BOTANY.—*A new disease of dahlias.*[1] THELMA BENNETT POST,[2] Bureau of Plant Industry. (Communicated by CHARLES DRECHSLER.)

Diseased dahlia stems received from Columbia, South Carolina, on July 29, 1932, bore both the pycnidial and sclerotial[3] stages of *Macrophomina phaseoli* (Maubl.) Ashby (1).[4] The specimens consisted of thick sections of stem from near the base. Most of the stem tissue was blackened, but some green water-soaked tissue was still evident. The pycnidia occurred in great numbers in the epidermis of the blackened areas. As the stem tissue dried, the fibers separated easily and the ends were split and frayed. Most of the pith had disappeared, leaving only a thin brittle remnant in which the sclerotia were imbedded in such profusion that it had the appearance of a black crust. No pycnidia were observed in this remnant and the sclerotia were not found elsewhere.

THE PYCNIDIA IN CULTURE

Sections of the leaf petioles, the stem, and the patch of green tissue remaining on the dahlia stem were planted after surface sterilization on acid corn meal agar and after three days sclerotia became visible to the unaided eye. No pycnidia appeared in these cultures. On the other hand, mature pycnidia of *Macrophomina phaseoli* appeared in a culture secured from sections of the tissue containing sclerotia eighteen days after the planting was made. This culture was on an acid corn meal agar plate and the appearance of pycnidia was preceded by abundant development of sclerotia (Fig. 7).

Spores from the pycnidia produced in culture were observed to germinate readily on potato dextrose agar and in a 2 per cent dextrose solution in sterilized tap water (Fig. 8). On the other hand, when spores from the pycnidia found on the host were planted on various media, i.e., corn meal, potato dextrose, and string bean agar, no germination occurred, although repeated trials were made. Small (2), who tried unsuccessfully to germinate the spores of pycnidia found among sclerotia of *Rhizoctonia bataticola*, attributed the failure to the fact that the trials were made two years after the material was collected and that the spores were therefore too old. The pycnidia and

[1] Received January 3, 1933.
[2] The writer is indebted to Dr. Freeman Weiss for assistance in preparation of the paper and to Dr. L. L. Harter and Miss Vera K. Charles for criticism and suggestions.
[3] Commonly designated as *Rhizoctonia bataticola* (Taub.) Butler.
[4] Identification suggested by Vera K. Charles.

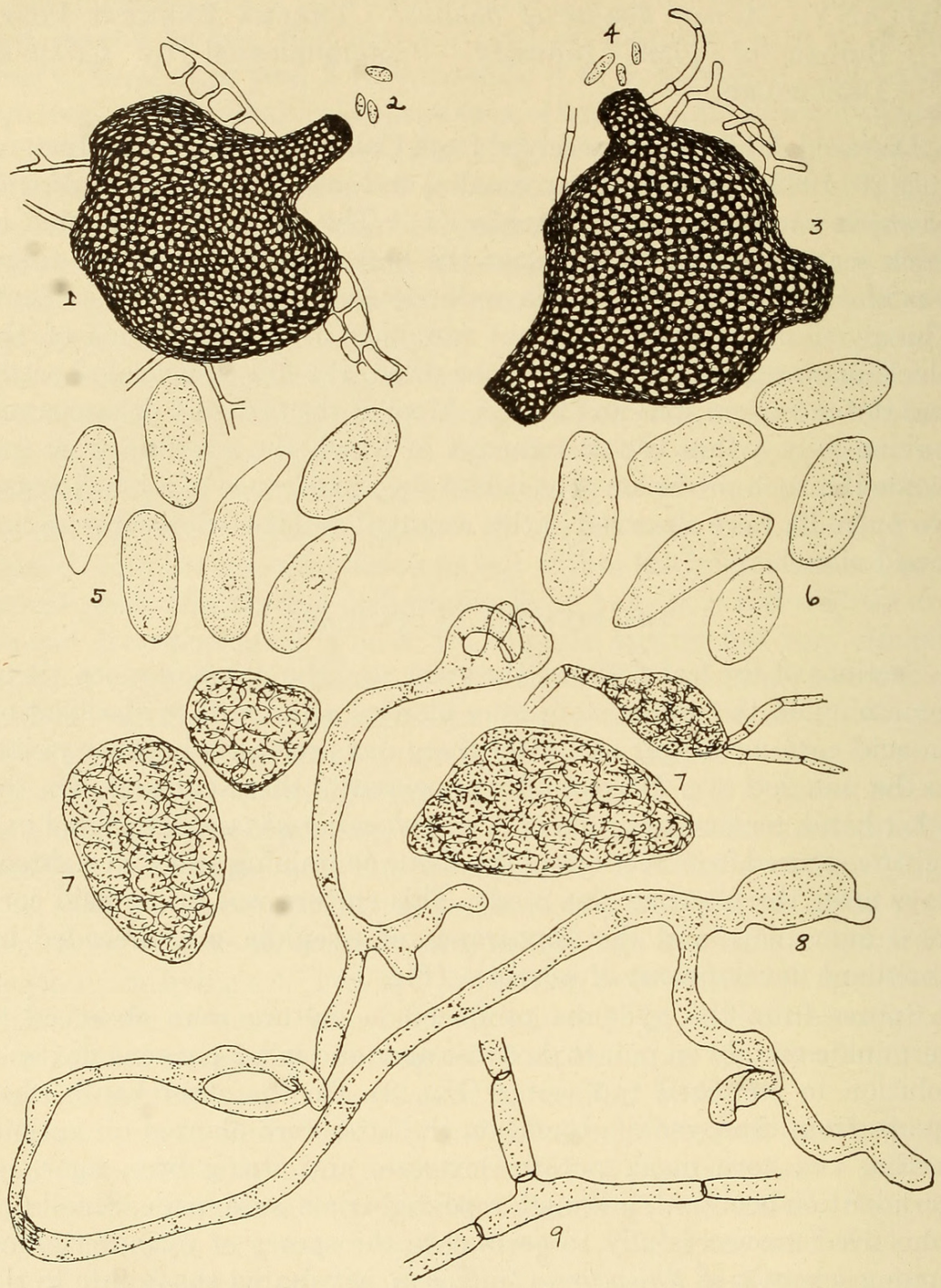

Fig. 1.—Pycnidium of *Macrophomina phaseoli* from dahlia tissue, (×200). Fig. 2.—Spores from above pycnidium, (×200). Fig. 3.—Pycnidium of same from culture (Leonian malt agar) showing development of several ostioles, (×200). Fig. 4.—Spores from above pycnidium, (×200). Fig. 5.—Spores from pycnidium on host, (×950). Fig. 6.—Spores from pycnidia of culture on dahlia stem. (×950). Fig. 7.—Sclerotia from culture on corn meal agar, (×200). Fig. 8.—Spore germinated in sterile tap water plus 2% dextrose. Drawn eighteen hours after being placed in the solution, (×950). Fig. 9.—*M. phaseoli* mycelium taken from culture on bean plug, (×950). All figures drawn with the aid of the camera lucida.

spores from the dahlia material were young and their failure to germinate in the writer's cultures could not be attributed to age.

Cultures were later made from the fibrous roots of the dahlia and the sclerotium-bearing fungus was recovered. No pycnidia developed in these cultures.

Spores from the pycnidia obtained in culture were placed in the liquid of tubes containing steamed dahlia stems. The stem was soon overgrown with mycelium, and mature pycnidia appeared five days after the inoculation (Fig. 6). Pieces of epidermis from these stems were planted on plates of various media, i.e., Leonian malt-agar, potato dextrose, corn meal, and string bean agar. On each medium pycnidia and sclerotia developed (Fig. 3). Spores were placed in the liquid of tubes containing sweet clover stems, sunflower stems, and string bean plugs. In each of these the fungus grew rapidly and produced numerous sclerotia, but no pycnidia appeared. As remarked by Haigh (3), "it is evident that a particular set of conditions . . . is necessary for their production."

The production of the pycnidia in culture is noteworthy, as they have only been recorded twice. Haigh (3) reported the occurrence of six or eight pycnidia of *Macrophomina phaseoli* in a culture of the so-called *Rhizoctonia bataticola* (Taub.) Butl. This culture was on maize meal, and was grown from a single spore of *M. phaseoli* obtained from beans affected with "ashy stem blight." The culture was so old that it was drying out at the edges. These pycnidia were larger and more elongated than those he had found in nature. Single spore cultures from these pycnidia always gave rise to pure growths of the fungus *Rhizoctonia bataticola*. There was no further report of the pycnidia in culture until in 1930, when Haigh (4) again obtained them. This time they were produced in a strain of the *Rhizoctonia bataticola* isolated from *Cajanus indicus*. Spores and sclerotia continued to produce pycnidia and sclerotia in culture, and Haigh regarded the strain as a saltant from the original culture of *R. bataticola* from *Cajanus*.

Whether the *M. phaseoli* reported in this paper arose as a saltant from the sclerotial fungus or from mycelium that may have been present among the sclerotia in the tissue from which the plates were made is not evident.

Three plates were made in the same manner from similar pieces of sclerotium-bearing tissue, but in only one did pycnidia appear. Furthermore, as pointed out earlier in this paper, pycnidia were observed only in the epidermis of the dahlia stem and not in the remnant of the pith where the sclerotia appeared. The rare occurrence of

the pycnidia in culture, despite the numerous cultures made by various workers over a period of several years, would seem to indicate saltation as the most tenable theory.

SINGLE SPORE CULTURES

Single spores grown on corn meal, beef, and potato dextrose agar gave rise to pure cultures of the sclerotium-bearing fungus and a fungus that produced both sclerotia and the pycnidial stage of *Macrophomina phaseoli*. The cultures producing pycnidia have been transferred and retransferred and have continued to produce pycnidia and sclerotia. The single spore cultures that produced the sclerotium-bearing fungus have also been transferred and retransferred, and no pycnidia have appeared in them.

DESCRIPTION OF THE FUNGUS

The pycnidia found in the epidermis of the dahlia stem in nature (Fig. 1) were 171–198μ in diameter and the spores (Fig. 2 and Fig. 5) were 18–25$\mu\times$7.2–9μ. These dimensions compare with the pycnidial dimensions of *Macrophomina phaseoli* (Maubl.) Ashby,[5] which are given (1) as mostly 100–200μ in diameter, and for the spores as 20–30$\mu\times$8–10μ. The thin-walled angular cells described by Ashby (1) are plainly visible in the young, immature pycnidium. The pycnidia became black and carbonaceous with age. The pycnidia on potato dextrose agar are 136–200μ and the spores are 18.2–28$\mu\times$7.2–10.8μ.

The sclerotia found in the pith in nature were 62μ to 117μ in diameter, while on potato dextrose agar they ranged from 40 to 80μ in diameter. Ashby (1) gives the sclerotial dimensions of *M. phaseoli* as 50–100μ in diameter in the tissues of herbaceous plants and as having the same dimensions in culture. He adds that Small found them up to 0.8 to 1 mm. in diameter in the roots of woody plants.

Haigh (4) separates the sclerotial forms of *Rhizoctonia bataticola* into three strains according to their mean sclerotial diameter. "As far as is known at present," he writes, "the pycnospores of *Macrophomina phaseoli*, from whatever source they were isolated, have always given in culture sclerotia which belong to the lowest of these groups." This, he believes, accounts for Ashby's remark that in cultures the variation of the sclerotia of *M. phaseoli* is 50 to 200μ. Haigh believes that it may be found that the two large sclerotial strains (A and B) have no connection with *M. phaseoli*. The size of the sclerotia from the dahlia tissue and of the spores from monosporous cultures, as reported

[5] The taxonomic position of the fungus is not clear and further study on this subject is intended.

in this paper, places them in strain C of Haigh's classification and further bears out his theory regarding the connection between that strain and *M. phaseoli*.

The pycnidia produced on the culture media displayed a tendency to form several ostioles, as many as four being found on one pycnidium. The pycnidia were also of greatly variable shapes and sizes. Those formed on the steamed dahlia stems appeared to be like those formed in nature, with single ostioles. They were produced abundantly and were filled with pycnospores. In no case was evidence of a stromatic origin found.

TAXONOMY OF THE FUNGUS

In 1904, D'Almeida and da Camara (5) found a *Macrophoma* on the branches of *Dahliae variabilis* Desf., in the Coimbra botanical garden in Portugal, which they named *Macrophoma henriquesiana*. They gave the diameter of the pycnidia as 140–190μ and the spore dimensions as 17–23μ×5–8μ. Although the spore measurements are slightly smaller than those given for *Macrophomina phaseoli* (20–30μ ×8–10μ), they are essentially the same, and the descriptions in other particulars tally. The drawings of the spores of *Macrophoma henriquesiana* are suggestive of those of *Macrophomina phaseoli* (Maubl.) Ashby. Ashby (1) has pointed out that variations in spore size on the same host may be considerable. Shaw (6) gave for them, as a maximum range on jute in India, 16–29μ×6–11μ and Sawada (7) for the same host in Formosa gave the spore dimensions as 16–23μ×7–10μ. It thus appears probable that *Macrophoma henriquesiana* d'Alm. & da Cam. is identical with *Macrophomina phaseoli* (Maubl.) Ashby and should be added to the list of synonyms.[6]

Small (2) found the sclerotia of *R. bataticola* in the roots and stems of dahlias in Ceylon, but does not report having found the *Macrophomina* stage in these plants. The sclerotia also developed on the skin of dahlia tubers that appeared to be healthy, but whose roots and stems were diseased.

A fungus disease of dahlias called "black blight" is mentioned but not identified in a list of Scottish fungus diseases published by Alcock and Foister (8) in 1931.

[6] The synonyms as given by Ashby (1) are: *Macrophoma phaseoli* Maubl. (1905), *Sclerotium bataticola* Taub. (1913), *Macrophoma corchori* Saw. (1916), *Macrophoma cajani* Syd. & Butl. (1916), *Macrophomina phillipinensis* Petr. (1923), *Rhizoctonia lamellifera* Small (1924), *Rhizoctonia bataticola* (Taub.) Butl. (1925), *Dothiorella cajani* Syd. & Butl. (1925), *Macrophoma sesami* (1922).

ETIOLOGY

The conditions of infection of the dahlia by *Macrophomina phaseoli* are not known. The tubers which produced the dahlia stems studied were new stock purchased from four separate firms. They were planted in a site that had been used as a vegetable garden for years, but there is no record of these vegetables having been diseased. At the present time there are vegetables growing in close proximity to the dahlias and these appear to be healthy. The dahlias grew and flowered in normal fashion until July, when the disease appeared. All the plants (about three dozen) were affected.

Ashby (1) asserts that the parasitism of *Macrophomina phaseoli* appears to be much influenced by the effect of environmental and nutritional conditions on the host. Haigh (4) concludes from his experiments that special conditions are required for successful inoculation with the fungus called *R. bataticola,* whose connection with *M. phaseoli* has been demonstrated.

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PALEOBOTANY.—*A new* Lygodium *from the late Tertiary of Ecuador.* Edward W. Berry, Johns Hopkins University.[1]

Among the large amount of material from the Loja basin in southern Ecuador which I owe to the industry of Professor Clodoveo Carrión of Loja there occurs sparingly small pinnules of the genus *Lygodium* Swartz of the fern family Schizaeaceae.

This represents a species which is obviously new and which differs considerably from any known species either existing or fossil. It is, however, based entirely on detached pinnules and this fact in conjunc-

[1] Received January 30, 1933.