HOST STATUS OF NOXIOUS WEED PLANTS ASSOCIATED WITH GOSSYPIUM HIRISUTUM - ZEA MAYS ROTATION SYSTEMS TO ROTYLENCHULUS RENIFORMIS

Amy L. Dismukes
Auburn University
Auburn, AL
K. S. Lawrence
Auburn University
Auburn, AL
A. J. Price
Auburn University
Auburn, AL
G. W. Lawrence
Mississippi State University
Miss St., MS
R. Akridge
Auburn University
Auburn, AL

Abstract

The reniform nematode (*Rotylenchulus reniformis*) is considered to be the major nematode problem of upland cotton (*Gossypium hirisutum*) in the southeast and mid south. A rotation system of cotton to corn is often utilized as a management technique because corn (*Zea mays*) is not a host to *R. reniformis* and will reduce populations. Many of the weed problems between the crops are similar. Recently populations of the reniform nematode have been maintained in a few cotton-corn rotations; thus it has been proposed that the noxious weeds associated with the rotation scheme may be hosts for this nematode and sustain populations during the corn production season. To test this hypothesis, selected weed species were screened for host status to the reniform nematode in the greenhouse. Corn and individual weed species populations were grown simultaneously in a microplot field study to evaluate reniform population density changes. A field trial was also conducted in a reniform infested cotton field located in Huxford, Alabama. Corn was grown under four herbicide regimes simulating various weed densities to determine if the noxious weed s associated with the cotton-corn rotation system would maintain or increase reniform nematode numbers.

Greenhouse trials indicated that of the 28 species tested, the majority of dicotyledonous noxious weed species have the capability to serve as host to the reniform nematode while the monocotyledonous weeds did not. In microplot studies, corn growing in combination with several of the individual weed species tested increases the reniform nematode populations. Noxious weed species in corn plots with only a pre emergence herbicide application increase reniform nematode populations as compared to the weed-free treatments. Noxious weed plants associated with the cotton-corn rotation system potentially may be the cause of persistent reniform populations when rotating with a non-host rotation crop.

Introduction

The reniform nematode is present throughout the world and is considered an important parasite of a wide range of agronomic crops including cotton. In 2004, the United States cotton industry lost approximately $166 million dollars or 204 million pounds of cotton to the reniform nematode. Alabama, Louisiana, and Mississippi sustained approximately 80% of this damage. Cotton plants infected with reniform nematode can produce a variety of symptoms that are generally dependant on growing conditions including severe stunting of the root system and the plant, reduced fruiting, wilting, and in Alabama interveinal necrosis of the leaves. A rotation system of corn and cotton is often practiced in these states. Corn is not a host to the reniform nematode and populations are reduced by this rotation system. However, many of the noxious weed species are similar between the two crops. Stable populations of the reniform nematode occasionally been observed in this rotation system, an unexpected occurrence, and the weeds that are associated with the system could account for this problem. The purpose of this research is to determine if noxious weed plants associated with the cotton-corn rotation system may be the cause of reniform nematode population's sustainability. The objectives of this research were: 1) to determine if noxious weed species are hosts to and allow reproduction of the reniform nematode; 2) to determine if corn growing simultaneously with individual weed species increases reniform nematode numbers; and 3) to determine if corn and mixed weed species populations growing together in a naturally infested reniform nematode field will sustain nematode populations. This research will determine which noxious weed species associated with the cotton-corn rotation system have the capacity to serve as host to the reniform nematode and increase nematode numbers under field conditions.

Materials and Methods

Greenhouse trials were conducted at the Plant Science Research Center at Auburn University. The host status of 28 noxious weed plants was evaluated in comparison to cotton to determine reniform nematode host status and reproductive potential (Table 1). Reniform populations were collected from cotton fields throughout Alabama and propagated on cotton cultivar Delta and Pineland 555 BG/RR. Eggs were extracted from the roots utilizing a 10% NaOCl solution. Vermiform nematodes were extracted from the soil using combined gravity screening and sucrose centrifugal flotation. Total reniform populations were enumerated and balanced for inoculation.

The seed of individual weed species and cotton were planted in polystyrene containers containing 500 cc of autoclaved loamy sand (72.5%, 25%. 2.5%, S-S-C, Ph 6.4) and inoculated with 2000 life stages of the reniform nematode. Tests were arranged in a randomized complete block design with 5 replications per test and each test repeated. The plants were harvested 60 DAI. Reniform nematodes and eggs were extracted and enumerated as previously described. Weed species with populations above the original inoculum level of 2000 were considered to host and support reproduction of the nematode. Reproduction factor values were determined (Rf = final population / initial population).

Microplot trials wre conducted on the North Plant Science Research Farm at Mississippi State University. Microplots consisted of 76 cm diameter fiberglass cylinders, placed 45 cm deep into soil and were infested with the renform nematode. Treatments consisted of corn (a negative control), cotton (a positive control), and corn growing with either Broadleaf Signalgrass, Coffee Senna, Common Ragweed, Johnsongrass, Mixed Morningglorys, Sicklepod, Teaweed, or Velvetleaf weeds. Microplot treatments were arranged in a randomized complete block design with 4 replications and the test was repeated. Cotton or corn seed was planted in a row in each microplot and seed from 8 individual weed species were broadcasted and covered by hand hoeing. Nematode samples were taken at corn planting and continued monthly through the growing season.

Field experiments were conducted in Huxford, AL in a cotton field naturally infested with reniform nematode. Treatments included: 1)) Dual and Atrizine at pre-emergence herbicides and monthly Roundup applicatons (weed-free); 2) Dual and Atrizine at pre-emergence and one Roundup application; 3) Dual and Atrizine at pre-emergence only; and 4) Dual at pre-emergence only. Herbicide applications were applied at recommended rates. Corn (Dyna-Gro 58K22 RR) was mechanically sown. Mixed weed seed was hand-broadcasted 30 days after corn planting over treatments 2, 3, and 4 (those without continued herbicide applications). The species chosen were based on initial greenhouse experiments. The experiment consisted of 4 row plots, 25 feet long, with 40 inch row spacing, and was arranged in a randomized complete block design with 6 replications. Nematode samples were taken monthly through the growing season. Reniform nematodes were extracted and enumerated as previously described. Biomass samples estimating weed growth were taken from a 1 m^2 area per plot at 60 days after planting and monthly thereafter. Corn yields were not determined due to the multiple hurricane damage in 2005.

Results and Discussion

Greenhouse trials indicate that of the 28 weed species tested, the majority of dicotyledonous noxious weed species are good hosts to the reniform nematode while the monocotyledonous species tested were not. Weed species with populations over the initial inoculum level are considered to host and allow for the reproduction of the reniform nematode. The following weeds all produced Rf values greater than 1 and thus are hosts of the reniform nematode: Black Medic, Blue Fescue, Coffee Senna, Coffee Weed, Common Ragweed, Common Waterhemp, Hemp Sesbania, Ivy Leaf Morningglory, Lambsquarter, Moringglory (*I. nill*), Mornigglory (*I. tricolor*), Musk Thistle, Pale Smartweed, Pitted Morningglory, Redrood Pigweed, Tall Mornigglory, Teaweed, Velvetleaf, and Wild Buckwheat (Table 1). Sicklepod, Velvetleaf, and the Morningglory species tested, all produced Rf values of greater than 50 and serve as excellent hosts for the reniform nematode. Thus, these weeds which are common to cotton corn rotation systems, could potentially increase reniform nematode populations if weed populations are high. Noxious weeds that produced Rf values of less than 1 indicating resistance to the reniform nematode include: Cogongrass, Corn Spurry, Curly Dock, Field Bindweed, Jimson Weed, Kochia, Purple Nutsedge, and Wild Mustard.

In the microplot studies, reniform nematode populations were higher ($P \leq 0.05$) throughout the season in the cotton treatments compared to corn and any of the corn plus noxious weed combinations (Table 2). Corn growing in combination with Sicklepod or mixed Morningglory species supported reniform nematode population numbers that were greater ($P \leq 0.05$) than corn growing alone at 60 and 120 days after planting; although, the reniform levels were not as high as those increased on cotton. Microplot treatments containing corn with the monocotyledonous weeds, Johnsongrass or Broadleaf Signalgrass, had decreasing reniform populations throughout the growing season. Therefore, the dicotyledonous weed plants, Sicklepod or mixed Morningglory, served as good hosts to the reniform nematode and allowing for reproduction of the nematode in the corn cycle of the cotton-corn rotation system.

In the corn field plots, reniform nematode populations were greater ($P<0.05$) in association with higher weed populations as compared to the weed-free treatments (Table 3). However, these increases in reniform numbers were not observed among treatments until the close of the season. At 150 days, the minimal pre-emergence and no post-emergence herbicide application treatment had higher reniform nematode populations than the recommended corn herbicide routine of a pre-emergence herbicide application with one roundup application. This reniform population response would be expected, due to the time required for population growth of the nematode. Noxious weed plants associated with the cotton-corn rotation system have the potential to increase reniform nematode populations in the corn cycle of the cotton-corn rotation system.

Table 1. List of noxious weed species and reniform nematode reproductive factor (Rf) values determining weed host status to the nematode in the greenhouse.

Scientific Name	Common Name	High rf	Low rf	rf mean
Medicago lupulina	Black Medic	12.128	0.000	2.592
Festuca glauca	Blue Fescue	3.798	0.000	1.550
Senna occidentalis	Coffee Senna	40.556	0.116	15.932
Sesbania punicea	Coffee Weed	18.077	0.309	5.902
Imperata cylindrica	Cogongrass	0.193	0.000	0.039
Ambrosia artemisifolia	Common Ragweed	17.613	0.167	8.100
Amaranthus rudis	Common Waterhemp	16.223	0.464	5.836
Spergula arvensis	Corn Spurry	2.781	0.000	0.539
Rumex crispus	Curly Dock	1.854	0.000	0.353
Convolvulus arvenisis	Field Bindweed	2.575	0.116	0.632
Sesbania herbacea	Hemp Sesbania	11.819	0.039	3.454
Ipomea hederacea	Ivy Leaf Morningglory	16.686	0.464	5.615
Datura stramonium	Jimsonweed	2.318	0.039	0.460
Kochia scoparia	Kochia	2.742	0.039	0.599
Chenopodium album	Lambsquarter	4.867	0.013	1.432
Carduus nutans	Musk Thistle	3.592	0.927	2.610
Ipomea tricolor	Morningglory	257.243	144.612	180.150
Ipomea lacunosa	Pitted Morningglory	19.004	0.129	5.129
Cyperus rotundus	Purple Nutsedge	0.270	0.000	0.155
Amaranthus retroflexus	Redroot Pigweed	4.172	0.142	1.681
Ipomea nil	Morningglory	174.727	57.706	120.070
Senna obtusifola	Sicklepod	90.614	1.120	15.867
Polygonum lapathifolium	Pale Smartweed	35.458	0.193	10.143
Ipomea purpurea	Tall Morningglory	163.487	22.016	95.420
Sida spinosa	Teaweed	35.226	2.318	11.840
Abutilon theophrasti	Velvetleaf	55.620	0.476	17.683
Polygonum convolvulus	Wild Buckwheat	30.359	0.129	7.213
Sinapis arvensis	Wild Mustard	3.013	0.000	0.838

*Population determined per 500 cc of soil.

**Rf (Reproductive factor) = final population / initial population

Table 2. Evaluations of individual noxious weed species growing in combination with corn to determine the reproduction potential of *Rotylenchulus reniformis* in a microplot environment by monthly soils samples.

Treatment	Planting*	30 DAP	60 DAP	90 DAP	120 DAP
	May	June	July	August	Sept
Coffee Senna + Corn	8375 a	1651 b	3863 a	984.9 cd	1757.4 c
Common Ragweed + Corn	6692 a	3428 b	2520 c	1123.3 cd	1631.9 c
Teaweed + Corn	8237 a	2816 b	2559 c	820.8 cd	1081.5 c
Velvet Leaf + Corn	10715 a	4007 b	3611 bc	1873.3 bc	1728.5 c
Miixed Morningglory + Corn	8111 a	4481 b	5259 bc	1342.2 bcd	3485.9 b
Sicklepod + Corn	8127 a	3486 b	8951 b	2491.3 b	4451.5 b
Johnsongrass + Corn	6032 a	4928 b	3776 bc	579.4 d	956.0 c
Broadleaf Signalgrass + Corn	5887 a	3148 b	3187 c	830.4 cd	1303.6 c
Corn	10232 a	3708 b	6112 bc	849.8 cd	1274.6 c
Cotton	8842 a	20713 a	16165 a	4210.1 a	10229.2 a
LSD (P≤0.05)	5859.5	4659.6	5463.4	1163.9	1583

* Populations per 150 cm3 of soil.

Nematode population reported as means from four replications. Tests were repeated.
The means within each column succeeded by different letters differ significantly according to Fisher's protected least significant difference test (P≤0.05).

Table 3. Monthly *Rotylenchulus reniformis* populations from corn grow with four herbicide regimes.

Plot Composition	Herbicide regimes**	*Rotylenchulus reniformis*/500 cc soil*					
		May	June	July	Aug	Sept	Oct
1. Corn	Dual @ preemergence Atrizine @ preemergence Roundup monthly	746.8	1575.0	1467.8	695.3	811.1	283.3 ab
2. Corn with weeds	Dual @ preemergence Atrizine @ preemergence Roundup prior to 30" in height	746.8	2390.5	1158.8	1030.0	643.8	141.6 b
3. Corn with weeds	Dual @ preemergence Atrizine @ preemergence	746.8	1931.3	1287.5	824.0	875.5	386.3 ab
4. Corn with weeds	Dual @ preemergence	746.8	1364.8	862.6	927.0	1377.6	515.0 a
LSD (P≤0.05)		0	1367.8	1086.4	540.65	742.67	303.4

* Populations determined per 150 cm^3 of soil.
Nematode populations reported as means from six replications.
The means within each column succeeded by different letters differ significantly according to Fischer's protected least significant difference test (P≤0.05).
**All herbicide regimes applied at recommended rates.