POPULATION DENSITIES OF *MELOIDOGYNE INCOGNITA* AND OTHER NEMATODES FOLLOWING SEVEN CULTIVARS OF COWPEA†

R. N. Gallaher[1] and R. McSorley[2]

Department of Agronomy, P. O. Box 110730,[1] and Department of Entomology and Nematology, P. O. Box 110620,[2] University of Florida, Gainesville, FL 32611, U.S.A.

ABSTRACT

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In two field experiments on sandy soils in Florida, densities of *Meloidogyne incognita* race 1 were lowest ($P \leq 0.05$) following the cowpea (*Vigna unguiculata*) cultivars Tennessee Brown, Mississippi Silver, and California Blackeye #5. Final densities of *M. incognita* in soil were high ($\geq$ 650/100 cm^3 soil) following the cultivars Whippoorwill, Pinkeye Purplehull, and Texas Purplehull. Population densities following the cultivar Purple Knuckle were intermediate. No consistent differences among cultivars were observed for population densities of other plant-parasitic nematodes. Mississippi Silver was the highest yielding cultivar in both experiments.

Key words: cowpea, cropping systems, *Criconemella ornata, Criconemella sphaerocephala,* host plant resistance, *Meloidogyne incognita, Paratrichodorus minor, Pratylenchus brachyurus, Pratylenchus scribneri, Vigna unguiculata.*

RESUMEN

Gallaher, R. N. y R. McSorley. 1993. Densidades poblacionales de *Meloidogyne incognita* y otros nematodos en siete cultivares de chícharo. Nematrópica 23:21–26.

En dos experimentos de campo en suelos arenosos de Florida, las densidades de *Meloidogyne incognita* raza 1 fueron las más bajas en los cultivares de chícharo Tennessee Brown, Mississippi Silver y California Blackeye #5. Las densidades finales de *M. incognita* en el suelo fueron altas (> 650/100 cm^3 de suelo) en los cultivares Whippoorwill, Pinkeye Purplehull y Texas Purplehull. Las densidades poblacionales fueron intermedios en el cv. Purple Knuckle. No se observaron diferencias consistentes entre los diferentes cultivares en las densidades poblacionales de otras especies de nematodos fitoparásitos. El cultivar Mississippi Silver presentó el rendimiento más alto en ambos experimentos.

Palabras clave: chícharo, *Criconemella ornata, Criconemella sphaerocephala, Meloidogyne incognita, Paratrichodorus minor, Pratylenchus brachyurus, Pratylenchus scribneri,* resistencia hospedadora, sistemas de cultivo, *Vigna unguiculata.*

INTRODUCTION

In designing cropping systems (9) to limit nematode impact, it is advantageous to have a wide range of crops and cultivars from which to select (3,8). Cowpea [*Vigna unguiculata* (L.) Walp.] is well adapted to cultivation in the tropics and in the southeastern United States, but can be damaged by root-knot nematodes (11). Fortunately, a number of the cowpea cultivars commonly cultivated in the United States have been developed with various degrees of resistance to one or more species and races of root-knot nematodes (1,4,6,10,12). It is important to know the extent of buildup of nematode population densities in the field when cowpea cultivars are used. The objectives of this study were to compare final nematode population densities and yield among

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seven cowpea cultivars in field sites infested with *Meloidogyne incognita* (Kofoid & White) Chitwood.

MATERIALS AND METHODS

Parallel experiments were conducted at two sites at the University of Florida's Green Acres Agronomy Research Farm in Alachua County, Florida, during the summer of 1991. Site 1 was planted to 'Wrens Abruzzi' rye (*Secale cereale* L.) during the winter of 1990–1991. The soil was Arredondo fine sand (92% sand, 3% silt, 5% clay) with pH 6.1 and 1.5% organic matter. Site 2 was planted to 'Dixie' crimson clover (*Trifolium incarnatum* L.) during the previous winter and had a similar soil type (90% sand, 4% silt, 6% clay) with pH 5.6 and 1.8% organic matter.

At each site, the experimental design was a randomized complete block with seven treatments and four replications. The seven treatments were the cowpea cultivars Whippoorwill, Pinkeye Purplehull, Texas Purplehull, Purple Knuckle, California Blackeye #5, Mississippi Silver, and Tennessee Brown. Individual plots consisted of four rows, 3.0 m long and 76 cm apart, with a 7.5-cm spacing between plants in the row. All plots at both sites were planted 24 May 1991.

Plots received 20 to 30 mm of irrigation water every 4 days during flowering and pod set whenever rainfall was low. Peas were sprayed twice with methomyl at 0.22 kg a.i./ha per application during late vegetative growth and early flowering to control insects. An application of 27 kg N, 5 kg P, and 14 kg K/ha was applied at planting. A sidedress application of 86 kg K, 55 kg S, and 54 kg Mg/ha was applied 4 weeks after planting. Weeds were controlled with two mechanical cultivations and by hand. Fresh-pod peas were harvested on 25 July, 2 August, 12 August, and 30 August. Tennessee Brown was harvested three additional times on 12 September, 27 September, and 17 October. Fresh pod moisture contents were determined gravimetrically after oven drying and data on fresh pod weights were adjusted to 50% moisture content for yield comparisons.

On 24 May and 23 August six cores of soil, 2.5 cm in diameter and 20 cm deep, were collected from the rhizosphere of plants in the center two rows of every plot at both sites. The six cores from each plot were composited and mixed, and nematodes were extracted from a 100-cm^3 subsample using a modified sieving and centrifugation procedure (5). On 23 August, three root systems were removed from the outer two rows of each plot, and washed in the laboratory. However, since deterioration of most root systems was severe, roots were not rated for egg masses or galls, nor were nematodes extracted from roots.

Nematode numbers were transformed to $\log_{10}(X+1)$ prior to analysis of variance, but yield data were not transformed. When significant treatment effects were detected ($P \leq 0.05$), means were separated using Duncan's multiple range test (2).

RESULTS AND DISCUSSION

Meloidogyne incognita race 1 occurred at both sites, as did *Paratrichodorus minor* (Colbran) Siddiqi. Both sites contained a 2:1 mixture of *Pratylenchus brachyurus* (Godfrey) Filipjev & Schuurmans Stekhoven and *P. scribneri* Steiner, based on mature females collected on 23 August. Both sites also had a 2:1 mixture of *Criconemella ornata* (Raski) Luc & Raski and *C. sphaerocephala* (Taylor) Luc & Raski. *Paratylenchus* spp. occurred only at site 2.

At site 1, the *M. incognita* population built up from low initial densities (six J2/100 cm^3 soil) to high final densities (>

850 J2/100 cm^3 soil) following Whippoorwill, Pinkeye Purplehull, and Texas Purplehull (Table 1). The lowest final densities occurred following Mississippi Silver and Tennessee Brown ($P \leq 0.05$). Final population densities of other nematode species at site 1 were similar on all cowpea cultivars and no differences in host suitability were detected.

At site 2, initial densities of *M. incognita*, (353 J2/100 cm^3 soil) were much higher than at site 1 (Table 1). As at site 1, the highest densities followed Whippoorwill, Pinkeye Purplehull, and Texas Purplehull ($P \leq 0.05$). The lowest densities followed California Blackeye #5, Mississippi Silver, and Tennessee Brown ($P \leq 0.05$). Densities of other nematode species were less affected by cultivar, but some differences ($P \leq 0.05$) among cultivars were detected for *P. minor* and *Pratylenchus* spp. (Table 1).

At both sites, Mississippi Silver had a greater total pod yield than any of the other cultivars (Table 2). Mississippi Silver and Pinkeye Purplehull were the most yield-determinant of the cultivars, producing 90% or more of their pods for harvest within a 2-week period at both sites (Table 2). The other cultivars considered to be yield-determinant were Purple Knuckle, Whippoorwill, and Texas

Table 1. Nematode population densities following seven cowpea cultivars at two sites in Alachua County, Florida, 1991.

Cowpea cultivar	Final population density (nematodes per 100 cm^3 soil)				
	Meloidogyne incognita	*Pratylenchus* spp.	*Paratrichodorus minor*	*Criconemella* spp.	*Paratylenchus* spp.[z]
	Site 1, following rye cover crop				
Whippoorwill	876 a	38 a	9 a	56 a	
Pinkeye Purplehull	852 a	35 a	20 a	225 a	
Texas Purplehull	2 623 a	30 a	18 a	64 a	
Purple Knuckle	81 b	27 a	19 a	240 a	
California Blackeye #5	30 b	71 a	18 a	183 a	
Mississippi Silver	6 bc	34 a	29 a	92 a	
Tennessee Brown	2 c	52 a	10 a	80 a	
Initial population density (nematodes per 100 cm^3 soil)	6	22	10	31	
	Site 2, following clover cover crop				
Whippoorwill	1 718 a	4 b	40 ab	16 a	280 a
Pinkeye Purplehull	978 a	7 b	56 a	28 a	30 a
Texas Purplehull	697 ab	22 ab	26 ab	35 a	44 a
Purple Knuckle	253 bc	15 ab	38 ab	18 a	38 a
California Blackeye #5	86 d	26 a	47 ab	52 a	47 a
Mississippi Silver	120 cd	26 a	12 b	18 a	65 a
Tennessee Brown	88 d	23 a	22 b	34 a	205 a
Initial population density (nematodes per 100 cm^3 soil)	353	8	25	30	107

Data are non-transformed means of four replications. For each site, means in columns followed by the same letter are not different ($P \leq 0.05$), according to Duncan's multiple range test performed on log-transformed data.

[z]*Paratylenchus* spp. did not occur at Site 1.

Table 2. Cowpea pod yield (kg/ha) at 50% moisture at two sites in Alachua County, Florida, 1991.

		Harvest date							
Cultivar	Fruiting habit	25 Jul	2 Aug	12 Aug	30 Aug	12 Sep	27 Sep	17 Oct	Total
		Site 1, following rye cover crop							
Whippoorwill	DET[z]	2 194 b	2 311 a	439 abc	296 a				5 240 ab
Pinkeye Purplehull	DET	2 920 b	1 068 bc	109 c	312 b				4 409 b
Texas Purplehull	DET	1 013 c	776 bc	142 c	4 b				1 936 c
Purple Knuckle	DET	3 027 b	1 547 ab	228 bc	129 b				4 931 b
California Blackeye #5	IND	655 c	455 c	732	103 b				1 946 c
Mississippi Silver	DET	5 680 a	699 bc	149 c	39 b				6 566 a
Tennessee Brown	IND	704 c	565 c	493 ab	306 a	151	143	112	2 472 c
		Site 2, following clover cover crop							
Whippoorwill	DET	306 c	1 036 b	296 ab	17 a				1 652 c
Pinkeye Purplehull	DET	2 548 a	371 bc	78 c	5 a				3 002 b
Texas Purplehull	DET	233 c	609 bc	151 bc	3 a				995 c
Purple Knuckle	DET	1 392 b	1 980 a	480 a	35 a				3 887 b
California Blackeye #5	IND	74 c	240 c	302 ab	59 a				676 c
Mississippi Silver	DET	3 082 a	2 230 a	278 b	26 a				5 616 a
Tennessee Brown	IND	64 c	301 bc	284 b	30 a	4	9	11	702 c

Data are means of four replications. For each site, means in columns followed by the same letter are not different ($P \leq 0.05$), according to Duncan's multiple range test.
[z]DET = determinant; IND = indeterminant.

Purplehull. Tennessee Brown was an indeterminate cowpea, producing flowers and fresh pea pods for harvest over about a 3-month period. California Blackeye #5 produced significant amounts of pods for harvest over a 3- or 4-week period and appeared to be intermediate between determinant and indeterminant types for fresh pod yield.

Analysis of yield data for the five determinant types of cowpea across both sites showed a negative relationship between fresh pod cowpea yield and final density of *M. incognita* J2 in the soil ($r = -0.681$ at $P \leq 0.05$ for nontransformed data, and $r = -0.766$ at $P \leq 0.01$ for log-transformed nematode counts). Mississippi Silver had the highest yield and the lowest numbers of *M. incognita* at both sites (Tables 1,2). Both indeterminant cowpea cultivars, Tennessee Brown and California Blackeye #5, resulted in relatively low final numbers of *M. incognita* at both sites (< 100 J2/100 cm^3 soil), but ranked among the lowest in fresh pod cowpea yield (Tables 1,2). The yields of all cultivars were higher at site 1 (where initial densities of *M. incognita* were low) than at site 2 (where initial densities were high). The percentage reductions in yield associated with the difference in initial populations at the two sites were greatest on Tennessee Brown and California Blackeye #5, suggesting that these indeterminant cultivars, although partially resistant (Table 1), have a low tolerance of *M. incognita* infection. Future experiments under controlled conditions may be helpful in clarifying the host-parasite relationships of *M. incognita* on these cultivars.

If cowpea is to be used in cropping systems, it is evident that cultivar selection is important in minimizing the *M. incognita* density that will result after the crop. Lowest final population densities were obtained with Tennessee Brown, Mississippi Silver, and California Blackeye #5. Mississippi Silver, which has been used as a *M. incognita*-resistant standard in several previous experiments (4,6,7), had the highest yields in both of our tests. In terms of final nematode densities, the previously untested Tennessee Brown compared favorably with Mississippi Silver and California Blackeye #5, both considered resistant to *M. incognita* (1,10). Whippoorwill and Texas Purplehull, which previously were reported to be moderately resistant to an unidentified race of *M. incognita* (10), resulted in high final densities of *M. incognita* race 1 and therefore would be undesirable choices in rotation systems with *M. incognita* race 1, as would Pinkeye Purplehull. For the range of plant-parasitic nematodes encountered at these sites, selection of a cowpea cultivar can probably be based on the *M. incognita* population alone, because most yield differences were associated with differences in *M. incognita* population densities, and the host suitability of cowpea to the other nematode species did not appear to show many consistent differences among cultivars.

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