Responses of cowpea (*Vigna unguiculata* (L.) Walp) cultivars to the root knot nematodes (*Meloidogyne incognita*) in Machakos County, Kenya

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ABSTRACT

Cowpea (Vigna unguiculata (L.) Walp), a pulse crop is high in protein and other essential nutrients. Cowpea seeds are rich in protein, starch, vitamin B, calcium and phosphorus. They make balanced protein mix when consumed with cereals as they supplement a cereal-protein mix with additional lysine. Cowpea leaves are rich in calcium, iron, vitamin A and C and a good source of zinc and folic acid. The growth and yield production is affected by root knot nematodes caused by Meloidogyne species. Experiments were conducted aimed at investigating the responses of four most popular cowpea cultivars in Machakos County to the root knot nematode (Meloidogyne incognita). The most popular cowpea cultivars in Machakos County are KVU 419, KVU 27-1, K.80 and M66. Analysis of variance (ANOVA) was done at P=0.05. Means were separated using LSD at P=0.05. Using the Galling Rating Index with 1-5 scale, (0= no galling; 5=all roots dead), cultivar KVU 419 was rated as the most susceptible while cultivar KVU 27-1 was rated as the most resistant with cultivars K.80 and M66 having intermediate resistance.

Key words: *Meloidogyne* spp., Cowpea cultivars, resistant, susceptible

INTRODUCTION

Cowpea has the highest acreage in Africa with Nigeria and Niger predominating (James, 1999). Other countries with significant acreage are Brazil, West Indies, India, USA, Burma, Sri Lanka, Yugoslavia and Australia. In Africa, cowpea is grown in association or relays with sorghum, millet and maize. Short season cowpea (60-65 days) are sometimes grown in a monoculture system or as a late relay crop in sorghum or maize to use residual moisture in the soil. The green pods provide protein, starch, minerals and vitamins. (MOA Kenya, 1993). Cowpea provides more than half the plant protein in human diets in subhumid tropics (Ricardo, 1985). It is also utilised for fodder and as a quick-growing cover crop under a wide range of conditions. It provides a high proportion of its own-Nitrogen requirement through fixation and leaves the fixed–N of up to 60-70kg/ha in the soil for the succeeding crop (Mulongoy, 1985).

Diseases are a major constraint in cowpea production. Root knot nematode diseases are major problem in cowpea production. They hamper plant water and nutrient uptake hence causing nutrient deficiency and other physiological dysfunctions. Naz *et al*., 2012. Use of nematicides to control root knot nematodes is becoming untenable because they are environmentally not friendly Ogumo, 2014; Kimani, 2016. Therefore finding cultivars that are resistant to these diseases is the best option in managing root knot diseases.

METHODOLOGY

Field tests were done using four common cultivars of cowpea namely KVU 419, KVU 27-1, K.80 and M66 obtained from KARI Katumani Dryland Research Station, Machakos. Five seeds were planted per hole and hand thinning done later to leave one plant for inoculation. The cultivars were planted in four rows one cultivar per row spaced at 50 cm between the rows and 20 cm within rows with a row constituting an experimental unit. There were four replications arranged in a complete randomised block design. The inoculum density was 1000 larvae per 5 ml. The observations were made regularly for symptoms development. Galled roots with root knot nematodes were plucked from the soil and disease assessment done using root knot gall rating index as used by Giamalva *et al.*, (1960) and inoculated using the method described by Hussey and Baker (1973).

In Greenhouse test, the same four most popular cowpea cultivars were used. They were planted in sterile soils in 18-cm-diameter plastic pots; 5 seeds per pot. A complete randomised design (CRD) with four replicates was used. Hand thinning was done after emergence of the seedlings to leave one plant per pot for inoculation. Plants were watered regularly and observations on symptom development were made. Plants were uprooted from the soil for disease assessment (Giamalva *et al*., 1960). Half kilogram of soil was taken from each pot immediately the plants were uprooted for nematode extraction using Baermann funnel technique (Baermann, 1917).

RESULTS

Greenhouse tests

Ratings of galling were taken from each sample and averaged. The mean root galling indices ranged from 1.5 to 3.0. The lowest and the highest root galling were associated with cultivars KVU 27-1 and KVU 419 respectively (Table1). There was significant difference (P = 0.05) between the galling indices of cultivars KVU 419 and KVU 27-1. There was no significant difference between the galling indices of cultivar KVU 27-1 and other cultivars (K.80 and M66) (Table 1).

Table 1: Root galling indices of cowpea cultivars in the greenhouse test

Cowpea Cultivar	Sample / Indices		Mean galling indices
KVU 419	Sample 1	4	
	Sample 2	2	
	Sample 3	2	3.0**a**[*]
	Sample 4	4	
KVU 27-1	Sample 1	0	
	Sample 2	1	1.5**b**
	Sample 3	2	
	Sample 4	3	
K-80	Sample 1	2	
	Sample 2	3	1.75**ab**
	Sample 3	1	
	Sample 4	1	
M66	Sample 1	3	
	Sample 2	2	2.75**ab**
	Sample 3	3	
	Sample 4	3	

[a*] In the column, means followed by the same letter are not significantly different (P =_0.05) from each other according to Least Significance Difference (LSD) Test.

Field tests

The root galling indices of the four cultivars ranged from 2.5 to 1.5 with the highest and lowest ratings associated with cultivars KVU 419 and KVU 27-1 respectively (Table 2). There was no significant difference among the galling indices (Table 2)

Table 2: Root galling indices of cowpea cultivars in the field test

Cowpea Cultivar	Sample / Indices		Mean galling indices
KVU 419	Sample 1	2	
	Sample 2	3	
	Sample 3	3	2.5**a**[*]
	Sample 4	2	
KVU 27-1	Sample 1	1	
	Sample 2	0	1.5**a**
	Sample 3	3	
	Sample 4	2	
K-80	Sample 1	2	
	Sample 2	3	2.25**a**
	Sample 3	2	
	Sample 4	2	
M66	Sample 1	3	
	Sample 2	3	2.25**a**
	Sample 3	1	
	Sample 4	2	

[a*] In the column, means followed by the same letter are not significantly different (P =_0.05) from each other according to Least Significance Difference (LSD) Test.

Cultivars with the highest and the lowest root gall ratings were associated with the highest and lowest number of *Meloidogyne* sp. juveniles respectively (Table 3).

Table 3: Number of *Meloidogyne incognita* juveniles per 500 grams of soil 90 days after planting.

Cowpea Cultivar	Number of *Meloidogyne incognita* larvae/ 500 gms soil		Average number of *Meloidogyne incognita* larvae/ 500 gms soil
KVU 419	Sample 1	137	
	Sample 2	130	
			131.75**a**[*]
	Sample 3	143	
	Sample 4	117	
KVU 27-1			
	Sample 1	80	
	Sample 2	65	64.5**c**
	Sample 3	67	
	Sample 4	46	
K-80			
	Sample 1	127	
	Sample 2	111	104**b**
	Sample 3	77	
	Sample 4	101	
M66			
	Sample 1	107	
	Sample 2	128	110**b**
	Sample 3	108	
	Sample 4	97	

[a*] In the column, means followed by the same letter are not significantly different (P =_0.05) from each other according to Least Significance Difference (LSD) Test.

DISCUSSIONS

The differences in root galling indices of the four cowpea cultivars KVU 419, KVU 27-1, M66 and K.80 reveal differences in their responses to *M. incognita* and indicate differences in their genetic make-up. Similar differences in cowpea genotypes have been reported (Roberts *et al*., 1996). In America, researchers identified cowpea cultivar accession IT845-2049 from Africa as having resistance to diverse populations of *M. incognita* and *M. javanica* (Roberts *et al*., 1996). The resistance of the cultivar was effective against nematodes isolates that are virulent to the gene *Rk* for resistance against root knot nematodes (Roberts *et al*., 1996, Abad *et al*., 2008). Fery and Dukes (1980) identified and designated gene *Rk* after resistance studies involving cultivars Iron Colossus and Mississippi Silver with F1 F2 F3 and backcross progenies from resistant X susceptible crosses that showed that these lines possess the same single dominant resistance gene which they designated *Rk*. Rodriguez *et al*., (1996) screened nine cowpea cultivars for resistance to the root knot nematode *Meloidogyne incognita* and identified IITA-3, Habana 82, Incarita-1, IT86D-364, IT87D,-1463-8, Vinales 144, P902, and ITTA-7 as highly resistant whereas the local variety (in USA) Cancharro as highly susceptible. The low mean root gall ratings of cultivar KVU 27-1 on a rating scale of 0-5 was indicative of the resistant nature of the cultivar to *M. incognita.* The high mean ratings of cultivar KVU 419 showed that cultivars KVU 419 is the most susceptible. Cultivars K.80 and M66 were intermediate in resistance. Generally, the mean ratings in the field and in the greenhouse did not differ significantly although the most susceptible cultivar differed slightly. The most susceptible cultivar KVU 419 had higher mean gall rating in the greenhouse than in the field. This could be due to confinement of the root knot nematode juveniles in the pots compared to field where they are able to migrate to other areas hence reducing the inoculum for field plants. The most resistant cultivar KVU 27-1 did not show any difference while those cultivars K.80 and M66 of intermediate resistance showed very slight difference both in the field and greenhouse. Although this study has revealed that cowpea cultivar KVU 27-1 supported low numbers of *M. incognita* and suppressed galling, further work is needed to assess crop loss and identify genes that confer the resistance.

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