Title: Mummy Berry Control in Organic Blueberries
(Final Report)

Grant Code: 2006-07 (Research Proposal)

PI: Harald Scherm
University of Georgia
Department of Plant Pathology
Athens, GA 30602
(706) 542-1258
scherm@uga.edu

Objective:
Evaluate a diverse panel of OMRI-approved biofungicides for control of mummy berry disease of rabbiteye blueberry in the field.

Justification:
Compared with tree fruits and other small fruits, there is considerable potential for organic production of blueberries in the southern United States. Rabbiteye blueberries (*Vaccinium virgatum*), which comprise a large majority of the blueberry acreage in the South, are native to the region and well-adapted to its warm and humid climate that favors a large complex of potential pest species. In addition, the crop can be grown successfully on poorer soils, such as those of the Piedmont near the population centers where the demand for organically produced fruit is greatest.

Although organic farming currently is the fastest growing sector of agriculture in the United States, organic production of blueberries in the South is still relatively limited. There is, however, considerable potential for expansion. Historically, the bulk of (conventionally produced) rabbiteye blueberry fruit has been worth only about $1 per pound, primarily because they ripen at the same time or after large volumes of highbush blueberry fruit come to the market. Since organic fruit do not compete in the same market segment as conventionally produced fruit, prices will be higher. In addition, since rabbiteye blueberry plants are long-lived, there are already large acreages of the crop in production that could be converted to organic practices relatively easily.

Rabbiteye blueberries traditionally have been considered disease-resistant. This is certainly true for root rot and dieback diseases, which are much less prevalent on rabbiteye blueberries than on other blueberry species. With a few exceptions (e.g., rust on Delite, Septoria leaf spot on Premier, and Gloeosporium leaf spot on Brightwell and Powderblue), most rabbiteye cultivars also possess good resistance to foliar diseases. However, all rabbiteye cultivars appear susceptible to mummy berry disease, caused by the fungus *Monilinia vaccinii-corymbosi*. The disease is widespread in the South and can result in significant economical losses annually. In a producer survey in Georgia, mummy berry was ranked the most important blueberry disease, being considered a “major” or “moderate” problem by more than 75% of the participating (conventional) producers (Scherm *et al*. 2001). Conventional growers control mummy berry disease with three to four applications of synthetic fungicide at the onset of and during bloom, when the infection leading to fruit mummification occurs (Scherm & Stanaland 2001). In the absence of chemical management options, mummy berry disease will be a major constraint to organic blueberry production.

Current guidelines for organic blueberry production (e.g., Kuepper & Diver 2004) recommend mulching or soil cultivation to bury the mummies, the sole survival structure of *M. vaccinii-corymbosi*, to prevent their germination in the spring. However, mulching may actually favor mummy germination (and thus subsequent infection) because of the mulch's moisture retaining ability. Furthermore, burial by soil cultivation is often ineffective because cultivation implements can operate only at a shallow depth near the crowns of the plants where most mummies are located (Ngugi *et al*. 2002). Thus, mummy berry management in organic production systems needs to include tactics directed against leaf and flower infection, in addition to those directed against the mummies on the ground.

While conventional fungicides to protect leaves and flowers from infection by *M. vaccinii-corymbosi* are not available to organic producers, they could be replaced with biofungicides approved by the Organic Materials Review Institute (OMRI), pending documentation of their efficacy against the disease. For Serenade Biofungicide (*Bacillus subtilis*), efficacy against *M. vaccinii-corymbosi* has been documented, albeit not at the same level as with synthetic fungicides (Scherm & Stanaland 2001). Several other OMRI-approved materials are available that have not been tested against mummy berry disease in the South. The critical evaluation of such biofungicides was the objective of this project.

Methodologies:
The test was carried out in a mature planting of rabbiteye blueberry (cvs. Brightwell and Tifblue) near Alma, GA (Bacon County). The following biofungicides were evaluated: 1) Actinovate (*Streptomyces lydicus*; 12 oz/ac), 2) Micro Sulf (micronized wettable sulfur; 15 lb/ac), 3) Organocide (seame oil + fish oil; 100 fl oz/ac), 4) PlantShield HC (*Trichoderma harzianum* T-22; 1.5 lb/ac), 5) Prev-Am (sodium tetraborohydrate decahydrate; 25 fl oz/ac), and 6) Serenade Max (*Bacillus subtilis* QST 713; 3 lb/ac) + Biotune surfactant (12 fl oz/ac). Additional treatments included 7) a chemical fungicide standard using Indar 75WSP (fenbuconazole; 2 oz/ac) and 8) an untreated control. Applications were made with an airblast sprayer in 50 gal/ac water on 8, 16, 22, and 30 March at, respectively, 25, 77, 85, and 94% cumulative bloom in Brightwell and 4, 39, 55, and 78% cumulative bloom in Tifblue. The experimental design was a randomized complete block with four replicates. Individual plots consisted of six bushes separated by untreated buffer rows. Blighted shoots (resulting from primary infection by ascospores) were counted on the four bushes in the center of each plot on 24 March for Brightwell and 29 March for Tifblue. At the time of fruit maturity on 15 June for Brightwell and 30 June for Tifblue, the four center bushes in each plot were shaken to dislodge mummified fruit. Mummies on the ground were collected from a 4.9-m × 1.0-m area within each plot, and infection was verified by visual examination of the fruit cross-section for presence of mycelia or pseudosclerotia of the causal agent, *Monilinia vaccinii-corymbosi*. Incidence

of fruit mummification (due to secondary infection by conidia) was expressed as number of mummies/m^2. Data were subjected to one-way analysis of variance for a randomized complete block design, separately for each cultivar.

Results:

During the dry spring of 2006, relatively low levels of disease developed at the experimental site (Fig. 1), especially with regard to secondary infection. Disease incidence was higher in Brightwell (21.1 strikes per bush and 14.0 mummies/m^2 in the untreated control) than in Tifblue (9.8 strikes per bush and 4.1 mummies/m^2). There was a marked disease gradient across the field, as indicated by a highly significant ($P < 0.01$) block effect in all analyses. By contrast, there was no significant treatment effect ($P > 0.30$) for either cultivar, even when an attempt was made to account for the disease gradient effect via analysis of covariance. Numerically, the Actinovate plots had lower levels of primary infection and the Serenade + Biotune plots had lower levels of secondary infection than the Indar standard in both cultivars (Fig. 1). However, this observation needs to be confirmed in future research with higher and more spatially uniform disease levels. Repeated applications of Organocide resulted in severe phytotoxicity (purplish discoloration and necroses on leaves and flowers) on both cultivars.

Conclusions:

Due to the dry spring, disease levels in the trial were too low to allow firm conclusions to be drawn. Nonetheless, the numerical disease reductions with Actinovate (for primary infection) and the Serenade + Biotune mixture (for secondary infection) were encouraging. Further research to examinethe performance of these treatments in years with higher disease pressure is warranted. Such research will be carried out in the next 3 years with funding recently obtained from the USDA's Integrated Organic Program. Seed funding from the SRSFC for the present project was instrumental for securing this highly competitive grant.

Impact Statement:

Mummy berry disease is one of the key factors limiting the expansion of the organic rabbiteye blueberry industry in the Southeast. In this project, several biofungicides approved by the Organic Materials Review Institute (OMRI) were evaluated for their efficacy against the disease. Although natural disease levels in the test field were too low to allow firm conclusions to be drawn, the numerical disease reductions with Actinovate (for primary infection) and the Serenade + Biotune mixture (for secondary infection) were encouraging. More importantly, seed funding from the SRSFC for the present project was instrumental for securing a 3-year, highly competitive grant from the USDA's Integrated Organic Program to develop best management practices and economic cost analyses for organic blueberry production in the Southeast.

Literature Cited:

Kuepper, G.L. and Diver, S. 2004. Blueberries: Organic Production. ATTRA Horticulture Production Guide, http://attra.ncat.org/attra-pub/blueberry.html

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Fig. 1. Incidence of primary infection (number of shoot strikes per bush) and secondary infection (number of mummies/m^2 of ground surface) on Brightwell and Tifblue rabbiteye blueberry in response to different biofungicide treatments. Values are means and standard errors of four replicate plots.