EVALUATION OF SESAME FOR CONTROL OF *MELOIDOGYNE ARENARIA* AND *SCLEROTIUM ROLFSII* IN PEANUT†

R. Rodríguez-Kábana, N. Kokalis-Burelle, D. G. Robertson, and L. W. Wells

Professor, Postdoctoral Fellow, Senior Research Associate, and Assistant Superintendent of Wiregrass Substation, respectively, Department of Plant Pathology, Auburn University, Alabama Agricultural Experiment Station, Auburn, AL 36849-5409, U.S.A.

ABSTRACT

Rodríguez-Kábana, R., N. Kokalis-Burelle, D. G. Robertson, and L. W. Wells. 1994. Evaluation of sesame for control of *Meloidogyne arenaria* and *Sclerotium rolfsii* in peanut. Nematropica 24:55–61.

Sesame (*Sesamum indicum*) was evaluated in a 6-year field experiment as a rotation crop for the management of root-knot nematode (*Meloidogyne arenaria*) and southern blight (*Sclerotium rolfsii*) in 'Florunner' peanut (*Arachis hypogaea*). The experiment was initiated in 1988 in an irrigated field with severe *M. arenaria* and *S. rolfsii* infestation which had been in peanut production with winter fallow for 10 years. Rotations with bahiagrass (*Paspalum notatum*) were included as positive controls. *Meloidogyne arenaria* juvenile (J2) population densities in soil were reduced in plots with sesame or bahiagrass, while aldicarb applied to monoculture peanut failed to reduce J2 population densities in all but 1 year. Incidence of southern blight was lowest in peanut following 2 years of bahiagrass, while disease incidence in peanut following 1 year of bahiagrass was no less than that in peanut monoculture. Cropping systems with sesame had no consistent effect on southern blight. Yield of peanut without nematicide following 1 year of sesame was higher than yield from continuous peanut without nematicide in 2 out of 3 years. Yield of peanut following 2 years of sesame was higher than monoculture peanut with and without nematicide. The relationship between *M. arenaria* juvenile populations and peanut yield was not influenced by cropping system and was significant for all years except 1990. Peanut yield was inversely and linearly related to the number of southern blight disease loci, and the relationship between these 2 variables was unaffected by cropping systems but was influenced by production year.

Key words: Arachis hypogaea, bahiagrass, crop rotation, *Meloidogyne arenaria*, nematode management, *Paspalum notatum*, peanut, *Sclerotium rolfsii*, sesame, *Sesamum indicum*, white mold.

RESUMEN

Rodríguez-Kábana, R., N. Kokalis-Burelle, D. G. Robertson, y L. W. Wells. 1994. Evaluación del ajonjolí para el control de *Meloidogyne arenaria* y *Sclerotium rolfsii* en maní. Nematrópica 24:55–61.

Ajonjolí (*Sesamum indicum*) fue evaluado a nivel de campo en un sistema de rotación de cultivos por seis años para el manejo del nematodo nodulador (*Meloidogyne arenaria*) y el tizón sureño (*Sclerotium rolfsii*) en una plantación de maní (*Arachis hypogaea*) variedad 'Florunner'. El experimento se inició en 1988 utilizándose un predio severamente infestado por *M. arenaria* y *S rolfsii*, y mantenido en monocultivo por diez años. Rotaciones con yerba de bahía (*Paspalum notatum*) se incluyeron como controles para este experimento. La población de larvas de *M. arenaria* en el suelo fue reducida en todas las rotaciones con ajonjolí o yerba de bahía, miéntras que aquellas en monocultivo y tratadas con aldicarb no mostraron efecto reductor. Parcelas previamente sembradas con yerba de bahía por dos años mostraron la más baja incidencia del tizón sureño en el maní, miéntras que rotaciones de un año con yerba de bahía seguida por maní presentaron igual incidencia que parcelas en monocul-

†Alabama Agricultural Experiment Station Journal Series Number 18-944799.

tivo. Sistemas de rotaciones con ajonjolí no tuvieron un efecto consistente sobre el tizón sureño. La producción de maní en parcelas sembradas con ajonjolí por un año, sin nematicida, fue mayor que dos de los tres años en monocultivo continuo. Parcelas con dos años de ajonjolí dieron rendimientos más altos que las rotaciones en monocultivo, sin nematicida. No se detectaron diferencias significativas entre las poblaciones de larvas de *M. arenaria*, producción de maní y el efecto del sistema de rotación. La producción de maní fue inversamente y linealmente relacionada con el número de daño por el tizón sureño. La relación entre estas dos variables no fue afectada por los sistemas de rotaciones, pero fue influenciada por la producción.

Palabras clave: ajonjolí, *Arachis hypogaea*, manejo de nematodos, maní, *Meloidogyne arenaria*, *Paspalum notatum*, rotación de cultivos, *Sclerotium rolfsii*, *Sesame indicum*, tizón sureño, yerba de bahía.

INTRODUCTION

Production of peanut (*Arachis hypogaea* L.) in the United States has been based primarily upon the use of high-yielding cultivars and pesticides for disease management (10). Crop rotation for pathogen suppression has not been a priority pest control strategy. Critical evaluation of the harmful effects of pesticides on consumers and the environment has led to the elimination of many nematicidal compounds from the market, and a substantial increase in the cost of remaining compounds (16).

The use of crop rotation for disease management is based upon the premise that monoculture results in increased pathogen inoculum density. Crop rotation systems separate the population development of the pathogen from the growth of the host plant through the introduction of: 1) nonhost plants, 2) less suitable hosts than the primary crop, or 3) plants that inhibit pathogen growth through either production of toxic compounds or support of an antagonistic microbial community in the rhizosphere (16). Sesame (*Sesame indicum* L.) is a crop valued for its seed and oil. The United States currently imports virtually all of its domestically consumed sesame products (19).

Seeds of sesame contain the lignins sesamin and sesamolin which are natural antioxidants not found in other edible oil crops. These compounds are insecticidal and insecticidal synergists, and also make sesame oil resistant to rancidity (2). Previous studies indicate that sesame root exudates may be repellent or toxic to *Meloidogyne* spp. (12,14). The objective of this research was to evaluate the effects of the sesame cultivar 'Benne' in a rotation system on the incidence of the two most important yield-limiting pathogens (7), *Meloidogyne arenaria* (Neal) Chitwood and *Sclerotium rolfsii* (Sacc.), in 'Florunner' peanut.

MATERIALS AND METHODS

An experiment was initiated in 1988 in an irrigated field with a severe *M. arenaria* infestation (>100 juveniles/100 cm^3 soil at the time of peanut harvest) at the Auburn University Wiregrass Substation in southeastern Alabama. The field had been in peanut production with winter fallow for 10 years. The soil was a sandy loam with pH 6.2, organic matter content <1.0% (w/w), and cation exchange capacity <10 meq/100 gm soil. Treatments consisted of the following cropping systems: 1) continuous peanut without nematicide; 2) continuous peanut with nematicide; 3) peanut without nematicide following 1 year of sesame; 4) same as treatment 3 but with nematicide; 5) peanut without nematicide following 2 years of sesame; 6) same as treatment 5 but with nematicide; 7) peanut without nematicide following 1 year of 'Pensacola' bahiagrass (*Paspalum notatum*

Flugge); 8) peanut without nematicide following 2 years of bahiagrass. The systems with bahiagrass were included to serve as positive controls since the grass is an excellent rotation crop for the management of *M. arenaria* in peanut (5,13,15).

Aldicarb was applied at planting as Temik® (Rhône-Poulenc AG Co., Research Triangle Park, North Carolina) 15G formulation in a 20-cm-wide band at 3 g a.i./10 m row (3.3 kg a. i./ha) with light (3–4 cm) incorporation into the soil. Each plot was eight rows wide and 10 m long with a total area of 73 m^2. There were eight replications per treatment (cropping system) arranged in randomized complete blocks. Cultural practices, fertilization, control of insects, weeds and foliar diseases in peanut were as recommended for the area (1,3). Bahiagrass seed and sesame seed were broadcast using 28 and 16 kg/ha, respectively; these crops received no pesticide treatments. Peanut yields were obtained by harvesting the two center rows of each plot at crop maturity. Bahiagrass and sesame were not harvested.

Soil samples for nematode analyses were obtained from each plot every year, 2–3 weeks before peanut harvest, to coincide with the period of maximal *M. arenaria* J2 population densities in soil (11). A sample consisted of 16–20 soil cores taken to a depth of 20–25 cm with a 2.5-cm-diam soil probe. The cores were taken from the root zone and were collected at approximately 0.5-m intervals from the center two rows (peanut), or the central 2-m-wide area (bahiagrass, sesame) of a plot. Cores from each plot were combined and a 100-cm^3 subsample was used to determine nematode numbers with the salad bowl incubation technique (9).

Incidence of southern blight (*Sclerotium rolfsii*) in peanut was assessed by counting the number of disease loci in the center two rows of each plot immediately after digging and inversion of the plants. A disease locus is defined as ≤ 30 cm of row with peanut plants killed by the pathogen (8).

All data were analyzed following standard procedures for analyses of variance (18). Fisher's least significant differences were calculated when F values were significant ($P \leq 0.05$). Curve fitting and regression analyses also were conducted by standard procedures (18). Unless other-

Table 1. Effect of rotation with peanut, sesame, and bahiagrass on population densities of *Meloidogyne arenaria* juveniles in a 6-year field study at the Auburn University Wiregrass Substation in southeastern Alabama, U.S.A.

Treatment (crop & year)[y]						*Meloidogyne arenaria* juveniles/100 cm^3 soil[z]					
1988	1989	1990	1991	1992	1993	1988	1989	1990	1991	1992	1993
P(-)	P(-)	P(-)	P(-)	P(-)	P(-)	219	260	137	187	65	161
P(+)	P(+)	P(+)	P(+)	P(+)	P(+)	76	287	161	173	79	306
S	P(-)	S	P(-)	S	P(-)	10	183	11	324	1	90
S	P(+)	S	P(+)	S	P(+)	5	65	17	49	1	123
S	S	P(-)	S	S	P(-)	2	44	17	14	0	26
S	S	P(+)	S	S	P(+)	7	6	3	1	1	40
B	P(-)	B	P(-)	B	P(-)	6	276	0	268	0	23
B	B	P(-)	B	B	P(-)	2	3	21	20	0	78
					FLSD ($P \leq 0.05$):	118	132	72	116	51	102

[y]P = peanut; S = sesame; B = bahiagrass; (-) = no nematicide; (+) = with aldicarb applied at 3.0 g a. i./10 m. row.
[z]Determined 2 weeks before peanut harvest.

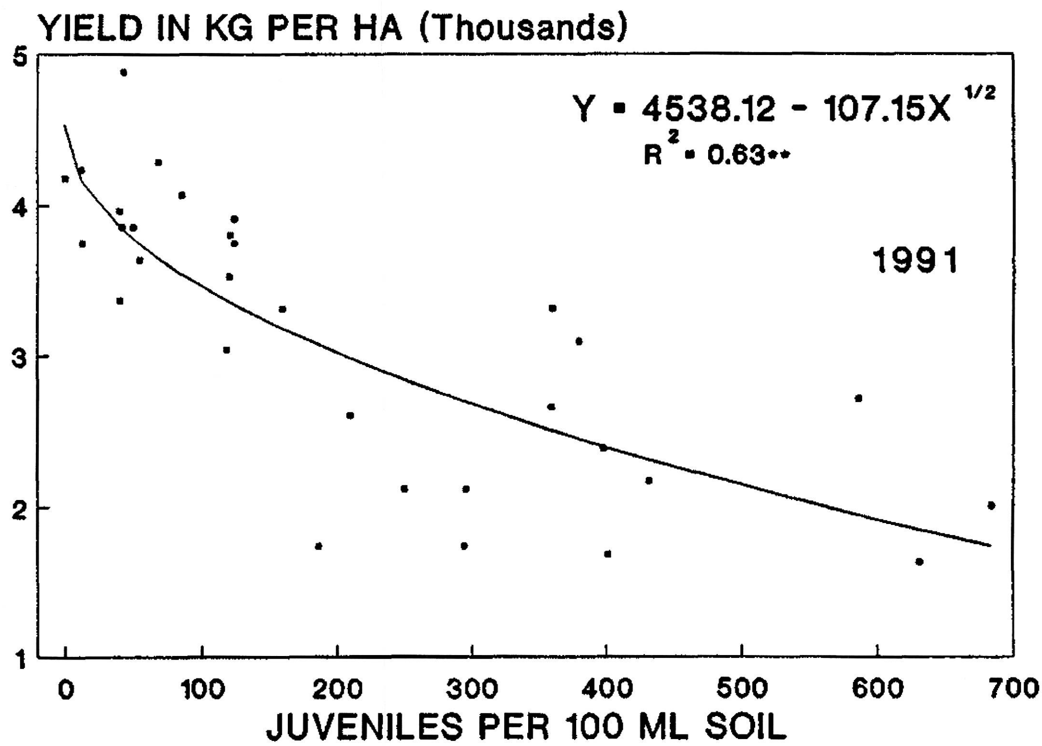

Fig. 1. Relationship between peanut yield/ha and populations of *Meloidogyne arenaria* juveniles in soil in 1991.

wise stated, all differences referred to in the text were significant at the 5% or lower level of probability.

RESULTS AND DISCUSSION

Meloidogyne arenaria J2 population densities in soil were very low (<50 juveniles/ 100 cm^3 soil) in plots planted with sesame or bahiagrass (Table 1). Aldicarb applied to monocultured peanut failed to reduce juvenile densities in all but 1 year (1988). In both 1990 and 1993, juvenile densities in plots with peanut following 2 years of sesame were lower than in continuous peanut. In 1989 and 1993, peanut following 1 year of sesame had lower juvenile densities than the peanut monoculture; however, in 1991 there were no differences among the monoculture systems and the sesame-peanut rotations. Plots with peanut following 2 years of bahiagrass had lower juvenile densities than monocultured peanut in 1990 and 1993; however, in 1993 this difference was only true at the 10% level of probability. Peanut following 1 year of bahiagrass had lower juvenile densities than continuous peanut in 1993 but not in the other 2 years when the system was in peanut. The relationship between *M. arenaria* juvenile population density (X) and peanut yield (Y) was calculated for 1989, 1990, 1991, and 1993, the years when rotation systems were planted in peanut. Data from 1991 is representative of the other years (Fig. 1). The relationship was not influenced by cropping system and was significant for all years except 1990. The function $y = a + bX^{1/2}$ described the relationship between the two variables better than linear or logarithmic models.

Table 2. Effect of rotation with peanut, sesame, and bahiagrass on southern blight and crop yield in a 6-year field experiment at the Auburn University Wiregrass Substation in southeastern Alabama, U.S.A.

Treatment (crop & year)[x]						Southern blight loci/100 m row[y]						Yield kg/ha					
1988	1989	1990	1991	1992	1993	1988	1989	1990	1991	1992	1993	1988	1989	1990	1991	1992	1993
P(-)	P(-)	P(-)	P(-)	P(-)	P(-)	44	82	91	86	77	68	2 170	2 522	2 604	2 983	2902	2 685
P(+)	P(+)	P(+)	P(+)	P(+)	P(+)	64	83	92	92	113	90	2 853	3 065	2 716	3 634	3417	2 387
S	P(-)	S	P(-)	S	P(-)	—	99	—	98	—	80	—	2 224	—	3 765	—	3 298
S	P(+)	S	P(+)	S	P(+)	—	104	—	76	—	101	—	2 859	—	4 096	—	2 636
S	S	P(-)	S	S	P(-)	—	—	84	—	—	69	—	—	3 214	—	—	3 065
S	S	P(+)	S	S	P(+)	—	—	69	—	—	76	—	—	3 369	—	—	3 076
B	P(-)	B	P(-)	B	P(-)	—	103	—	96	—	79	—	3 369	—	2 007	—	2 907
B	B	P(-)	B	B	P(-)	—	—	68	—	—	48	—	—	3 461	—	—	3 562
FLSD ($P \leq 0.05$):						NS[z]	NS	19	NS	35	17	566	599	442	561	414	372

[x]P = peanut; S = sesame; B = bahiagrass; (-) = no nematicide; (+) = with aldicarb applied at 3.0 g a.i./10 m row.
[y]A disease locus is a length of row ≤ 30 cm affected by the disease.
[z]NS = not significant.

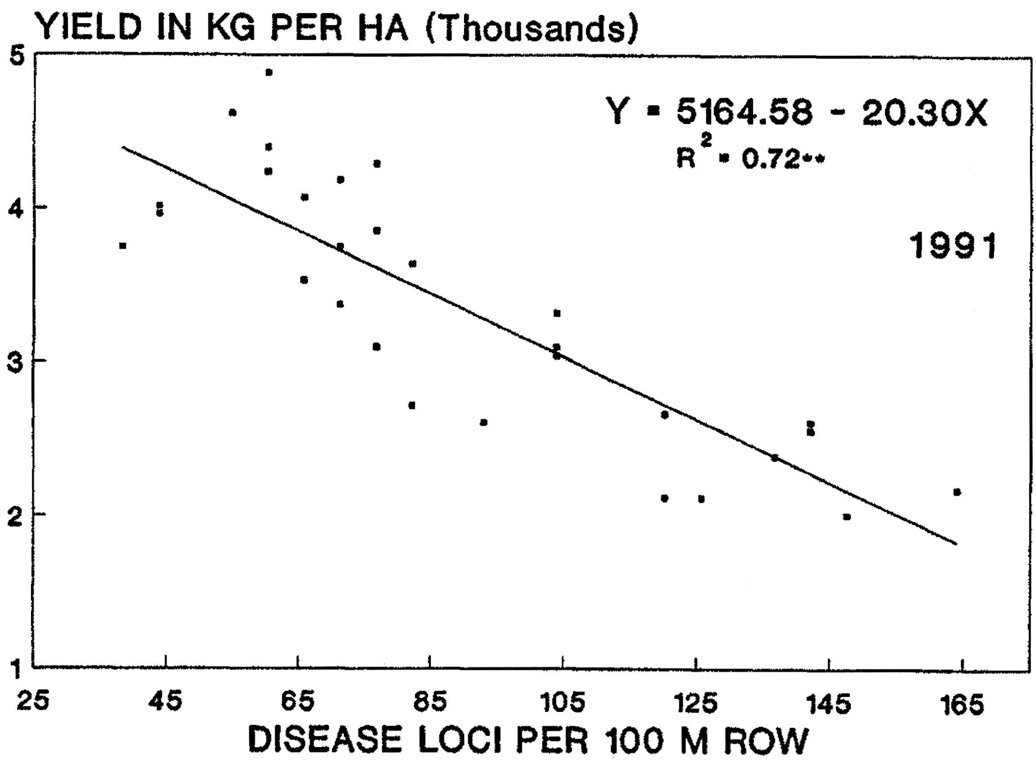

Fig. 2. Relationship between peanut yield/ha and incidence of *Sclerotium rolfsii* in 1991.

Incidence of southern blight was lowest in peanut following 2 years of bahiagrass (Table 2). Cropping systems with sesame had no consistent effect on southern blight. The average numbers of disease loci in peanut following sesame were, with one exception (1990 peanut with nematicide following 2 years of sesame), not different from those for continuous peanut. Southern blight levels in peanut following 1 year of bahiagrass were equivalent to those in peanut monoculture. Peanut yields were inversely and linearly related to the number of southern blight disease loci. The relationship between the 2 variables was unaffected by cropping system but was influenced by production year, as represented by 1991 data (Fig. 2). Yield loss varied from 11 to 27 kg/locus.

Aldicarb applied to continuous peanut resulted in increased yields in 3 out of the 6 years of the study (Table 2). Yields of peanut following 2 years of sesame were higher than those of the monocultured peanut both with and without nematicide in 1990 and 1993. Yields of peanut without nematicide following 1 year of sesame were higher than the yields from continuous peanut without nematicide in 1991 and 1993, but not in 1989. When nematicide was applied to peanut following 1 year of sesame, yields were increased in 1991 but not in 1989 or 1993 when compared to nematicide treated, monocultured peanut. When peanut followed 2 years of bahiagrass, yields were higher than in the monoculture system; however, peanut yield after 1 year of bahiagrass was higher than that from monoculture in only 1 year (1989) of the 3 years when plots in this rotation were planted with peanut.

In conclusion, sesame was comparable to bahiagrass in reducing *M. arenaria* juvenile populations in soil, but had no effect on the incidence of *S. rolfsii.* Peanut yields were increased when peanut was planted after 2 years of sesame. These results support previous investigations of nematode population dynamics and peanut yield response in rotations with sesame (12,14). An increased demand for sesame products coupled with unpredictable foreign supplies have created a need to reevaluate domestic sesame production (19). The majority of research in the United States on sesame has been on the development of indehiscent types (17), and the use of various cultural practices (4,6). The potential of sesame as an economical crop for use in rotation systems in the southeastern United States and possible differences between sesame cultivars for control of *M. arenaria* warrants further investigation.

LITERATURE CITED

1. ALABAMA COOPERATIVE EXTENSION SERVICE. 1993. Alabama pesticide handbook. Circular ANR 500. Auburn University, Auburn, Alabama, U.S.A.
2. BEDIGIAN, D., and J. R. HARLAN. 1986. Evidence for cultivation of sesame in the ancient world. Economic Botany 40:137–154.
3. COPE, J. T. Jr., C. E. EVANS, and H. C. WILLIAMS. 1981. Soil test fertilizer recommendations for Alabama soils. Circular 252. Agricultural Experiment Station. Auburn University, Auburn, Alabama, U.S.A.
4. DELGADO, M., and D. M. YERMANOS. 1975. Yield components of sesame (*Sesamum indicum* L.) under different population densities. Economic Botany 29:69–78.
5. DICKSON, D. W., and T. E. HEWLETT. 1989. Effects of bahiagrass and nematicides on *Meloidogyne arenaria* on peanut. Journal of Nematology (Annals of Applied Nematology) 21:671–676.
6. MULKEY, J. R., H. J. DRAWE, and R. E. ELDRIDGE, Jr. 1987. Planting date effects on plant growth and development in sesame. Agronomy Journal 79:701–703.
7. PUNJA, Z. K. 1985. The biology, ecology and control of *Sclerotium rolfsii.* Annual Review of Phytopathology 23:97–127.
8. RODRIGUEZ-KABANA, R., P. A. BACKMAN, and J. C. WILLIAMS. 1975. Determination of yield losses to *Sclerotium rolfsii* in peanut fields. Plant Disease Reporter 59:855–858.
9. RODRIGUEZ-KABANA, R., and M. H. POPE. 1981. A simple incubation method for the extraction of nematodes from soil. Nematropica 11:175–186.
10. RODRIGUEZ-KABANA, R., and P. S. KING. 1985. Evaluation of selected nematicides for the management of *Meloidogyne arenaria* in peanut: A multi-year study. Nematropica 15:155–164.
11. RODRIGUEZ-KABANA, R., C. F. WEAVER, D. G. ROBERTSON, and E. L. SNODDY. 1986. Population dynamics of *Meloidogyne arenaria* in peanut. Nematropica 16:53–63.
12. RODRIGUEZ-KABANA, R., P. S. KING, D. G. ROBERTSON, and C. F. WEAVER. 1988. Potential of crops uncommon to Alabama for management of root-knot and soybean cyst nematodes. Annals of Applied Nematology (Supplement to Volume 20 of Journal of Nematology) 2:116–120.
13. RODRIGUEZ-KABANA, R., C. F. WEAVER, D. G. ROBERTSON, and H. IVEY. 1988. Bahiagrass for the management of *Meloidogyne arenaria* in peanut. Annals of Applied Nematology (Supplement to Volume 20 of Journal of Nematology) 2:110–114.
14. RODRIGUEZ-KABANA, R., D. G. ROBERTSON, L. WELLS, P. S. KING, and C. F. WEAVER. 1989. Crops uncommon to Alabama for the management of *Meloidogyne arenaria* in peanut. Journal of Nematology (Annals of Applied Nematology) 21:712–716.
15. RODRIGUEZ-KABANA, R., D. G. ROBERTSON, C. F. WEAVER, and L. WELLS. 1991. Rotations of bahiagrass and castorbean with peanut for the management of *Meloidogyne arenaria.* Journal of Nematology (Annals of Applied Nematology) 23:658–661.
16. RODRIGUEZ-KABANA, R., and G. H. CANULLO. 1992. Cropping systems for the management of phytonematodes. Phytoparasitica 20:211–224.

Received: *29.IV.1994*
Recibido:

Accepted for publication: *10.V.1994*
Aceptado para publicacion: