

Comparative Resistance of Selected Acala 1517 Cotton Cultivars to *Meloidogyne incognita* Race 3¹

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Abstract: Little information is available regarding the levels of *Meloidogyne incognita* race 3 resistance in Acala 1517 cotton cultivars compared with cultivars grown outside the southwestern United States. Levels of *M. incognita* egg production were compared among commercial Acala cultivars 1517-E2, 1517-SR1, 1517-75, 1517-77BR, and SJ-5, resistant and susceptible standards Auburn 634 and M-8 and breeding lines Acala 5701-W and N6072 grown for 45 days in the greenhouse. The Acala 1517 cultivars all performed similarly, demonstrating moderate nematode resistance. Egg production on the 1517 cultivars was less than on SJ-5 and less than one-fifth that on M-8. Auburn 634 was most resistant, followed by N6072. Total egg production per plant and egg production per gram dry root were not correlated but proved to be reliable indicators of relative resistance to *M. incognita*.

Key words: *Gossypium hirsutum*, cotton, *Meloidogyne incognita*, root-knot nematode, resistance.

Cultivars of Acala 1517 cotton (*Gossypium hirsutum* L.) are characterized by long staple length, high fiber strength, and superior performance under the shorter growing season and cooler night temperatures in eastern Arizona, all of New Mexico, and parts of west Texas. Resistance in cotton to *Meloidogyne incognita* (Kofoid & White) Chitwood (6), the principal cotton nematode pathogen in this region, and factors influencing resistance (2,4,10) have been widely investigated. Resistant cultivars are defined as those that are poor hosts for root-knot nematode reproduction (4,7,8,10). Such cultivars are available but are not widely grown because of lower agronomic acceptability, compared with other commercial cultivars (10). Comparisons of commercial cultivar performance with that of resistant (Auburn 634, Acala N6072) and susceptible (M-8) standards is a way of assessing resistance levels in commercial cotton. Such information is available for selected cultivars grown in the southeastern United States, California, and western Arizona (4,7,8), but not for Acala 1517 cultivars grown in the upper Chihuahuan Desert regions. In this paper, we compare the resistance of four Acala 1517 cultivars to that of selected *M. incognita* re-

sistant or susceptible cotton cultivars and breeding lines.

MATERIALS AND METHODS

The population of *M. incognita* race 3 (9) used in this experiment was isolated from tomato (*Lycopersicon esculentum* Mill.) in Las Cruces, New Mexico. It was increased in the greenhouse on tomato (*L. esculentum* cv. Rutgers), and egg masses were sent to the International *Meloidogyne* Project at North Carolina State University for race and species verification. Ten replications each of nine cotton cultivars or advanced breeding lines were arranged in a completely randomized design and evaluated for root-knot nematode resistance. These included Acala cultivars 1517-E2, 1517-SR1, 1517-75, 1517-77BR, and SJ-5, resistant standard Auburn 634, susceptible standard M-8, and breeding lines Acala 5701-W and N6072. Acid delinted seeds were germinated in plastic germination tubes (3.8 × 23 cm) containing sterile sand. After cotyledon expansion, seedlings were gently removed and excised 5.5 cm below the hypocotyl-radical junction (7), and single seedlings were transplanted into previously inoculated 15-cm pots.

Before transplanting, *M. incognita* race 3 egg inoculum was recovered (3) and stored for 24 hours in single-strength Hellers medium (5) at 15 C, pH 6.8. Plastic pots 15 × 15 cm containing a steam-sterilized 2:1 sand:soil mixture (87% sand, 8% silt,

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5% clay) were watered to field capacity 36 hours before inoculation. Each pot received three 1.0-ml aliquots of egg suspension, placed in separate 2-cm-deep holes in the soil for a total inoculum density of 9,600 eggs per pot. Holes were covered with soil, and each pot was watered 12 hours later with 25 ml Hellers medium. Sixty hours after inoculation, cotton seedlings were transplanted into these pots and maintained in the greenhouse (20 C night, 32 C day). All plants were fertilized with an aqueous solution of 20-20-20 NPK 2 days after transplanting and watered as needed throughout the experiment.

Plants were harvested 25 days after transplanting. Root systems were washed free of soil, and total eggs per root system were recovered following agitation in a 1.5% sodium hypochlorite solution for 10 minutes. Fresh and dry root weights were recorded for each plant. Numbers of eggs per plant, eggs per gram dry root, and RF values (final egg count per initial inoculum density) were determined for each plant. Data were analyzed using SAS (SAS Institute, Cary, North Carolina) general linear models procedure, and cultivar differences were partitioned using Fisher's least-significant difference test. All egg counts were transformed to $\ln(X + 1)$ before statistical analyses to reduce variance heterogeneity

associated with widely different nematode reproduction rates among cultivars.

RESULTS AND DISCUSSION

Consistent with previous studies (4,7,8), Auburn 634 exhibited the highest level of resistance to *M. incognita* race 3 (Table 1). Breeding line Acala N6072, though not as resistant as Auburn 634, supported less egg production than other Acala cultivars. The four Acala 1517 cultivars all performed similarly, exhibiting moderate resistance to *M. incognita* race 3 but significantly greater resistance than Acala SJ-5. Egg counts were also significantly less (one-fifth to one-tenth as many eggs per root system or per gram of root) than those from the susceptible cultivar M-8.

Egg assays are recognized as the most reliable method to evaluate cultivar resistance to species of *Meloidogyne* (1,7,8). In our experiment, egg production per gram dry root and total egg production per plant were reliable indicators of relative resistance in cotton to *M. incognita* race 3. There was little correlation, however, between the two measurements ($r = 0.165$, $P = 0.120$), indicating differences in root proliferation as well as egg production among cultivars and (or) individual plants. We believe evaluations of nematode reproduction per unit of root (i.e., number per gram dry root)

TABLE 1. Egg recovery per plant, eggs per gram of root, and reproductive factors (RF) for *Meloidogyne incognita* race 3 on selected cotton cultivars and breeding lines.

Cultivar or line	Eggs per root system		Eggs per gram dry root		
	$\ln(X + 1)$ †	Antilog‡	$\ln(X + 1)$	Antilog‡	RF§
M-8	11.387 a	88,168	9.912 a	20,177	10.4 a
Acala SJ-5	10.866 ab	52,365	8.847 b	6,956	6.6 b
Acala 5701-W	10.323 bc	30,424	8.638 bc	5,641	3.6 c
Acala 1517-E2	9.714 cd	16,548	8.028 c	3,066	2.2 cde
Acala 1517-SR1	9.670 cd	15,835	8.303 bc	4,037	2.1 cde
Acala 1517-75	9.487 d	13,187	8.219 bcd	3,712	2.3 cd
Acala 1517-77BR	9.031 d	8,358	7.363 d	2,072	1.2 de
Acala N6072	7.716 e	2,244	5.829 e	340	0.3 de
Auburn 634	5.963 f	389	4.182 f	65	0.1e
LSD 0.05	0.692		0.791		2.2
MSE	0.610		0.790		6.2

† Data are means of 10 replicates. Egg numbers were transformed to $\ln(X + 1)$ for statistical analyses. Means followed by the same letter do not differ significantly at $P = 0.05$ using Fisher's least significant difference test.

‡ Numbers are the antilog of means from the transformed data.

§ Ratio of total eggs extracted per initial eggs inoculated.

remove some of the variability associated with differences in root production among cultivars and provide a better estimate of host suitability for nematode reproduction. Recent work (11) indicates that the relative resistance levels to *M. incognita* race 3 in Acala 1517 might also be expected to occur when challenged by *M. incognita* race 4. RF values satisfactorily represented relative differences in resistance among cultivars in our study and that of Kirkpatrick and Sasser (4).

LITERATURE CITED

1. Barker, K. R., J. L. Starr, and D. P. Schmitt. 1987. Usefulness of egg assays in nematode population-density determinations. *Journal of Nematology* 19:130-134.
2. Carter, W. W. 1982. Influence of soil temperature on *Meloidogyne incognita* resistant and susceptible cotton, *Gossypium hirsutum*. *Journal of Nematology* 14:343-346.
3. Hussey, R. S., and K. R. Barker. 1973. A comparison of methods of collecting inocula of *Meloidogyne* spp., including a new technique. *Plant Disease Reporter* 57:1025-1028.
4. Kirkpatrick, T. L., and J. N. Sasser. 1983. Parasitic variability of *Meloidogyne incognita* populations on susceptible and resistant cotton. *Journal of Nematology* 15:302-307.
5. Loewenberg, J. R., T. Sullivan, and M. L. Schuster. 1960. The effect of pH and minerals on the hatching and survival of *Meloidogyne incognita* larvae. *Phytopathology* 50:215-217.
6. McClure, M. A., K. C. Ellis, and E. L. Nigh. 1974. Resistance of cotton to the root-knot nematode, *Meloidogyne incognita*. *Journal of Nematology* 6:17-20.
7. Shepherd, R. L. 1979. A quantitative technique for evaluating cotton for root-knot nematode resistance. *Phytopathology* 69:427-430.
8. Starr, J. L., and J. A. Veech. 1986. Susceptibility to root-knot nematodes in cotton lines resistant to the fusarium wilt/root-knot complex. *Crop Science* 26:543-546.
9. Taylor, A. L., and J. N. Sasser. 1978. Biology, identification and control of root-knot nematodes (*Meloidogyne* species). North Carolina State University and the U.S. Agency for International Development, Raleigh, North Carolina.
10. Veech, J. A. 1978. An apparent relationship between methoxy-substituted terpenoid aldehydes and the resistance of cotton to *Meloidogyne incognita*. *Nematologica* 24:81-87.
11. Veech, J. A., and J. L. Starr. 1986. Comparison of development, reproduction, and aggressiveness of *Meloidogyne incognita* races 3 and 4 on cotton. *Journal of Nematology* 18:413-415.