

Reniform Nematode Reproduction and Soybean Yield of Four Soybean Cultivars in Arkansas¹

R. T. ROBBINS, L. RAKES, AND C. R. ELKINS²

Abstract: A field infested with *Rotylenchulus reniformis* in the Arkansas River valley near Pine Bluff, Jefferson County, Arkansas, was used to test the effects of *R. reniformis* on four commonly grown soybean cultivars (Lloyd, Tracy-M, Bedford, Forrest). At planting, the plots averaged 950 vermiform reniform nematodes per 100 cm³ of soil. At harvest, the average *R. reniformis* reproductive index (final/initial population density) was 2.62 for Tracy-M, 2.50 for Lloyd, 1.72 for Bedford, and 0.81 for Forrest. Yields were highest for the cultivar Lloyd, followed by Bedford, Forrest, and Tracy-M. Initial population densities of *R. reniformis* were positively correlated ($P = 0.05$) with final population densities when all cultivars were calculated together. Neither initial nor final densities were correlated with yield.

Key words: *Glycine max*, *Heterodera glycines*, nematode, reniform nematode, resistance, *Rotylenchulus reniformis*, soybean, yield.

The reniform nematode, *Rotylenchulus reniformis*, is a parasite of several crop plants (4). Most of the information about the resistance of soybean, *Glycine max*, to *R. reniformis* is from the mid 1960's to mid 1970's (1-3,5,9,11,15). The only cultivar registration from that era that claimed resistance to *R. reniformis* was for Centennial. Three recently developed cultivars that have resistance to *R. reniformis* stated in their registrations are as follows: Padre, developed for the lower Rio Grande Valley; Gregg, a group VII from Louisiana; and Hartwig, which also has resistance to all known races of *Heterodera glycines*, the soybean cyst nematode, and to certain species of root-knot nematodes, *Meloidogyne* spp.

A *R. reniformis* infestation level of ca. 2.6 nematodes/cm³ soil caused ca. 25% reduction in the seed yield of Hood soybean in greenhouse tests (10), and an infestation level of ca. 6.6 nematodes/cm³ soil reduced yields of Lee, Bragg, Hood, Hampton 266, Jackson, Dyer, and Pickett by an average of 33%. In a 5-year rotation experiment, fumigation increased the yield of suscepti-

ble cv. Lee 68 ca. 168 kg/ha, whereas resistant cv. Pickett 71 was not affected (16).

Rotylenchulus reniformis occurs in 38 countries (4). In the United States, *R. reniformis* has been reported from the southern United States (6,8). It was first reported from Crawford County, Arkansas, in 1982 (12), but most of the infested area in Arkansas is in Jefferson County, an area with extensive cotton acreage.

The objectives of this study were as follows: i) to determine the reproduction of *R. reniformis* in the field for selected cultivars that had highly variable *R. reniformis* reproduction in greenhouse tests (13); and ii) to evaluate the yield performance of these soybean cultivars in a field infested with *R. reniformis*.

MATERIALS AND METHODS

A *R. reniformis*-infested field in the Arkansas River valley near Pine Bluff, Jefferson County, Arkansas, was selected as a test site in 1992. The soil is a Roxana silt loam (9% sand, 84% silt, 7% clay); pH 5.8; <1% slope; coarse-silty, mixed, nonacid, thermic, typic Udisluvent. In 1990, when cotton was grown in the field, the grower noted uneven plant growth in late July. A soil sample revealed 761 *R. reniformis*/100 cm³ soil. Cotton was planted again in 1991 followed by winter wheat.

Soybean plots were planted on 23 June 1992. The experiment consisted of 72 main plots, 30.5 m long and eight rows

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² Professor and Research Assistants, Department of Plant Pathology, Nematology Laboratory, University of Arkansas, Fayetteville, AR 72701.

wide. Rows were 0.76 m apart. Two row subplots in each main plot were planted to the soybean cultivars Forrest (resistant to *R. reniformis*), Bedford (moderately resistant), Tracy-M (moderately susceptible), or Lloyd (susceptible) in a split-plot design. Cultivars were chosen because they represented different levels of *R. reniformis* reproduction in preliminary results from a greenhouse plot study of the 30 cultivars most commonly grown in Arkansas in 1990 (13).

At planting, 16 cores (25 cm deep, 2.3-cm-d) were taken from each plot, and at harvest eight cores of similar size were taken from each subplot. The samples were well mixed and a 100-cm³ subsample was suspended in water. The suspension was poured through nested 841- over 38- μ m-pore sieves. Nematodes and debris retained on the 38- μ m-pore sieve were separated by sugar centrifugal-flotation (7). Seeds of plants from the middle 15.25 m of each subplot (30.5 m total) were harvested with a plot combine on 4–6 November 1992.

Analysis of variance and Waller-Duncan k-ratio (k ratio = 100) *t* tests were calculated with SAS procedures (14). Nematode counts were transformed ($\log_{10} [x + 1]$) for analysis. Actual counts are presented in the tables. Yield data were not transformed.

RESULTS

The initial population density (Pi) of vermiform *R. reniformis* in the plots ranged

from 120 to 3,912/100 cm³ soil (\bar{x} = 950). Three of the 72 plots were struck by lightning, which adversely affected yield; thus data from these three plots were not included in the analyses. The final population density (Pf) of *R. reniformis* was highest on Tracy-M and Lloyd and lowest on Forrest (Table 1). The average *R. reniformis* reproduction rates (Pf/Pi) were 2.62 on Tracy-M, 2.50 on Lloyd, 1.72 on Bedford, and 0.81 on Forrest. The greatest seed yield was harvested from Lloyd, followed by Bedford, Forrest, and Tracy-M (Table 1). Seed yields of the four cultivars ranged from a high of 2,328 kg/ha to a low of 2,063 kg/ha.

Correlation coefficients calculated from $\log_{10} (x + 1)$ transformed data revealed a significant ($P = 0.05$) positive correlation between *R. reniformis* Pi and Pf when all cultivars were calculated together ($r = 0.555$) and for the individual cultivars Lloyd ($r = 0.270$) and Tracy-M ($r = 0.396$). Neither Pi nor Pf was correlated with yield.

DISCUSSION

The Pf/Pi in this Arkansas field was less than three for all cultivars tested; however, Pi was considered to be high (9.5 *R. reniformis*/cm³ of soil). When compared with the 25 and 33.1% yield losses at Pi of 2.6 and 6.6 *R. reniformis*/cm³ soil, respectively, reported by Rebois and Johnson (10), the 11.4% difference in yield between Tracy-M and Lloyd in our test seems min-

TABLE 1. Correlations of initial (Pi) and final (Pf) *Rotylenchulus reniformis* population densities, reproductive indices, and seed yields of four soybean cultivars in a field near Pine Bluff, Arkansas, in 1992.

Cultivar	Rating†	Correlations Pi:Pf		Reproductive indices (Pf/Pi)		Yield (kg/ha)	
		<i>r</i>	<i>P</i>	Mean	SE	Mean	SE
Tracy-M	MS	0.396	(0.001)	2.62 a	0.36	2063 d	32.4
Lloyd	S	0.270	(0.025)	2.50 a	0.29	2328 a	29.2
Bedford	MR	0.141	(0.247)	1.72 b	0.19	2248 b	37.0
Forrest	R	0.206	(0.090)	0.81 c	10.14	2167 c	35.8
All cultivars		0.555	(0.001)	—	—	—	—
CV				33.77		1.32	

Values followed by the same letter are not significantly ($P = 0.05$) different according to the Waller-Duncan k-ratio *t* test (k-ratio = 100). CV was calculated from transformed nematode counts [$\log_{10} (x + 1)$] from 69 plots; actual counts are given (data not included for three plots damaged by lightning).

† Reaction to *Rotylenchulus reniformis* in a preliminary greenhouse study.

imal. Yield, however, was not correlated with *R. reniformis* Pi or Pf in our study.

Resistant to *R. reniformis* is reported to be linked to *H. glycines* race 3 resistance in soybean (3,5,9,11). The cv. Mack is an exception; it has resistance to *H. glycines* race 3 but is susceptible to reniform nematode (3). Our test shows that Lloyd, which has *H. glycines* race 3 resistance, is similar to Mack in susceptibility to *R. reniformis* reproduction. Three cultivars in this study have resistance to *H. glycines*: Bedford to races 3 and 14, Forrest to races 1 and 3, and Lloyd to races 3 and 14, whereas Tracy-M is susceptible. The resistance-susceptibility of these four cultivars to *R. reniformis* is not clear. Forrest was the most resistant to *R. reniformis* reproduction in a greenhouse test (13), but did not yield as well as susceptible Lloyd or moderately resistant Bedford in our field test. The average seed yield of Bedford, Forrest, Lloyd, and Tracy-M in Arkansas Soybean performance tests for 1988 through 1991 were 2,526, 2,486, 2,305, and 2,486 kg/ha, respectively. Newer cultivars such as Lloyd may be more tolerant to *R. reniformis*.

When the data from this study are compared with those from a greenhouse study (13), the reproductive indices were very different (for Forrest, 0.81 in the field vs. 4.23 in the greenhouse; for Bedford, 1.72 vs. 24.58; for Lloyd, 2.50 vs. 67.06; for Tracy-M, 2.62 vs. 43.71). The differences may be attributed partly to the higher Pi in the field, 9.5 vs. 2.0 *R. reniformis*-cm³ soil. Apparently, cultivar field tests are needed to help sort out susceptibility, resistance, and tolerance to *R. reniformis*. Caution should be taken in interpretation of the results of this test because data are presented from one year only. Additional data could not be taken because the farmer opted to grow cotton on the test area in 1993.

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