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RENIFORM REDUCTION IN CRVP FIELDS THROUGH CROP ROTATION

Donald E. Plunkett
Cooperative Extension Service
Little Rock, AR
Terence L. Kirkpatrick
Cooperative Extension Service
Hope, AR
Ron Matlock
Cooperative Extension Service
Benton, AR
Reginald W. Talley
Cooperative Extension Service
Clarendon, AR

Abstract

The Cooperative Extension Service, University of Arkansas, has conducted Cotton Research Verification Program (CRVP) demonstrations since 1980. This whole-field program is used to demonstrate the effective use of research-based crop production information in real-world production systems. The CRVP has been very effective over the years in introducing new technology and concepts into Arkansas production systems. Fields are enrolled in the CRVP by growers and are selected based on specific criteria, including the potential for producing a profitable crop**.** Where production problems are found, management to correct these problems in the CRVP fields is also generally applicable to other growers in the area with similar problems. A yield limitation that is frequently found in Arkansas cotton fields is plant-parasitic nematodes. Both the root-knot nematode (RKN) and the reniform nematode (RN) are present in the state and can cause significant yield suppression. A three-year evaluation of two CRVP fields was conducted to determine the influence of crop rotation in control of RN. Results indicate that either rice or corn for a single year lowers RN population densities significantly. Unfortunately, RN numbers resurge rapidly during the first year the field is planted back to cotton.

Introduction

RN was first reported in Arkansas during the late 1980s (Robbins et al., 1989), but was not considered to be a significant problem because incidence was low (<1%). By 1994, incidence of RN, however, had increased dramatically and was reported to be a significant problem in the southern and mid-Mississippi and Arkansas Delta production areas (Stewart, et al, 1994). In 1995, Lorenz (Lorenz, et al, 1995) indicated that reniform nematode ranked second only to RKN for economic yield loss induced by nematodes in the United States. This nematode is a root semi-endoparasite with a wide host range that includes both cotton and soybean, but apparently not rice, corn, or grain sorghum, all of which are commonly grown in Arkansas. In cotton and soybean fields RN may increase rapidly during the growing season. However, when fields are planted to corn, rice, or grain sorghum, population densities tend to decrease dramatically. This paper will present information on the effects of both corn and rice on RN population densities in rotation with cotton.

Methods and Materials

Two fields in Jefferson Co. near the town of Altheimer, AR were selected for the study. Field 1, which had been in cotton monoculture for the period 1994-1998, was divided arbitrarily into four 10-acre blocks and each block was sampled for nematodes shortly after cotton harvest in 1998. An adjacent field (Field 2) which was of approximately equal size, and that had been planted to corn during the 1998 season, was divided into two equal parts and sampled for nematodes at the same time. RN population densities averaged across the four blocks in Field 1 were 41,022 nematodes/pint of soil. No RN were detected in Field 2 (Table 1).

During the 1999 season, Field 1 was planted to rice, and cotton was grown in the field in 2000. Field 2 was planted in cotton in both 1999 and 2000 and the crops were managed under CRVP guidelines. In addition, during the 2001 season, Field 2 was again planted to corn and 31 grids (of approximately 1.5 acres each) were designated using a Garmin 162 Global Positioning System for more intensive nematode sampling (Table 2). The fields were sampled for nematodes each fall (1999 and 2000) immediately following crop harvest from the same blocks that were described above. 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 and corn, while random samples were collected when rice was grown. The cores were bulked and mixed, and then soil was assayed using semi-automatic elutriation followed by centrifugal flotation.

Results and Discussion

1999

After rice RN population density in Field 1 was lowered from an average of over 40,000 nematodes/pint of soil to just over 2,000 per pint of soil, a reduction of over 80 percent (Table 1, Figure 1). Conversely, Field 2, which had undetectable levels of RN after corn in 1998 had a RN population density of >10,000/pint of soil by the end of the 1999 cotton crop (Table 1, Figure 2).

2000

Soil samples for nematode assay were collected at different times for the two fields in the fall of 2000. Sampling for Field 2 was done while the field was extremely dry following a very dry and hot August and September. Field 1 was sampled after a fall rain and penetration with the soil probe was easier to accomplish. The nematode assays showed a dramatic change in RN numbers in Field 1 after one year back in cotton production (Table 1, Figure 1). One sample area contained over 31,000 RN per pint of soil. There was a slight increase in the counts for Field 2 over those taken the previous fall, which may have been due to the difficulty in sampling due to dry weather (Table 1, Figure 2).

2001

Of the 31 sample sites mapped with the GPS, 13 contained RN with the highest level being 1,591(Table 2). No site reached the damage threshold level for RN in cotton in Arkansas (5,000/pint).

Summary

Crop rotation had a significant impact on reducing the numbers of reniform nematode in the fields studied from 1998 to 2000. While rotations that included either rice or corn significantly decreased the number of RN, a return to cotton production resulted in a rapid resurgence in population density after just one year. Crop rotation may hold some promise for lowering reniform populations, but the effect appears to be limited to only one season after cotton is again grown. 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). It is possible that longer rotations out of cotton may provide greater nematode suppression, although the economic feasibility of growing most of the rotational crops instead of cotton is questionable.

References

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Table 1. Reniform nematode assay results, 1998- 2001, Jefferson County CRVP.

Year	Field 1 (site)	Reniform nematode (per pint soil)	Previous crop	Field 2 (site)	Reniform nematode (per pint soil)	Previous crop
1998	N-1:	49,318	Cotton	all	0	Corn
	N-2:	31,136				
	S-3:	36,591				
	S-4:	47,045				
1999	N-1:	2273	Rice	N	12,045	Cotton
	N-2:	455		S	7,273	
	S-3:	2045				
	S-4:	1818				
2000	N-1:	31,136	Cotton	N	13,182	Cotton
	N-2:	16,591		S	6,591	
	S-3:	26,364				
	S-4:	30,227				

Table 2. Reniform nematode grid soil assay results, with 31 GPS sample sites, fall 2001 Jefferson County, following corn.

Site	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10
Reniform nematode (per pint soil)	909	0	0	455	0	0	0	227	0	682
Site	N11	N12	N13	N14	N15	N16	N17	N18	N19	
Reniform nematode (per pint soil)	1136	0	0	0	0	0	0	0	455	
Site	S20	S21	S22	S23	S24	S25	S26	S27	S28	S29
Reniform nematode (per pint soil)	909	0	682	455	0	1136	909	0	1591	0
Site	S30	S31								
Reniform nematode (per pint soil)	0	227								

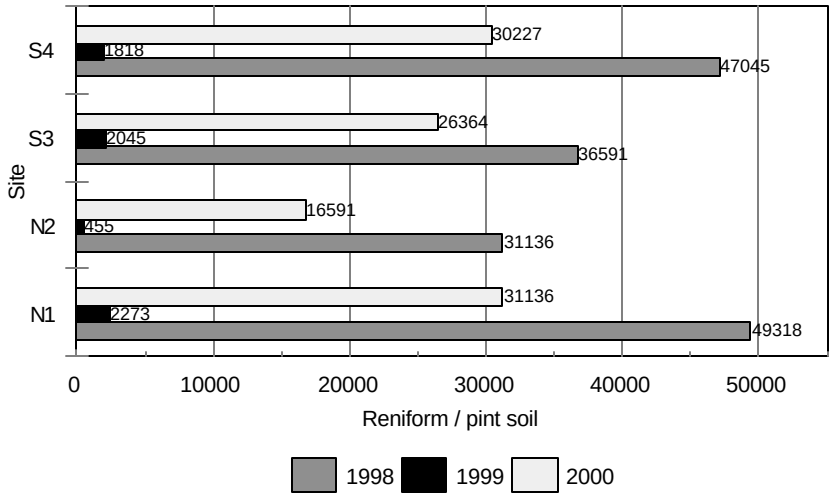

Figure 1. Nematode Assay 98-00 Field 1.

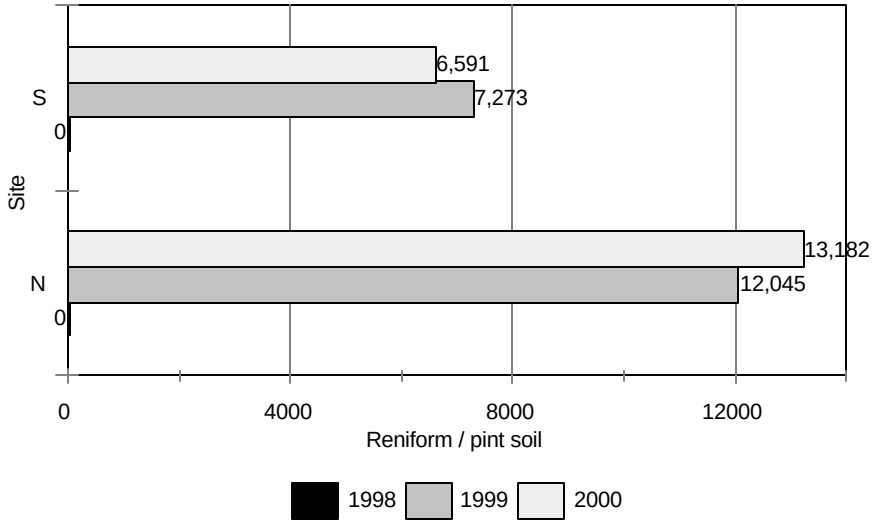

Figure 2. Reniform Nematode 98-00 Field 2.