Root-knot Nematode Resistance in *Arachis Glabrata*[1]

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ABSTRACT

Peanut root-knot nematode (*Meloidogyne arenaria* race 1) is an important pest of cultivated peanuts (*Arachis hypogaea* L.). Experimental data do not exist, however, to indicate whether this nematode might be a potential pest of peanuts grown for forage production. Florigraze and Arbrook, two recently released cultivars of rhizoma peanut (*Arachis glabrata* Benth.) and P.I. 446898 (*Arachis* spp.) with perennial forage potential, were evaluated for their interaction with *M. arenaria* race 1, *M. javanica*, and *M. incognita* races I and III. Individual plants, grown in 150 cm^3 Conetainers^R, were inoculated with 3,000 eggs of one of the four *Meloidogyne* spp. populations. After three months gall and egg mass scores and soil-nematode counts were determined for each plant sample. A second long-term experiment evaluated Florigraze that was repeatedly inoculated with high levels of root-knot nematodes. Both rhizoma peanut cultivars were highly resistant to all root-knot nematodes tested; Florigraze appeared to be immune. P.I. 446898 was intermediate between the rhizoma peanuts and the susceptible alyceclover check. This is the first known report of such high levels of *Meloidogyne arenaria* resistance in *Arachis* spp. Further screending of *A. hypogaea* material can be justified based on these results and Vavilov's "Law of homologous series". If no resistance is found in *A. hypogaea*, *A. glabrata* may provide a source of resistance that may be transferred to *A. hypogea* through hybridization.

Key Words: *Meloidogyne arenaria*, *Arachis hypogaea*, rhizoma peanuts, perennial peanuts, intercropping.

Root-knot nematodes (*Meloidogyne* spp.) have been identified as a serious pest in commercial peanut (*Arachis hypogaea* L.) production. *M. arenaria* race 1 ("peanut root-knot nematode") has been singled out by numerous researchers as the primary nematode affecting peanut production in the Southeastern Coastal Plain of the U.S. (6). A large number of *A. hypogaea* lines have been screened, but no source of resistance has been identified within the species (5). Further, no known source of resistance to this nematode has been identified that can be used in breeding cultivated peanuts (5).

Rhizoma peanut (*Arachis glabrata* Benth.) is a warm-season perennial forage legume having value as both a hay and grazing crop (8). Two released cultivars, Florigraze and Arbrook have rhizomes and are long-lived perennials. The longevity of these perennial peanuts can be attributed to many physiological and morphological characteristics which differentiate them from the cultivated peanut. Among these are relatively superior disease and insect resistances, especially to early and late leafspot (*Cercospora arachidicola* and, *C. personatum*) and rust (*Puccinia arachidis*). The rhizoma peanuts are propagated vegetatively. Although numerous researchers have dug propagating material and experimental plants from nematode infested areas, no root-knot damage has been noted (8, 12).

Rhizoma peanuts have shown some potential for use as a nitrogen fixing understory for intercropping systems (8). Knowledge of the resistance of perennial peanuts to root-knot nematodes would be helpful in predicting the success of nematode susceptible crops grown in conjunction with them.

Research is currently being conducted to develop techniques for making wide species crosses in the *Arachis* species. These include embryo rescue techniques and peg maintenance treatments at ICRISAT (10, 11) and protoplast fusion techniques (7). Development of successful crossing techniques would make knowledge of potential sources of *M. arenaria* resistance extremely useful. This study was conducted to determine if rhizoma peanuts and an unclassified perennial species of *Arachis* (P.I. 446898) are resistant to peanut and other root-knot nematodes.

Materials and Methods

Experiment I

Individual Florigraze and Arbrook rhizomes were planted in 150 cm^3 Conetainers^R and allowed to establish for 1 month prior to inoculation with root-knot nematodes. In addition P.I. 446898 and common alyceclover (*Alysicarpus vaginalis*), FL-100, were seeded in the same size conetainers two weeks prior to inoculation. Nematode treatments included *M. arenaria* race I, *M. javanica*, *M. incognita* race I and III, and an uninoculated check. The methods of nematode inoculation and plant culture used have been described elsewhere by Quesenberry *et al.* (9), except that in this study 3,000 nematode eggs were applied per container instead of 1,200-1,500 in order to assure a more rigorous test for determining if resistance existed. The experiment was arranged as a randomized complete block design with seven replications. Germplasm sources were arranged as main plots and nematode species as subplots. Plants were inoculated on 18 June, 1985 and scored on 13 September, 1985. Soil removed from each treatment was saved and nematode counts were made on each soil sample using a centrifugal flotation technique (1).

Experiment II

This was a long term evaluation of the effect of repeated inoculation with large numbers of root-knot nematode eggs. Florigraze rhizoma peanuts were grown in a 15 L styrofoam container from February 1983 through February 1986 in a greenhouse at Gainesville, FL. Approximately every 4 months, nematode eggs of all four nematode species were applied evenly to the soil. Nematode numbers varied at each application as these were residual nematodes from other screening tests, but frequently exceeded 50 per cm^3 of soil. Periodic observations of roots were made during the three year period of the study. On the final date roots were shaken free of most soil and then washed and stained with Phloxine B for 15 min. to determine if galls and egg masses were present (3).

Results and Discussion

Experiment I

Both types of perennial peanuts studied were more resistant to all nematode species than alyceclover (Table 1). No galls were produced by any nematode species on

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Table 1. Root-knot gall and egg mass scores per root system of Arbrook and Florigraze rhizoma peanut and P.I. 446898 (*Arachis* spp.) peanut and FL 100 alyceclover inoculated with three *Meloidogyne* species, Gainesville, FL, 1985.

	M. arenaria		M. javanica		M. incognita race I		M. incognita race III	
Legume	galls	egg masses	galls	egg masses	galls	egg masses	galls	egg masses
	score [a]							
Florigraze	0.0 a*	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Arbrook	0.6 b	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
P.I. 446898	3.3 c	2.0 b	1.7 b	0.0 a	0.5 a	0.0 a	0.5 a	0.0 a
FL-100	5.0 d	4.5 c	5.0 c	5.0 b	5.0 b	4.8 b	5.0 b	4.8 b

[a] Gall and egg mass (galls) scores were based on a scale of 0-5 with 0 = no galls, 1 = 1 or 2 galls, 2 = 3-10 galls, 3 = 11-30 galls, 4 = 31-100 galls, and 5 = over 100 galls per root system.

* Means in column followed by the same letter are not significantly different at the 0.05 probability level according to Duncan's Multiple Range Test.

Florigraze. Arbrook developed no galls when inoculated with *M. javanica* or *M. incognita* race I and III, and less than one gall per root system when inoculated with *M. arenaria*. P.I. 446898 was susceptible to *M. arenaria*, but was less galled and less seriously stunted than common alyceclover. These results correlate well with observations by A. E. Kretschmer that P.I. 446898 was galled but not seriously reduced in growth in the field (personal communication). In previous comparisons of P.I. 446898 with cultivated peanut, Holbrook found a similar galling response (4). In this study it was also slightly galled by both *M. javanica* and *M. incognita*.

No egg masses were produced on any of the rhizoma peanut roots by any of the nematodes (Table 1). No egg masses were produced by *M. javanica* or *M. incognita* on P.I. 446898, but a small number were produced by *M. arenaria*. These responses were in sharp contrast to the large number of egg masses produced on alyceclover.

Nematode numbers in the conetainers at the end of the experiment were greatly reduced from the 2,000 per 100 cm^3 applied originally in the conetainers containing Florigraze and Arbrook (Table 2). Alyceclover had essentially the same number of nematodes as initially applied.

Table 2. Number of *Meloidogyne* spp. juveniles per 100 cm^3 soil in conetainers following removal of rhizoma peanut and FL-100 alyceclover plants, Gainesville, FL, 1985.

Legume	M. arenaria	M. javanica	M. incognita race I	M. incognita race III
	nematodes/100 cm^3 soil			
Arbrook	1.2 b*	0.0 a	0.0 a	0.0 a
Florigraze	0.1 a	0.0 a	0.0 a	0.0 a
FL-100	2,200.0 c	1,800.0 b	2,700.0 b	2,700.0 b

* Means in column followed by the same letter are not significantly different at the 0.05 probability level according to Duncan's Multiple Range Test.

Experiment II

No egg masses or galls were observed on Florigraze throughout the 3-year period of experiment II. This confirmed the immune reaction observed in experiment I. Combined with the previous observations of no root-knot nematode problems in the released rhizoma peanut cultivars, the evidence indicates that Florigraze can be considered immune to the *Meloidogyne* species and races studied. Further, Arbrook can be considered as highly resistant or immune as indicated in experiment I. This is the first known report of such high levels of resistance to root-knot nematodes within the *Arachis* genus. Until crossing methods are developed which allow the intercrossing of *A. glabrata* and *A. hypogaea* this source of resistance can not be utilized directly in *A. hypogaea*, germplasm. However, such results should encourage breeders to collect and screen more cultivated peanut germplasm, supported by Vavilov's "law of homologous series in heritable variation" which states that traits found in one species of a genus are likely to occur in other species of that genus (2).

The high level of resistance in rhizoma peanuts to three species of root-knot nematodes that are major pests to many crops suggests that they may be desirable for intercropping or rotation with other high-value crops that are susceptible to those nematodes. If perennial peanuts can suppress root-knot nematodes as well as contribute nitrogen through symbiotic fixation, they may prove especially valuable for strip-cropping or rotation with vegetables, or as an understory cover crop with such root-knot-susceptible tree crops as peaches. These possibilities should be attractive to both the producers of the propagating material and to those whose long-term crop management systems would be improved by a cover crop with this combination of characteristics.

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