

BULLETIN No. 199.

NOVEMBER, 1901.

New York Agricultural Experiment Station.

GENEVA, N. Y.

AN EPIDEMIC OF CURRANT ANTHRACNOSE.

F. C. STEWART AND H. J. EUSTACE.



PUBLISHED BY THE STATION.

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AN EPIDEMIC OF CURRANT ANTHRACNOSE.

F. C. STEWART AND H. J. EUSTACE.

SUMMARY.

During the past season the currant crop in the Hudson Valley has been seriously injured by anthracnose, a fungous disease causing the appearance of numerous small, dark brown spots on the leaves which turn yellow and fall prematurely. Currant canes were quite generally defoliated early in the season and the exposure of the ripening fruit to the sun brought about sunscald, resulting in a loss of nearly one-half the crop in some plantations.

The disease attacks the leaves, petioles, fruit, fruit stems and canes. In New York State it is present among currants, almost every season, but there is no record of its destructive occurrence since 1889. Although it attacks also gooseberries and black currants it has not injured them in the same locality where red currants have been seriously damaged by it. It is readily distinguished from the ordinary leaf spot by the size of the spots, which are much smaller.

The weather conditions last spring seem to have been particularly favorable to it; but judging from the past history of the disease it is not likely to become a constant pest. Fruit growers need not be alarmed. Probably, it will become epidemic only occasionally.

Although there are scarcely any experimental data at hand, it is likely that anthracnose may be prevented by spraying with Bordeaux mixture; and since currant worms make necessary at least one application of Bordeaux, and leaf spot (a disease known to be preventable by spraying), is always more or less prevalent, and it seems likely that the destructive disease known as cane blight may be checked, it is recommended that currants in the Hudson Valley be sprayed regularly every season.

INTRODUCTION.

The region between Highland and Newburgh in the Hudson River Valley is the principal fruit-growing section of Eastern New York. Grapes, peaches, raspberries and currants are grown extensively. Currants are grown more extensively here than in any other part of the State. They constitute one of the leading fruit crops in this famous fruit-growing section.

While visiting this locality June 13 and 14, 1901, we observed that the currant foliage was quite generally affected with a form of leaf blight or anthracnose caused by the fungus *Glæosporium ribis*. The lower leaves were yellow and thickly covered with very small brown spots. Almost all the currant plantations were more or less affected and the presence of the disease could be detected at a considerable distance by the yellow color of the foliage. In some cases the leaves were already dropping quite freely. Fruit growers were alarmed. They were not accustomed to see the currant foliage behave in this way.

Since there seemed liable to be an epidemic of this somewhat unusual disease we planned to watch its progress. During the remainder of the season we made frequent visits to the locality and kept close watch on the disease, particularly in a badly affected plantation on the farm of Mr. J. A. Hepworth near Milton. This plantation consisted of about five acres in a peach orchard on high, well-drained, slaty soil.

SYMPTOMS.

The disease works from below, upward. The lower leaves become thickly covered with small dark-brown spots, turn yellow and fall. The disease appears in June and continues active throughout the season or until the bushes have been completely defoliated. In the present case it must have appeared rather suddenly and become epidemic about June 8. When we made our first observations, June 13, it was already so abundant that fruit growers were cognizant of it. Ten days earlier we had

spent two days visiting fruit plantations in this same locality and at that time we neither saw nor heard of any trouble with currants except cane blight which is always destructive there.¹ Although we were seeking the diseases of raspberries rather than those of currants, it is likely that the currant anthracnose would have come to our attention had it been at all abundant at that time. In a letter dated June 10, Mr. A. B. Clarke, of Milton, states that it was very abundant in his plantation at that date.

During June the affected plantations were readily recognized, even at a considerable distance, by the yellow color of the foliage; but in July this was much less noticeable. By July 10 the few leaves still remaining on the bushes were scarcely at all yellow although thickly covered with anthracnose spots. By June 26 the fruit was beginning to ripen and thereafter the affected plantations were to be recognized by their conspicuous red color. The falling of the leaves left the load of ripening fruit exposed to view.

In addition to the leaves, the fungus attacked the leaf stalks or petioles, causing conspicuous black, slightly sunken spots. It also attacked the fruit stems, the berries and the new canes. The spots on the fruit stems were black and resembled those on the petioles. They were from one-fourth to one-half inch in length and extended half way or more around the stem. On the berries the spots were black and circular and bore some resemblance to fly specks. While the berries were green the spots on them were fairly numerous and readily seen; but as the berries ripened the spots became less conspicuous. This may have been due to the fact that the small berries toward the tip of the cluster were the ones most severely attacked and as a result many of them dropped before ripening. The affected berries did not rot; and the presence of the spots on the fruit stems seemed to affect the berries but slightly. Very rarely did the berries wither from this cause. Peck's² statement that the fungus does not attack the berries is certainly an error.

Thinking it possible that the fungus attacks also the wood, we made a close examination of the canes in the badly affected Hep-

¹ See Bul. 167 of this Station, p. 292.

² Peck, C. H. Rep. N. Y. State Mus. Nat. Hist., 43: 52.

worth plantation and were immediately rewarded by the discovery of yellowish pustules which upon microscopic examination proved to be the acervuli or spore conceptacles of *Glæosporium ribis*. This was on July 10. Most of the acervuli seemed immature, but some of them contained spores identical with those found on the leaves, thus leaving no doubt that *Glæosporium ribis* occurs on currant canes. At our next visit, July 23, it was found that the acervuli were mostly mature and contained an abundance of typical *G. ribis* spores. A quantity of the affected canes was collected and preserved. They will probably be distributed in Seymour and Earle's *Economic Fungi*. So far as observed, the acervuli occur only on wood of the present season's growth. The color of the acervuli is pale yellow or light brown and differs but little from that of the cane. Consequently, they are inconspicuous. However, when they are numerous, one acquainted with them may locate them with the unaided eye. The fungus seems to do very little harm to the cane, producing but a trifling discoloration of the bark and none at all of the wood.

We believe this to be the first account of the discovery of *Glæosporium ribis* on currant canes. Considering the inconspicuousness of the acervuli, it is not strange that they have been overlooked. It is also possible that under ordinary circumstances the fungus does not attack the canes. Whenever a plant disease becomes epidemic it is likely to behave somewhat differently from its usual manner. However, be this as it may, the discovery is an important one because it shows where the fungus probably passes the winter and that the canes are to be considered a source of infection in the spring.

HOW DISTINGUISHED FROM OTHER CURRANT LEAF DISEASES.

Among fruit growers the currant disease under consideration is usually known as leaf blight or sometimes as leaf spot. Since there are at least two other common currant leaf diseases which go by the same name much confusion would be avoided if fruit growers would follow the custom of mycologists and call this disease anthracnose. Mycologists apply the name anthracnose

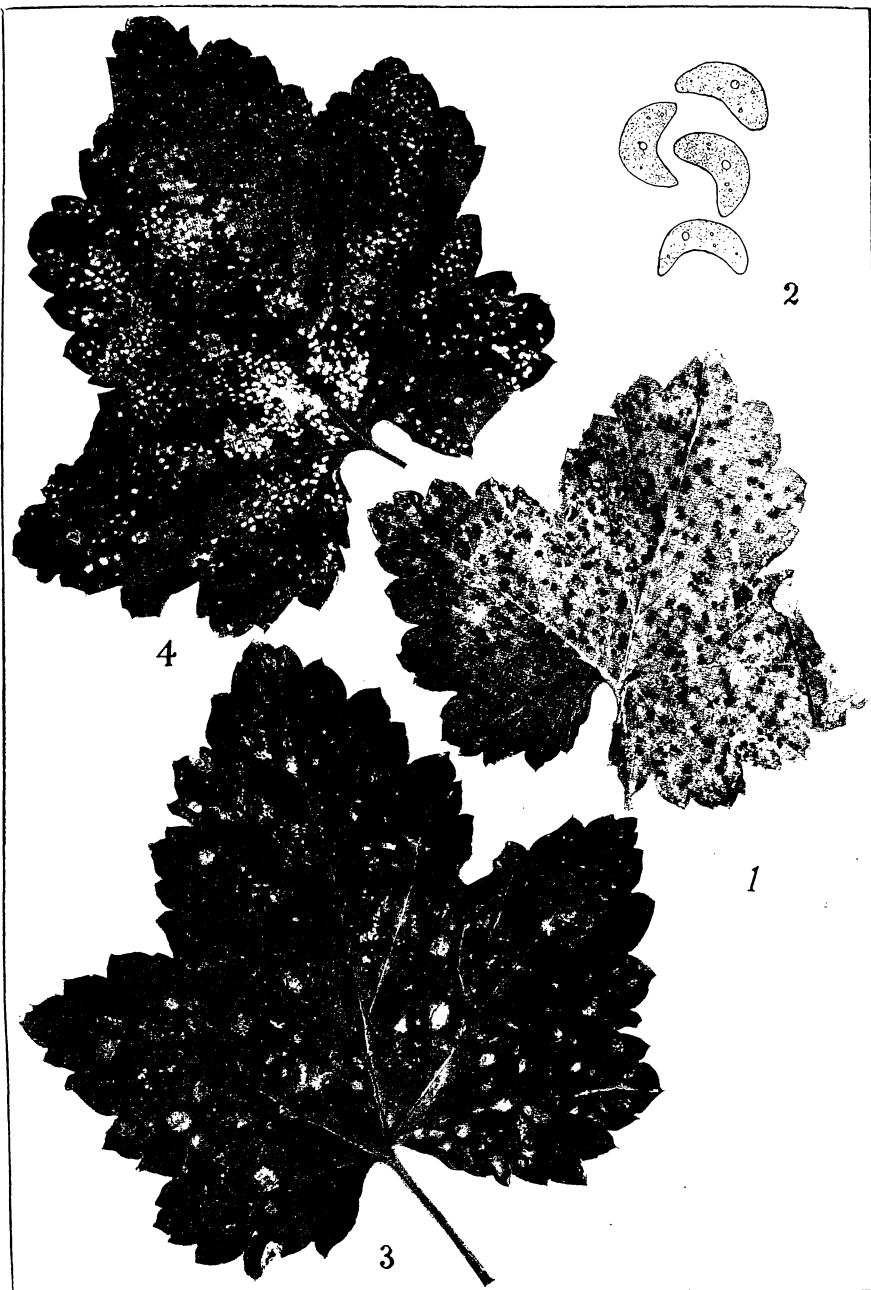


PLATE I.—COMMON LEAF DISEASES OF THE CURRANT.

to diseases caused by species of fungi belonging to *Glœosporium*, *Colletotrichum* and a few other closely related genera.

The currant disease which is properly called leaf spot is the one caused by the fungus *Septoria ribis* Desm. This produces on the leaves dead, brown (or gray) spots which are usually circular in outline and have a diameter of about one-eighth inch (See Plate I, Fig. 3). As a rule, leaf spot is readily distinguished from anthracnose by the size of the spots, anthracnose spots being much smaller—often no larger than a pin head. However, the spots formed by *Septoria ribis* on both red and black currants, may sometimes be angular and quite small, although always larger than those of *Glœosporium ribis*. A notable example of this came under our observation at Milton, where a large

EXPLANATION OF PLATE I.

- FIG. 1. *A leaf of red currant affected with anthracnose, Glœosporium ribis. Natural size.*
- FIG. 2. *Spores of Glœosporium ribis. Magnification 825 diameters.*
- FIG. 3. *A leaf of red currant affected with leaf spot, Septoria ribis. Natural size.*
- FIG. 4. *A leaf of red currant showing the work of the four-lined leaf-bug, Pœcilocapsus lineatus. Natural size.*

plantation of black currants, *Ribes nigrum*, was quite severely attacked by leaf spot as early as July 10. Since, at this date, *Septoria ribis* had shown itself only in traces on red currants in this locality, and the character of the spots was so much out of the ordinary, we were much surprised to find that the trouble was due to *Septoria ribis*. The spots were quite angular and scarcely more than one-third their usual size. The variety of currant is one said to have originated near Milton where it is known as the Mackey.

The *Septoria* leaf spot is very common in New York and is usually the chief cause of the dropping of currant leaves in this State; but during the past season it was almost wholly absent

from the locality where anthracnose was epidemic until about July 23, when it appeared in abundance and destroyed the few leaves left by anthracnose.

Another form of so-called leaf spot which occurs on currant leaves in the Hudson Valley, sometimes in considerable abundance is that caused by the four-lined leaf-bug, *Pæcilocapsus lineatus*.³ The spots caused by this insect are angular and translucent or else black with a water-logged appearance. (See Plate I, Fig. 4). They are wholly different in appearance from anthracnose spots and, moreover, they occur on leaves at the tips of the canes; whereas, anthracnose appears first on the lower leaves, and may attack leaves on any part of the plant.

A third leaf disease of currants is one which may be called leaf blight. It is caused by the fungus *Cercospora angulata* Wint. According to Pammel⁴ this fungus is common on currants in Iowa.

In New York State it seems to be rare. In 1897 we received specimens of it from Highland, and in 1900 specimens were sent us from Long Island. During the past season we have sought for it in the Hudson Valley, but have not found even a trace of it. The spots formed by it are considerably larger than anthracnose spots.

Occasionally we have met with a form of leaf spot caused by a species of *Phyllosticta*. The spots are larger even than those of *Septoria ribis* so there need be no danger of confusing them with anthracnose spots.

THE FUNGUS.

Glæosporium ribis (Lib.) Mont. & Desm.

The fungus which is the cause of currant anthracnose was named *Glæosporium ribis* by Montagne and Desmazieres⁵ in 1867. For some time previous it had been known as *Leptothyrium ribis*, which name is, therefore, a synonym. *Cryptosporium ribis* Fckl. is also a synonym.

³ See Bul. 167 of this Station, p. 291; also Cornell Agr. Exp. Sta. Bul. 58.

⁴ Pammel, L. H. Iowa Agr. Exp. Sta. Bul. 13:67.

⁵ Montagne & Desmazieres. Kicks' Flore crypt. Flandres 2: 95.

As already stated, it attacks the leaves, petioles, fruit stems, fruit and canes. The spores are formed in pustules, technically known as acervuli, which originate underneath the epidermis of the leaf, chiefly on the upper surface. The epidermis becomes blackened and elevated so as to form a small pimple. At maturity, this pimple is ruptured at the summit and the spores escape in a gelatinous mass which appears as a whitish or flesh colored speck at the center of the spot. The spores, which are one-celled and uncolored, are somewhat variable as to size and shape. Usually they are strongly curved and somewhat larger at one end. (See Plate I, Fig. 2). As we have found them, the spores measure 12 to 24μ in length by 5 to 9μ in width, the most common size being 19 by 7μ .

In our experience there has never been any difficulty to find the spores in abundance on the affected leaves. They are also fairly abundant on the new canes and on the petioles. On the canes they are much more easily found while the canes are fresh. Upon drying, the contrast of color distinguishing the acervuli largely disappears. From dried specimens of the canes the spores are most easily obtained by scraping the bark after a brief immersion in water. On the fruit stems and berries the spores are found less frequently.

So far as known, *Glæosporium ribis* has but the one spore form above described. However, it is quite possible that there exists, also, an ascigerous form in which the fungus passes the winter. Fuckel⁶ has suggested such a relationship with *Sphæria circinata* Fckl. [= *Gnomoniella circinata* (Fckl.) Sacc.]

By means of artificial cultures Miss Stoneman⁷ has shown that two other species of *Glæosporium*, *G. cingulatum* Atk. and *G. biperatum* E. & E., have in their life cycle ascigerous forms referable to a pyrenomycetous genus for which she proposes the name *Gnomoniopsis*.

Excellent figures of *Glæosporium ribis* are found in Briosi & Cavara's *Funghi parassiti delle piante coltivate od utili*, Fasc. IX, Nr. 222.

⁶Fuckel, L. *Symbolæ Mycologicae*, p. III.

⁷Stoneman, Bertha. A Comparative Study of the Development of some Anthracnoses. *Botanical Gazette*, 26: 101-106.

Other species of *Glæosporium* attacking members of the genus *Ribes*, the genus to which the cultivated currants and gooseberries belong, are *G. curvatum* Oud. on leaves of *R. nigrum*, the black currant; *G. tubercularioides* Sacc. on leaves of *R. aureum*, the Missouri currant; and *G. ribicolum* E. & E. on fruit of the English gooseberry.

AMOUNT OF DAMAGE DONE.

Although the fungus *Glæosporium ribis* is widely distributed over Europe, Asia, Australia and North America, and has long been known to mycologists, it seems to have attracted very little attention as a fungus of economic importance. While it is frequently mentioned in works on fungi it is not often spoken of as doing any serious damage to currants.

The first mention of its occurrence in this country seems to have been that made by Berkeley,⁸ in 1873, who reported it on leaves of black currant collected in Connecticut. In 1884 Peck⁹ found it on the leaves of the fetid currant, *Ribes prostratum*, in the Adirondacks. According to Dudley¹⁰ and also Peck¹¹ there was a serious outbreak of the disease in New York State in the season of 1889. Prof. Dudley, at that time Cryptogamic Botanist of the Cornell Experiment Station, made the disease the subject of a two-page article which was published as a part of Bulletin 15 of that Station and also in the Annual Report of the same Station for 1889. Although so brief that Prof. Dudley himself called it a note, the article is, even to the present time, the most comprehensive published account of currant anthracnose as it occurs in America. He reports¹² the disease abundant on white currants at Ithaca and destructive to red currants in the vicinity of Rochester. Peck¹³ says: "A currant-leaf fungus, *Glæosporium ribis*, has also been excessively virulent. In some localities currant leaves

⁸ Berkeley M. J. *Grevillea*, 2: 83.

⁹ Peck, C. H. Rep. N.Y. State Mus. Nat. Hist., 38: 98.

¹⁰ Dudley, W. R. Cornell Agr. Exp. Sta. Bul. 15: 196-198; same in Second Ann. Rep. Cornell Agr. Exp. Sta., 1889, pp. 196-198.

¹¹ Peck, C. H. Rep. N. Y. State Mus. Nat. Hist., 43: 52.

¹² Dudley. Loc. cit.

¹³ Peck. Loc. cit.

have been so severely attacked by it that their vigor was destroyed and they fell to the ground long before the usual time. In my own garden the currant bushes were as destitute of foliage in August as they usually are in November."

Since 1889 it has been mentioned by Pammel¹⁴ as occurring on red currants in Iowa and Halsted¹⁵ has reported its occurrence on cultivated gooseberries in New Jersey; but we find nothing in the literature to indicate that it has been at all destructive during the past eleven years. However, from our own observations we are inclined to believe that in New York, particularly in the Hudson Valley, it occurs to some extent nearly every season and that, in some instances, it has been destructive. June 12, 1897, Mr. H. R. Leeder of New Paltz reported to the Station that his currants were dropping their leaves badly. The specimen leaves accompanying his letter showed an abundance of *Glæosporium ribis* which was probably the cause of the leaves dropping. It is noteworthy that this outbreak, like the one of the present season, occurred before the middle of June. On July 7 of the same year Mr. F. A. Sirrine observed that in the vicinity of Highland, currants were dropping their leaves badly. Specimens of the fallen leaves were examined by one of the writers of this article and found to be infested with *Cercospora angulata* and *Glæosporium ribis*. June 28, 1900, we observed a plantation of red currants on Long Island which was severely attacked by *Glæosporium ribis*. *Septoria ribis* was also present in small amount. In this plantation the *Glæosporium* had attacked the fruit stems to so great an extent as to attract the attention of the foreman in charge. Nevertheless, we saw no evidence of damage from this cause. None of the berries were dropping or shriveling. Dr. B. M. Duggar informs us that *Glæosporium ribis* was abundant on currants in the Hudson Valley in the autumn of 1900. In a plantation at Rochester we found a few currant bushes quite severely attacked by *G. ribis*, August 30, 1900; but this was the only case of the disease observed in Western New York last year. The season was an excessively dry one.

¹⁴ Pammel, L. H. *Journal of Mycology*, 7: 101. In a letter dated November 5, 1901, Prof. Pammel writes us that he has not observed the disease in Iowa since 1891.

¹⁵ Halsted, B. D. N. J. Agr. Coll. Exp. Sta. Report for 1895, p. 331.

During the past season currant anthracnose became epidemic in the Hudson Valley about June 8. By June 13 many leaves were falling and it was already evident that the crop would be considerably injured. In some plantations one-half the foliage was gone by June 26 and by July 10 the bushes were completely defoliated except for small tufts of leaves at the tips of some of the canes. The fruit commenced to ripen about June 26 and by July 10 the harvest was in progress. About July 1 there was a week of excessive heat with a clear sky. As a result, currants throughout the Hudson Valley suffered severely from sunscald. Most of the leaves having fallen, the fruit was left exposed to the direct rays of the sun. However, it is likely that the injury was not all due to exposure to the sun. Some of it was probably due to the inability of the defoliated canes to supply the berries with water notwithstanding the fact that the soil was filled with water owing to frequent showers. The loss from sunscald and shriveling of the berries was enormous. Mr. Hepworth has 18 acres of currants from which he sold, in 1900, 50,000 quarts of fruit. In 1901 the same plantation yielded only 26,000 quarts. This loss of nearly one-half the crop Mr. Hepworth attributes to the effect of anthracnose and the accompanying sunscald. In the five-acre plantation mentioned in the introduction to this bulletin the loss was estimated to be about two-thirds of the crop. The fruit set as well in 1901 as in 1900 and there was no other disease besides anthracnose except cane blight which was no more destructive in 1901 than in 1900. Therefore, had it not been for the anthracnose the crop of 1901 would probably have been as large as that of 1900. Moreover, the loss on the present season's fruit crop is not all. The dropping of the leaves so early in the season must seriously interfere with the proper ripening of the wood and the formation of fruit buds for next year. How great will be the damage from this cause can not be determined until next season. As already stated, some plantations were almost completely defoliated by July 10. By July 22 many plantations were completely defoliated and many more had lost from one-half to two-thirds of their foliage. As a rough estimate we would say, that in the region between Highland and Newburgh probably two-thirds of all currant leaves (excepting black currants) had

fallen by July 22. About this time *Septoria ribis* also appeared and assisted in completing the destruction. At what time the defoliation was complete we are unable to say, since we did not visit the region between July 22 and September 2. On the latter date very few green currant leaves were to be found ; and yet, normally, currants hold their leaves until heavy frosts. On the Station grounds at Geneva, sprayed currants of many different varieties were in nearly full foliage as late as October 15.

The disease was more destructive in old plantations than among young plants. Plants in the nursery row were attacked latest of all and consequently suffered least. It was a common observation among fruit growers that the disease was more severe on high, dry soil than in lower situations where the soil was heavier and naturally moister. Our own observations confirmed this. The disease was also somewhat less severe on plants which were partially shaded. It is a common practice in the Hudson Valley to plant currants between the rows in peach orchards. Hence, it comes about that many bushes are in partial shade. The shaded plants were not attacked so early as were those fully exposed to the sun.

Concerning the amount of damage done by currant anthracnose elsewhere than in the Hudson Valley, we have little information. At Geneva, some plantations lost a large part of their foliage because of anthracnose, and it was present in greater or less amount in almost all plantations ; but the damage done by it does not appear to have been great. Prof. Craig informs us that the disease was common at Ithaca.

HOST PLANTS.

While *Glæosporium ribis* may attack several different species of *Ribes* it has a decided preference for *R. rubrum* to which belong the red and white varieties of cultivated currants. It has been frequently reported on *R. nigrum*, the black currant, but according to our observations it is not at all destructive to black currants to say the least. While watching the progress of the disease in the Hudson Valley we examined several plantations of black currants, but in no case found any damage done to them by

anthracnose. In one case a row of black currants stood between two rows of red ones. The red currants were all severely attacked by anthracnose, but the foliage of the black currants was perfect and apparently free from the disease.

The cultivated gooseberry, *Ribes grossulariæ*, is also said to be subject to anthracnose. In the region where anthracnose was epidemic on currants there are several commercial plantations of gooseberries none of which were affected by the disease to any extent.

It also appears that among the red currants some varieties are somewhat more susceptible than others. Our observations on this point are not as full as they should be and so we are unable to give a list of resistant varieties; but it is probable that this difference in susceptibility is sufficiently great to be turned to practical account in case anthracnose should become an important factor in currant culture.

On July 23, when the disease was in full sway, we made some observations at Middle Hope where four varieties of red currant, Fay's Prolific, Victoria, Prince Albert and Pres. Wilder, were growing in the same plantation under practically the same conditions. On Fay's Prolific, anthracnose had caused about two-thirds of the foliage to drop and Victoria had lost about one-third of its foliage; while Prince Albert and Pres. Wilder were perfect in foliage and practically free from the disease. Gooseberries growing nearby were also unaffected.

THE OUTLOOK FOR THE FUTURE.

The question has been asked, Will anthracnose be destructive next season? Also, Is it likely to appear regularly every season hereafter and become a menace to the currant industry? It is our opinion that currant growers need not be alarmed. Anthracnose is by no means a new disease of currants. It has existed in the currant plantations of New York for at least twelve years and probably longer. In 1889 it was destructive; but since that time there is no published record of any damage done by it in this State. Judging from the past history of the disease it seems unlikely that it will become troublesome except in an occasional

season when all conditions are favorable to it.¹⁶ However, we are not unmindful of the fact that diseases which spring suddenly into prominence as the currant anthracnose has done during the past season sometimes continue to be very destructive. Striking examples of this are afforded by the cucumber downy mildew, *Plasmopara cubensis*, and the asparagus rust, *Puccinia asparagi*. The former first appeared in this country in 1889 and has since become so destructive in the Eastern United States that the growing of late cucumbers must have been abandoned had it not been discovered that the disease can be controlled by spraying.¹⁷ The first epidemic of asparagus rust occurred in 1896 in New Jersey, Long Island and Southern New England.¹⁸ Prior to 1896 it was practically unknown in America ; but each season since 1896 it has been destructive and seems to be established as a permanent scourge of asparagus.

Concerning the outlook for currants in 1902, it is safe to predict that the crop in the Hudson Valley will be somewhat shortened, owing to the premature falling of the leaves last summer ; but the virulence of anthracnose will probably depend very largely upon the nature of the weather next spring. The prevalence of the disease in 1901 is certainly favorable to another epidemic in 1902 provided the weather conditions are favorable. The new wood and fallen leaves are everywhere covered with multitudes of the spores ready to start infection again next spring if they have a chance. In the Hudson Valley, the spring of 1901 was a very wet one as was also the spring of 1889 when the other epidemic occurred ; so it appears that the disease is favored by wet weather.

¹⁶ Exactly what weather conditions are most favorable to the disease is not known. The two epidemics of recent years in this State have both occurred in wet seasons (1889 and 1901) and naturally we infer that wet weather is favorable to the disease. However, Dr. Weiss states (Weiss, J. E. Die Blattfallkrankheit der Johannisbeersträucher. *Praktische Blätter für Pflanzenschutz*, 3: 3), that in southern Bavaria the disease was epidemic in the dry seasons of 1898 and 1899, but scarcely any damage was done in the wet season of 1897.

¹⁷ For the history of *Plasmopara cubensis* see Bul. 119 of this Station, p. 164.

¹⁸ Halsted, B. D. N. J. Exp. Sta. Bul. 129.

TREATMENT.

If it becomes necessary to fight currant anthracnose resort must be had to spraying, which seems to be the only promising line of treatment, except, perhaps, the planting of resistant varieties. Spraying with the copper compounds, particularly Bordeaux mixture, is effective against many fungous diseases of foliage and there is little doubt that currant anthracnose may be controlled in this way. However, there is but little experimental data bearing on this point. Prof. Pammel¹⁹ at the Iowa Experiment Station, has conducted more experiments on the spraying of currants than any one else in this country and shown that *Septoria ribis* and *Cercospora angulata* may be controlled by spraying with Bordeaux mixture; but *Glæosporium ribis* was not a factor in any of his experiments. Dr. Halsted²⁰ made the following experiment: "In a row of eight gooseberry bushes, two were selected for treatment. Beginning April 25, three applications of Bordeaux were made previous to May 22. The bushes were again sprayed August 13. The foliage was somewhat injured by an anthracnose (*Glæosporium ribis* Lib.), but there was no practical difference between the sprayed and unsprayed plants." As far as they go, the results of this experiment are unfavorable to the control of currant anthracnose by spraying.

Currant growers in the Hudson Valley fully realize the importance of protecting their plants against the ravages of currant worms²¹ which strip the bushes of their leaves in a surprisingly

¹⁹ Pammel, L. H. Iowa Agr. Exp. Sta. Bul. 13: 45-46; Bul. 17: 419-421; Bul. 20: 716-718; Bul. 24: 987-988; Bul. 30: 289-291.

²⁰ Halsted, B. D. N. J. Agr. Coll. Exp. Sta. Rep. for 1895, p. 331.

²¹ Two distinct species of currant worms occur in the Hudson Valley, which not only differ in appearance but also in habits. The one generally known as the currant span-worm, called gooseberry span-worm in some sections, (*Diastictis ribearia*), is single brooded; while the imported currant-worm or currant saw-fly (*Nematus ventricosus*), has two broods each year. The larva of the first is a caterpillar. They appear early, sometimes before the currant leaves are even fairly expanded. They grow rapidly and feed voraciously. By the last of May or first of June they are full grown and stop feeding. At this time they are about one inch long, of a bright yellow color, marked with white lines on the sides together with numerous black spots and dots. They can also be distinguished from

short time. Of late years they have abandoned the use of hellebore, the standard remedy for currant worms, and substituted for it Bordeaux mixture containing Paris green, green arsenoid or some other arsenical poison. Promptly upon the first appearance of the worms the bushes are given a thorough spraying with the poisoned Bordeaux mixture. If the work is well done, and rains not too frequent, a single application suffices for the season. Whereas, if hellebore is used it is usually necessary to make two

the imported currant-worm by their habit of looping the body when they travel. These worms leave the bushes about the first of June and go into the ground where they change to the chrysalis form. Early in July they issue as adult moths or millers and can be seen flying over the fields during July and part of August. In color the adult moth is pale yellow with dusky spots or bands on the wings. Seen at a distance it could easily be mistaken for the butterfly of the cabbage-worm flying over the currant fields. The eggs are deposited on the branches of the currants and do not hatch until the following spring.

The imported currant-worm is the slug-like caterpillar of a saw-fly. The flies appear about the time the span-worm hatches from the egg. They pair first, then lay their eggs upon the underside of the currant leaves, usually along the larger veins. The eggs hatch a week or ten days after being deposited. Owing to the time required for laying and hatching the eggs, the worms do not appear until one or two weeks after the span-worm has commenced feeding. The larvæ of the saw-fly reach maturity in June, at which time they are about three-quarters of an inch long. They go to the ground and spin cocoons around themselves in which they change to chrysalides. During July they change again to adult flies; as a result a second brood of worms occurs after the crop of fruit is gathered. This worm can be distinguished from the span-worm by its color, which is usually green covered with black dots, with the extremities sometimes tinged with yellow; also by the fact that it does not loop the body when it travels, but does frequently curl itself up sidewise when feeding.

In most sections of the country the last described species is usually the most common currant pest. When hellebore is recommended, this is the worm that is supposed to be doing the damage.

The currant growers of the Hudson Valley have two distinct species of worms to combat and these worms appear at three distinct periods. This would require not only frequent applications of hellebore but also large quantities of it. Such treatment is expensive. The use of hellebore has also proven worthless as a remedy for the span-worm, as shown by the fact that in 1897 the fields in the vicinity of Highland, even where hellebore was applied frequently, were completely stripped by this pest. These conditions have done much to induce growers to use some arsenical compound in Bordeaux mixture.—F. A. SIRRINE.

or more applications, because there are generally two and sometimes three broods of worms during the season and the hellebore applied for the first brood is washed off by rain before the appearance of the second brood. Bordeaux mixture, on the contrary, is not readily removed by rain and enough of it still remains on the leaves to kill the second brood of worms. Besides requiring but a single application, the Bordeaux mixture has an additional advantage in that it protects the foliage, to a considerable extent, against leaf spot. The superiority of Bordeaux mixture²² is so evident that the use of hellebore has been almost entirely abandoned, except in cases where the application has been postponed until the fruit is so large that there is danger of spotting it if Bordeaux is used. The application of the poisoned Bordeaux is made upon the first appearance of worms; but last spring the worms appeared somewhat later than usual and so the Bordeaux was applied later. In fact, many persons accustomed to spray for worms did not do so the past season because there were so few worms that it seemed unnecessary.

Some persons thought they saw evidence that the single application of Bordeaux for worms had lessened the amount of damage from anthracnose. In the plantation of Mr. A. B. Clarke at Milton, we observed that in one portion anthracnose was considerably more severe than in an adjacent portion. Upon inquiry as to the cause we were informed that one portion had been sprayed once with Bordeaux mixture while the other had not. In this case there appeared to be a marked benefit from spraying; but in general the Bordeaux applied for worms did not have much effect on the anthracnose. Probably, the application was made too late.

In the absence of experimental data we can only make suggestions as to treatment. Bordeaux mixture will probably control the disease, but the spraying must be commenced early. In view

²² It appears that poisoned Bordeaux mixture as a remedy for currant worms came into use in the Hudson Valley about 1898. It was recommended by Mr. F. A. Sirrine in a short article published in the *Eastern New York Horticulturist* for October, 1897. Mr. J. A. Hepworth of Marlborough and Messrs. W. D. Barns & Son of Middle Hope were among the first to use it.

of the fact that the anthracnose fungus inhabits the canes, the first application should be made on the bare canes before the leaves appear.²³ Special attention should be given to the new wood because there is where the spores are most abundant. In fact no spores have yet been found on the old wood. However, the old wood should also be sprayed, because it is possible that some spores do occur on it, and, also, because of the possible effect on cane blight. How the fungus of cane blight gets into the canes is not known, but there is good reason for believing that thorough spraying of the canes will have a tendency to prevent its attacks. The second spraying should be made while the leaves are unfolding, and thereafter the treatment should be repeated at intervals of ten to fourteen days until there is danger of permanently spotting the fruit. Upon the appearance of worms add Paris green or green arsenoid to the mixture. In wet seasons one or two applications should be made after the fruit is gathered.

Spraying in the early part of the season should be done with especial thoroughness and regularity in order, if possible, to keep the diseases completely under control until the time when the spraying must be discontinued on account of spotting the fruit.

To restate the matter briefly : Spray thoroughly with Bordeaux mixture, commencing before the leaves appear. Make the second treatment as the leaves are unfolding and thereafter at intervals of ten to fourteen days until the fruit is two-thirds grown. In

²³ For the first treatment a strong solution of copperas (iron sulphate) may be used instead of the Bordeaux. Make a saturated solution (that is, add copperas to water until no more will dissolve) and apply while the buds are swelling but *before they break*. By some, this treatment is thought to be beneficial for grape anthracnose (See N. Y. Agr. Exp. Sta. Bul. 86: 79; and Bul. 170: 410), particularly when about one per ct. of sulphuric acid is added to the copperas solution. But if the sulphuric acid is added the mixture can not be applied with a spraying machine, because it is so very corrosive. In that case it must be applied with a swab or whisk broom. The fungus of grape anthracnose is closely related to that of currant anthracnose and there is some reason for believing that any treatment which is successful for the one would be successful for the other. Nevertheless, we have recommended Bordeaux mixture for the first treatment for the following reasons : (1) Bordeaux is likely to be equally effective ; (2) The treatment is less complicated ; (3) There is no danger of injury to the plants or to the sprayer.

wet seasons make one or two applications after the fruit is gathered. When worms appear add Paris green or green arsenoid to the Bordeaux.

It seems to us probable that currant growers in the Hudson Valley will find spraying, as suggested above, a profitable practice. Anthracnose may not be epidemic except occasionally, but it probably does some damage nearly every season. Leaf spot is nearly always plentiful in the latter part of the season, and sometimes causes the leaves to fall before the fruit is ripe. Cane blight is always destructive, and one application must be made for the worms anyway. We believe that loss from all these troubles may be materially lessened by spraying. While the currant bears premature defoliation remarkably well, preservation of the foliage must result in increased vigor of the plants and, consequently, larger yields of fruit.