SCREENING OF COWPEA VARIETIES FOR RESISTANCE TO *MELOIDOGYNE INCOGNITA* UNDER FIELD CONDITIONS

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ABSTRACT

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Field studies were conducted in 2002 and 2003 to assess the reaction of 15 varieties of cowpea for resistance to a natural infestation of *Meloidogyne incognita* race 2. Ten weeks after planting; ten randomly selected plants per treatment were examined for root-galls and nodules. Data were also collected on plant height, days to 50% flowering, days to maturity, 100 seed weight and yield. The data collected were subjected to analysis of variance and correlation analysis. Root galling varied among varieties. Root-gall indices correlated negatively with number of pods and leaves. Root-gall index was positively correlated with stem girth. Out of the 15 varieties, IT84S-2246-4 was the most resistant with a reproduction factor of 0.45. Five varieties exhibited tolerance to root-knot nematode.

Key words: Cowpea, field conditions, *Meloidogyne*, resistance, root-knot nematode, screening, *Vigna unguiculata*.

RESUMEN

Adegbite, A. A., N. A. Amusa, G. O. Agbaje, and L. B. Taiwo. 2005. Evaluación de la resisitencia de variedades de *Vigna unguiculata* al nematodo del nudo radical en condiciones de campo. Nematropica 35:155-159.

En 2002 y 2003, se realizaron ensayos de campo para evaluar la reacción de 15 variedades de *Vigna unguiculata* a una infestación natural de *Meloidogyne incognita.* Diez días después de la siembra, se seleccionaron 10 plantas al azar por tratamiento para evaluar síntomas y nodulación. También se tomaron datos de altura de plantas, días hasta 50% de floración, días hasta madurez, peso de 100 semillas y productividad. Los datos se sometieron a análisis de varianza y de correlación. Se encontraron diferencias entre variedades en el número de agallas. Los índices de agallas radicales se correlacionaron positivamente con el grosor de los tallos, y negativamente con la cantidad de vainas y hojas. De 15 variedades evaluadas, IT84S-2246-4 fue la más resistente, con un factor reproductivo de 0.45. Cinco variedades mostraron tolerancia al nematodo.

Palabras clave: condiciones de campo, *Meloidogyne*, nematodo del nudo radical, resistencia, *Vigna unguiculata.*

INTRODUCTION

Meloidogyne incognita is found on cowpea, *Vigna unguiculata* (L.) Walp. in most growing areas of the world (Sasser, 1980). This nematode constitutes a major constraint to cowpea production (Sikora and Greco, 1990). Symptoms of infection are presence of root galls, excessive branching of roots, and reduced root systems. Poor germination and death of seedlings may be observed in cases of heavy infestations (Mishra, 1992).

Cowpea is an important food legume and essential component of cropping systems in the drier regions of the tropics and subtropics (Singh *et al.*, 2003) and is important to the livelihood of millions of people (Quin, 1997). As a legume, cowpea can contribute to soil fertility, mainly through its nitrogen fixing abilities. Cowpea residue is an important fodder resource for ruminant livestock (Tarawali *et al.,* 1997) and provides an inexpensive and nutritious food for human consumption (Quin, 1997).

Some commonly grown cowpea cultivars and genotypes have been evaluated for resistance to *Meloidogyne* spp. In India, Subramaniyan *et al.* (1997) identified only three out of 37 lines as resistant to *M. incognita.* By contrast, eight of nine cultivars were rated as resistant to the same species in Cuba (Rodriguez *et al.*, 1996). In Venezuela, one of eight varieties was resistant to *Meloidogyne* spp. (Crozzoli *et al.,* 1995).

Recently, several breeding lines of cowpea have been developed in Nigeria, but little is known about their reaction to *Meloidogyne* species. In Nigeria, control of nematodes with nematicides may be uneconomical, and producers are not well trained in methods of application. Use of resistant varieties reduces labor and is an environmentally sound management strategy for reducing production cost (Roberts *et al.*, 1996). This project was undertaken to assess the reactions of cowpea germplasm to a natural field infestation of *M. incognita.*

MATERIALS AND METHODS

Experiments were conducted in 2002 and 2003 on the same field at the Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, Ibadan-Nigeria, located at 3°54'E and 7°30'N. Annual rainfall is 1,220 mm and the daily mean temperature is 28°C ± 2°C. The soil is coarse loam, grayish brown in color, friable, and is classified as Rhodic Harplustalf, Iwo series (USDA, 1990). The experimental site had been previously cultivated for 2 years with okra (*Abelmoschus esculentus* (L.) Moench, cv. V35), which is susceptible to root-knot nematode. The experimental plot was naturally infested with *M. incognita.* The identity of *M. incognita* was confirmed using perinneal patterns, as race 2, as described by Eisenback *et al.* (1981). Out of the 15 varieties of cowpea tested, Erusu local was obtained from Erusu Akoko in Ondo State; four were obtained from Institute of Agricultural Research and Training, Moor Plantation, Ibadan, while the rest were from International Institute of Tropical Agriculture, (IITA) Ibadan-Nigeria. The experiment was laid out in randomized complete block design. The field was ploughed and harrowed, and the seeds were planted on the prepared field. Each of the 15 cowpea cultivars or lines was replicated four times. Plots were four rows wide by 2 m long. Plant spacing was 60 × 30 cm with two seeds/hole. The seeds were not treated with pesticides. Weeds were removed manually, 4 and 8 weeks after planting. Basal application of fertilizer was carried out on the plots 2 weeks after planting, using NPK (15:15:15) and a single superphosphate at a rate of 120 kg N, 50 kg P_2O_5 and 50 kg K_2O/ha. The height of each plant was measured from the soil surface to the tip of the highest leaf. The number of days for each plant to reach 50% flowering from the time of planting was noted, and stem girths were measured using vernier caliper. Days to maturity, 100 seed weight, and yield were determined at harvest.

Soil samples were taken from the treatment plots before planting and after harvest, in order to determine the initial and final population densities (P_i and P_f). Ten soil core samples were taken from the plot at a depth of 20 cm, and thoroughly mixed to form composite samples. Composite samples were taken to the laboratory in sealed plastic bags where they were stored at 10°C for 24 hr. The samples were then thoroughly mixed and 250 cm^3 soil subsamples were processed using the tray extraction method of Whitehead and Hemming (1965).

Ten weeks after planting, ten randomly selected plants per plot were carefully uprooted and the adhering soil was washed off for assessment of root-galls and nodules, using a stereoscopic microscope. The visual rating scale for galling was; 0-immune, 1-highly resistant, 2-moderately resistant, 3-moderately susceptible, 4-susceptible, and 5-highly susceptible. The nodules were carefully excised from the roots, air dried for 2 hours, weighed and counted. Eggs were extracted from roots and estimated using the sodium hypochlorite method of Hussey and Barker (1973). Host status rating was determined using the rating scheme developed by Sasser *et al.* (1984) based on root gall index and reproductive factor (R), where $R = P_f/P_i$ (Table 1).

Data were collected on plant height, days to reach 50% flowering, days to reach fruit maturity, weight of 100 seeds, and pod yield. The data collected were subjected to analysis of variance and correlation analysis. Correlation analysis was carried out using Pearson's method and means were separated by Duncan's multiple range test (Gómez and Gómez, 1984).

Table 1. Resistance rating scale for root-knot nematode.

Root Gall index[z]	R-factor for host efficiency [y]	Host status
≤2	≤1	Resistant
≤2	≥1	Tolerant
≥2	≤1	Hypersusceptible
≥2	≥1	Susceptible

[y]Reproductive factor: $R = P_f/P_i$, where P_i = initial population density, and P_f = final population density.
[z]Gall index: 0 = no gall formation; 5 = heavy gall formation.

RESULTS AND DISCUSSION

Data collected in 2002 and 2003 were combined for analysis because of their consistency. The cowpea cultivars and lines evaluated in this study varied in their host status to *Meloidogyne incognita.* (Table 2). All but one of the cowpeas tested were susceptible to root-knot nematode infection. Only IT84S-2246-4 had a reproduction factor less than 1.0, based on Sasser *et al.* (1984) (Table 1). Erusu local, IT86D-715, IT91K-180, IT93K-573-1, and TVX 3236 were tolerant to root-knot nematode infection, with grain yield ranging between 1025 and 1138 kg/ha, had gall index rating of <2 and reproduction factor of >1. These cowpeas also exhibited good nodulation (Table 2). All the susceptible cultivars exhibited reduced nodulation. Ife BPC, Ife Brown, Ife 98-12, IT90K-277-2, IT95K-1491, IT96D-610, Tade Brown 4, TV2 393, and TVU 1190 were intolerant to root-knot nematode infection.

This investigation identified resistance and tolerance in cowpea varieties to natural infestation of *Meloidogyne* incognita. The degree of reaction of the different genotypes to the nematode differed significantly, with IT84S-2246-4 appearing to be resistant to this species. Similar results have been reported, where IITA breeding lines IT84S-2049 and IT84S-2246-4 had resistance to isolates of *Rk*-virulent *M. incognita* and *Rk*-aggressive *M. javanica* (Roberts *et al.*, 1992, 1994).

Intensified cropping of susceptible cultivars, particularly on sandy soils, can lead to rapid increase in nematode populations and substantial damage to crops (Matthew *et al.*, 1998). Host resistance and cultural

Table 2. Reaction of cowpea cultivars and lines to infection by *Meloidogyne incognita* in the field.

Cultivar or line	Plant ht (cm)[z]	Days to 50% flowering	Days to maturity	Seed wt (per 100)	Yield (kg ha^{-1})	Gall index	Nodule no./plant	Reproduction factor ($R = P_f/P_i$)
Erusu local	48 a	52 a	95 a	16 a	1025 bc	1.5 ab	55 ab	1.5 ab
Ife BPC	42 bc	46 ab	85 bc	14 a	895 de	3.0 a	30 bc	1.5 ab
Ife Brown	40 bc	45 ab	85 bc	12 ab	875 de	3.5 a	35 bc	1.5 ab
Ife 98-12	45 ab	48 ab	84 bc	15 a	825 de	3.0 a	28 cd	1.5 ab
IT84S-2246-4	45 ab	40 bc	85 bc	14 a	1066 ab	1.5 ab	60 a	0.4 d
IT86D-715	43 bc	46 ab	83 bc	13 a	1138 a	1.5 ab	50 ab	1.5 ab
IT90K-277-2	43 bc	42 bc	80 cd	15 a	956 cd	3.0 a	50 ab	1.5 ab
IT91K-180	45 ab	42 bc	85 bc	15 a	1078 ab	1.5 ab	50 ab	1.5 ab
IT93K-573-1	40 bc	43 bc	90 ab	14 a	1132 a	1.2 ab	55 ab	1.6 a
IT95K-1491	42 bc	40 bc	85 bc	10 bc	932 cd	2.8 a	30 bc	1.2 bc
IT96D-610	41 bc	47 ab	80 cd	13 ab	985 cd	3.0 a	35 bc	1.5 ab
Tade Brown-4	45 ab	49 ab	85 bc	15 a	952 cd	3.0 a	29 cd	1.5 ab
TV2 393	39 bc	48 ab	83 bc	10 bc	875 de	3.0 a	30 bc	1.5 ab
TVU 1190	35 cd	40 bc	85 bc	12 ab	958 cd	2.0 ab	35 bc	1.8 a
TVX3236	35 cd	40 bc	80 cd	12 ab	1038 bc	1.3 ab	53 ab	1.5 ab
Year								
2002	41.9 a	44 a	84 a	12.9 a	980 a	2.20 a	41.8 a	1.38 a
2003	42.2 a	45 a	86 a	13.7 a	984 a	2.44 a	42.2 a	1.50 a
Mean	42	44.5	85	13.3	982	2.32	42	1.44

[z]Values are average of 10 plants.
Means followed by the same letter in the same column are not different ($P < 0.05$), according to Duncan's multiple range test.

practices, such as periodic fallows and rotation with non-host crops, are the only practical means of managing these pests.

In a cover crop study, resistant cowpea breeding line IT84S-2049 and the resistant cowpea cultivar Iron Clay, reduced soil population densities of *M. incognita* compared to fallow and susceptible cowpea treatments (Matthew *et al.*, 1998). The nematode-resistant cowpea cover crops also produced more biomass compared to the susceptible check. The reduced nematode populations resulted in higher yields in a subsequent susceptible tomato cultivar, compared to yields obtained when planted after susceptible cowpea.

This study identified some cowpea breeding lines and cultivars that were resistant or tolerant to *M. incognita* under field conditions within a short period of time (10 weeks). By combining the information on cowpea yield, *Rhizobium* nodulation, and host status of various cowpea breeding lines and cultivars evaluated, plant breeders can improve cowpea production and help with the economy in Nigeria.

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