Reduction of Substrate Colonization by *Botryosphaeria obtusa*

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ABSTRACT

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Prunings left in the orchard are an important inoculum source for apple fruit rot fungi. The use of a flail mower immediately after a pruning operation is a suitable alternative to costly physical removal of the prunings. Chopped wood less than 3 cm long is rapidly decomposed by saprophytic organisms, thus reducing pathogen colonization.

Additional key words: epidemiology, sanitation

In Georgia, an integrated approach using chemical, cultural, and biologic methods is essential for economic control of apple fruit diseases because inoculum is abundant and environmental conditions frequently favor disease development. The apple fruit rot disease black rot, caused by *Botryosphaeria obtusa* (Schw.) Shoemaker, can result in up to 80–100% crop loss if not properly controlled (1). This organism colonizes and sporulates on the bark of dead wood either in the tree or on the ground (2).

The sources and amount of initial inoculum are important epidemiologic and control factors that must be considered in field studies. Knowledge of the source of inoculum many times dictates the best approach to control of the pathogen. For example, a pathogen that survives on plant debris may be controlled by plowing under or physically removing the debris. Without knowledge or control of inoculum sources, inoculum at the beginning of the growing season may be at such a level that disease may exceed the economic threshold.

The only economically feasible method of controlling black rot in Georgia is with a program that integrates chemical control with sanitation, ie, removal of dead wood and prunings from the orchard (1,2). Because the cost of removing these prunings by hand is high, apple growers in Georgia are examining other methods of reducing the inoculum, including the use of a flail or rotary mower attached to a tractor. A flail mower consists of a number of free-

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swinging blades that break and chop the debris on the ground. The objective of our study was to determine if such a method is feasible in reducing the substrate colonization of *B. obtusa* in the orchard after winter and summer prunings.

MATERIALS AND METHODS

From April through December 1978, wood samples from prunings lying on the ground were collected approximately every 2 wk from three commercial apple orchards about 48 km apart in north Georgia; only one sample was obtained during July and December. Unchopped wood lying within the orchard rows and chopped wood lying between the rows were collected at each location. Samples were also collected from areas where the prunings had been chopped with a rotary mower. At each orchard, 40 samples each of chopped and unchopped wood were randomly chosen within a 1-km length of row. The flail mower was used during June at each location; the flail-chopped wood was up to 3 cm long. Only winter pruning was done at two of the locations. At the third location, summer pruning was done after winter prunings were chopped in June.

The samples of chopped and unchopped wood from each location were surface-sterilized in 0.525% sodium hypochlorite and plated on acidified potato-dextrose agar; the unchopped wood was shortened to accommodate the petri plate. The plates were placed under fluorescent lights at room temperature for 2 wk, at which time all fungi reported to rot fruit were identified. The data from all orchards were statistically analyzed using an analysis of variance for a split plot in time design. An FLSD value for the difference between two treatments at a given date was calculated.

RESULTS

Figure 1A is a plot of the percentage of samples colonized by *B. obtusa* from chopped and unchopped wood from one of the two apple orchards in which only winter pruning was conducted. The percentage of chopped wood from which *B. obtusa* could be isolated decreased rapidly from June until September, after which the organism was no longer recovered. The percentage of unchopped wood from which *B. obtusa* could be isolated remained high until November, at which time it declined. Over the sampling period, the percentage of unchopped wood from which *B. obtusa*

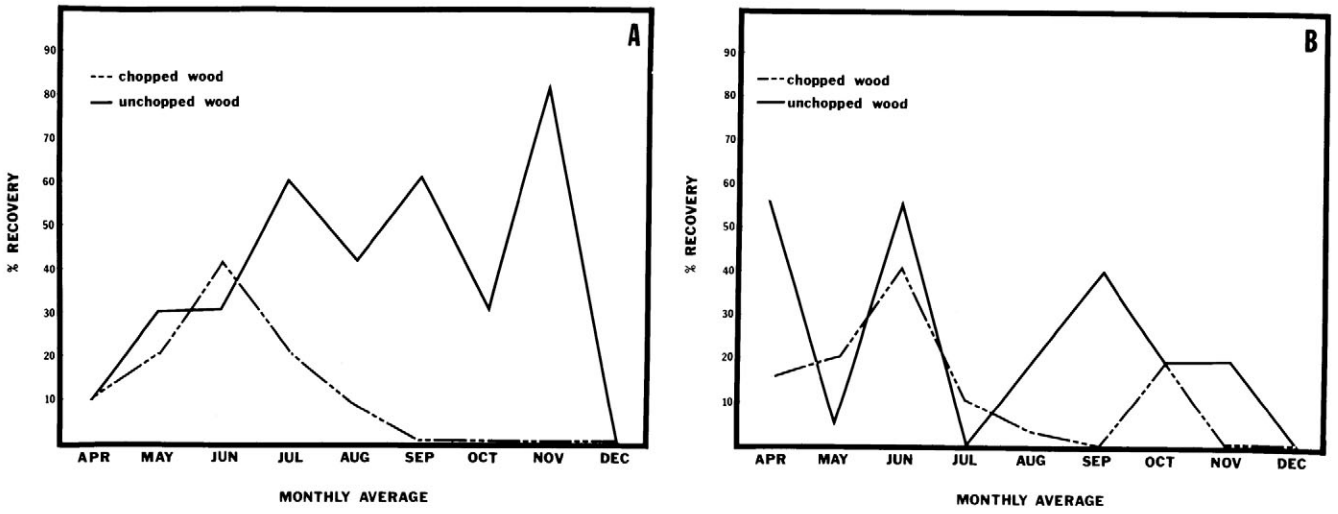

Fig. 1. Monthly average of percentage of recovery of *Botryosphaeria obtusa* from unchopped prunings and prunings chopped with a flail mower. **(A)** Winter pruned orchard (FLSD = 46.68%). **(B)** Winter and summer pruned orchard (no significant differences).

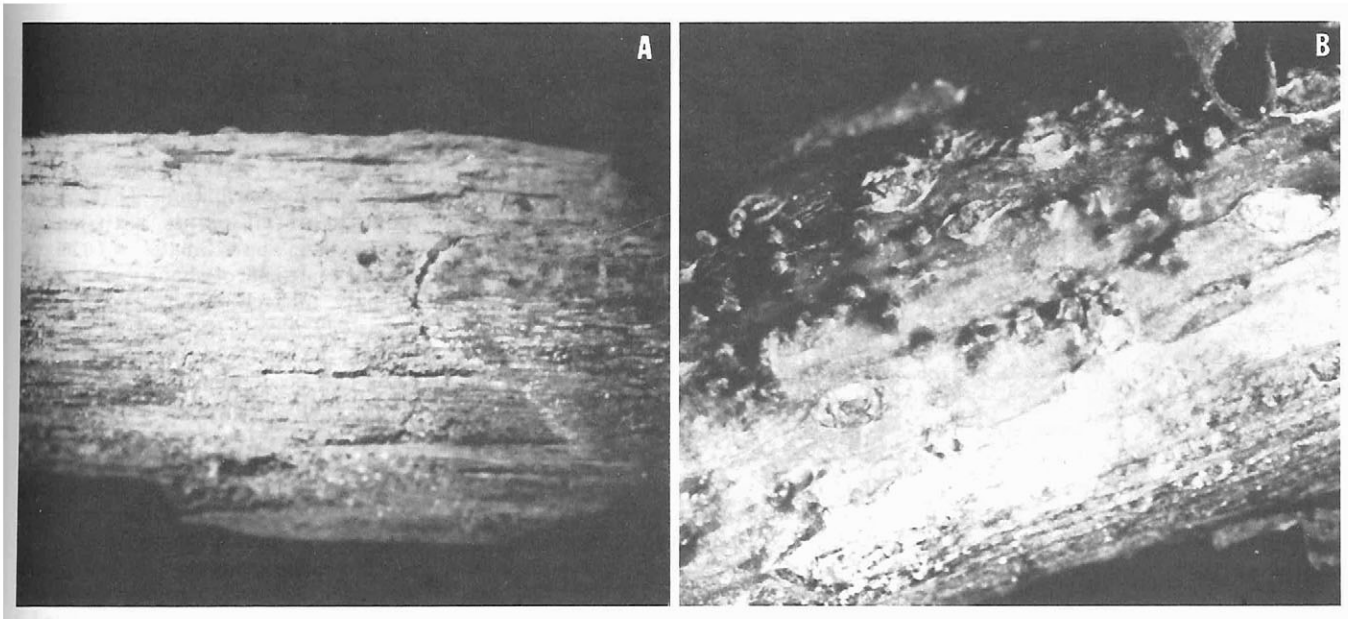

Fig. 2. (A) Wood chopped with a flail mower, showing absence of bark and pycnidia. **(B)** Unchopped wood, showing intact bark and abundant pycnidial production.

could be isolated was significantly different ($P = 0.05$) than that of chopped wood. The FLSD value for the difference between two treatments at a given date was 46.68%. The data from the other winter-pruned orchard were similar, as was the statistical significance.

Figure 1B is a plot of the percentage of recovery of *B. obtusa* from samples of chopped and unchopped wood from the orchard in which both winter and summer pruning were done. The percentage of recovery of *B. obtusa* from chopped and unchopped wood followed a similar pattern throughout the study, eventually declining in November. Over the sampling period, there were no significant differences ($P = 0.05$) in the percentage of recovery of *B. obtusa*. The rotary mower was ineffective in chopping the wood to a size comparable to that obtained with the flail mower. The amount of fungal colonization of the bark of unchopped wood was not significantly different ($P = 0.05$) from that of wood chopped with a rotary mower and was similar to that of unchopped wood in the flail mower plots.

DISCUSSION

The major source of inoculum of *B. obtusa* is the bark of dead wood in the tree or on the ground (2). Sanitation is aimed at eliminating this source through an intensive pruning program. The apple grower, however, is then faced with eliminating the prunings from the orchard. Removal of the prunings by hand is expensive. An alternative is the use of a flail mower, which reduces available sites for colonization by chopping and dispersing the prunings. Chopped prunings are more rapidly overgrown by grass than unchopped wood and remain moist longer, allowing extensive colonization by isolates of *Trichoderma* and other saprophytic organisms. The flail mower, in conjunction with natural decomposition, removes the bark from the prunings (Fig. 2), thus eliminating the site of colonization of *B. obtusa*. To achieve maximum benefit in reducing fungal inoculum, the flail mower must be used immediately after all pruning operations. Repeated passes at slow speeds are required to chop the prunings to a size of less than 3 cm. Power requirements for operation and blade cost for the flail mower are high, but other mowers do not pick up and rechop the prunings.

Prunings left on the orchard floor can serve as inoculum sources for the colonization of tree cankers and dead wood left in the trees as well as for infection of fruit from bloom until midseason. The chopping of winter prunings effectively reduces the amount of inoculum available for possible spread from prunings to tree.

Additional prunings during the summer negate the beneficial effects of the flail mower. This wood provides additional substrate sites for colonization by *B. obtusa*. If the summer pruning were omitted or if these prunings were chopped with the flail mower, results similar to those shown in Figure 1A could be expected.

This study has shown that the flail mower is an alternative to physical removal of prunings from the orchard for reducing substrate colonization and substrate inoculum production by *B. obtusa*. Other organisms that sporulate on dead wood on the ground and in the tree are *B. dothidea* (Moug. ex Fr.) Ces et de Not., the cause of bot or white rot, and *Glomerella cingulata* (Stonem.) Spaulding & Von Schrenk, the cause of bitter rot (1). Similar results could be expected in reducing substrate colonization of these organisms, which are ecologically similar to *B. obtusa*.

LITERATURE CITED

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