemplating planting a pecan orchard in South Mississippi or points within a 200-mile radius of the Gulf coast, the scab-resistant and immune varieties mentioned on page 5 are recommended. In the case of established orchards of susceptible sorts, top-working to scab-resistant varieties is sometimes carried out. However,

Fig. 8. Schley pecans, sprayed 5 times. (Photographed by J. M. Beal, Miss. A. & M. College.)
this is in many instances objectionable from the standpoint of time that is lost before the tree is able to put on sufficient growth to produce profitable crops. In such instances, spraying to control the disease is preferable.

**LITERATURE CITED**


![Fig. 9. Schley pecans (checks) not sprayed. (Photographed by J. M. Beal, Miss. A. & M. College.)](image)