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USING AN INTEGRATED PEST MANAGEMENT ROTATIONAL CROP PROGRAM TO SUPPRESS RENIFORM NEMATODE

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Abstract

The Cooperative Extension Service, University of Arkansas, has conducted Cotton Research Verification Program (CRVP) demonstrations since 1980. The whole field demonstrations of research based Cooperative Extension Service recommendations have been used to bring new technology and production practices to farmer fields. Fields enrolled in the CRVP are selected based on specific criteria set by the Cooperative Extension Service.

A soil analysis is taken in the fall preceding initial enrollment of a cooperator and field into a research verification program. The analysis for the CRVP is for both fertility and nematode detection. Nematode pressure, usually rootknot nematode (*Meloidogyne incognita*) [RKN], or Reniform nematode (*Rotylenchulus reniformis*)[RN] can be yield-limiting problems for cotton producers. .Reniform nematode presence was first reported in Arkansas (Robbins, et al, 1989) in the late 1980's and were not a significant problem at that time. By 1994 the reniform nematode was reported to be a significant problem in the southern and mid-Mississippi and Arkansas Delta production areas (Stewart, et al, 1994). Data in 1995 (Lorenz, et al, 1995) indicated that reniform nematode ranked second only to RKN for economic yield loss in the United States. The reniform nematode is a root parasite that has a large host plant range. They build up rapidly in cotton production fields and may survive well on soybean roots. Corn roots seem to be resistant to reniform nematode buildup and significant decrease in reniform nematode numbers are noted when corn is in a rotation with cotton. Levels also decrease well with rice rotations.

This paper will present information regarding the use of an integrated pest management approach to suppressing reniform nematode in one specific field near Altheimer, Arkansas during the production seasons of 1999 through 2002.

Methods and Materials

To demonstrate the effectiveness of crop rotation in RN population reductions a four-year crop rotation study was conducted through an Integrated Crop Research Verification Program (ICRVP) piloted during the four-year study of a research verification demonstration in Jefferson County, Arkansas.

Field selection began in the fall of 1998 on a farm near Altheimer, Arkansas. During enrollment of the new field for the 1999 CRVP in Jefferson County, Arkansas, a field was suggested for enrollment by the cooperator. That field (Field 1) was rejected due to what was deemed too high a population of reniform nematode for economical cotton production (Table 1). An adjacent field (Field 2) was selected that was planted to corn during 1998 and which showed no reniform nematode pressure after the corn crop.

Field 2 was rotated from corn in 1998 to cotton in 1999 and 2000. For nematode sampling in 1999 and 2000, the field was divided into north and south sampling divisions that represented approximately half the field each. In addition, during the 2001 season, Field 2 was again planted to corn in the pilot program of Integrated Crop Research Verification Program (ICRVP). Thirty-one grids (of approximately 1.5 acres each) were designated using a Garmin 162 Global Positioning System for more intensive nematode sampling (Table 2). Field 2 was returned to CRVP in 2002.

Field 2 was sampled for nematodes each fall soon after crop harvest. In 2001 each of the 31 grids in Field 2 was sampled. Approximately 10 soil cores were collected from each block with a sampling tube (1 inch diameter). All cores were taken to a depth of 6 inches from the plant bed for cotton, while random samples were collected when corn was grown because the field had been disked prior to the time of sampling. The cores were bulked and mixed, and then soil was assayed using semi-automatic elutriation followed by centrifugal flotation.

Results and Discussion

1998

A fall 1998 nematode assay for Field 2 indicated a zero level of RN in a field wide sample submission (Table 1).

1999

Field 2 escalated from zero RN in the fall 1998 sample to an average of over 10,000 RN after just one year in cotton. Samples were taken from both a north and south division of the field.

2000

Field 2 was planted to a second year of cotton in 2000. Nematode sampling for Field 2 was done while the field was extremely dry following a very dry and hot August and September. There was a slight, but not significant, increase in the reniform nematode counts for Field 2 over those taken in 1999.

Root systems of the cotton plants in 2000 were poor, possibly due to stress of a difficult emergence in the spring of 2000. Many plants did not have taproots. Some plants also exhibited abnormal development with many having an aborted terminal and double or triple terminal development.

2001

Grid sampling of Field 2 after a year in the ICRVP (Corn) was performed and 31 sample sites were mapped with the Garmin 162 GPS. Thirteen sites tested positive for RN with the highest level being 1591 at one point. No site reached the Arkansas Cooperative Extension Service treatment threshold of 5,000 RN per pint of soil. Due to the field history of a rapid build up of RN once cotton is in rotation behind corn on this farm, nematicides must be a recommended practice at the time of cotton planting even when RN levels are below treatment level as they were after corn in 2001.

2002

A final grid sampling of Field 2 was performed after harvest of the 2002 cotton crop by re-locating the waypoints used for the 2001 sampling grid. There was a significant increase (Figure 1) in the number of sites that exceeded the threshold of 5,000 RN per pint of soil that would cause a recommendation of nematicide for the next crop of cotton.

Of the 31 sites sampled, two had no detectable levels of RN. Twenty-four of the sites were above the treatment threshold that triggers a recommendation of nematicide for cotton production. Five of the sites had RN levels below that which triggers nematicide use.

Summary

Crop rotation had a significant impact on reducing the numbers of reniform nematode in Field 1 and Field 2 from 1998 to 2001. While rotations significantly decreased the number of RN in check areas, a return to the susceptible crop- cotton- caused a rapid surge in the levels of RN after just one year back to cotton.

Crop rotation may hold some promise for lowering reniform populations. Crops such as corn, grain sorghum and rice are poor or non-hosts for this nematode, and rotation of cotton with these crops may lower reniform numbers for subsequent crops (Kirkpatrick et al, 1997).

The sampling study over five falls on Field 2 near Altheimer, Arkansas indicates a rapid reduction in reniform numbers when corn is in rotation to cotton. This study also shows the rapid return of reniform populations after just one year back in the susceptible crop, cotton (Figure 1). Further research is needed to determine interactions of disease and varietal responses of cotton grown in the rotations. In both 1999 and 2002 when cotton was planted after a corn rotation, Field 2 was planted to a conventional cotton variety. In 2000, the cotton variety was a stacked gene, *Roundup Ready* line that was susceptible to Bronze Wilt.

More research is needed to determine the actual level at which reniform cause economic yield losses in known infested fields.

References

Bateman, R.J., T.L. Kirkpatrick, and R.T. Robbins. 2000. Root-knot and reniform nematode distribution in Arkansas, 1990-1999. 2000 Proceedings Beltwide Cotton Conferences. National Cotton Council of America. Memphis, TN.

Kirkpatrick, T.L. and G. Lorenz, 1997. The reniform nematode, an emerging problem in Arkansas cotton. Proceedings of the 1997 Cotton Research Meeting, page 52, Special Report 183, Arkansas Agricultural Experiment Station.

Kirkpatrick, T.L., S.M. Culp and S. Taylor, 1994. Reniform nematode control in Arkansas. Proceedings of the 1994 Cotton Research Meeting, page 163, Special Report 166, Arkansas Agricultural Experiment Station.

Lorenz, G., T.L. Kirkpatrick, D. Vangilder, R.T. Robbins and J.D. Barham, 1995. Proceedings of the 1995 Cotton Research Meeting, page 143, Special Report 172, Arkansas Agricultural Experiment Station.

Robbins, R.T., R.D. Riggs, and D. Von Steen. 1989. Phytoparasitic nematode surveys of Arkansas cotton fields, 1986-88. Supplement to the Journal of Nematology 21(4S):619-623.

Table 1. Reniform nematode assay results, 1998-2000, Altheimer, AR, ICRVP.

	Field 1				
	Reniform Nematode per pint of soil				
Year	N1	N2	S3	S4	Previous crop
1998	49, 318	31, 136	36, 591	47, 045	Cotton
1999	2, 273	455	2, 045	1, 818	Rice
2000	31, 136	16, 591	26, 364	30, 227	Cotton
	Field 2				
	Reniform Nematode per pint of soil				
Year	Whole field	N division	S division	Avg/field	Previous crop
1998	0	Na	Na	0	Corn
1999	Na	12, 045	7, 273	9659	Cotton
2000	Na	13, 182	6, 591	9886	Cotton

Table 2. Reniform nematode assay results, Field 2, grid samples, 2001, after a year of corn; 2002, after a year of cotton.

	Reniform nematode, per pint of soil				
Site	Number per pint		Site	Number per pint	
north division	2001	2002	south division	2001	2002
N1	909	2045			
N2	0	22727			
N3	0	1500			
N4	455	8636			
N5	0	3864			
N6	0	15455			
N7	0	909			26136
N8	227	7045	S20	909	26818
N9	0	5227	S21	0	11591
N10	682	4091	S22	682	0
N11	1136	11818	S23	455	9091
N12	0	10227	S24	0	12045
N13	0	1364	S25	1136	13182
N14	0	6136	S26	909	14318
N15	0	19091	S27	0	15682
N16	0	7727	S28	1591	0
N17	0	5455	S29	0	16818
N18	0	11591	S30	0	8864
N19	455	1360	S31	227	
Average	203	8409		492	12,879

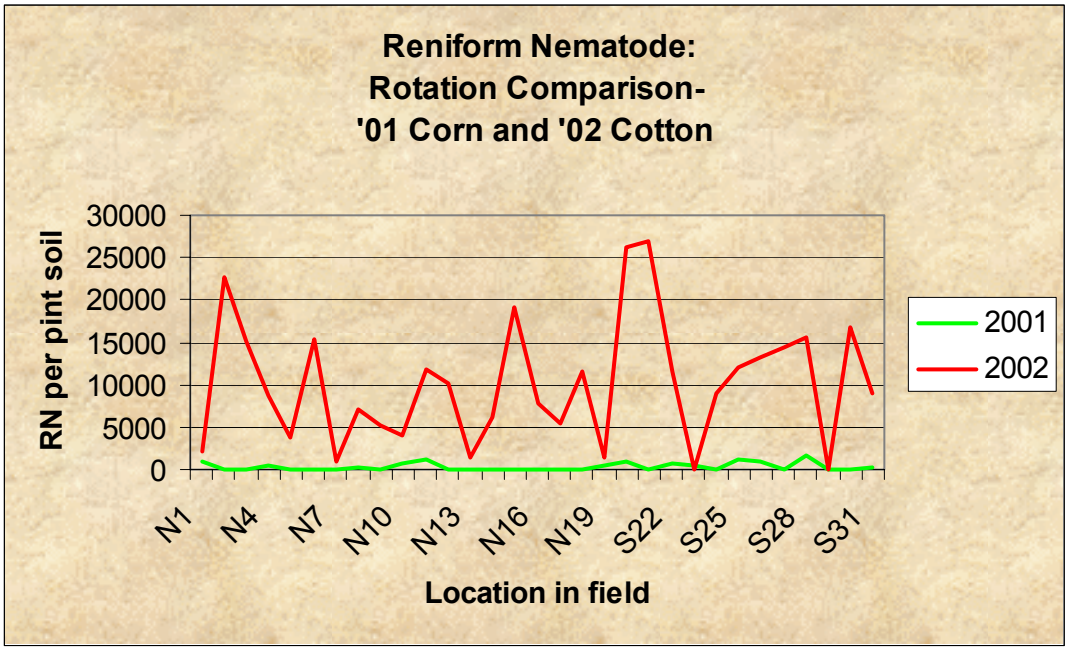

Figure 1. Rotation Comparison.

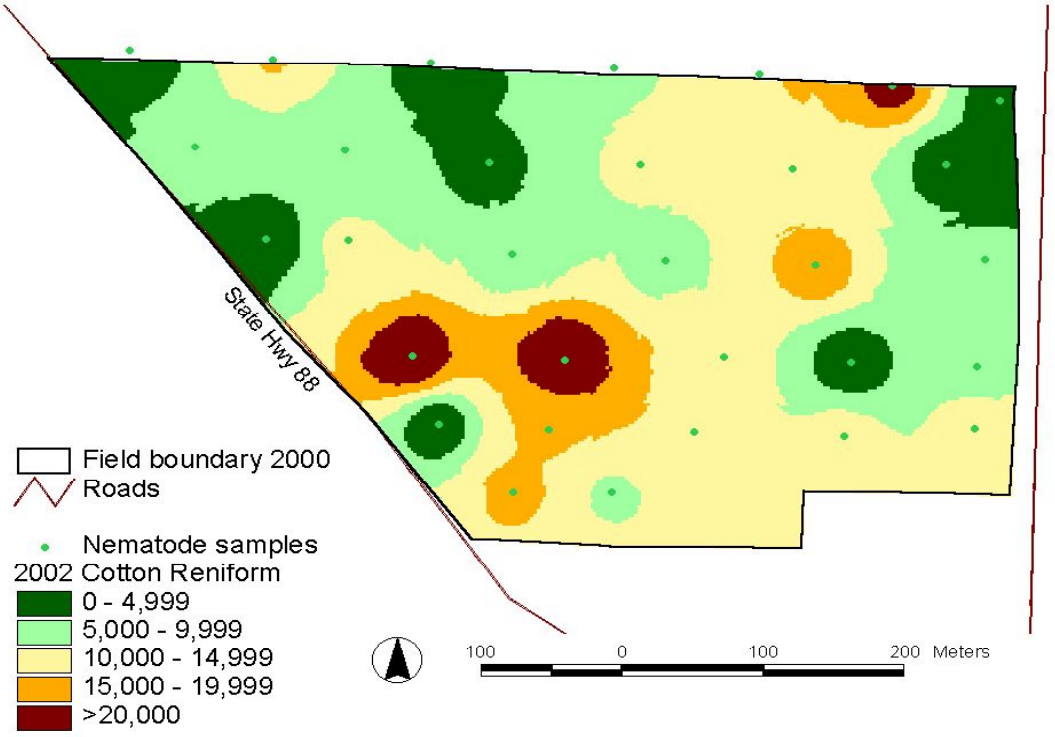

Figure 2. 2002 Reniform Nematode Assay