RENIFORM NEMATODE REPRODUCTION ON SOYBEAN CULTIVARS AND BREEDING LINES IN 2013

R. T. Robbins
University of Arkansas
Fayetteville, AR
G. Shannon
University of Missouri
Portageville, MO
P. Chen
University of Arkansas
Fayetteville, AR
S. K. Kantartzi
Southern Illinois University
Carbondale, IL
L. E. Jackson
E. E. Gbur
D. G. Dombek
J. T. Velie
University of Arkansas
Fayetteville, AR
T. R. Faske
University of Arkansas,
Lonoke, AR

Abstract

During 2013, 142 soybean varieties from the Arkansas Variety Testing Program and 125 breeding lines and varieties from Public Soybean Breeders: 2 from USDA Jackson, TN (Arelli); 41 from Arkansas (Chen), 20 from the Missouri (Shannon), and 62 from Southern Illinois (Kantartzi) were tested in the greenhouse to determine their suitability as hosts for the reniform nematode, *Rotylenchulus reniformis*. All treatments were inoculated with 2,000 vermiform RN. The Variety Testing Varieties were grown for 90 days and the Public Breeders Lines for 92 days. The RN resistant varieties Anand, Forrest, and Hartwig, the RN susceptible cultivar Braxton, and fallow reniform nematode 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 Variety testing Program cultivars with RI's significantly greater than the RI on the resistant checks Anand, Hartwig and Forrest were considered suitable hosts for *R. reniformis*. Of the Arkansas Variety test lines 134 of 142 supported more reniform reproduction than Anand, Hartwig and Forrest and were considered suitable hosts; however MPG-S-5214NRR, Delta Grow 4940, ARMOR X1410, Willcross RY2513N, Leland, ARMOR X47C, Schillinger 4712R2, and Eagle Seed 5650RR had magnitude of resistance that was similar to the resistant controls Anand, Hartwig or Forrest. The reniform nematode did not reproduce more than: Hartwig on19 of the 125; Anand on 31 of the 125; and Forrest on 52 of the 125 breeding lines and varieties submitted by Public Soybean Breeders. Five of the eight private soybean varieties that did not support more reproduction than the 3 resistant checks (Anand, Hartwig and Forrest) may be useful in a Cotton-Soybean Rotation to reduce the numbers of reniform nematodes and allow cotton to be grown economically. This is especially important because most chemical nematicides are being phased out.

Introduction

In the United States from the middle-Atlantic states south and west to Texas the reniform nematode (*Rotylenchulus reniformis*) causes considerable damage and yield loss to cotton and soybean. At present no commercial upland cotton varieties have reniform nematode resistance, whereas several sources of reniform nematode resistance exist in soybean. This resistance is often linked to resistance from Peking and PI437654 to the soybean cyst nematode (*Heterodera glycines*) and excludes resistance from PI-88788. Use of reniform nematode resistant soybean in a rotation with cotton can be a useful option. Public soybean breeding lines from programs at Arkansas, Missouri, North Carolina, Southern Illinois, and USDA from 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 reniform nematode 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. A history of the reniform nematode in the South was given to the Southern Soybean Disease Workers (Robbins 2013b). During the 1999 to 2012 period yearly tests have determined the host status for over 2,100 soybean lines (Robbins et al., 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007a, 2008, 2009, 2010, 2011, 2012, 2013a). 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, 2011, 2012, 2013a). The objectives of the 2013 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 and 3) to list useful lines for cotton-soybean rotations from 2010 to 2013 .

Methods

The soybean lines and cultivars tested in 2013 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 (approximately 86% sand, 8% silt, 6 % 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 two, 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 an inoculum survivor control. After 90 days for the private varieties and 92 days for the public lines 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, Forrest 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

Of the Arkansas Variety test lines 134 of 142 supported more reniform reproduction than Anand, Hartwig and Forrest and were considered suitable reniform hosts; however MPG-S-5214NRR, Delta Grow 4940, ARMOR X1410, Willcross RY2513N, and Leland had log ratios not significantly ($P \leq 0.05$) higher than Anand, and Hartwig and indicates they were not different in supporting reproduction from these two resistant checks; whereas ARMOR X47C, Schillinger 4712R2, and Eagle Seed were not different than Forrest and were not believe to be as have as useful of level of resistance (Table 1).

Table 1. *Rotylenchulus* reniformis data of Log Ratio, Converted Log Ratio, Average count, and Reproduction index (Pf/Pi) on 142 selected soybean cultivars and lines from the Arkansas Soybean Variety Testing Program 2013 tests.

	Log Ratio	Converted Log Ratio	Average Count	Pf/Pi
Fallow	0.07	0.18	888	0.44
MPG-S-5214NRR	0.20	0.57	2940	1.47
Delta Grow 4940	0.30	0.99	5480	2.74
Anand	0.31	1.00	4804	2.40
ARMOR X1410	0.34	1.18	6296	3.15
Willcross RY2513N	0.35	1.23	6560	3.28
Leland	0.50	2.16	13400	6.70
Hartwig	0.51	2.22	13088	6.54
Forrest	0.60	2.94	23516	11.76
ARMOR X47C	0.88	6.54	69640	34.82
ARMOR X48C	0.98	8.62	146332	73.17
Schillinger 4712R2	1.02	9.36	61824	30.91
Eagle Seed 5650RR	1.05	10.28	86000	43.00
Croplan R2C4412	1.06	10.56	82736	41.37
Delta Grow 5361LL	1.06	10.61	95060	47.53
ARMOR X1404	1.07	10.62	90976	45.49
AgBorn ABX 27041	1.09	11.42	86604	43.30
AgVenture 50K5RR™	1.11	11.85	121796	60.90
Progeny P 5111 RY	1.11	11.94	98036	49.02
Delta Grow 4981LL	1.12	12.24	80184	40.09
Progeny P 5333 RY	1.13	12.58	101076	50.54
Pioneer P53T51L™	1.13	12.62	77100	38.55
NK S52-Y2 Brand	1.15	13.06	107060	53.53
R09-430	1.16	13.31	171760	85.88
Delta Grow 5130	1.16	13.40	75300	37.65
LG C5122R2	1.16	13.55	100440	50.22
ARMOR 53-R88	1.19	14.44	109300	54.65
HALO 5:01	1.19	14.51	88500	44.25
Go Soy 5312 LL	1.19	14.56	136168	68.08
NK S43-K1 Brand	1.19	14.63	114220	57.11
Pioneer P47T36R	1.20	14.86	95600	47.80
S09-9943	1.20	14.90	119900	59.95
HBK LL4950	1.21	15.34	121776	60.89
AgBorn ABX 2174	1.23	15.82	85700	42.85
Dyna-Gro S49LL34	1.23	16.17	146244	73.12
USG 74B83R	1.24	16.28	87700	43.85
REV® 51R53™	1.24	16.31	131132	65.57

ARMOR X1401	1.24	16.34	113400	56.70
Eagle Seed 5400RR	1.24	16.67	162375	81.19
Pioneer 95Y10	1.25	16.67	114100	57.05
AgVenture 55K5RR™	1.25	16.74	145700	72.85
Pioneer P50T40R	1.25	16.99	99900	49.95
Progeny P 4930 LL	1.26	17.34	131200	65.60
Progeny P 4747 RY	1.27	17.50	119100	59.55
AGS 45R212	1.27	17.64	360068	180.03
REV® 48R44™	1.27	17.83	152276	76.14
Progeny P 4710 RY	1.28	18.19	124500	62.25
Davis 4146RR2YS	1.30	19.12	109900	54.95
Progeny P 4211 RY	1.31	19.39	142116	71.06
Mycogen 5N478RR2	1.32	20.06	117600	58.80
ARMOR 49-R56	1.33	20.33	175404	87.70
Delta Grow 5125	1.33	20.40	172328	86.16
Progeny P 4850 RY	1.33	20.63	117900	58.95
Morsoy EXP 55	1.34	20.64	239444	119.72
HBK XLL4969	1.34	20.75	161660	80.83
ARMOR X1408	1.37	22.23	117300	58.65
Willcross RY2494NS	1.38	22.80	152800	76.40
AgBorn ABX 2499	1.38	22.86	317156	158.58
AgBorn ABX 2105	1.39	23.37	118500	59.25
NK S45-V8 Brand	1.39	23.56	125400	62.70
HBK LL4850	1.40	24.16	134500	67.25
AGS 43R212	1.40	24.30	132000	66.00
ARMOR 45-R60	1.41	24.43	138300	69.15
HBK LL4650	1.41	24.62	125400	62.70
Eagle Seed 4998RR	1.42	25.15	188100	94.05
Pioneer P46T21R	1.44	26.31	129100	64.55
HALO X530	1.44	26.47	149200	74.60
LG C4867R2	1.45	27.48	169200	84.60
USG 74A33R	1.45	27.50	160100	80.05
Davis 4347RR2YS	1.46	27.85	202600	101.30
Dyna-Gro S56RY84	1.46	27.94	170300	85.15
HALO 5:01-5	1.47	28.36	198200	99.10
Progeny P 4900 RY	1.47	28.50	174000	87.00
Morsoy Xtra 49X14	1.47	28.53	293512	146.76
AgBorn ABX 2784	1.48	29.10	144000	72.00
Willcross WX2464N	1.48	29.14	187900	93.95
Mycogen 5N451R2	1.48	29.35	158500	79.25
Progeny P 5213 RY	1.49	29.85	175900	87.95
S09-13635	1.49	29.87	164400	82.20
Croplan R2C4772	1.50	30.78	187700	93.85

Croplan R2C4752S	1.50	30.90	191500	95.75
Pioneer 94Y23	1.51	31.01	179900	89.95
Progeny P 4560 LL	1.51	31.33	163000	81.50
Pioneer P49T97R	1.51	31.67	157000	78.50
R08-2797	1.51	31.69	193400	96.70
REV® 47R34™	1.52	31.84	174100	87.05
HALO 5:26	1.52	31.91	160500	80.25
AGS 47R212	1.54	33.62	186000	93.00
Mycogen 5N431R2	1.54	33.67	167900	83.95
REV® 46R64™	1.54	33.83	198300	99.15
Morsoy Xtra EXP 44	1.54	33.91	200200	100.10
Eagle Seed 4918RR	1.54	33.99	171800	85.90
ARMOR X49C	1.54	34.04	527900	263.95
HALO X477	1.54	34.06	322500	161.25
Progeny P 5711 RY	1.55	34.29	199800	99.90
Delta Grow 5481LL	1.55	34.87	229700	114.85
ARMOR X1409	1.56	35.17	207800	103.90
UA 4913C	1.56	35.50	238300	119.15
ARMOR X1406	1.56	35.64	193000	96.50
Willcross RY2543N	1.57	35.97	238200	119.10
Pioneer P43T14L™	1.57	36.41	196000	98.00
HALO 4:40	1.57	36.53	180000	90.00
Delta Grow 5480	1.58	36.72	187000	93.50
Go Soy 4512 LL	1.58	37.25	187000	93.50
HBK LL5350	1.58	37.35	182000	91.00
ARMOR 4744	1.59	37.91	192000	96.00
Mycogen 5N423R2	1.59	37.98	204900	102.45
R10-130RY	1.59	38.00	196000	98.00
S09-10871	1.59	38.19	229200	114.60
ARMOR X1413	1.59	38.21	193600	96.80
HBK XLL4665	1.59	38.22	217200	108.60
Pioneer P50T64R	1.60	38.54	192000	96.00
ASGROW AG4934	1.60	39.25	247000	123.50
Pioneer P54T94R	1.61	39.38	380500	190.25
Pioneer 95Y80	1.61	39.51	212000	106.00
HALO 4:95	1.62	40.25	210800	105.40
S09-13608	1.62	40.77	226200	113.10
HALO X496	1.62	41.07	261700	130.85
Delta Grow 4925	1.63	41.20	207000	103.50
Progeny P 4613 RY	1.63	41.30	210000	105.00
NK S47-N3 Brand	1.63	41.36	206000	103.00
Pioneer P49T80R	1.63	41.63	309000	154.50
R10-197RY	1.63	41.79	231000	115.50

Progeny P 4313 RY	1.64	42.52	208000	104.00
Progeny P 5555 RY	1.64	42.99	265400	132.70
NK S46-L2 Brand	1.65	43.81	230200	115.10
AgVenture AvDX - D913	1.65	43.98	336600	168.30
MPG 4714NRR	1.66	44.22	540900	270.45
Pioneer P55T57R	1.67	45.36	393760	196.88
Willcross RY2533N	1.67	45.67	231000	115.50
LG C4544R2	1.67	45.71	285400	142.70
R04-1268RR	1.67	45.76	234000	117.00
Delta Grow 5575	1.69	47.53	251000	125.50
Croplan R2C5342	1.69	47.94	264000	132.00
Braxton	1.69	48.04	331800	165.90
Progeny P 4819 LL	1.71	49.77	285000	142.50
Dyna-Gro S54RY43	1.72	51.28	258000	129.00
R05-374	1.72	51.33	252000	126.00
ASGROW AG4534	1.73	52.90	429800	214.90
R10-428RY	1.74	53.46	273000	136.50
UA 5213C	1.75	55.28	302000	151.00
AgVenture AvDX - D613	1.76	56.19	537000	268.50
Pioneer P48T53R	1.77	58.11	504000	252.00
MPG 4514NRR/STS	1.77	58.42	318000	159.00
Morsoy RT 5429	1.78	59.04	303000	151.50
AgVenture AvDX - V213	1.79	60.79	345000	172.50
S09-6201R	1.81	63.82	308000	154.00

Blue and italics not different than Anand, Hartwig, and Forrest.
Red and italics not different than Forrest.

The reniform nematode did not reproduce more than: Hartwig on19 of the 125; Anand on 31 of the 125; and Forrest on 52 of the 125 breeding lines and varieties submitted by Public Soybean Breeders and may be very useful in soybean resistant breeding of soybean (Table 2).

Table 2. *Rotylenchulus reniformis* data of Breeder, Line, Log + 1 mean, Reniform count mean, and Reproduction index (Pf/Pi) on 125 selected soybean breeding lines cooperating Southern Soybean Breeders 2013 tests.

Line	Log+1 Mean	Reniform Count Mean	Reproduction Index = Pf/Pi
Fallow	*0.091*	*192*	*0.1*
S11-20124	*0.139*	*348*	*0.17*
S11-20345	*0.153*	*360*	*0.18*
S11-20195	*0.203*	*696*	*0.35*
S11-20182	*0.216*	*588*	*0.29*
S11-20337	*0.244*	*660*	*0.33*
S11-5727	*0.256*	*960*	*0.48*
S11-17054	*0.261*	*816*	*0.41*

LS08-6425	*0.293*	*1056*	*0.53*
Hartwig	*0.302*	*780*	*0.39*
S10-11200	*0.323*	*948*	*0.47*
S10-11227	*0.346*	*1368*	*0.68*
JTN-5109	*0.347*	*1248*	*0.62*
S11-16973	*0.353*	*1440*	*0.72*
S10-10368	*0.376*	*1440*	*0.72*
S11-20356	*0.472*	*1572*	*0.79*
S11-17025	*0.497*	*2556*	*1.28*
Anand	*0.544*	*2388*	*1.19*
R09-1970	*0.57*	*4784*	*2.39*
R08-527	*0.581*	*10668*	*5.33*
Forrest	*0.685*	*7800*	*3.9*
R10-7339RR	*0.857*	*66020*	*33.01*
LS08-6433	*0.899*	*55272*	*27.64*
LS08-6418	*0.928*	*60472*	*30.24*
UA 5213C (R05-4114)	*0.949*	*26156*	*13.08*
R10-7587	*0.962*	*88120*	*44.06*
LS08-6506	*0.968*	*22736*	*11.37*
Osage	*1.022*	*23280*	*11.64*
R07-1826	*1.059*	*17708*	*8.85*
LS08-6446	*1.067*	*78092*	*39.05*
LS08-6444	*1.067*	*45236*	*22.62*
LS08-6447	*1.083*	*208736*	*104.37*
LS08-6405	*1.091*	*58192*	*29.1*
LS08-6436	*1.124*	*20876*	*10.44*
LS08-6406	*1.244*	*21192*	*10.6*
S11-14710	*1.13*	*121312*	*60.66*
LS08-6441	*1.161*	*68824*	*34.41*
S11-8794	*1.164*	*63036*	*31.52*
LS08-6424	*1.169*	*63412*	*31.71*
R09-4798	*1.203*	*19800*	*9.9*
R10-5595	*1.206*	*42468*	*21.23*
LS08-6421	*1.212*	*22196*	*11.1*
LS08-6448	*1.215*	*43284*	*21.64*
R10-428 RY	*1.222*	*78300*	*39.15*
JTN-3109-4	*1.234*	*110828*	*55.41*
R04-1250RR	*1.21*	*150696*	*75.35*
R10-1663	*1.261*	*35292*	*17.65*
R07-6669	*1.277*	*160852*	*80.43*
LS08-6412	*1.293*	*70308*	*35.15*
S09-13185	*1.293*	*64764*	*32.38*
R09-1822	*1.314*	*65788*	*32.89*

LS08-6451	*1.319*	*108096*	*54.05*
S11-9618	1.358	53200	26.6
LS08-6450	1.358	32812	16.41
LS08-6443	1.386	42300	21.15
LS08-6431	1.411	104168	52.08
LS08-6504	1.386	80812	40.41
LS08-6411	1.306	149760	74.88
LS08-6420	1.408	152616	76.31
R09-430	1.261	287020	143.51
LS08-6442	1.413	226168	113.08
LS08-6426	1.419	149152	74.58
LS08-6408	1.443	95164	47.58
UA 5612	1.445	105748	52.87
LS08-6428	1.458	88228	44.11
Ozark	1.47	296620	148.31
LS08-6510	1.484	191872	95.94
LS08-6429	1.488	184693.6	92.35
LS08-6417	1.491	66900	33.45
R06-4475	1.495	146024	73.01
LS08-6505	1.498	90864	45.43
S11-14954	1.506	76524	38.26
S10-6090	1.517	90024	45.01
LS08-6440	1.538	180024	90.01
LS08-6410	1.545	299912	149.96
R10-115	1.597	141164	70.58
LS08-6404	1.626	91752	45.88
LS08-6432	1.649	250180	125.09
R10-197	1.649	39300	19.65
R09-4571	1.654	211220	105.61
LS08-6427	1.656	131176	65.59
LS08-6445	1.662	176588	88.29
R05-374	1.663	94204	47.1
LS08-6423	1.67	219648	109.82
R10-5709	1.672	310132	155.07
LS08-6434	1.7	138572	69.29
R10-4892	1.71	76752	38.38
LS08-6407	1.729	336036	168.02
LS08-6422	1.735	117624	58.81
LS08-6503	1.737	223472	111.74
R10-2465	1.742	127052	63.53
LS08-6403	1.76	112300	56.15
LS08-6439	1.762	111512	55.76
R10-5721	1.765	177768	88.88

LS08-6437	1.784	153944	76.97
R10-130 RY	1.786	365860	182.93
LS08-6419	1.786	200112	100.06
R10-1288	1.79	107920	53.96
R09-5137	1.791	364760	182.38
LS08-6413	1.803	146304	73.15
R07-10322	1.806	80600	40.3
LS08-6508	1.814	151428	75.71
R10-3185	1.854	130972	65.49
LS08-6430	1.885	312116	156.06
LS08-6507	1.896	231456	115.73
R10-28	1.916	350160	175.08
LS08-6438	1.925	96100	48.05
LS08-6435	1.938	197012	98.51
UA 4913C (R05-3239)	1.941	120100	60.05
R10-216	1.943	187000	93.5
Spencer	1.953	193024	96.51
LS08-6415	1.963	115620	57.81
LS08-6512	1.966	100500	50.25
LS08-6414	1.972	149160	74.58
LS08-6509	1.987	183944	91.97
LS08-6449	2.005	186000	93
R10-197 RY	2.04	267060	133.53
LS08-6409	2.075	302800	151.4
R09-1589	2.084	467824	233.91
LS97-1610	2.119	168300	84.15
LS08-6416	2.12	348000	174
R10-1191	2.194	200604	100.3
Braxton	2.213	311088	155.54
R04-1268RR	2.236	337000	168.5
R08-2797	2.257	491060	245.53
LS08-6511	2.324	518000	259
LS08-6452	2.328	250000	125
R09-5088	2.33	247020	123.51
R10-230	2.392	501064	250.53
S11-8787	2.572	326000	163

Blue and italics not different than Hartwig, Anand, and Forrest.
Red and italics not different than Anand and Forest.
Green and italics not different than Forest

Lists of the public soybean varieties from the test years 2010, 2011. 2012, and 2013 are given in Table 3. These varieties would be especially important for a cotton-soybean rotation where reniform is a problem.

Table 3. Private soybean varieties tested in 2010, 2011, 2012, and 2013 exhibiting reniform resistance that could be of use in a cotton-soybean rotation.

2010	2011	2012	2013
Armor ARX492	JTN-5203	Armor 49-C3	MPG-S-5214NRR
Asgrow AG5431	Delta Grow DG5252R2y	MPG5214	Delta Grow 4940
Asgrow AG5531	Progeny 5191	REV®55R83	ARMOR X1410
HBK RY5520			Willcross RY2513N
SSC-049N			Leland
SSC-051N			
USG 75T40			

Summary

Reniform nematode resistant soybean varieties may be useful in cotton-soybean rotations. Of the 142 private soybean lines tested in 2013 five exhibited adequate resistance to be considered useful in a cotton-soybean rotation. All Varieties tested can be found in Table 1.

Public breeding lines with a useful level of reniform resistance in varieties and breeding lines tested in 2013 are listed in Table 2. Of 125 varieties and lines 19 are of possible use in reniform resistance breeding programs. Those with resistance to root-knot nematode would be especially important in breeding programs. In table 3 all soybean varieties with levels of resistance to reniform nematode useful in cotton-soybean rotations of tests since 2010 are listed. Finding the older varieties may be a challenge as many private varieties last only a very few seasons.

References

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 insoybean 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. 136.

Robbins, R. T., P. Chen, L. Rakes, L. E. Jackson, E. E. Gbur,D. G. Dombek, and E. Shipe. 2005. Reniformnematode 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.

Robbins, R. T., E. Shipe, P. Arelli, P. Chen, L. Rakes, L. E. Jackson, E. E. Gbur and D. G. Dombek. 2008. Reniform Nematode Reproduction on Soybean Cultivars and Breeding Lines in 2007. Proceedings of the Beltwide Cotton Conferences, Nashville, TN, 330-336.

Robbins, R. T., E. Shipe, P. Arelli, P. Chen, L. Rakes, L. E. Jackson, E. E. Gbur and D. G. Dombek. 2009. Reniform Nematode Reproduction on Soybean Cultivars and Breeding Lines in 2008. Proceedings of the2009 Beltwide Cotton Conferences, San Antonio, TX Pgs. 104-114.

Robbins, R.T., P. Chen, L. E. Jackson, E. E. Gbur, D. G. Dombek, E. Shipe, P. Arelli, G. Shannon, and C. Overstreet. 2010. Reniform Nematode Reproduction on Soybean Cultivars and Breeding Lines in 2009. Proceedings of the 2010 Beltwide Cotton Conferences, New Orleans, LA Pgs. 190-199.

Robbins, R. T., E. Shipe, P. Arelli, P. Chen, G. Shannon, K. M. Rainey, L. E. Jackson, E. E. Gbur, D. G. Dombek, and J. T. Velie. 2011. Reniform nematode reproduction on soybean cultivars and breeding lines in 2010. Proceedings of the 2011 Beltwide Cotton Conferences, Atlanta, Georgia, January 4-7, 2011, Pgs. 167-174.

Robbins, R. T., E. Shipe, P. Arelli, P. Chen, G. Shannon, S. K. Kantartzi, L. E. Jackson, E. E. Gbur, D. G. Dombek, and J. T. Velie. 2012. Reniform nematode reproduction on soybean cultivars and breeding lines in 2011. Proceedings of the 2012 Beltwide Cotton Conferences, Orlando, FL, January 3-6, 2012. Pgs. 223-233.

Robbins, R. T., G. Shannon, P. Chen, S. K. Kantartzi, L. E. Jackson, E. E. Gbur, D. G. Dombek, and J. T. Velie. 2013a. Reniform nematode reproduction on soybean cultivars and breeding lines in 2012. Proceedings of the2013 Beltwide Cotton Conferences, San Antonio, TX. Pgs. 129-137.

Robbins, R. T., 2013b. A History of the Reniform Nematode in the South. Southern Soybean Disease Workers, March, 14 2013. (Abst.).