PROGRESS ON DEVELOPMENT OF ROOT-KNOT NEMATODE RESISTANT AND RENIFORM NEMATODE TOLERANT COTTON GERMPLASM

C. G. Cook
Novartis Seeds, Inc.
Santa Rosa, TX
A. F. Robinson and A. C. Bridges
USDA-ARS
College Station, TX
J. A. Bautista
USDA-ARS
Weslaco, TX

Abstract

In the United States, root-knot (race 3), and reniform nematodes are the most economically damaging pests of Upland cotton. Progress in developing root-knot nematode resistant germplasm has occurred; however, development of reniform nematode resistant germplasm has received little attention. This report summarizes the progress of the Weslaco and College Station, TX USDA-ARS efforts. Three new strains, RN96625-1, RN96425 (same as RN96424), and RN96528 (same as RN96527) have shown excellent potential as breeding lines. In addition, when new F_3 nematode selections were grown near to and compared with standard non-nematode selected varieties and breeding lines, soil vermiform populations were similar among entries at 6-12 inch and 18-24 inch depths. At 30-36 inches, vermiform populations of the F_3 selections were generally one-half of the populations measured for the standard cultivars and breeding lines.

Introduction

The root-knot (*Meloidogyne incognita* race 3) (RKN) and reniform (*Rotylenchulus reniformis*) nematodes are the most serious and widespread pests of Upland cotton, *Gossypium hirsutum* (Lawrence and McLean, 1999; Thomas, 1999). Both species can reduce yield and the RKN can also increase the incidence of fusarium wilt, caused by *Fusarium oxysporum*. Robinson et al. (1999) reported that for the major cultivars grown in the USA between 1950 and 1996, only Stoneville LA887, Paymaster 1560, and CPCSD Acala Nem-X, showed high RKN resistance. Although all of the major cultivars tested were susceptible to the reniform nematode, germplasm with low levels of resistance (Jones et al., 1988; Cook et al., 1997a) or good tolerance (Cook et al., 1997b) has been developed. Our research objectives were to develop germplasm with improved RKN and reniform nematode and fusarium wilt resistance, good lint yield and fiber quality.

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Materials and Methods

The Weslaco, TX studies were conducted in 1998 and 1999 at the USDA North Farm. Experimental design was a split-plot, with four replications. Main plots were the two reniform nematode treatments, a Telone II fumigation treatment and an untreated reniform nematode-infested control. Subplots were the entries. Plots were single rows, 30 ft long and spaced 3.3 ft apart. Plot yields were determined by hand harvesting a 13.1 row feet sample. Reported fusarium wilt ratings are from the 1998 results at the LAES Red River Station, Bossier City, LA and from the 1999 results at the Fusarium Wilt Nursery, AL. RKN nematode gall rating were also collected at the Bossier City location. Methodology used for laboratory and greenhouse RKN gall ratings and population counts was previously reported (Cook et al., 1997c; Robinson et al., 1999).

Results

Field results from the 1998 and 1999 USDA-ARS reniform nematode nursery are presented in Table 1. The three USDA selections (RN designations) were generally equal to or better than the susceptible check, Stoneville 474. Yield reductions and reniform vermiform populations were less for the selections and this was more pronounced in 1998. Vermiform populations were less for RN96625-1 in both years. At Bossier City, LA, fusarium wilt and RKN gall ratings of the RN selections were lower than Stoneville 474 and comparable to the resistant check, Stoneville LA887 (Table 2). At the Alabama Fusarium wilt nursery, visible wilt symptoms were less than Rowden, the susceptible check. Wilt resistance of RN96425 was similar to M-315, the resistant check. Greenhouse RKN gall ratings and log multiplication factor measurements indicated than the three USDA RN selections were more resistant than DPL 16, the susceptible check (Table 3). The three entries all have a good level of RKN resistance. In continuation of the project, several new F_3 selections were planted in the reniform nematode nursery for evaluation in 1999. The 6-12 and 18-24 inch depth soil vermiform populations of the F_3 selections were similar to nearby planted standard cultivars and breeding lines. However, at the 30-36 inch soil depth, vermiform populations of the F_3 selections were 1180 vermiform per 100 g soil compared to 2470 vermiform per 100 g soil for the non-nematode resistant selected cultivars and breeding lines. Recent studies by A.F. Robinson have indicated that reniform nematodes survive very well at depths greater than 24 inches and populations may actually be greater at this depth. The lower nematode numbers at 30-36 inches for the F_3 selections was unexpected and additional studies will be conducted to confirm these findings. Results of these studies indicate that good sources of nematode resistant germplasm have been developed and should be very useful as breeding material.

Although lint percent of the three RN lines is lower than desired, fiber quality measurements have been very good.

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Table 1. 1998-1999 lint yield, yield reduction and vermiform population for selected entries.

Entry	Yield	Reduction	Vermiform
	lb/ac	%	no./100 g
1998			
RN96625-1	1045	6.5	89
RN96528	1005	5.2	162
RN96425	1105	1.7	130
STV 474	846	13.1	1537
1999			
RN96625-1	1262	8.4	365
RN96527	1144	14.4	525
RN96425	1129	17.8	405
STV 474	1151	21.3	610

Table 2. Fusarium wilt and root-knot nematode root gall ratings for selected entries.

	Wilt rating	RKN rating	Wilt percent
RN96625-1	2.3	1.3	8
RN96527	1.9	1.9	9
RN96425	1.2	1.4	4
STV 474	3.9	3.7	.
STV LA887	1.2	1.5	.
M-315	.	.	1
Rowden	.	.	20

Wilt and gall ratings from the Bossier City, LA Red River Station. Ratings 1=no symptoms, 5=>95% with symptoms
Wilt pecent from the Alabama Fusarium Wilt nursery.

Table 3. Greenhouse gall rating and log multiplication factor for selected entries.

Entry	Gall rating	Log Multiplication factor
RN96625-1	2.00**	0.90**
RN96528	2.42**	1.54**
RN96425	1.42**	1.41**
Auburn 623	0.92**	0.53**
STV LA887	2.25**	0.87**
DPL 16	4.25	3.60

** Significant at the 0.01 probability level
Gall rating 1=no galls, 5=>95% of root system galled