

**EFFECT OF INITIAL POPULATION DENSITY OF  
MELOIDOGYNE INCOGNITA RACE 3 ON  
THE GROWTH OF KENAF (*HIBISCUS CANNABINUS* L.)<sup>†</sup>**

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ABSTRACT

Barillas, J. R., G. W. Lawrence, and K. S. McLean. 1993. Effect of initial population density of *Meloidogyne incognita* race 3 on the growth of kenaf (*Hibiscus cannabinus*). *Nematropica* 23:15–19.

In a greenhouse experiment, seedlings of kenaf (*Hibiscus cannabinus*) cv. Tainung I were inoculated with *Meloidogyne incognita* race 3 at initial population densities (Pi) of 0, 100, 500, 1 000, 2 500, and 5 000 eggs + second-stage juveniles/500 cm<sup>3</sup> soil. After 60 days, plant height, stalk diameter, and root and stem weights were significantly reduced at Pi = 5 000 but not at lower Pi's. Shoot dry weights were reduced 46% compared with the untreated control. The total nematode population (eggs and second-stage juveniles recovered from roots and soil) increased with increasing inoculum levels and the reproductive factor (R = final population/initial population) decreased as the initial inoculum level increased.

*Key words:* *Hibiscus cannabinus*, inoculum, kenaf, *Meloidogyne incognita*, nematode reproduction, population dynamics, southern root-knot nematode.

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RESUMEN

Barillas, J. R., G. W. Lawrence y K. S. McLean. 1993. Efecto de la densidad inicial de la población de *Meloidogyne incognita* raza 3 sobre el crecimiento de kenaf (*Hibiscus cannabinus*). *Nematropica* 23:15–19.

En un experimento de invernadero, se inocularon plántulas de kenaf (*Hibiscus cannabinus* cv. Tainung I) con poblaciones iniciales (Pi) de 0, 100, 500, 1 000, 2 500 y 5 000 huevos y segundos estadios juveniles de *Meloidogyne incognita* raza 1 por 500 cm<sup>3</sup> de suelo. A los 60 días después de la inoculación, el nematodo redujo significativamente la altura de la planta, el diámetro del tallo y los pesos del tallo y las raíces con Pi de 5 000, pero no en aquellas plantas con Pi menores. El peso del follaje se redujo en un 4% en relación con el testigo. La población total de nematodos (huevos y segundos estadios juveniles recuperados de las raíces y del suelo) aumentó de acuerdo con la densidad inicial, mientras que la tasa de incremento poblacional (Pf/Pi) disminuyó.

*Palabras clave:* dinámica de poblaciones, *Hibiscus cannabinus*, kenaf, *Meloidogyne incognita*, nematodo agallador, reproducción del nematodo.

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INTRODUCTION

Kenaf (*Hibiscus cannabinus* L.) is a short-day, annual herbaceous plant, originally cultivated for the soft bast fiber in the stem. It is a member of the Malvaceae family and is closely related to okra, jute, and cotton.

Kenaf is believed to have originated in Africa, where *H. cannabinus* and closely related species are found growing in many countries (6). Although kenaf has been cultivated for several thousand years, it was not grown commercially for fiber extraction until around 1900. Kenaf

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is used for cordage, fishing nets, floor matting, backing for rugs, sacking materials, twine, ropes, and cables (5,8).

In 1952, the U.S. Department of Agriculture cited kenaf as a source of paper pulp in India (13). In 1962, Clark *et al.* examined blending kenaf with wood pulp. The resulting blend produced a paper with a desirable tensile strength, burst strength, and brightness (4).

A potential limitation to the successful cultivation of kenaf in the United States is its susceptibility to *Meloidogyne incognita* Kofoid & White (Chitwood) (17). The pathogenicity of *M. incognita* to kenaf was first described in Florida in 1944 (15). More recently, kenaf was found to be a host for populations of *M. incognita* representing the four host races (16).

*Meloidogyne incognita* is the predominant species of root-knot nematode in the southern United States and it is a major pathogen of cotton and soybean (7). This nematode has the potential to become a serious problem in the cultivation of kenaf in Mississippi since both soybean and cotton are widely grown and are hosts.

Although some research has been conducted toward determining damage thresholds for *Hoplolaimus aegypti* on kenaf fiber yield (9), the effect of *M. incognita* on kenaf yield has received little attention (1,10,11,12). The objective of this research was to examine the relationship between the initial population density of *M. incognita* race 3 and the growth of kenaf under greenhouse conditions. Net nematode reproduction was also measured.

## MATERIALS AND METHODS

The experiment was conducted in the Plant Pathology/Nematology greenhouse at Mississippi State University during 1990.

A population of *M. incognita* (race 3) was obtained from infected cotton plants (*Gossypium hirsutum*) and increased on tomato (*Lycopersicon esculentum*). Eggs and second-stage juveniles (J2) were extracted by cutting the roots into 0.5-cm pieces and placing them in 0.525% sodium hypochlorite for 4 min (3). The resulting suspension was passed through a 50- $\mu$ m-pore sieve (200 mesh) nested over a 28- $\mu$ m-pore sieve (500 mesh). Eggs and J2 were rinsed on the 28- $\mu$ m-pore sieve and collected for use as inoculum.

Seeds of kenaf cv. Tainung 1 were germinated for 72 hr and transplanted into 12-cm-diam clay pots containing a 1:1 mixture (v:v) of steam-sterilized sand and soil. *Meloidogyne incognita* eggs and J2 were delivered in 10 ml total volume of water into two 1.5-cm-diam  $\times$  3-cm-deep depressions in each pot. Treatments consisted of initial population densities (Pi) of 0, 100, 500, 1 000, 2 500, and 5 000 eggs + J2/500 cm<sup>3</sup> soil.

Treatments were arranged in a randomized complete block design with eight replications. Plants were grown in the greenhouse at a temperature ranging from 25 to 32 °C and were harvested after 60 days. The experiment was repeated.

At harvest, plant height, stem diameter, and weights of shoots and roots were recorded. Second-stage juveniles were extracted from soil by gravity screening and sucrose centrifugation (3). The eggs in a 1-g random sample of roots were extracted by the sodium hypochlorite method and counted (3). Root galling was rated using a 0 to 5 scale, where 0 = no galling, 1 = 1–2 galls, 2 = 3–10 galls, 3 = 11–30 galls, 4 = 31–100 galls, and 5 = more than 100 galls per root system (14). Data were analyzed and means were compared using Fisher's protected least significant difference test. Quadratic equations

were fit by least squares to relationships between initial nematode densities and plant growth (as measured by stem weights and heights).

## RESULTS AND DISCUSSION

Results of the two replicated experiments were similar. The data presented are from the first run.

*Effects on kenaf:* At harvest, plant height in untreated pots averaged 84.5 cm. All plant growth parameters were significantly reduced in pots inoculated with 5 000 eggs + J2/500 cm<sup>3</sup> soil when compared with the untreated control. Plant heights were reduced 24.6% and stalk diameter at the base of the plant was reduced 21.7% (Table 1). Fresh and dry shoot weights in the same pots were reduced 48% and 46%, respectively. The quadratic models that best described the relationships between Pi and plant growth parameters (plant height, stem diameter, and shoot weight) suggested that growth may have been stimulated at low inoculum densities. However, plant growth stimulation was not observed in the second run of the test.

Fresh root weights of inoculated plants were consistently increased when compared with the untreated plants, and dry root weights were consistently reduced. Dry root weights were significantly reduced even at Pi = 100 and 1 000 (Table 1). The increase in fresh root weight in the infected plants must be due to increased water content. This phenomenon has been reported for roots of various other plants infected by root-knot nematodes.

*Nematode reproduction:* As initial inoculum levels increased, *M. incognita* population densities at harvest (Pf) also increased. The Pf ranged from 18 400 at Pi = 100 to 148 700 at Pi = 5 000 (Table 2). The reproductive factor (R = final population/initial population) decreased from 184.4 at Pi = 100 to 29.7 at Pi = 5 000 (Table 2). The number of egg masses recovered per gram of root increased as initial inoculum levels increased, from 1.0 at Pi = 100 to 16.6 at Pi = 5 000 (Table 2). The average number of eggs per egg mass at Pi = 5 000 (733) was about half that at Pi = 2 500 (1 320) (Table 2), suggesting a crowding effect due to the increased number of galls in the roots. All

Table 1. Effect of *Meloidogyne incognita* race 3 on plant growth of kenaf cv. Tainung 1 in greenhouse pots, 60 days after inoculation.

Inoculum density (Pi) <sup>2</sup>	Plant height (cm)	Basal stem diameter (mm)	Shoot weight (g)		Root weight (g)	
			Fresh	Dry	Fresh	Dry
0	84.5	6.0	31.8	3.9	14.9	1.99
100	95.4	5.9	34.8	4.4	25.2	0.76
500	91.9	6.0	33.9	4.0	26.1	0.86
1 000	97.1	6.3	35.1	4.1	22.6	0.75
2 500	89.1	6.3	33.7	4.0	34.7	1.64
5 000	63.7	4.7	16.5	2.1	19.4	0.93
FLSD ( $P \leq 0.5$ )	14.7	0.8	8.1	1.2	10.3	1.2

Data are means of eight replications. Means compared using Fisher's protected least significant difference test.

<sup>2</sup>Eggs + second-stage juveniles/500 cm<sup>3</sup> soil.

Table 2. Reproductive parameters of *Meloidogyne incognita* on kenaf cv. Tainung 1 in greenhouse pots, 60 days after inoculation.

Inoculum density (Pi) <sup>w</sup>	Final population (Pf) <sup>x</sup>	Reproductive factor (R) <sup>y</sup>	Root gall index <sup>z</sup>	Egg masses/g of root	Eggs/egg mass
0	0	0	0.0	0.0	0
100	18 442	184.4	4.8	1.0	1 079
500	45 943	91.5	4.8	1.6	1 135
1 000	69 717	69.7	4.9	3.3	1 018
2 500	111 212	44.5	4.9	8.5	1 322
5 000	148 739	29.7	5.0	16.6	733
FLSD ( $P \leq 0.05$ )	44 364		0.3	5.7	615

Data are means of eight replications. Means compared using Fisher's protected least significant difference test.

<sup>w</sup>Eggs + second-stage juveniles/500 cm<sup>3</sup> soil.

<sup>x</sup>Eggs in roots + juveniles recovered from 500 cm<sup>3</sup> soil.

<sup>y</sup>R = Final population/Initial population.

<sup>z</sup>Root galling was rated on a 0–5 scale where 0 = no galling, 1 = 1–2 galls, 2 = 3–10 galls, 3 = 11–30 galls, 4 = 31–100 galls, and 5 = more than 100 galls per root system.

initial population densities (Pi) resulted in a root galling index greater than 4 (Table 2). This high root gall index and the high reproductive factor measured at all inoculum levels confirm that Tainung 1 is a highly suitable host for *M. incognita* (14).

In this 60-day greenhouse study, kenaf plant growth parameters were consistently reduced only at Pi = 5 000 *M. incognita* eggs + J2/500 cm<sup>3</sup> soil. Lower initial population densities did not reduce plant growth but they increased to high levels (18 000–150 000 nematodes/500 cm<sup>3</sup> soil) greatly exceeding the highest Pi levels tested, and may have reduced plant growth if the experiments had been extended beyond 60 days. Moreover, relative host sensitivity of a plant characterized under greenhouse conditions, where there is a minimal stress, frequently differs from plant growth responses under field conditions (2). Therefore, additional nematode population development studies on kenaf grown under field conditions are needed to determine damage thresholds for economic injury.

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