REACTION OF *DESMODIUM* SPECIES AND OTHER TROPICAL PASTURE LEGUMES TO THE ROOT-KNOT NEMATODE *MELOIDOGYNE JAVANICA*

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ABSTRACT

The detection of the root-knot nematode, Meloidogyne javanica, *as a pathogen of* Desmodium *spp. in Colombia, is the first reported case in South Aemerica. In the field, promising pasture legumes* D. gyroides, D. heterocarpon *and* D. ovalifolium *were severely damaged, while adjacent stands of* Centrosema, Leucaena, Stylosanthes *and* Zornia *spp. were not affected. In greenhouse trials with* 38 *tropical pasture legumes, only* 13 *accessions, including* 10 *of* Desmodium *spp., were susceptible. Accessions of* D. distortum, D. heterophyllum, Leucaena leucocephala, Pueraria phaseoloides, Stylosanthes *spp. including* 6 *Australian commercial cultivars, and* Zornia latifolia *were resistant. Although* M. javanica *has a narrow pasture legume host range and a very limited distribution throughout pasture evaluation sites, its pathogenicity to promising* Desmodium *spp. merits future surveys to determine its occurrence in the major pasture regions of tropical South America.*

INTRODUCTION

In recent years, several *Desmodium* spp. native to Asia and the Pacific Islands, in particular *Desmodium gyroides* (Syn. *Codariocalyx gyroides*), *D. heterocarpon* and *D. ovalifolium* (Syn. *D. heterocarpon*), have been identified as promising pasture legumes for tropical South America (Anon. 1978) and southern Florida (Kretschmer *et al.* 1979). These legumes have remained resistant to foliage fungal pathogens and insect pests for 15 years in southern Florida (Kretschmer *et al.* 1979) and for several years at a number of sites in tropical South America (Anon. 1978, J. M. Lenné unpublished). Similarly, no important foliage fungal diseases have been reported from their centre of origin (Wan Zainun Nik, personal communication).

During 1978 and 1979, patches of stunted, chlorotic and wilted plants developed in experimental stands of *D. gyroides* and *D. ovalifolium* in Colombia, South America. Many plants were defoliated and died. Large confluent galls, characteristic of an attack by root-knot nematode, were found on roots of affected plants. Microscopic examination of galls and associated soil showed numerous nematodes with many females and egg masses inside the galls. No other pathogenic organisms were found. Studies were initiated to determine the identity of the nematodes, their distribution throughout pasture evaluation sites in tropical South America and their pathogenicity to *Desmodium* spp. and other tropical pasture legumes.

MATERIALS AND METHODS

From August 1978 to September 1979, intensive surveys of legumes, grasses and other plants were made at the CIAT (Centro Internacional de Agricultura Tropical) Research Stations—Santander de Quilichao and Carimagua, Colombia. Samples of roots and soil were examined microscopically to determine the presence or absence of nematodes. Roots of *Desmodium* spp. and native plants were examined at another 17 forage evaluation sites throughout tropical South America, particularly where *D. gyroides* and *D. ovalifolium* were being tested.

The pathogenicity of the isolated nematode to *Desmodium* spp. and other tropical pasture legumes was determined in greenhouse pot trials. Acid scarified seed of 38 tropical pasture legumes were germinated on moist filter paper in Petri dishes

and grown in soil in 25 × 18 cm plastic pots (4 seedlings per pot) in the greenhouse. *Rhizobium* inoculum was applied 5 days after planting. Nematode inoculations were made 3 weeks after planting.

Inoculum was prepared from galled roots of *D. ovalifolium* washed free from soil, shaken vigorously in a 10% NaOCl solution for 3 minutes and rinsed several times in sterile distilled water. These roots were finely chopped, wrapped loosely in paper tissue, placed on nylon mesh discs in Petri dishes with sterile distilled water and incubated at 28°C. After 48 hours, the nylon mesh and roots were removed and solutions containing many second stage nematode larvae were bulked for inoculation. The volume was adjusted to 10,000 nematodes per litre. Five ml of inoculum (50 nematodes) was dispensed into a small hole near the roots of each of 16 plants per legume. The inoculum was agitated frequently to ensure even inoculation. Five ml of sterile distilled water was applied to holes near the roots of each of 16 control plants per legume. Plants were harvested 10 weeks after inoculation and carefully washed to remove soil adhering to roots. Root gall ratings were made according to the following scale: 0 = no galls, 1 = 1–5 galls per plant, 2 = 6–10 galls per plant, 3 = 11–20 galls per plant, 4 = more than 20 galls per plant. Galls were examined to confirm the presence of nematodes and eggs.

RESULTS

Identification

The perineal patterns of female nematodes from galled roots of affected *Desmodium* spp. and weed hosts, collected at Santander de Quilichao and Carimagua, Colombia, were examined. The nematodes were identified as *Meloidogyne javanica* (Treub 1885) Chitwood 1949.

Survey results

Surveys failed to detect *M. javanica* or any other *Meloidogyne* spp. on *Desmodium* spp. and other plants at 17 pasture evaluation sites in tropical South America. These included 2 sites in Bolivia, 4 in Brazil, 2 in Colombia, 1 in Ecuador, 3 in Peru and 5 in Venezuela.

At Santander de Quilichao, however, the nematode was widespread on several *Desmodium* spp., including *D. gyroides, D. heterocarpon* and *D. ovalifolium,* and many weeds of the family Compositae. It was not detected on native legumes, including *Desmodium* spp. Although intensive surveys of native legumes, and other plants at Carimagua failed to detect *M. javanica,* it caused considerable defoliation and plant death in stands of *D. ovalifolium* established vegetatively. All stands established by seed were root-knot nematode-free. Apart from *Desmodium* spp., root-knot nematode was not detected on any other legume under pasture evaluation at these two sites.

Pathogenicity tests

Only 13 of the 38 tropical pasture legumes tested in a greenhouse pot trial were susceptible to *M. javanica* from *D. ovalifolium* CIAT 350 (Table 1). These included 10 out of 13 *Desmodium* spp. accessions, *Calopogonium mucunoides* CIAT 739, *Centrosema* hybrid CIAT 438 and *Macroptilium* sp. CIAT 535. The latter two legumes were only slightly susceptible. Reactions of *D. heterocarpon* accessions varied from moderately susceptible to resistant. *Desmodium gyroides* CIAT 3001, *D. ovalifolium* CIAT 350 and *Desmodium* sp. CIAT 336 were more susceptible. Accessions of *Desmodium distortum, Desmodium heterophyllum, Leucaena leucocephala, Pueraria phaseloides, Stylosanthes* spp., including commercial cultivars Cook, Endeavour, Paterson, Schofield, Seca and Verano, and *Zornia latifolia* were resistant.

TABLE 1

Effect of Meloidogyne javanica *on* Desmodium *spp. and other tropical pasture legumes in greenhouse inoculation tests*

Legume	CIAT Accession No.	Other Accession Nos.	Reaction[1]
Calopogonium mucunoides	739		2
Centrosema hybrid	438		1
Desmodium barbatum	3063		1
Desmodium gyroides	3001		3
Desmodium heterocarpon	365		2
Desmodium heterocarpon	3669	IRFL[2] 1695	1
Desmodium heterocarpon	3670	IRFL 1696	1
Desmodium heterocarpon	3671	IRFL 1697	1
Desmodium heterocarpon	3672	IRFL 1698	0
Desmodium heterocarpon	3675	IRFL 2798	2
Desmodium heterocarpon	365	IRFL 588	2
Desmodium heterophyllum	349		0
Desmodium distortum	335		0
Desmodium ovalifolium	350		3
Desmodium sp.	336		3
Leucaena leucocephala	734		0
Macroptilium sp.	535		1
Pueraria phaseoloides	9900		0
Stylosanthes capitata	1019		0
Stylosanthes capitata	1078		0
Stylosanthes capitata	1097		0
Stylosanthes capitata	1315		0
Stylosanthes capitata	1318		0
Stylosanthes capitata	1405		0
Stylosanthes fruticosa	1955	CPI[3] 41116	0
Stylosanthes guianensis	136		0
Stylosanthes guianensis	184		0
Stylosanthes guianensis	1950	Cook[4]	0
Stylosanthes guianensis	13	Endeavour	0
Stylosanthes guianensis	17	Schofield	0
Stylosanthes hamata	147		0
Stylosanthes hamata	1953	Verano	0
Stylosanthes humilis	1952	Paterson	0
Stylosanthes scabra	4	Seca	0
Stylosanthes scabra	1009	CPI 40205	0
Stylosanthes viscosa	1954	CPI 33941	0
Zornia latifolia	728		0
Zornia latifolia	881		0

[1]Rating (Average for 16 plants) scale: 0=no galls, 4=more than 20 galls per plant.
[2]IRFL=Agricultural Research Center, Fort Pierce, Florida Accession Number.
[3]CPI=Commonwealth Plant Introduction Number, Australia.
[4]Cultivar name.

DISCUSSION

Although this is the first report of the pathogenicity of *M. javanica* to *Desmodium* spp. in tropical South America, similar observations have been made previously in Africa (Linde *et al.* 1959, Luc and Guiran 1960), Australia (Colbran 1958), Florida (Rolfs 1898) and India (Barber 1901). In Malaysia, *D. ovalifolium,* a common cover crop in rubber plantations, is susceptible to root-knot nematode (Anon. 1955, Beeley 1939, Watson 1963).

While *M. javanica* is distributed world-wide on *Desmodium* spp., it is not, at present, common in pasture evaluation sites in tropical South America. It was detected at only 2 of the 19 sites surveyed. At Santander de Quilichao, Colombia,

its widespread occurrence on *Desmodium* spp. and Compositae species suggests that it is indigenous. Its detection at Carimagua, Colombia, solely in vegetatively propagated stands of *D. ovalifolium* suggests that it was introduced with contaminated cuttings or soil. Since the nematode infected species of Compositae at Santander de Quilichao are widely distributed in tropical South America it is suggested that *Desmodium* spp. at other sites should be checked periodically for the presence of root-knot nematode galls.

Meloidogyne javanica from *D. ovalifolium* CIAT 350 has a narrow legume-host range. In the field, it was detected on *Desmodium* spp. only. Stands of *Centrosema, Leucaena, Stylosanthes* and *Zornia* spp., in close proximity to nematode infested *D. gyroides* and *D. ovalifolium* stands, were root-knot nematode-free. In greenhouse tests, 10 of the 13 susceptible legumes were *Desmodium* spp. accessions. Other susceptible legumes included *Calopogonium mucunoides, Centrosema* hybrid and *Macroptilium* sp. *Meloidogyne* spp., including *M. javanica,* have been recorded previously on members of the genera *Centrosema* (Beeley 1939, Luc and Guiran 1960) and *Macroptilium* (Hutton *et al.* 1972) and on *C. mucunoides* (Beeley 1939, R. M. Sonoda, personal communication). Although *Leucaena leucocephala* was resistant, it is susceptible to *M. javanica* in New Guinea (Thrower 1958).

Variation in reaction to root-knot nematode among accessions of *D. heterocarpon* in greenhouse tests, in the field in Colombia (J. M. Lenné unpublished) and in southern Florida (A. E. Kretschmer, personal communication) suggests the possibility of selecting for resistance to the pathogen. The probability of success is high (R. M. Riedel, personal communication).

Because of its limited distribution throughout pasture evaluation sites, *M. javanica* is not regarded as an important pathogen of tropical pasture legumes at present. However, its pathogenicity to promising accessions of *D. gyroides* and *D. ovalifolium* suggests that future monitoring of the distribution of *M. javanica* throughout the major pasture regions of tropical South America is most worthwhile.

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REFERENCES

ANON. (1955)—Further legume cover crops in the rubber plantations. Planters Bulletin of the Rubber Research Institute of Malaya, March 1955: 31-38.

ANON. (1978)—Annual Report, Centro Internacional de Agricultura Tropical, CIAT, Cali, Colombia. pp. B19-32.

BARBER, C. A. (1901)—A tea-eelworm disease in South India. *Bulletin of the Department of Land Use and Agriculture, Madras* **2:** 227-234.

BEELEY, F. (1939)—A nematode pest of roots of cover plants. *Journal of the Rubber Research Institute, Malaya* **9:** 51-58.

COLBRAN, R. C. (1958)—Studies of plant and soil nematodes. 2. Queensland host records of root-knot nematodes (*Meloidogyne* species). *Queensland Journal of Agricultural Science* **15:** 101-136.

HUTTON, E. M., WILLIAMS, W. T. and BEALL, L. B. (1972)—Reactions of lines of *Phaseolus atropurpureus* to four species of root-knot nematode. *Australian Journal of Agricultural Research* **23:** 623-632.

KRETSCHMER, A. E., BROLMANN, J. B., SNYDER, G. H. and COLEMAN, S. W. (1979)—'Florida' Carpon *Desmodium*—a perennial tropical forage legume for use in South Florida. Agricultural Experiment Stations Institute of Food and Agricultural Sciences, University of Florida, Gainesville. Circular S-260.

LINDE, W. J. VANDER, CLEMITSON, J. G. and CROUS, M. E. (1959)—Host-parasite relationships of South African root-knot eelworms (*Meloidogyne* spp.). Science Bulletin of the Department of Agriculture Technical Service, Union of South Africa 385: 1-16.

LUC, M. and GUIRAN, F. DE (1960)—Les nematodes associes aux plantes de l'ouest Agricain. Liste preliminaire. *Agronomique Tropical Nogent* **15:** 434-449.

ROLFS, P. H. (1898)—Diseases of the tomato. Florida Agricultural Experiment Stations Bulletin 47: 145-146.

THROWER, L. B. (1958)—Observations on the root-knot nematode in Papua-New Guinea. *Tropical Agriculture Trinidad* **35:** 213-217.

WATSON, G. A. (1963)—Cover plants in Malayan rubber plantations. *World Crops* **15:** 48-52.

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