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Host Suitability of Crops under Yam Intercrop to Root-knot Nematode (*Meloidogyne incognita* Race 2) in South-Western Nigeria

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Abstract

Twelve crops commonly grown in association with yam in South-Western Nigeria were evaluated for resistance to root-knot nematode *Meloidogyne incognita* (Kofoid and White 1919) Chitwood 1949, race 2 infection using the quantitative modification by Sasser *et al.* (1984) of host suitability designations of Canto-Saenz (1983) for plants infected with root-knot nematode in 1998 and 1999 planting seasons. Observations, based on gall indices and recovery of the juvenile larvae from the roots and soil indicated that *Abelmoschus esculentus*, *Corchorus olitoris* cv Angbadu and *Sphenostylis stenocarpa* cv Nsukka Brown were highly susceptible, while *Arachis hypogaea* cv UGA 4, *Cajanus cajan* cv Cita-2, *Cucumis melo* cv Bara To139, *Manihot esculenta* cv TMS 30572, *Sorghum bicolor* and *Zea mays* cv DMR-LSR-Y were hyper-susceptible to *Meloidogyne incognita* race 2 with reproductive factor and gall index of ≤1 and ≥2 respectively. *Crotalaria juncea*, *Mucuna cochinchinensis* and *Stylosanthes gracilis* were resistant to *Meloidogyne incognita* race 2 with reproductive factor and gall index of ≤1, ≤2 and ≥2 respectively. These intercrops if planted on yam mounds will play a prominent role in altering the populations of root-knot nematode *Meloidogyne incognita* race 2.

Keywords: *Meloidogyne incognita* race 2, yam, intercropped species, root-galls indices, host-suitability, south-western Nigeria

1 Introduction

A large number of plant-parasitic nematodes associated with yam cultivation have been reported from various yam producing areas of the world (Ayala and Acosta, 1971; Bridge, 1972; Thompson *et al.*, 1973; Adesiyan and Odihirin, 1977; Caveness, 1982; Hahn *et al.*, 1989; Lowe, 1992; Green and Florini, 1996; Agbaje *et al.*, 2002, 2003). These are the yam nematode *Scutellonema bradys*, the root-knot nematode *Meloidogyne* spp. and the lesion nematode *Pratylenchus* spp., which are all field and post-harvest pests (Hahn *et al.*, 1989; Lowe, 1992; Agbaje *et al.*, 2002).

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Green and Florini (1996) noted that planting yam with crops susceptible to root-knot nematodes would increase the nematode population and reduce yield and tuber quality in both field and storage. In fields, where root-knot nematodes are problems, the use of intercrops which have some root-knot resistance will help to control the pest (Hahn *et al.*, 1989; Sasser and Taylor, 1978; Atu and Enyinnia, 1983; Singh *et al.*, 1974). This paper reports on the host status of crops commonly intercropped with yam in South-Western Nigeria to *Meloidogyne incognita* race 2.

2 Materials and Methods

The two-year study was carried out at Institute of Agricultural Research and Training, Moor Plantation, Ibadan and Ilora derived Savanna Research Station in 1998 and were repeated in 1998 and 1999. The twelve crops most commonly intercropped with yam in South-Western Nigeria (Table 1): *Abelmoschus esculentus* cv V35, *Arachis hypogaea* cv UGA4, *Cajanus cajan* cv Cita-2, *Corchorus olitorus* cv Angbadu, *Crotalaria juncea*, *Cucumis melo* cv Bara To139, *Manihot esculenta* Crantz cv TMS 30572, *Mucuna cochinchinensis*, *Sorghum bicolor* cv CSH9, *Sphenostylis stenocarpa* cv Nsukka Brown, *Stylosanthes gracilis* and *Zea mays* cv DMR-LSR-Y were sourced locally together with hybrid yam TDr 89/02665 obtained from International Institute of Tropical Agriculture (IITA), Ibadan.

Table 1: Scientific, common and local names of 12 intercropped species and yam cultivar used in the experiment.

Scientific name	*Common name*	*Local name*
Abelmoschus esculentus cv V35	Okra	Ila
Arachis hypogaea cv UGA4	Groundnut	Epa/Yere
Cajanus cajan cv Cita- 2	Pigeon pea	Otili/Sese
Corchorus olitorus cv Angbadu	Vegetable jute	Ewedu-Angbadu/Ooyo
Crotalaria juncea	Croto	Payin-Egba
Cucumis melo cv Bara To 139	Mellon	Egusi-Bara
Manihot esculenta cv TMS 30572	Cassava	Ege/Gbaguda
Mucuna cochinchinensis	Buffalo bean	Yerepe/Ewe-ina
Sorghum bicolor cv CSH9	Guinea corn	Oka-Baba
Sphenostylis stenocarpa cv Nsukka Brown	Yam bean	Feregede
Stylosanthes gracilis	Stylo/Forage crop	Saworo/Koropo
Zea mays cv DMR-LSR-Y	Maize	Agbado
Dioscorea rotundata cv TDr89/02665	Yam	Isu/Ako-isu

Sandy-loam soil obtained from the field was heat-sterilized in an electric sterilizer and rested for four weeks to restore stability in polyethylene bags.
Approximately 10kg of sterile soil were weighed into each of one hundred and thirty

(130) 15 litre plastic buckets used for the experiment. Five seeds of each intercrop together with yam setts with an average weight of 250g were sown in each plastic buckets, ten plastic buckets for each treatment. Seedlings were thinned to one per plastic bucket five days after germination. The seedlings were then inoculated with 5000 eggs of *Meloidogyne incognita* race 2 the next day. The eggs were extracted from a culture of the nematode maintained on *Celosia argentea* L. roots through the HUSSEY and BARKER (1973) sodium hypochlorite (NaOCl) method. The identity of *M. incognita* race 2 was confirmed using perenial pattern as described by EISENBACK *et al.* (1981). Uninoculated units served as control. There were twenty-six treatments replicated five times, the experiment being a randomized block design.

Thirty weeks after inoculation three of the five replicates per treatment were randomly selected for assessment of root galls by turning the buckets upside down and carefully freeing the root system of each intercrop and the yam of soil. The roots were washed carefully under a gentle stream of tap water, mopped dry and assessed under a stereoscopic microscope for galls.

Eggs were extracted from the roots and estimated using the HUSSEY and BARKER (1973) sodium hypochlorite method. A sample of 250 cm^3 soil from each bucket was assayed for juveniles of *M. incognita* race 2 using WHITEHEAD and HEMMING (1965) tray modification of the Baermann technique. Data obtained were used for host status rating with the quantitative method of SASSER *et al.* (1984) of rating plants for resistance to root-knot nematode (RKN) (Table 2).

Table 2: Quantitative scheme for assignment of Canto-Saenz's host suitability (resistance) designations (SASSER *et al.*, 1984)

Plant damage (Gall Index)	*Host Efficiency (Reproductive factor)*	*Degree of resistance.*
≤ 2	≤ 1	resistant
≤ 2	≥ 1	tolerant
≥ 2	≤ 1	hypersusceptible
≥ 2	≥ 1	susceptible

3 Results and Discussion

The intercrops differed in their status as hosts to *M. incognita* race 2 (Table 3). The root-gall index ratings indicated that *M. incognita* race 2 reproduced highly on *Abelmoschus esculentus* cv V35, *Corchorus olitorus* cv Angbadu and *Sphenostylis stenocarpa* cv Nsukka Brown while no appreciable root-gall index occurred on soil sample containing *Crotalaria juncea*, *Mucuna cochinchinensis* and *Stylosanthes gracilis*.

In 1999, gall indices for *A. hypogaea* cv UGA4, *C. cajan* cv Cita-2, *C. melo* cv Bara To 139, *M. esculenta* cv TMS 30572, *S. bicolor* CSH 9 and *Zea mays* cv DMR-LSR-Y were significantly ($P < 0.05$) lower from those of *A. esculentus* cv V35, *C. olitorus*

Table 3: Root galling and reproductive factor on roots of plants commonly intercropped with yam following inoculation with 5000 eggs of *Meloidogyne incognita* race 2 in the pot experiment.

	Root-gall Indices *				*Reproductive factor* † (R=P_f/P_i)	*Degree of resistance*
	Ibadan		*Ilora*			
	1998	*1999*	*1998*	*1999*		
Abelmoschus esculentus cv V35	5.0^a	5.0^a	4.8^a	4.7^a	2.85	susceptible
Arachis hypogaea cv UGA4	2.6^b	3.8^b	2.8^b	3.8^b	0.85	hypersusceptible
Cajanus cajan cv Cita-2	3.0^b	4.0^b	3.2^b	4.0^b	0.95	hypersusceptible
Corchorus olitorus cv Angbadu	4.6^a	4.8^a	4.8^a	4.8^a	2.95	susceptible
Crotalaria juncea	1.0^c	0.0^c	1.0^c	0.0^c	0.60	tolerant
Cucumis melo cv Bara To139	2.5^b	3.8^b	2.3^b	3.8^b	0.95	hypersusceptible
Manihot esculenta cv TMS30572	2.4^b	3.8^b	2.6^b	3.8^b	0.90	hypersusceptible
Mucuna cohinchinensis	1.0^c	0.0^c	1.0^c	0.0^c	0.55	tolerant
Sorghum bicolor	2.4^b	3.8^b	2.5^b	3.7^b	0.95	hypersusceptible
Sphenostylis stenocarpa cv Nsukka Brown	5.0^a	5.0^a	4.8^a	4.8^a	2.80	susceptible
Stylosanthes gracilis	1.0^c	0.0^c	1.0^c	0.0^c	0.60	tolerant
Zea mays cv DMR-LSR-Y	2.4^b	3.7^b	2.6^b	3.8^b	0.85	hypersusceptible
Discorea rotundata cv TDr 89/02665	2.4^b	2.2^b	2.1^b	2.3^b	0.90	hypersusceptible

* Mean of five replicates. Means followed by the same letters are not significantly different at ($P < 0.05$) according to DMRT. Gall indices on scale of 0-5 where 0 ≙ no gall; 1 ≙ 1-2 galls; 2 ≙ 3-10 galls; 3 ≙ 11-30 galls; 4 ≙ 31-100 galls; 5 ≙ $>$ 100 galls.

† Reproductive factor R = P_f/P_i, where P_i is the initial nematode population and P_f is the final nematode population.

cv Angbadu and *S. stenocarpa* cv Nsukka Brown (Table 3). Observation in both years showed that the root-gall indices were lowest for *C. juncea*, *M. cochinchinensis* and *S. gracilis*. The possible reasons for the differences were due to increase in number of both wet and intensity of the rain fall observed during the period of the experiment. Another factor of significant is the nutrient status of the various treatments, which indicated that the nutrient status of the various treatment plots was in the range suitable for most arable crops including yam. This high soil fertility possibly contributed to the significant differences in the gall indices.

In 1999, no galling was observed on the roots of *C. juncea*, *M. cochinchinensis* and *S. gracilis* in the two locations used for the experiment (Table 3) but their nodulation was profuse. This type of response had been reported by other studies (Caveness, 1982; Rhoades, 1964; Rhoades and Forbes, 1986; Ayala *et al.*, 1967; Haroon and Smart, 1983). Also these crop species can be use specifically to attract root-knot nematodes thereby diverting or reducing the nematode population and increasing yield of the subsequent crops planted.

The number of *M. incognita* juveniles (J_2) extracted from the plant roots and soil rhizosphere reflected the susceptibility of the host.

Using the host suitability rating of Sasser *et al.* (1984), where the reproduction factor was determined, *A. esculentus* cv V35, *C. olitorus* cv Angbadu and *S. stenocarpa* cv Nsukka Brown could be classified as susceptible because the gall-index (G.I) is greater than 2 while the host efficiency (reproductive factor in Table 2) is greater than 1.

From this study, *A. hypogaea* cv UGA4, *C. cajan* cv Cita-2, *C. melo* cv Bara To139, *M. esculenta* cv TMS 30572, *S. bicolor* cv CSH-9 and *Zea mays* cv DMR-LSR-Y could be classified as hyper-susceptible in which the (G.I) is greater than 2 and the host efficiency (R-factor) is $\leq$1 while *C. juncea*, *M. cochinchinensis* and *S. gracilis* could be classified as resistant with gall index $\leq$2 and the host efficiency $\leq$1 (Table 2).

If susceptible crops such as *A. esculentus*, *C. olitorus* and *S. stenocarpa* are planted before or after yam plants, attack on yam by *M. incognita* race 2 will be more severe by increasing the nematode population and reducing the quality and market value of the tubers (Green and Florini, 1996; Agbaje *et al.*, 2002).

In South-Western Nigeria, several crops are incorporated into yam cultivation and planting of resistant intercrops like *Crotalaria juncea*, *Mucuna cochinchinensis* and *Stylosanthes gracilis* would prevent nematode populations build-up around yam plants.

References

Adesiyan, S. O. and Odihirin, R. A.; Plant-parasitic nematodes associated with yam tubers in Mid-West State, Nigeria; *Nigerian Journal of Plant Protection*; 3:171–179; 1977.

Agbaje, G. O., Adegbite, A. A. and Akinlosotu, T. A.; Performance of new hybrid yam (*D. rotundata* Poir) varieties in the forest zone of Nigeria; *Tropicultura*; 21(3):149–152; 2003.

Agbaje, G. O., Adegbite, A. A., Akinlosotu, T. A. and Shoyinka, S. A.; Performance of new hybrid yam varieties (*D. rotundata* Poir) under different cropping systems; *African Journal of Root and Tuber Crops*; 5(1):8–11; 2002.

Atu, U. G. and Enyinnia, T.; Weed hosts of *Meloidogyne incognita* in root crop fields in South-Eastern Nigeria; *Nigerian Journal of Plant Protection*; 7:39–49; 1983.

Ayala, A. and Acosta, N.; Observations on Yam (*D. alata*) nematodes; *Nematropica*; 1(2):39–40; 1971.

Ayala, A., Roman, J. and Tejera, E. G.; Pangola grass as a rotation crop for pineapple nematode control; *Journal of Agriculture, University of Puerto Rico*; 51:94–96; 1967.

Bridge, J.; Nematode problems with yams (*Dioscorea* spp.) in Nigeria; *Pest Articles and News Summaries (PANS)*; 1:89–91; 1972.

Canto-Saenz, M.; The nature of resistance to *Meloidogyne incognita* (Kofoid and White 1919) Chitwood 1949; in: *Proceedings, Third Research and Planning Conference on Root-Knot Nematodes, Meloidogyne spp. March 22-26, 1982*, edited by Carter, C.; 160–165; International Meloidogyne Project, Lima, Peru, North Carolina University Graphics; 1983.

Caveness, F. E.; Plant parasitic nematodes and IITA mandate food crops: A position paper; IITA, Ibadan, Nigeria, 15pp.; 1982.

Eisenback, J. D., Hirschmann, H., Sasser, J. N. and Triantaphyllou, A. C.; *A guide to the four most common species of root-knot nematodes (Meloidogyne spp.) with a pictorial key.*; A cooperative publication of North Carolina State University and USAID; 1981; 48pp.

Green, K. R. and Florini, D. A.; Pests and pathogens of yams in storage: A meeting report; *African Journal of Root and Tuber Crops*; 1(2):38–42; 1996.

Hahn, S. K., Isoba, J. C. G. and Ikotun, T.; Resistance Breeding in Root and Tuber crops at the IITA, Ibadan, Nigeria; *Crop Protection*; 8:147–168; 1989.

Haroon, S. and Smart, G. C.; Root extracts of pangola digit grass affect hatch and larval survival of *Meloidogyne incognita*; *Journal of Nematology*; 15:646–649; 1983.

Hussey, R. S. and Barker, K. R.; A comparison of methods of collecting inocula of *Meloidogyne* spp. including a new technique; *Plant Disease Reporter*; 57:1025–1028; 1973.

Lowe, J., (Ed.) *Plant Health Management Research Monograph 2: Nematological Research at IITA 1969-1988: a summary of investigations conducted by Fields E. Caveness*; IITA, Ibadan, Nigeria; 1992; 52pp.

Rhoades, H. L.; Effect of *Crotalaria spectabilis* and *Sesbania exaltata* on plant nematode populations and subsequent yield of snap beans and cabbage; *Proceedings of Florida State Horticultural Society*; 77:233–237; 1964.

Rhoades, H. L. and Forbes, R. B.; Effects of fallow, cover crops, organic mulch and phenimaphos on nematode populations, soil nutrients and subsequent growth; *Nematropica*; 16:141–151; 1986.

Sasser, J. N., Carter, C. C. and Hartman, K. N.; *Standardization of Host Suitability Studies and Reporting of Resistance to Root-Knot Nematodes*; Raleigh, North Carolina, USA: A Cooperative publication of the North Carolina State University, Department of Plant Pathology and USAID; 1984.

Sasser, J. N. and Taylor, A. L.; *Biology, Identification and Control of Root-knot Nematode (Meloidogyne spp.)*; Releigh, North Carolina, North Carolina State University; 1978.

Singh, B., Bhatti, D. S. and Singh, K.; Resistance to Root-knot Nematode (*Meloidogyne* spp.) in Vegetable Crops; *Pest Articles and News Summaries*; 20:58–67; 1974.

Thompson, A. K., Been, B. O. and Perkins, C.; Nematodes in Stored Yams; *Experimental Agriculture*; 9(3):281–286; 1973.

Whitehead, A. G. and Hemming, J.; A comparison of some quantitative methods of extracting small vermiform nematodes from soil; *Annals of Applied Biology*; 55:25–38; 1965.