ALTERNARIA PANAX, THE CAUSE OF A ROOT-ROT OF GINSENG

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While working with diseases of ginseng (Panax quinquefolium) during the summer of 1913, the authors obtained from a garden near Cleveland, Ohio, roots which showed a peculiar dry-rotted condition about the crown. The dark-brown center of the lesion characterizing this dry-rot was more or less sunken and firm to the touch and gradually shaded into the yellowish white color of the healthy root. It is distinguished from other root-rots by its lack of odor and the fact that the rotted roots never become soft. Plate XII is a reproduction of a photograph of three roots showing the typical lesions of the disease.

When the rot is near the crown of the root, the top of the plant often shows signs of the disease. These signs are a wilting and yellowing of the leaves, which on being disturbed drop off readily at the point of attachment to the main stalk. Such a condition may, however, be caused by other root-rots attacking ginseng, as, for example, the rot caused by Phytophthora cactorum.

Because of the unusual character of these lesions, numerous isolations were made from them, and in all cases an Alternaria-like fungus closely resembling Alternaria panax Whet. was secured in pure culture. In order to determine whether these two fungi were identical, a series of inoculations on roots and tops were made with both cultures. In addition, a study was made of their macroscopic and microscopic appearance. This work was begun during the summer of 1913 in Ohio and repeated during the summer of 1914 in New York.

In the main two methods of inoculation were followed. Healthy roots were taken from the garden, washed, freed from their fiber roots, sterilized for 10 minutes in a 1 to 1,000 solution of mercuric chloride, washed in sterile distilled water, and placed in sterilized test tubes. The roots were then injured by making an incision in them with a sterile scalpel, and in this incision was placed a small portion of the fungus from a pure culture. Roots treated in the same way but not inoculated were used as checks. Six series of inoculations were made in this manner, using the Alternaria-like fungus isolated from dry-rotted roots. Ninety-five per cent of infection was secured, and the checks in all cases remained healthy. Typical lesions (Pl. XII) were produced in every instance. In no case did the rotted condition involve the entire root. The time necessary after inoculation for the lesion to appear varied from seven to nine days. Once established the progress of the rot was also very slow.
At the time the above series were being run, five series of similar inoculations were made with a pure culture of *Alternaria panax*, the necessary checks for each series being used. One hundred per cent of infection was obtained with this fungus, the symptoms and lesions resulting from the inoculation being in every case similar to and indistinguishable from those obtained with the Alternaria-like fungus. Plate XIII, figure 1, shows a longitudinal section through one inoculated root.

In order to test further the pathogenicity of these fungi and to confirm their identity, inoculations were made directly in the soil on roots to which the tops were still attached. Six series were made with the Alternaria-like fungus and five with *Alternaria panax*. The soil was removed from around the crown of the roots and an incision was made in the crown. Into this incision was placed the inoculating material from pure cultures of the two fungi. Ninety-two per cent of infection resulted from the Alternaria-like fungus and eighty-five per cent from *Alternaria panax*. The symptoms and lesions were again characteristic and similar in each case.

Further inoculations were made on the tops by inoculating the leaves with mycelium from pure cultures of both fungi. For some unexplainable reason, or owing to the plants having been sprayed with Bordeaux mixture, no definite results were secured during the summer of 1913. In June, 1914, the work was repeated. Typical leaf-spots of *Alternaria panax* were produced in abundance with both fungi. Plate XIII, figure 2, is a reproduction of a photograph of the lesions produced on ginseng leaves with the species of Alternaria isolated from roots. Spores from these spots were secured and examined. No differences could be noted.

Reisolations were made from the inoculated roots and leaves, and a fungus identical with the original one used for inoculating was obtained. Numerous attempts to produce infection on the roots without previously injuring them gave only negative results.

Inasmuch as these fungi show no cultural differences and as both are able to infect the leaves and roots of the ginseng plant, the only conclusion warranted by the data at our disposal is that they are identical. This being the case, the blight problem confronting the ginseng grower becomes more complicated. Heretofore it has not been supposed that *Alternaria panax* is able to cause a rot of the root.

The above facts warrant the ginseng grower in taking other means besides spraying in the control of this disease. The means recommended, in addition to spraying, are (1) care in transplanting so as to injure the roots as little as possible, (2) the removal of all tops and stems in the fall, and (3) where the crowns of the roots are sufficiently deep below the surface of the soil, burning over the surface of the bed with a thin layer of straw after the tops have been removed.
PLATE XII

Lesions on ginseng roots due to *Alternaria panax.*
Alternaria panax

PLATE XII

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Fig. 1.—Longitudinal section of ginseng root showing the results of inoculation with *Alternaria panax*.

Fig. 2.—Inoculations on ginseng leaves with the species of *Alternaria* isolated from ginseng roots.