RENIFORM NEMATODE REPRODUCTION ON SOYBEAN CULTIVARS AND BREEDING LINES IN 2010

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Abstract

During 2010, 161 soybean varieties from the Arkansas variety testing program, 64 breeding lines and varieties: 20 from Clemson (Shipe), 6 from Arkansas (Chen), 2 from the USDA Jackson TN (Arelli), and 20 from Missouri (Shannon), and 16 from Virginia Tech (K. M. Rainey) were tested in the greenhouse to determine their suitability as hosts for the reniform nematode (RN), *Rotylenchulus reniformis*. All treatments were inoculated with 2,000 vermiform RN. The treatments were grown for 93 days. The RN resistant varieties Anand, Forrest, and Hartwig, the RN susceptible cultivar Braxton, and fallow RN infested soil served as controls. The mean number of vermiform nematodes extracted from the soil of each treatment was calculated, as were the reproductive indices (RI = Pf/Pi), and PF/PI's of Anand, Hartwig, and Forrest for both tests. Arkansas test cultivars with RI's significantly greater than the RI on Anand (1.00) were considered suitable hosts for *R. reniformis*. Of the Arkansas test varieties 137 of 161 supported more reproduction than Anand. The following varieties; (Armor) ARX492, (ASGROW) AG5431, (ASGROW) AG5531, (Hornbeck) HBK RY5520, (Missouri Line) S06-3053, (Missouri Line) S06-6053, (Midwest Premium Genetics) SSC-049N, (Midwest Premium Genetics) SSC-051N, and (UniSouth Genetics) USG 75T40 were not different than Anand. Numerically 43 of the 64 breeding lines RN reproduced more than on Forrest and they may be of interest in Reniform nematode resistant soybean breeding programs. The commercial private lines that did not support more reproduction than Anand may be useful in a Cotton-Soybean Rotation to reduce the numbers of reniform nematodes and allow cotton to be grown economically.

Introduction

In the Southeastern United States reniform nematode (*Rotylenchulus reniformis*) causes considerable damage and yield loss to cotton and soybean. No cotton varieties have reniform nematode resistance, whereas several sources of reniform nematode resistance exist in soybean. This resistance is often linked to resistance to the soybean cyst nematode (*Heterodera glycines*). Use of reniform nematode resistant soybean in a rotation with cotton can be a

useful option. Public soybean breeding lines from programs at Arkansas, Clemson, Missouri, North Carolina, Virginia Tech, and USDA in Jackson Tennessee that have a low rate of reniform nematode reproduction may prove very useful in breeding for reniform nematode resistance.

Information on the reproduction of the reniform nematode on contemporary soybean cultivars is limited. Robbins, et al. (1994) reported on the reproduction of the reniform nematode on 30 soybean cultivars. In 1996 Robbins & Rakes reported RN reproduction on 16 soybean cultivars, 45 germplasm lines, 2 cultivars (Hartwig, Cordell) with resistance from PI's 437654 and 90763, respectively, and the differentials used in the soybean cyst nematodes race determination tests. During the 1999 to 2008 period yearly tests have shown the host status for over 1,650 soybean lines (Robbins et al. 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007a, 2008, 2009, 2010). These papers form the basis for reniform nematode reproduction information on contemporary soybean lines. The breeding lines tested for reniform nematode reproduction are given by Robbins et al. (2007b, 2008, 2009, 2010)

The objectives of the 2009 study were to: 1) Identify new soybean cultivars that are poor hosts for the reniform nematode that would be useful in rotation with cotton or other reniform nematode susceptible crops in reniform nematode infested fields. 2) To identify useful breeding lines for use in selection of new reniform nematode resistant cultivars.

Methods

The soybean test lines and cultivars in 2010 were from both private and public sources. Seeds of all cultivars were germinated in vermiculite and transplanted into 10-cm-diam. clay pots containing 500 cm^3 of pasteurized fine sandy loam soil (ca. 91% sand, 5% silt, 4 % clay, <1% O.M.). The reniform nematode inoculum was obtained by washing the soil from the roots of the susceptible cultivar Braxton grown in the greenhouse for at least 10 weeks, suspending the nematodes in water, and pouring the nematode suspension through nested 850- and 38-µm-pore sieves. The material on the 38-µm-pore sieve was placed on a tissue in a Baermann funnel. All vermiform stages of *R. reniformis* were collected after 16 hours.

A total of 2,000 vermiform reniform nematodes were injected with an autopipe into three, 2.5 cm-deep holes made in the soil in each pot containing one seedling in the cotyledon stage the day of transplanting. Pots were arranged in a randomized complete block design, with five replications per line or cultivar. Soybean cultivars Anand, Forrest and Hartwig were included as resistant controls, Braxton as a susceptible control and an inoculated pot with no plant {fallow) as a survivor control.

After 93 days (June 14-September 14, 2010), the number of vermiform reniform nematodes in the soil of each pot was determined (Jenkins, 1974). A reproductive index (RI), defined as the number of eggs + vermiform nematodes at test termination (Pf)/initial inoculation level (Pi), was calculated for each cultivar. In addition, the ratio of the RI of each cultivar to the RI of Anand and Hartwig was calculated. The log ratio data [log10 (RF + 1)] or [log10 (RA + 1)] were analyzed as a randomized complete block using analysis of variance. Log ratio transformations were used because of the high degree of variation in nematode counts within a cultivar. All statistical analyses were carried out using SAS version 8 (SAS Institute, Cary, NC).

Results & Discussion

Nine lines in the Arkansas Soybean Variety program tested had log ratios not significantly ($P \leq 0.05$) higher than Anand (Red in Table 1). This indicates they were not different in supporting reproduction from Anand (Resistant).

From a total of 64 Public Breeder lines and cultivars in the test of the Arkansas, Clemson, USDA Jackson TN, Missouri, and Virginia Tech 11 were not significantly higher than Anand (Red, in Table 2). From the 11 resistant lines and cultivars tested none were from Arkansas, 5 were from Clemson, 9 were from Missouri, and 1 each from

Clemson and Virginia Tech. These lines may be useful in breeding new soybean varieties with resistance to the reniform nematode. They would be especially important if they are also shown to also have soybean cyst and root knot nematode resistance.

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Table 1. *Rotylenchulus reniformis* reproduction on 161 selected soybean cultivars and lines from the Arkansas Soybean Variety Testing Program in 2010 tests.

Cultivar	Cultivar Log + 1 Mean	Nematode Count Mean	Cultivar RI = Pf/Pi Mean
Fallow	0.05	960	0.48
ASGROW AG5531	0.09	1680	0.84
S06-3053	0.10	1968	0.98
USG 75T40	0.10	1824	0.91
Armor ARX492	0.10	1896	0.95
SSC-051N	0.11	2352	1.18
Hartwig	0.13	2616	1.31
S06-6053	0.13	2748	1.37
Anand	0.33	7176	3.59
ASGROW AG5431	0.34	29440	14.72
SSC-049N	0.40	35136	17.57
HBK RY5520	0.48	29520	14.76
Armor ARX1552	0.61	67224	33.61
Forrest	0.65	29872	14.94
Armor ARX1551	0.68	108084	54.04
HBK R5529	0.70	47360	23.68
USG 75J50R	0.94	148696	74.35
Terral-REVTM 54R21	0.95	66700	33.35
MorSoy R2S480	1.04	97600	48.80
Delta King DKX1533	1.06	127600	63.80
MorSoy R2S4800	1.09	154700	77.35
Dyna-Gro 37RY47	1.13	291700	145.85
Delta King DKX1537	1.15	170544	85.27
Progeny 4750RR	1.15	185480	92.74
Progeny 5610RY	1.16	151140	75.57
eMerge XP4520	1.18	299220	149.61
HBK RY5220	1.18	241744	120.87
Terral-REVTM 44R22	1.19	119500	59.75
Delta King DKX1473	1.19	159300	79.65
Willcross RR2878NS	1.20	296152	148.08
SS-11L.48N	1.20	174228	87.11
ASGROW AG4630	1.20	133100	66.55
MorSoy R2491	1.20	167100	83.55
Armor ARX1472	1.20	140200	70.10
Delta Grow 4795RR2	1.21	176000	88.00
Eagle Seed ES 5390RR2	1.21	282656	141.33
HBK RY5820	1.25	170600	85.30
MPG 4707NRR/STS	1.25	203232	101.62

NK S46-U6 Brand	1.25	173600	86.80
MorSoy R2S4629	1.25	209800	104.90
Progeny 5210RY	1.26	185000	92.50
eMerge XC5110	1.26	137900	68.95
AgVenture AV54X4RR	1.27	310780	155.39
Dyna-Gro 35x43	1.27	155400	77.70
Delta King DKX1539	1.28	166400	83.20
Dyna-Gro 33G48	1.29	150900	75.45
USG 75T18	1.29	198732	99.37
Eagle Seed ES 5355	1.31	185300	92.65
ASGROW EXP946R2	1.31	180620	90.31
Croplan RC4877	1.32	214800	107.40
HBK R4829	1.32	290200	145.10
Davis 149RRCNS	1.32	209900	104.95
Terral-REVTM 49R10	1.32	177100	88.55
Davis 147RRCNS	1.33	198000	99.00
MPG-X-410-1	1.33	183600	91.80
SS-09L.49N	1.33	232260	116.13
Terral-REVTM 54R10	1.34	257500	128.75
Dyna-Gro 37RY52	1.35	247600	123.80
Progeny 5960LL	1.36	200600	100.30
USG 74G99L	1.36	197400	98.70
Croplan RC4417	1.37	249700	124.85
Delta King DKR4440	1.37	197500	98.75
Armor ARX1535	1.37	182300	91.15
Stine 5400-4	1.38	183800	91.90
Progeny 4920RY	1.38	235100	117.55
Armor ARX1478	1.39	185100	92.55
Delta King DKX1492	1.39	383800	191.90
Terral-REVTM 56R21	1.39	279200	139.60
Progeny 4810RY	1.39	198500	99.25
Armor ARX1477	1.39	253700	126.85
NK S49-A5 Brand	1.39	275080	137.54
VP Maxx 49C9RR	1.39	350468	175.23
MorSoy R2S481	1.40	245100	122.55
Armor ARX1471	1.40	248500	124.25
NK S47-R3 Brand	1.40	214500	107.25
Progeny 4209RY	1.41	239700	119.85
Willcross RR2507NS	1.41	226000	113.00
Delta King DKR4744	1.41	216700	108.35
Armor ARX1536	1.42	508800	254.40
S07-5151	1.42	311700	155.85
Dyna-Gro 35RY47	1.42	258400	129.20
S07-5117	1.43	299100	149.55
Progeny 5310RY	1.43	244280	122.14
Eagle Seed ES 5190RR2	1.43	247000	123.50
ASGROW EXP948R2	1.43	193300	96.65
Progeny 4510RY	1.44	234600	117.30
ASGROW AG5331	1.45	221200	110.60
Armor 46-N7	1.45	470516	235.26
Terral-REVTM 45R10	1.45	354100	177.05
Progeny 4610RY	1.46	275800	137.90

Progeny 5330RR	1.46	298200	149.10
Progeny 5110RY	1.46	281560	140.78
USG 75J10R	1.47	345900	172.95
USG 75J90R	1.48	301200	150.60
Armor 47-G10	1.48	237720	118.86
USG 74T59	1.48	299600	149.80
NK S51-T8 Brand	1.49	272440	136.22
Delta King DKX1474	1.49	293000	146.50
Braxton	1.49	385900	192.95
Terral-REVTM 48R10	1.50	298300	149.15
Stine 51LA02	1.50	267600	133.80
Armor 47-R33	1.51	287300	143.65
Terral-REVTM 48R21	1.52	251080	125.54
UA 4910	1.52	251000	125.50
MorSoy R2520	1.52	251300	125.65
Pioneer 94Y92	1.53	337700	168.85
Armor ARX1531	1.53	397600	198.80
Croplan R2T4799S	1.53	276800	138.40
Terral-REVTM 48R22	1.53	341200	170.60
S07-5049	1.54	309100	154.55
VP Maxx 44X1RR	1.54	407100	203.55
ASGROW AG4531	1.54	256000	128.00
Croplan RC4749	1.54	266700	133.35
Delta King DK5363	1.54	258000	129.00
HBK RY4620	1.55	360000	180.00
Progeny 5160LL	1.55	380800	190.40
Croplan RC4757S	1.55	302000	151.00
Pioneer 94Y71	1.56	305800	152.90
Dyna-Gro 34RY46	1.56	352480	176.24
Armor ARX1481	1.56	318500	159.25
Terral-REVTM 57R21	1.56	295840	147.92
Eagle Seed ES 4998	1.56	270000	135.00
MorSoy R2540	1.56	264000	132.00
HBK RY4920	1.56	290320	145.16
Delta King DKX1540	1.57	326600	163.30
Terral-REVTM 55R21	1.57	409900	204.95
Progeny 4960LL	1.57	315600	157.80
Terral-REVTM 49R22	1.58	387500	193.75
eMerge XC4910	1.59	512900	256.45
DB06-2257	1.59	322900	161.45
Armor ARX1482	1.59	389500	194.75
R04-572	1.59	414420	207.21
SS-10L.51N	1.60	319000	159.50
Delta Grow 4880RR	1.61	331000	165.50
Willcross RY2460S	1.61	356000	178.00
Dyna-Gro SX10354L	1.61	388400	194.20
HBKR4924	1.62	302000	151.00
V03-3650	1.62	413700	206.85
Davis 247RRS	1.62	410400	205.20
Terral-REVTM 49R11	1.62	330000	165.00
Armor ARX1532	1.63	350000	175.00
Willcross RY2481S	1.63	335480	167.74

NK S44-D5 Brand	1.65	393000	196.50
MPG 4611NRR/STS	1.66	360000	180.00
MorSoy R2521	1.66	462200	231.10
NK S56-G6 Brand	1.66	370000	185.00
R05-235	1.66	350800	175.40
AgVenture AV48A8RR	1.66	397000	198.50
S07-15722	1.67	557600	278.80
Progeny 5460LL	1.67	380000	190.00
Delta King DKX1538	1.68	481900	240.95
Terral-REVTM 47R22	1.68	349000	174.50
Stine 49L28	1.68	347000	173.50
Dyna-Gro 35P53	1.68	617800	308.90
ASGROW EXP944R2	1.69	396000	198.00
Croplan RC5007S	1.70	438400	219.20
MorSoy R2496	1.71	556000	278.00
R05-3239	1.71	649600	324.80
Delta King DKX1534	1.75	407000	203.50
MorSoy R2490	1.75	410000	205.00
USG 75UJ10R	1.76	505440	252.72
Armor 47-F8	1.83	641000	320.50
MPG 4577NRR	1.84	529000	264.50
Delta King DKX1491	1.86	704000	352.00
R06-4433	1.87	551000	275.50
DB06-3442	1.90	621000	310.50

Red not different from Anand

Table 2. *Rotylenchulus reniformis* reproduction on selected Breeding Lines in 2010 tests.

Breeding Line	Breeder	Cultivar Log + 1 Mean	Nematode Count Mean	Cultivar RI = Pf/Pi Mean
Fallow		0.28	1110	0.56
SO7-14903	Shannon	0.33	1308	0.65
SO5-11400	Shannon	0.58	2340	1.17
SO8-6800	Shannon	0.68	2760	1.38
SO8-12102	Shannon	0.79	3264	1.63
SO8-14910	Shannon	0.87	4540	2.27
Hartwig	Resistant Check	0.93	3930	1.97
Anand	Resistant Check	1.00	3840	1.92
SO7-14892	Shannon	1.09	5296	2.65
SO7-11606	Shannon	1.56	7176	3.59
SO8-17961	Shannon	1.90	10892	5.45
SO7-14902	Shannon	2.03	9108	4.55
V04-5842	Rainey	2.08	9532	4.77
SC98-1930	Shipe	2.38	14576	7.29
SO8-18197	Shannon	3.16	18796	9.40
JTN-5110	Arelli	3.95	20028	10.01
V03-4705	Rainey	6.12	31124	15.56
V95-0016	Rainey	6.13	25400	12.70
V03-4661	Rainey	6.81	28000	14.00
SO8-4628	Shannon	7.86	45988	22.99

SC07-786	Shipe	7.89	36200	18.10
V06-0241	Rainey	8.41	33400	16.70
V06-0197	Rainey	8.56	40500	20.25
MOTTE	Shipe	9.33	44840	22.42
Forrest	Resistant Check	9.35	46136	23.07
SC06-687	Shipe	9.58	42728	21.36
V06-1045	Rainey	9.63	71216	35.61
Osage	Chen	9.83	65996	33.00
SC07-1490	Shipe	9.96	52964	26.48
SO8-17357	Shannon	10.24	47880	23.94
SC07-1596	Shipe	10.96	103832	51.92
SO7-2680	Shannon	11.00	51700	25.85
V03-4660	Rainey	11.41	82140	41.07
V06-0245	Rainey	11.82	61052	30.53
SO8-14100	Shannon	12.21	56900	28.45
SC07-1027	Shipe	12.37	57800	28.90
V06-0613	Rainey	12.73	58100	29.05
RM1-1639	Chen	13.29	58300	29.15
MAXCY	Shipe	13.67	59900	29.95
SO7-14472	Shannon	13.68	63200	31.60
GLENN 09	Rainey	13.69	82000	41.00
SANTEE	Shipe	13.999	56400	28.20
SO8-7048	Shannon	14.314	100208	50.10
SO7-18772	Shannon	14.411	65800	32.90
V06-1025	Rainey	15.547	78400	39.20
SO8-10645	Shannon	15.959	68500	34.25
ARK S5	Chen	16.064	114396	57.20
BO5-8046	Rainey	16.236	72500	36.25
V05-2505	Rainey	16.308	85900	42.95
JTN-3109	Arelli	16.344	75100	37.55
RM6-9508	Chen	17.76	73200	36.60
ARK 8109	Chen	17.89	81700	40.85
SC07-1352	Shipe	18.472	77600	38.80
SC07-1455	Shipe	18.528	85400	42.70
SC05-642	Shipe	19.038	80900	40.45
SO8-14132	Shannon	19.178	87700	43.85
V06-0038	Rainey	19.23	102428	51.21
SC02-208	Shipe	20.149	84000	42.00
Braxton	Susceptible Check	20.746	106000	53.00
SC07-912	Shipe	20.904	90200	45.10
SC07-1518	Shipe	21.716	89600	44.80
SC06-676	Shipe	21.887	96100	48.05
HAGOOD	Shipe	22.499	88300	44.15
SO7-5206	Shannon	23.036	99400	49.70
SC07-1029	Shipe	23.402	99700	49.85
SC07-150	Shipe	23.652	110700	55.35
ARK S1	Chen	26.918	104700	52.35
SC07-108	Shipe	29.858	117680	58.84
V06-1014	Rainey	29.941	164600	82.30

Red not different from Anand or Hartwig