Progress Report for Research Funding

Title: Evaluation of a Flame Cultivator for Mummy Berry Control in Blueberry

PIs: Harald Scherm
University of Georgia
Department of Plant Pathology
Athens, GA 30602
scherm@uga.edu

Bobby Boozer
Auburn University
Chilton Research & Extension Ctr.
Clanton, AL 35045
rboozer@acesag.auburn.edu

Objective:

Determine the effect of flame cultivation on the incidence of primary infection by the mummy berry fungus, *Monilinia vaccinii-corymbosi*.

Justification and Description:

Mummy berry has been ranked as the most important disease of blueberry in the southeastern states in a recent producer survey (Scherm *et al.*, 2001). Losses occur due to the blighting of shoots and flowers and through fruit mummification which leads to downgrading of affected fruit loads. The disease is caused by the fungus *Monilinia vaccinii-corymbosi* which oversummers and overwinters in infected, mummified fruit on the orchard floor. Mummies germinate in early spring and produce apothecia, the sole source of primary inoculum. Ascospores, discharged from apothecia, infect young, expanding vegetative tissues in the spring, causing a leaf and shoot blight. Conidia produced on the blighted leaves subsequently infect open flowers via the stigma and style, followed by stromatization of mycelia in the developing fruit and associated fruit mummification. Mummies drop to the ground prior to or during harvest.

In commercial blueberry production in the Southeast, mummy berry disease is managed primarily by fungicide sprays from vegetative bud break to the end of bloom (Scherm & Stanaland, 2001). Substantial yield losses can still occur, however, indicating that this strategy does not always provide optimal disease control. Furthermore, there is an expanding market from consumers who prefer pesticide-free fruit, especially in pick-your-own plantings. Alternative disease management approaches are therefore needed to supplement current disease controls. From an epidemiological viewpoint, management tactics targeting mummies on the ground could be very effective given that mummies are the only source of primary inoculum.

Some blueberry producers employ mechanical cultivation for weed control, and this practice has been documented to reduce the risk of mummy berry disease by burying mummies and preventing their germination (Ngugi *et al*., 2002). Unfortunately, however, most mummies on the ground are located near the crowns of the plants where cultivation implements cannot be operated at a sufficient depth due to risk of injury to shallow blueberry roots. Alternative cultural practices are therefore needed to inactivate these mummies near the plant rows.

In lowbush blueberry in Maine, burning, used at 2-year intervals to manage plant growth, has resulted in substantial suppression of mummy berry disease (Lambert, 1990). Indeed, when burning was substituted by mowing, disease incidence increased 90-fold over the next six crop cycles. When light burning was resumed in a previously mowed field, disease incidence dropped two- to threefold in the next crop cycle (Lambert, 1990). These observations strongly suggest that a heat-generating practice similar to light burning, if it could be implemented in rabbiteye blueberry, could be useful for inactivating mummies of *M. vaccinii-corymbosi*, particularly those located near the plant rows. In this project, we modified a commercial flame cultivator for use in blueberry and evaluated its effect on the incidence of primary infection by *M. vaccinii-corymbosi*.

Methodology:

Flame cultivator design: A propane-operated four-burner unit (Flame Engineering, Inc., LaCrosse, KS) was modified by mounting the burners on a hydraulically retractable arm on a small four-wheel trailer (Fig. 1). During operation, the trailer was pulled behind a tractor traveling at a speed of 3.9 to 4.9 km h^{-1} along the row middle, while the retractable arm allowed the working distance to the treated plant row to be adjusted. The unit required two individuals for operation, one to drive the tractor and a second person to engage the burners and to adjust the working distance. The burners provided flame coverage in a 0.9-m swath next to the plant row.

Experiment I (Social Circle, GA): This site was a pick-your-own blueberry planting with a history of severe mummy berry disease. Treatment plots were established along four adjacent rows of mature 'Brightwell' and 'Tifblue' plants. Each row was separated into three blocks (replications), each of which was further subdivided into two plots with or without application of flame cultivation. Each plot was two rows wide and ten bushes long. Flame treatments were applied to both sides of each row on March 12, 20, and 27. Average leaf bud stage (NeSmith *et al*., 1998) on March 19 and 27 was 3.0 and 4.6 for 'Brightwell' and 2.9 and 4.5 for 'Tifblue', respectively. No fungicides were used during the experimental period. Incidence of primary infection by *M. vaccinii-corymbosi* was determined on April 5, 11, 17, and 25 by counting the number of newly blighted shoots ('strikes') on three bushes in the center of each plot; counts were made only on one side of each bush. Values were totaled for the four assessment dates and expressed as cumulative number of strikes per bush. We were unable to directly assess the effect of flaming on mummies on the ground due to a low density of mummies in the planting.

Experiment II (Sterrett, AL): The area selected for treatment consisted of five adjacent rows in a mature planting of rabbiteye blueberry. One row of 'Climax' in the center of the area was utilized for data collection. Individual plots were eight bushes long and arranged in a randomized complete block design with two treatments (with or without flaming) and three replications. No fungicides were applied during the experimental period. Flame treatments were made on March 14 and 26. An earlier treatment planned for March 7 had to be discontinued due to high fire hazard -- the planting harbored a high population of overwintered annual grasses which readily ignited under dry conditions. Mummies collected from this planting were observed to produce apothecia in mid-March. On April 10, the number of strikes in five randomly selected sample sites per plot was counted; each sample site consisted of a $0.3 \times 0.3\text{-m}^2$ canopy area.

Results:

Disease pressure was very high at the two sites. For example, untreated control plots of 'Brightwell' in the GA planting had close to 170 strikes per bush on average. Under these conditions, flame cultivation did not reduce disease incidence significantly (Table 1). In the AL planting, flame treatments reduced strike numbers by 43% on average (Table 1), but even this reduction was not statistically significant ($P > 0.22$).

Conclusions and Impact:

Our attempts in utilizing a flame cultivator to inactivate mummies and thus reduce the incidence of primary infection met with limited success. Various factors could have been responsible:

- Disease pressure in both plantings may have been too high for control strategies targeted against initial inoculum to be effective.
- While the burner unit was able to operate close to the plant row, a strip centered in the row middle remained untreated. Mummies in this area could have provided inoculum for primary infection. Perhaps the use of mechanical cultivation in the row middles in combination with flame cultivation along the rows could lead to more pronounced disease suppression.
- The soil surface in both plantings was covered with vegetation (sod and weeds) which may have protected the mummies on the ground from receiving sufficient heat exposure. Flame

cultivation may be more successful when applied to a bare soil surface.

- The presence of overwintered, combustible grasses in the AL planting prevented us from applying flame treatments during dry conditions. Thus, treatments could not always be applied at sufficiently close intervals in a timely manner.
- Although the plots used in this study were relatively large, inoculum from nearby control plots could have contributed to infection in the treated plots.

As long as these issues remain unresolved, flame cultivation has limited potential for practical use in a mummy berry control program.

Literature Cited:

Lambert, D.H. 1990. Plant Disease 74:199-201.
NeSmith, D.S., Krewer, G., and Williamson, J.G. 1998. HortScience 33:757.
Ngugi, H.K., Scherm, H., and NeSmith, D.S. 2002. Phytopathology 92:877-883.
Scherm, H., NeSmith, D.S., Horton, D.L., and Krewer, G. 2001. Small Fruits Review 1(4):17-28.
Scherm, H., and Stanaland, R.D. 2001. Small Fruits Review 1(3):69-81.

Table 1. Incidence of primary infection by *Monilinia vaccinii-corymbosi* in plots of rabbiteye blueberry that were either treated or not treated with a flame cultivator in March.

	Social Circle, GA[a]		Sterrett, AL[b]
Treatment	'Brightwell'	'Tifblue'	'Climax'
Flame-cultivated	162.8 ± 46.9	109.0 ± 25.5	5.7 ± 1.6
Untreated control	167.9 ± 52.5	118.7 ± 43.9	10.0 ± 3.8
LSD ($\alpha = 0.05$)	54.1	80.7	10.7

[a] Values are means and standard errors of numbers of strikes per bush based on three replicate plots with three bushes assessed per plot. Counts were made only on one side of each bush.
[b] Values are means and standard errors of numbers of strikes per 0.09-m^2 canopy area based on three replicate plots with five sample sites assessed per plot.

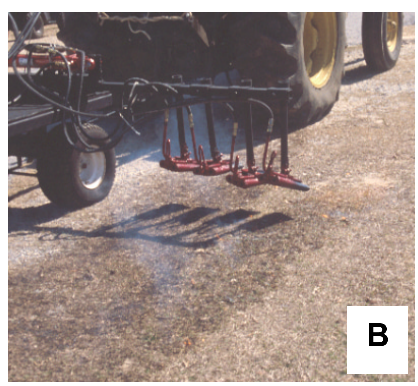

Fig. 1. Modified flame cultivator unit evaluated for suppression of mummy berry disease. Overall view of the unit (**A**); close-up view of a test run on a grassy surface (**B**); operation of the unit in a blueberry planting (**C**).