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The Reniform Nematode, a Southern Problem.

Some of my thoughts after 30 years of working with this nematode.

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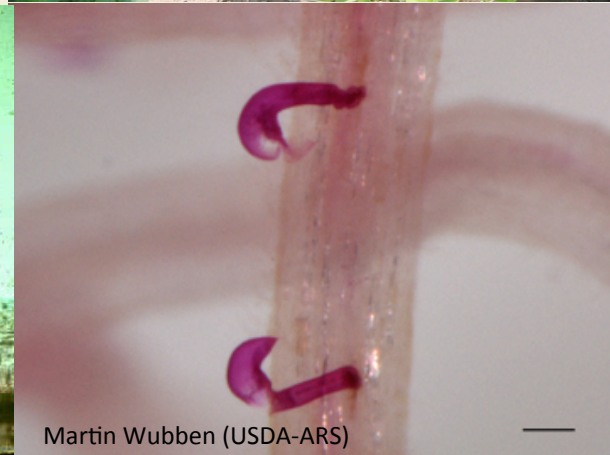
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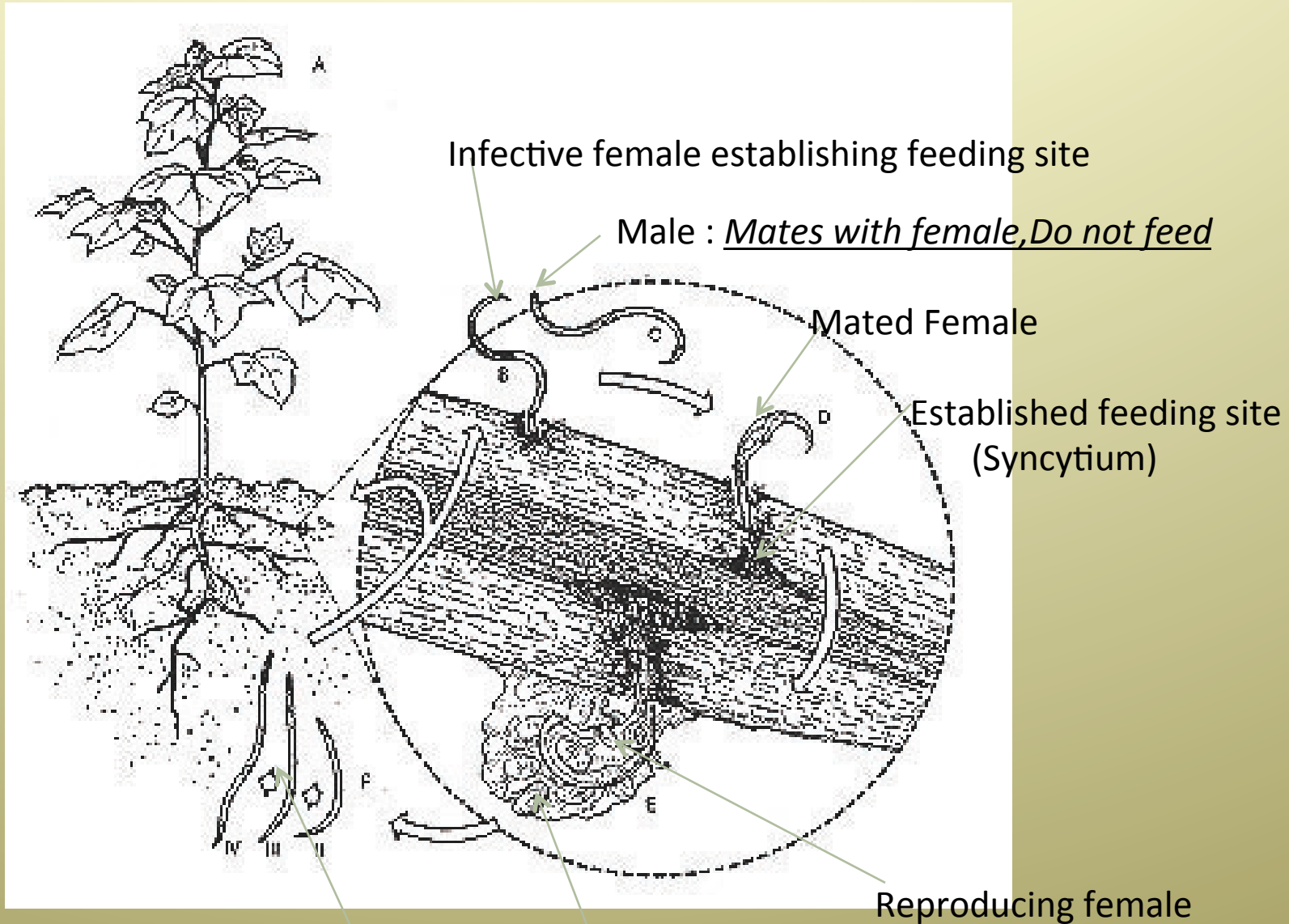


Martin Wubben (USDA-ARS)



Gary Lawrence Miss. State

Reniform Nematode Life Cycle



Juvenile Stages : In soil : Do not feed

Eggs in gelatinous mass

A HISTORY OF RENIFORM NEMATODE AND SOUTHERN USA DISTRIBUTION

The reniform nematode (*Rotylenchulus reniformis*) was described by Lindford & Ovilera in 1940 from Cowpea in Hawaii.

It was recognized soon after its description by A. L. Smith in Georgia in 1940. The next year, 1941, it was reported from Louisiana by A. L. Smith & A. L. Taylor .

In 1942 it was reported from Florida by G. Steiner.

In 1959 it was reported in Alabama (Minton & Hopper) and Texas (Norton).

Brodie found it in North Carolina in 1961.

Fassuliotis and Rau found it in soybean fields in South Carolina in 1965

I first saw it in Arkansas in 1979 and reported it in 1982.

In 1990 Gary Lawrence reported that in Mississippi it was first found in 1968.

It has also been reported from Missouri & Tennessee(1992), and Virginia (2002).

Host Range

Over 300 plant species have been reported as host of Reniform.

Much of the initial work on Reniform was reported by R. V. Rebois or by Wray Birchfield and their co-authors.

Most of their work was done from the late 60's to early 80's.

Much of the early work was done on cotton for which its damage is more obvious .

They showed that Reniform was very resilient. It can survive long periods in dry soil.

They showed the formation of feeding sites in roots. These feeding site are similar to those of Soybean Cyst nNematode (syncytium) and quite different than that of Root-Knot nematode (giant cells).

HISTORY OF THE RENIFORM NEMATODE IN ARKANSAS

I first identified *Rotylenchulus reniformis* in Arkansas in the summer of 1979 . The samples were from a soybean field in the Arkansas River valley near Kibler Arkansas (About 50 miles South of Fayetteville).

About 10-12 years ago I was curious and sampled the field again and was able to find the nematode on Squash growing in the field.

I next found reniform in a sample from soybean from Ashley County, AR (Near the Arkansas-Louisiana border).

I the mid eighties I found the nematode in several cotton and soybean fields in Jefferson County AR near Pine Bluff.

After finding reniform in Jefferson County several Central AR Counties were found to have reniform, found mainly on Cotton and South of Interstate 40.

These populations were obviously causing substantial economic loss to cotton.

It has been also been found in Mississippi & Clay Counties adjacent to the Missouri Bootheel.

MY RENIFORM NEMATODE PROJECTS IN ARKANSAS

MY EARLY RENIFORM PROJECTS

In cooperation with the Arkansas Crop Reporting Service, surveys of soybean in Arkansas from 1978 – 1986 I did not find reniform nematode, in each year 128 to 143 samples were taken.

In cooperation with the Arkansas Crop Reporting Service surveys ,of cotton in Arkansas from 1986– 1988 sampled 97 to 103 fields and I found 1 infested field each year.

Soybean acreage in the mid to late 80's was widely planted to SCN resistant lines with resistance conferred from Peking (i. e. Forrest, Centennial) .

When soybean lines derived from PI88788 became prevalent soybean became a good host and reniform became more and more evident. (So did Root-knot)

In a Reniform Distribution study in 1990 Heald & Robinson reported reniform in 3 Arkansas counties. JON, 22:696-699. (Crawford, Ashley, Jefferson)

MY EARLY RENIFORM PROJECTS (cont.)

I tested 3 cotton and 3 soybean lines in a 1991 greenhouse study. JON 23;548.

500 reniform/500 CC soil Pot
60 days 8 reps

SOYBEAN	RI = Pf/Pi
Kirby	4.5
Forrest	9.9
Davis	217.6
COTTON	
L-910	284.3
Auburn-56	282.1
DPL-20	213.1

In 1992 I tested 4 soybean lines in the field. JON 26:656-658.

Line	RI
Tracy-M	2.62
Lloyd	2.50
Bedford	1.72
Forrest	0.81

MY EARLY RENIFORM PROJECTS (cont.)

I tested the 30 most commonly grow varieties in Arkansas in greenhouse tests
In 1991 and 1992 .

TABLE 2. Reproductive indices of *Rafaelenchulus reniformis* on the 30 soybean cultivars most commonly grown in Arkansas in 1990 from greenhouse studies in 1991 and 1992.

1991			1992			Combined 1991-1992			
Cultivar	N	Reproductive index†	Cultivar	N	Reproductive index	Cultivar	N	Reproductive index	Rating‡
Braxton	4	26.6 a	Braxton	5	130.2 a	Braxton	9	84.2 a	S
Lee 74	5	21.6 ab	Coker 6955	5	109.4 ab	Lee 74	10	54.3 ab	S
Davis	4	17.0 abc	Lloyd	5	120.1 abc	Coker 6955	10	63.1 ab	S
A-5403	5	17.0 abc	Lee 74	5	86.9 abcd	Walters	9	53.9 ab	S
Hartz 5164	4	16.1 abcd	Walters	5	83.1 abcd	Davis	9	52.7 ab	S
Walters	4	17.5 abcd	Narrow	5	82.0 abcd	Narrow	9	52.7 ab	S
Coker 6955	5	16.8 abcd	Davis	5	81.3 abcd	Pioneer 9442	8	44.2 ab	S
Leflore	5	17.6 abcd	Delta Pine 415	5	78.1 abcd	Lloyd	10	67.1 ab	S
Narrow	4	16.1 abcd	Williams 82	5	69.0 abcd	A-6297	9	43.3 b	I
A-6297	4	13.8 abcd	A-6297	5	66.9 abcd	Delta Pine 415	9	49.5 b	I
Pioneer 9442	5	14.6 abcd	Tracy-M	5	68.3 abcd	Hartz 5164	9	38.1 b	I
Delta Pine 415	4	13.7 abcd	Hartz 6686	5	64.1 abcd	Williams 82	9	44.3 b	I
Williams 82	4	13.3 abcd	Pioneer 9641	5	67.8 abcd	Tracy-M	9	43.7 b	I
Tracy-M	4	13.0 abcde	Delta Pine 105	5	64.9 abcd	A-5403	10	36.6 bc	I
Hutcheson	4	11.5 abcde	Pioneer 9592	5	65.3 abcd	Hartz 6686	9	40.4 bc	I
Lloyd	5	14.0 bcde	Pioneer 9442	5	62.0 abcd	Delta Pine 105	9	41.3 bcd	I
A-5979	4	10.9 bcde	A-6785	5	60.1 abcd	Pioneer 9641	8	45.1 bcd	I
Delta Pine 105	4	11.8 bcde	Hartz 5164	5	55.7 abcde	Hutcheson	9	36.4 bcd	I
Hartz 6686	4	10.7 bcde	Hutcheson	5	56.3 bcdef	Leflore	10	55.7 bcd	I
AT 550	4	11.1 bcde	A-5403	5	56.3 bcdef	A-5979	9	34.2 bcd	I
Pioneer 9581	4	11.1 bcde	A-5979	5	52.7 bcdef	A-6785	9	38.1 bcd	I
Pioneer 9592	5	9.6 cde	Leflore	5	95.8 cdef	Pioneer 9592	10	37.4 bcd	I
A-6785	4	10.6 cde	Bedford	5	40.0 def	Bedford	9	24.6 cd	I
Pioneer 9641	3	7.4 def	Pioneer 9581	5	35.0 efg	Pioneer 9581	9	24.4 cd	I
Bedford	4	5.3 efg	AF 550	5	25.5 fg	AT 550	9	19.1 d	I
Coker 485	4	3.9 fg	Sharkey	5	11.6 gh	Sharkey	10	7.6 e	R
Sharkey	5	3.5 fg	Centennial	5	12.9 gh	Stonewall	10	8.9 e	R
Stonewall	5	3.5 fg	Stonewall	5	14.6 gh	Centennial	9	8.4 e	R
Centennial	4	2.7 g	Coker 485	5	7.3 h	Coker 485	9	5.8 e	R
Forrest	4	2.1 g	Forrest	5	5.9 h	Forrest	9	4.2 e	R
CV		18.8			13.8			18.6	

Values followed by the same letter are not significantly different according to Waller-Duncan k-ratio t test; k-ratio = 500. CV calculated from transformed data; actual count means are given. Five hundred cm² soil was used in each 10-cm-d day pot.

† Reproductive index = final nematode population density/initial nematode population density.

‡ S = susceptible, I = intermediate, and R = resistant reniform nematode rating determined by sameness in all three analyses.

MY EARLY RENIFORM PROJECTS (cont.)

In 1994 I reported reniform reproduction on the SCN Race differentials.*

Robbins & Rakes JON 28;612-615.

Line	Reaction	RI
Lee*	S	313.2
Braxton	S	297.4
PI 88788 *	MS	152.4
PI 437654	R	16.0
Forrest	R	11.4
Pickett *	R	10.3
Peking*	R	9.8
PI 90763*	R	6.5
Inoc. fallow		0.3

MY EARLY RENIFORM PROJECTS (cont.)

Reniform resistance of the 45 PI lines of Anand & Gallo. (Plant Dis. 68;593-595.)
Robbins & Rakes JON 28;612-615.

Resistant			Moderately resistant			Susceptible		
PI 437690	R	2.4	PI 407729	MS	56.2	Columbia	S	128.7
PI 438497	R	2.8	PI 417091	MS	60.3	PI 408192-2	S	137.6
PI 437679	R	3.1	PI 416762	MS	60.4	PI 417094	S	141.5
PI 437725	R	3.2	Cloud	MS	68.9	PI 438496B	S	159.3
PI 438489B	R	3.2	PI 89014	MS	71.8	PI 54591	S	162.6
PI 89772	R	3.4	PI 437655	MS	74.5	Patoka	S	167.7
PI 404166	R	4.0	PI 438503A	MS	81.6	PI 438183	S	168.6
PI 438498	R	4.1	PI 91138	MS	83.4	PI 88788	S	173.8
PI 84751	R	4.3	Ilsoy	MS	86.6	PI 398682	S	174.1
PI 404198B	R	5.1	PI 437770	MS	88.4	PI 79609	S	189.8
Peking	R	5.3	PI 79693	MS	97.1	<i>Lee 74</i>	S	190.0
PI 339868B	R	5.4	PI 87631-1	MS	99.9	PI 92720	S	200.4
PI 404198A	R	5.6	PI 200495	MS	101.6	PI 437488	S	203.1
PI 437654	R	6.1	PI 209332	MS	106.6	PI 407944	S	210.1
PI 90763	R	6.3	PI 89008	MS	109.8	PI 398680	S	265.5
PI 303652	R	11.0				<i>Braxton</i>	S	308.1
<i>Forrest</i>	R	15.3						

Checks in Italics

RENIFORM REPRODUCTIVE INDICES ON SOYBEAN FROM THE ARKANSAS SOYBEAN VARIETY TESTING PROGRAM, 1998-2012.

Year	# tests	Time weeks	Inoculum	Statically the same	Practical Resistant	Soil & eggs	Soil only
1998	282	11	1,166	92	17	X	
1999	226	9	2,540	93	6	X	
2000	118	10	2,256	56	2	X	
2001	139	10	1,744	7	5	X	
2002	127	13	1,956	2	2	x	
2003	129	14	1,200	7	6	x	
2004	194	16	1,200	9	7		x
2005	209	15	1,056	21	5		x
2006	198	13	1,750	9	2		x
2007	128	15	2,034	37	4		x
2008	162	12	1,500	9	4		x
2009	148	13	1,600	5	2		x
2010	161	13	2,000	5	0		x
2011	147	12	2,000	3	3		x
2012	157	10	2,000	3	3		x
Totals	2525	12.4	1,744	358	68		

LINES TESTED FOR PUBLIC SOYBAN BREEDERS

In 2001 I tested about 30 lines from Clemson of Emerson Shipes advanced Breeding lines.

I then over the next two years I tested a few lines submitted by Louisiana and Texas Nematologists.

In about 2004 I started asking Southern Public Soybean Breeders to Submit advanced soybean lines for Reniform testing.

Since then I have requested and tested lines for Emerson Shipe (Clemson), Grover Shannon (Missouri), Pengyin Chen (Arkansas), Prakash Arelli (USDA, Jackson, TN), Katy Rainey (VPI) and Stella Kantartzi (Southern Illinois) as a service.

OTHER RENIFORM TESTING

I have assisted with testing for reniform markers with Georgia and Missouri

Reniform Assessment : R. T. Robbins, University of Arkansas

The assessment process is very straight forward: We normally use 5 replicates and color code each rep. Each line is number coded. We use 3 resistant checks (Forrest, Hartwig. and Anand), a susceptible check (Braxton) and an inoculated fallow (to show survival rate with no plant)

We transplant a single seedling in the cotyledon stage into a 4 inch clay pot and inoculate with 1,500 to 2,000 vermiform (worm shaped ie. young females, Males and juveniles.

- At the experiments termination (10 to 13 weeks) we extract the nematodes from 1/5th of the pot's soil (500 CC) and count them (this provides backup samples).

Dividing this final number (Pf) by the inoculation number (Pi) gives us the reproductive index (RI). Very resistant lines will have a RI of less than 1, while resistant lines will have a low RI less than 5 or so. Susceptible plants will have a RI of up to 200 or greater.

There are generally several lines in which the plants have varying levels of reproduction (from very low to very high numbers. These are heterozygous for resistance, whereas the very low numbered RI's are probably homozygous for resistance. It is not quite that simple but that is the general idea.