Nematodes and Their Control in Upland Cotton

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Abstract

Cotton fields from 133 townships in 7 Arizona counties were surveyed for nematodes. Plant parasitic species were found in all fields sampled. Lesion nematodes (Pratylenchus spp.) were found in 33% of the samples and Root-knot nematodes (Meloidogyne spp.) were found in 35% of the samples. Field trials in Pinal Coiunty were conducted in 1998, 1999, and 2000 to determine the impact of nematode control on the yield of Upland cotton. Telone II® increased lint production in 20 of 24 trials.

Introduction

A beltwide survey of nematodes attacking cotton was initiated in 1991 under the auspices of the National Cotton Council with financial assistance from Aventis CropScience. (then Rhône-Poulenc Ag Company). Arizona was included in the survey and the results are detailed in this report. When it became evident that the Southern Root-knot nematode (*Meloidogyne incognita*) was widespread in Arizona's cotton farmlands, field trials were undertaken to determine the impact of this nematode on cotton yields and to evaluate appropriate control measures. Initial trials were conducted in Maricopa County where it was demonstrated that Telone II® at 5 gallons per acre could increase yields in nematode-infested fields. Results of these trials were published in previous issues of **The Cotton Report** (1995-1997). The purpose of the current study was to provide similar information for cotton producers in Pinal County, where the incidence of Root-knot nematode is less widespread but locally important. Our goals were twofold: to determine preplant, population threshold values for nematode infestation levels and to determine the efficacy of Telone II® in improving yields. Field trials were begun in 1998 and completed this year.

Materials and Methods

Survey

The nematode survey was conducted in Eastern and Central Arizona during the growing-season of 1992-1993 and continued in Western Arizona in July of 1998. Fields were chosen at random in each township. Samples were taken from the rhizosphere, to a depth of 12 inches, with ¾-inch diameter Oakfield sampling probes, providing a sample core of approximately 50 cc of soil. From 16 to 20 cores were taken per acre and these were combined to yield a bulk sample that was blended prior to nematode analysis. Ten to 12 acres were sampled at each site. Sites were identified by recording the trap number of the nearest boll weevil trap placed at the edge of the field by the Southwest Boll Weevil Eradication Program. The locations of these sites were then translated into Universal Mercator Units for geostatistical recording. Nematodes were extracted by placing 250 cc of soil under an intermittent mist of heated water for 72 hours. Extracted nematodes were identified (to genus) by morphological examination under the microscope. Because nematode population levels vary throughout the year numbers of nematodes in samples were not determined.

Field Trials

Field trials were conducted on commercial sites (with diverse cropping histories and management practices) at 24 locations in Pinal County. Preplant nematode population levels were determined by soil sampling as described above, except that samples were taken from fallow fields after the rows had been listed. When soils were too dry to sample

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prior to planting, samples were taken postplant following the first irrigation. Because treatments consisted only of Telone II® and untreated controls, trials were designed with alternating plots of treated or untreated replications, 6, 8, 10, or 12 rows each depending on the grower's equipment configuration. Row length varied from 1200 to 1400 feet, and row spacing was from 32 - 40 inches depending upon the site. The number of replicated plots per trial varied from 5 to 10 depending upon available space and the extent of the nematode infestation.

Telone II® was applied to the soil, 7 to 14 days prior to planting, by injection through single chisels, placed 12-14 inches deep on row centers. Chisel traces were compressed, and an inch or two of soil was thrown over the tops of the rows, by bed-shaping disks that followed the chisels. Application rate was 5 gallons per acre of the formulated material. Standard agronomic practices and pest control were followed. Test plots were harvested and weighed individually. Yield per acre was extrapolated from test plot yields assuming a gin turnout of 35% at all locations. Data were analyzed statistically by ANOVA and return on investment was calculated assuming that Telone II® was $10.80 per gallon, application costs were $8.00 per acre and the price of cotton was $0.70 per pound.

Results

All cotton fields in the survey contained at least one species of plant-parasitic nematode (Table 1). Root-knot nematodes, *Meloidogyne* spp., were found in all counties except Pima and Yuma. In Maricopa County, 55 percent of the townships sampled contained Root-knot nematodes. Lesion Nematodes, *Pratylenchus* spp. occurred in all counties. More than 50% of the townships in Greenlee, Pima, and Graham Counties were infested. Other plant-parasitic nematodes (but not necessarily pathogens of cotton) included Aphelenchus and other Aphelenchidae, Ditylenchus, Helicotylenchus, Longidorus, Neotylenchus and other Neotylenchidae, Trichodorus, Tylenchorhynchus, and Tylenchus as well as a few other less-common species. Of particular note was the absence of Reniform nematode, *Rotylenchulus reniformis*, in any of the townships sampled.

Compared to untreated control plots, application of Telone II® resulted in increased lint production in 20 of 24 trials conducted over a three year period. Increases ranged from 2 to 23% and estimated return on investment ranged from a loss of $78.10 to a gain of $281.00 per acre (Table 2 & 3).

Discussion

Of the species detected in the nematode survey, *Meloidogyne* spp., pose the greatest threat to cotton production. *Pratylenchus* spp., are also potent plant pathogens, but little is known about their effect on cotton. Although the remaining species found in the survey may be parasites of cotton, they are not considered to be a serious pathogens. Reniform nematode, *Rotylenchulus reniformis*, was not detected in any samples. Reniform nematode is prevalent on cotton throughout the cotton belt with the exception of Arizona, California, and New Mexico. In many states it surpasses Root-knot nematode in its distribution and economic impact.

The primary nematode present in the experimental plats was *Melodogyne incognita*. It was not always possible to relate preplant population levels of this nematode to yield increases resulting from the application of Telone II®. Low winter rainfall in 1998 and 1999, left the soil very dry during the planting season. As a result, nematode populations were lower than usual and, in many cases, not detectable. Under such conditions, even with 700,000 nematodes randomly distributed in the top acre-foot of soil, the chances detecting just one nematode is less than 50% in a one kilogram soil sample. *M. incognita* is considered to have a reproduction ratio of 1:10 on cotton. This means that a single adult female is capable of producing 10 offspring that will reach reproductive maturity. At harvest, given a life cycle of 30 to 40 days in the field, more than a single generation of nematodes can be produced. Thus, with an initial population of only 700,000 the population at harvest can easily exceed 14,000, 000 nematodes per acre, a level well within the range that crop damage occurs. Consequently, positive responses to Telone II® were sometimes observed in fields in which extremely low populations were detected by preplant sampling. For this reason, we believe that the threshold concept is not applicable under the conditions in which cotton is grown in Arizona. A more realistic approach would be to assume that crop damage will result if even one nematode is found in a sample taken between December and planting. An alternative would be to sample 3-5 days after the last irrigation in the Fall when nematode numbers would be at their maximum and more easily detected.

Our trials in Pinal County confirm earlier work in Maricopa County where it was shown that soil fumigation with Telone II® at 5 gallons per acre could be profitable in soils infested with Root-knot nematodes. Many growers are of the opinion that Root-knot nematode is not a significant problem in Pinal County. This may be so in heavier soils, but our results show that some form of control should be contemplated when Root-knot occurs in sandy soils. Root-knot nematodes prefer lighter soils and crop damage generally is more severe in soils with a high percentage of sand. These conditions are found more often in Eastern Pinal County, but local conditions vary and, wherever sandy soils occur in the state, Root-knot nematodes should be considered a potential threat.

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Table 1. Occurrence of plant-parasitic nematodes in Arizona cotton fields, by county.

Nematode Genus or Family	Cochise (21)*	Graham (13)	Greenlee (3)	Maricopa (38)	Pima (5)	Pinal (33)	Yuma (20)
Aphelenchus	57**	31	33	34	40	42	55
Other Aphelenchidae	14	0	0	3	20	6	5
Ditylenchus	43	0	0	0	0	0	0
Helicotylenchus	0	0	0	0	20	9	5
Longidorus	0	0	0	3	0	3	0
Meloidogyne	38	39	33	55	0	12	0
Neotylenchidae	10	0	33	50	20	27	55
Pratylenchus	33	54	66	24	60	27	10
Trichodorus	23	0	0	3	0	0	0
Tylenchorhynchus	20	15	0	13	0	24	30
Tylenchus	19	0	0	0	0	0	45
Others	10	0	0	0	0	0	35

* Number of townships sampled

** Percent of samples in which the genus of nematode was detected.