

PHYTOPHTHORA CROWN ROT OF DOGWOOD

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With plate 216

A DISEASE, which has been responsible for the disfiguration and ultimate death of flowering dogwood trees (*Cornus florida* L.) in various localities on Long Island, New York, was called to the attention of the writer during the summer of 1934. Early observations soon revealed that apparently healthy trees may be attacked and badly damaged within a year or so after becoming infected. Some may be killed in a relatively short time while others may remain alive much longer; however, in either case their ornamental value is soon impaired. In several instances where a diseased tree had been removed and replaced by a healthy one from the nursery or woods, it too became infected and died. Thus far the disease is known to occur only in trees planted on lawns and in gardens; it has not been observed in natural woodland stands.

During the past three years numerous field observations, culture studies and inoculation tests have been made, the results of which demonstrate for the first time the general nature and cause of this disease.

SYMPTOMS

The most obvious symptoms of the crown rot disease of dogwood constitute those associated with a general weakening of the top (Plate 216, Figure 1). The leaves are few, small, light green or chlorotic, usually drooped and their edges rolled. The tips of twigs and branches die, finally involving the larger ones and eventually the entire top. Commonly a severely infected tree bears an abnormal abundance of fruit for several years before it is completely killed.

A more careful examination of such a tree reveals that the seat of the trouble is a characteristic necrotic lesion at the crown; the weakened top is only an indirect expression of the condition of the bark and sapwood of the trunk. At first the lesion is quite obscure and may not be seen without the removal of the outer bark. Eventually, as the extent of the lesion increases, the bark over the older affected parts breaks and sap frequently oozes from the openings in the form of a slime-flux (Plate 216, Figure 2). Such lesions have a marked odor of fermentation and

are attractive to bees and other insects. The bark over the older areas dies, becomes dry and finally falls from the trunk.

Internally the affected tissues of the bark and sapwood are markedly discolored (Plate 216, Figure 3). In older areas the affected tissue is dark brown while at the edge, or more "active" part of the lesion, it is often pinkish, purplish to blue, or light brown and frequently it appears as a streaked variegated zone of all these colors.

When the bark over a typical lesion is removed, the full extent of the affected area is clearly demonstrated. From the level of the soil surface upwards the shape of the lesion is commonly that of a parabola and its surface is characteristically zonate (Plate 216, Figure 3). These zonations apparently represent the progressive advances of the lesion due to alternate favorable and unfavorable periods for growth of the pathogene. The lesion finally involves the greater part of the crown before the tree is eventually killed. Since the typical necrotic lesion at the crown is the seat of the trouble, "crown rot" is proposed for the name of this disease.

THE PATHOGENE

A phycomycetous fungus has been consistently isolated from the characteristic lesions of affected crowns. Tissue plantings made from bark or sapwood of the outer zone of the rotted area commonly yield pure cultures of the fungus. On potato dextrose agar the pathogene grows from such plantings within three days and forms a mat of white, cottony, aërial mycelium.

Based on the works of Tucker (1931), Leonian (1934), and Tompkins, Tucker and Gardner (1936), this fungus has been identified as *Phytophthora cactorum* (L. and C.) Schroet. The mycelium grows rapidly on all ordinary nutrient agar media at room temperature (20° to 25° C.), but on corn meal agar growth was still better at 27.5°C. Oogonia, accompanied by paragynous antheridia, form in great profusion on oat agar in petri dishes within a few days after a new culture is started. The thick-walled oospores are yellowish and average 25.0 microns in diameter with a range of 21.3 to 30.5 microns (500 measurements). Sporangia develop quite abundantly on a synthetic nutrient agar medium prepared from a modified Richard's Solution in which sugar was omitted. They are borne on slender sporangiophores arising from the larger vegetative hyphae; they are ovate, definitely papillate, and average 35.4 by 44.2 microns with a range of 23.2 to 43.5 by 29.0 to 68.1 microns (100 measurements). Two methods of sporangial germination have been observed, namely, by germ tubes and zoospores. In

liquid medium the zoospores are quite active at first; but they soon become quiescent and within a short time germinate by germ tubes. These observations concerning the development and morphology of the various spore forms are similar to those more fully described and illustrated by Rosenbaum (1915) for the same species, *P. cactorum*, isolated from ginseng.

The pathogenicity of this phycomycetous organism was strongly indicated by its consistent association with the typical necrotic lesions at the crown of affected trees. To determine its pathogenicity experimentally, inoculation tests were conducted on plants both in the greenhouse and in the field. For the greenhouse test 35 seedlings of *Cornus florida*, approximately one-quarter of an inch in diameter at the base and 24 to 30 inches in height, were used. All were separately established in pots and were fully in leaf at the time inoculations were made. A wound was made with a sterile scalpel in the stem of each plant at the soil surface by a downward diagonal incision through the bark to the cambium area. Mycelium from an actively growing culture of the suspected pathogene on potato dextrose agar was inserted into the wounds of 25 plants, while sterile potato dextrose agar was placed in the wounds of the remaining 10 plants to serve as checks. A piece of water-saturated absorbent cotton was wrapped about the inoculated wound of each plant and, to retain the moisture, a layer of sphagnum moss was placed over the soil surface of each pot.

Four weeks after the seedlings were inoculated, external symptoms of infection began to appear and at the end of seven weeks 16 of the 25 plants inoculated were dead, while all check plants remained perfectly healthy. The first symptom to appear was a sudden wilting of the foliage. Within a day or so wilting was followed by a drying and browning of all the leaves. When the bark was removed from the basal portion of the stem of such plants, the bark and sapwood above and below the point of inoculation was discolored brown, the discoloration commonly extending into the root bases below and up the stem four to six inches above the soil surface. Not only were the bark and the outer surface of the sapwood discolored, but the discoloration extended through the wood into the pith. The typical phycomycetous hyphae and oogonia were abundantly present in the affected tissues of the bark, wood and pith. The pathogene was consistently reisolated from the discolored wood of these infected seedlings, plantings made from the upper limits of the lesion usually yielding pure cultures of the pathogene.

Similar results were obtained from inoculation tests conducted on larger trees in the field. Typical lesions in the bark and sapwood fol-

lowed inoculations through wounds at the crown, and the pathogene was readily reisolated from all parts of such lesions.

The results of these studies, therefore, demonstrate that the crown rot disease of flowering dogwood is caused by *Phytophthora cactorum* (L. and C.) Schroet. Even though forms of this pathogene have been reported on various members of at least 30 different families of higher plants (Tucker, 1933), apparently this is the first report of its occurrence on *Cornus florida* L. or any other member of the Cornaceae. Nevertheless, *P. cactorum*, as well as several other species of *Phytophthora* are known to cause quite similar diseases in other woody plants, for example, trunk canker of apple (Bains, 1935), crown rot of walnut (Barrett, 1928), crown canker of peach and prune (Smith and Smith, 1925), crown rot of avocado trees (Fawcett, 1916), foot rot and canker of *Citrus* (Fawcett, 1915), *Phytophthora* canker of *Hevea* (Petch, 1911), and still others. The general nature and symptoms which have been described for these diseases by the various writers are strikingly comparable with those of the crown rot disease of dogwood.

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EXPLANATION OF PLATE 216

Symptoms of the crown rot disease of dogwood

- Fig. 1. A severely infected tree, exhibiting a weakened top with reduced foliage, dying twigs and branches, and an abundance of fruit.
- Fig. 2. Trunk of an infected tree (approximately 12 inches in diameter), showing rotted crown; the necrotic lesion had been partially removed at the left, but at the right of the excision the bark over the portion of the lesion which still remains has broken and the sap is exuding in the form of a white, foamy, slime-flux.
- Fig. 3. Trunk of an infected tree with bark removed (approximately 6 inches in diameter), exposing the typical, discolored, concentrically zoned lesion in the sapwood.

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