BULLETIN No. 179. NOVEMBER, 1900.

New York Agricultural Experiment Station.

GENEVA, N. Y.

AN ANTHRACNOSE AND A STEM ROT OF THE CULTIVATED SNAPDRAGON.

F. C. STEWART.

PUBLISHED BY THE STATION.

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BULLETIN No. 179.

AN ANTHRACNOSE AND A STEM ROT OF THE CULTIVATED SNAPDRAGON, *Antirrhinum Majus L.*[1]

F. C. STEWART.

SUMMARY.

The cultivated snapdragon suffers severely from a fungous disease in which the stems and leaves are covered with elliptical or circular sunken spots. This disease is called anthracnose and is caused by a fungus new to science. The fungus is here fully described and figured and given the name *Colletotrichum antirrhini*.

In an experiment made on Long Island, plants sprayed once a week with Bordeaux mixture remained entirely free from the disease while unsprayed plants under parallel conditions were completely ruined by it.

It is recommended that cuttings be taken only from healthy plants and that the plants be sprayed with Bordeaux mixture, commencing as soon as the cuttings are rooted and continuing at intervals of from one to two weeks until the plants are put into the greenhouse in the fall. If later treatments are required ammoniacal solution of copper carbonate should be substituted for the Bordeaux. The plants should be given good ventilation and the foliage wet as little as possible.

Stem rot is another fungous disease of less importance. It attacks the succulent shoots causing them to suddenly wilt and die. The diseased stems are covered with the pycnidia of a fungus belonging to the genus *Phoma* and it has been shown by inoculation experiments that this *Phoma* is the cause of the disease. Although no experiments have been made it is probable that stem rot may be prevented by spraying with Bordeaux mixture as for anthracnose.

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[1] Read in abstract before the Botanical Section of the American Association for the Advancement of Science at the New York meeting, June 26, 1900.

THE ANTHRACNOSE.

Early in the spring of 1897 the writer's attention was called to an anthracnose which was doing serious damage to a bench of *Antirrhinum majus* in a greenhouse on Long Island. Upon inquiry among florists it was learned that the anthracnose is a common disease, and wherever it occurs is more destructive than any other disease to which the Antirrhinum is subject, sometimes completely ruining an entire crop.

It attacks the plants at any stage of their growth, both in the greenhouse and in the field. In the greenhouse it is more destructive in the fall and spring than during the winter. In the field its ravages are most conspicuous in August and September.

On the stems it produces numerous elliptical sunken spots from three to ten millimeters in length; and on the leaves circular dead spots having a diameter of from three to five millimeters. These spots are caused by an undescribed species of *Colletotrichum* for which we here propose the name *Colletotrichum antirrhini.*[2]

ON THE STEMS.

Stems of all ages are attacked: The coalescence of several large spots may girdle the plant at the base; a single large spot may strangle a succulent terminal portion; or the fungus may kill the lateral shoots while the main stem remains green. On the older woody stems the spots are considerably sunken, but on succulent shoots this character is scarcely noticeable. The spots are elliptical, their major axes having a length of from three to ten millimeters and lying parallel to the axis of the shoot. At first they are dirty white with a narrow brown bor-

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[2] *Colletotrichum antirrhini* n. sp. Producing depressed spots on stems and leaves of *Antirrhinum majus* L.; stem spots elliptical, often confluent, 3–10 mm. long; leaf spots orbicular, 3–5 mm. in diameter. Acervuli numerous and crowded, particularly on the stem spots; amphigenous on the leaf spots. Stroma well developed; on the leaves only slightly colored, but on the stems dark brown. Setæ abundant, especially on the stems, dark brown, 50–100 μ long, unbranched, mostly straight, tapering uniformly to a sub-acute point. Conidia 16–21 $\times$ 4 μ, straight or slightly curved, with rounded ends or frequently obtusely pointed at one side of one end, granular with a vacuole at the center when young. Basidia short.

der. In a short time several minute pimples, which are at first brown but soon turn black, appear in the central portion. Microscopic examination shows these pimples to consist of a brown stroma. Neither spores nor setæ are present at this time. It is in this black-pimple condition that the fungus is generally found. Still, under favorable conditions of moisture the spots fruit profusely; and both spores and setæ may be obtained in abundance at any time by placing spots showing the black pimples in a moist chamber for about 48 hours. However, very old spots may refuse to fruit under any conditions. With the appearance of spores and setæ the spots become quite black over the greater part of their surface. The acervuli are numerous and so crowded that it is difficult to distinguish the individuals even with the aid of a good magnifier. The stroma is dark brown and well developed.

Several setæ are borne on each acervulus. The majority of them are straight but some are bent. They are dark brown and taper uniformly to a moderately sharp point. As a rule they are 3-septate but 2-septate and 4-septate individuals are not uncommon. They are 50 to 100μ in length and unbranched.

The conidia are non-septate, colorless and mostly about 4½ times as long as broad, measuring 16–21 x 4 μ. The majority of them are slightly curved, with both ends rounded or else with a short obtuse point at one side of one end (Plate III, fig. 3). The young conidia have granular contents and almost invariably a single vacuole near the center; but with age more vacuoles appear and finally they become two to four nucleate. The writer's observations on plants in the greenhouse at Geneva lead him to believe that a high degree of humidity in the atmosphere is necessary to the production of spores; but it is difficult to harmonize this idea with the statements of florists who say that the disease may be very destructive in dry seasons. During the extremely dry summer of 1899, a correspondent in Massachusetts lost, through this anthracnose, all field grown plants propagated from cuttings. It also did considerable damage to plants grown from seed.

The basidia are very short being scarcely distinguishable except in very thin sections.

ON THE LEAVES.

Plants attacked by anthracnose show multitudes of dead leaves which remain hanging on the stems a long time.

The leaf spots are circular, slightly sunken and have a diameter of from three to five millimeters. They originate as yellowish-green spots with indefinite outline, but very soon become dirty white, or sometimes greenish, definitely outlined and very frequently have a narrow brown border. If the plants have good ventilation and are kept moderately dry neither spores nor setæ are formed and the spots retain their dirty white color ; but in a moist chamber both spores and setæ make their appearance in from 24 to 48 hours. Upon the appearance of spores and setæ, the leaf spots instead of turning black (as is the case with the stem spots) merely become smoke colored. This is owing to the fact that the stromata of the acervuli are much lighter in color and the setæ much less numerous than on the stem spots. The stromata are also less developed than those on the stems.

AN EXPERIMENT ON TREATMENT.

From the nature of the disease it was expected that it could be prevented by spraying. Accordingly, the following experiment was made: On May 15, 1897, 110 Antirrhinum plants, six to eight inches high and apparently healthy were set in two rows of 55 plants each. One row was sprayed once a week with Bordeaux mixture, receiving in the course of the summer 17 applications, while the other row was left unsprayed for a check. During the latter part of July the disease began to appear abundantly on the unsprayed row. By August 2d the contrast between the sprayed and unsprayed rows was very striking and as time passed this contrast became more marked until at the time of the last spraying, September 7th, the unsprayed plants were all ruined and most of them were dead while the sprayed plants were in perfect health. (See Plates I and II.)

RECOMMENDATIONS FOR TREATMENT.

Cuttings should be taken from healthy plants only. Anthracnose is often transmitted from one generation of plants to the next by means of infected cuttings; hence plants grown from

cuttings usually suffer more from anthracnose than do plants grown from seed. It is very improbable that the disease can be transmitted by means of the seed.

So far as known at present, this anthracnose attacks no other plant besides the Antirrhinum. Therefore, the florist whose grounds are free from the disease will have no trouble so long as he propagates only from his own stock or from seed. In such a case the source of danger is in diseased cuttings and plants from other establishments. How far the disease may be carried by the wind is not known, but probably less than a half mile.

Where anthracnose is troublesome spraying with Bordeaux mixture should be commenced as soon as the cuttings are rooted and continued until the plants are transplanted into the greenhouse in the fall. The spraying should be done thoroughly and at intervals of from one to two weeks according to the weather and the severity of the disease. If the plants can be kept free from disease until they go into the greenhouse, it may not be necessary to give them further treatment. Should it seem necessary to spray in the greenhouse we would suggest the use of ammoniacal solution of copper carbonate as it will not spot the flowers and foliage so much. Overwatering should be carefully avoided and the foliage wet as little as possible. Thorough ventilation will also aid in keeping the disease in check.

THE STEM ROT.

In December, 1898, we observed a stem rot or perhaps it might more appropriately be called a branch blight working among some Antirrhinums in one of the Station greenhouses. During the remainder of the winter and the following spring this disease became common and caused considerable damage. The same disease appeared again last winter but not so destructively.

It attacks chiefly the succulent shoots causing several inches of the terminal portion to wilt and die. In some cases, particularly on shoots which have become somewhat woody, a section of the stem an inch or more in length turns brown while the portion beyond remains green. In a short time, however, the whole branch dies. More frequently all of the affected portion wilts

and becomes discolored without the appearance of a spot at any particular place on it. The point of attack may be close to the soil but is usually at considerable distance above it and never below it so far as observed.

In all cases numerous pycnidia of a species of *Phoma* soon make their appearance on the lower part of the affected portion. In the course of the investigation other fungi were sometimes found on the diseased stems but the *Phoma* was so abundant and so constantly present that it was suspected to be the cause of the trouble. Pure cultures of the *Phoma* were obtained and 11 succulent shoots inoculated with it as follows: About three inches below the tip of each shoot a puncture was made, a small quantity of fungus inserted and then the puncture covered by wrapping the stem with grafting wax. Ten check shoots were treated in identically the same manner except that no fungus was inserted in the puncture.

The inoculations were made April 30. At the end of five days four inoculated shoots were wilted; two more wilted on the 8th day, two others on the 9th day, and on the 11th day all eleven inoculated shoots were fully wilted. Seven of them had rotted so badly at the point of inoculation that they had broken over and the tops hung down. As late as June 19, seven weeks after inoculation, all ten check shoots were perfectly healthy. On other occasions the *Phoma* has been inoculated into the shoots without covering the wounds with wax. Shoots so inoculated have generally died in from four to ten days according to their succulency. Woody stems, however, do not readily succumb to inoculation.

The specific name of this *Phoma* has not yet been determined. The spores are colorless, 4–5 μ long by about 2 μ wide, and issue from the ostiolum in a colorless, gelatinous, rope-like mass. The fungus attacks woody stems with difficulty, but under suitable conditions it is an active parasite on tender shoots, and might easily become destructive. It could probably be controlled by spraying with Bordeaux mixture, as for anthracnose.

EXPLANATION OF PLATES.

PLATE I.—A sprayed plant of *Antirrhinum majus*, representing the condition, on August 13, of the sprayed row in the experiment described on page 108. A little more than one-third natural size.

PLATE II.—An unsprayed plant of *Antirrhinum majus*, representing the condition, on August 13, of the check row in the experiment described on page 108. A little more than one-third natural size.

The plants shown in Plates I and II were not grown in the pots but were put into them for convenience in photographing.

PLATE III. Fig. 1.—Portion of a stem and two leaves of *Antirrhinum majus* attacked by *Colletotrichum antirrhini*. Natural size.

Fig. 2.—A section of an acervulus of *C. antirrhini* from a stem spot. Drawn with the aid of a camera-lucida.

Fig. 3.—Five spores of *C. antirrhini*. Magnification, 780 diameters.

Fig. 4.—A seta of *C. antirrhini*.

Type specimens of *Colletotrichum antirrhini* have been deposited in the following herbaria: Herbarium of Cornell University, Ithaca, N. Y.; herbarium of the New York State Museum, Albany, N. Y.; herbarium of the New York Agricultural Experiment Station, Geneva, N. Y.; and the herbarium of the Iowa State College, Ames, Iowa.

PLATE I.

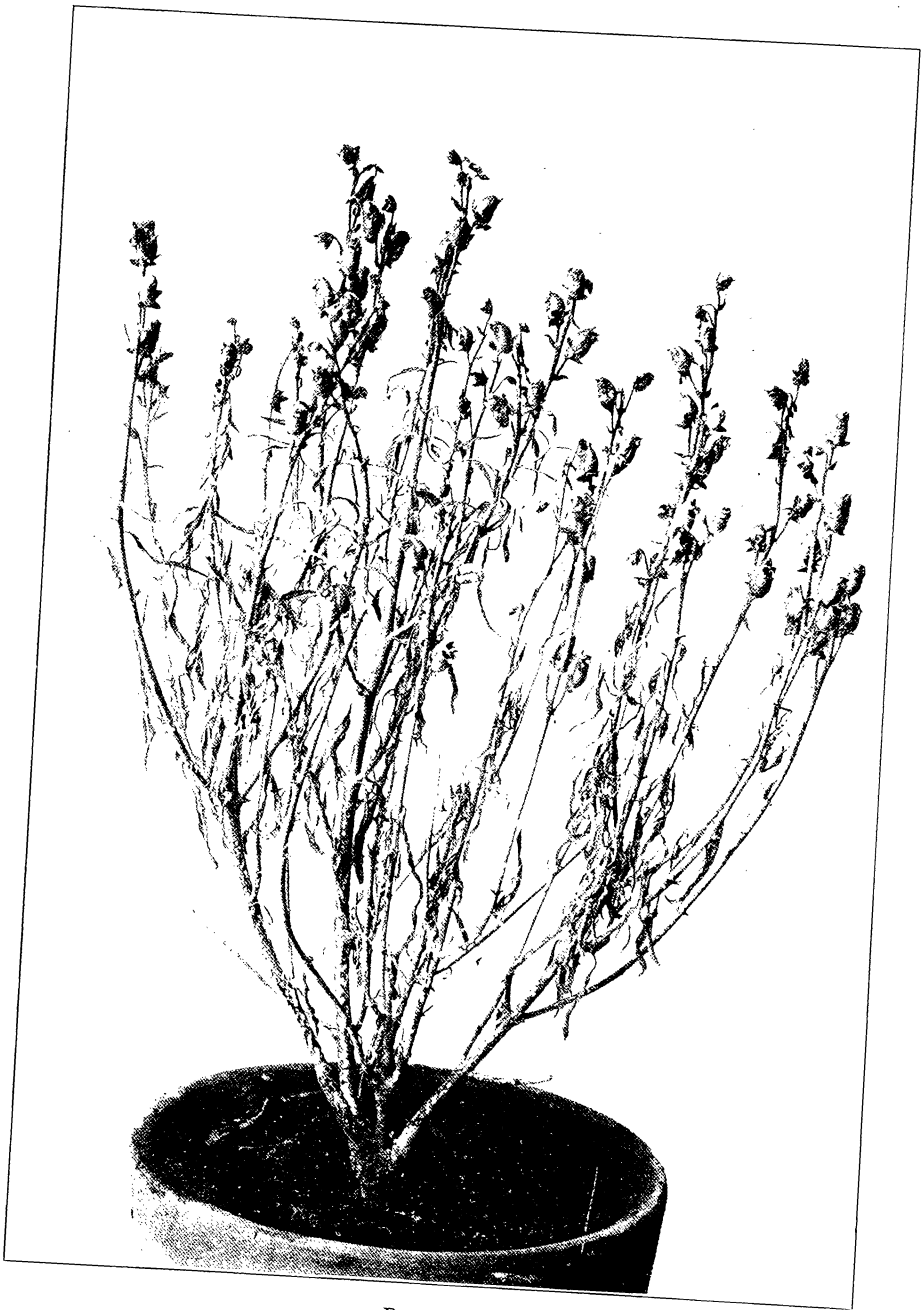
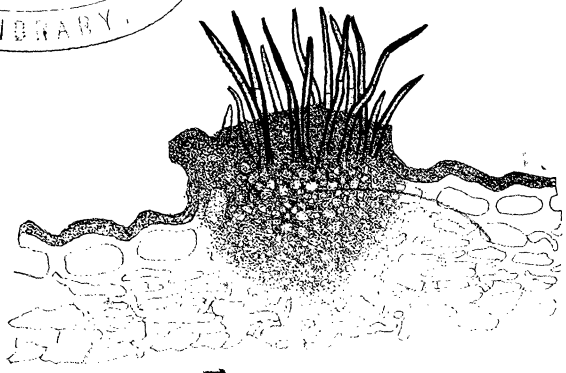


PLATE II.



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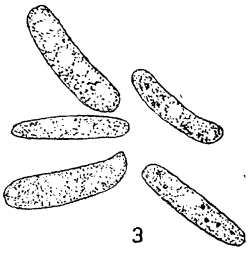

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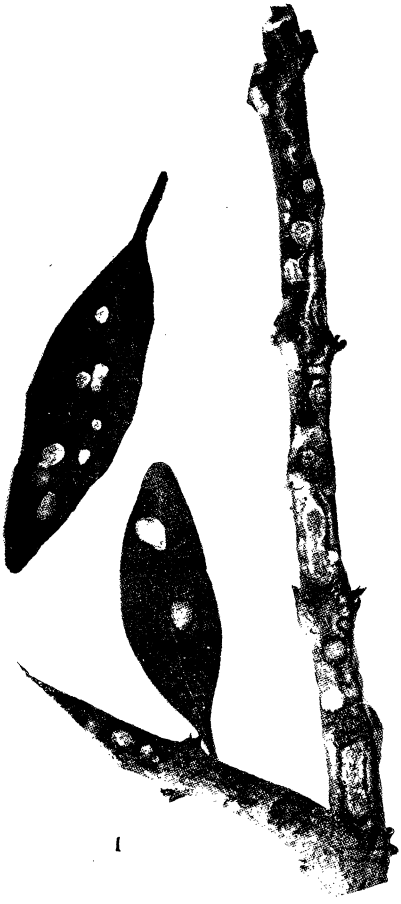

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PLATE III.