

**Identification and management of blueberry (*Vaccinium* spp.) replant disease associated with ring nematodes (*Mesocriconema* spp.).**

Progress Report

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Research Proposal

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**Objectives:** To evaluate post-plant management of blueberry replant disease, associated with ring nematodes (*Mesocriconema* Spp.) with a foliar-applied nematicidal compound (Movento, Bayer CropScience), in combination with other management practices.

**Justification:** Blueberry production in Georgia has a farm gate value in excess of \$100 million dollars and accounts for almost one-third of the total fruit and nut crop value for the state. Most of this production is centered in southeastern Georgia. A slow decline in plant vigor and an associated replant disease has been observed on a number of blueberry farms in this area of Georgia, which led to an investigation of possible causes. Soil assays showed that a plant-parasitic nematode previously unreported on blueberry was associated with the diseased plant symptoms. Plant-parasitic nematodes are microscopic, soil-inhabiting, have a worm-like shape, and attack plant roots directly with their sharp, hollow stylets. It was determined that the nematodes found on blueberry in Georgia were in a group called ring nematodes (*Mesocriconema* spp.). On a perennial crop like blueberry, plant-parasitic nematodes can build up year after year, sometimes for a decade or more until population levels are high enough to cause damage. Symptoms of nematode damage include stunting, yellowing, shoot death and eventually plant death. If a grower plants young blueberry plants back into a nematode-infested soil, damage in the replanted area may be immediate and severe – a replant disease. Commercial blueberry acreage has increased dramatically over recent years, and at the same time, older farms are being replanted. Observations by growers, county agents, and specialists have identified poor growth, yellowing, and stunting associated with blueberry replant areas. Symptoms observed on blueberry were similar to those seen in peach tree short-life disease, in which ring nematodes (*Mesocriconema* spp.) have also been implicated. Subsequent to these field experiments, ring nematodes were collected from infested grower fields and applied to greenhouse pots and field microplots. In these more controlled experiments, it was again demonstrated that blueberry is a host for ring nematodes, and that the nematodes reduce plant vigor (Jagdale et. al. 2010).

In 2010, after establishing that ring nematodes were associated with blueberry replant disease, a survey was conducted of plant-parasitic nematodes infesting commercial blueberry fields in Georgia. Soil assays were done in June and November. Remarkably, 48% of the blueberry farms sampled in Georgia were infested with ring nematodes in the June sampling, and the percentage of farms with ring nematodes had increased to 52 % by November 2010 (Jagdale et. al. 2011). For the blueberry survey sample areas that had ring nematodes present in the June survey, the mean nematode population density was 290/ 100 cm<sup>3</sup> soil, and had increased to 400/ 100 cm<sup>3</sup> soil in the November samples, for a 36% overall increase in ring nematode counts. 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 / 100cm<sup>3</sup> soil (Davis, R.F. 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. Due to the widespread distribution of ring nematodes in blueberry, and the demonstrated pathogenicity of this species, blueberry replant disease could become a major limitation to continued production on existing farms.

Two preliminary experiments were established in June, 2008, where randomized plots of replanted blueberry were pre-treated with nematicidal soil fumigants. In these experiments, ring nematode numbers and plant vigor were determined and



Figure 1. Blueberry on a replant disease site treated with methyl bromide (left) and untreated control (right)

compared to untreated control plots. Positive results were observed both for Telone (1-3 dichloropropene), which controls primarily nematodes, and methyl bromide, which is a biocide and may also control other pathogenic organisms. A follow-up assessment was performed for the experiment in Homerville in June 2010. Two years after initial treatment and planting, ring nematode numbers were still lower, and plant vigor was higher for all the fumigant treatments as compared to the untreated controls with no plastic cover. Unexpectedly, the plots that were covered with plastic film, but not treated with any soil fumigants also had lower nematode numbers and higher plant vigor than the untreated, uncovered controls. It should also be noted that the ring nematode populations were increasing in the treated plots, and were already at levels that would be damaging to plant growth and yield. Blueberry yields and ring nematode population levels were subsequently determined in June 2011 for plots treated with methyl bromide and for the untreated control plots. Three years after planting, blueberry yield per plant was 300% greater in plots treated with methyl bromide/ chloropicrin, as compared to untreated controls (Fig. 2). Ring nematode population levels were 61% lower in plots treated with methyl bromide/ chloropicrin, as compared to untreated controls. However, ring nematode population densities had built up to more than 300/ 100 cm<sup>3</sup> soil in the fumigated plots over the three years. This density of nematodes is potentially damaging to blueberry, and the populations will continue to increase every year. It is apparent that soil fumigation offers only a temporary reduction in ring nematode population densities. It remains to be determined how long the higher productivity of treated blueberry plants will be extended.

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. It is possible to delay the onset of blueberry replant disease by application of soil fumigants, with considerable additional cost, but eventually the ring nematode will come back, and plant vigor will suffer, thus shortening the life of the planting. At this time there is no post-plant nematode control method available for blueberry. A post-plant control would allow the grower to recover from undetected infestations of ring nematode, and help to maintain healthy plant vigor throughout the expected life of the planting. This project will evaluate pre-plant soil treatments in combination with a new foliar-applied post-plant insecticide/ nematicide, Movento (spirotetramat, Bayer CropScience), along with additional management practices for control of nematodes on blueberry.

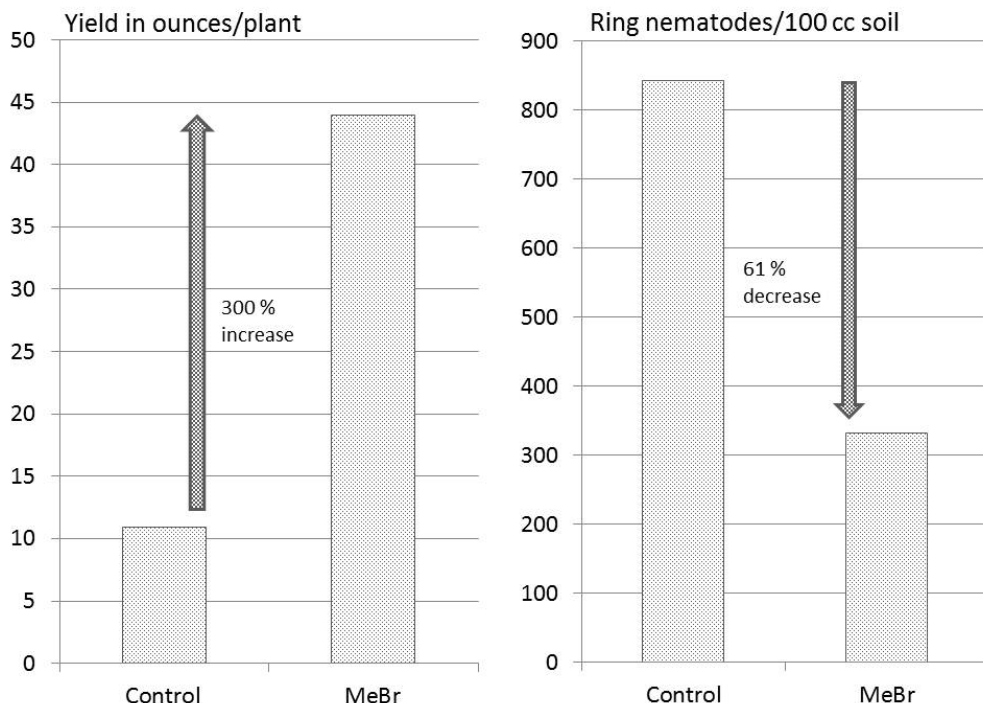


Figure 2. Blueberry yield and ring nematode (*Mesocriconema* spp.) population densities in plots treated with methyl bromide (MeBr) and untreated control plots. Plots were treated in June 2008, and data were collected in June 2011.

Movento has demonstrated nematicidal activity in post-plant foliar application on walnut and grape (McKenry, M. 2009, McKenzie, M. unpublished). The nematode problems and crop production practices of these crops is similar enough to blueberry to indicate that Movento treatments may be effective against blueberry replant disease.

**Methodologies:** Due to the potentially devastating impact of ring nematodes on blueberry production in Georgia, long-term nematode management trials were installed on blueberry farms in southeastern Georgia during 2011. Experimental plots were established on two blueberry farms located in Appling and Bacon counties that were infested with ring nematodes. Treatments included pre-plant fumigation with methyl bromide (50%)/ chloropicrin (50%) at 400 lbs/ acre, Telone II at 10 and 30 gallons/ acre, pre-plant solarization of the soil for 77 days, and untreated controls, with all treatments to be combined with and without Movento post-plant treatments at the recommended rate of 10 fl. oz. per acre. Repeated treatments will be applied at approximately 3 month intervals. The experimental design was a randomized split-plot design with 6 replicates at each site. Blueberry plants will be managed as recommended for the area. Plant-parasitic nematode population densities were assayed prior to solarization, prior to soil fumigation, and post fumigation. The first application of Movento will be in the spring when plants are actively growing, and at 6 month intervals after that. Nematode populations were assayed by systematically collecting 10 soil cores per plot from the blueberry root zone of each plot. Each sample was mixed, and a 100 cm<sup>3</sup> subsample was removed for assay. Plant-parasitic nematodes were collected from the soil by sieving and centrifugation (Jenkins, W.R., 1964), and

the nematodes were identified and counted with a stereomicroscope. Subsequent nematode population assays will be performed at regular intervals to track ring nematode population increases. Plant vigor ratings and plant heights will be determined on the nematode sampling dates. Data will be analyzed with analysis of variance, followed by mean separation to determine the efficacy of the treatments. Regression analysis will be used to determine the relationship of blueberry growth to ring nematode population densities.

### **Results:**

Research plots have been established on 2 farms, soil solarization has been completed, and pre-plant nematicide treatments have been applied. Blueberry planting is in progress and will be completed by end of January 2012. Application of the post-plant nematicide will begin in March 2012, and will continue for at least 1 year after that. Nematode assays were completed pre-solarization, pre-fumigation, and post-fumigation. Nematode assays and assessments of plant vigor will be conducted at regular intervals until the experiment is terminated. For the solarization plots, 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 surfaces on May 25, and removed on August 11. The maximum soil-surface temperature recorded under plastic was 152F. Soil fumigants were applied in late August. Treated plots were aerated after 3 weeks, and planting was begun in late October. One of the research sites has been planted with southern highbush varieties Star and Farthing. The second site has not yet been planted. Soil assays collected before and after application of treatments showed that ring nematode population densities were significantly reduced by all treatments (Table 1). Soil fumigation treatments lowered the ring nematode counts to nearly zero, whereas soil solarization alone reduced the nematode counts by more than 50% prior to the application of fumigants. Ring nematode counts were also lower in the untreated plots after the fumigation procedures were completed due to cultivation, bedding, soil mixing and lack of a host plant during the interim time period.

### **Conclusions:**

Soil fumigation with either methyl bromide/chloropicrin or Telone II dramatically reduced the population densities of ring nematodes. Both rates of Telone II were extremely effective. Soil solarization alone, a tactic that could be used by organic growers, reduced the ring nematode counts to moderate levels, but this reduction may not be sufficient to protect the plants from subsequent damage. It is expected that the nematode populations will rebound in all of the treatments after planting. It will be several years before the long-term success of the soil fumigation and solarization treatments can be determined.

### **Impact Statement:**

Management tactics to reduce population densities of ring nematodes in replant situations have been identified. Telone II can be recommended as a suitable replacement for methyl bromide, and soil solarization may be an acceptable tactic for organic blueberry growers.

Table 1. Effects of soil fumigation and solarization on Ring nematode (*Mesocriconema* spp.) population densities. Combined data from two blueberry replant sites in Appling and Bacon County, Georgia.

Treatment	Ring nematodes per 100 cm <sup>3</sup> soil	
	Pre-fumigation	Post-fumigation
Methyl bromide/ Cloropicrin (400 lbs/ acre)	498 a*	3 c
Telone II (10 gal/ acre)	453 a	6 c
Telone II (30 gal/ acre)	444 a	0 c
Soil solarization (77 days pre- fumigation)	177 b	140 b
Untreated (with plastic cover)	411 a	238 a
Untreated (no plastic)	487 a	203 a

\* Means within columns followed by the same letter are not significantly different (P<0.05). N=24 replicate plots.

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