REACTION OF THREE COOL-SEASON ANNUAL LEGUME SPECIES TO *MELOIDOGYNE ARENARIA* AND *HETERODERA GLYCINES*

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ABSTRACT

Mosjidis, J. A., R. Rodríguez-Kábana, and C. M. Owsley. 1993. Reaction of three cool-season annual legume species to *Meloidogyne arenaria* and *Heterodera glycines*. Nematropica 23:35–39.

Breeding lines and accessions of *Vicia villosa* Roth, *V. sativa* L., and *Lathyrus hirsutus* L. were evaluated for resistance to *Meloidogyne arenaria* race 2 and *Heterodera glycines* race 4 in the greenhouse. *Vicia villosa* accessions were susceptible to *M. arenaria* whereas some *V. sativa* accessions were completely resistant. All *L. hirsutus* accessions were sensitive to *M. arenaria*; however, nematode reproduction and damage symptoms were significantly less than on the hairy vetch control. None of three cool-season legumes was susceptible to *H. glycines*.

Key words: Heterodera glycines, Lathyrus hirsutus, Meloidogyne arenaria, resistance, root-knot nematode, soybean cyst nematode, *Vicia villosa, Vicia sativa.*

RESUMEN

Mosjidis, J. A., R. Rodríguez-Kábana, and C. M. Owsley. 1993. Reacción de tres especies de leguminosas de invierno frente a *Meloidogyne arenaria* y *Heterodera glycines*. Nematrópica 23:35–39.

Lineas puras y germoplasma de *Vicia villosa* Roth, *V. sativa* L. y *Lathyrus hirsutus* L. se evaluaron en invernadero para determinar su resistencia a *Meloidogyne arenaria* y *Heterodera glycines*. Todo el germoplasma de *V. villosa* fue susceptible a *M. arenaria*, mientras que una parte del material genético de *V. sativa* fue completamente resistente. Todo el germoplasma de *L. hirsutus* fue susceptible a *M. arenaria*, pero los niveles de reproducción y los síntomas de daño fueron significativamente más bajos que los del testigo. Ninguna de las tres especies de leguminosas estudiadas fue susceptible a *H. glycines*.

Palabras clave: Heterodera glycines, Lathyrus hirsutus, Meloidogyne arenaria, nematodo agallador, nematodo del quiste de la soya, resistencia, *Vicia villosa, Vicia sativa.*

INTRODUCTION

Cool-season annual forage legumes are used in crop rotations to improve soil fertility and as a cover crop in water and soil conservation programs (1,5). Among the many cool-season forage legumes that have been tested for adaptation and productivity in the southeastern United States, hairy vetch (*Vicia villosa* Roth) and common vetch (*Vicia sativa* L.) are well known and widely accepted (4). A less known legume is caley pea (*Lathyrus hirsutus* L.), introduced from the Mediterranean region. In the southeastern U.S.A., caley pea has been utilized as a cattle forage as well as a cool season cover crop. Caley pea is mostly grown on wet clays of the lower Mississippi Delta area and on calcareous clays of the Alabama and Mississippi Black Belt (6).

Of the many nematode species that attack plants, the root-knot nematode *Meloidogyne arenaria* (Neal) Chitwood and the soybean cyst nematode (*Heterodera glycines* Ichinoe) are among the most important in the southeastern region of the U.S.A. Common vetch cultivars resistant to the root-knot nematodes *M. incognita* and *M. javanica* but susceptible to an unidentified race of *M. arenaria* have been

released (2,3). Research has not been conducted to evaluate the resistance of recently developed breeding lines. Our present knowledge of root-knot nematode resistance in hairy vetch is limited to an unidentified accession (8,9). No information is available on the response of caley pea to nematodes. The objectives of this study were to determine the reaction of breeding lines and accessions of hairy vetch, common vetch, and caley pea to *M. arenaria* race 2 and *H. glycines* race 4, and to select lines resistant to those nematodes.

MATERIALS AND METHODS

One experiment included hairy vetch breeding lines 8, 12, and 26 from plant introduction (PI) 9053961 collected in Southern Alabama, and hairy vetch PI 383803 from the National Plant Materials Center, Beltsville, Maryland, together with seven PI's, five breeding lines, and five cultivars of common vetch from Auburn University. Twenty-three caley pea accessions were tested in a separate experiment (Table 1). Caley pea accessions were ecotypes collected from fields and roadsides in central and northern Alabama by the U.S. Soil Conservation Service Plant Materials Center, Americus, Georgia.

Soil for the experiments was a sandy loam (pH 6.2; organic matter content < 1.0%; cation exchange capacity < 10 meq/100 g soil) from a field planted to soybean [*Glycine max* (L.) Merr.] and infested with *Meloidogyne arenaria* race 2 and *Heterodera glycines* race 4. The soil was sieved (< 1 mm) and mixed 1:1 (v:v) with fine (< 0.1 mm) siliceous river sand. The mixture will be referred to as soil. The soil was apportioned in 1-kg amounts and placed in cylindrical 10-cm-diam, 1-L capacity plastic pots. The pots were placed on greenhouse benches and planted with 5 seeds per pot. 'Davis' soybean and commercial hairy vetch were included in each experiment to serve as positive controls (hosts) for *H. glycines* (soybean) and *M. arenaria* (soybean and vetch). Initial populations of nematodes were determined by extracting nematodes with the salad bowl

Table 1. Origins of the vetch and caley pea entries tested.

Species	Accession	Origin
Hairy vetch (*Vicia villosa*)	PI 9053961	U.S.A.
	PI 383803	U.S.A.
Common vetch (*Vicia sativa*)	PI 220914	Belgium
	PI 239922	Iran
	PI 284057	Czechoslovakia
	PI 284368	Australia
	PI 284375	Algeria
	PI 284379	Morocco
	PI 284563	Germany
	Cahaba White	U.S.A.
	Vantage	U.S.A.
	Vanguard	U.S.A.
	Nova II	U.S.A.
	Warrior	U.S.A.
Caley Pea (*Lathyrus* hirsutus)	T 39828	U.S.A.
	T 48912	U.S.A.
	T 48915	U.S.A.
	T 52084	U.S.A.
	T 52085	U.S.A.
	T 52086	U.S.A.
	T 52088	U.S.A.
	T 52097	U.S.A.
	T 52099	U.S.A.
	T 52101	U.S.A.
	T 52102	U.S.A.
	T 52658	U.S.A.
	T 52660	U.S.A.
	T 52969	U.S.A.
	T 52970	U.S.A.
	T 53011	U.S.A.
	T 53012	U.S.A.
	T 54213	U.S.A.
	T 54214	U.S.A.
	T 54221	U.S.A.
	T 54223	U.S.A.
	T 54235	U.S.A.
	T 54241	U.S.A.

incubation method (10) from eight 100-cm^3 soil samples. The average numbers of juveniles were 55 and 12/100 cm^3 soil for *M. arenaria* and *H. glycines*, respectively.

Plants were allowed to grow for 8 weeks when they were removed by careful washing of the soil around the roots. The number of root galls caused by *M. arenaria* were counted and the degree of galling was assessed using Zeck's scale (11), where 0 represents no galls and 10 represents maximal galling. The general appearance of roots was evaluated using a subjective scale from 1–5 where 1 represented the best root system and 5 represented the worst. The fresh weights of roots and shoots were recorded. Nematodes were then extracted from roots by the salad bowl incubation method.

In each experiment there were eight replications (pots) per treatment arranged in a completely randomized design. All data were analyzed following standard procedures for analysis of variance (7).

Table 2. Parameters of resistence to *Meloidogyne arenaria* race 2 and *Heterodera glycines* race 4 measured for four hairy vetch and 17 common vetch entries, and for 'Davis' soybean (experimental control) in an 8-week greenhouse experiment.

	Overall plant growth			*M. arenaria*			*H. glycines*
Entry	Shoot weight (g)	Root weight (g)	Root condition[x] (1–5)	Gall rating[y] (0–10)	Galls per gram of root	Juveniles per gram of root	Cysts per gram of root
Davis soybean	.91[z]	.70[z]	4.0[z]	3.7	36	374	62
Hairy vetch							
Commercial hairy vetch	.12	.17	4.5	7.7	207	665	0
PI 383803	.14	.17	4.5	7.9	157	784	0
Line 26	.23	.21	4.4	6.4	133	624	0
Line 12	.17	.19	4.8	8.0	170	737	0
Line 8	.17	.16	4.5	6.9	196	922	0
Common vetch							
PI 220914	.31	.21	3.0	1.0	5	47	0
PI 239922	.17	.11	5.0	7.9	312	1 193	0
PI 284057	.32	.13	3.3	0.2	2	13	0
PI 284368	.17	.09	4.3	6.3	228	739	0
PI 284375	.52	.20	2.8	0.0	0	30	0
PI 284379	.41	.24	3.7	5.3	103	1 815	0
PI 284563	.45	.21	1.9	0.0	0	3	0
R7 P5	.66	.44	3.2	3.9	43	502	0
Cahaba White	.31	.22	2.7	0.0	0	0	0
Vantage	.39	.22	2.9	0.0	0	31	0
Vanguard	.28	.13	3.5	0.0	0	0	0
Nova II	.34	.10	3.6	0.0	0	0	0
Warrior	.38	.11	3.9	0.0	0	0	0
R4 P4	.30	.12	3.7	0.1	0	0	0
R7 P2	.35	.15	4.4	5.4	145	2 972	0
R7 P7	.27	.17	4.7	6.3	170	2 394	0
R9 P1	.44	.19	3.3	0.0	0	0	0
LSD ($P \leq 0.05$)	.10	.07	0.5	0.8	31	600	

[x]Root condition scale: 1 = best, 5 = worst.
[y]Gall rate scale: 0 = no galls, 10 = maximum galling.
[z]Data not included in the analysis.

Fisher's least significant differences were calculated when F values were significant ($P \leq 0.05$). Unless otherwise stated all differences referred to in the text were significant at the 5% or lower level of probability.

RESULTS AND DISCUSSION

All hairy vetch entries were highly susceptible to *M. arenaria* (Table 2). No differences were found among the breeding lines and a large number of second-stage juveniles (J2) of *M. arenaria* were recovered from all entries. Gall ratings ranged between 6.4 and 8.0, and numbers of galls per gram of roots were between 133 and 196 (Table 2). Davis soybean was the only crop susceptible to *H. glycines*; all entries of hairy vetch, common vetch, and caley pea were immune.

High levels of resistance to *M. arenaria* were found in 11 of the common vetch entries (Table 2). No J2 were detected in the cultivars Cahaba White, Vanguard, Nova II, and Warrior or in the breeding

Table 3. Parameters of resistence to *Meloidogyne arenaria* race 2 and *Heterodera glycines* race 4 measured for 21 caley pea entries and for 'Davis' soybean (experimental control) in an 8-week greenhouse experiment.

	Overall plant growth			*M. arenaria*			*H. glycines*
Entry	Shoot weight (g)	Root weight (g)	Root condition[x] (1–5)	Gall rating[y] (0–10)	Galls per gram of root	Juveniles per gram of root	Cysts per gram of root
Davis soybean	.60[z]	.85[z]	3.6[z]	4.3	65	3 599	59
Commercial hairy vetch	.11[z]	.15[z]	4.8[z]	6.6	298	4 472	0
Caley pea							
T 39828	.18	.21	4.0	5.4	203	203	0
T 48912	.20	.18	4.4	5.9	148	73	0
T 48915	.18	.13	3.8	3.4	123	196	0
T 52084	.15	.16	4.0	6.0	186	67	0
T 52085	.15	.12	4.6	7.3	131	69	0
T 52086	.12	.07	4.9	8.1	191	102	0
T 52088	.13	.09	4.9	7.8	145	565	0
T 52097	.17	.12	4.0	5.5	109	101	0
T 52099	.10	.54	4.8	6.8	236	559	0
T 52101	.11	.07	4.8	7.3	178	124	0
T 52102	.13	.12	4.3	6.7	151	264	0
T 52658	.11	.09	4.2	6.7	182	132	0
T 52660	.16	.13	4.8	7.2	161	1 220	0
T 52969	.15	.11	4.3	5.7	137	265	0
T 52970	.15	.14	4.3	6.5	122	217	0
T 53011	.16	.14	4.5	7.3	162	291	0
T 53012	.15	.11	4.5	6.6	120	312	0
T 54213	.12	.09	4.4	6.5	119	288	0
T 54214	.19	.13	4.1	4.7	88	113	0
T 54221	.15	.11	4.6	6.7	167	243	0
T 54223	.26	.09	4.5	6.3	141	70	0
T 54235	.18	.10	4.6	5.0	113	118	0
T 54241	.15	.07	4.0	3.6	98	369	0
LSD ($P \leq 0.05$)	.06	.05	0.6	1.6	70	728	

[x]Root condition scale: 1 = best, 5 = worst.
[y]Gall rate scale: 0 = no galls, 10 = maximum galling.
[z]Data not included in the analysis.

lines R4 P4 and R9 P1. Vantage, PI 220914, PI 284057, PI 284375, and PI 284563 had only small numbers of J2, which were not statistically different from zero. Gall ratings of these entries ranged from 0 to 1 and the number of galls per gram of roots ranged between 0 and 4.6 (Table 2). Thus, this study confirms results from previous studies (4,8) which showed that there are genotypes in common vetch that are resistant to *Meloidogyne* species. Agronomic characteristics and field performance of the resistant lines will be further studied to determine if they warrant release as cultivars.

Few differences in reaction to *M. arenaria* were measured in the caley pea accessions. Twenty two accessions had 67 to 559 J2 per gram of root whereas T 52660 had a significantly higher number (1 220). All caley pea accessions had a significantly lower number of root-knot juveniles than Davis soybean and commercial hairy vetch (Table 3). Gall ratings ranged between 3.4 and 8.1 among the caley pea accessions whereas hairy vetch had 6.6 and Davis soybean had 4.3. The number of galls per gram of roots ranged between 88 and 203 among the caley pea accessions. The accessions T 54214, T 54241, T 54235, T 54213, T 53012, and T 52085 had the lowest numbers of galls (Table 3). Several of these accessions have also performed well in yield tests across Alabama and Georgia (Mosjidis and Owsley, unpublished data).

In summary, all hairy vetch accessions tested were highly susceptible to *M. arenaria* race 2 whereas some common vetch entries where completely resistant. All caley pea accessions were susceptible to *M. arenaria* race 2; however, the levels of nematode reproduction and damage symptoms were significantly lower than in the hairy vetch control. None of the vetch and caley pea entries was susceptible to *H. glycines* race 4.

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