RENIFORM NEMATODE REPRODUCTION ON SOYBEAN CULTIVARS AND BREEDING LINES IN 2008

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Abstract

During 2008, 162 soybean varieties from the Arkansas variety testing program and 82 breeding lines and varieties: 26 from Clemson (Shipe), 17 from Arkansas (Chen), 8 from the USDA Jackson TN (Arelli), 11 from the Missouri (Shannon), and 18 from North Carolina (Koenning) were tested in the greenhouse to determine their suitability as hosts for the reniform nematode (RN), *Rotylenchulus reniformis*. All treatments were inoculated with 1, 500 vermiform RN. 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, and Forrest for both tests. Arkansas test cultivars with RI's significantly greater than the RI on Forrest (1.00) were considered suitable hosts for *R. reniformis*. Of the Arkansas test varieties 152 of 162 supported more RN reproduction than Forrest and 2 varieties (MPG 5308nRR and AgVenture AV 53D3NRR supported less than all three of the resistant checks. The following varieties; MPG 5308nRR, AgVenture AV 53D3NRR, Eagle Seed ES 4818RR, Armor 39-K4, Eagle Seed ES 4906RR, Asgrow AG 5606, Eagle Seed ES 5121RR, Asgrow AG 4705, and Progeny 4508RR, were not different than Forrest. On 46 of the 82 breeding lines RN reproduction was more than on Forrest.

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 (RN) resistance, whereas several sources of RN resistance exist in soybean. This resistance is often linked to resistance to the soybean cyst nematode (*Heterodera glycines*). Use of RN resistant soybean in a rotation with cotton can be a useful option. Public

soybean breeding lines from programs at Arkansas, Clemson, Missouri, North Carolina and USDA in Jackson Tennessee having low reniform reproduction may prove very useful in breeding for RN resistance.

Information on the reproduction of the RN on contemporary soybean cultivars is limited. Robbins, et al. (1994) reported on the reproduction of the RN 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). These papers form the basis for RN reproduction information on contemporary soybean lines. The breeding lines tested for reniform nematode reproduction are given by Robbins et al. (2007b, 2008)

The objectives of the 2008 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 RN susceptible crops in RN infested fields.

2) To identify useful breeding lines for use in selection of new RN resistant cultivars.

Materials and Methods

The soybean test lines and cultivars in 2008 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 RN 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 1,500 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. 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 and Braxton as a susceptible control.

After 12 weeks (June 16-September 16, 2008), 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 Forrest 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 and Discussion

Seven lines in the Arkansas Soybean Variety program tested had log ratios not significantly ($P \leq 0.05$) higher than Forrest (italics, bold, & both red and blue in Table 1). This indicates they were not different in supporting reproduction from Forrest (Resistant). Those lines in bold, italics, and blue on table 1 are not different than Anand (more Resistant than Forrest).

A total of 37 lines and cultivars in the test of the Arkansas, Clemson, USDA Jackson TN, Missouri, and North Carolina lines 37 were not significantly higher than Forrest (italics, bold, both red and blue in Table 2). Of the 37 lines and cultivars tested none were from Arkansas, 13 were from Clemson, 8 were from Missouri, and 5 were from USDA Jackson TN, and 11 were from North Carolina. This indicates these 37 were not different in supporting RN reproduction from Forrest. 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 have soybean cyst and root knot nematode resistance.

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Table 1. *Rotylenchulus reniformis* reproduction on 162 selected soybean cultivars and lines from the Arkansas Soybean Variety Testing Program in 2008 tests.

Treatment Cultivar or Check**	Cultivar RI (Pf/Pi)* Log + 1	Cultivar Average Real #	Cultivar RI (Pf/Pi) Real #
Fallow	*0.412*	*516*	*0.34*
MPG 5308nRR	*0.555*	*684*	*0.46*
AgVenture AV 53D3NRR	*0.617*	*792*	*0.53*
Hartwig	*0.968*	*1245*	*0.83*
Anand	*0.988*	*1176*	*0.78*
Forrest	*4.481*	*5415*	*3.61*
Eagle Seed ES 4818RR	*4.956*	*10952*	*7.30*
Armor 39-K4	*6.661*	*25688*	*17.13*
Eagle Seed ES 4906RR	*6.988*	*14648*	*9.77*
ASGROW AG 5606	*7.894*	*17276*	*11.52*
Eagle Seed ES 5121RR	*8.631*	*13808*	*9.21*
ASGROW AG 5803	8.724	18948	12.63
ASGROW AG 4705	*8.739*	*10496*	*7.00*
USG 74H48	8.806	33328	22.22
Progeny 4508RR	*9.350*	*18360*	*12.24*
Schillinger 499.RC	9.575	18876	12.58
Progeny 5408RR	9.804	14808	9.87
Pioneer 95Y70	9.898	23332	15.55
Progeny 3906RR	10.490	17116	11.41
Armor 53-Z5	10.960	26284	17.52
Schillinger 478.RCS	11.092	19084	12.72
Delta King DK XTJ848	11.125	61460	40.97
Dyna-Gro 35F55	11.534	48004	32.00
Progeny 4408RR	11.674	22784	15.19
SO4-20912	12.338	21796	14.53
Progeny 5108RR	12.560	17456	11.64
Great Heart GT-462CRR	12.996	25496	17.00
USG 74A91	13.301	39720	26.48
Progeny 4807RR	13.362	20668	13.78
Crows C5015R	13.433	19840	13.23
Delta Grow 4820RR	13.558	32904	21.94
MPG 4909nRR	13.642	29424	19.62
Pioneer 94Y90	13.832	39764	26.51

Croplan RC5663	14.158	30844	20.56
Terral TV45R18	14.192	25812	17.21
NK S59-B8	14.464	47300	31.53
USG 7495nRS	14.736	30512	20.34
Pioneer 95Y40	15.394	22444	14.96
SO5-4678	15.504	24804	16.54
Eagle Seed ES XVT675RR	15.783	30160	20.11
R04-1276RR	15.805	32220	21.48
Stine 5482-4	16.005	34896	23.26
MorSoy RT5388N	16.837	32156	21.44
Delta King XTJ950	17.120	30344	20.23
Armor ARX4560	17.127	24716	16.48
Progeny 4918RR	17.172	29660	19.77
Croplan Genetics RC4877	17.239	23608	15.74
Deltapine DP 5335RR/S	17.401	35108	23.41
MorSoy RTs4707N	17.456	20948	13.97
Armor 42-M1	17.566	23232	15.49
SO4-4604	17.748	32952	21.97
MorSoy RT4707N	17.762	25592	17.06
MPG 5505nRR/STS	17.898	30956	20.64
Armor ARX4717	18.096	25672	17.11
AgVenture AV 51X5RR	18.247	25460	16.97
Delta Grow 5170RR	18.581	23976	15.98
Delta Grow 4870RR	18.792	34868	23.25
Croplan Genetics RC4207	19.506	31728	21.15
MorSoy RTs4688N	19.592	25452	16.97
Crows C4519R	19.626	33024	22.02
SO4-3924	19.736	29424	19.62
Croplan Genetics RC4998	19.835	30892	20.59
ASGROW DK 5068a	20.039	52212	34.81
Croplan Genetics RC4417	20.399	26896	17.93
ASGROW DK 4866	20.402	26688	17.79
Terral TV49R19	20.477	33636	22.42
AgVenture AV 54X4RR	20.492	47124	31.42
R04-1274RR	20.644	43844	29.23
MorSoy RT5168N	20.663	30136	20.09
USG 74E68	21.016	27608	18.41
AgVenture AV 49X0	21.249	47660	31.77
Armor GP-500	21.297	71868	47.91
Croplan Genetics RC4757	21.780	46316	30.88
Schillinger 538.R	22.035	26600	17.73

Schillinger 458.RCS	22.055	30200	20.13
Dyna-Gro 32P48	22.063	31184	20.79
Delta King DK4968	22.071	45100	30.07
ASGROW AG 5503	22.110	28236	18.82
Croplan Genetics RC5007	22.249	43240	28.83
Eagle Seed ES 4991RR	23.012	33680	22.45
Progeny 5308RR	23.294	43600	29.07
MPG 4907nRR/STS	23.354	37800	25.2
Progeny 4718RR	23.479	35160	23.44
Delta Grow 5450RR	23.485	45610	30.41
USG 74A88	23.516	34840	23.23
AgVenture AV 50D2	23.794	29456	19.64
AgVenture AV 52P2NRR	23.819	29700	19.80
Terral TV49R27	23.875	37048	24.70
Terral TV54R28	23.893	61532	41.02
Delta King DK 4995	24.010	41400	27.60
MPG 4905nRR	24.167	35000	23.33
Eagle Seed ES 4777RR	24.530	37484	24.99
ASGROW AG 4606	24.834	34400	22.93
Crows C4142R	24.97	31300	20.87
ASGROW AG 4907	25.332	52044	34.70
Pioneer 94Y60	25.491	52920	35.28
USG 74A45	25.712	33500	22.33
Progeny 4206RR	26.002	31500	21.00
MorSoy RT5906N	26.158	33900	22.60
MorSoy RT5688N	26.179	35000	23.33
Schillinger 477.TCS	26.976	32500	21.67
Pioneer 94Y70	27.749	37900	25.27
Eagle Seed ES 5555RR	27.769	48220	32.15
ASGROW DKB 46-51	27.877	33300	22.20
Progeny 5218RR	27.929	40244	26.83
MPG 4808nRR	28.113	37100	24.73
MorSoy RTs4488N	28.385	41632	27.75
Dyna-Gro 32B57	28.605	42596	28.40
Dyna-Gro 33Y45	28.754	34700	23.13
MPG 5407nRR	28.901	48016	32.01
Dyna-Gro 33P54	29.013	42944	28.63
USG 74A27	29.340	39900	26.60
SO4-21237	29.374	47980	31.99
Delta King DK 48-J3	29.758	43500	29.00
Terral TV47R17	29.888	37200	24.80

ASGROW AG 3906	30.145	46800	31.20
ASGROW AG 5304	30.400	40700	27.13
MorSoy RT5288N	31.000	39600	26.40
Terral TV46R19	31.253	43700	29.13
Delta King XTJ949	32.548	42800	28.53
MPG 4705nRR	32.563	39100	26.07
R04-1250RR	32.568	46200	30.80
MPG 48-2nRR	32.978	40500	27.00
Delta King DK XTJ949	33.005	64800	43.20
Legacy LS 54-27RR	33.213	45900	30.60
Delta King DK48-J3	33.351	26304	17.54
Delta King DK4995	34.235	54780	36.52
Progeny 5208RR	35.604	61072	40.71
MorSoy RT4888N	35.920	47400	31.60
Delta King XTJ946	36.010	61760	41.17
Eagle Seed ES 5519RR	36.267	47200	31.47
HBK RS5227	36.640	50200	33.47
Croplan Genetics RC4908	36.980	45900	30.60
Terral TV52R28	37.038	46500	31.00
Progeny 5107RR	37.179	53728	35.82
ASGROW AG 4303	37.439	49780	33.19
AgVenture AV 50X6RR	39.088	52800	35.20
Armor GP-533	39.129	52900	35.27
Legacy LS 54-17RR/STS	39.423	49500	33.00
USG 75Z98	39.560	51000	34.00
Terral TV47R18	39.971	58100	38.73
USG 74F96	40.077	47900	31.93
NK S47-D9	40.738	50200	33.47
ASGROW AG 4405	41.475	50800	33.87
Schillinger 557.RC	43.813	70224	46.82
Progeny 4908RR	43.823	64000	42.67
Armor 55-A5	43.883	54500	36.33
Pioneer 95M50	44.099	68500	45.67
R04-170RR	45.308	55900	37.27
AgVenture AV 49X9NRR	45.390	54300	36.20
Delta King DK XTJ 950	45.776	37100	24.73
AGS 606RR	47.674	90220	60.15
Terral TV52R757	48.048	65000	43.33
R03-224	49.056	69300	46.20
Croplan RC5437	51.762	61600	41.07
AGS 568RR	51.863	67300	44.87

Pioneer 95Y20	52.448	70700	47.13
NK S52-F2	53.383	65500	43.67
Delta Grow 5570RR/STS	53.721	68100	45.40
ASGROW AG 5905	53.938	68500	45.67
Dyna-Gro 31R54	55.700	81000	54.00
Delta Grow 5280RR	56.935	80400	53.60
USG 75Z38	57.726	76000	50.67
Dyna-Gro 33C59	58.565	76900	51.27
Braxton	62.730	83000	55.33
Pioneer 95Y41	74.140	101300	67.53

*RI = Reproductive Index; Pf = Population final; Pi = Population initial.
Treatment Cultivar = ***Blue* not statistically different than Anand; ***Red*** not statistically different than Forrest.

Table 2. *Rotylenchulus reniformis* reproduction on selected Breeding Lines, 2008.

Line or Variety	Breeding Program	Cultivar RI (Pf/Pi) Log + 1	Cultivar Average Real #	Cultivar RI (Pf/Pi) Real #
Fallow	***Check***	***0.073***	***308***	***0.2***
Fowler	***N. Carolina***	***0.177***	***732***	***0.5***
JTN-4308	***USDA***	***0.295***	***1272***	***0.8***
Jake	***N. Carolina***	***0.303***	***1368***	***0.9***
JTN-5303	***N. Carolina***	***0.354***	***1524***	***1.0***
S06-3027	***Missouri***	***0.392***	***1716***	***1.1***
S06-3095	***Missouri***	***0.400***	***1764***	***1.2***
JTN-5203	***N. Carolina***	***0.411***	***1800***	***1.2***
JTN-5208	***USDA***	***0.438***	***1980***	***1.3***
Hartwig	***Resistant Check***	***0.456***	***1965***	***1.3***
NO2-7084	***N. Carolina***	***0.525***	***2388***	***1.6***
S06-3050	***Missouri***	***0.536***	***2388***	***1.6***
SC98-1930	***Clemson***	***0.643***	***2676***	***1.8***
NC Raliegh (7002)	***N. Carolina***	***0.677***	***3036***	***2.0***
S04-8882	***Missouri***	***0.760***	***3312***	***2.2***
JTN-5593	***N. Carolina***	***0.801***	***3660***	***2.4***
NC02-307	***N. Carolina***	***0.844***	***3636***	***2.4***
Anand	***Resistant Check***	***0.860***	***4104***	***2.7***
S06-3033	***Missouri***	***0.865***	***3780***	***2.5***

S05-11268	***Missouri***	***0.881***	***5036***	***3.4***
JTN-5308	***USDA***	***0.938***	***5672***	***3.8***
NCC05-357	***N. Carolina***	***1.223***	***5184***	***3.5***
S05-11482	***Missouri***	***1.234***	***17436***	***11.6***
SC04-83	***Clemson***	***1.502***	***6864***	***4.6***
SC03-9093	***Clemson***	***1.558***	***6516***	***4.3***
Delsoy 5710	***N. Carolina***	***1.647***	***45204***	***30.1***
SC01-803	***Clemson***	***1.684***	***7704***	***5.1***
MOTTE	***Clemson***	***1.687***	***8692***	***5.8***
SANTEE	***Clemson***	***1.711***	***10248***	***6.8***
JTN-4408	***USDA***	***1.771***	***13344***	***8.9***
S06-3041	***Missouri***	***1.814***	***17668***	***11.8***
SC01-783A	***Clemson***	***1.858***	***8776***	***5.9***
JTN-5108	***USDA***	***1.984***	***8280***	***5.5***
SC01-819	***Clemson***	***2.055***	***9464***	***6.3***
SC02-208	***Clemson***	***2.113***	***10892***	***7.3***
Forrest	***Resistant Check***	***2.291***	***9900***	***6.6***
SC03-9151	***Clemson***	***2.360***	***10484***	***7.0***
NCC01-69 Black	***N. Carolina***	***3.110***	***14268***	***9.5***
SC05-642	***Clemson***	***3.134***	***13680***	***9.1***
SC05-647	***Clemson***	***3.388***	***75540***	***50.4***
NC02-21500	N. Carolina	**3.577**	**15016**	**10.0**
S06-4197	Missouri	**4.595**	**66208**	**44.1**
SC05-566	***Clemson***	***4.630***	***59004***	***39.3***
NCC01-69 Brown	N. Carolina	**6.650**	**43400**	**28.9**
R04-357	Arkansas	**9.235**	**51944**	**34.6**
R00-1194F	Arkansas	**11.230**	**85040**	**56.7**
JTN-4208	USDA	**14.098**	**99316**	**66.2**
SC05-525	Clemson	**17.509**	**130852**	**87.2**
R03-946	Arkansas	**18.552**	**88880**	**59.3**
SC05-654	Clemson	**19.571**	**220316**	**146.9**
JTN-4108	USDA	**19.768**	**128824**	**85.9**
R04-632	Arkansas	**22.176**	**124075**	**82.7**
R04-122	Arkansas	**24.296**	**129880**	**86.6**
S06-6906	Missouri	**24.357**	**119200**	**79.5**
SC03-9090	Clemson	**24.941**	**177324**	**118.2**
S06-6836	Missouri	**25.062**	**131640**	**87.8**
Bedford	N. Carolina	**26.433**	**135200**	**90.1**
R01-2346	Arkansas	**26.921**	**131060**	**87.4**
R03-1232	Arkansas	**27.626**	**193072**	**128.7**
S06-9423	Missouri	**27.997**	**134125**	**89.4**

NCC02-21416	N. Carolina	**30.334**	**130240**	**86.8**
SC05-522	Clemson	**31.161**	**176820**	**117.9**
SC05-545	Clemson	**31.982**	**240132**	**160.1**
SC05-557	Clemson	**32.699**	**181620**	**121.1**
R04-342	Arkansas	**34.675**	**179440**	**119.6**
SC05-505	Clemson	**35.553**	**217800**	**145.2**
R04-170RR	Arkansas	**35.966**	**160880**	**107.3**
R05-4114	Arkansas	**37.226**	**198060**	**132.0**
JTN-4508	USDA	**37.925**	**167760**	**111.8**
S06-4154	Missouri	**38.221**	**207700**	**138.5**
R04-198	Arkansas	**38.966**	**173100**	**115.4**
Ozark	Arkansas	**41.505**	**182960**	**122.0**
R02-3065	Arkansas	**42.827**	**221440**	**147.6**
R01-327	Arkansas	**45.366**	**221900**	**147.9**
N02-188	N. Carolina	**48.137**	**240440**	**160.3**
SC05-694	Clemson	**49.792**	**221920**	**147.9**
Hutecheson	N. Carolina	**51.339**	**213000**	**142.0**
SC05-530	Clemson	**51.391**	**273400**	**182.3**
Osage	Arkansas	**53.248**	**292500**	**195.0**
R03-224	Arkansas	**54.567**	**303240**	**202.2**
Holiday	N. Carolina	**61.070**	**290560**	**193.7**
UA4805	Arkansas	**64.083**	**300840**	**200.6**
SC05-606	Clemson	**65.393**	**272000**	**181.3**
Braxton	Checks	**68.346**	**365500**	**243.7**
SC05-598	Clemson	**69.179**	**419300**	**279.5**
SC05-589	Clemson	**71.618**	**454800**	**303.2**
SC05-573	Clemson	**88.969**	**411000**	**274.0**

*RI = Reproductive Index; Pf = Population final; Pi = Population initial.
Line or Variety = ***Blue* not statistically different than Anand; ***Red*** not statistically different than Forrest.