2013 SRSFC Project Final Report

SRSFC Project # 2013-05

Title: Evaluation of blueberry (*Vaccinium* spp.) cultivars for susceptibility to replant disease associated with ring nematodes (*Mesocriconema ornatum*).

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Objectives: To evaluate susceptibility of rabbiteye and southern highbush blueberry cultivars to replant disease associated with ring nematodes (*Mesocriconema ornatum*).

Justification: Blueberry (*Vaccinium* spp.) replant disease is an increasing problem as growers are replacing older plantings more frequently. Blueberry replant disease is characterized by poor growth, yellowing, stunting, and severely reduced yields in replanted areas. 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 nematode (*Mesocriconema ornatum*) in the soil around the affected plants. Experiments with pre-plant fumigant nematicides demonstrated that plant growth, vigor, and yield were significantly higher where nematode densities were reduced by nematicidal treatments (Noe, et. al. 2012). 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. 2013).

In 2010, two surveys of plant-parasitic nematodes infesting commercial blueberry fields were conducted 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 cm^3 soil in the farms that had the species present in June, and a mean density of 400/ 100 cm^3 soil in the follow-up survey in November, for a 36% overall increase in ring nematode counts over 5 months (Jagdale et. al., 2013). 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^3 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. It may be possible to delay the onset of blueberry replant disease by application of soil fumigants, but eventually the ring nematode will reproduce and increase to damaging population density levels. The ultimate economic success of preplant treatments for long-term control of nematodes in blueberry has not yet been determined.

Previous projects funded with support from the Southern Region Small Fruit Consortium have evaluated preplant fumigant nematicides, soil solarization, and post-plant nematicides to manage plant-parasitic nematodes on blueberry replant sites (Noe, et. al. 2012). Our SRSFC project for 2013 was to evaluate selected rabbiteye and southern highbush varieties for resistance or tolerance to *M. ornatum*. Additional management options are needed for long-term blueberry production on replant sites. It is likely that a successful long-term solution for replant disease,

Figure 1. Cultivar evaluation plots on a blueberry replant site. Rabbiteye and highbush cultivars are shown. Photo taken May, 2013.

especially on southern highbush, will include a combination of tactics, including preplant soil fumigation, pine bark soil amendments, and selection of the most tolerant/ resistant blueberry varieties.

Methodologies:

Rabbiteye cultivars, including Brightwell, Ochlocknee, Powder Blue, Premiere, and Vernon, and southern highbush cultivars, including Emerald, Farthing, Rebel, Star and Legacy were evaluated for resistance and tolerance to blueberry replant disease in field plots (Figure 1). Research plots were established at replant sites on two blueberry farms that are naturally infested with ring nematodes. Six replicate plots of each cultivar were arranged in a randomized-complete-block design. Each plot consisted of 4 plants in a row spaced 120 cm apart. Rows were spaced 3 m apart. Plots were planted during the fall, 2011. Nematode assays and assessments of plant size and vigor were conducted at regular intervals. Nematode populations were assayed by systematically collecting 5 soil cores per plot from the blueberry root zones. Each sample was mixed, and a 100 cm^3 subsample was removed for assay. Plant-parasitic nematodes were collected from the soil by sieving and centrifugation, and the nematodes were identified and counted with a stereomicroscope (Jenkins, 1964). Plant vigor ratings and plant volumes were determined on a scale of 1 to 5, 1 = poor vigor, 5 = healthiest. Percent plant survival data were also collected as (number of surviving plants / number planted (4)) * 100. Research plots were cultivated and managed as is typical for the area. Data were analyzed with analysis of variance, followed by mean separation to determine differences among cultivars and cultivar types ($P<0.05$).

Results:

At the Appling County site, differences were observed among cultivars in the numbers of ring nematodes at both the May and October sampling dates (Table 1). Nematode population densities increased between the May and October sampling for all of the cultivars, but the increases were most dramatic for the highbush cultivars. Ring nematode counts in excess of 1,000 per 100 cm^3 soil would be considered extremely high with respect to potential damage to the host. Plant growth parameters showed the devastating impact of replant disease on highbush cultivars. Plant volumes and vigor were much lower than the levels observed for rabbiteye cultivars, and plant survival was also considerably lower in the highbush plots. Within the highbush group, at 2 years after planting, only 33% of the Emerald plants were still alive, whereas 100% of the Farthing plants survived. However, when the plant volume of the Farthing plants are compared to the rabbiteye cultivars, Farthing was obviously heavily damaged by the replant disease. Plant survival rates were very high in the rabbiteye cultivars. Overall ring nematode population densities were lower at the Bacon County site, but the effects of replant disease on highbush cultivars was similar to the Appling County site (Table 2). In general, plant growth parameters were lower for all cultivars at the Bacon County site, as compared to the Appling County site. Note that among the highbush cultivars, Farthing had the highest survival rate and Emerald had the lowest survival rate at both locations. However, plant growth rates would not produce an economically viable planting for any of the highbush cultivars. The rabbiteye cultivar Premier also performed well at both locations. A combined comparison of highbush and rabbiteye types showed that the highbush types had higher nematode numbers and lower plant growth parameters than the rabbiteye types at both sites (Table 3). In October 2013, highbush types supported 5 times more ring nematodes at Appling County, and 6 times more nematodes at Bacon County, than were supported by rabbiteye types. Conversely, rabbiteye plant growth was 17 times higher at Appling County and 4.2 times higher at Bacon County, than was recorded for highbush types.

Conclusions:

Replant disease is a devastating problem on highbush blueberry cultivars. If not managed, the disease can destroy an entire planting before entering production. Although differences were observed among highbush cultivars, none of those tested would perform adequately without using additional management practices for replant disease. Rabbiteye cultivars appeared more tolerant of the disease, but soil fumigation trials have shown that rabbiteye cultivars also suffer severe damage without additional disease management practices (Noe, et. al. 2012). A comparison of the 2 sites included in this study showed that extremely high numbers of ring nematodes are not required for the disease to manifest, but the differences between highbush and rabbiteye cultivars was greater under higher nematode pressure.

Impact:

Cultivar selection will be an essential part of managing replant disease in blueberry. Some cultivars performed better than others, but all may need additional disease management practices. Even more important than cultivar selection may be the decision to grow either highbush or rabbiteye types on a replant site. The type of planting may dictate which disease management

options would be required. This information will be available to growers as needed. An additional recommended practice is to conduct nematode soil assays prior to replanting any blueberry site in Georgia.

Table 1. Soil assay counts of ring nematode, *Mesocriconema ornatum*, and plant growth parameters of blueberry cultivars, *Vaccinium* spp., at Appling County, GA site.

	Number of nematodes/ 100 cm^3 soil		Plant growth parameters Oct 2013		
Cultivar	May 2013	Oct 2013	Plant volume cm^3 X 10^3	Plant Vigor[3]	Percent plants surviving
Southern Highbush					
Emerald	165 ab[1]	762 ab	-[2] -	0.7 d	33 c
Farthing	223 ab	1000 a	104 c	2.5 b	100 a
Legacy	151 ab	1204 a	65 c	2.3 b	88 a
Rebel	309 a	1192 a	50 c	1.4 c	67 b
Star	153 ab	606 ab	21 c	1.5 c	58 b
Rabbiteye					
Brightwell	135 ab	251 b	911 b	4.2 a	96 a
Ochlocknee	24 b	140 b	934 b	4.1 a	100 a
Powder Blue	35 b	127 b	1048 ab	4.3 a	96 a
Premier	120 ab	160 b	1670 a	4.4 a	100 a
Vernon	33 b	264 b	1135 ab	4.1 a	100 a

[1]Means with the same letter are not significantly different, $P<0.05$. Six replications of each cultivar.
[2]Insufficient surviving plants to calculate mean volume.
[3]Vigor rated on a scale of 1 to 5, 1 = poor vigor, 5 = healthiest.

Table 2. Soil assay counts of ring nematode, *Mesocriconema ornatum*, and plant growth parameters of blueberry cultivars, *Vaccinium* spp., at Bacon County, GA site.

	Number of nematodes/ 100 cm^3 soil		Plant growth parameters Oct 2013		
Cultivar	May 2013	Oct 2013	Plant volume cm^3 X 10^3	Plant Vigor[3]	Percent plants surviving
Southern Highbush					
Emerald	20 bc[1]	174 ab	-[2] -	0.4 b	29 d
Farthing	18 bc	41 b	101 b	2.0 ab	83 ab
Legacy	37 ab	160 ab	211 ab	2.1 ab	58 bcd
Rebel	43 a	76 ab	- -	2.1 ab	46 cd
Star	23 abc	202 a	112 b	1.3 b	67 abc
Rabbiteye					
Brightwell	14 c	20 b	634 ab	3.6 a	92 ab
Ochlocknee	26 abc	18 b	575 ab	3.8 a	96 a
Powder Blue	34 abc	19 b	498 ab	3.4 a	83 ab
Premier	19 bc	24 b	859 a	3.7 a	88 ab
Vernon	33 abc	29 b	871 a	3.4 a	100 a

[1]Means with the same letter are not significantly different, P<0.05. Six replications of each cultivar.
[2]Insufficient surviving plants to calculate mean volume.
[3]Vigor rated on a scale of 1 to 5, 1 = poor vigor, 5 = healthiest.

Table 3. Comparison of soil assay counts of ring nematode, *Mesocriconema ornatum*, and plant growth parameters of southern highbush and rabbiteye blueberry types at Appling and Bacon County, GA sites.

	Number of nematodes/ 100 cm^3 soil		Plant growth parameters Oct 2013		
	May 2013	Oct 2013	Plant volume cm^3 X 10^3	Plant Vigor[2]	Percent plants surviving
Appling County					
Southern Highbush	200 a[1]	953 a	67 b	1.7 b	69 b
Rabbiteye	70 b	189 b	1148 a	4.2 a	98 a
Bacon County					
Southern Highbush	28 a	134 a	149 b	1.6 b	57 b
Rabbiteye	25 a	22 b	688 a	3.6 a	92 a

[1]Means with the same letter are not significantly different, P<0.05. Thirty replications of each type.
[2]Vigor rated on a scale of 1 to 5, 1 = poor vigor, 5 = healthiest.

Citations:

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