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NOTES ON NEW YORK PLANT DISEASES, II.

F. C. STEWART



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*Connected with Grape Culture Investigations.

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NOTES ON NEW YORK PLANT DISEASES, II.¹

F. C. STEWART.

SUMMARY.

This bulletin is the second number of a series containing brief notes on various plant diseases in New York. The principal items are as follows: The downy mildew of alfalfa occurs almost every season, but rarely causes appreciable damage. The yellow leaf blotch of alfalfa has been found at Geneva. A fruit rot of apples caused by *Leptosphaeria coniothyrium* was observed for the first time on apples from Waterport. Apples apparently perfect at harvest time may show much fruit-pit after two months in common storage. A stem-constriction disease of unknown cause occasionally occurs on apple trees in nurseries. Apple and pear seedlings are much subject to a disease the chief symptom of which is a blackening of the roots and stem at the surface of the soil. The cause has not been determined. The petiole rot of the spotted arum, caused by *Bacillus carotovorus*, is described in detail. A case of proliferation in the inflorescence of *Bromus inermis* is noted. Butternut trees often cast their leaves prematurely in consequence of the attack of an anthracnose fungus, *Gnomonia leptostyla*; but *Microstroma juglandis* is of rare occurrence on butternut leaves. The blackleg disease of cabbage caused by *Phoma lingam*, was first observed on Long Island in 1903. It has since become common and troublesome in some parts of the State. On Long Island, the decaying leaves of cabbage plants designed for seed production and stored during winter in trenches are often thickly covered in spring with shiny, round, brown or black bodies of the size of mustard seed. These are the sclerotia of an unidentified fungus which appears to be responsible

¹ Notes on New York plant diseases, I, the first number of this series, was published in December, 1910, as Bulletin 328.

for a part of the decay. A disease of cabbage called black leaf-speck is described. A destructive storage rot of carrots is caused by the fungus *Sclerotinia libertiana*. Soft rot, caused by *Bacillus carotovorus*, is often associated with it. The leaf spot and twig blight of catalpa caused by the catalpa midge, *Cecidomyia catalpæ*, is often mistaken for a fungus disease. The leaf spot of cherries, a destructive fungus disease, can be controlled by proper spraying; but the yellow leaf, distinguished by the absence of brown spots, is a non-parasitic malady uncontrollable by spraying. The western sand cherry, *Prunus besseyi*, is very susceptible to twig blight caused by *Sclerotinia cinerea*. *Fomes applanatus* occasionally attacks the trunks of living cherry trees causing heart rot. *Gloeosporium caulivorum*, an anthracnose fungus with sickle-shaped spores, occurs frequently on red clover and sometimes causes considerable damage. *Pseudopeziza trifolii*, which causes a leaf spot disease of red clover, is common but not often destructive. Two rare clover diseases, a Rhizoctonia leaf rot of white clover and a Cereospora leaf blight affecting white and alsike clovers are described. A case of damping-off of field-grown cucumber seedlings was found to be due to the common damping-off fungus, *Pythium debaryanum*. Several diseases of the currant are discussed, viz.: the relative importance of anthracnose and leaf spot; currant berries attacked by *Pseudopeziza ribis*; a Botrytis leaf spot; the angular leaf spot, a rare disease; crinkle leaf, a new disease which is interesting but unimportant; Fomes root rot, in which the causal fungus, *Fomes ribis*, tho plainly parasitic, injures its host but slightly; fruit drop, a widespread trouble due to some sudden check in growth; a root rot caused by *Hypholoma perplexum*; powdery mildew on red and black currants; sunburn of leaves and fruit; tipburn affecting the leaves; failure of buds to develop; a white deposit on the canes; witches' brooms; and yellow leaf, a non-parasitic trouble. Under elm, four diseases are described, viz.: Anthracnose, a leaf disease caused by *Mycosphaerella ulmi*; a non-parasitic yellow-leaf disease; trunk injury induced by a box "protector;" and an interesting case of a tree in which many branches died from some cause which could not be determined.

ALFALFA.

Medicago sativa.

DOWNY MILDEW, *Peronospora trifoliorum* DeBy. This fungus continues to occur frequently in New York alfalfa fields but rarely causes appreciable damage. It may be found from about the middle of May until frost. The earliest date of its appearance noted during the past ten years is May 17, in 1911, and May 18, in 1912. In both of these cases it was found at Geneva on alfalfa plants 10 to 12 inches high. On May 28, 1910, it was abundant at Riverhead, Long Island.

ASCOCHYTA LEAF SPOT, *Ascochyta imperfecta* Pk. Since the publication of Bulletin 305, in which this disease was first described, specimens of affected leaves were sent to the late Dr. C. H. Peck who has described the causal fungus and given it the name *Ascochyta imperfecta* (33).

YELLOW LEAF BLOTCH, *Pyrenopeziza medicaginis* Fckl. This is an addition to the list of alfalfa diseases in New York. It has been fully described by F. R. Jones (18) who has identified the pycnidial form of the causal fungus (the form in which it is found on living leaves) as *Phyllosticta medicaginis* Fckl. and proven the ascigerous form to be *Pyrenopeziza medicaginis* Fckl. Our attention was directed to it by Prof. J. E. Howitt who sent specimens from Guelph, Canada. Upon making an examination of alfalfa fields in the vicinity of Geneva in June, 1912, a little of the disease was found; but further observations have not been made and we do not know how common it may be in the State.

APPLE.

Malus sylvestris.

CONIOTHYRIUM FRUIT-ROT, *Leptosphaeria coniothyrium* (Fckl.) Sacc. In July, 1917, a package containing five green (unripe) apples was received from Waterport, N. Y. Each apple bore one or two sunken brown spots, 3 to 6 mm. in diameter, with conspicuous red borders. The surface of every spot was thickly covered with pycnidia of a species of *Coniothyrium*, apparently *C. fuckelii*, the pycnidial form of *Leptosphaeria coniothyrium*. This fungus causes a form of canker which is not uncommon on apple wood in New

York (29), but it has not previously come to our attention in the rôle of a parasite on apple fruit. However, it has been reported by Stevens and Hall (38) as causing a fruit rot of apples in North Carolina.

STEM CONSTRICTION. Cause undetermined. Two cases of this have come to our attention. Both occurred in nurseries at Geneva. On July 17, 1901, it was observed that the leaves on several seedling apple trees 14 to 18 inches high were dead. Plainly, this was due to strangulation. On the trunk at the surface of the soil the bark was dead, brown and shrunken all the way round, forming a well-marked constriction about an inch long. Both above and below the constriction the bark was still green, but all leaves above the constriction were dead. On most of the affected plants new shoots had started below the constriction. No fungus was visible on the surface, but microscopic examination revealed the presence of slender, hyalin fungus hyphae in the diseased bark and wood. The fungus was not identified.

On June 20, 1911, Mr. Parrott, the Station Entomologist, brought us a number of seedling apple trees which were wilting in consequence of a constriction of the stem at the surface of the soil. The bark was dead and shrunken tight to the wood over a section about one-half inch long. Apparently, this was an earlier stage of the disease observed in 1901.

In both of the above cases the diseased trees were widely scattered among healthy ones. Perhaps this is related to the stem-and-root disease of apple seedlings described on page 161. Possibly, it is due to excessive heat like the disease of pine seedlings described by Hartley (14). Altho usually fatal the constriction disease is probably of little or no economic importance owing to its rare occurrence.

FRUIT-PIT. Non-parasitic. About October 25, 1913, a quantity of each of 120 varieties of apples grown on the Station farm was picked and put into storage. Only perfect specimens were selected because it was intended to use these apples in the fruit exhibits to be made by the Station during the following winter. During the first three weeks of storage the temperature of the storage room was kept below 50° F. by the use of ice. After about November 15 no artificial methods of cooling or heating were employed.

On December 23 each variety was carefully examined for the purpose of selecting specimens for a fruit exhibit at Rochester. It was then discovered that about 50 per ct. of the apples of one variety, Lehigh Greening, were severely affected with fruit-pit² while none of the other 119 varieties grown and stored under parallel conditions were affected. This indicates that the Lehigh Greening is very susceptible to fruit-pit. It appears to show, also, that fruit-pit may develop in storage.

However, the application of the iodine test revealed the presence of considerable starch in the dead, brown tissue underneath the surface spots. This means either that the disease was present at harvest time and overlooked, because the spots did not show on the surface, or else the apples were not fully ripe when picked.

STEM-AND-ROOT DISEASE OF SEEDLINGS. Cause undetermined. During the past ten years the Horticultural Department of the Station has had much trouble with a disease affecting the stem and roots of apple and pear seedlings grown in "flats" in the greenhouse. Usually, the disease has made its appearance early in April when the plants were about one inch high with two to four leaves besides the seed leaves. The browning or blackening (in the case of the pear) of the leaves is the first symptom noticed. Upon examination, the roots and portion of the stem below the surface of the soil are found dead and black. Frequently, plants are found with a short section of the stem at the surface of the soil dead and shriveled while parts above and below this point appear normal. This appears to be the early stage. Many plants so affected recover without ever showing any leaf symptoms. In fact, many plants showing pronounced root and leaf symptoms ultimately recover. The mortality among affected plants is not as high as one might expect considering the condition of the roots.

The symptoms of the disease suggest a parasitic organism as the cause. On several occasions the writer has made a microscopic examination of the roots and stems of affected plants without finding any fungus which might be held responsible for the trouble. Neither is there any ocular evidence of the presence of bacteria in unusual numbers. Nevertheless, in the season of 1911, when the soil used was partially sterilized, there were fewer diseased plants than usual.

² The disease described by the author in Bul. 164 of this Station, pp. 215-219, and by Brooks in *Bul. Torrey Bot. Club*, 35: 430-432.

Suspicion having fallen on the fertilizer used, the nitrate of soda in particular, chemical fertilizers were entirely omitted in 1909 without the least diminution in the amount of disease.

ARUM, SPOTTED.

Amorphophallus simlense.

PETIOLE ROT, *Bacillus carotovorus* Jones. In an article by H. A. Harding and the present writer (12), published in *Science* about sixteen years ago, mention was made of a bacterial soft rot of the petioles of *Amorphophallus simlense*. At the time, it was the intention of the authors to publish a more complete account of the disease later. This idea being now abandoned, it seems desirable to publish a note on the subject here.

Amorphophallus simlense is one of the giant aroids grown for ornament or as a curiosity. In the open, it flowers in early spring, then throws up a single large leaf with a spotted, succulent petiole one to two feet in length and three-fourths of an inch to one inch in diameter. This leaf, if not attacked by disease, persists until frost.

The disease in question first came to the writer's attention at Floral Park, Long Island, early in June, 1897. At this date it was already scattered all thru a plat of about 4000 plants in three rows about twenty rods long. As the season advanced the plants one by one succumbed to the disease until by September 1 about 25 per ct. were dead. During the next five years the disease was present at the same place each year, but less destructive than in 1897. No observations have been made since 1902.

The disease first attacks the petiole at or below the surface of the soil. The affected tissue may be either moist and water-soaked in appearance or dry and brown. In either case the discoloration extends rapidly from the base of the petiole to its summit. In plants attacked during the early part of the season the diseased tissue is very moist, soft and foul smelling and the epidermis may be easily removed by rubbing with the fingers. In plants attacked after the middle of July the diseased tissue is usually brown and quite dry. Whether the rot assumes the wet or the dry form appears to depend more upon the age of the leaf than upon the state of the weather.

Almost from the first appearance of the disease the leaf blade begins to change color and by the time the rot has reached the summit of the petiole the blade is yellow. The whole leaf now falls to the ground and rapidly decays. A prominent character of the disease is its tendency to run up one side of the petiole while the opposite side remains sound. It is very common to find petioles with a wide strip on one side rotten from bottom to top while the opposite side is sound thruout the entire length. When the affected leaf topples over it usually falls with the diseased side down.

The disease is remarkably rapid in its action. Frequently the attacked leaf falls within four days after the first symptoms of disease. Among eleven leaves artificially inoculated during the latter part of June three fell within 100 hours after inoculation.

No new leaves are put forth to replace the dead ones. The tubers do not rot, but it appears probable that they serve as carriers of the disease.

As stated in the article above mentioned, inoculation experiments with pure cultures have shown *Bacillus carotovorus* to be the cause of the disease.

BROME GRASS.

Bromus inermis.

PROLIFERATION OF THE INFLORESCENCE. On July 11, 1915, the writer's attention was attracted by the peculiar appearance of some brome grass growing by the roadside near Geneva. Many of the heads had a leafy appearance. Upon examination it was found that the leafy appearance was due to the transformation of some or all of the spikelets into leafy shoots. The length of the leafy shoots varied, but, usually, it was two or three times that of a normal spikelet.³

BUTTERNUT.

Juglans cinerea.

ANTHRACNOSE, *Gnomonia leptostyla* (Fr.) Ces. & De Not. Butternut trees often cast their leaves prematurely in consequence of the attacks of a fungus thought to be identical with that causing the anthracnose of black walnut leaves. Affected leaves show irregular brown spots of all sizes from a mere speck up to about

³ Host Herbarium Specimen No. 75.

three-eighths of an inch across. On the tips and margins of the leaves the spots frequently coalesce and form large, dead, brown areas. Acervuli of the conidial stage of the causal fungus (known as *Marssonina juglandis* (Lib.) Sacc.⁴ occur on both surfaces of the spots. Hyalin, two-celled, sickle-shaped conidia are abundant. Usually, September is the season of the most conspicuous effects of the disease; but, according to Duggar (9), "almost complete defoliation of some trees has been noted as early as the latter part of July in New York."

WHITE MOLD, *Microstroma juglandis* (Bereng.) Sacc. This, also, is a fungus disease affecting butternut leaves but it is rare and unimportant in New York. It is recognized by the small patches of white mold which appear on the under surfaces of the leaves. In specimens collected by the writer at Milton, N. Y., September 2, 1901, the causal fungus had spores like those described and illustrated by Peck (31, p. 30 and pl. I, figs. 15-17) for a fungus which he found on butternut leaves at Charlton, N. Y.⁵ Peck referred his fungus, doubtfully, to *Microstroma leucosporum* Niessl; but Saccardo (34) gives it as *M. juglandis* var. *brachysporum*.

CABBAGE.

Brassica oleracea.

BLACKLEG. *Phoma lingam* (Tode) Desm. Apparently, this troublesome disease of cabbage is becoming quite prevalent in some parts of New York, particularly in Ontario County where it has been reported repeatedly as causing serious damage during the past three or four years. The variety most frequently affected is Allhead Early. In some cases the diseased plants are scattered irregularly thru the field, but it often happens that many plants in one row are dead or dying with the disease while the plants in the adjoining row are all healthy. This leads to the belief that the disease is frequently contracted in the seedbed and disseminated with the seedlings. It has been proven by Henderson (16) that the disease may originate in infected seed. Also, it appears probable that a diseased seedling may infect others with which it comes in contact in the process of transplanting. The common practise

⁴ *Gloeosporium juglandis* (Lib.) Mont. is a synonym.

⁵ Host Herbarium Specimen No. 76.

of bunching the seedlings and placing the roots in water preparatory to transplanting is highly favorable to such infection. This may account for the marked tendency of the disease to appear in certain rows and not in others. Probably the disease may also be spread from one plant to another in the same row by cultivation.

The danger arising from the use of infected seed may be largely, but not wholly, avoided by soaking the seed for fifteen minutes in a 1-1000 solution of corrosive sublimate as recommended by Harding *et al* (13) for the prevention of blackrot, or by "immersion for twenty to twenty-five minutes in a 1:200 solution of 40 per ct. formaldehyde, followed by washing in clear water," as recommended by Henderson (16, p. 430).

How long the blackleg disease has been in America is unknown. It was first definitely recognized by Manns (26) in Ohio in 1910, but its occurrence in Minnesota as early as 1906 is indicated by a statement made by Washburn (44), State Entomologist of Minnesota, in his report of that year. It is quite possible that it may have existed here several years but been confused with other root troubles.

In this connection it is worthy of note that the writer has positive knowledge of the occurrence of cabbage blackleg on Long Island in 1903. It was at Riverhead in a field of one and one-half acres of cabbage which had been planted late for the purpose of raising plants to set out for seed production the following season. On November 6, when our observations were made, between 35 and 50 per ct. of the plants were either dead or dying. Most of the dead plants had succumbed quite recently and were not yet dry. They were scattered irregularly over the field. Usually, the roots of affected plants had died and decayed leaving only the stem which, also, was frequently badly decayed in its lower portion. In some cases the roots were in fair condition, but the plant was rendered worthless by a large canker on the stem. In the woody portion of the lower part of the stem there were black streaks resembling the blackened bundles found in the stems of plants attacked by blackrot, but this was evidently not a case of blackrot because the black streaks did not extend up the stem as far as the attachment of the leaves and scarcely any of the plants showed leaf symptoms of blackrot. Some plants showed evidence of injury by cabbage maggots, but the bulk of the trouble was plainly due to some

other cause. Rhizoetonia, also, was readily eliminated as a possible cause. Finally, it was observed that the stems of affected plants almost invariably bore pycnidia of a species of *Phoma*. These pycnidia were not readily detected with the unaided eye, but by washing the stems and making use of a hand lens it was easy to find *Phoma* pycnidia on the stem of practically every affected plant. Every one of 32 affected plants selected at random showed the pycnidia. The conclusion was reached that the *Phoma* found on the stems was the probable cause of the trouble, but the identity of the fungus remained unknown until the appearance, in 1906, of an article by J. Ritzema Bos (4) describing a similar disease of cabbage in Holland caused by *Phoma oleracea* Sacc. (= *Phoma lingam* [Tode] Desm.).

STORAGE ROT. Fungus undet. On Long Island, cabbage plants intended for seed production are stored over winter in shallow trenches made with a plow. The plants are set in the trench close together, heads up, and covered with dirt by throwing a couple of furrows over them from both sides. The following spring, about April 1, the dirt covering is removed and such plants as are still sound are set out to produce seed. There is always some, and often considerable, loss from rot which is partly due to freezing, partly to the attacks of the soft rot organism, *Bacillus carotovorus* Jones, and partly to a fungus which produces large numbers of sclerotia.

This note has to do with the sclerotia. They are invariably present when the trenches are opened and often occur in such large numbers as to attract attention. Some of them are to be found on almost every decaying cabbage leaf. In different stages of maturity they are white, yellowish, reddish-brown and black. When mature they are usually the size of a large mustard seed (sometimes considerably larger) roundish, black, and shiny, and but slightly attached to the leaf.⁶ (Plate II, fig. 1.) As a rule, very little mycelium is in evidence and no fruiting stage has been found in association with the sclerotia. Attempts to germinate the sclerotia have failed.

In this connection there should be mentioned some sclerotia found on decaying cabbages stored in a cellar at the Experiment

⁶ Museum Specimens Nos. 142 and 143.

Station. These were roundish, black, and shiny and closely resembled the sclerotia found on Long Island except that they were somewhat smaller and associated with a luxuriant sterile growth of coarse, white mold. (Plate III, fig 1.) Under the microscope the white mold was found to consist of branched, tree-like structures composed of bundles of hyphae packed together as in the stipe of an agaric. Often these tree-like structures sprung directly from sclerotia. (Plate III, fig. 2.)

While it is unknown to what fungus either of these two kinds of sclerotia belong, it may be said that they do not belong to *Sclerotinia libertiana* which is sometimes parasitic on cabbage plants (15). Some sclerotia of *Sclerotinia libertiana* are shown in Plate II, fig. 2, for comparison. These were taken from a mother seed plant which was wilting and dying from an attack of a cottony, white fungus (*Sclerotinia libertiana*) on the lower portion of the stem.

BLACK LEAF-SPECK. Cause undetermined. In April, 1911, a cabbage grower of North Tonawanda sent to the Station some specimens of diseased cabbage leaves accompanied by the following letter: "I send you some cabbage leaves of the Danish [Danish Ballhead] variety, and would like to have you tell me what it is that affects them. This is only an ordinary sample, some being much worse. There was quite a large proportion of the crop affected. It was unsalable. It does not show until January when the cabbage gets white. We store in the barn where cabbage is kept just above freezing point. We first noticed it a year ago on the crop of 1909. Can you give a remedy?"

The specimens sent were white leaves from the interior of a cabbage head. They were plentifully sprinkled with minute black spots varying in size from a mere point to the size of a small pin-head. Many of them resembled fly specks. Most of the spots were broadly elliptical, their major axes lying parallel with the larger veins of the leaf. In location, they bore no definite relation to the veins. Some were seated on the veins, while others were on the parenchyma between the veins. Some were visible on both sides of the leaf, others on one side only. Sometimes the spots occurred singly, and sometimes in irregular groups. (Plate IV, fig. 2.) With the aid of a hand lens it could be seen that the surface of the spots was slightly sunken.

What appears to have been the same disease was observed at Canandaigua in the fall of 1910. In this case, the plants became affected while still in the field, and the outer as well as the inner leaves showed the spotting. In specimens of affected leaves received from Long Island in February, 1915, the spots, tho typical in other respects, were visible only from one side of the leaf.

The writer has been unable to determine the cause of this disease or connect it, definitely, with any of the described diseases of cabbage. However, there is a possibility that it is McCulloch's bacterial spot disease caused by *Bacterium maculicolum* (25).

The apparent absence of fungus hyphae from the diseased tissue (as demonstrated by microscopic examination of free-hand sections) indicates that no fungus is responsible for it.

CARROT.

Daucus carota.

STORAGE ROT, *Sclerotinia libertiana* Fekl. and *Bacillus carotovorus*. Jones. Where carrots are stored in large quantities, either in cellar storage or cold storage, one of the regular troubles is a form of rot in which areas of softened tissue are covered with a copious growth of white mold. Several times during the past twenty years carrot growers on eastern Long Island have complained to the Station of heavy losses due to this rot. Cold storage houses in Rochester, also, have occasionally reported loss from the same cause.

The white mold is *Sclerotinia libertiana* Fekl. It may be identified by the large, black, somewhat irregular sclerotia which are produced in considerable numbers on the decaying carrots. The writer's studies have convinced him that this fungus alone may cause extensive decay of stored carrots; but, usually, there is associated with it an active soft rot bacillus, probably *Bacillus carotovorus* Jones, which hastens the decay and greatly increases the amount of damage done. *Botrytis vulgaris* and species of *Fusarium* and *Penicillium*, also, are frequently associated with the decay.

The idea that *Sclerotinia libertiana* may cause a rot of carrots is not new. The literature of plant diseases contains numerous references to it. Stevens (37) has described a form of carrot rot caused by a fungus which produces sclerotia resembling mustard seeds.

CATALPA.

Catalpa spp.

TWIG BLIGHT AND LEAF SPOT, *Cecidomyia catalpae* Comstock. From time to time the Botanical Department of the Station has been called upon to explain the nature of a twig blight and leaf spot of young catalpa trees the symptoms of which strongly suggest parasitic fungi or bacteria as the cause. The writer has been much puzzled by these troubles, but has reached the conclusion that the twig blight and a part, at least, of the leaf spot are caused by an insect, the catalpa midge, *Cecidomyia catalpae* Comstock.

The twig blight and leaf spot may occur in association or separately. In August and September short shoots of the current season's growth are found to be dead, blackened and shriveled. Upon cutting open the dead shoots one may or may not find small, yellowish larvæ of the catalpa midge. How early the larvæ may occur the writer does not know, but he has found them abundant the latter part of September. The spots on the leaves are brown, circular and commonly 3 to 7 mm. in diameter. They may be either destitute of fungi or bear numerous pycnidia of a species of *Phyllosticta* (*P. catalpæ* E. & M.). Whether the *Phyllosticta* is always responsible for the spots on which it occurs is not known; but there is good reason to suspect that spots which do not bear fungi are the work of the catalpa midge.

A full account of the catalpa midge and its work are given by Gossard in Bulletin No. 197 of the Ohio Experiment Station.

CHERRY.

Prunus spp.

LEAF SPOT, *Coccomyces hiemalis* Higgins. This is a common fungus disease in which the leaves first show numerous small brown spots, then turn yellow and fall prematurely. In the seasons of 1916 and 1917, owing to long continued spells of wet weather in the spring, leaf spot was unusually prevalent and destructive over the greater part of the State. In many orchards of sour cherries the trees were almost completely defoliated before the fruit was fully ripe. Many trees were so much weakened that they afterward died of winter injury.

Fruit growers who have attempted to control the disease by spraying have sometimes succeeded and sometimes failed to a greater or less extent. As is often the case, it is uncertain whether the failures reported were due to the method of treatment being inherently faulty or to its having been improperly or carelessly applied. Failure to obtain good results from spraying is often due to lack of thoroness.

In a recent report on experiments made in Wisconsin, Keitt (20) recommends plowing under the fallen leaves before the blossoms open and spraying two or three times with bordeaux mixture, 3-3-50, or lime-sulfur, 1-40. The first spraying should be made soon after the petals fall and a second one two weeks later. If a third spraying seems necessary it should be made as soon as the fruit is harvested. In each application add arsenate of lead to the fungicide at the rate of three-fourths to one pound of the powder or one and a half to two pounds of the paste to each fifty gallons.

YELLOW LEAF. Non-parasitic. Occasionally the leaves of sour cherry trees turn yellow and fall prematurely in large numbers without being attacked by any fungus or insect. This trouble is readily distinguished from leaf spot by the absence of brown spots on the leaves. It is caused by unfavorable soil and weather conditions and is not preventable by spraying.

WINTER INJURY (?). Cherry trees often die unexpectedly and mysteriously. In many cases death occurs quite suddenly after the leaves appear in spring. Sweet cherries, particularly, are liable to go this way. An examination of all parts of the tree, including the roots, usually fails to reveal the cause of the trouble and death is vaguely attributed to "winter injury." While this diagnosis may be correct, in a general way, it is highly desirable to know more definitely how the death of the trees is brought about and what conditions induce it.

A puzzling case which may, perhaps, be classed with winter injury troubles came under the observation of the writer recently. It occurred at Geneva in a cherry orchard about twenty years old. The variety was Montmorency. Thruout the season of 1917 seventeen trees showed symptoms of ill health.

Up to the spring of 1917 it had not been observed that any of the trees were abnormal. The orchard contained a full stand of fairly thrifty trees quite uniform in size and appearance. The

affected trees all stood in one row tho not in consecutive order. This fact aroused the suspicion that the trees in this row had received different treatment from those in the remainder of the orchard, but diligent inquiry failed to discover confirmatory evidence. However, it is possible that this row failed to receive an application of nitrate of soda given the remainder of the orchard in the summer of 1916 to counteract the effect of a severe attack of leaf spot.

There seemed to be no difference in soil conditions which would account for the trouble. The surface drainage and underdrainage were both good and the same where the affected trees stood as elsewhere. Around one of the affected trees the soil was removed over a radius of about thirty inches and to a depth of three feet. All of the roots thus exposed were alive and apparently normal.

The blasting of the blossoms was the first symptom to attract attention. Soon after blooming the affected trees became conspicuous by the small size of their leaves. By June 8, 1917, it appeared that the trees would surely die, but all lived thru the summer.

As an experiment, six of the trees were severely pruned ("dehorned"). This proved beneficial. The pruned trees produced many new shoots twelve to thirty inches long having large leaves. The unpruned trees (with two exceptions) made no new growth whatever while normal trees added from two to six inches of new growth at the tips of their branches. The leaves of unpruned affected trees were fewer, smaller and darker green than the leaves of normal trees.

In the spring of 1918, after an unusually severe winter, the affected trees were all still alive. By June 5 the "dehorned" trees had made new shoots six to ten inches long, but bore no fruit. The unpruned trees were very scant of foliage and had made no new wood growth, but they bore a little fruit. It now appears that less severe pruning might have been more effective in rejuvenating the affected trees.

TWIG BLIGHT, *Sclerotinia cinerea* (Bon.) Schröt. On June 11, 1918, a block of the western sand cherry, *Prunus besseyi*, in a Geneva nursery was found to be severely affected with twig blight caused by the brown-rot fungus. The affected plants were bushes consisting of twelve to twenty-five willow-like shoots three to four feet high. Originally, they were dwarf peach trees on sand cherry stocks; but the peach trees, having made an unsatisfactory growth, were cut

back to within a few inches of the ground in the hope that new and better tops would be produced from dormant buds. For some reason the peach buds failed to develop and sprouts from the stocks came up instead.

About 25 per ct. of the shoots were blighted at the top, the length of the blighted portion varying from six to eighteen inches. While some of the shoots had died quite recently, others had been dead for some time. The causal fungus had first attacked and blighted the blossoms, then passed down the flower pedicels into the axis of the shoot where the bark and wood were killed and discolored over a section one-half to one and one-half inches in length. Usually, the point of attack was indicated by a drop of exuded gum; and gray tufts of *Monilia conidia* were often to be seen on the bases of small, lateral shoots nearby. Occasional fruits attacked and killed by the fungus also bore tufts of conidia. The leaves on all parts above the stem lesion wilted and died from lack of water.

This case is of interest because the host plant, *Prunus besseyi*, is one of the parents of the hybrid Compass plum previously reported by the writer as being severely attacked by the *Monilia* stage of *Sclerotinia fructigena* in a similar manner (40). Altho the causal fungus is probably the same, the name used here is different. Recent studies by Matheny (28), Bartram (2) and others indicate that the fungus causing brown-rot of stone fruits in this country is referable to *Sclerotinia cinerea* rather than to *S. fructigena*.

TRUNK ROT, *Fomes applanatus* (Pers.) Wallr. The writer has twice observed sporophores of *Fomes applanatus* on the trunks of living cherry trees.

In one case (at Shortsville) the affected tree belonged to a small-fruited variety of sweet cherry (*Prunus avium*). Its trunk was about two feet in diameter and, except for a narrow crack, appeared sound externally tho undoubtedly somewhat affected by heart-rot within. At the top, the tree was alive with the exception of one large branch which was dead. A single well-developed sporophore of *F. applanatus* about six inches wide sprung from the crack in the trunk about two feet above the ground.

The other case (at Geneva) also involved a sweet cherry tree of unknown variety. The trunk was about a foot in diameter. Its condition is not known except that the wood was nowhere exposed. It bore a sporophore of *F. applanatus* at a height of about ten inches

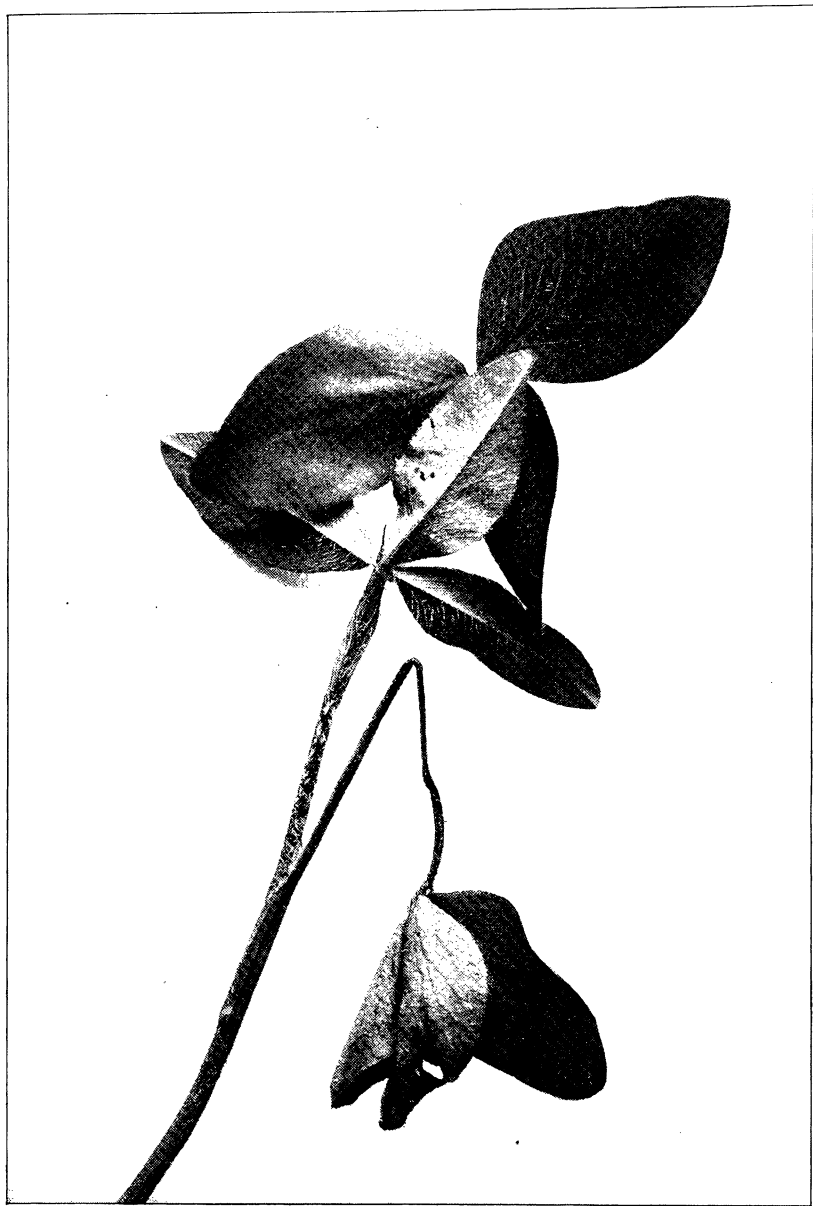


PLATE I.—ANTHRACNOSE OF CLOVER.

Upper portion of a stem of red clover with a leaf whose petiole has been attacked by *Gloeosporium caulivorum*.
(Natural size.)

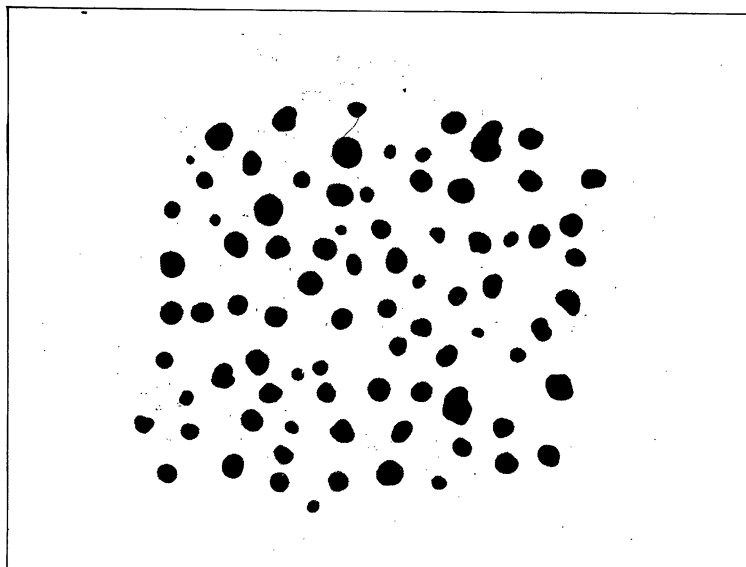


Fig. 1. Sclerotia of unknown fungus; from decaying leaves of cabbage plants stored in trenches.

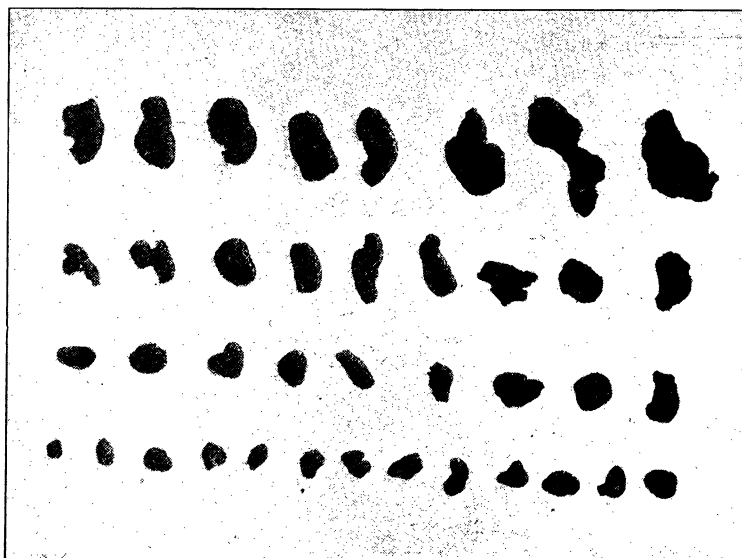


Fig. 2. Sclerotia of *Sclerotinia libertiana*; from a mother seed plant affected with stem rot.

PLATE II.—SCLEROTIA OF CABBAGE ROT FUNGI.
(Both figures natural size.)



Fig. 1. Portion of decaying leaf with growth of white fungus (at left) and black sclerotia (at center).

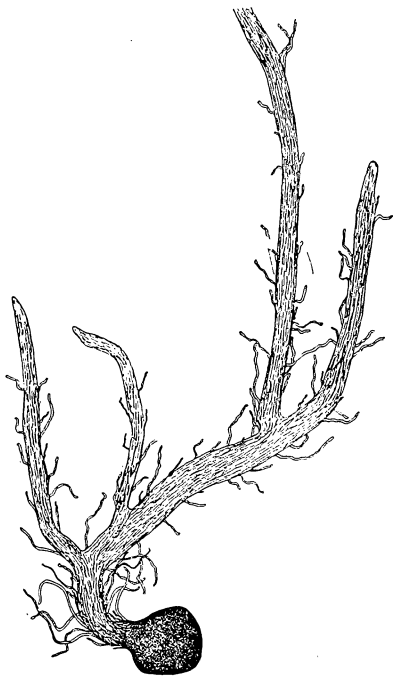


Fig. 2. A strand of white fungus springing from a sclerotium.

PLATE III.—FUNGUS ON CABBAGE STORED IN A CELLAR.

(Fig. 1 natural size; fig. 2 magnified several times.)



Fig. 1. Berries of red currant attacked by *Pseudopeziza ribis*.

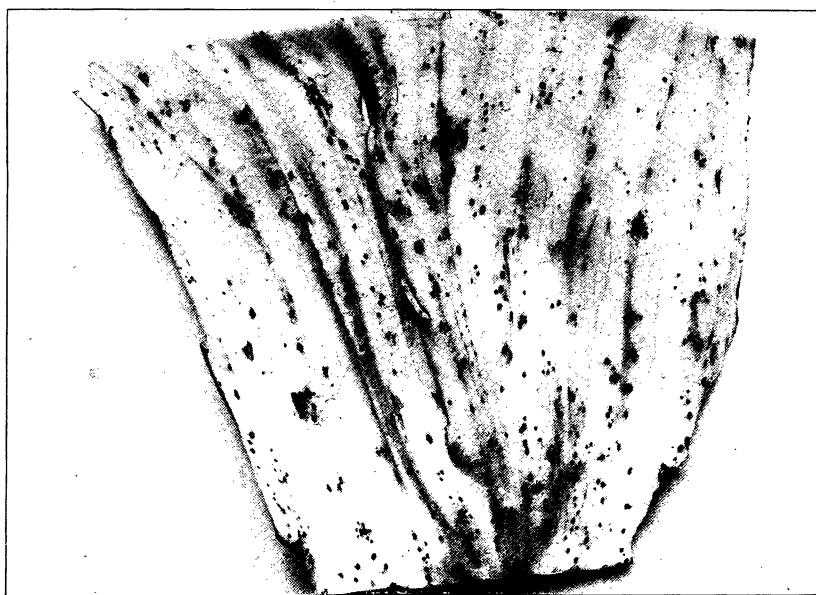


Fig. 2. Portion of cabbage leaf affected with black leaf-speck.

PLATE IV.—ANTHRACNOSE OF CURRANTS AND BLACK LEAF-SPECK OF CABBAGE.
(Both figures natural size.)



PLATE V.—WITCHES' BROOM ON RED CURRANT.
(One-half natural size.)

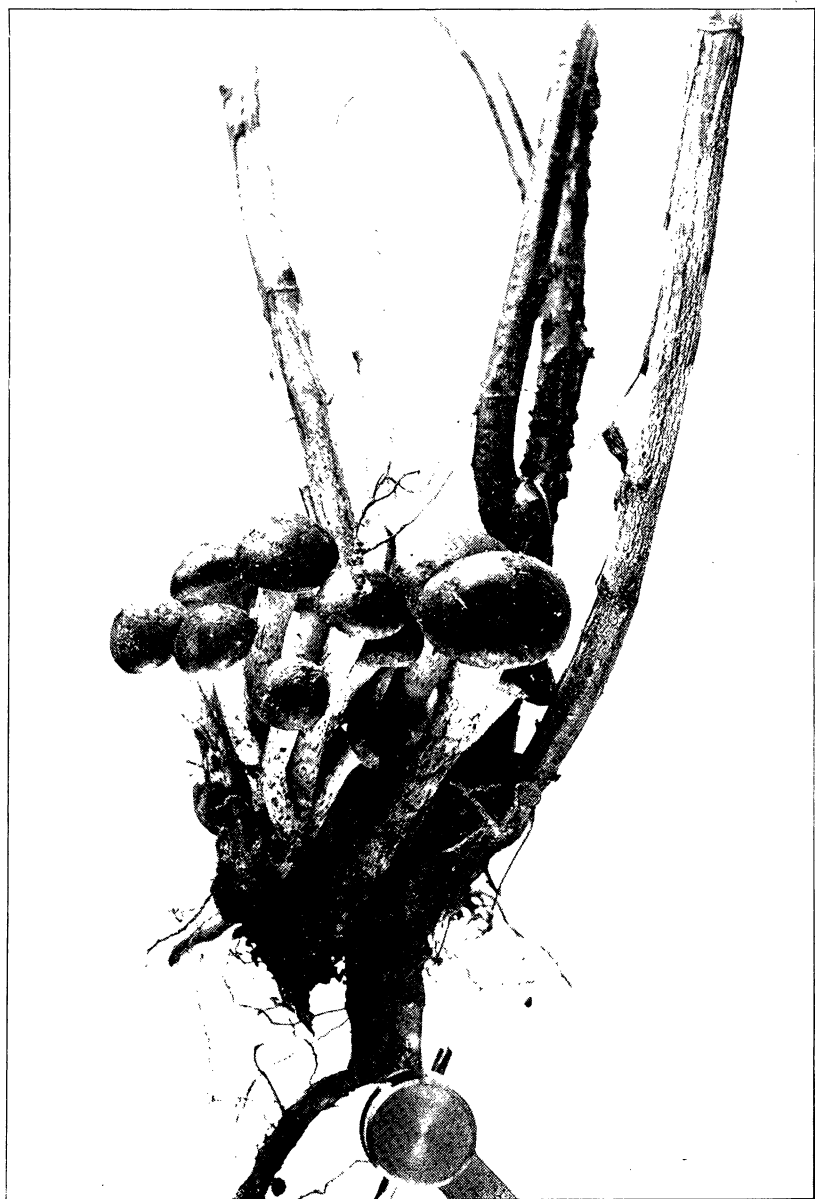


PLATE VI.—*Hypholoma perplexum* ON LIVING CURRANT PLANT.
(Three-fourths natural size.)



PLATE VII.—*Fomes ribis* ON LIVING CURRANT PLANT.

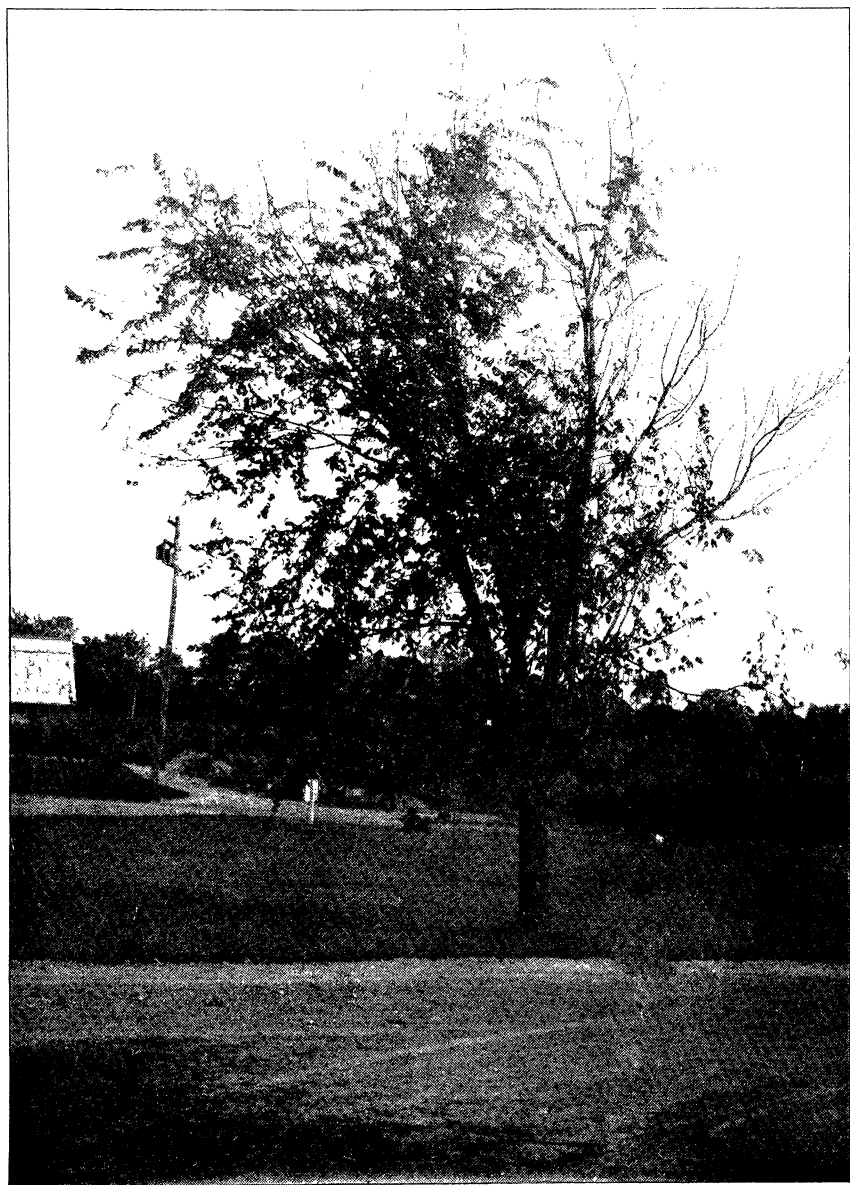


PLATE VIII.—ELM TREE AFFECTED WITH UNKNOWN DISEASE.

above the ground. Dead branches scattered thru the top indicated that the vigor of the tree was decidedly on the decline.

CLOVER.

Trifolium spp.

ANTHRACNOSE, *Gloeosporium caulivorum* Kirch. Early in June, 1914, the writer was asked to investigate the unhealthy condition of some red clover fields in the vicinity of Seneca Castle. In one field of several acres the crop of hay was nearly ruined. The clover stems were still green, but most of the leaves were dead and black and many had fallen. Two other fields on the same farm were injured in a similar manner but less severely. Severe attacks of the same disease occurred also at Geneva, Newark and South Lima. The trouble was due to an anthracnose caused by the fungus *Gloeosporium caulivorum* Kirch.⁷

As no observations were made in 1915 or 1916, nothing is known about the occurrence of the disease in those years.

In 1917 it was first observed at Geneva on June 6 in a field in which, at this time, the clover stood twelve to fourteen inches high but had not yet commenced to bloom. To the casual observer the crop in this field appeared to be in excellent condition; but close examination revealed the fact that it was thoroly infected with anthracnose thruout. Here and there leaves were hanging limp beside their stems because their petioles were soft rotten (Plate I). While some of the hanging leaves were dead and black, the majority were still green. This indicated that they had been attacked recently. The weather being showery they had not shriveled as quickly as they would have done had it been dry. Usually, there was only one affected leaf on a stem, namely, the third one from the top. Occasionally, the fungus had attacked one of the large veins in the leaf causing a V-shaped, dead, brown area. Spores of the causal fungus were plentiful on the lesions. Lesions on the stems were rare at this time, but became quite numerous later. Notwithstanding the infection of the plants was general and the weather almost continuously wet, it was about two weeks before the ravages of the disease became conspicuous. A fair crop of hay was harvested.

⁷ Host Herbarium Specimen No. 77.

More destructive outbreaks were reported from Seneca County and McConnellsville.

Gloeosporium caulivorum, the causal fungus, was first described and illustrated in 1902 by Kirchner (21) who studied an outbreak of the disease in Germany. According to Stevens and Hall (39) it was "first reported in the United States by Sheldon (35) in 1906 and has since been noted as serious in a number of states." However, its American literature is very meager, the most important paper being that of Fulton (11) published in *Science* in 1910.

As usually found, the stems and leaf petioles of diseased plants show black streaks or elongated, black, sunken spots covered with acervuli of the causal fungus. Identification of the fungus is made easy by the fact that its spores are strongly curved, while those of *Gloeosporium trifolii* Pk. and *Colletotrichum trifolii* Bain & Essary, the other two anthracnose fungi of clover, are straight.

Undoubtedly, this disease is of more frequent occurrence and greater importance in New York than is indicated by the few cases here recorded. It is not a new disease in this State. The Station herbarium contains specimens collected by the writer at Geneva in 1903.

LEAF SPOT, *Pseudopeziza trifolii* (Pers.) Fckl. A field of red clover near Geneva was quite severely attacked by this disease during the latter part of June, 1914. The upper leaves on almost every plant were affected. Owing to the occurrence of anthracnose (*Gloeosporium caulivorum*) and rust (*Uromyces fallens*) in the same field it was difficult to estimate accurately the amount of damage done by leaf spot. The aggregate loss in yield from the three diseases probably exceeded 25 per ct. of the crop. However, the actual loss must have been greater than this because hay made from plants so much diseased must be of inferior quality.

The spots show, conspicuously, on both surfaces of the leaf. They are brown, roundish or irregular, one to three millimeters across, and often coalesce forming large, dead, brown areas. With the aid of a hand lens apothecia may be seen on some of the spots. At first the apothecia are merely rounded brown elevations, but later they become cup-shaped. They occur on both surfaces of the leaf and contain asci and paraphyses in abundance, but at the time of our latest observations (June 30) ascospores were still rare.^s

^s Host Herbarium Specimen No. 78.

Altho clover leaf spot is frequently mentioned in the literature, the accounts of it are nearly all brief. It seems to be generally considered an unimportant disease. No mention of it is made in any of Peck's Reports (30). However, it appears to be rather common, tho probably not often destructive, in New York. It often attacks the lower leaves as well as the upper ones.

The causal fungus is closely related to the fungus of alfalfa leaf spot, *Pseudopeziza medicaginis*. In fact, some mycologists consider it identical with that species, or, at least, merely a form of it. (19, 27)

LEAF BLIGHT, *Cercospora* sp. This is a rare disease. It has come to our attention but once. In this case it was on the leaves of white clover (*Trifolium repens*) at several different points in a Geneva park. Leaves of alsike clover (*T. hybridum*) growing with the white clover were similarly affected. It appeared during wet weather in the latter part of August, 1912.

The affected leaves were covered with irregular, dead, brown spots which varied greatly in size and shape, often being quite large. On the upper surface the spots were thickly dotted with tufts of conidio-phores which could be detected with a hand lens. Microscopic examination revealed the presence of typical *Cercospora* spores varying greatly in size and considerably in the number of septa.⁹ It has not been determined to what species of *Cercospora* the fungus belongs.

Chester (6) uses the name *Cercospora helvola* var. *medicaginis* for a fungus which he found on red and crimson clovers and alfalfa in New Jersey. Ellis and Everhart (10) record *Cercospora helvola* on white clover at Newfield, N. J. Peck (31, p. 29) mentions the occurrence of *Cercospora zebrina* on *Trifolium agrarium* at Sandlake, N. Y. No. 461 of Ellis and Everhart's *Fungi Columbiani* is a specimen of *Cercospora zebrina* on *Trifolium agrarium* collected at New Brunswick, N. J.

LEAF ROT, *Rhizoctonia* sp. In a luxuriant growth of white clover (*Trifolium repens*) at Geneva, large numbers of the lower leaves became rotten. The affected leaves had a water-soaked appearance. They were loosely bound together and their tissues traversed in all directions by *Rhizoctonia* hyphæ. Also, sclerotia of *Rhizoctonia* were attached to petioles of some of the leaves.

⁹ Host Herbarium Specimens Nos. 79 and 80.

This happened during a period of very wet weather on the latter part of August, 1912. Probably it is a rare occurrence.

CUCUMBER.

Cucumis sativus.

DAMPING OFF, *Pythium debaryanum* Hesse. On July 12, 1917, some specimens of diseased cucumber seedlings were received from Shortsville. They were field-grown plants which had suddenly toppled over soon after the appearance of the seed leaves above ground. The owner stated that a considerable percentage of the plants in a field of about two acres were similarly affected.

Upon seeking an explanation of the trouble it was found that the stems of the seedlings were soft rotten at the surface of the soil and the constant presence of *Pythium oogonia* in the decaying tissue pointed to *Pythium debaryanum* as the cause.

Pythium debaryanum is notorious as one of the fungi which cause damping-off of seedlings of many kinds in greenhouses and gardens. Its ravages among field crops are less known. In the present instance a period of warm, wet weather furnished conditions favorable for the attack.

FASCIATION. A cucumber plant of the variety Telegraph, growing in the Station greenhouse in the summer of 1917, had a fasciated stem. The plant was about seven feet high. At the surface of the soil the stem was nearly cylindrical and three-fourths of an inch in diameter; but it gradually flattened and widened until it attained a width of 2.5 inches at the top. The fasciated portion bore a single large branch which was entirely normal. It also bore normal flowers and fruit.

CURRENT.

Ribes vulgare and *R. nigrum*.

ANTHRACNOSE, *Pseudopeziza ribis* Kleb. In Bulletin 199 of this Station (41, p. 69) the opinion was expressed that the Septoria leaf spot is the chief cause of the premature dropping of currant leaves in New York. More extended observations made during the past seventeen years lead us to believe that, on the whole, anthracnose is considerably more abundant and important than the Septoria leaf spot. Often, the two diseases work together. The virulence of anthracnose varies greatly from year to year. It may be epidemic

one season and almost wholly absent the next. In the Hudson Valley, where it wrought great havoc in 1901, only traces of it could be found in 1902. It caused almost complete defoliation of currants in the Hudson Valley in the years 1903, 1909 and 1912, and in central New York in 1910 and 1914; while the years 1907 and 1908 were notable for the almost complete absence of the disease from all parts of the State.

Apparently, the damage done by anthracnose and *Septoria* leaf spot is not as great as one might expect from the extent of the defoliation which they cause. Altho both diseases may be controlled by spraying, either with lime-sulfur solution or with bordeaux mixture, it is doubtful if spraying is profitable on the average.

During a severe outbreak of anthracnose at Kenwood in June, 1910, large numbers of the currant berries were attacked. A few affected berries were observed, also, at Milton in 1909. On the berries the disease takes the form of small, dark brown or black spots resembling fly specks (Plate IV, fig. 1). These spots bear apothecia containing the characteristic curved spores of the anthracnose fungus. The occurrence of *P. ribis* on currant berries has been noted previously by Stewart and Eustace (41, p. 65) and by Clinton (8, p. 12).

The variety *Victoria*, tho not immune, is notably resistant to anthracnose. Evidence of this has been seen repeatedly. In the latter part of July, 1909, the writer made some observations on anthracnose in a plantation of about 3300 bearing currant bushes at Ripley. The great majority of the bushes were of the variety *Fay's Prolific*; but bushes of *Victoria* were scattered here and there all thru the plantation and at one side there were also a few solid rows of this variety. The bushes of *Fay's Prolific* were so much defoliated by anthracnose that the fruit had been considerably injured by sunscald. The bushes of *Victoria*, on the contrary, were all in full foliage and almost free from anthracnose. Only a few were slightly affected. The contrast was striking.

BOTRYTIS LEAF SPOT, *Botrytis* sp. At Geneva, in September, 1907, the writer found occasional leaves of red currants showing circular, dead, brown spots one-fourth inch to one inch in diameter. No fungus was visible on the upper surfaces of the spots, but the under surfaces were covered with a growth of conidiophores of *Botrytis* which was visible to the unaided eye. With the aid of a hand lens the masses of spores on the tips of the conidiophores could be easily seen.

During June, 1909, similar brown spots one-fourth to one-half inch in diameter were plentiful on leaves of red currants at Milton. Sometimes the spots were on the margin of the leaf, sometimes on the interior; sometimes on old, yellow leaves, sometimes on vigorous green ones; sometimes in the shade, sometimes in the sun. Always, the under surface (and sometimes, also, the upper surface) was covered with *Botrytis*. Frequently, at the center of the spot on the upper surface there were to be seen the remains of a *Botrytis*-infested currant berry which, apparently, had fallen upon the leaf and infected it. Plainly, the brown spots were caused by the *Botrytis*. The damage done was negligible.

Peck (32, p. 19) has reported the occurrence of *Botrytis plebeja* Fres. on the lower surface of large brown spots on living leaves of currants at Menands, N. Y. Probably, our disease and fungus are the same as his.

During prolonged periods of wet weather the same *Botrytis* is parasitic, also, upon the green fruit, fruit pedicels and young shoots of red currants.

ANGULAR LEAF SPOT, *Cercospora angulata* Wint. The statement of Hesler and Whetzel (17, p. 219) that this disease is common in New York does not accord with our experience. Specimens of it were received from Highland in 1897 and from Long Island in 1900. Since 1900 we have not seen it. Peck does not mention it in any of his reports.

CRINKLE LEAF. Among red currants there occur, occasionally, plants with crinkled leaves which are more deeply cut and sharply lobed than normal leaves; also, the leaves are somewhat smaller and darker green than normal. Frequently, the epidermis is separated from the parenchyma of the leaf on the under surface. Affected plants, tho not much reduced in size, are markedly less productive than normal plants. Numerous examples of this disease have been observed at Milton, Highland and Fayetteville. At first it was suspected that the affected plants were merely of a different variety from their neighbors; but this idea was given up when it was discovered that different portions of the same bush may show normal and crinkled foliage at the same time. Several cases of this kind have been observed. One-half of a bush at Milton was affected in 1909 and again in 1910; while the other half, springing from the same trunk, bore normal foliage in both seasons. The contrast

in appearance between the normal and affected portions was striking. Affected plants do not die. They may show the disease for several years in succession. Whether affected plants ever recover we do not know. The cause is unknown.

FOMES ROOT ROT, *Fomes ribis* (Schum.) Fr. *Fomes ribis* is a woody, yellowish-brown bracket fungus which grows most often around the crowns of currant and gooseberry plants, but occasionally, also, on certain other shrubs and the trunks of sassafras trees. (36.) In New York, the writer has observed it only on the currant and at the following places: Westbury, Highland (two farms), Fayetteville and Geneva. That the fungus is parasitic on its currant host there can be no doubt; but it is not seriously injurious to it.

The writer once made a thoro study of an affected currant plantation at Highland. The currant plants were of the variety Victoria, a red-fruited variety of *Ribes vulgare*. They had been set eleven years. Many of the plants were affected. The owner stated that he had first observed the fungus the first or second year after the plants were set and every year since. Apparently, it had been introduced on nursery stock. It was confined to a portion of the plantation which had been set with purchased plants. An adjoining portion of the plantation, set at the same time with home-grown plants of the same variety, had not shown a single affected plant. The fungus grew around the crowns of the plants at the surface of the soil and in close contact with the living canes which appeared as if they had grown up thru the mass of fungus. (Plate VII.) Often the mass of fungus was a foot in diameter and clung to the currant canes so tenaciously that it was necessary to use a hammer and chisel to separate them.¹⁰ Yet the plants appeared to be in perfect health. Altho they must have been affected for several years they were quite as large and thrifty as unaffected plants beside them.

Likewise, a currant plant of the variety White Grape, a white-fruited variety of *Ribes vulgare*, growing on the Experiment Station grounds at Geneva, was affected by *F. ribis* during a period of at least four years without apparent injury.

Similar testimony concerning the harmlessness of *Polyporus ribis* (= *Fomes ribis*) has been given by van Hall (43) and McCubbin (24, p. 971).

¹⁰ Host Herbarium Specimen No. 81.

FRUIT DROP. The dropping of currant berries when partly grown is the cause of much loss. This trouble is comparable to the "June drop" in apples. It is widespread and occurs more or less every year. Losses of one-third of the crop are not uncommon. The green berries may drop at any time before they are about three-fourths full grown. In severe attacks the ground underneath the bushes is conspicuously littered with the fallen berries. Invariably the dropping is chiefly from the distal (outward) portion of the cluster. In extreme cases nearly or quite all of the berries of a cluster may fall; and even in mild attacks the ends of the fruit stems are bare.

It is quite generally conceded that weather conditions are, in some way, responsible for fruit drop, but there is much diversity of opinion among fruit growers as to the particular kind of weather which induces it. Probably, anything which suddenly checks the growth of the fruit soon after it is set may cause it to drop; for example, excessive heat, drought, a sudden drop to low temperature, or a long period of cold, rainy weather.

Fruit drop is *not* due to imperfect pollination. Currants are self fertile. Moreover, we have known severe attacks of fruit drop to occur in seasons when the weather conditions at blooming time were ideal for cross pollination. In fact, it appears that an unusually heavy setting of fruit is likely to be followed by an unusually large amount of fruit drop.

The writer has no recommendations to make for the prevention of fruit drop.

HYPHLOMA ROOT ROT, *Hypholoma perplexum* Pk. While examining a worn-out plantation of red currants at Milton on September 27, 1909, the writer found two bushes each of which had a cluster of mushrooms growing at the base. (Plate VI.) Upon digging up the bushes it was found that the mushrooms were rather firmly attached to the wood of the currant plants just below the surface of the soil. Both plants were living, but each had some dead canes and the wood was dead at the point of attachment of the fungus. The fungus was identified by the late Dr. C. H. Peck as a small form of *Hypholoma perplexum* Pk. While it may have been merely saprophytic on the dead wood the circumstances were such as to warrant the suspicion that it was growing parasitically. In either case it is quite unimportant, having been seen but this once.

POWDERY MILDEW, *Sphaerotheca mors-uvae* (Schw.) B. & C. On red currants, powdery mildew is not uncommon. It occurs chiefly on nursery stock; occasionally, on fruiting plants. Usually, the damage done is negligible; but occasionally slight injury results. It attacks the fruit, leaves and young wood at the tips of the shoots, covering them with a conspicuous growth of mycelium which is white when young and cinnamon brown when mature. The perithecia, which contain but a single ascus each, occur on both surfaces of the leaves and imbedded in the dense, brown mycelium covering the shoots.¹¹

Several years ago a currant grower at Milton complained of the condition of some red currant cuttings which he had bought from a neighbor. Specimen cuttings, which he sent for examination in mid-winter, were thickly covered over two or three inches of their tips with the cinnamon brown mycelium of *S. mors-uvae*. The presence of mature perithecia made positive identification of the fungus possible. The tips of the affected cuttings were somewhat shrunk. The sender reported that many of the cuttings were like the samples sent, and he feared that they might not make strong plants. However, his fears appear to have been unwarranted because the growth of the cuttings, when planted, proved to be entirely satisfactory.

On the black currant (*Ribes nigrum*), *S. mors-uvae* occurs only rarely. The writer has found it twice on this host. On October 16, 1912, many yearling plants of black currant in a nursery at Stanley were found to be affected. The mildew was confined to the leaves and wood at the tips of the shoots. The affected leaves were smaller than normal. The mildew on the upper surfaces of the leaves was white; that on the under surfaces, cinnamon brown. On the wood, also, it was cinnamon brown. Perithecia were numerous on both surfaces of the leaves (particularly on the under surfaces) and on the wood.¹²

The following day, in a nursery at Orleans, powdery mildew was found attacking leaves at the tips of shoots of black currant in the same manner as at Stanley. In this case the plants were two years old and of the variety Black Champion.

It is noteworthy that the autumn of 1912 was unusually warm and wet and exceptionally favorable for the late growth of black currants.

¹¹ Host Herbarium Specimen No. 82.

¹² Host Herbarium Specimen No. 83.

The occurrence of *S. mors-uvae* on black currants in New York has been reported previously by V. B. Stewart (42).

SUNBURN OR SUNSCALD. When a period of very hot weather follows a period of wet weather and rapid growth, the fruit and leaves of red currants are liable to become sunburned. The leaves show large, irregular, dead, brown spots. The ripe berries first become light in color with the appearance of having been scalded. Later, they shrivel.

Sunburn is especially to be feared when the bushes carry a heavy load of fruit. The rapid increase in the size and weight of the berries as they ripen causes the canes to bend outward and downward. Then the tender leaves and berries on the interior of the bush become suddenly exposed to the sun. Should bright, hot weather occur while the bushes are in this condition a large percentage of the fruit may be ruined by sunburn. Such trouble may be avoided, to a large extent, by picking part of the fruit early to relieve the canes of a part of their load.

TIPBURN. Cause undetermined. During August, 1912, the foliage of red currants in the vicinity of Milton was conspicuously affected in a manner not observed before or since. Viewed from a short distance the foliage appeared yellow and brown and the canes partly defoliated. Close inspection revealed anthracnose (*Pseudopeziza ribis*) as the cause of a part of the yellowing of the leaves; but many leaves were of yellowish green color without any anthracnose spots and almost all of the leaves had dead, brown margins exactly like potato leaves affected with tipburn.¹³ It was observed that the yellowing and browning of the leaves were most severe on spots of light, dry soil and on low, heavy, poorly-underdrained soil; also, on uncultivated soil as compared with cultivated soil. The weather was dry and the plants were plainly suffering from lack of water. Accordingly, the yellowing and marginal browning of the leaves were suspected of being due to the same cause as potato tipburn, namely, excessive transpiration and lack of water. However, in view of the fact that leaf-hoppers may cause a similar marginal browning of the leaves of potatoes and certain other plants (1), a positive statement concerning the cause of this currant trouble cannot be made. While the writer's notes do not mention leaf-hoppers it is possible that some were present.

¹³ Host Herbarium Specimen No. 84.

UNDEVELOPED BUDS. Beach (3; p. 418), writing of the variety Cherry, says: "There is also a noticeable tendency to imperfect buds at or near the ends of the shoots, especially on bearing plants. Sometimes two or three joints near the end of the shoot have no buds." While this condition is, perhaps, more noticeable on Cherry than on other varieties of currants, it is not confined to Cherry. Several other varieties are often affected.

It is best observed at the time the leaves are unfolding in spring. The imperfect buds do not swell like normal buds. Upon dissection they are found to contain green tissue. This shows that they are not winter-injured buds and have not been killed by a parasite. They are merely undeveloped buds; but the cause of their failure to develop is unknown.

WHITE CRYSTALLIN DEPOSIT ON CANES. When currant canes are pruned in the spring and there is a copious flow of sap, a conspicuous white deposit forms on the bark below the wounds made in pruning. Sometimes this deposit forms a smooth, white coating on the bark; at other times it is gathered into little heaps. In either case it has the appearance of a fungus growth for which it is often mistaken. Upon microscopic examination the white deposit is found to consist of long, needle-shaped crystals arranged in hemispherical clusters resembling chestnut burs.¹⁴ As the crystals are soluble in water the white deposit disappears when rain comes. For microscopic examination the crystals should be mounted in glycerin in which medium they are but slowly soluble. Chemical tests made by Mr. A. W. Bosworth, formerly Associate Chemist of the Station, indicate that the crystals are some organic compound of calcium. Certainly, their chemical composition is different from that of the large polyhedral crystals found in the bark of currant canes.

WITCHES' BROOM. Only one witches' broom on currant has been observed. This was a fine specimen found at Fredonia July 28, 1909.¹⁵ It was borne near the tip of a tall cane of red currant which, under the weight of the broom, bent far over toward the ground. The broom consisted of 13 vigorous shoots three to eight inches long and five shorter ones — all of the current season's growth and bearing leaves. It was attached at the base of a living 4-inch

¹⁴ Host Herbarium Specimen No. 85.

¹⁵ Museum Specimen No. 144.

shoot of the previous season's growth. (Plate V.) Altho a careful examination of the broom was made its cause was not discovered.

Lemée (39, p. 433) has figured a witches' broom found on red currants in France. His statement that it was caused by the rust fungus, *Cronartium ribicola*, cannot be accepted without evidence.

YELLOW LEAF. Non-parasitic. It is not uncommon for the leaves of red currants to become pale yellow and fall early in June without showing blemishes of any kind. The affected leaves are chiefly the small, broad-petioled first leaves at the bases of the shoots, altho many full-sized leaves may be mingled with them. This may occur on thrifty bushes as well as unthrifty ones and on bushes of any age. It is similar to yellow leaf of the cherry. Usually, it is unimportant.

Severe drought occurring in midsummer may cause a yellowing of currant foliage which, viewed at a distance, resembles a severe attack of anthracnose. Bushes on thin, dry soil show it most. The absence of brown spots on the leaves distinguishes this trouble from anthracnose. The yellow leaves usually wither before they fall.

ELM.

Ulmus spp.

ANTHRACNOSE, *Mycosphaerella ulmi* Kleb. This disease has been observed several times. It attacks, chiefly, young trees of the English elm (*Ulmus campestris*) in nurseries and Camperdown elms (*U. glabra* var. *camperdownii*) of all ages. In the nursery, it may cause extensive defoliation as was observed by the writer at Brighton, in August, 1900, and at Geneva, in October, 1912. Affected leaves show numerous small, reddish brown spots and irregular, dead, brown areas on their upper surfaces; while beneath, they are thickly dotted with conspicuous heaps of white or cream colored spores. The margins of the leaves turn brown and roll upward.¹⁶

The parasitic stage of the causal fungus is an imperfect form which is usually given the name *Phleospora ulmi* (Fr.) Wallr.; but Briosi and Cavara (5, No. 98) and Clinton (7, p. 727), who hold that it belongs in the genus *Septogloeum*, call it *Septogloeum ulmi* (Fr.) Bri. & Cav. However, it having been demonstrated by Klebahn (22) that the fungus possesses, also, an ascigerous, or perfect stage,

¹⁶ Host Herbarium Specimen Nos. 86 and 87.

which he calls *Mycosphaerella ulmi*, the rules of mycological nomenclature require the use of that name for the fungus.

A few observations made by the writer indicate that, in different collections, the spores of the fungus are quite variable in size and shape. As we have found them, they are 3-4-septate, usually quite strongly curved, and measure 34-38 x 5.5-6.5 μ . In No. 157 of Seymour and Earle's Economic Fungi, on *Ulmus fulva*, the spores are 3-septate, straight, and measure 33.5 x 6.3 μ . In No. 648 of Krieger's Fungi Saxonici, on *Ulmus campestris*, they are 3-4-septate, strongly curved, and measure 49.5 x 4.7 μ .

YELLOW LEAF. Non-parasitic. In common with several other kinds of trees, Camperdown elms are liable to become affected with a non-parasitic yellow-leaf disease which causes them to shed a part of their leaves during June. Affected leaves first turn yellow without any spotting, then become brown and shriveled. Usually, they fall before changing color from yellow to brown. Yellow leaf is most severe when a long period of wet weather in May is followed by dry, hot weather in June. Altho the quantity of fallen leaves is often considerable, the health of the trees is not likely to be seriously impaired; but the litter which they make is objectionable.

DYING OF BRANCHES. In 1913, the diseased condition of an eleven-year-old elm tree on the Station grounds attracted the writer's attention. When the tree came into leaf certain branches were dead and bare. Upon inquiry, it was learned that similar dead branches had been pruned out of the top of the tree in previous years. An examination of the dead branches failed to reveal the presence of any insect or fungus parasite which might be held responsible for their death.

Additional observations were made during the succeeding three summers without the cause of the trouble being discovered. Each year the number of dead branches increased until by the fall of 1916 nearly one-half of the tree was dead. (Plate VIII.) Invariably, the branches died during winter — never while the tree was in foliage. The fungi found on the dead branches were *Cephalothecium roseum* Cda., *Nectria* sp., *Sphaeropsis* sp., and an unidentified fungus; but all occurred only in small quantity. Mr. W. O. Gloyer, Associate Botanist, made a fruitless search of the dead tissues for the mycelium of the blister canker fungus, *Nummularia discreta*: and Mr. Parrott,

the Station Entomologist, who carefully examined the dead branches for evidence of insect attack found only a little of the work of the shot-hole borer. Also, it is reasonably certain that there was no defoliation of the branches by insects.

Finally, in September, 1916, the tree was dug out, the roots examined and the trunk and larger branches cut up; but nothing was found which would account satisfactorily for the unhealthy condition of the tree. The roots appeared normal, and the trunk and branches were sound except for incipient heart-rot in the center of the trunk near the base.

Other elm trees of the same age standing on either side of the diseased tree at a distance of thirty feet were thrifty and entirely free from dead branches:

TRUNK INJURY from box "protector." In the summer of 1910 the trunk of an elm tree on the Station grounds was encased in a "protector," consisting of a tight, wooden box twenty inches square by six feet high, to protect it from injury by animals. The tree was a thrifty one with an uninjured trunk ten inches in diameter.

In the spring of 1912 the tree showed pronounced symptoms of ill health. Soon after the leaves started they stopped growing and early in the summer the tree died. Upon removing the box "protector" it was found that the bark was dead over a large portion of the trunk. There were patches and strips of dead bark alternating with areas of live bark. The injury extended from the ground upward to a height of about eight feet. A part of the injury, at least, was a year old, for some of the wounds had healed. The dead bark was permeated by the conspicuous white mycelium of an unidentified fungus. Also, two species of boring insects were working in the bark; but Mr. Parrott, the Station Entomologist, expressed the opinion that they were not responsible for the trouble.

While there is much uncertainty concerning the immediate cause of the injury — whether winter injury, fungus, or borers — the indirect responsibility of the box "protector" seems to be clear. It appears that the close boxing of elm trunks is a dangerous practise. Tree protectors should be so constructed as to admit light and air freely to all sides of the trunk; otherwise they may do more harm than good.

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