



# Response of selected kenaf cultivars to *Meloidogyne incognita* under greenhouse conditions

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## ABSTRACT

**Kenaf (*Hibiscus cannabinus* L.) is being investigated as an alternative industrial crop for inclusion in crop rotation programmes for the management of various plant parasitic nematodes. In Nigeria, cropping patterns and cultural practices vary from one area to another, thereby creating a great diversity in the combinations of nematodes species present and in the problems they cause. Root-knot nematodes, *Meloidogyne incognita* is the most serious potential problem to kenaf production. It was therefore necessary to determine if kenaf can be included in the cropping systems of resource poor farmers in areas where root-knot nematodes are problematic. The host-status and host-sensitivity of kenaf cultivars Ifeken 100, Ifeken 400, Cuba 108 and Tianung-1 to the root-knot nematode (*M. incognita*) were tested under greenhouse conditions. A split-plot design experiment with five replications was designed, where the main plot factors comprised with or without nematodes and the sub-plot factors are four kenaf cultivars. Twelve weeks after initiating treatments, the reproductive factors of *M. incognita* on kenaf cultivars were greater than one, without the cultivars suffering damage from the nematode infection. Results of the study show that the four cultivars were tolerant to *M. incognita*. Therefore these cultivars are not suitable for use in crop rotation programmes in the management of *M. incognita* since they would increase nematode build-up for subsequent susceptible crops.**

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## INTRODUCTION

Kenaf (*Hibiscus cannabinus* L.) is a member of the family Malvaceae and the third largest fiber crop of economic importance after cotton and jute (Agency for International Development, 1968). It is indigenous to Africa and the species *H. cannabinus* most likely originated from Sudan, although it is commonly cultivated for both food and fiber in West Africa. Fiber in both the retted and raw forms is used in the manufacture of cordage and newsprint. Leaves and small branches, when ground, have high digestibility and can be used as a source of roughage and protein for cattle and sheep (Bada and Kalejaiye,

2010). As a source of cellulose fiber for pulp production (Francois et al., 1992; Webber III, 1996), the economic importance of kenaf is made more important due to diminishing stocks of hardwood and softwood trees in the world.

The consequence of forest reduction is gradual global desertification. Also, increase in the global consumption of paper and paper board materials have increased the importance of kenaf as a wood substitute. It is estimated that kenaf is 3 to 5 times more productive per unit area of land than pulpwood trees and produces a pulp that is equal or superior to many woods (Theisen et al., 1978).

In Nigeria, there is renewed interest in the special properties of this industrial crop because it may provide a reasonable income for poor-resource farmers (Raji and Fadare, 2003). However, for those smallholder farmers, it

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is preferable that only alternative crop being introduced should not increase the numbers of nematode species that could be problematic to their other crops. In Nigeria, cropping patterns and cultural practices vary from one area to another, creating a great diversity in the combination of nematode species present and in the problem they cause. Root-knot nematodes (*Meloidogyne* spp.) are among the most damaging and economically important pests of subtropical and tropical crops throughout the world (Starr et al., 2005). It was therefore necessary to determine if kenaf can be included in the cropping systems of resource poor farmers in areas where root-knot nematodes are problematic. The objective of this study was to determine the host-status and host-sensitivity of four economically promising kenaf cultivars to *Meloidogyne incognita* in Nigeria.

## MATERIALS AND METHODS

The study was carried out at Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, Ibadan-Nigeria, located at 3° 54' E and 7° 30' N. The trials were established in March, 2016 and in March, 2017 respectively under greenhouse conditions. A susceptible kenaf variety (Ex-Shika) was planted in the soil for effective reproduction of *M. incognita* (Adegbite et al., 2008). Two months after inoculation, the (Ex-Shika) plants were removed; the soil was sieved and thoroughly mixed. Forty 30 cm diameter pots were filled with infested soil. Each pot was sampled for nematodes before kenaf seeds were sown. Kenaf cultivars were sowed directly into the pots.

Enough sandy loam soil comprising 81% sand, 6% silt and 13% clay was prepared to provide for forty 30 cm diameter pots. The soil was steam pasteurized and inoculated with approximately 100 eggs and juveniles of *M. incognita* obtained from a *M. incognita* green house colony. A susceptible kenaf cultivar was planted in the soil for effective reproduction of *M. incognita*. Two months after inoculation the kenaf plants were removed, soil sieved, composited and mixed thoroughly. Pots were filled with infested soil and each pot was sampled for nematodes before kenaf seeds were planted to obtain initial population (Pi). Pots were placed on the green house benches at 0.3 m inter-row and 0.3 m intra-row spacing. At termination, 12 weeks after planting, nematodes were extracted from 250 mL soil using the sugar-centrifugation method (Jenkins, 1964) for the determination of the final population (Pf). Ambient day/night temperatures and day-length averaged 28/18°C and 14 h respectively.

The experiment was laid out in a randomized split-plot design with five replications. Main plot treatments comprised nematode infested and nematode free pots whereas the sub-plot treatments were four cultivars of

Ifeken 100, Ifeken 400, Cuba 108 and Tianung-1. Plants were irrigated twice a day and lights were installed in the green house to extend the day-length, thus preventing bolting as kenaf is a short day plant. At harvest, 12 weeks after planting, shoots were cut at the soil level and oven-dried for 72 h at 70°C and weighed. Root systems were removed from the pots, immersed in water to remove soil particles, blotted dry and weighed to facilitate the calculation of nematode density per total roots per plant. Root galling was assessed using the 0 – 5 scale, where 0 = no galls, 1 = 1 – 2 galls, 2 = 3 – 10 galls, 3 = 11 – 30 galls, 4 = 31 – 100 galls and 5 = > 100 galls (Taylor and Sasser, 1978).

Nematodes were extracted from 10 g roots per plant by maceration and blending for 1 min in 1% NaOCl (Hussey and Baker, 1973), then passed through 38 mm sieves, with nematodes being separated from debris of the aliquot through the sugar-floatation and centrifugation method (Coolen, 1979). Soil per plot was thoroughly mixed and a 250 cm<sup>3</sup> soil sample was collected. Nematodes were extracted from soil samples using the sugar-floatation and centrifugation method and eggs and juveniles were counted from 10 mL aliquot with the use of stereomicroscope. Nematode numbers from the roots were converted to nematodes per total root system per plant, whereas soil nematode numbers were converted nematode per pot. Reproductive factor (Rfs), described as final population/initial population numbers, were computed and measured data were subjected to analysis of variance using SAS software (SAS, 2004).

## RESULTS AND DISCUSSION

There were significant differences among cultivars for pre and final nematode numbers (Table 1). Tianung-1 had the highest number of initial nematodes with Ifeken 400 having the lowest initial nematode numbers, whereas, Cuba 108 and Tianung-1 had the highest final nematode numbers. The reproduction factors of *M. incognita* on all the four cultivars were greater than 1 which suggests that the nematode reproduced on all the four cultivars, there were no significant interaction between nematode application and cultivars for dry root weight and dry shoot weight (Table 2). Also, *M. incognita* did not affect both root and shoot weight of the four kenaf cultivars.

In plant parasitic nematodes, nematode-plant relations are described using the concept of host-status and host-sensitivity (Seinhorst, 1965). Host-status is described using the reproductive factor, which is a measure of the reproductive potential of a nematode on a given host, also referred to as reproductive factor (Windham and Williams, 1988). All reproductive factors below unity suggest that the nematode fails to reproduce on a given host, whereas, values above one indicate that the nematode was able to reproduce in the test plant. The

**Table 1.** Initial nematode numbers (Pi), final nematode numbers (Pf) and the reproductive factor of *M. incognita* on kenaf cultivars (ab).

Cultivar	Pi	Pf	Rf
Ifeken 400	90 <sup>c</sup>	308 <sup>c</sup>	3.41 <sup>b</sup>
Ifeken 100	150 <sup>b</sup>	729 <sup>b</sup>	4.86 <sup>a</sup>
Cuba 108	240 <sup>b</sup>	1387 <sup>a</sup>	5.78 <sup>a</sup>
Tianung-1	685 <sup>a</sup>	1000 <sup>a</sup>	1.46 <sup>c</sup>
L.S.D 0.05	57	238	1.38

<sup>a</sup>, Reproductive factor = Rf/Pi; <sup>b</sup>, Means followed by the same letter in a column are not significantly different at P = 0.05.

**Table 2.** Influence of initial nematode numbers of *M. incognita* and four kenaf cultivars on dry root weight and dry shoot weight.

Source of variation	Dry root weight (g)			Dry shoot weight (g)	
	DF	SS	P-value	SS	P-value
Replication	4	1.48	0.45	220.10	0.09
Nematode (N)	1	10.35	0.43	0.258	0.96
Error (a)	4	0.86		86.87	
Cultivar (c)	3	6.38	0.02	592.71	0.01
N & C	3	3.12	0.13	22.36	0.87
Error (b)	22	1.62		92.18	
Total	37	23.81		1014.48	
R <sup>2</sup>		0.56		0.56	

DF, Degree of freedom; MS, mean square.

use of reproductive factors needs for determination of the Seinhorst (1967) equilibrium point (E), beyond which all reproductive factors are below unity since competition for infection sites becomes intense (Kwaye et al., 2008). Host-sensitivity is described using the host-status and the plants responses to nematode infection (Seinhorst, 1967). When the host-plant allows nematode reproduction and the plant suffers yield loss, the plant is described as a susceptible host, whereas a host that does not incur yield loss is referred to as a tolerant host. However, if reproduction is not allowed and there is, as a result, no yield loss, the test plant is said to be a resistant host (Seinhorst, 1967).

*M. incognita* decreased and increased yield of kenaf cultivars Kompolti and VIR-140, respectively (Van Biljon, 2005). However, Van Biljon (2005) did not report the final nematode population densities (Pf) on both cultivars. Generally, nematodes at densities lower than the damage threshold level have a stimulating effect on yield of various crops (Mashela, 2002; Wallace, 1973). In Europe, several kenaf cultivars with claims of resistance to this nematode had since been released (De Meijer, 1993, 1995).

## Conclusion

Results of the current study suggest that the four kenaf cultivars were all tolerant to *M. incognita*. Consequently, these cultivars are not suitable for inclusion in crop rotation programme for the suppression of *M. incognita* numbers since they would result in nematode build-up for subsequent susceptible crops.

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