RENIFORM NEMATODE REPRODUCTION ON SOYBEAN CULTIVARS AND PUBLIC BREEDING LINES IN 2007

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Abstract

During 2007, 128 soybean varieties from the Arkansas Soybean variety testing program and 48 breeding lines (30 breeding lines from the Clemson, 6 from the Arkansas, and 12 from the USDA Jackson TN breeding programs) were tested in the greenhouse to determine their suitability as hosts for the reniform nematode (RN), *Rotylenchulus reniformis*. All treatments were inoculated with 2,034 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 (Population final/Population initial)), and PF/PI's of Forrest, Anand, and Hartwig for both tests. Arkansas variety test entries with RI's significantly greater the converted log $_{10\ +\ 1}$ ratio of Hartwig than the RI on Hartwig (1.00) were considered suitable hosts for *R. reniformis*. The Arkansas Soybean varieties entries showing low reproduction may be useful in a cotton-soybean rotation when reniform nematode is present. The breeding lines showing low reproduction might be useful in developing reniform nematode resistant varieties

Introduction

In the Southeastern United States reniform nematode (*R.otylenchulus 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. Soybean breeding lines from programs at Arkansas, Clemson, Missouri, and USDA in Jackson Tennessee having low reniform reproduction rates have been identified in greenhouse tests by Robbins et al. (2007). Use of these soybean breeding lines 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 2007 period yearly tests showed the host status for over 1,500 soybean lines (Robbins et al. 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007a). 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)

The objectives of the 2007 study were to 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 and to identify useful breeding lines for use in selection of new RN resistant cultivars.

Materials and Methods

The 128 soybean Arkansas test cultivars in 2007 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.). 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. On the same day (June 8) a total of 2,034 vermiform RN were injected with an autopipette into three, 2.5 cm-deep holes made in the soil in each pot containing one soybean seedling in the cotyledon stage. Pots were arranged in a randomized complete block design, with five replications per cultivar. Soybean cultivars Anand, Forrest and Hartwig were included as resistant controls and Braxton as a susceptible control.

After 15 weeks (June 8-September 26-30, 2007), the number of vermiform RNin the soil of each pot was determined. 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 Hartwig (RH (Arkansas test)) or Anand (RA (Breeding line test) was calculated. The log ratio data [log10 (RH + 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

Four lines in the Arkansas Soybean Variety program tested had log ratios not significantly ($P \leq= 0.05$) higher than Hartwig (italics and blue in Table 1). This indicates they were not different in supporting reproduction from Hartwig. Those lines in red on table 1 are not different that Forrest.

Table 1. Reproduction of *Rotylenchulus reniformis* on 128 new Soybean lines tested in the Arkansas Variety Testing Program in 2007.

Cultivar	Soil Mean	Pf/Pi	Converted Log Ratio
Fallow	*504*	*0.25*	*0.585*
Anand	*912*	*0.45*	*0.931*
Hartwig	*792*	*0.39*	*1.000*
Pioneer 93M90	*1440*	*0.71*	*1.469*
AGVENTURE 44D4	*2508*	*1.23*	*2.588*
Forrest	*3312*	*1.63*	*2.926*
DB02-2517	*10116*	*4.97*	*3.892*
MPV 4406nRR	*9368*	*4.61*	*4.312*
Armor X4228	*8024*	*3.94*	*4.460*
Terral TVX47R118	*6760*	*3.32*	*4.681*
Terral TV57R14	*23796*	*11.7*	*4.745*
S04-6013RR	*9708*	*4.77*	*4.818*
Schillinger 467RCP	*12396*	*6.09*	*5.014*

Armor 47-F8	8696	4.28	5.593
Deltapine 07-3980RR	10056	4.94	5.858
Schillinger 457RCP	15036	7.39	6.235
R01-3474	6884	3.38	6.295
ASGROW AG4604	14028	6.9	6.387
Terral TVX48R018	9780	4.81	6.655
R03-176	14476	7.12	6.749
HBK R4724	12048	5.92	6.889
MORSOY RTS4007N	8820	4.34	7.006
AGS 606RR	54156	26.63	7.750
Terral TV44R27	16236	7.98	8.002
Progeny 4949RR	14528	7.14	8.032
ASGROW AG4605	12540	6.17	8.075
Terral TVX47R018	14252	7.01	8.250
Armor X4996	9972	4.9	8.584
Delta King XTJ848	12360	6.08	9.012
Dyna-Gro 35D44	13556	6.66	9.146
Legacy LS47-57NRR	16512	8.12	9.194
Deltapine DP5914RR	22132	10.88	9.651
Progeny 4405RR	13188	6.48	9.776
R03-1250	20812	10.23	9.811
EXCEL 8474NRR	25548	12.56	9.823
USG 7440nRR	19856	9.76	9.845
Delta Grow 4780RR	15736	7.74	10.025
Delta Grow 4860RR	27320	13.43	10.078
Armor X4560	12432	6.11	10.178
Dyna-Gro 38X47	14072	6.92	10.249
Deltapine DP4888RR/S	16584	8.15	10.259
Progeny 4507RR	12708	6.25	10.855
Delta Grow 4970RR	15416	7.58	10.904
Terral TVX45R118	20488	10.07	11.122
S04-6008RR	22544	11.08	11.267
Schillinger XP49	10696	5.26	11.276
Pioneer 94B73	15652	7.7	11.392
USG 7494nRR	12572	6.18	11.465
Terral TV46R15	15924	7.83	11.768
MONSANTO EXP 644AR	16312	8.02	11.798
NK BRAND S45-E5	15672	7.71	12.023
MORSOY RT4707N	22832	11.23	12.350
Progeny 4206RR	16632	8.18	12.529
HBK R4727	24524	12.06	12.637
AGVENTURE 46J5NRR	25308	12.44	12.725
Progeny 4804RR	24152	11.87	13.141
Deltapine 07-3972RR	15184	7.47	13.557
Progeny 4807RR	18352	9.02	14.278
Progeny 4606RR	17900	8.8	14.586
Progeny 4706RR	22144	10.89	14.652
Deltapine DPX4334RR	20176	9.92	14.670
HBK C5894	28988	14.25	14.697
USG 74F78	13996	6.88	15.397

Dyna-Gro 35Z49	32448	15.95	15.412
Deltapine DP4450RR	17488	8.6	15.626
ASGROW AG4103	20660	10.16	15.930
HBK R5727	30028	14.76	16.342
Terral TVX46R018	22212	10.92	16.370
Deltapine DP4112RR/S	19064	9.37	17.268
NK BRAND S46-U6	20528	10.09	17.499
Delta King XTJ847	22460	11.04	17.529
Armor X4717	18920	9.3	17.547
Legacy LS57-26CRR	22532	11.08	17.622
DB03-2811	47660	23.43	17.931
Legacy LS49-57RR	29668	14.59	18.168
AGVENTURE 47G3NRR	22832	11.23	18.179
AGVENTURE 57D7RR	23000	11.31	18.239
Deltapine DP4724RR	36632	18.01	18.497
DEKALB DKB46-51	45816	22.53	18.563
USG 75J97	34412	16.92	18.586
Pioneer 94M71	33556	16.5	18.637
S04-5969RR	26656	13.11	18.973
R02-3263RR	20272	9.97	19.164
Deltapine DPX4727RR	22580	11.1	20.094
V98-9005	98560	48.46	20.155
Delta King DK4567	17528	8.62	20.461
Terral TVX45R018	18404	9.05	21.127
HBK R3927	32212	15.84	21.513
Deltapine 07-4732RR	30820	15.15	21.547
Delta Grow 4470RR/STS	24308	11.95	21.764
Armor 49-V6	29656	14.58	22.052
HBK R4527	103132	50.7	23.330
Armor X4995	46328	22.78	23.576
Delta Grow 4975LARR	24356	11.97	23.744
Deltapine DP4546RR	49324	24.25	24.093
MPV 4905nRR	35884	17.64	24.646
R03-1134	60564	29.78	25.524
MONSANTO EXP 645AR	22356	10.99	25.526
ASGROW AG4903	74704	36.73	25.558
Delta King DK55T6	45364	22.3	25.979
Delta Grow 4960RR	42248	20.77	26.541
V98-2711	28156	13.84	27.449
Progeny 5706RR	30016	14.76	27.562
DB03-1381	25584	12.58	27.604
NK BRAND S49-W6	37940	18.65	27.742
Dyna-Gro 33Y45	32676	16.06	28.009
Schillinger XP47	45236	22.24	28.385
TN03-12RR	54772	26.93	28.467
MORSOY RTS4556N	31864	15.67	28.880
R03-1128	50412	24.78	29.389
R04-1073	66524	32.71	29.722
Progeny 5650RR	79712	39.19	31.956
AGVENTURE 49D6NRR	47344	23.28	32.649

Delta King DK4968	33964	16.7	32.705
ASGROW AG4405	33272	16.36	33.315
Deltapine 07-4950RR	59536	29.27	34.773
MORSOY RTS4706N	30900	15.19	36.789
HBK R4924	40380	19.85	37.612
Dyna-Gro 33C59	45440	22.34	38.551
Terral TVX56R018	45300	22.27	38.612
DB03-8416	51588	25.36	40.742
Progeny 4906RR	40700	20.01	44.689
DB03-10440	53472	26.29	46.020
MPV 4808RR	119036	58.52	46.044
ASGROW AG5905	60040	29.52	48.432
R04-122	58124	28.58	48.880
Dyna-Gro 32B57	57976	28.5	48.959
NK BRAND S49-H7	43280	21.28	52.802
Progeny 4817RR	47900	23.55	54.855
R04-357	88680	43.6	56.543
Armor X4561	49200	24.19	56.793
Delta Grow 5970RR	68824	33.84	58.971
Braxton	119235	58.62	90.256

Italics and Blue not different than Hartwig.
Italics and Red not different than Forrest.

A total of 16 lines in the test of the Arkansas, Clemson, and USDA Jackson TN soybean breeding lines were not significantly higher than Hartwig (italics and blue in Table 2). The soybean lines in italics and red are not different than Forrest. This indicates these 16 were not different in supporting reproduction from Hartwig.

Table 2. Reproduction of *Rotylenchulus reniformis* on 48 new breeding lines tested from public soybean breeders from Arkansas, Clemson, and USDA Jackson TN in 2007.

Breeder	Line	Soil mean	Pf/Pi	Converted Log Ratio
Check	*Fallow*	*1332*	*0.67*	*0.412*
Shipe	*SC01-819*	*2904*	*1.45*	*0.617*
Arelli	*JTN-5307*	*2112*	*1.06*	*0.729*
Arelli	*JTN-4307*	*2076*	*1.04*	*0.846*
Check	*Hartwig*	*2160*	*1.08*	*1.000*
Shipe	*SC98-1930*	*4408*	*2.2*	*1.087*
Arelli	*JTN-5207*	*4780*	*2.39*	*1.128*
Check	*Anand*	*3336*	*1.67*	*1.287*
Check	*Forrest*	*5080*	*2.54*	*1.405*
Arelli	*JTN-5203*	*3708*	*1.85*	*1.448*
Shipe	*SC02-208*	*5192*	*2.6*	*1.756*
Arelli	*JTN-4607*	*5456*	*2.73*	*1.795*
Shipe	*SC03-9093*	*7504*	*3.75*	*1.931*
Arelli	*JTN-5107*	*6208*	*3.1*	*2.45*
Shipe	*SC04-83*	*14056*	*7.03*	*2.548*
Shipe	*SC03-9383*	*7764*	*3.88*	*2.603*

Shipe	*SC03-9151*	*17268*	*8.63*	*2.964*
Shipe	*SC04-297*	*10824*	*5.41*	*3.117*
Shipe	*SANTEE*	*11044*	*5.52*	*3.135*
Shipe	*MOTTE*	*9264*	*4.63*	*3.243*
Shipe	*SC04-304*	*11952*	*5.98*	*3.379*
Chen	*UA 4805*	*33972*	*16.99*	*3.659*
Shipe	*SC04-134*	*20536*	*10.27*	*4.448*
Shipe	*SC03-9090*	*44864*	*22.43*	*4.676*
Shipe	*SC01-803*	*18564*	*9.28*	*5.991*
Shipe	SC01-783A	15136	7.57	6.355
Chen	Ozark	50912	25.46	7.038
Chen	R02-3263 RR	22092	11.05	9.607
Arelli	JTN-5106	63420	31.71	12.389
Arelli	JTN-4107	44964	22.48	12.594
Shipe	SC04-615	72400	36.2	12.765
Arelli	JTN-4207	63340	31.67	12.914
Shipe	SC04-306	91364	45.68	14.093
Shipe	SC04-53	119412	59.71	15.861
Arelli	JTN-4507	60556	30.28	16.94
Shipe	SC04-417	64972	32.49	17.453
Shipe	SC04-375	105224	52.61	17.637
Arelli	JTN-4407	97708	48.85	19.68
Shipe	SC04-362	61848	30.92	19.982
Shipe	SC04-188	81096	40.55	21.77
Chen	R04-1276 RR	105424	52.71	22.729
Shipe	SC04-390	121912	60.96	24.333
Arelli	JTN-033	76800	38.4	24.363
Chen	Osage (R98-1821)	95800	47.9	25.164
Shipe	SC04-167	118148	59.07	26.118
Shipe	SC04-41	138228	69.11	28.511
Chen	R01-4834 RR	88200	44.1	34.526
Shipe	SC04-386	90800	45.4	34.744
Shipe	SC04-121	170500	85.25	51.693
Shipe	SC04-27	154900	77.45	67.856
Shipe	SC04-128	178100	89.05	80.352
Shipe	SC04-35	196200	98.1	87.837
Check	Braxton	251500	125.75	107.264

Italics and Blue not different than Hartwig.
Italics and Red not different than Forrest.

The objectives of the 2006 study were to 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 and to identify useful breeding lines for use in selection of new reniform resistant cultivars. The Arkansas Soybean varieties entries showing low reniform nematode reproduction may be useful in a cotton-soybean rotation when reniform nematode is present. The breeding lines showing low reniform nematode reproduction might be useful in developing reniform nematode resistant varieties

Literature cited

Hussey, R. S., and K. R. Barker. 1973. A comparison of methods of collecting inocula of *Meloidogyne spp*., including a new technique. Plant Disease Reporter 57:1025-1028.

Jenkins, W. R., 1964. A rapid centrifugal-flotation technique for separating nematodes from soil. Plant Disease Reporter 48:692.

Robbins, R. T., L. Rakes, and C. R. Elkins. 1994. Reproduction of the reniform nematode on thirty soybean cultivars. Supplement to the Journal of Nematology 26:659-664.

Robbins, R. T., and L. Rakes. 1996. Resistance to the reniform nematode in selected soybean cultivars and germplasm lines. Journal of Nematology 28:612-615.

Robbins, R. T., L. Rakes, L. E. Jackson, and D. G. Dombek. 1999. Reniform nematode resistance in selected soybean cultivars. Supplement to the Journal of Nematology 31:667-677.

Robbins, R. T., L. Rakes, L. E. Jackson, E. E. Gbur, and D. G. Dombek. 2000. Host suitability in soybean cultivars for the reniform nematode, 1999 tests. Supplement to the Journal of Nematology Vol. 32:614-621.

Robbins, R. T., L. Rakes, L. E. Jackson, E. E. Gbur, and D. G. Dombek. 2001. Host suitability in soybean cultivars for the reniform nematode, 2000 tests. Supplement to the Journal of Nematology Vol. 33:314-317.

Robbins, R. T., E. R. Shipe, L. Rakes, L. E. Jackson, E. E. Gbur, and D. G. Dombek. 2002. Host suitability in soybean cultivars for the reniform nematode, 2001 tests. Supplement to the Journal of Nematology Vol. 33 378-383.

Robbins, R. T., E. R. Shipe, L. Rakes, L. E. Jackson, E. E. Gbur, and D. G. Dombek. 2003. Host suitability in soybean cultivars for the reniform nematode, 2001 tests. Proceeding, Beltwide Cotton Conferences, Nashville, TN, January 2003.

Robbins, R. T., L. Rakes, L. E. Jackson, E. E. Gbur, and D. G. Dombek. 2004. Reniform Nematode Reproduction on Soybean in Tests conducted in 2003. Proceeding, Beltwide Cotton Conferences, San Antonio, TX, January 2004.

Robbins, R. T., P. Chen, L. Rakes, L. E. Jackson, E. E. Gbur,D. G. Dombek, and E. Shipe. 2005. Reniform nematode reproduction on soybean cultivars in tests conducted in 2004. Proceedings of the Beltwide Cotton Conferences, New Orleans, 137-145.

Robbins, R. T., L. Rakes, L. E. Jackson, E. E. Gbur, D. G. Dombek, P. Chen, E. Shipe and G. Shannon. 2006. Reniform nematode reproduction on soybean cultivars and breeding lines in 2005 tests. Proceedings of the Beltwide Cotton Conferences, San Antonio, 46-59.

Robbins, R. T., E. Shipe,P. Arelli, P. Chen, G. Shannon, L. Rakes, L. E. Jackson, E. E. Gbur, and D. G. Dombek. 2007a. Reniform nematode reproduction on soybean cultivars and breeding lines in 2006 tests. Proceedings of the Beltwide Cotton Conferences, New Orleans, 161-169.

Robbins, R. T., E. Shipe, G. Shannon, P. Arelli, and P. Chen. 2007b. Public soybean breeding lines tested for reniform nematode (*Rotylenchulus reniformis*) reproduction. Journal of Nematology 39:92.