Southern Region Small Fruit Consortium

2012 Project Report

Title: Integrated management of blueberry (Vaccinium spp.) replant disease associated with ring nematodes (Mesocriconema spp.).

Progress Report
SRSFC Project # 2012-04
Research Proposal

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<u>Objectives</u>: To evaluate pre- and post-plant management of blueberry replant disease, associated with ring nematodes (*Mesocriconema* Spp.) with a combination of management tactics.

<u>Justification:</u> Blueberry replant disease is a serious threat to continued blueberry (*Vaccinium* spp.) production in Georgia, and possibly in other growing areas of the Southeastern US. Commercial blueberry acreage has increased dramatically over recent years and many farms are being replanted. Blueberry replant disease is characterized by poor growth, yellowing, stunting, and severely reduced yields in replanted areas (Fig. 1). Symptoms on blueberry are similar to those seen in peach tree short-life disease, in which ring nematodes (*Mesocriconema xenoplax*) have been implicated. Fields with blueberry replant disease symptoms typically exhibit high population density levels of a similar species of ring nematodes (*Mesocriconema ornatum*) in the soil around the affected plants. Preliminary experiments with pre-plant fumigant nematicides demonstrated that plant growth, vigor, and yield were significantly higher where nematode densities were reduced by nematicidal treatments. Further experiments in greenhouse pots and field microplots again demonstrated that blueberry is a host for ring nematodes, and that the nematodes reduce plant vigor (Jagdale et. al. 2010).

Figure 1. Plants showing symptoms of blueberry replant disease.

In 2010, two surveys were conducted of plant-parasitic nematodes infesting commercial blueberry fields in Georgia and North Carolina. Remarkably, more than half of the blueberry farms sampled in Georgia had ring nematodes present. Nematode assays showed a mean population density of 290/ 100 cm3 soil in the farms that had the species present in June, and a mean density of 400/ 100 cm3 soil in the follow-up survey in November, for a 36% overall increase in ring nematode counts over 5 months (Jagdale et. al., 2011). The damage threshold for ring on blueberry is not known, but for the closest situation for comparison, short-life of peach, the damage threshold is 1 nematode / 100cm3 soil (Davis, et. al., 2009). This means that if the nematode is present at any density, the grower can expect crop losses to occur. This is not an unlikely scenario for blueberry, because like peach, the crop is grown over a period of many years. If any nematodes are present that are parasitic on blueberry, they will eventually increase to damaging levels. The widespread occurrence of ring nematodes in blueberry, and the demonstrated pathogenicity of this species, indicates that blueberry replant disease could become a major limitation to continued production on existing farms.

The economic impact of blueberry replant disease could be devastating to growers establishing new plantings. The estimated cost of establishing and maintaining blueberry is $9,500 per acre per year (Fonsah et. al, 2007). For the critical first 4 years, this is a total investment of $38,000 per acre. If the farm is infested with ring nematodes, as 52% of the fields sampled in Georgia were, then the grower could lose the entire investment at about the time that the blueberries would normally be coming into production. The ultimate economic success of preplant treatments for long-term control of nematodes in blueberry has not yet been determined.

Methodologies: This project was begun in the Spring of 2011. Research plots were established, soil solarization was completed, and pre-plant nematicide treatments were applied before planting was begun in Fall 2011. Blueberry planting was completed in December 2011. Nematode assays and assessments of plant vigor, plant height, and plant volume were conducted in May and September of 2012. Experimental plots were established on two blueberry farms located in Appling and Bacon counties in Georgia that exhibited replant disease and were infested with ring nematodes. Treatments included pre-plant soil fumigation with methyl bromide/chloropicrin and two rates of 1-3,dichloropropene, pre-plant solarization of the soil for 77 days, and untreated controls with and without plastic covers. Older plants were removed, the site was prepared, and new planting beds were established in early June 2011. Clear plastic film was applied to soil solarization treatments on May 25, and removed on August 11. The maximum soil-surface temperature recorded under plastic was 152F. Plots were treated with soil fumigants in September 2011, and planted 6-10 weeks later. Split-plots were established within all pre-plant treatments with the split-plots divided into a control and Movento (spirotetramat, Bayer CropScience) application. Blueberry cultivars used were rabbiteye cultivars Alapaha and Premier, and southern highbush cultivars Star and Farthing. Spirotetramat was applied at the rate of 6 fl. oz. per acre mixed with a penetrating adjuvant, with a backpack sprayer using a hollow cone nozzle to wet all leaves. The post-plant nematicide Movento was applied in May 2012 and again in August 2012, and applications will continue in the spring and fall of each year. Plant-parasitic nematode population densities were assayed prior to treatment with soil solarization and fumigants, at planting, and at regular intervals after planting. Nematode populations were assayed by systematically collecting 10 soil cores per plot from the blueberry root zone. Each sample was mixed, and a 100 cm^3 subsample was removed for assay. Plant-parasitic nematodes were collected from the soil samples by sieving and centrifugation, and the nematodes were identified and counted with a stereomicroscope (Jenkins, W.R., 1964). Plant vigor ratings, plant heights, and plant volumes were determined on the nematode sampling dates. Data were analyzed with analysis of variance, followed by mean separation to determine the efficacy of the treatments

Results:

Pre-plant soil fumigation: The results from this project to date have been encouraging, but further demonstrate the potentially serious levels of damage caused by *M. ornatum* on blueberry. In 2012, during the first growing season of these studies, preplant soil treatment with methyl bromide/chloropicrin, or 1,3-dichloropropene reduced *M. ornatum* population densities to nearly nondetectable levels (Table 1). Nematode population densities were also lower in the solarized plots than the nontreated plots but were higher than all the soil fumigant treatments. In May 2012, seven months after treatments were applied, *M. ornatum* population densities remained lower in the treated plots than in nontreated plots. In September 2012, one year after treatment, blueberry plant growth and vigor were significantly higher, with plant volumes approximately 2 to 3 times larger in plots treated with soil fumigants versus nontreated plots with no plastic cover. This study also indicated that use of a plastic cover alone may reduce losses due to replant disease.

Post-plant nematicide: During the 2012 growing season, with results based on a single application of the post-plant nematicide spirotetramat in April 2012, there was significant evidence of reduced population densities of ring nematodes and increased plant growth and vigor in treated plots compared to nontreated controls. For sites and main-effect treatments combined, plots treated with spirotetramat in April had greater plant volumes than nontreated plants in measurements done in September 2012 (28.4 vs 23.0 X 10^3 in^3, respectively, $P<0.10$), and also higher plant vigor ratings (2.9 vs 2.8, respectively, $P<0.10$). Ring nematode numbers assayed in August 2012 tended to be lower in spirotetramat treated plots compared to nontreated controls, combining all main-effect treatments, but the differences were not significant (121 vs 137 nematodes/ 100 cm^3 soil respectively). When spirotetramat treatment was compared to nontreated sub-plots within main-effect treatments, ring nematode numbers were significantly lower in plots that also were treated pre-plant with methyl bromide and with soil solarization. In the remaining four pre-plant treatments, no significant differences were detected in nematode numbers comparing spirotetramat to nontreated subplots. Note that all of the pre-plant treatments resulted in significantly lower population densities of *M. ornatum* compared to controls with no pre-plant treatment (Table 1). Greater plant growth and vigor were also observed in sub-plots treated with spirotetramat compared to nontreated controls within the main effect treatments of 1-3,dichloropropene (322 kg/ha), and soil solarization. Plant growth tended to be greater in all of the spirotetramat treated plots within all main effect treatments.

Discussion: . Soil treatment with fumigant nematicides is an effective option to reduce population densities of *M. ornatum* on blueberry replant sites. Methyl bromide is no longer available to blueberry growers, but 1-3,-dichloropropene may be a suitable alternative. Soil solarization is a partially effective control method that may be desirable to organic producers. Solarization likely will need to be combined with other organic methods to achieve an acceptable level of control. A 2-3 fold increase in blueberry plant growth was observed during the first growing season in plots treated with soil fumigants. However, these experiments will need to be monitored for a period of at least 5 years, to determine if the resurgence of *M. ornatum* population densities over time will cause yield losses as the blueberry planting comes into production. Pest management research on a long-term perennial crop such as blueberry is a long-term commitment. The goal of this research is also to show positive long-term benefits from the application of post-plant nematicidal/insecticidal products in combination with pre-plant treatments. The results shown here are for the first growing season, after only one application of spirotetramat. The results to date for the application of a post-plant nematicide are very encouraging, with detectable effects on the nematode population, and an overall 23% increase in blueberry growth during the first growing season. This research plan is certainly worthy of further study, and should show more definitive results in subsequent growing seasons. Our goal is to keep the research in place until plantings enter production and commercial yields can be determined.

Impact Statement: Management tactics to reduce population densities of ring nematodes in replant situations have been identified and have been shown to be effective throughout the first growing season after planting. Telone II (1-3,-dichloropropene) can be recommended as a suitable replacement for methyl bromide, and soil solarization may be an acceptable tactic for organic blueberry growers. Blueberry plant growth was increased dramatically and very visibly by the use of pre-plant soil fumigants. Growers are becoming increasingly aware of the need for nematode control on replant sites and appropriate materials are available. The results from application of spirotetramat as a post-plant nematicide are encouraging after the first growing season, and this product may provide a tool for growers to limit the resurgence of *M. ornatum* population densities after they have been reduced by pre-plant soil fumigation.

Table 1. Effects of soil fumigation and solarization on *Mesocriconema ornatum* population densities and blueberry growth and vigor. Combined data from two blueberry replant sites, two varieties at each site in Appling and Bacon County, Georgia.

Treatment	*M. ornatum* per 100 cm^3 soil Pre-treat. Aug. 2011	Post-treat. Oct. 2011	May 2012	Plant volume (cm^3 X 10^3) Sept. 2012	Plant vigor***
Methyl bromide/ Chloropicrin 50:50 (448 kg/ha)*	498 a**	3 c	9 c	32.2 ab	3.2 a
1,3-Dichloropropene (107 kg/ha)	453 a	6 c	20 c	34.6 a	3.1 a
1,3-Dichloropropene (322 kg/ha)	444 a	0 c	19 c	26.4 bc	3.1 a
Soil solarization (77 days pre-fumigation)	177 b	140 b	79 b	23.7 c	2.8 b
Untreated (with plastic cover)	411 a	238 a	157 a	25.2 bc	2.8 b
Untreated (no plastic)	487 a	203 a	154 a	12.1 d	2.2 c

*Broadcast equivalent rates.
** Means within columns followed by the same letter are not significantly different ($P<0.05$). N=24 replicate plots.
***Visual plant vigor rating from 0 = dead to 5 = most healthy and vigorous appearance.

Citations:

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