Effect of some plant as soil amendments in the management of *Meloidogyne incognita* on cucumber *(Cucumis sativus* L*)*

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ABSTRACT

The root-knot nematode, *Meloidogyne incognita* constitutes a major constraint to cucumber production. The management of the nematode calls for efforts that are cost-effective, culturally acceptable and environmentally safe. The focus of this study, was to assess the use of dry milled leaves of marigold (*Tagetes erecta*), Mexican sunflower (*Tithonia diversifolia*), Siam weed (*Chromolaena odorata*), and tree basil (*Ocimum gratissimum*), as soil amendments in the control of the root-knot nematode *M. incognita* on cucumber. Greenhouse and field experiments were conducted simultaneously at the National Horticultural Research Institute, Ibadan between 2008 and 2009 to investigate the effects of dry milled leaves of marigold, Mexican sunflower, Siam weed and tree basil each at rates of 1 ton/ha and 2ton/ha; and carbofuran at 1.5 kg a.i./ha and 2.5 kg a.i./ha on *M. incognita* infecting cucumber. Inoculated and unamended pots and plots served as control. In the greenhouse experiment, carbofuran-treated plants and Mexican sunflower-treated at 2t/ha produced the highest number of fruits (3 fruits per plant) P=0.05 compared to other treatments while basil-treated and the unamended control produced the least number of fruits (1 fruit/plant). The least galling (1.25) P=0.05 (1.25) and lowest nematode population at harvest (125/250ml soil) were recorded in carbofuran-treated plants and carbofuran-treated soilssoil respectively. No galls were observed on uninoculated control. Under field conditions, carbofuran-treated plotslants and Mexican sunflower at 2t/ha had the highest number of fruits

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(3.75). No fruit was produced in basil-treated plants and the unamended control. The least root galling (1.00) was also recorded from carbofuran and Mexican sunflower-treated plants while carbofuran-treated and Mexican sunflower-treated plotssoils had the least nematode population after harvest (10.25/250ml soil and 14.74/250ml soil, respectively.

The findings suggest that incorporation of marigold, Siam weed or Mexican sunflower at 2t/ha before planting by mixing the dried milled leaves powder with the soil was ieffective for root-knot nematode control in cucumber..

KEYWORDS: Galling index, Meloidogyne incognita, cucumber, galling index, *nematode population.*

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INTRODUCTION

Cucumber (*Cucumis sativus* L) is an edible fruit vegetable belonging to the family Cucurbitaceae. It is the second most important crop of the family next to watermelon. It is believed to have originated in Northern India (Anon, 2000). Cucumber production in Nigeria is fast becoming popular since it is a useful ingredient in the preparation of salad and liquor drink. AdditionallyIt also has has medicinal and therapeutic values such as in the cure of hypertension and skin diseases . It is also has a valuable source of potassium, sodium, magnesium, silicon, phosphorous, chlorine and fluorine (Rai and Yadav, 2005). Consumption of cucumber with vegetables, cereals, fruits, nuts and salads enhances the nutritional value of food items (Anon, 2000).

Pests and diseases constitute a major threat to the production of cucumber in Nigeria. Amongst these areis the rootknot nematodes, *Meloidogyne* spp. (Darekar and Bele, 1990). Other nematodes such as sting nematodes occasionally cause some losses in cucumber production. Complete failure of this crop due to *Meloidogyne incognita* has been observed in some localities (Darekar *et al*. 1988). Root-knot nematodes, Meloi*dogyne spp*. are widely distributed in Nigeria and have a wide host range (Adesiyan *et al*., 1990). .

The control of these nematodes by nematicides has been effective but they are costly, cause ecological hazards and are environmentally

unsafe. These have greatly reduced their use by many farmers (Adesiyan *et al*., 1990). Therefore this work focused on the use of low input plant sources as soil amendments for the management of root-knot nematode infecsting cucumber.

MATERIALS AND METHODS

Greenhouse studies were conducted in two separate trials with carbofuran and air-dried, milled leaf samples of marigold **(***Tagetes erecta***)**, Siam weed(*Chromonaela odorata)*, Mexican sunflower *(Tithonia diversifolia)* and tree basil *(Occimum gratissimum).* The experimental design was randomized complete block with 12 treatments in four replicates. The treatments were made up of 1t/ha and 2t/ha of each of the four plants, two rates of carbofuran 1.5kg a.i./ha and 2.5kg a. i./ha, inoculated and uninoculated controls.

Two weeks before planting, carbofuran 3G at two rates: 1.5 kg a. i./ha and 2.5 kg a. i./ha, and air-dried leaf powdermilled powdered of *Tagetes erecta,* (leaves) *Chromolaena odorata* (Leaves) *Tithornia diversifolia* (leaves) and *Ocimum gratissimium* (leaves) at the rates of 1t/ha and 2t/ha (Oyedunmade and Olabiyi, 2006) were applied to steam-sterilized soil in 11 litres buckets of 25cm diameter. Two cucumber seeds (Marketmore variety) were sown in each of the 48 buckets containing 12.5 kg of steam-sterilized soil. One week after germination, the seedlings were thinned down to one uniformly vigorous plant per pot. The plants in 44 of the plastic buckets were inoculated with 10,000 eggs of *M. incognita.* The plants in the remaining 4 buckets were not inoculated. They served as uninoculated control. The treatments were not applied to four pots which served as unamendment inoculated control.

A field naturally infested with *M. incognita* was used for the field study. Three months before the commencement of this study *Celosia argentea* was planted on this field to further increase the nematode population in the soil . The experimental plot was 16m x 9m. This was divided into four blocks . Thereafter, the field was divided into four 4 equal blocks of 16m x 1.5m each. Each block was further divided into 11 plots of 1.5m x 2.5m each. There was alley of 1m between blocks and 0.5m between plots. The experiment was laid out in randomized complete block design with eleven treatments in four replicates. The treatments were made up of air-dried milled samples of marigold (*Tagetes erecta*), Siam weed (*Chromonaela odorata)*, Mexican sunflower *(Tithonia diversifolia)* and tree basil *(O.ccimum gratissimum)* each at two rates 1t/ha and 2t/ha;

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carbofuran at two rates: 1.5kg a.i./ha and 2.5kg a. i./ha and control (unamended).

Soil sample was collected from each of the 44 plots into labeled polyethylene bags before planting. These were taken to the laboratory for extraction of nematodes using the method of WhiteHehead and Hemming (1965). The nematodes were identified under a light microscope while population estimation was done with the aid of Doncaster counting dish (Doncaster, 1962) and stereomicroscope.

Air-dried milled samples of Marigold **(***Tagetes erecta***)**, Siam weed (*Chromonaela odorata)*, Mexican sunflower *(Tithonia diversifolia) and* Tree basil *(Ocimum gratissimum)* each at two rates: 1t/ha and 2t/ha were applied to 32 plots and Carbofuran 3G at two rates 1.5kg a.i./ha and 2.5kg a. i./ha were also applied to 8 plots by mixing with the soil, twoone week after application of the soil amendments the cucumber seeds (marketmore variety) were sown at a spacing of 50cm within 75cm between row this gave a total of 15 plants per plot and a plant population of 660 in the whole field.

Data were collected on vine length, Number of leaves, number of branches, vine diametergirth for six weeks, at harvest number of fruits, fruit weight and fruit length were also collected. Six weeks after inoculation the experiments were terminated and the following data were also collected, fresh shoot weight, gall index on 0-5 scale, root weight, nematode population in 250ml soil and egg population in the root.

All Data collected were analysed using analysis of variance with PC/SAS software and significant differences among treatments were separated using Duncan Multiple Range (DMRT) at probability level of 5%.

RESULTS AND DISCUSSION

The highest mean number of fruits was recorded on plants that was treated with Mexican sunflower at 2t/ha which was not significantly different P=0.05 from the carbofuran treated plants at 2.5kg a.i./ha (Table 1). The plants treated with carbofuran at 2.5 kg a.i. and 1.5kg a.i. had the lowest mean galling indices while inoculated control had the highest galling index. At 6 weeks after inoculation, control plants (inoculated control was the most galled for both trials (5.00). This level of galling was significantly higher P=0.05 than those of other plants. The plants treated with carbofuran at 2.5kga.i./ha were the least galled (1.25) this was not significantly lower P=0.05 than the galling in plants treated with

Table 1: Effects of carbofuran, Mexican sunflower, Basil, Siam weed and Marigold on Yield of cucumber infected with M. incognita 1st and 2nd Trials green house experiments

	1st Trial				2nd Trial			
Trt	Fshwt (g)	DShwt (g)	NFruit	FruitWt (g)	Fshwt (g)	Dshwt (g)	NFruit	FruitWt (g)
Marigold (1t/ha)	212.50c	28.63d	1.00ab	93.75b	181.25c	23.69c	0.75ab	80.00cd
Marigold (2t/ha)	228.75bc	30.63d	1.25ab	87.50b	211.50bc	29.41bc	0.75ab	90.00cd
Chromolaena (1t/ha)	220.00bc	31.55cd	1.00ab	118.75ab	201.25bc	27.17bc	0.75ab	68.75d
Chromolaena (2t/ha)	192.50cd	35.03c	1.00ab	112.50ab	188.75cd	23.28c	1.00ab	87.50d
Tithonia (1t/ha)	281.25a	24.84e	0.50b	128.00ab	258.75a	26.15bc	0.50b	120.00bc
Tithonia (2t/ha)	298.75a	43.05a	2.25a	346.00a	281.50a	33.82a	1.75ab	205.00a
Basil (1t/ha)	243.75b	33.82c	0.75ab	207.00ab	223.75b	28.45bc	0.75ab	87.50d
Basil (2t/ha)	228.75bc	33.58c	1.00ab	250.00ab	211.25bc	27.95bc	1.00ab	118.75bc
Carbofuran (1.5kg a. i/ha	142.50e	23.50e	2.00ab	165.00ab	127.50d	21.04d	1.75ab	140.00ab
Carbofuran (2.5kg a. i/ha	200.00c	31.63cd	2.25a	328.00a	206.25c	28.57bc	2.00a	188.75ab
Inoculated control	197.50cd	33.05cd	0.75ab	181.25ab	172.50cd	24.15cd	0.75ab	106.25bc
Uninoculated control	175.00d	27.23d	1.25ab	287.50ab	171.25cd	20.50d	1.75ab	185.00ab

Means followed by the same letter in the same column are not significantly different by Duncan Multiple Range Test ($P \leq 0.05$)

FShwt = Fresh shoot weight, DSwt = Dry shoot weight, NFruit = Number of fruits, FruitWt = fruit weight

Table 2: Effects of carbofuran, Mexican sunflower, Basil, Siam weed and Marigold on plant root damage and nematode reproduction on cucumber infected with M. incognita 1st and 2nd Trials green house experiments

	1st Trial				2nd Trial			
Trt	Gl	Rt Pop	Soil Pop	Rf	Gl	Rt Pop	Soil Pop	Rf
Marigold (1t/ha)	2.00bc	2325c	750ab	0.31bc	1.75bc	2100b	555.00b	0.27b
Marigold (2t/ha)	2.00bc	5050bc	650ab	0.57bc	1.90bc	4125b	512.50b	0.47b
Chromolaena (1t/ha)	1.75bc	2375c	450bc	0.28c	1.75bc	1750b	387.50bc	0.22b
Chromolaena (2t/ha)	2.52b	4750bc	525bc	0.53bc	2.50b	4500b	350.00bc	0.48b
Tithonia (1t/ha)	2.75b	4050bc	550bc	0.46bc	2.68b	4000b	312.50bc	0.43b
Tithonia (2t/ha)	2.00bc	4025bc	250bc	0.42bc	1.75bc	1925b	112.50bc	0.21b
Basil (1t/ha)	2.50b	8500b	400bc	0.89b	2.00b	4475b	312.50bc	0.48b
Basil (2t/ha)	1.25c	5150bc	550abc	0.57bc	1.20c	1435b	212.50bc	0.18b
Carbofuran (1.5kg a. i/ha	1.25c	1475c	225bc	0.17c	1.25c	1525b	175.00bc	0.12b
Carbofuran (2.5kg a. i/ha	1.25c	1525c	125bc	0.16c	1.25c	975b	100.00bc	0.16b
Inoculated control	5.00a	18550a	1150a	1.97a	5.00a	17900a	1575.00a	1.95a
Uninoculated control	0.00d	0.00d	0.00d	0.00d	0.00d	0.00c	0.00d	0.00b

Means followed by the same letter in the same column are not significantly different by Duncan Multiple Range Test ($P \leq 0.05$)
Gl = Gall indices Rt pop = Root nematode population, Soil pop = Soil nematode population, Rf = Nematode Reproductive factor

Table 3: Effects of carbofuran, Mexican sunflower, Basil, Siam weed and Marigold on fresh shoot weight, dry shoot weight, number of fruit and fruit weight of cucumber infected with M. incognita 1st and 2nd Trials under field conditions

	1st Trial				2nd Trial			
Trt	Fshwt (g)	Dshwt (g)	NFruit	FruitWt (g)	Fshwt (g)	Dshwt (g)	NFruit	FruitWt (g)
Marigold (1t/ha)	220.84bcd	40.12abcd	2.5a	407.5a	224.25bcd	39.36abcd	2.8a	360.00b
Marigold (2t/ha)	316.67ab	59.11a	3.75a	505.00a	311.50ab	48.75a	4.00a	427.50ab
Chromolaena (1t/ha)	120.00d	25.84d	3.25a	477.50a	115.67d	23.62d	3.28a	420.00ab
Chromolaena (2t/ha)	121.80d	27.94cd	3.75a	522.50a	120.48d	26.34cd	3.78a	467.50ab
Tithonia (1t/ha)	156.67cd	32.96bcd	3.00a	447.5a	151.73cd	35.15a	3.4a	400.00b
Tithonia (2t/ha)	321.67ab	55.75a	3.5a	532.5a	289.50ab	45.38a	3.8a	487.50ab
Basil (1t/ha)	235.83bcd	45.59abc	0.5b	92.50b	231.34cd	30.42abc	0.86b	82.5c
Basil (2t/ha)	266.25abc	48.41ab	0.00b	0.00b	242.25bcd	38.2ab	0.5b	75.86c
Carbofuran (1.5kg a. i/ha	364.58a	42.32abcd	565.00a	565.00a	327.61a	40.67a	4.25a	542.50ab
Carbofuran (2.5kg a. i/ha	395.75a	58.51a	620.00a	620.00a	357.67a	53.32a	5.00a	650.00a
control	125.00d	24.81d	0.00c	0.00c	120.00e	20.15d	0.00c	0.00d

Means followed by the same letter in the same column are not significantly different by Duncan Multiple Range Test ($P \leq 0.05$)
FShwt = Fresh shoot weight, DSwt = Dry shoot weight, NFruit = Number of fruits, FruitWt = fruit weight

Table 4: Effects of carbofuran, Mexican sunflower, Basil, Siam weed and Marigold on plant root damage and nematode reproduction on cucumber infected with M. incognita 1st and 2nd Trials green house experiments

Trt	1st Trial GI	Rt Pop	Soil Pop	Rf	2nd Trial GI	Rt Pop	Soil Pop	Rf
Marigold (1t/ha)	1.00bc	30.75c	20.00c	0.46d	1.04bc	39.45c	25.00c	0.56c
Marigold (2t/ha)	1.5b	27.50c	16.25c	0.61d	1.8b	28.67c	422.25c	0.71c
Chromolaena (1t/ha)	1.25bc	33.25c	26.75	0.75d	1.24bc	34.65c	25.00c	0.75c
Chromolaena (2t/ha)	1.50b	31.50c	23.25c	0.60d	1.40b	32.00c	21.25c	0.64c
Tithonia (1t/ha)	0.75bc	19.50c	26.25c	0.46d	0.65bc	20.48c	30.25c	0.51c
Tithonia (2t/ha)	0.25c	16.75c	14.75c	0.43d	0.32c	15.34c	15.50c	0.44c
Basil (1t/ha)	4.25a	120.75b	133.25b	2.51b	5.00a	100.56b	157.50b	2.96b
Basil (2t/ha)	3.75a	94.50b	120.75b	1.61c	3.45a	92.50b	121.25b	2.11b
Carbofuran (1.5kg a. i/ha	1.00bc	20.00c	14.25c	0.39d	0.78bc	18.45c	11.25c	0.41c
Carbofuran (2.5kg a. i/ha	1.00bc	17.00c	10.50c	0.30d	0.58bc	17.25c	8.75c	0.33c
control	4.5a	230.00a	342.5a	5.47a	5.00a	220.24a	406.25a	4.73a

Means followed by the same letter in the same column are not significantly different by Duncan Multiple Range Test ($P \leq 0.05$)

Gl = Gall indices Rt pop = Root nematode population, Soil pop = Soil nematode population, Rf = Nematode Reproductive factor

The use of leaf powder of marigold, siam weed and Mexican sunflower showed a significant increase in growth and yield of cucumber which was found to be associated with the increasing rate of application of these plants and subsequent decrease in nematode population this was also observed by Firoza and Maqbool 1996b on tomatoes. Carbofuran treated plants had the least galling while the least nematode population was recorded also in carbofuran treated soil. Marigold, Siam weed and Mexican sunflower treated plants were less galled than control plants and the treated soil had less nematode population than untreated soil. This implies that carbofuran was effective in reducing nematode population as well as root-knot infection however, marigold, Mexican sunflower and siam weed compared positively with this synthetic nematicide. This observation is also collaborated with findings of Polthanee and Yamazaki, 1996 on rice in which marigold (*Tagetes patula)* was effective in controlling root-knot nematode (*M. incognita)* of rice in north-eastern Thailand. Marigold treatment (grown and incorporated into soil before planting rice) suppressed nematode root galling and increased rice grain yield by 46% over the untreated check. The increase in yield was attributed to a reduction of nematode population in the soil. In addition, marigold plant materials served as organic manure and provided nutrients for rice growth (Polthanee and Yamazaki, 1996).

Amendment with chopped green leaves of marigold effectively reduced *M. incognita* on okra and cowpea the crops yield also increased by 94-135% in okra and 45-50% in cowpea (Ajith and Sheela, 1996). Kashaja *et al.,* 1999 incorporated *Chromolaena odorata* as soil organic amendment this improved the yield of *Musa* spp. and reduced the population of *M. incognita*. Studies on the comparative effects of the incorporation of leaves of *Brassica campestris*, *Catharanthus roseus, Pedilanthus tithymaloides, Ricinus communis, Azadirachta indica* and *C. procera* at 80g/kg soil with carbofuran application at 2kg a.i/ha for the control of *M. incognita* on tomato showed that *B. campestris, P. tithymaloides, R. communis, A. indica* and *C. procera* were as effective as carbofuran for control of *M. incognita* (Rao and Reddy, 1992). Oyedunmade and Olabiyi (2006) reported that aqueous extracts and leaf powdered of siam weed, red acalypha and bitter leaf reduced population of root-knot nematode *M. incognita* both in soil and root of sesamum. All the findings above were collaborated with the current findings, in which all the milled plants at 2t/ha applied as soil amendment compared comparatively with carbofuran under field conditions.

The findings suggest that incorporation of marigold, Siam weed or Mexican sunflower at 2t/ha before planting by mixing the dried milled powdered with the soil will effectively prevent root-knot nematode population from reaching economic injury level.

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