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ENVIRONMENT-FRIENDLY MANAGEMENT OF ROOT KNOT NEMATODES (*MELOIDOGYNE INCOGNITA*) ON COWPEA

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Abstract: **Root knot nematodes are microscopic, wormlike animals that live in the soil and feed on the roots of plants. They are highly pathogenic to cowpea causing severe damage and yield loss. To manage nematodes, chemical nematicides proved effective but their hazardous effects on environment, high cost and non-availability at the time of need necessitates the search for safer and cheaper alternative control measures. Screen house experiment was conducted to test the efficacy of *Cassia siamea* leaf powder in the management of *Meloidogyne incognita* on cowpea. Four different doses viz. 25, 50, 75 and 100g of the leaf powder were separately mixed with 4kg of soil in a 25cm diameter plastic pot. Non-amended pots served as control. Cowpea seeds were sown in each pot and each seedling was inoculated with about 3000 freshly hatched juveniles of *Meloidogyne incognita*. The experiment was laid out in a completely randomized design with five replications. Result of the study showed that all the treatments significantly ($p<0.0001$) reduced root galls, nematode population and improved growth and yield of cowpea. Although all treatments were effective in reducing root galls and nematode population, a gradual decrease in nematode population and number of galls was observed with each increase in the level of amendment. The highest nematode population (733.34) was recorded in the control plants while the plants treated with 100g *C. siamea* leaf powder recorded the lowest nematode population (146.67) representing 80.00% reduction as compared to the control plants. Similarly, the highest number of galls (107.75) was recorded in the control plants whereas the plants treated with 100g dose of the amendment recorded the lowest number of galls (21.50) representing 80.05% reduction as compared to the control.**

***Keywords:* *Cassia siamea*, Cowpea, Management, *Meloidogyne incognita* and Root gall.**

1. INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp) is a dicotyledonous plant belonging to the *Fabaceae* family. It is the most important grain legume in West Africa, which provides a source of profitable revenue between 23 and 29% of the selling price (Langyintuo *et al.*, 2003). Cowpea seeds are important in diets for the high protein content providing protein to rural as well as the urban dwellers as a substitute for the animal protein (Wakili, 2013). *Meloidogyne* spp. is a major problem of cowpeas in most crop growing regions of the world (Sikora *et al.*, 2005). Adegbite (2011) reported cowpea grain yield loss of 39% due to infestation by *Meloidgyne incognita.* Similarly, Babatola and Omotade (1991) reported a cowpea grain yield loss of 69% due to infestation by *Meloidogyne incognita.* The symptoms of *Meloidgyne incognita* infection include formation of root galls which results in growth reduction, nutrient and water uptake reduction, increased wilting, mineral deficiency, as well as weak and poor yielding plants (Umar, 2012). The use of synthetic nematicides is considered the most effective practical means of combating the menace of plant-parasitic nematodes on cowpea (Al-naser et al, 2015). However, chemical control of root knot nematodes leads to environmental hazards because of the high toxicity and persistence of the nematicides (Oka *et al*., 2014). As an alternative, organic soil amendment has been found to be cheaper, less harmful to man and effective in the management of plant-parasitic nematodes (Aminanyanaba *et al.*, 2015, El-Nagdi *et al.,* 2016). In view of this, the present research was carried out to assess the efficacy of *Cassia siamea* leaf powder in the control of *Meloidogyne incognita* on cowpea.

2. MATERIALS AND METHODS

Soil preparation and sterilization:

Top soil of 0–30 cm depth was used for the experiment in this study. The soil was steam-sterilized by heating with lighted firewood in a large metal pot to a temperature of 100^{o}C and maintained for one hour.

Amendment Application Rate:

Ground leaves of *Cassia siamea* at the rate of 25, 50, 75 and 100g were separately mixed with 4kg of steam-sterilized soil and the mixtures were transferred into 25 cm diameter perforated plastic pots.

Sowing of Seeds:

Seeds of cowpea, cv. “Kanannado” were sown into the pots filled with the mixture of steam-sterilized soil and leaf powder, and the control pots which contain only steam-sterilized soil. Three seeds were sown per pot at a depth of 2cm, but the seedlings were thinned to one per pot six days after emergence. The pots were watered once a day regularly and the potted soil around the base of the plants was loosened from time to time without disturbing plant roots using hand fork to avoid compacting.

Preparation of Inoculum:

Second-stage juvenile nematodes were used as inoculum. Eggs of *Meloidogyne incognita* were collected from a pure culture maintained on tomato roots using sodium hypochlorite technique (Hussey and Barker, 1973). The eggs were placed in a tap water in petri dish and incubated for 24 hours at room temperature for hatching. After hatching, the second-stage juveniles were collected and larval suspension was prepared in tap water.

Inoculation Procedure:

The cowpea plants were inoculated two weeks after planting into the pots. The population of about 3000 juvenile nematodes per plant was used. Four holes about 2cm deep and 1cm wide each were made in the soil around each seedling to expose the roots. The second-stage juvenile nematode suspension was applied into each hole with a syringe and the holes were filled with moist soil. Each treatment was replicated five times and the pots were laid out in a completely randomized experimental design in the screen house. The experiment was terminated sixty days after sowing.

Data Collection:

Growth and yield parameters:

At harvest, data were collected on shoot height using measuring tape, fresh weight of shoots and grain yield per plant were determined using electronic balance.

Estimation of nematode population in the soil:

The population of nematodes in the soil was determined using the modified Baermann funnel extraction technique (Barker, 1985).

Estimation of nematode population in the roots:

The population of nematode in the roots was determined using maceration method followed by Baermann’s funnel technique (Southey, 1970).

Assessment of gall index:

The roots were rated for the number of galls using a rating scheme described by Ogbuji (1981) as follows: 0 = 0 gall, 1 = 1 – 3 galls, 2 = 4 – 10 galls, 3 = 11 - 30 galls, 4 = 31 - 100 galls 5 = > 100 galls.

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Statistical Analysis:

All data collected were subjected to analysis of variance (ANOVA) and the means were separated using Duncan multiple range test.

3. RESULTS AND DISCUSSION

The results showed that all the treatments significantly (P<0.0001) suppressed the development of *Meloidogyne incognita* population in the soil as compared to the control. The highest population of 733.34 was recorded in the control treatment, while the population dropped to as low as 146.67 in the rhizosphere of plants treated with 100g of *C. siamea* leaf powder (CLP), representing 80.00% reduction over the control. This was followed by 75g CLP (253.34) 65.45% reduction, 50g CLP (306.67) 58.18% reduction and 25g CLP (373.34) with 49.09% reduction as compared to the control (Fig.1).

The highest population of *M. incognita* in the roots (189.34) was recorded in the control plants, while the lowest population (29.34) representing 84.5% reduction over the control was recorded in the plants grown in the soil amended with the 100g CLP. Likewise, this was followed by 75g (32.00) 83.1% reduction, 50g CLP (37.34) 80.28% reduction and 25g CLP (41.34) with 78.17% reduction as compared to the control treatment (Fig. 2).

The reproductive capacity of the nematodes was also significantly (P<0.0001) affected by the treatments imposed on the plants (Fig.3). The highest rate of reproduction of *Meloidogyne incognita* (1.041) was observed in the control plants, which was significantly different from other treatments. The highest reduction in the reproduction rate (0.206) representing 80.21% reduction as compared to the control was recorded in plants administered with 100g leaf powder of *C. siamea*. This was followed by plants administered with 75g (0.349) representing 66.47 % reduction, 50g (0.422) with 59.46% reduction and 25g (0.506) 51.39% reduction in the reproduction rate as compared to the control treatment.

The number of root galls incited by *Meloidogyne incognita* on the roots of cowpea peaked at 107.75 in the control (Fig.4), but ranged from as low as 21.50 in the 100g *C. siamea* leaf powder treated plants to 35.00 in the 25g *C. siamea* leaf powder treated plants. The plants treated with 100g of the leaf powder had the highest root gall reduction efficacy (80.05%), followed by plants treated with 75g (76.33%), 50g (73.78%) and 25g (67.52%). Fresh shoot weight and shoot height per plant were significantly (P<0.0001) higher in the plants treated with *C. siamea* leaf powder than in the control plants. The lowest shoot weight (10.18g) was recorded in the control plants, whereas the highest fresh shoot weight (37.93g) representing 272.59% increase over the control was recorded in plants treated with 100g of the leaf powder. Plants treated with 75g, 50g and 25g leaf powder recorded (34.11g) 235.07%, (31.39) 208.35% and (24.22g) 137.92% shoot weight increase over the control respectively (Table 1).

The lowest shoot height (10.50cm) was noted in the control plants, while the highest shoot height 61.34cm representing 484.19% increase over the control was recorded in plants treated with 100g leaf powder followed by 75g leaf powder (56.60cm) 439.05% increase, 50g leaf powder (45.34cm) 331.81% increase and 25g leaf powder (37.54cm) 257.52% increase over the control (Table 1).

Number of seeds per plant and grain yield per plant were significantly (P<0.0001) higher in the plants treated with *C. siamea* leaf powder than in the control plants. The highest number of seed per plant (54.75) was obtained from the plants treated with100g leaf powder followed by 75g leaf powder (50.75), 50g leaf powder (44.50) and 25g leaf powder (34.50). The lowest number of seeds per plant (10.00) was recorded in the control (Table 1).

The lowest grain yield (2.26g) was noted in the control plants while the highest grain yield (12.75g) representing 464.16% increase as compared to the control was recorded in plants treated with 100g leaf powder. Plants treated with 75g, 50g and 25g leaf powder recorded (10.69g) 373.01%, (9.58g) 323.89% and (7.29g) 222.57% yield increase respectively.

Results of this study showed that amending soil with leaf powder of *C. siamea* suppressed the population of *M. incognita* both in the soil and the roots of cowpea plants with a concomitant increase in growth and yield of cowpea. This result is in agreement with the previous findings of El-Nagdi *et al.* (2016) who reported that application of botanicals as soil amendment cause significant reduction in root knot nematode infestation which consequently lead to increase in the growth of different plants. Similarly, Bello *et al.* (2006) reported that water extract of seed, leaf and bark of *Cassia siamea* significantly inhibited larval hatch of *Meloidogyne incognita*. Previous studies on phytochemical screening showed that *Cassia siamea* contained anthraquinones, alkaloids, phytobatannins, saponin, tannins, oxalate and phylate

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(Smith, 2009). The significant reduction in nematode population, root knot disease and nematode reproduction factor observed in the plants treated with leaf powder of *Cassia siamea* may be due to the presence of these phytochemical in the leaves which might have been released into the soil during decomposition process. Presumably the nematicidal constituents are absorbed by the root with adverse effect on the feeding habit of the nematodes.

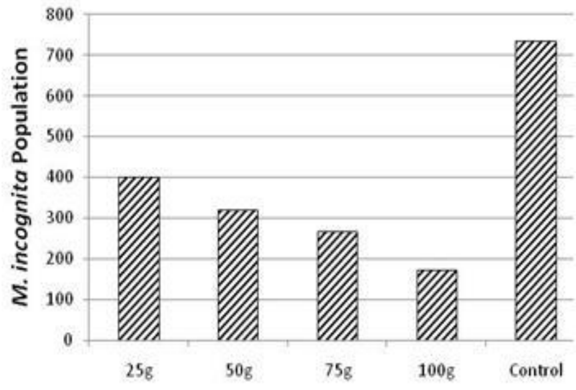

Fig 1: Effects of *C. siamea* leaf powder on population of *M. incognita* in the soil

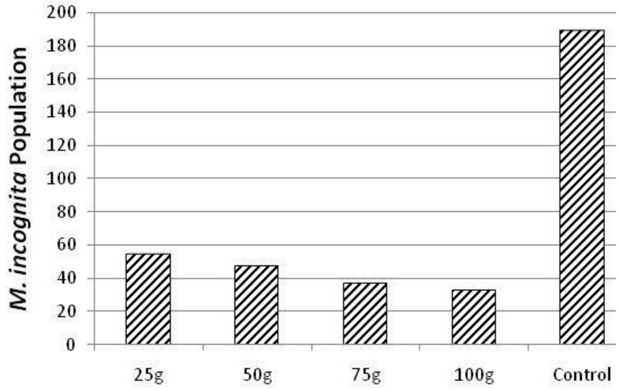

Fig 2: Effects of *C. siamea* leaf powder on the population of *M. incognita* in cowpea roots

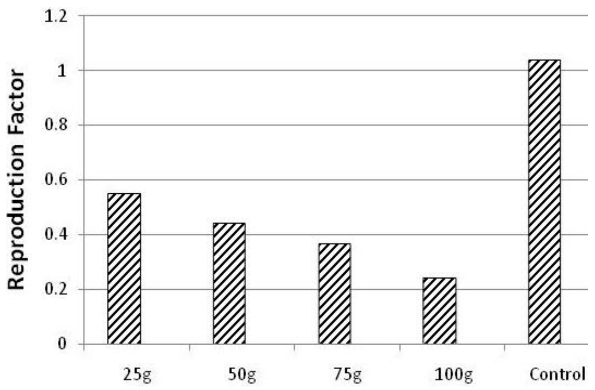

Fig 3: Effects of *C. siamea* leaf powder on reproduction factor of *M. incognita* in cowpea roots

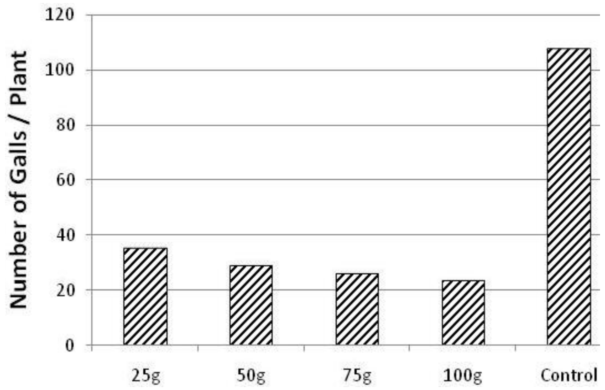

Fig 4: Effects of *C. siamea* leaf powder on the number of galls in cowpea roots

Table 1: Effect of *C. siamea* leaf powder (CLP) on the growth and yield of cowpea plants

Treatments	Fresh Shoot wt.(g)	Shoot Height (cm)	No. of seeds/ plant	Grain yield/ plant (g)
CLP 25g	24.22^{c} (137.92)	37.54^{c} (257.52)	34.50^{b} (245.0)	7.29^{b} (222.57)
CLP 50g	31.39^{b} (208.35)	45.34^{b} (331.81)	44.50^{ab} (345.0)	9.58^{b} (323.89)
CLP 75g	34.11^{b} (235.07)	56.60^{a} (439.05)	50.75^{ab} (407.5)	10.69^{ab} (373.01)
CLP 100g	37.93^{a} (272.59)	61.34^{a} (484.19)	54.75^{a} (447.5)	12.75^{a} (464.16)
Control	10.18^{d}	10.50^{d}	10.00^{c}	2.26^{c}

Means in the same column followed by the same letter do not differ statistically between themselves at 5% probability level as indicated by Duncan's test. Figures in parentheses indicate percentage increase as compared to the control.

4. CONCLUSION

In conclusion, the findings of this study showed that the leaf powder of *C. siamea* have strong nematicidal properties and its addition to the soil control the population build up of *Meloidogyne incognita* and results in better growth of cowpea. This finding is very important from the point of view of controlling root knot nematodes affecting cowpea since the use of synthetic nematicides by subsistence farmers is plagued with several limitations, such as prohibitive cost, lack of technical expertise in their applications and the environmental pollution they likely cause.

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