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Cotton Germplasm: Root-Knot Nematode Resistance in Day-Neutral Primitive Accessions

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ABSTRACT

Germplasm cannot be fully utilized until it is evaluated for useful traits. The objective of this study was to screen 79 day-neutral primitive accessions of cotton, *Gossypium hirsutum* L., for resistance to the southern root-knot nematode, *Meloidogyne incognita* (Kofoid and White) Chitwood race 3. The southern root-knot nematode is a major pest of cotton. Cotton lines were evaluated in a greenhouse test for egg-mass production after being grown for 40 days i n pots inoculated with nematode eggs. None of the lines produced as few egg masses as our highly resistant check M315 RNR. Twenty-four lines had significantly fewer egg masses than highly susceptible M8, an indication they have an intermediate level of re sistance. Evaluations such as these aid in the use of germplasm in breeding programs.

INTRODUCTION

The southern root-knot nematode, *Meloidogyne incognita* (Kofoid and White) Chitwood, is a pest that has a wide host range of plant species. Among these are Upland cotton, *Gossypium hirsutum* L. Root-knot nem atodes damage roots, affecting the ability of the plant to transport water and nutrients. This damage can result in increased susceptibility to seedling diseases and fusarium wilt [*Fusarium oxysporum* Schleft. f. sp. *vasinfectum* (Atk.) Snyd. And Hans] in mature plants.

The development and use of cultivars with resistance to root-knot nematodes could reduce losses in cotton from this nematode and the pathogens that interact with it to cause diseases. Shepherd (1974) developed and relea sed Auburn 623 RNR, which had exceptional resistance to the root-knot nematode; however, it had agronomic deficiencies. The Auburn 623 RNR source of resistance was transferred to elite germplasm lines that had vastly improved agronomic traits (Shepherd et al., 1989, 1996).

In a search for additional sources of resistance, Shepherd (1983) evaluated 471 photoperiodic primitive accessions of cotton and found 18 that were resistant. He subsequently released 12 day-neutral converted germplasm lines (Shepherd et al., 1988).

A program has been in place for a number of years to incorporate day-neutral genes in the primitive accessions of cotton (McCarty et al., 1979). McCarty and Jenkins (1992) reported agronomic and fiber data for 79 access ions, which had been converted to day-neutral flowering types. This report presents root-knot nematode screening data for these 79 accessions.

MATERIALS AND METHODS

The root-knot nematode evaluation was conducted in the greenhouse following methods previously reported by Shepherd (1979). Plants were grown in 8.9x7.6-centimeter (diameter by depth) plastic pots filled with fumigated Wickham sandy loam soil. Approximately 5,000 root-knot nematode eggs were deposited into a 2-centimeter hole in the center of each pot. The hole was filled with sand, and the pots were covered for 7 days with sequential layers of plastic, brown paper, and aluminum foil to allow the eggs to hatch and the juveniles to disperse. After 7 days, the covering was removed, and one seed was planted in each pot. The covering was placed over the bed for an additional 3 days and then removed. This step minimized mois ture loss while the seed germinated. The pots were arranged in a randomized complete block design with cotton lines as treatments. The test consisted of three five-plant replications, with each plant in a separate pot. Seventy-nine (BC4F5) day-neutral pri mitive accessions and two checks were grown in this test. These day-neutral accessions had previously been released as germplasm lines (McCarty and Jenkins 1993). M8 was used as the susceptible check and M315 RNR as the resistant check.

Approximately 40 days after planting, the plants were excised about 5 centimeters above the soil line. Roots were washed with a high-volume, low-pressure spray of water to remove the soil. The roots were then placed in plastic containers filled with water by cotton line.

The number of egg masses per plant was used to determine the resistance level of the cotton lines tested. The excised roots were placed in a Phloxine B solution for 15 minutes and then rinsed. The egg masses were staine d a pinkish-red, which aided in making counts. Egg masses were counted and recorded for each plant.

RESULTS AND DISCUSSION

The results of the root-knot nematode screen are presented in Table 1. None of the day-neutral lines were as resistant as M315 RNR. M315 RNR is a highly resistant germplasm line (Shepherd et al., 1 989, 1996). Twenty-four day-neutral lines had significantly fewer egg masses than highly susceptible M8.

Shepherd (1983) evaluated the photoperiodic version of most of these primitive accessions and found them to be susceptible. He rated accession T78 as being resistant andT247 and T255 as being intermediate in resistance in his study based on a galling and a reproduction index.

In our screen, the day-neutral versions of these accessions were rated as intermediate to resistant. During our day-neutral conversion process, we did not practice any selection other than for the flowering trait.

The egg mass number for most of the day-neutral accessions was not different from the susceptible check M8. This was in agreement with what Shepherd (1983) reported for the photoperiodic accessions.

Germplasm must be evaluated for useful traits before it can be fully utilized. Evaluations, such as the one

reported here, aid plant breeders in making germplasm selections for breeding programs. This research is part o f an ongoing ARS research program to evaluate race stock germplasm for useful traits and make this information available to the germplasm system. The lines reported here have been converted from photoperiodic to day-neutral and released to breeders for us e. These evaluations on reaction to root-knot nematode generate knowledge that is crucial when germplasm is used in crosses to improve upland cotton cultivars.

Table 1. Average number of root-knot nematode egg masses per plant in day-neutral primitive cotton lines, M8 (susceptible check), and M315 (resistant check).

Entry	Egg masses per plant	Entry	Egg masses per plant	Entry	Egg masses per plant
T-2DN	122	T-87DN	117	T-174DN	140
T-7DN	144	T-88DN	102	T-175DN	114
T-17DN	145	T-91DN	138	T-180DN	103
T-24DN	90	T-96DN	101	T-182DN	165
T-30DN	140	T-100DN	100	T-197DN	61
T-31DN	95	T-101DN	104	T-206DN	140
T-32DN	145	T-102DN	117	T-212DN	147
T-33DN	153	T-104DN	116	T-215DN	66
T-36DN	114	T-106DN	79	T-226DN	113
T-40DN	117	T-113DN	128	T-228DN	140
T-43DN	136	T-117DN	107	T-237DN	132
T-45DN	108	T-119DN	95	T-239DN	105
T-48DN	118	T-120DN	108	T-243DN	99
T-53DN	105	T-121DN	146	T-244DN	105
T-55DN	117	T-124DN	115	T-245DN	127
T-57DN	76	T-140DN	114	T-247DN	92
T-60DN	130	T-150DN	131	T-257DN	98
T-61DN	130	T-151DN	163	T-326DN	164
T-62DN	93	T-154DN	119	T-570DN	137
T-63DN	100	T-155DN	106	T-612DN	127
T-67DN	108	T-156DN	144	T-633DN	115
T-68DN	111	T-158DN	140	T-634DN	116
T-72DN	138	T-162DN	118	T-641DN	147
T-74DN	138	T-164DN	112	T-1000DN	152
T-76DN	155	T-165DN	94	T-1149DN	124
T-77DN	110	T-168DN	134	**M8**	**149**
T-78DN	77	T-170DN	116	**M315 RNR**	**3**
				LSD 0.05	**41**

References

McCarty, J.C., Jr., J.N. Jenkins, W.L. Parrott, and R.G. Creech. 1979. The conversion of photoperiodic

primitive race stocks of cotton to day-neutral stocks. Mississippi Agricultural and Forestry Experiment Station Research Report 4(19):4.

McCarty, J.C., Jr., and J.N. Jenkins. 1992. Characteristics of 79 day-neutral primitive race accessions. Mississippi Agricultural and Forestry Experiment Station Technical Bulletin 184.

McCarty, J.C., Jr., and J.N. Jenkins. 1993. Registration of 79 day-neutral primitive cotton germplasm lines. Crop Science 33:351.

Shepherd, R.L. 1974. Transgressive segregation for root-knot nematode resistance in cotton. Crop Science 14:872-875.

Shepherd, R.L. 1979. A quantitative technique for evaluating cotton for root-knot nematode resistance. Phytopathology 69:427-430.

Shepherd, R.L. 1983. New sources of resistance to root-knot nematodes among primitive cotton. Crop Science 23:999-1002.

Shepherd, R.L., J.C. McCarty, Jr., J. Jenkins and W.L. Parrott. 1988. Registration of twelve nonphotoperiodic lines with root-knot nematode resistant primitive cotton germplasm. Crop Science 28:868-869.

Shepherd, R.L., W.L. Parrott, J.C. McCarty, Jr., and J. Jenkins. 1989. Notice of release of nine root-knot nematode resistant germplasm lines of upland cotton *Gossypium hirsutum* L. USDA/Mississippi Agricultural and Forestry Experiment Statio n Memo.

Shepherd, R.L., J.C. McCarty, Jr., J. Jenkins and W.L. Parrott. 1996. Registration of nine cotton germplasm resistant to root-knot nematode. Crop Science 36:820.