

Title: Pre- and post-plant application of fluensulfone on blueberry (*Vaccinium* spp.) for management of replant disease caused by *Mesocriconema ornatum*.

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Name, Mailing and Email Address of Principal Investigators:

James P. Noe

Associate Professor of Plant Pathology
University of Georgia
Athens, GA 30602
Phone: (706) 542-1293
FAX: (706) 542-1262
Email: jpnoe@uga.edu

Phillip M. Brannen

Extension Plant Pathologist - Fruits
University of Georgia
Athens, GA 30602
Phone: (706) 542-1250
FAX: (706) 542-4102
Email: pbrannen@uga.edu

Ganpati B. Jagdale

Assistant Research Scientist - Nematology
University of Georgia
Athens, GA 30602
Phone: (706) 542-9144
FAX: (706) 542-5957
Email: gjbaldal@uga.edu

Objectives: To evaluate a newly-registered nematicide, Nimitz, for efficacy in extending blueberry productivity in replant disease fields.

Justification:

Blueberry (*Vaccinium* spp.) replant disease continues to be a major problem as growers are replacing older plantings with increasing frequency. Blueberry replant disease is characterized by poor growth, yellowing, stunting, and severely reduced yields in replanted areas (Brannen et. al 2014). Previous field trials have shown plant mortality rates as high as 71% in southern highbush plantings. Experiments with pre-plant fumigant nematicides demonstrated that plant growth, vigor, and yield were significantly higher where nematode densities were reduced by treatment with preplant soil fumigants (Noe et. al 2014a). A systematic survey of blueberry farms in Georgia showed that more than half the plantings had significant numbers of ring nematodes, *Mesocriconema* spp., present in the soil (Jagdale et. al. 2013). At this time, the only available effective treatment for plant-parasitic nematodes on blueberry is preplant fumigation with Telone (1-3 dichloropropene, Dow AgroSciences). Telone fumigation is very expensive (\$575 per acre), requires a delay before planting, may have to be done at a time that is inconvenient for the grower, and affects organic certification for the treated field. Preplant soil fumigation is only effective for a limited amount of time and the nematodes resurge to damaging levels in 2-3 years (Noe et. al 2014a). Preplant soil fumigation alone will not provide a long enough period of nematode control to allow profitable blueberry production. There is a critical need for an effective post-plant nematicide to extend the benefits of nematode control.

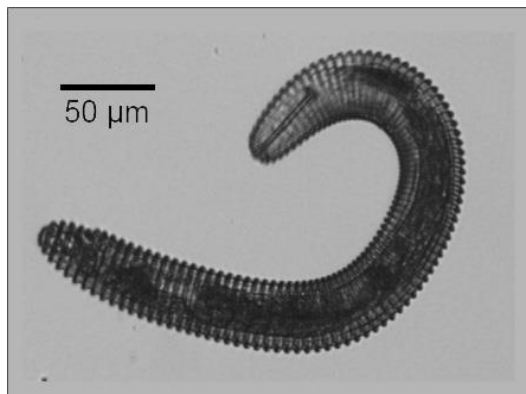


Figure 1. Ring nematode, *Mesocriconema ornatum*, associated with blueberry replant disease.

A new nematicidal compound, Nimitz (fluensulfone, Adama, Inc.), was registered in 2014. This is the first registration of a new, potentially efficacious post-plant nematicide in the US since 1974. Nimitz has shown promise in early trials on vegetables (Morris, et. al. 2012). Current registration is only for vegetables, but the anticipated tier 2 registration includes fruit crops. We need to evaluate the efficacy of this product on blueberry and determine the most effective application methods for our growers. It is likely that a successful long-term solution for replant disease, especially on southern highbush, will include a combination of tactics, including preplant soil fumigation, pine bark soil amendments, selection of the most tolerant/ resistant blueberry varieties, and periodic use of a post-plant nematicide.

Methodologies:

Efficacy of fluensulfone to control ring nematodes, *Mesocriconema ornatum*, will be evaluated in greenhouse trials, and at field experimental sites. In the greenhouse, 20 cm-dia-pots were filled with a greenhouse soil mix amended with nematode-infested soil from a grower's field, resulting in an *M. ornatum* population density of 200/ cm³ soil. Fluensulfone at rates of

1.96 and 3.92 kg/ha was applied with 300 ml water per pot as a drench. Control pots received 300 ml of water. Five days after application, rabbiteye blueberry cv. Vernon seedlings were planted in each pot. Pots were maintained on greenhouse benches with watering and fertilization as needed. Population densities of *M. ornatum* were determined at 40 and 100 days after fluensulfone application. At 100 days after application, the experiments were terminated and dry shoot weights and plant heights were determined for each pot. Two experimental trials were completed with 8 replications of each treatment in each trial.

In the field trials, fluensulfone was evaluated both as a pre-plant incorporated and as a post-plant drip-irrigation applied nematicide. Two experimental trials for each application method were completed, with one trial of each application type located in Bacon and Clinch County, GA.

For the post-plant application trial, 2 sites were selected with established blueberry plantings that were naturally infested with high numbers of *M. ornatum*. Fluensulfone was applied through 1.3 cm drip tubes placed on either side of the plants. Three treatments consisted of a single application at a rate of 1.96 kg/ha, two applications at a rate of 1.96 kg/ha, and a water control, run through the tubes with 57 liters of water per plot. The second application was done 90 days after the first application. The selected sites had been planted with rabbiteye cv. Premier in Clinch County and rabbiteye cv. Brightwell in Bacon County. Each plot consisted of 4 plants, with 6 replications per treatment at each experimental site arranged in a randomized-complete-block design. Research plots were cultivated and managed as is typical for the area. Plant-parasitic nematode assays and assessments of plant size and vigor were completed at regular intervals. Nematode populations were assayed by systematically collecting 10 soil cores per plot from the blueberry root zones. Each sample was mixed, and a 100 cm³ 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. Data were analyzed with analysis of variance, followed by mean separation to determine the differences among treatments.

For the pre-plant incorporated trials, treatments with fluensulfone at 2.8 and 5.6 kg/ha were applied to prepared beds with a backpack sprayer and tilled to 15-cm-depth and then irrigated with 1.3 cm water. Control plots were tilled and irrigated. After treatment plots were planted with rabbiteye cv. Vernon in Clinch County and southern highbush cv. Farthing in Bacon County. Each plot consisted of 5 plants, with 6 replications per treatment at each experimental site arranged in a randomized-complete-block design. Research plots were cultivated and managed as is typical for the area. Plant-parasitic nematode assays and assessments of plant size and vigor were completed at regular intervals. Data were analyzed with analysis of variance, followed by mean separation to determine the differences among treatments.

Results:

Two pre-plant experimental trials were completed in the greenhouse. In one of the trials, treatment with fluensulfone at 3.92 kg/ha reduced population densities of *M. ornatum* at 40 days after treatment, and increased both dry shoot weight and plant height of blueberry cv. Vernon (Table 1). In that same trial, the population densities of *M. ornatum* increased in the treated pots

after the 40 day assays, and at 100 days after treatment with fluensulfone there were no significant differences among treatments. No significant differences among treatments were detected in the second greenhouse trial.

Two sets of field experiments were completed, one with pre-plant application and one with post-plant application of fluensulfone, with two trials for each experiment. In one of the post-plant application trials, fluensulfone application at 1.96 kg/ha through irrigation tubing decreased population densities of *M. ornatum* at 75 days after treatment (Table 2). For the dual-application treatment, a second application of fluensulfone was made 90 days after the first. At 90 days after the second application, population densities of *M. ornatum* in both the single and dual application treatments were significantly lower than in the control plots. Plant growth was significantly greater (44%) in plots that received a single application of fluensulfone in volume estimates taken at 180 days after application. In the second post-plant application experimental trial, and in both pre-plant application trials, treatment with fluensulfone did not significantly increase plant growth, or reduce population densities of *M. ornatum* compared to control treatments.

Conclusions:

Fluensulfone showed promise as a post-plant application to manage ring nematodes on blueberry. In the two trials where significant results were reported, the effects were positive enough to indicate that the productive life of a blueberry planting with ring nematodes could be extended by use of this product. However, in four of the six experimental trials no significant results were observed. Clearly more work is needed to determine optimal application methods and timing to achieve consistent control results. Also, soil types may play a major role in the movement and activity of this product, and those effects will need to be identified to predict best practices for the use of fluensulfone. The results of these studies should be interpreted in light of comparisons to other products available for use post-plant on blueberry for control of nematodes. At this time, there are no other effective products available on the market for post-plant control of nematodes on blueberry. There is nothing to use for comparison. The only effective nematicidal product is Telone (1-3 dichloropropene) which can only be used pre-plant. Where Telone is used, the effects are temporary, and eventually the nematodes reproduce enough to reach damaging levels. Fluensulfone needs further study, before a determination can be made as to its value to blueberry growers.

Impact Statement:

These studies showed promise for fluensulfone as a post-plant nematicidal product on blueberry. If more consistent results can be obtained, the eventual availability of an effective post-plant control measure would extend the productive life of blueberry plantings with replant disease. Significant plant growth increases were observed in the two trials where the product was effective. Fluensulfone could also provide a means to extend the life of a planting where Telone could not be used, such as in organic production areas. The value of additional productive years for affected plantings will depend on the values of future crops compared to the cost of replanting a site.

Table 1. Effect of fluensulfone on *Mesocriconema ornatum* population densities on blueberry cv. Vernon in a greenhouse trial.

Treatment	<i>M. ornatum</i> / 100 cm ³		100 DAA	
	40 DAA*	100 DAA	Dry shoot weight (g)	Plant height (cm)
Nontreated control	60 a**	64 a	2.2 a	15 a
Fluensulfone 1.96 kg/ha	54 ab	77 a	3.3 ab	21 ab
Fluensulfone 3.92 kg/ha	40 b	66 a	4.2 b	25 b

* Days after application

** Means within columns followed by the same letter are not significantly different (P<0.1). N=8 replicates.

Table 2. Effect of post-plant applications of fluensulfone on *Mesocriconema ornatum* population densities on blueberry cv. Premier at a Clinch County, GA site.

Treatment	<i>M. ornatum</i> / 100 cm ³		Plant volume (cm ³)
	75 DAA*	180 DAA	180 DAA
Nontreated control	1343 a**	1493 a	1611 a
Fluensulfone 1.96 kg/ha	893 b	979 b	2319 b
Fluensulfone 1.96 kg/ha X 2***	977 ab	864 b	2105 ab

* Days after first fluensulfone application.

** Means within columns followed by the same letter are not significantly different (P<0.1). N=6 replicates.

*** Second application was 90 days after the first application.

Citations:

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