ASSESSMENT OF NEMACUR-ALTERNATIVES FOR EFFICACY AGAINST PLANT PARASITIC NEMATODES, 2013

FINAL REPORT

Robert L. Wick

Stockbridge School of Agriculture

University of Massachusetts

Introduction

Nematodes cause significant damage to various golf courses throughout New England. We have lost Nemacur (fenamiphos) as a viable treatment for nematodes. There have been a number of alternative products that have emerged on the market for controlling nematodes; some are in the experimental stage and some are commercially-available. All claim to be effective; however, in almost all cases they have not performed as promised when applied at labeled rates. Two new, commercially available products for nematodes on turfgrasses are Agri-Terra (trialed as Agri-Trap in this report) and Nemitol. Both of these materials have low toxicity to the applicator and their companies claim promising results for controlling nematodes.

Agri-Terra (Agri-Trap) has been reported to reduce populations of cyst and root-knot nematodes in field trials (1, 2). Cal-Agri Products information states: "… a broad-spectrum nematicide that is highly effective against many genera of plant parasitic nematodes when applied at-plant to shallow rooted crops, and post-plant to turf. No re-entry restriction is required." Agri-Terra is potassium mono-phosphate, polysaccharides and surfactants. Cal Agri Products claims that it kills nematodes by covering the cuticle of the nematode.

Nemitol is a mixture of 0.42% capsaicin and 3.7% ally isothiocyanate. The Engage Agro label states that it repels and controls nematodes.

Promax, a 3.5% thyme oil formulation is an OMRI listed product sold by Huma Gro and manufactured by Bio Huma Nectics Inc. From Huma Nectics advertisement: "OMRI® listed as an organic control of parasitic nematodes and soil borne diseases through contact activities and has systemic residual control. PROMAX™ works for the control of Nematodes as a cell membrane disruptor" (3).

Neemix is 4.5% azadirachtin. Azadirachtin is a large complex molecule found in neem seeds of *Schistocerca gregaria* a leguminous tree that grows in South Asia. Azadirachtin has long been known to have insecticidal activity.

Methods and Results

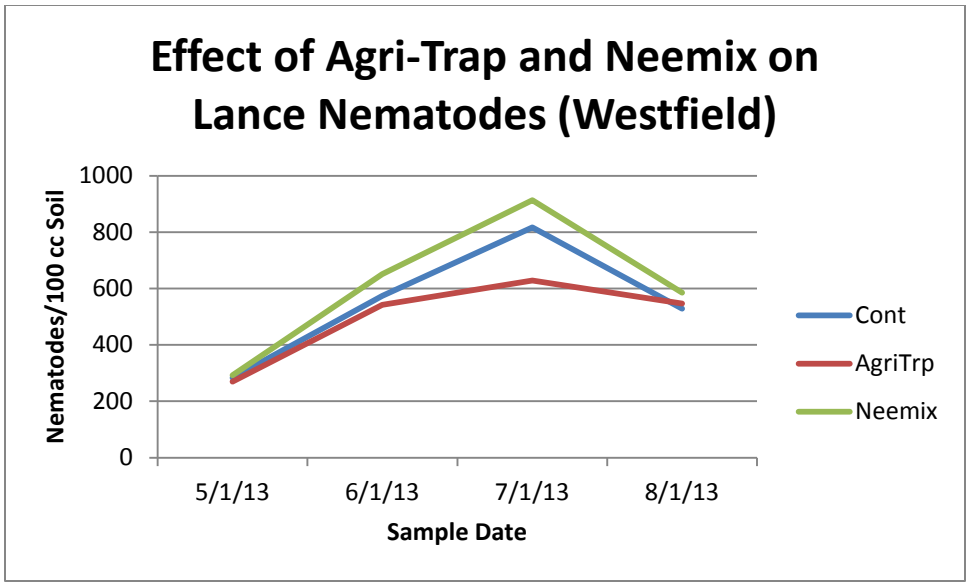
Evaluation of Agri-Trap® and Neemix® for controlling plant parasitic nematodes in golf greens

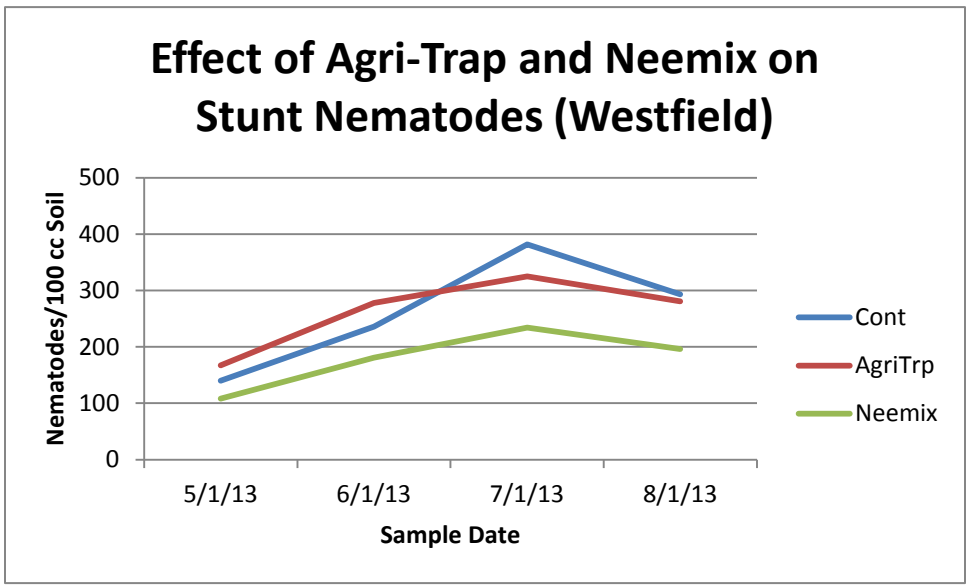
A golf green in Westfield, Massachusetts was treated to evaluate Agri-Ttrap® (potassium mono-phosphate, polysaccharides and surfactants) and Neemix® (4.5% azadirachtin). The green was approximately 58 years old and consisted of a mixture of annual bluegrass and creeping bentgrass. Sand top-dressing over the years resulted in approximately 4 in. of a loamy sand (USDA criteria) perched on native soil. Mechanical analysis of the top 4 in. showed it to be 86.4% sand, 10.3% silt, and 3.36% clay. Agr-Trap was applied to each plot in a 2.0 gal watering can at the rate of 3 fl oz/1,000 sq ft. Application was followed by 3 gal of clear water per plot; a total of 0.224 in. of water. Neemix was applied similarly at the rate of 8.4 oz/1,000 sq ft but in a total of 4 gallons of water. Applications of both products were made on: 21 May, 31 May, 18 Jun and 7, Jul. The treatment and control were replicated six times (plots were 6 ft x 6 ft) and completely randomized. Soil was sampled on 16 May, 18 Jun, 25 Jul and 29 Aug by removing 10, 1 x 4 in. soil cores per plot and bulking together. Nematodes were recovered by wet sieving/sugar flotation and identified to genus. *Tylenchorhynchus* (stunt) and *Hoplolaimus* (lance) nematodes were assessed. The data were subjected to analysis of variance.

There were no differences in turf color or thinning among the treatments. There were no significant differences in nematode populations between treatments and the control.

	Hoplolaimus/6.2 cu in. (100 cc) soil			
Treatment and rate/1,000 sq ft	16 May	18 Jun	25 Jul	29 Aug
Control	283	574	817	528
Agri-Trap 3 fl oz	270	542	628	547
Neemix 9 fl oz	292	651	914	585

	Tylenchorhynchus/6.2 cu in. (100 cc) soil			
Treatment and rate/1,000 sq ft	16 May	18 Jun	25 Jul	29 Aug
Control	140	236	328	293
Agri-Trap3 fl oz	167	278	325	281
Neemix 9 fl oz	108	181	234	196


Effect of Agri-Trap and Neemix on Lance Nematodes (Westfield)
Nematodes/100 cc Soil
1000
800
600
400
200
0
5/1/13
6/1/13
7/1/13
8/1/13
Sample Date
Cont
AgriTrp
Neemix


Effect of Agri-Trap and Neemix on Stunt Nematodes (Westfield)
Nematodes/100 cc Soil
500
400
300
200
100
0
5/1/13
6/1/13
7/1/13
8/1/13
Sample Date
Cont
AgriTrp
Neemix

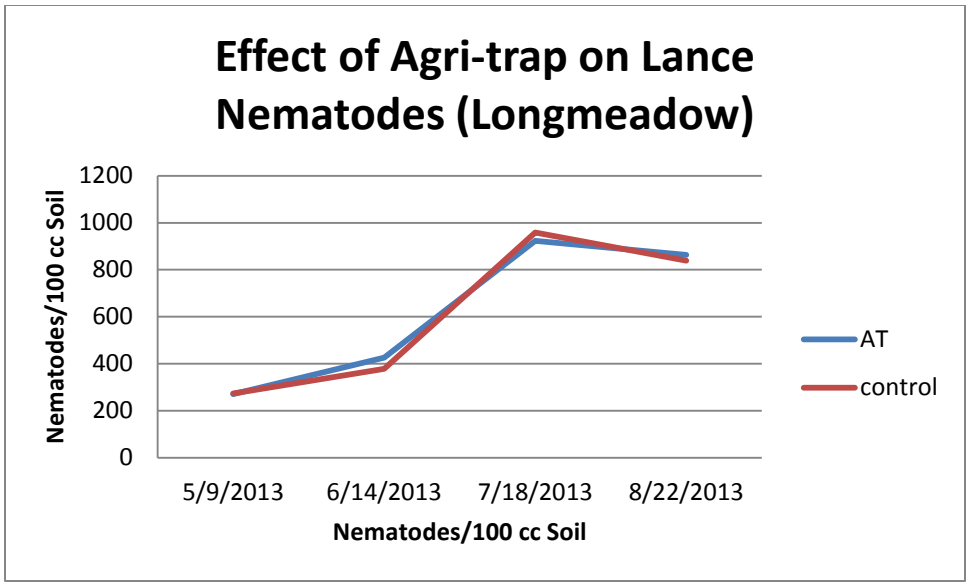
Evaluation of Agri-trap® for controlling plant parasitic nematodes in golf greens

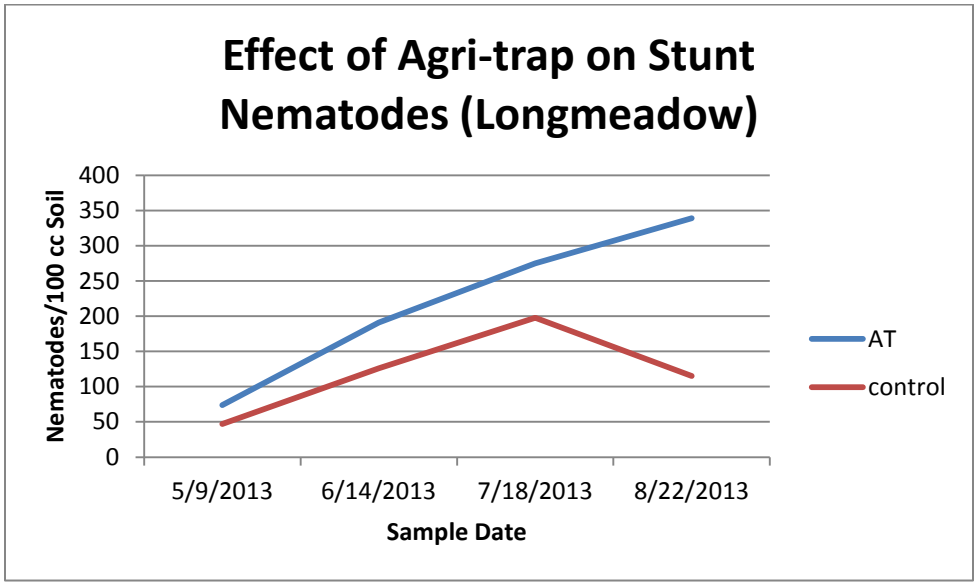
A golf green in Longmeadow, Massachusetts was treated to evaluate Agri-trap® (potassium mono-phosphate, polysaccharides and surfactants). The green was approximately 48 years old and consisted of a mixture of annual bluegrass and creeping bentgrass. Sand top-dressing over the years resulted in approximately 4 in. of a loamy sand (USDA criteria) perched on native soil. Mechanical analysis of the top 4 in. showed it to be 75.6% sand, 20.7% silt, and 3.7% clay. Agri-trap was applied to each plot in a 2.0 gal watering can at the rate of 3 fl oz/1,000 sq ft. Application was followed by 3 gal of clear water per plot; a total of 0.224 in. of water. Applications were made on: 17 May, 30 May, 13 Jun, and 18 Jul. The treatment and control were replicated six times (plots were 6 ft x 6 ft) and completely randomized. Soil was sampled on 9 May, 13 Jun, 18 Jul and 22 Aug by removing 10, 1 x 4 in. soil cores per plot and bulking together. Nematodes were recovered by wet sieving/sugar flotation and identified to genus. *Tylenchorhynchus* (stunt) and *Hoplolaimus* (lance) nematodes were assessed. The data were subjected to analysis of variance.

There were no differences in turf color or thinning among the treatments. There were no significant differences in lance nematode populations between treatments and the control. There was a significant drop in the stunt population control compared to the Agri-trap treatment on 22 Aug; this was probably an artifact.

	Hoplolaimus/6.2 cu in. (100 cc) soil			
Treatment and rate/1,000 sq ft	9 May	14 Jun	18 Jul	22 Aug
Control	273	378	958	839
Agri-trap 3 fl oz	270	426	923	839

	Tylenchorhynchus/6.2 cu in. (100 cc) soil			
Treatment and rate/1,000 sq ft	9 May	14 Jun	18 Jul	22 Aug
Control	47 a	126 a	198 a	115 a
Agri-trap3 fl oz	74 a	191 a	275 a	339 b


Effect of Agri-trap on Lance Nematodes (Longmeadow)
Nematodes/100 cc Soil
1200
1000
800
600
400
200
0
5/9/2013
6/14/2013
7/18/2013
8/22/2013
Nematodes/100 cc Soil
AT
control


Effect of Agri-trap on Stunt Nematodes (Longmeadow)
Nematodes/100 cc Soil
400
350
300
250
200
150
100
50
0
5/9/2013
6/14/2013
7/18/2013
8/22/2013
Sample Date
AT
control

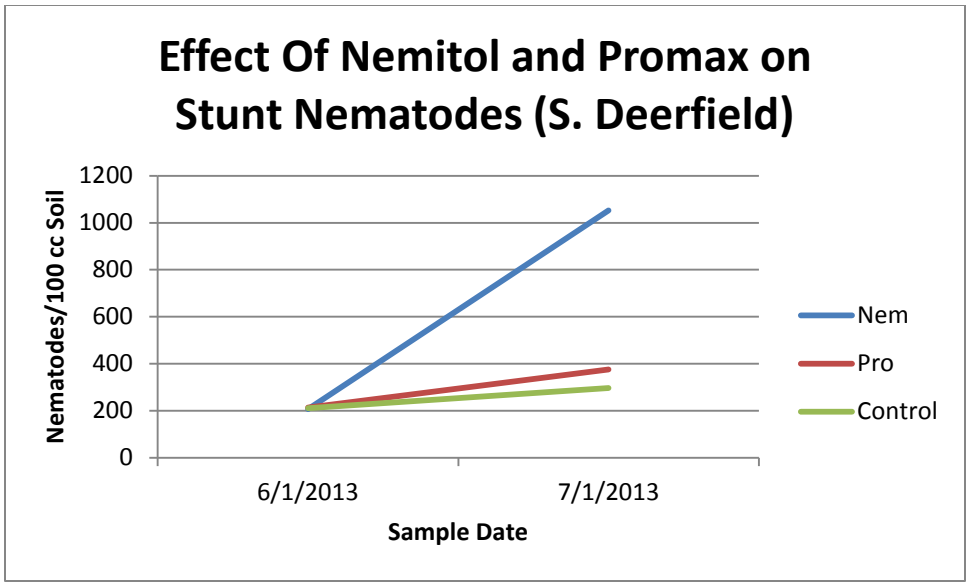
Evaluation of Nemitol® and Promax® for controlling plant parasitic nematodes in golf greens

A golf green in S. Deerfield, Massachusetts was treated to evaluate Nemitol® (0.42% capsaicin and 3.7% ally isothiocyanate) and Promax (3.5% thyme oil). The green was approximately 5 years old and consisted primarily of creeping bentgrass with some annual bluegrass. Mechanical analysis of the top 4 in. showed it to be 94.7% sand, 3.1% silt, and 2.2% clay. USDA textural class, sand. Treatments were applied 4 times at weekly intervals. Nemitol was applied to each plot in 2.0 gal water with a watering can at the rate of 10.3 fl oz/1,000 sq ft. with Integrate 20 (Tri block co polymer 15.25%, glucoethers 4.75%) at 3.3 fl oz/1000 sq ft. Subsequent applications of Nemitol had only 2.1 oz/1000 sq ft. of Integrate 20. Promax was applied to each plot in a 2.0 gal water can at the rate of 6.0 oz/1000 sq ft. All applications were followed by 2 gal of clear water per plot; a total of 0.18 in. of water. Applications were made on: 7 Jun, 13, Jun, 20 Jun and 27 Jun. The treatment and control were replicated six times (plots were 6 ft x 6 ft) and completely randomized. Soil was sampled on 6 Jun and 7 Jul by removing 10, 1 x 4 in. soil cores per plot and bulking together. Nematodes were recovered by wet sieving/sugar flotation and identified to genus. *Tylenchorhynchus* (stunt) nematodes were assessed. The data were subjected to analysis of variance.

There were no differences in turf color or thinning among the treatments. There was a significant difference in the stunt population between the Nemitol treatment and the control on 11Jul; the Nemitol treatment was nearly 5X higher than the control. The most likely explanation for the difference would be that the differences were an artifact due to highly unequal distribution of nematodes in several of the plots. The experiment could have been continued to better evaluate the Promax but it was felt that since four applications at weekly intervals did not show any suppression over the course of one month that Promax would not likely be an effective material to suppress nematodes.

	Tylenchorhynchus/6.2 cu in. (100 cc) soil	
Treatment and rate/1,000 sq ft	6 Jun	7 Jul
Control	210 a*	296 a
Nemitol 10.3 fl oz	207 a	1052 b
Promax 6.0 fl oz.....	213 a	375 a

**Means in a column followed by the same letter are not significantly different at $P = 0.05$ level according to LSD test.



Summary

Agri-Trap did not control lance or stunt nematodes at two different sites, Longmeadow MA and Westfield MA. This was surprising and disappointing considering positive reports from Louisiana State University with this product on root-knot and cyst nematodes (1). It may be worthwhile to trial this product at a higher rate or more applications; however, Agri-Trap was applied 3 times at one week intervals at the recommended rate. The apparent increase in stunt populations at the Westfield site was probably an artifact of the unequal distribution of nematodes in the soil, despite the fact that 10 subsamples from each of six replicated plots were taken.

Neemix failed to control stunt and lance nematodes at the Westfield site; and, this is consistent with results (not reported) from a previous year, and an earlier trial with a neem oil product. Nevertheless neem products have been shown to be effective insecticides.

Four applications of Nemitol did not control stunt nematodes at the S. Deerfield location, in fact, Nemitol treated plots had almost 5 times more stunt nematodes than untreated controls; and, this was after four weekly applications of the product. It is not likely that Nemitol stimulated the stunt nematode population; perhaps the control population was underestimated (unequal distribution) or suppressed (natural causes) or some other factor (natural or otherwise) inhibited the stunt nematodes in one or more of the control plots.

Four applications of Promax at weekly intervals did not control stunt nematodes at the S. Deerfield plots. Other natural oils trialed in earlier years also failed to control plant parasitic nematodes.

Despite the poor showing of these materials for the control of plant parasitic nematodes, they should not be ruled out for use in turfgrasses until these results have been corroborated by other researchers (under controlled, replicated conditions). Agri-trap has been shown to control

nematodes in field soil but perhaps the thatch in turfgrass ecosystems binds to the material thus preventing it from reaching the target. I would like to see Agri-trap trialed in turfgrasses again, perhaps during aerification or by injection into the soil. Neem products on the other hand have not fared well in this or previous trials carried out at the University of Massachusetts; I would not recommend this product for suppression of nematodes in turfgrasses. A product containing mustard oil, like Nemitol, resulted in greener, healthier appearing turf in a Florida trial but it did not reduce plant parasitic nematodes in FL. In the S. Deerfield trial, there was no apparent increase in turfgrass health or suppression of nematode populations; I would not recommend this product in turfgrasses. Promax did not reduce stunt nematodes after four weekly applications; perhaps it should be tested again but at this time I could not recommend this product for managing plant parasitic nematodes in turfgrasses.

Acknowledgments

I would like to thank Noah Adamo, Departmental Assistant and Nematology Technician for his contribution to these trials. I also thank superintendents Tony Sowers, Herb Watson, and UMass Joseph Troll Turf Research Facility Superintendent Thom Griffin. This research was supported by the New England Regional Turfgrass Foundation and UMass Extension.

Citations

1.) http://www.academia.edu/172304/Effect_of_Agri-Terra_on_Soil_and_Plant_Parasitic_Nematodes_Evidences_of_the_Physical_Mode_of_Action

2.) http://www.mbao.org/2007/Proceedings/073McGawleyEMsfor2007MBAO.pdf

3.) http://humagroturf.com/tag/organic-fungicide/