

Precision, Site-Specific Application of Nematicides to Increase Yields, Reduce Costs, and Diminish Environmental Impacts .

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CRITICAL ISSUE

Nationwide, more than \$9,000,000,000 is lost each year to plant-parasitic nematodes. Hundreds of millions of dollars are lost in Arizona and the Western states. Surveys have shown that much of Arizona's cultivated land is infested to some degree. For example, all of the cotton acreage and 80 to 90% of our citrus is infested with one or more species. A survey of wine grapes in 1999 showed that every vineyard in the state also was attacked by plant-parasitic nematodes. No plant is immune to all nematodes and every crop grown in the West is subject to their depredations. Yield losses in melons can exceed 25 %, carrots 30%, and table grapes 20%. Our studies have shown that when nematodes are controlled, yield of cotton can be increased by more than 600 pounds of lint per acre (\$420 in 2003) while, at the same time, water usage and fertilizer applications can be reduced. In citrus, we have shown that lemon production can be increased by more than 11,000 pounds per acre by controlling plant-parasitic nematodes. Among the most serious of these soil-borne pests are the Root-knot nematodes, *Meloidogyne* spp. The recent demise of the 700-acre Verde Grande Vineyard in Pinal County can be attributed largely to declining yields due to *Meloidogyne incognita*. In many parts of the State, honeydew and cantaloupe production would not be possible without expensive soil fumigation with nematicides, and complete crop failures have been recorded in nematode-infested soil. In short, nematodes are easily the most important plant pathogens in Arizona.

Because the visual symptoms induced by nematodes feeding on roots are seldom specific (chlorosis, stunting, early wilting, etc.), nematode injury cannot be diagnosed by examination of the foliage or, in most cases, even the roots. Moreover, 99.9% of plant-parasitic nematodes are microscopic and invisible in the soil. Therefore, the only means of determining the distribution and population levels of nematodes is to take soil samples from the rhizosphere, extract the nematodes in the laboratory, and examine them under a microscope. This method is expensive, \$20-40 dollars per sample in private laboratories, and time-consuming, up to 30-40 minutes per sample. Consequently, it is not suited for the large-scale sampling and surveys necessary to map the distribution of nematodes in commercial fields. Even the soil-sampling process itself is prohibitive. Mapping nematode distribution in a 40-acre block could require as many as 5000 samples for statistical reliability.

As a consequence of this shortcoming, economic control of plant-parasitic nematodes is limited by the technology used to detect the presence of nematodes in soil. Current methods of nematicide application rely on treating entire fields, regardless of nematode distribution within the treated area. Thus, considerable nematicide may be wasted on areas that do not pose a nematode threat. GPS-guided, precision application of nematicides offers a means of reducing

this waste, increasing the return on investment of nematicides, and lessening their environmental impact. The technology is available and easily adapted to nematode control.

This project proposes to determine nematode distribution in infested fields with GPS-coupled yield monitors. Correlation of yield with nematode population levels will be determined by sampling. The resulting yield/nematode maps will then be utilized to guide GPS-equipped tractors for precision application of nematicides.

OUTCOMES

Precision application of nematicides only to nematode-infested areas will increase yields at reduced cost and environmental impact. Successful implementation of this methodology will give Arizona's cotton growers a competitive edge and the technology should be easily adaptable to other crops where yield monitors are employed.

EVALUATION

This study will demonstrate that nematode distribution in infested fields can be determined by yield monitors and effectively controlled by treating only the infested areas. The outcome will be measured by taking incremental yield measurements over an entire field and comparing normally high yielding areas with those from low-yielding areas that have been treated with a nematicide (see "Output" below).

OUTPUT

A commercial grower, Brett Whitmer, in Graham County, Arizona, has been using a cotton yield monitor for the past two years. The monitor is GPS-coupled and yield maps of Mr. Whitmer's cotton fields have been made available for this project. One such field, a 37 acre field known to be infested with the root-knot nematode, *Meloidogyne incognita*, has been identified and selected for this study. We will modify an existing Telone (1-3, dichloropropene) injection applicator with a GPS controller that will apply Telone at precise locations in the field as determined by the yield maps. Any area that yields less than 1300 pounds of lint per acre will be treated. Based on 2003-2004 yield maps, only 11 combined acres meet this criterion; the remaining acres will remain untreated. To demonstrate that yield loss is correlated with the presence of the nematode, the field will be grid-sampled on a 55 x 55 foot grid. Approximately 4500 soil cores will be taken (9 from each grid square) and those from each grid square will be pooled to yield 414 bulk samples. Root-knot nematodes will be extracted from the bulk samples and counted. GPS determination of the location of each grid square will enable the construction of a "nematode map" which can be overlaid on the yield maps to provide correlations between nematode population levels and cotton lint yield. The yield monitor will then be employed for the 2005 harvest to determine the increase in yield due to nematode control.

INPUT/ BUDGET

Funds will be required to convert our Telone injection equipment to a GPS-controlled applicator. Nematode sampling will be accomplished largely by faculty and staff from the University of Arizona and the Safford Agricultural Center, as part of their regular duties. Additional help will be needed in the form of "Temporary" employees hired on an hourly basis. Time and travel

expense will enable the Tucson members of the team to travel to Safford for sampling, Telone application, and harvest, and for the Safford staff to travel in-state to collect equipment and transport it to Safford. Mr. Whitmer will plant, maintain, and harvest the crop according to commercial standards without cost to the project.

Equipment Purchase/Conversion.....	\$2,800
Temporary Help.....	500
Consumable Supplies.....	500
Travel	1200
Total Funds Requested.....	\$5,000

EXTENSION EDUCATION COMPONENT – Sharing of Results

Results of this study will be shared with others throughout the state by inclusion in the annual University of Arizona “Cotton Report”, and nationally by presentation at the annual meeting of the National Cotton Council, “Nematode Survey and Education Committee.” Prepublication information will be shared by Internet posting to the Safford County website and a manuscript of the project results will be submitted to the Journal of Nematology. Results will also be presented at local workshops and field days in Graham and Cochise Counties throughout 2005 and early 2006.