Use of Silver Nanoparticles for Nematode Control on the Bermudagrass Putting Green

Young-Ki Jo, J.L. Starr, and Youjun Deng
Texas A&M University

Turfgrass and Environmental Research Online
Volume 12, Number 2 | March-April 2013

Objectives:

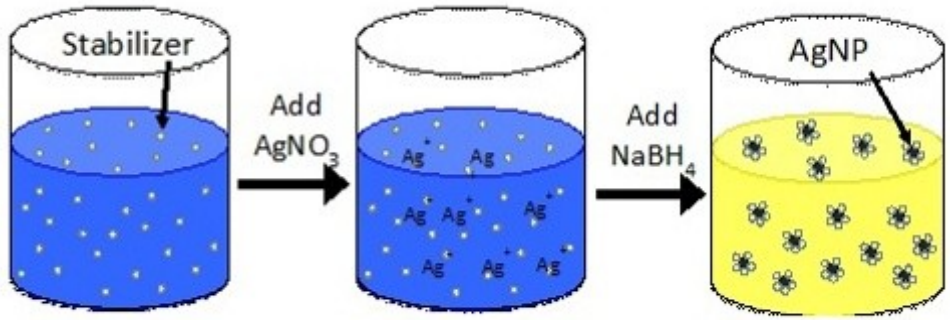
1. *Develop silver nanoparticle compounds with nematicidal activity.*
2. *Evaluate the efficacy of silver nanoparticles for control of nematode and improvement of turf quality in the bermudagrass putting green.*

Plant-parasitic nematodes can be a critical limiting factor for maintaining warm-season turfgrasses in golf courses. Nematode problems on intensively managed bermudagrass putting greens are reported frequently in Texas. The sole effective nematicide, Nemacur (fenamiphos), was banned from turfgrass use in 2008, and no comparable alternative is currently available. This lack of options for controlling nematode poses serious problems in turfgrass management, particularly for intensively managed golf course fairways and putting greens

To meet the aesthetic and recreational demands, golf course superintendents are heavily dependent on conventional synthetic pesticides. However, the use of pesticides poses substantial human health and environmental risks. Particularly, conventional synthetic nematicides including Nemacur are more toxic to humans and animals compared to other pesticides. Silver nanoparticle compounds that we have developed will help to alleviate these safety concerns by producing a universal, environmentally friendly nematicide at a comparable cost to conventional pesticides. The silver nanoparticles have multi-site modes of action to kill nematodes and will provide a great alternative of the conventional nematicides.

Nematicide efficacy was evaluated on two golf courses in the Houston metropolitan area and the turfgrass research field at Texas A&M University in 2011. The first field trial (Trial 1) was conducted on the bermudagrass cultivar 'Tifway 419' putting green (5-inch sand cap) at a golf course in Houston. This putting green was determined to be highly infested with sting nematodes (Belonolaimus spp.) before the field experiment began. The second and third trials (Trials 2 and 3) were conducted on the bermudagrass cultivar 'Miniverde' putting green (5-inch sand cap) at another golf course in Sugar Land. This putting green was highly infested with root-knot nematodes (Meloidogyne spp.) before the field experiment began. The fourth trial (Trial 4) was

Figure 1. Synthesis of silver nanoparticles for controlling nematodes in golf course turfgrasses.



TERO Vol. 12(2):22-24 | March-April 2013
USGA ID#: 2012-09-443
TGIF Number: 219651

conducted on the bermudagrass cultivar ´TifEagle´ putting green at Texas A&M University research farm in College Station infested with root–knot nematodes.

Individual plots measured 24–36 ft2 and were arranged in a randomized complete block design with four replications. Individual treatments were applied at a pressure of 40 psi using a CO2–pressurized boom sprayer equipped with two TeeJet 8002 nozzles. Silver nanoparticles (AgNP) were chemically synthesized in the lab. All nematicides were agitated by hand and applied at the equivalent of 2 gal dilute nematicide spray per 1000 ft2. Immediately after treatment, additional water was applied until the soil was saturated. Turf quality (1–9 scale: 6 = acceptable and 9 = best) were measured. In addition, to determine the change of nematode populations in turfgrass, composite soil and root samples were collected from each test plot using a standard 2.5 cm diameter soil probe. Soil cores were collected from each plot and mixed to form a composite sample. Nematodes will be extracted from each 100 cc soil sample using the modified Baermann funnel system, identified to genus, and counted using an inverted compound microscope.

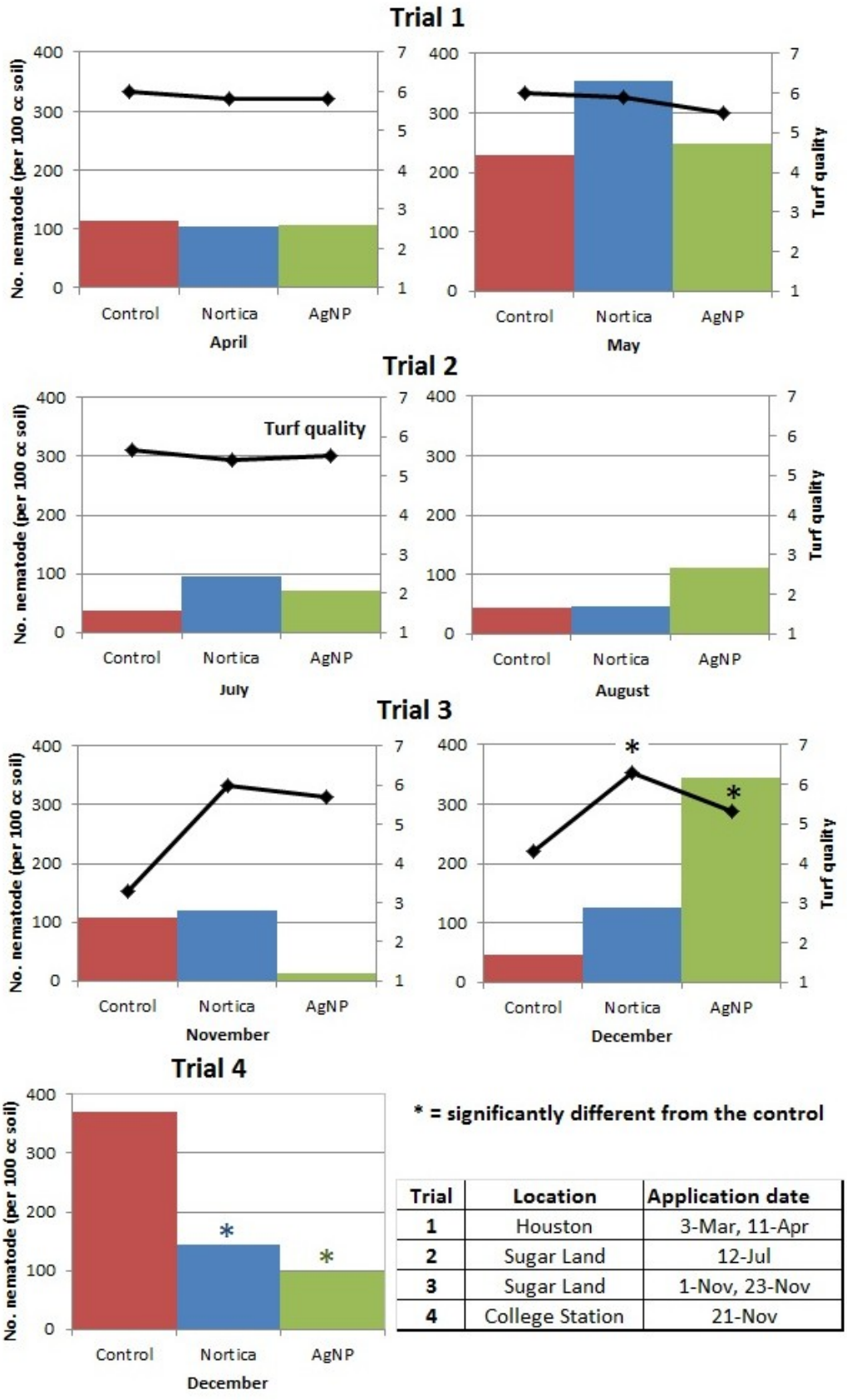
In the 2011 field trials, one or two applications of silver nanoparticles at 14–21 day intervals were evaluated and compared with the other commercial nematicide in terms of turfgrass quality and nematode population in the soil. Turfgrass quality was not directly associated with the number of nematodes in the soil. No nematode treatments significantly decreased nematode population compared with the untreated control in the spring and summer. However, the application of nematicides in November significantly reduced the nematode populations in Trial 4 or improved the turfgrass quality in Trial 3. Silver nanoparticles did not cause any phytotoxicity on turfgrass during these field experiments. Natural populations of nematode were highly variable by the season and the location. The follow–up field evaluations are ongoing in 2012 and will continue in 2013.

Summary Points

- One or two applications of silver nanoparticle in the spring and summer did not decrease nematode populations immediately compared with the untreated control.
- The application of silver nanoparticle in November significantly reduced nematode populations and improved the turfgrass quality.
- Silver nanoparticles did not cause any noticeable phytotoxicity on bermudagrass.
- Natural populations of nematode are not uniformly distributed and changed by the season and the location, and were not directly associated with turfgrass quality.

TERO Vol. 12(2):22–24 | March–April 2013
USGA ID#: 2012–09–443
TGIF Number: 219651

Figure 2. Nematicide efficacy was evaluated on two golf courses in the Houston metropolitan area and the turfgrass research field at Texas A&M University in 2011.



Trial	Location	Application date
1	Houston	3-Mar, 11-Apr
2	Sugar Land	12-Jul
3	Sugar Land	1-Nov, 23-Nov
4	College Station	21-Nov

TERO Vol. 12(2):22–24 | March–April 2013
USGA ID#: 2012–09–443
TGIF Number: 219651