## SOYBEAN VARIETY SOIL TYPE AND IRRIGATION EFFECTS ON RENIFORM NEMATODE POPULATIONS D. L. Bailey K. S. Lawrence D. W. Held Department of Entomology and Plant Pathology Auburn University, AL

# **Abstract**

In this study, a survey of soybean varieties were examined to determine reniform nematode population potentials and plant growth reductions. In the greenhouse variety trial, 83% of the varieties that were tested produced more nematodes than Hutcheson the commercial susceptible standard. With the data extracted from the greenhouse trial, varieties were selected with the strongest signs of being tolerant or resistant. They were then implemented into a field trial during the summer of 2013. Results indicated yield ranged from 68 to 34 bu/A for Progeny P6710Ry and Bayer HBK RY5421, respectively. During this trial we found 52% of the varieties supported higher nematode population densities compared to Hutcheson, and produced yields above 55 bu/a.

#### **Introduction**

The reniform nematode, *Rotylenchulus reniformis* Linford & Oliveira, is one the most damaging nematode pathogens of cotton in Alabama (Gazaway et al., 2003). With the rising prices of soybeans (\$14.26 bu/A), soybeans acreage is increasing across the southeast and Alabama. Soybean acreage has is rising in Alabama now covering 340,000 acres while cotton acreage has dropped 80,000 acres since 2011 (USDA, 2013). Soybeans are being planted in fields that were previously cropped in cotton and many of these cotton fields are infested with *R. reniformis*. In AL, LA, and MS, *R. reniformis* has been known to cause yield losses of approximately 1,721,796 bales (Blasingame and Petal, 2013). In our AL fields, *R. reniformis* cause devastating yield losses in cotton with 40% yield losses in 2011 and 2013. Soybeans are also a suitable host for *R. reniformis*. Greenhouse evaluations of soybean varieties in Arkansas have reported only 3 out of 157 varieties were resistant to R. *reniformis*. These varieties could be useful when used in a soybean cotton rotation (Robbins et al., 2013). In previous studies conducted 40 years ago, *R. reniformis* nematodes reduced yields 25% in susceptible varieties of soybeans (Rebois and Johnson, 1973). If these nematodes can reduce yield by 1,721,796 bales in cotton, how much are they reducing soybeans yields?

## **Methods and Materials**

Greenhouse and field trials were conducted during the spring and summer of 2013. *R. reniformis* were increased for the greenhouse trials in the greenhouse on Hutcheson soybeans grown in 500 cm<sup>3</sup> polystyrene pots maintained in the greenhouse. The nematodes were allowed to grow on the soybean plants in greenhouse conditions for 60 days. *R. reniformis* vermiform life stages were extracted from the soil in the pots using gravitational sieving followed by sucrose centrifugation. Eggs were collected from the roots of soybean plants by mixing the roots in a rotary shaker for four minutes in a 0.625% NaOCl solution. The eggs were then washed over a layered 75 µm and 25 µm sieves. Nematodes were enumerated at 40X with a Nikon TSX inverted microscope. Eggs and extracted vermiform life stages were combined and a solution was standardized to 4000 nematodes/5mL of water for inoculation.

The greenhouse variety trials consisted of 41 commercially available soybean varieties which are available for production in the southeast along with Hartwig and Hutcheson, our standard nematode resistant and susceptible comparison varieties. The Hartwig line was originally bread to be resistant to Soybean Cyst nematode and was the only resistant line to use in this trial. Cone-tainers that contained 150cc of autoclaved soil mixture of 68% sand, 20% silt, and 12% clay were placed in the greenhouse where all 43 varieties were tested. Each cone-tainer was planted with two soybean seed and 4000 *R. reniformis* vermiform and egg life stages were pipetted into each cone-tainer after planting. Soybean varieties were arranged in a RCBD on the greenhouse bench and replicated 5 times with the entire test being repeated twice. The experiment was harvested at 60 days to give the nematodes time to complete two generations and parameters measured included root fresh weight and number of nematode eggs. Statistical ANOVA was run using JMP pro 10 and a Tukey-Kramer HSD was used to compare means of the varieties. From the greenhouse assay, 23 varieties were selected to be further tested in the field trials, which took place in a *R. reniformis* infested field at Tennessee Valley Research and Extension Center (TVREC). The field at TVREC was a

Decatur Silt Loam soil that consists of 57% sand, 28% silt, and 15% clay and contained an average population of 4500 vermiform nematodes per 150 cm<sup>3</sup> of soil and pivot irrigation was used when needed. This trial was a RCBD with four replications and nematodes were collected 45 days after planting (DAP) and at 140 DAP near harvest. Yields were also collected to compare varieties.

### **Results**

Greenhouse trials indicated many of the soybean varieties tested support *R. reniformis* nematode populations that are similar to the Hutcheson. Progeny P 5111 RY, Asgrow AG4832, Asgrow AG5831, Bayer HBK RY 4721, and Asgrow AG5732 supported the lowest numbers of *R. reniformis* in the greenhouse (Table 1). These varieties also developed fresh root weights that were greater than Hutcheson.

Soybeans yielded from a high of 68 to 34 bu/A for Progeny P 6710 RY and Bayer HBK RY5421, respectively (Table 2.). Five varieties, Progeny P 6710 RY, Progeny P 4850 RY, Bayer HBK RY 4620, REV 47R34, and Dyna-Gro S56RY84 yielded 60 bu/A or more. Four varieties, Progeny P 4850 RYS, USG 75Q42R, Hartwig, and Hutcheson supported the lowest *R. reniformis* populations per gram of root in the field at 45 DAP. Interestingly, Progeny P 4850 RYS, produced the second highest yield (62 bu/A) and supported very low nematodes numbers (37 eggs/gram of root) similar to the resistant Hartwig. Nematode population densities at soybean harvest were similar between all varieties ranging from 850 to 2820 *R. reniformis* per 150 cm<sup>3</sup> of soil. Comparing varieties, Bayer HBK RY4620 was one of the top yielding varieties at 61 bu/A while Bayer HBK RY5421 yielding only 34 bu/A but both varieties supported the same nematode population per gram of root at 45 DAP. The 27 bu/A difference between these two varieties, at \$14.26/bu would increase a farmers earnings by \$385.00/A if Bayer HBK RY4620 was the variety planted.

We were unable to correlate high nematode population densities on soybean roots at 45 days (Fig.1) after planting to reductions in yield. The data suggest that the *R. reniformis* population densities at 45 DAP did not consequently correlate with yield loss. Roots weights ranged from a high of 73.9 g to 40.2 g for Agrow AG 5532 and REV 52R74 respectively. Varieties that produced higher yields had a tendency to grow larger root systems. Progeny P 6710 RY produced the largest yield at 68 bu/A and produced one of the largest root systems (63.7 g).

Varieties that are high yielding and support low numbers of nematodes may have some level of resistance to the *R*. *reniformis* nematode. This suggests that planting varieties with high yields and low nematode numbers could help keep nematode populations at a lower level for following crops. When looking at the overview of the entire field trial, varieties with higher yields tended to have larger root weights and medium/low nematode populations. In conjunction, we see the varieties with lower root weights supported higher nematode numbers and lower yields.

<i>R. reniformis</i> eggs and vermiform life stages								
Variety	/gram of root 60 I	Root weight (gm)*						
Bayer HBK RY5221	779	A**	3.7	CD				
Asgrow AG7333	475	AB	4.7	BCD				
Asgrow AG6132	437	AB	5.2	ABCD				
NK Brand S74-M3	420	AB	5.1	ABCD				
Progeny P 7310 RY	394	AB	4.3	BCD				
Henderson	389	AB	5.0	ABCD				
Asgrow AG6732	299	AB	5.6	ABCD				
Asgrow AG5633	281	AB	5.6	ABCD				
Asgrow AG7532	247	AB	5.3	ABCD				
Bayer HBK RY5521	244	AB	4.7	BCD				
Carver	239	AB	5.3	ABCD				
NK Brand S77-T7	236	AB	6.4	ABCD				

Table 1	<b>I</b> . (	Green	house soy	bean var	iety screen	for Rotyle	nchulus	reniformis	nematode	host susc	eptibilit	y, 20	)13
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Dyna-Gro 37RY52	224 AB	5.3 ABCD
SS 5911N R2	223 AB	6.6 ABC
SS 6810N R2	206 AB	5.1 ABCD
Asgrow AG7231	196 AB	6.0 ABCD
Dyna-Gro 37RY52	194 AB	7.3 AB
Bayer HBK RY4620	193 AB	5.9 ABCD
SS 5510N R2	193 AB	5.2 ABCD
Bayer HBK RY5421	189 AB	5.2 ABCD
Progeny P 5655 RY	173 AB	6.3 ABCD
Dyna-Gro 36RY68	167 AB	5.1 ABCD
Progeny P 6710 RY	159 AB	3.3 D
Dyna-Gro S47RY13	155 B	4.8 BCD
Progeny P 5811 RY	148 B	4.8 BCD
Dyna-Gro 39RY57	144 B	6.9 AB
Dyna-Gro 34RY75	139 B	7.5 A
S51-H9	137 B	6.0 ABCD
Dyna-GroS48RS53	124 B	5.9 ABCD
Asgrow AG4933	117 B	6.0 ABCD
Progeny P 5711 RY	115 B	5.9 ABCD
SS 5112N R2	114 B	6.0 ABCD
Dyna-Gro S54RY43	114 B	5.8 ABCD
Stonewall	106 B	5.6 ABCD
Asgrow AG7733	97 B	6.5 ABCD
Progeny P 5111 RY	94 B	3.9 BCD
Asgrow AG4832	89 B	4.9 BCD
Asgrow AG5831	85 B	5.5 ABCD
Hutchenson	81 B	4.1 BCD
Bayer HBK RY4721	73 B	5.1 ABCD
Hartwig	59 B	3.5 CD
Asgrow AG5732	58 B	6.4 ABCD
<i>P</i> -value	≤0.05	≤0.05

\*Root weights were taken 60 DAP. \*\*Means in the same column followed by the same letter do not differ significantly ( $P \le 0.05$ ) according to Tukey-Kramer HSD.

Variety	Root fresh weight* 45 DAP	<i>R. reniformis</i> life stages/ gram of root 45 DAP		<i>R. reniformis</i> life stages / 150 cm <sup>3</sup> 140 DAP	Yield	bu/A
Progeny P 6710 RY	63.7	55	AB	1333	67.8	A**
Progeny P 4850 RYS	62.7	37	В	1139	61.6	AB
Bayer HBK RY 4620	65.5	53	AB	1448	60.8	AB
REV 47R34	49.4	45	AB	1506	60.7	AB
Dyna-Gro S56RY84	59.8	73	AB	1564	59.8	AB
Dyna-Gro S56RY84	53.8	71	AB	1178	59.4	AB
NK S 52-Y2	61.3	76	AB	869	58.7	AB
Mycogen 5N451R2	49.3	102	AB	850	57.2	AB
SS 5213 NR2	48.9	67	AB	2820	56.6	AB
USG 75Q42R	57.2	34	В	2124	56.2	AB
NK S49-48	55.8	45	AB	1120	55.8	AB
Asgrow AG 4934	56.2	66	AB	2066	54.6	AB
Dyna-Gro S48RS53	54.4	91	AB	2646	52.9	AB
Asgrow AG 5532	73.9	108	AB	1622	52.6	ABC
Hartwig	40.6	39	В	1043	52.0	ABC
Schillinger 4712 R2	46.5	66	AB	1139	51.6	ABC
REV 52R74	40.2	56	AB	1333	51.1	ABC
SS 4912 NR2	47.4	92	AB	1738	50.6	ABC
Bayer HBK R5226	48.1	84	AB	2318	49.7	ABC
Progeny P 5711 RY	46.6	120	AB	2009	49.6	ABC
Bayer HBK RY 5221	49.0	169	A**	1564	44.8	BC
Hutcheson	54.9	40	В	1777	43.7	BC
Bayer HBK RY5421	54.7	44	AB	888	33.9	С
<i>P</i> -value	NS	≤0.	05	NS	$\leq 0$	.05

Table 2. TVREC soybean variety screen for reniform nematode susceptibility, 2013.

\*Root weights were taken 45 DAP. \*\*Means in the same column followed by the same letter do not differ significantly ( $P \le 0.05$ ) according to Tukey-Kramer HSD.



Figure 1. Reniform eggs per gram of fresh root numbers compared yield for each soybean variety.

#### Discussion

The primary goal of this study is to understand the damage potential that R. *reniformis* may have to soybeans in the Southeast. This study is ongoing and will need multiple years to determine the yield damage potential for the reniform nematode to soybeans. The first year of trial from this study reviles, susceptible and potentially tolerant soybean varieties were tested. Many varieties in the field produced economical yields under high reniform nematode populations. Some of the varieties that supported high population of nematodes also produced comparable yields to those that supported low numbers. The susceptible Hutcheson supported lower numbers of nematodes and probably as a result of the nematode feeding the root systems the roots did not develop and this variety was one of the lowest yielding varieties. The variety that chosen for a season is very important. Many varieties offered by the same distributor have very different yields and nematode susceptibilities.

## **Literature Cited**

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