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Distribution and Potential Importance of Plant-parasitic Nematodes Associated with Pigeonpea in Kenya

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Abstract. The distribution of plant-parasitic nematodes in different agroecological zones representing the major pigeonpea-producing regions in northeastern Kenya was studied in January 1992. Forty two nematode species belonging to 25 genera were associated with pigeonpea in these regions. *Aphelenchus avenae* and *Ditylenchus* spp. were frequently detected. *Scutellonema unum*, *Meloidogyne javanica* and *Rotylenchulus parvus* were potentially important species associated with pigeonpea; *S. unum* was detected in 44% of the samples, *M. javanica* in 40%, and *R. parvus* in 37%. Incidence of the root-knot disease caused by *Meloidogyne* spp. was 19.5%. Crop growth was stunted and patchy in many of the root-knot nematode infested fields. All the nematode species except *Meloidogyne* sp. have been reported for the first time in association with pigeonpea in Kenya.

Keywords: Kenya, *Meloidogyne javanica*, Nematode distribution, Pigeonpea, *Rotylenchulus parvus*, *Scutellonema unum*.

INTRODUCTION

Pigeonpea (*Cajanus cajan* (L.) Millsp.) is one of the important grain legumes in the semi-arid tropics. In Kenya, the second largest producer in the world, pigeonpea is grown on over 164 000 ha with yields ranging from 300 to 500 kg/ha (Omanga *et al.*, 1991). Cultivation of pigeonpea is mainly concentrated in the Eastern Province and 90% of the crop is grown particularly in Machakos and Kitui districts (Mbatia and Kimani, 1991). The legume is intercropped mainly with maize, sorghum and field bean. Pigeonpea yields are relatively low in farmers' fields due to many factors such as low rate of adoption of improved varieties and the prevalence of insect pests and fungal diseases (Ireri, 1991).

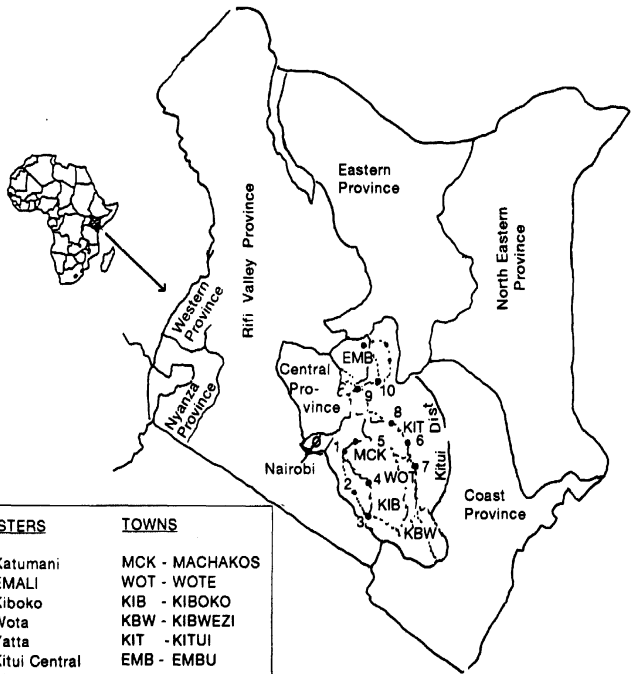
There is very little information available on plant-parasitic nematodes associated with pigeonpea in Kenya. Therefore, a survey of major pigeonpea-growing regions was conducted to record the associated plant-parasitic nematodes and identify potentially important constraints to pigeonpea production in this country. This report on nematodes of pigeonpea in Kenya will be useful in developing Geographic Information Systems on the biotic constraints of pigeonpea in East Africa.

MATERIALS AND METHODS

Forty one locations in Machakos, Makueni, Kitui and Embu districts, representing different agroecological zones (Fig. 1) were randomly selected for sampling in January 1992. These areas are characterized by high temperatures (20-34°C) and low (500-700 mm/year), erratic and poorly distributed bimodal rainfall (Omanga *et al.*, 1991a, Braun, 1980). A majority of the soils in these regions is Alfisols with weak surface structures due to low organic matter and high sand contents. The crop was planted in October-November and at the time of the survey, plants were about 50-60 days old at most locations. The distance between pigeonpea rows was very wide and variable to accommodate 2-5 rows of other crop plants. The individual fields were the basic units of the survey.

Composite soil samples were collected with the help of a 25-cm long soil sampler from each field, down to a depth of 15-20 cm. Each sample consisted of 6-10 soil cores. Root samples were also collected along with the soil. The nematodes were extracted from 250 cm^3 soil samples by suspending them in water, passing them through nested sieves (850, 180 and 38-µm-pore), and placing the residue from the 38-µm-pore sieve on a modified Baermann funnel (Schindler, 1961). Residue collected on a 180-µm-pore sieve was examined for

Fig. 1. Regions surveyed for plant parasitic nematodes associated with pigeonpea in Kenya.



CLUSTERS	TOWNS
1. Katumani	MCK - MACHAKOS
2. EMALI	WOT - WOTE
3. Kiboko	KIB - KIBOKO
4. Wota	KBW - KIBWEZI
5. Yatta	KIT - KITUI
6. Kitui Central	EMB - EMBU
7. Kitui South	
8. Kabati	
9. Mwea	
10. Embu	

Table 1. List of plant-parasitic nematodes associated with pigeonpea in Kenya.

Location (nearest village)	Agroecological zone	Nematode species
		Embu district, Embu cluster
Kirithiri	LM 4	*Meloidogyne* sp., *Pratylenchus* sp., *Rotylenchulus parvus*+(Williams) Sher, *Scutellonema* sp., *Scutellonema unum* Sher*, *Xiphinema* sp.
Maturori	UM 4	*Meloidogyne* sp., *R. parvus*, *Rotylenchulus* sp., *Scutellonema* sp., *S. unum**
Kiringa	UM 3	*Aphelenchus avenae* Bastian+, *Aphelenchoides* sp., *Meloidogyne* spp.*, *Scutellonema* sp.
Thagayia	LM 3	*Ditylenchus* sp., *Meloidogyne* spp*, *Pratylenchus* sp., *R. parvus*
		Machakos district, Katumani cluster
Katumani	UM 4	*Aphelenchoides bicaudatus* (Imamura) Filipjev & Schuurmans Stekhoven, *Ditylenchus* sp*, *Filenchus* sp., *Meloidogyne* sp., *Pratylenchus* sp.
Katumani	UM 4	*A. avenae*, *Ditylenchus* sp., *Helicotylenchus dihystera* (Cobb) Sher, *Neodolichorhynchus gladiolatus* (Fortuner & Amougou), Jairajpuri & Hunt+, *Ottolenchus* sp.+, *Paraphelenchus* sp.+, *Pratylenchus* sp., *Pratylenchus zeae* Graham, *Sakia* sp.+, *S. unum*+*
Katumani	UM 4	*Boleodorus* sp.+, *Ditylenchus* sp., *Paratrichodorus minor* (Colbran) Siddiqi+, *Sakia* sp., *S. unum*+
Kimutwa	UM 4	*A. avenae*, *Ditylenchus* sp., *R. parvus*+*
Makaveti	UM 4	*Basiria* sp.+, *Ditylenchus* sp., *Filenchus* sp., *Longidorus* spp., *Meloidogyne* sp., *Paratylenchus* sp., *Pratylenchus* sp., *R. parvus**, *Scutellonema magniphasmum* Sher+
		Machakos district, Emali cluster
Sultan Hamud	LM 4	*A. avenae*, *A. bicaudatus*, *Ditylenchus* sp., *Ottolenchus* sp., *R. parvus**
Emali	LM 4	*Aphelenchoides* sp., *A. avenae*, *Ditylenchus* sp., *Filenchus* sp., *Gracilacus peperpotti* Schoemaker+, *Gracilacus* spp.+, *Pratylenchus sefaensis* Fortuner+, *Scutellonema brachyurum* (Steiner) Andrássy*+, *Tylenchorhynchus ventrosignatus* Tobar Jimenez+
		Makueni district, Wote cluster
Kalii	LM 5	*Helicotylenchus paraplatyurus* Siddiqi+, *Helicotylenchus pseudorobustus* (Steiner) Golden+, *Hoplolaimus* sp., *Meloidogyne* spp., *Pratylenchus* sp., *S. unum**, *T. ventrosignatus*
Kampi-ua-mawe	LM 5	*A. avenae*, *Meloidogyne* sp., *S. unum**
Wote	LM 4	*A. avenae*, *Aphelenchoides* sp., *Basiria* sp.+, *Ditylenchus* sp., *Hirschmanniella oryzae* (van Breda de Haan) Luc & Goodey, *Hoplolaimus seinhorsti* Luc, *Paraphelenchus* sp., *S. unum**, *Tylenchorhynchus* sp.
Kisau	LM 3	*A. avenae*, *Basiria* sp., *Ditylenchus* sp., *Malenchus* sp.+, *Meloidogyne* spp.*, *Mulkorhynchus* sp.+, *Ottolenchus* sp., *Scutellonema* sp.*
		Kitui district, Yatta cluster
Yatta	LM 4	*A. avenae*, *H. dihystera*, *S. unum**, *Tylenchorhynchus goffarti**
Yatta	LM 5	*A. avenae*, *R. parvus*, *Xiphinema* sp.
Kyangui	LM 5	*A. avenae*, *Meloidogyne* sp., *Pratylenchus zeae*, *R. parvus**
Kyangui	LM 5	*Meloidogyne* spp.
Yatta	LM 5	*Ditylenchus* sp., *Filenchus* sp., *Paurodontus* sp.+, *Tylenchorhynchus* sp.
		Kitui district, Central Kitui cluster
Unya	UM 4	*Aphelenchoides* sp., *A. avenae*, *Basiria* sp., *Ditylenchus* sp., *P. zeae*, *R. parvus**, *Sakia* sp., *S. magniphasmum*, *S. unum*
Tunguta	UM 4	*A. avenae*, *Ditylenchus* sp., *Ottolenchus* sp., *R. parvus*, *S. magniphasmum*, *S. unum**, *Tylenchorhynchus* sp.
Ithookwe	UM 4	*Boleodorus* sp., *Ditylenchus* sp., *P. zeae*, *Pratylenchus* sp., *S. unum**
Ngangani	UM 4	*A. avenae*, *Aphelenchoides* sp., *Ditylenchus* sp.*, *Filenchus* sp., *Ottolenchus* sp., *Paralongidorus* sp., *P. zeae*

Matinyani	UM 4	*A. avenae**, *Nothotylenchus* sp.+, *P. zeae*
		Kitui district, Kitui South cluster
Kisasi	LM 4	*A. avenae*, *H. dihystera*, *Pratylenchus* sp., *P. zeae*, *S. magniphasmum*, *S. unum**
Kisasi	LM 4	*A. avenae*, *Filenchus* sp., *Helicotylenchus microcephalus* Sher+, *S. unum**, *Tylenchorhynchus* sp.
Mbitini	LM 4	*A. avenae*, *Aphelenchoides* sp., *Ditylenchus* sp., *Filenchus* sp., *Meloidogyne* sp.*, *Ottolenchus* sp., *Pratylenchus* sp., *R. parvus*, *S. unum*, *T. goffarti*
Ikanga	LM 5	*A. avenae*, *Filenchus* sp., *Ottolenchus* sp., *Pratylenchus* sp., *R. parvus**, *S. unum*, *T. goffarti*
		Kirinyaga district and subregion
Mwea	LM 4	*Aphelenchus* sp., *Meloidogyne* sp., *Rotylenchus* spp., *S. magniphasmum*, *S. unum**
Kiadego	LM 4	*Aphelenchus* sp., *Ditylenchus* sp., *Meloidogyne* sp. *Pratylenchus* sp.
Muounduku	LM 3	*Aphelenchus* sp., *Meloidogyne* sp., *Pratylenchus* sp., *Rotylenchulus* sp.
		Makueni district, Kiboko cluster
Kiboko	LM 5-6	*A. avenae**, *A. bicaudatus*, *Ditylenchus* sp., *Gracilacus* sp.
Usungu	LM 5	*A. avenae*, *Ditylenchus* sp., *Pratylenchus* sp, *Tylenchorhynchus goffarti*
Kallii	LM 5	*A. avenae**, *Ditylenchus* sp., *Ottolenchus* sp., *Pratylenchus delattrei* Luc+
Mbuvo	LM 5	*A. avenae**, *Ottolenchus* sp., *Pratylenchus* sp.
		Kitui district, Kabati cluster
Kabati	LM 5	*A. avenae*, *Ditylenchus* sp., *Filenchus* sp., *Helicotylenchus* sp., *Ottolenchus* sp., *R. parvus**, *S. unum*, *T. goffarti*
Mutonguni	LM 5	*A. avenae*, *Ditylenchus* sp.*, *Filenchus* sp., *Pratylenchus sudanensis*, *Rotylenchulus leptus* Dasgupta *et al.*+, *Scutellonema* sp., *T. goffarti*, *Telotylenchoides lobatus* (Loof & Yassin) Siddiqi+
Masinga	LM 5	*Ditylenchus* sp.+, *Duosulcius* sp.+, *Filenchus* sp. *Helicotylenchus* sp., *Meloidogyne* sp.*, *Ottolenchus* sp., *Pratylenchus* sp., *S. brachyurum*+
Kivaa	LM 5	*A. avenae*, *Ditylenchus* sp., *Meloidogyne* sp., *Pratylenchus* sp., *R. parvus**, *S. unum*

* Predominant nematode population
\+ First report on pigeonpea (Nene *et al.*, 1989)
UM = Upper midlands; LM = Lower midlands

Classification of agroecological zones:
Zone 3: (Semi-humid, average annual rainfall 800-1400 mm, mean annual temperature 16-18°C);
Zone 4: (Semi-humid to semi-arid, average annual rainfall 600-1100 mm, mean annual temperature 16-20°C);
Zone 5: (Semi-arid, average annual rainfall 450-900 mm, mean annual temperature 20-24°C);
Zone 6: (Arid, average annual rainfall 300-550 mm, mean annual temperature 24-30°C).

Table 2. Potentially important nematode species associated with pigeonpea in Kenya.

District	Cluster	No. of locations surveyed	Agroecological zones	Important species
Machakos	Katumani and Emali	9	4, 5	*Rotylenchulus parvus*, *Scutellonema unum*
Makueni	Makueni	6	4, 5	*Meloidogyne javanica*, *Scutellonema unum*
Kitui	Yatta and Central Kitui	11	4, 5	*R. parvus*, *S. unum*
Kitui	South Kitui and Kabati	8	5, 6	*R. parvus*, *S. unum*
Embu	Embu	7	3, 4	*Meloidogyne* spp., *R. parvus*

nematode cysts under a stereoscopic binocular microscope. Roots (2-5 g) were gently rubbed on the sieve to release any *Heterodera* cysts, or mature females of reniform (*Rotylenchulus*) and root-knot (*Meloidogyne*) nematodes. The nematodes in suspensions were killed and fixed in 2% hot formalin. The nematodes were identified to generic and wherever possible, to species levels. *Meloidogyne* spp. were identified on the basis of perineal pattern morphology. The most abundant nematode population in each sample was identified.

RESULTS AND DISCUSSION

The plant-parasitic nematodes in 41 pigeonpea fields are given in Table 1. *Aphelenchus avenae* and *Ditylenchus* spp. were observed most frequently. Juveniles of *Meloidogyne javanica* were noticed in 40% of the locations but galls on roots were not seen at many of these locations, probably because their size was very small, or they were not produced at all. *Scutellonema unum* was present in 44% of the locations surveyed, and *Rotylenchulus parvus* was present in 37% of the locations. Incidence of the root-knot disease caused by *Meloidogyne* spp. (*M. javanica* and *Meloidogyne* sp.) was 19.5%. Many nematode galls were observed on the roots. Pigeonpea growth was stunted at these locations and plant damage was severe in sandy soils. Perineal pattern morphology of most of these populations conformed to that of *M. javanica*. *S. unum*, *M. javanica* and *R. parvus* were three potentially important species associated with pigeonpea (Table 2). Young females and cysts of *Heterodera* spp. were not found in any of the root and soil samples; however, empty and broken cysts were observed at 10 locations, and these could not be identified up to species level.

Scutellonema is an important nematode in Africa, and species of this genus are prevalent in the continent. These species attack a large number of cultivated plant species. *S. brachyurum* on maize in South Africa, *S. bradys* on yam, and *S. cavenessi* and *S. clathricaudatum* on groundnut and pearl millet in West Africa are important constraints (Jatala and Bridge, 1990; Minton and Baujard, 1990; Sharma *et al.*, 1992). Siddiqi (1972) listed 9 species of *Scutellonema* with their hosts and localities in Africa. Pigeonpea is a good host of *S. clathricaudatum*. Association of *S. unum*, *S. magniphasmum*, *S. brachyurum* and *Scutellonema* n. sp. require further investigations on pathogenicity and yield loss.

Rotylenchulus parvus is widely distributed in eastern and southern Africa, being reported from Kenya, Mauritius, South Africa, Zambia and Zimbabwe (Heyns, 1976). It is reported on 20 plant species in 4 families, and causes severe root distortion and occasional necrosis on the roots of sugarcane (Jatala, 1991). *R. parvus* has not been reported in association with pigeonpea; however, *R. reniformis*, a related species, is an important pest of pigeonpea (Nene *et al.*, 1989, Sharma and McDonald, 1990). Information on the pathogenicity of *R. parvus* on pigeonpea is essential to understanding its importance as a constraint to pigeonpea. Maize, which is most commonly intercropped with pigeonpea in Kenya, is a very good host of *R. parvus* (Jatala, 1991).

Meloidogyne javanica is an important nematode pest of pigeonpea in Malawi. *M. javanica* and *M. incognita* are widely distributed in cultivated areas in Kenya (Whitehead and Kariuki, 1960; Kanyagia, 1983). Stunted pigeonpea plants had very severe galling of roots and apparently healthy plants growing in close proximity had only a few galls on roots. Root-knot disease of pigeonpea is presumed to be a serious problem in some locations, and more surveys are required to assess its importance as constraints to pigeonpea production.

Determining the distribution and importance of nematodes on a regional basis is an on-going, gradual and long-term process. This preliminary survey indicates nematode species of possible economic importance in pigeonpea production in Kenya. Further work on host range and actual damage potential of some of these nematode species is suggested. Incidentally, all the nematode species except *Meloidogyne* sp. are being reported for the first time in association with pigeonpea in Kenya, and many nematode species are being reported for the first time in association with pigeonpea (Table 1).

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