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VELVETBEAN FOR THE MANAGEMENT OF ROOT-KNOT AND SOUTHERN BLIGHT IN PEANUT

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ABSTRACT

Rodríguez-Kábana, R., J. W. Kloepper, D. G. Robertson, and L. W. Wells. 1992. Velvetbean for the management of root-knot and southern blight in peanut. Nematropica 22:75–80.

The value of Florida velvetbean (*Mucuna deeringiana*) as a rotation crop for the management of root-knot nematode (*Meloidogyne arenaria*) and southern blight (*Sclerotium rolfsii*) in 'Florunner' peanut (*Arachis hypogaea*) was studied from 1989–1991 in a field experiment in southeastern Alabama. The field had been in peanut with winter fallow for the preceeding 10 years and was heavily infested with *M. arenaria*. In 1991, the yield of peanut following 2 years of velvetbean (V–V–P) was 47% higher than the yield of monoculture peanut without nematicide [P(–)] and 20% higher than that of monoculture with aldicarb [P(+)] applied at-plant (0.302 g a.i./m row in a 20-cm band). Compared with peanut plots, plots with velvetbean in 1989 and 1990 had low populations of *M. arenaria* juveniles in soil at peanut harvest. In 1991, *M. arenaria* juvenile populations in soil were lowest in plots with the V–V–P rotation and highest in those with P(–); numbers of juveniles in plots with P(+) were lower than in P(–) plots and equivalent to the numbers in plots with V–V–P. The V–V–P rotation had no effect on the incidence of southern blight in peanut.

Key words: Arachis hypogaea, chemical control, crop rotation, cultural practice, *Meloidogyne arenaria, Mucuna deeringiana,* nematicide, peanut, pest management, root-knot nematode, tropical legumes, *Sclerotium rolfsii,* southern blight.

RESUMEN

Rodríguez-Kábana, R., J. W. Kloepper, D. G. Robertson y L. W. Wells. 1992. El frijol terciopelo para controlar la mustia blanca y el agallamiento de las raíces en el maní. Nematrópica 22:75–80.

Se estudió durante 1989–1992 la utilidad del frijol terciopelo (*Mucuna deeringiana*) como cultivo de rotación para el manejo del nematodo agallador (*Meloidogyne arenaria*) y de la mustia blanca (*Sclerotium rolfsii*) en maní 'Florunner' en un experimento de campo en el sureste de Alabama. El campo experimental había estado en producción de maní con baldío de invierno por 10 años y estaba altamente infestado con el nematodo. En 1991 el rendimiento de maní siguiendo 2 años de frijol (T–T–M) resultó superior en un 47% al del maní en monocultivo sin tratamiento nematicida [M(–)] y en un 20% al del maní tratado con aldicarb (0.302 g i.a./m de surco en una franja de 20 cm de ancho) en la siembra [M(+)]. En contraste con las parcelas con maní, las sembradas con frijol terciopelo en 1989 y 1990 no mostraron poblaciones apreciables de larvas de *M. arenaria* en el suelo en el tiempo de cosecha del maní. En 1991 las poblaciones de larvas de *M. arenaria* más bajas del experimento se observaron en las parcelas con T–T–M y las más altas en aquellas con M(–); las poblaciones de larvas en las parcelas con M(+) resultaron equivalentes en número a las de las parcelas con T–T–M e inferiores a las otras con M(–). La rotación T–T–M no afectó la incidencia de la mustia blanca en el maní.

Palabras clave: Arachis hypogaea, cambios de cultivo, cacahuete, control químico, frijol terciopelo, maní, manejo de plagas, *Meloidogyne arenaria, Mucuna deeringiana,* mustia blanca, nematodo agallador, prácticas agronómicas, rotación de cultivos, *Sclerotium rolfsii.*

INTRODUCTION

Damage from the root-knot nematode *Meloidogyne arenaria* is one of the principal yield limiting factors in the production of peanut (*Arachis hypogaea*) in the United States (13). The nematode is widespread in the southeastern United States (5,10) and yield losses caused by it can be severe (25). In the past, management of *M. arenaria* in peanut was based on the use of inexpensive and highly efficacious nematicides (DBCP, EDB) (18). The recent removal of these fumigants has left peanut producers with a limited number of nematicides which are more expensive and not as efficacious as the banned fumigants (17). There are currently no commercially available peanut cultivars resistant to *M. arenaria* (11,13). Crop rotation and cultural practices are thus the remaining tools for the management of root-knot problems in the crop. A number of crop rotation systems are effective for suppressing root-knot nematode in peanut (15,16,23); however, implementation of rotation systems is very dependent on economic, ecological, and other constraints faced by growers in individual fields (26). It is, thus, important to study new crops to provide growers with information necessary for development of alternative rotation systems that suppress root-knot. Past studies have shown that a number of crops unusual in Alabama may be useful for controlling root-knot problems in peanut (19,20). Velvetbean (*Mucuna deeringiana*) is an African legume introduced to the southeastern United States in the late 19th century as a green-manure and pasture crop (9,12). It was used in combination with corn (*Zea mays*) to improve soil fertility and to provide winter fodder for swine in the field (12). Velvetbean production declined rapidly with the introduction of synthetic N fertilizers in the 1940's (9). Early studies demonstrated that velvetbean was useful for control of root-knot nematodes and other soil-borne pathogens (12,28). More recently, greenhouse and microplot studies at Auburn demonstrated the value and the legume for suppressing *Meloidogyne* spp. (21). This paper presents results of a study on velvetbean-peanut rotation for the management of *M. arenaria*.

MATERIALS AND METHODS

The study was conducted in a field at the Wiregrass substation, near Headland, Alabama, that had been in peanut for the previous 10 years and was heavily infested with *M. arenaria* (> 200 juveniles/100 cm^3 soil at peanut harvest). The soil was a sandy loamy with pH 6.2, organic matter content < 1.0% (w/w), and cation exchange capacity < 10 meq/100 g soil. The experiment was initiated in 1989 and consisted of the following treatments: continuous peanut (cv. Florunner) without nematicide [P(–)]; continuous peanut with nematicide [P(+)]; and peanut without nematicide following two years of velvetbean (V–V–P). The nematicide, aldicarb, was applied at-plant in a 20-cm-wide band at 0.302 g a.i./m row using an electrically driven Gandy applicator (Gandy Company, Owatonna, Minnesota, U.S.A.). The nematicide granules were incorporated to a depth of 2–4 cm using spring-activated tines attached to the planting equipment. Seeds were planted 5 cm deep. Plots in the experiment were eight rows wide and 10 m long. Rows were set 0.9 m apart and there were eight plots per treatment arranged in a randomized complete-block design.

Cultural practices and control of foliar diseases, insects, and weeds in peanut were according to recommendations for the area (1,2,3). Velvetbean was planted at 22 kg seed/ha and was fertilized as for peanut. Velvetbean plots did not have significant insect or foliar disease problems and were consequently not sprayed with any pesticide.

Soil samples for nematode analysis were collected each year 2 weeks before peanut digging (in early September) to coincide with the period of maximal *M. arenaria* juvenile population densities in soil (24). Samples consisted of 18–20 soil cores collected 15–20 cm deep from the two center rows of each plot at approximately 0.5-m spacings. The cores were collected using a standard 2.5-cm-diam soil probe. Cores from a plot were composited and a 100-cm^3 subsample was used to determine nematode numbers using the salad bowl incubation technique (22).

The incidence of southern blight (*Sclerotium rolfsii*) in peanut was determined each year immediately after digging and inversion of the plants by counting the number of disease loci ("hits") in the center two rows of each plot; a disease locus is a length of row ≤ 30 cm (one foot) with all plants killed by the fungus (14).

Peanut yield data were obtained by harvesting the two center rows of the plots at maturity of the crop. Data on velvetbean green matter production was not obtained. The legume was left on the ground through the winter each year until March when it was plowed under.

All data were analyzed with the appropriate analysis of variance (8), and Fisher's least significant differences (FLSD) were calculated. Unless otherwise stated, all differences referred to were significant at the 5% or lower level of probability.

RESULTS AND DISCUSSION

Velvetbean, in contrast to peanut, did not support significant *M. arenaria* juvenile populations in the soil (Table 1). The application of aldicarb reduced juvenile populations in 2 of the 3 years of the study. In 1991, juvenile densities in V–V–P plots were lower than in P(–) plots but were not significantly different from those in P(+) plots.

The velvetbean-peanut rotation had no effect on the incidence of southern blight in peanut (Table 2). At-plant application of aldicarb reduced the number of disease loci in 1989 but not in 1990 and 1991.

In 1991, the velvetbean-peanut rotation resulted in increases in peanut yield of 47% over the P(–) treatment and 19.8% over the P(+) treatment (Table 3). Also in 1991, P(+) yield was 23.1% higher than that from P(–); however, aldicarb failed to increase yields significantly in the previous 2 years.

Table 1. End-of-season populations of *Meloidogyne arenaria* juveniles as influenced by aldicarb and rotation of 'Florunner' peanut (*Arachis hypogaea*) with velvetbean (*Mucuna deeringiana*) in a field experiment at the Wiregrass substation, near Headland, Alabama.

Cropping sequence and year[y]			Juveniles/100 cm^3 soil[z]		
1989	1990	1991	1989	1990	1991
P(–)	P(–)	P(–)	188	342	126
P(+)	P(+)	P(+)	74	442	62
V	V	P(–)	23	9	41
		FLSD (P = 0.05)	31	100	55

[y]P = peanut; V = velvetbean; (–) = no nematicide treatment; (+) = at-plant treatment with aldicarb at 0.302 g a.i./m row applied in a 20-cm band.

[z]Nematodes extracted by the salad bowl method from soil collected 2–3 weeks before peanut harvest.

Table 2. Incidence of southern blight caused by *Sclerotium rolfsii* as influenced by aldicarb and rotation of 'Florunner' peanut (*Arachis hypogaea*) with velvetbean (*Mucuna deeringiana*) for management of *Meloidogyne arenaria*.

Cropping sequence and year[y]			Disease loci/100 m row[z]		
1989	1990	1991	1989	1990	1991
P(−)	P(−)	P(−)	71	119	65
P(+)	P(+)	P(+)	53	121	55
V	V	P(−)	—	—	63
		FLSD (P = 0.05)	12	17	16

[y]P = peanut; V = velvetbean; (–) = no nematicide treatment; (+) = at-plant treatment with aldicarb at 0.302 g a.i./m row applied in a 20-cm band.
[z]A disease locus is defined as a length of row ≤ 30 cm with all plants killed by *S. rolfsii*.

The results indicate that velvetbean is an excellent rotation crop for the management of *M. arenaria* in peanut. This tropical legume is a non host for this nematode and other *Meloidogyne* spp. (21,27). Velvetbean exerts a suppressive effect on development of *Meloidogyne* popoulations and there is evidence that this effect may be due to the production of nematicidal root exudates (27). Kloepper *et al.* have shown that the rhizosphere bacterial microflora of velvetbean are significantly different from those of other legumes (6). Several bacterial species isolated from velvetbean rhizosphere may be antagonistic to phytonematodes (7).

Other studies have shown velvetbean dry matter production in excess of 6 T/ha for velvetbean (unpublished data). The legume thus offers the possibility of combining suppression of *M. arenaria* populations and improvement of soil fertility when incorporated into soil as green manure. Velvetbean was used in the past in the southeastern United States for these purposes and to reduce problems caused by *Fusarium* wilt and root-knot nematodes in cotton and other crops (12,28). In southern Mexico, velvetbean rotations with corn are useful in increasing yields and in suppressing damage from phytonematodes and other soilborne pathogens (4). Our results corrobrate these findings and extend the value of this tropical legume to the management of root-knot in peanut production.

Table 3. Effect of velvetbean (*Mucuna deeringiana*) as a rotation crop on yield of 'Florunner' peanut (*Arachis hypogaea*) in a field experiment at the Wiregrass substation, near Headland, Alabama.

Cropping sequence and year[z]			Yield (kg/ha)		
1989	1990	1991	1989	1990	1991
P(−)	P(−)	P(−)	1 899	2 251	2 116
P(+)	P(+)	P(+)	2 088	2 631	2 604
V	V	P(−)	—	—	3 119
		FLSD (P = 0.05)	391	437	463

[z]P = peanut; V = velvetbean; (–) = no aldicarb treatment; (+) = at-plant treatment with aldicarb at 0.302 g a.i./m row applied in a 20-cm band.

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