

## WATERMELON STEM-END ROT

[PRELIMINARY PAPER]

By F. C. MEIER,

*Student Assistant, Cotton and Truck Disease Investigations,  
Bureau of Plant Industry*

During the last few years in certain parts of the United States shippers have been seriously troubled by a decay which attacks watermelons (*Citrullus vulgaris*) in transit and may sometimes destroy or render unsalable a large percentage of a shipment before it reaches its destination. Owing to this fact, in the season of 1915 the Department of Agriculture began a careful investigation of shipping conditions, in the course of which the present writer had an opportunity to make a laboratory study of some decayed material.

This material was taken from a shipment received in Washington, D. C., on July 24, 1915. The shipment consisted of five carloads of approximately 900 watermelons each, no one car of which yielded more than 300 salable melons, owing to the prevalence among them of the disease. The decayed watermelons were distributed through the car entirely without reference to position, a fact which made it seem manifestly impossible that the trouble could have originated from mechanical or chemical injury received from contact with the walls or the floor of the car.

This examination indicated, moreover, that, as has been reported in the case of other shipments, the injury of these watermelons had occurred in a very uniform manner. In its early stages the presence of the decay was indicated by a watery discoloration of the rind in an area closely surrounding and apparently extending from the stem. Beginning in this way there were all stages of decay up to those where about half or three-quarters of the melon were involved. In such cases the rind of this portion had become soft and wrinkled, so that in cross section it appeared much like that of the watermelons shown in the lower row of Plate XVII, figure 1. The meat below this part of the rind was slimy and blackened, while that at the opposite end of the melon remained sound, not having as yet become included in the decay. Owing to the warm, moist conditions at this season, the portion involved was covered by a gray or somewhat black mold, so that the origin of the trouble could not be readily ascertained.

An abundance of material being available at this time, an attempt was made to find out whether the injury was due to the action of some fungus, and, if this proved to be the case, to obtain the specific organism

in pure culture. In endeavoring to obtain such cultures, the following procedure was adopted. Several watermelons were selected in which the decay was just beginning to be apparent. A razor was flamed; and with this, a funnel-shaped section, which included a portion of both diseased and healthy tissue, the two being separated by a more or less distinct line of demarcation, was cut from the melon. After the razor had been flamed again, the section was divided along the line of demarcation which distinguished the advancing edge of the decay, the plug being cut from the inside toward the outer surface. This gave access to a portion of the rind to which the fungus filaments were probably just advancing and which would be unlikely to contain concomitant forms. From this region, using a sterile platinum needle, small portions were removed from just below the surface and placed directly on synthetic agar in sterile Petri dishes. After two days, during which the plates were kept at a temperature of 27° C., an abundant mycelial growth of a gray color appeared in every instance. A number of transfers of the mycelium thus obtained were made to potato cylinders, and in all cases a fungus developed which possessed the characteristics of the genus *Diplodia*. In order to test the capacity of this organism for producing the decay, the pure culture was inoculated into a sound watermelon at three widely separated points, at each of which the characteristic rot was reproduced.

The direct connection between this fungus and the disease having been thus indicated, 16 healthy watermelons were obtained for more inoculations. They were bought at the wharf in Washington, D. C., and came from the Pyankatank River district in Virginia, a region free from the disease, so far as is known. It may be well to mention in this connection that the decay has usually been reported as occurring on the variety known as "Tom Watson." This is probably due to the fact that in the last few years this melon has been grown somewhat to the exclusion of other varieties. Of the melons chosen for inoculation, three were "Excel" melons; the remainder were of the "Tom Watson" variety.

These melons were placed on a table near a large window which was kept open the greater part of the day, and were protected from the direct light of the sun by a cardboard screen. For a period of nine days, during which time the melons were under observation, the average temperature was 26.5° C. Of these 16 watermelons, 8, two of which were of the "Excel" variety, were inoculated with the fungus, the cultures used in this case having been derived from the original subculture. This was accomplished by making with a sterile knife at a single point near the stem an incision, into which a bit of the growing fungus mycelium was introduced. A similar wound was made in the remaining 8 melons, including the third "Excel" variety, but no infectious matter was introduced. Within 36 hours the 8 inoculated melons began to show

signs of decay, while the 8 checks remained perfectly sound throughout the course of the experiment. There was no decay present on the inoculated melons except that which originated at the point of inoculation.

The decay is first noticeable as a somewhat circular discolored area surrounding and extending from the point of inoculation. On the watermelons observed in the laboratory this area gradually increased in size until at the end of six days about half of the melon was involved. At this time the advance of the decay seemed to become less rapid and the area which was first decayed began to show a blackening due to the formation of pycnidia by the fruiting fungus. This area spread daily, and at the close of nine days the stem end of the melon presented a withered, charred appearance. Plate XVII, figure 1, is a reproduction of a photograph of nine of these melons. The four in the upper row are checks; the five below were inoculated.

The fructification of the fungus may be briefly described as follows:

Pycnidia separate or confluent, smooth or, under moist conditions, covered with loose olivaceous hyphæ, 180 to 250 $\mu$  in diameter. Spores 24 to 30 $\mu$  by 10 to 14 $\mu$ , oval, uniseptate, dark brown. On the material taken from the watermelons inoculated in Washington no paraphyses could be detected. They are present, however, when the organism is grown upon potato cylinders, a fact which would tend to support the conclusions reached by Taubenhau,<sup>1</sup> to whose work reference will be made in the following paragraph.

It has long been known that those members of the Sphaeropsideae which produce brown uniseptate spores are extremely variable. The distinctions between the genera *Diplodia*, *Botryodiplodia*, *Chaetodiplodia*, *Lasiodiplodia*, and *Diplodiella* have been based on slight structural variations in the pycnidia. The points of separation are the relation of the pycnidia to one another, whether scattered or cespitose; their relation to the host, whether subcutaneous, erumpent, or superficial; the presence or absence of bristles and of paraphyses. These are all characteristics which one might expect to vary somewhat with the characteristics or the condition of the host. This variation probably occurs; and for this reason there has been some uncertainty as to the proper position certain species should occupy in classification. *Botryodiplodia theobromae* Pat., which causes a dieback of *Hevea braziliensis* in Ceylon, southern India, and the Malay States, is an example; and in his account of this fungus Petch<sup>2</sup> remarks that—

Among the names which are known to refer to this species are *Macrophoma vestita*, *Diplodia cacaoicola*, *Lasiodiplodia theobromae*, *Diplodia rapax*, and there are probably others. *Botryodiplodia theobromae* is its earliest name, as far as is known, but some prefer to call it *Lasiodiplodia theobromae*.

<sup>1</sup> Taubenhau, J. J. The probable non-validity of the genera *Botryodiplodia*, *Diplodiella*, *Chaetodiplodia*, and *Lasiodiplodia*. In *Amer. Jour. Bot.*, v. 2, no. 7, p. 324-331, pl. 12-14. 1915.

<sup>2</sup> Petch, Thomas. *Physiology & Diseases of Hevea braziliensis* . . . 268 p., 16 pl. London, 1911.

Taubenhaus, as a result of his inoculations upon sweet potato (*Ipomoea batatas*) with *Diplodia tubericola* E. and E., *Diplodia gossypii* Zim., *Diplodia natalensis* Pole Evans, and *Lasiodiplodia theobromae* (Pat.) Griff. and Maubl., suggests that the characteristics of the genus *Diplodia* be so extended that it may include all of the five genera.

This genus, although it is not thought to include forms which are absolute parasites, is nevertheless a source of serious trouble among some of our cultivated plants. The injury is usually confined to a fruit rot or to a dieback of the younger branches or shoots as in the Citrus disease prevalent in Florida and the Isle of Pines.<sup>1</sup> In both cases the fungus has been described as following an injury which has been previously inflicted either by mechanical means or as the result of the action of some other fungus. In the United States the more important crops which hitherto have been known to be affected are sweet potato, Citrus fruits, corn (*Zea mays*), and cotton (*Gossypium* spp.) In our Southern States the *Diplodia* injury is of considerable consequence in connection with these products. As one enters the Tropics the number of plants which are attacked increases. Among the list of hosts found here are *Citrus* spp., *Hevea* spp., *Theobroma cacao*, and *Thea* spp. In certain cases where the growing plant is attacked, the injury produced is sufficient to cause the death of the host, as is the case with *Diplodia vasinfecta* Petch, which causes an internal rootrot of tea.

Since the cotton, sweet-potato, and watermelon fields of the South are not widely separated, it is of some interest from the economic standpoint to know whether a species found on one host will grow equally well upon another. Plate XVII, figure 2, shows a watermelon nine days after it had been inoculated with a culture of *Diplodia tubericola* E. and E. obtained from Mr. L. L. Harter, of the Bureau of Plant Industry. The decay took the same course in this melon as has been described for the other inoculated material, which is shown in Plate XVII, figure 1. The pycnidia which were produced, however, retained the paraphyses.

While the *Diplodia* injury is apparently the cause of serious loss in the watermelon industry, there are other ways in which the crop suffers. Dr. W. A. Orton, Pathologist in Charge of Cotton and Truck Disease Investigations, Bureau of Plant Industry, who has made a careful study of shipping conditions, is inclined to believe that the injury is confined to certain districts. In other sections, anthracnose, due to *Colletotrichum lagenarium*, is the source of considerable trouble. To the losses thus caused by fungi must be added a small percentage of melons which have been damaged by rough treatment and by the use of cars which have been employed for the transportation of fertilizer or chemicals to the fields.

<sup>1</sup> Earle, F. S., and Rogers, J. M. Citrus pests and diseases at San Pedro in 1915. In San Pedro Citrus Path. Lab. 1st Ann. Rpt. 1915, p. 5-41, 19 fig. [1915.]

## PLATE XVII

Watermelons, showing the effect of inoculation with species of *Diplodia*:

Fig. 1.—The upper four melons were held as checks; the lower five are melons nine days after having been inoculated with a culture of *Diplodia* sp. which had been isolated from a decaying watermelon obtained from a freight car at Washington, D. C.

Fig. 2.—A watermelon nine days after having been inoculated with a culture of *Diplodia tubericola* E. and E.

