Epidemiology and Symptomatology of Apple Bitter Rot

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Journal Series Paper No. 943 of the University of Georgia College of Agriculture Experiment Stations.

ABSTRACT

Viable inoculum of *Glomerella cingulata* was produced on apple bitter rot mummies during March and April and the pathogen was isolated from developing fruit during April and May. Artificial inoculations 2 weeks after bloom produced previously unrecognized symptoms similar to those observed under field conditions, and produced typical bitter rot symptoms ca. 6 weeks later. Phytopathology 61:1028-1029.

Bitter rot of apple caused by *Glomerella cingulata* (Stoneman) Spaulding & von Shrenk has been a problem in eastern and midwestern apple areas since the turn of the century, and is currently one of the most important rots of apples in the southeast. The disease can be found to some extent in almost every Georgia orchard every year, and frequently causes extensive losses in middle Georgia plantings where the industry has developed in recent years. Despite its long history of widespread occurrence and importance, bitter rot has continued to be unpredictable and troublesome. This indicates a void in the knowledge of the epidemiology of the disease, and emphasizes the need for further investigations.

Descriptions in the literature of apple bitter rot are those that develop late in the season. Investigators have reported that infection does not take place until the fruit approaches maturity (1, 2, 3, 5, 6). Some have gone so far as to state that immature fruits are resistant (4). These reports have led to development of control programs calling for bitter rot sprays 30-40 days after bloom. Observations over the years in Georgia, however, indicate that a low level of infection occurs in early spring, and that lesions resulting from such infections serve as a source of secondary inoculum during the summer.

Fruit from susceptible seedlings and a Grimes cultivar showing outbreaks of bitter rot year after year at the Georgia Mountain Experiment Station were utilized for studies on symptoms associated with infections by *G. cingulata* and the disease cycle during 1968-70. As bitter rot stem cankers are difficult to identify with certainty, fruit mummies were used to determine production of primary inoculum. Fruit mummies were collected at 13- to 16-day intervals from 15 March to 1 May each year, and placed in moist chambers at 20 C to determine the capacity of the pathogen to produce viable inoculum. In addition, collections were made during rainy periods to determine the seasonal occurrence of viable inoculum under field conditions. Areas on trees showing mummies with inoculum during rainy periods were tagged for collections and isolations later in the season.

In further studies of early-season infections, 14-day-old cultures of *G. cingulata* grown on potato-dextrose agar were used as a source of conidia to inoculate fruit of a 6-year-old Detroit tree growing on Malling IX roots. Fruit on one-half the tree was sprayed at the petal-fall stage of development with an aqueous suspension of 10,000 spores/ml. Then the tree was enclosed in a plastic chamber equipped with a humidifier and kept moist for 48 hr. Beginning 15 days later, a captan spray program was applied throughout the remainder of the season. Observations and platings of inoculated fruit were made at 2-week intervals.

Studies on presence of field inoculum during March and April, on isolations from fruit during April and May, and on artificial inoculations during May showed that primary fruit infections by *G. cingulata* may occur before, during, or soon after bloom. Symptoms associated with early-season infections appear first soon after bloom as minute, gray-brown flecks (Fig. 1) similar to early-season symptoms resulting from infections by *Physalospora obtusa* (Schw.) Cke. (7). The flecks usually do not develop further until the fruit begins to ripen. Then typical bitter rot symptoms appear.

Although the proportion of fruit mummies from seedling trees that produced viable inoculum varied from 5-20%, the percentages were not correlated with date of collection. Spores were produced on samples collected on each date from 15 March to 1 May each year. Less than 5% of mummies from the Grimes cultivar showed viable inoculum. The first viable spores

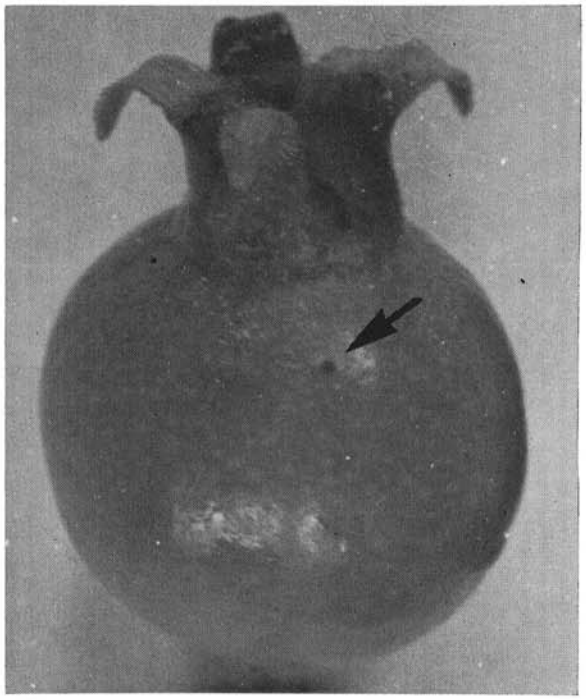

Fig. 1. Early-season bitter rot symptoms (×4).

found on bitter rot mummies under field conditions during the 3-year study were on 15 April 1968, 6 April 1969, and 19 April 1970. These dates followed rainy periods with maximum day temperatures of 19-24 C.

Glomerella cingulata was isolated from symptomless fruit of seedling trees during the last week of April each year. Date of appearance of the earliest lesions from which *G. cingulata* could be isolated varied from 1 May in 1969 to 10 May in 1970. Detroit fruit inoculated 1 May 1969 showed symptoms about 2 weeks later. The fungus was reisolated from 60% of platings showing symptoms similar to those in Fig. 1. Typical bitter rot symptoms developed on 14% of the inoculated fruit 6-8 weeks after inoculation; 1% of fruit on noninoculated portions of the tree were affected.

Early-season symptoms associated with the bitter rot disease of apples have not been recognized previously, nor has this phase of the disease cycle been established. Symptoms and other characters of bitter rot given by Schrenk & Spaulding (6) have been carried down through the years by others, and few workers have made fundamental investigations. The symptoms established in the literature are those appearing late in the season as the fruit begins to ripen (1, 6). It now appears that primary infections may occur early in the season, even before bloom, and may serve as source of secondary inoculum. These additions to the knowledge of the disease cycle and symptoms of bitter rot of apple should provide a basis for more effective control of the disease in the southeastern apple area.

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