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The Effect of Oil Seed Cakes and Ploughing Against Plant Parasitic Nematodes on Cowpea (*Vigna unguiculata* (L.) Walp)

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Abstract: The effects of four-soil amendments (groundnut cake, neem cake, castor cake and NPK) and ploughing against plant parasitic nematodes in cowpea (*Vigna unguiculata* (L) Walp) CV IAR 48 were investigated between 2003 and 2004. The experiment was carried out at the Teaching and Research Farm, Federal University of Technology, Yola, Nigeria between the month of August and October 2003 and 2004. The experimental plot was ploughed at normal (20 cm) and deep (60 cm), leveled and demarcated into subplots measuring 2×2 m^2 with 1 m alleys in a complete randomized block design. The treatments were oil seed cakes of neem (*Azadirachta indica*), groundnut (*Arachis hypogea*) and castor (*Ricinus communis*) applied at 120 kg ha^{-1}, N.P.K. (20.10.10) as urea at 90 kg N ha^{-1}, single super phosphate 45 kg P ha^{-1} and murate of potash, 45 kg K ha^{-1} were incorporated into the field before planting cowpea seeds. The untreated control received no treatment. There were 5 treatments and 3 replications. The oil cakes were incorporated into the soil 4 weeks to allow the proper decomposition before seed of cowpea variety IAR-48 were planted into the subplots. NPK (20:10:10) was applied as basal application at planting. The result of the investigation indicated that soils amended with neem cake gave better nematode control. Also the 60 cm depth of ploughing gave lower population of plant parasitic nematodes than the unamended control plots.

Key words: Plants parasitic nematodes, oil seed cakes, N.P.K, ploughing, cowpea, protein, growth parameters

INTRODUCTION

Cowpea also called "southern pea" and "Black eye pea" has been cultivated for many years in the developing world. The crop is well adapted to the stressful growing condition of the tropics and has the excellent nutritional qualities. Cowpea provides more than half of the plant protein in human diets in some part of the tropics. A pulse crop high in protein (24%) and soluble carbohydrate (62%) and small amount of other nutrients (Rachie, 1985; Bliss, 1975). On its account to fix nitrogen efficiently up to 240 kg ha^{-1} as it provides a high proportion of its own nitrogen requirements, besides leaving a fixed nitrogen deposit in soil of up to 60-70 kg ha^{-1} for the succeeding crop (Rachie, 1985). The hay of the crop is also used as animals feed. Nigeria is the leading producer of cowpea with 850,000 t produce annually (Rachie, 1985).

Cowpea is one of the most aggressively attacked by a legion of pests especially in southern Nigeria (Caveness, 1979; Rachie, 1985). In Nigeria cowpea are attacked by *M. incognita, M. acrita, M. arenaria, M. javanica, Rotylenchulus* and *Hoplolaimus* sp. in all regions where root-knot nematodes have been reported (Ogunfowora, 1976; Caveness, 1979). To obtain any appreciable yield of the crop there is need to step up control measures against plants parasitic nematodes. The used of chemical nematicides is perhaps the most effective and reliable method in nematode control infecting crops. However, one of the major problems of nematicides usage is its toxicity to both human and the environment. The attention is now shifted to less hazardous and environment friendly control measures such as organic amendments and inorganic fertilizers for the control of plant-parasitic nematodes. The aim of the study was to investigate the effects of oil seed cakes, inorganic fertilizer and ploughing in the control of plant-parasitic nematodes in cowpea fields.

MATERIALS AND METHODS

The experiment was carried out at the Teaching and Research Farm, Federal University of Technology, Yola, Nigeria between the month of August and October 2003 and 2005. The experimental plot was ploughed, leveled

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and demarcated into subplots measuring 2×2 m^2 with 1 m alley in a complete randomized block design. The treatments were oil seed cakes of neem (*Azadirachta indica*), groundnut (*Arachis hypogea*), castor (*Ricinus communis*) applied at 120 kg ha^{-1}, N.P.K. (20.10.10) as urea at 90 Nkg ha^{-1}, single super phosphate 45 kg P ha^{-1} and murate of potash, 45 kg K ha^{-1} were incorporated into the field before planting cowpea seeds. The untreated control received no treatment. There were treatment and 5 replications. The oil cakes were incorporated into the soil 4 weeks to allow proper decomposition before seed of cowpea variety IAR-48 were planted into the subplots. N.P.K. (20:10:10) was applied as basal application at planting. Cowpea was planted at the spacing of 50×50 cm at 2 plants/hill and later thinned down to one plant/hill. All organic activities were carried out when necessary. The experiment was carried out under normal ploughing (20 cm) and deep ploughing (60 cm). The physico-chemical characteristics of the soil was carried out by taken 500 g soil of each subplot before mixing it thoroughly in a bucket and 200 g was taken for analysis.

Nematodes population was determine before the incorporation of the amendments and at the end of the experiments using the modified Baermann funnel method (Whitehead and Hemming, 1965). Nematodes suspension obtained were counted by transferring 5 mL of the suspension into a Doncaster counting dish. From each nematode suspension, using a dissecting microscope, Several nematodes were picked from 10 aliquots of 2 mL each and gentle killed in hot water, fixed in TAF and mounted in glycerine (Golden, 1990). The nematodes were dissected using compound microscope and identifying them using their major identification structures to genera level. The total number of each genus from each of the treated soil was estimated. Root galls were also counted from each plant.

Data were collected on plant height, number of leaves/plants, number of pod/plants, shoot and root fresh and dry weights, root nodule index (on 0-5 scale) as described by Sartaj and Alam (1994). Nitrate reductase activity in the leaves was estimated by the method of Jaworski (1971), chlorophyll content of leaves was estimated by the method of Hiscox and Israelstam (1979). All data collected were subjected to analysis of variance and Duncan's new multiple range test at 5% was used to separate means.

RESULTS AND DISCUSSION

The result of the physico chemical, analysis of the soil indicates that the soil is sandy loam with pH 6.7. The soil contains 1.75% carbon and 3.03% organic matter with total NPK (me/100 g) as 0.04, 0.9 and 0.2, respectively. This shows that the soil had very low percentage of NPK.

Table 1: Effect of soil amendments and normal ploughing (20 cm) against plant-parasitic nematodes population on cowpea (*Vigna unguiculata* (L) Walp) CV IAR 48 in the field experiment in 2003 and 2004 in Yola, Nigeria

	Population of plant parasitic nematodes/500 g soil									
	2003					2004				
Treatments	Mj	Ma	Hi	Rr	Pr	Mj	Ma	Hi	Rr	Pr
CN (no amendment)	698^{a}	268^{a}	42^{a}	138^{a}	40^{a}	756^{a}	356^{a}	83^{a}	152^{a}	74^{a}
Groundnut cake	231^{b}	156^{b}	36^{a}	122^{b}	22^{b}	139^{b}	98^{b}	20^{b}	103^{b}	10^{b}
Neem cake	145^{c}	78^{c}	18^{b}	68^{c}	20^{b}	94^{c}	38^{c}	8^{c}	32^{c}	8^{b}
Castor cake	196^{c}	98^{b}	22^{b}	40^{d}	18^{b}	102^{d}	62^{d}	12^{c}	18^{d}	12^{b}
N.P.K. (20.10.10)	265^{b}	112^{b}	24^{b}	41^{d}	24^{b}	130^{b}	70^{d}	12^{c}	10^{d}	14^{b}

Mean of seven observations. Means with same letters in same column are not significantly different at 5% according to Duncan's multiple range test. Mj-*Meloidogyne javanica*, Mi- *Meloidogyne incognita*, Hi- *Hiplolaimus indicus*,Rr- *Rotylenhulus reniformis*, Pr- *Pratylenchus* sp, CN- Control

Table 2: Effect of soil amendments and deep ploughing (60 cm) against plant-parasitic nematodes population on cowpea (*Vigna unguiculata* (L) Walp) CV IAR 48 in the field experiment in 2003 and 2004 in Yola, Nigeria

	Population of plant parasitic nematodes/500 g soil									
	2003					2004				
Treatments	Mj	Ma	Hi	Rr	Pr	Mj	Ma	Hi	Rr	Pr
CN (no amendment)	530^{a}	220^{a}	37^{a}	146^{a}	47^{a}	480^{a}	130^{a}	33^{a}	140^{a}	40^{a}
Groundnut cake	201^{b}	120^{b}	20^{b}	102^{b}	14^{b}	119^{b}	80^{b}	12^{b}	88^{b}	11^{b}
Neem cake	128^{c}	54^{c}	10^{b}	38^{c}	10^{b}	80^{c}	17^{c}	8^{c}	10^{c}	5^{b}
Castor cake	140^{d}	88^{b}	12^{b}	18^{d}	12^{c}	92^{d}	44^{d}	10^{c}	12^{c}	8^{b}
N.P.K. (20.10.10)	265^{b}	92^{b}	14^{b}	20^{d}	14^{b}	97^{d}	30^{e}	9^{c}	10^{c}	10^{b}

Mean of seven observations. Means with same letters in same column are not significantly different at 5% according to Duncan's multiple range test. Mj-*Meloidogyne javanica*, Mi- *Meloidogyne incognita*, Hi- *Hiplolaimus indicus*,Rr- *Rotylenhulus reniformis*, Pr- *Pratylenchus* sp, CN-Control

Table 3: Effect of soil amendment and normal ploughing (20 cm) against plant-parasitic nematodes on cowpea (*Vigna unguiculata* (L) Walp) CV IAR 48 in the field experiment in 2003 in Yola, Nigeria

Treatments	PLH (cm)	NL	NP/plant	FSW(g)	FRW(g)	DSW(g)	DRW(g)	RNI(0-5)	GI/plant	NRA	Total CHL content
CN (no amendment)	16.51[a]	13.49[a]	11.14[a]	30.11[a]	40.20[a]	13.10[a]	22.91[a]	1.06[a]	5[a]	0.237[a]	1.298[a]
Groundnut cake	26.47[b]	22.61[b]	24.60[b]	53.39[b]	15.16[b]	15.0[b]	1.03[b]	3.60[b]	3[c]	0.441[b]	3.261[b]
Neem cake	32.33[c]	28.60[c]	30.15[c]	71.59[c]	20.31[c]	20.32[c]	4.01[c]	4.71[b]	2[b]	0.599[b]	3.663[b]
Castor cake	28.87[b]	23.51[b]	27.21[b]	53.20[b]	16.52[b]	15.09[b]	1.98[b]	3.31[b]	3[c]	0.456[b]	3.250[b]
N.P.K. (20.10.10)	26.32[b]	23.01[b]	22.01[b]	54.11[b]	16.91[b]	15.75[b]	1.72[b]	3.11[b]	3[c]	0.432[b]	3.252[b]

Mean of seven observations. Means with same letters in same column are not significantly different at 5% according to Duncan's multiple range test. PLH-Plant height, NL- Number of leaves, NP- Number of pods, FSW- Fresh shoot weight, DSW-Dry shoot weight, RNI- Root nodule index, GI-Galling index, NRA- Nitrate reductase activity, CHL- Chlorophyll, CN- Control

Table 4: Effect of soil amendment and deep ploughing (60 cm) against plant-parasitic nematodes on cowpea (*Vigna unguiculata* (L) Walp) CV IAR 48 in the field experiment in 2003 in Yola, Nigeria

Treatments	PLH (cm)	NL	NP/plant	FSW(g)	FRW(g)	DSW(g)	DRW(g)	RNI(0-5)	GI/plant	NRA	Total CHL content
CN (no amendment)	14.33[a]	14.51[a]	13.17[a]	28.31[a]	45.71[a]	13.61[a]	25.32[a]	2.01[a]	5[a]	0.298[a]	1.474[a]
Groundnut cake	32.41[b]	27.02[b]	28.71[b]	56.21[b]	21.30[b]	15.01[b]	5.32[b]	4.32[b]	3[b]	0.562[b]	3.732[b]
Neem cake	40.11[c]	33.22[c]	36.22[c]	77.25[c]	26.41[c]	25.72[c]	6.41[b]	4.64[b]	2[c]	0.671[b]	4.964[b]
Castor cake	35.19[b]	27.11[b]	31.31[b]	58.19[b]	22.36[b]	16.22[b]	4.15[b]	4.37[b]	3[b]	0.542[b]	3.572[b]
N.P.K. (20.10.10)	31.06[b]	27.53[b]	29.65[c]	57.38[b]	22.71[b]	15.16[b]	4.63[b]	4.41[b]	3[b]	0.521[b]	3.421[b]

Mean of seven observations. Means with same letters in same column are not significantly different at 5% according to Duncan's multiple range test. PLH-Plant height, NL- Number of leaves, NP- Number of pods, FSW- Fresh shoot weight, DSW-Dry shoot weight, RNI- Root nodule index, GI-Galling index, NRA- Nitrate reductase activity, CHL- Chlorophyll, CN- Control

Table 5: Effect of soil amendment and deep ploughing (20 cm) against plant-parasitic nematodes on cowpea (*Vigna unguiculata* (L) Walp) CV IAR 48 in the field experiment in 2004 in Yola, Nigeria

Treatments	PLH (cm)	NL	NP/plant	FSW(g)	FRW(g)	DSW(g)	DRW(g)	RNI(0-5)	GI/plant	NRA	Total CHL content
CN (no amendment)	14.52[a]	12.22[a]	13.75[a]	22.75[a]	42.72[a]	6.23[a]	25.22[c]	1.71[a]	5[a]	0.278[a]	0.361[a]
Groundnut cake	28.32[b]	25.22[b]	27.21[b]	56.11[b]	27.21[b]	14.67[c]	1.56[a]	3.66[b]	3[b]	0.632[b]	3.561[b]
Neem cake	34.33[c]	31.21[c]	32.76[c]	72.69[c]	32.76[c]	17.12[b]	3.44[b]	4.41[a]	1[c]	0.711[b]	3.942[b]
Castor cake	29.61[b]	26.11[b]	29.82[b]	55.68[b]	29.82[b]	13.56[c]	1.23[a]	3.32[b]	3[b]	0.621[b]	3.457[b]
N.P.K. (20.10.10)	28.11[b]	25.62[b]	27.62[b]	54.11[b]	27.62[b]	12.11[c]	1.43[a]	3.01[b]	3[b]	0.644[b]	3.521[b]

Mean of seven observations. Means with same letters in same column are not significantly different at 5% according to Duncan's multiple range test. PLH-Plant height, NL- Number of leaves, NP- Number of pods, FSW- Fresh shoot weight, DSW-Dry shoot weight, RNI- Root nodule index, GI-Galling index, NRA- Nitrate reductase activity, CHL- Chlorophyll, CN- Control

Table 6: Effect of soil amendment and deep ploughing (60 cm) against plant-parasitic nematodes on cowpea (*Vigna unguiculata* (L) Walp) CV IAR 48 in the field experiment in 2004 in Yola, Nigeria

Treatments	PLH (cm)	NL	NP/plant	FSW(g)	FRW(g)	DSW(g)	DRW(g)	RNI(0-5)	GI/plant	NRA	Total CHL content
CN (no amendment)	14.33[a]	12.19[a]	12.43[a]	20.34[a]	47.12[a]	8.45[a]	24.32[a]	1.19[a]	5[a]	0.101[a]	0.986[a]
Groundnut cake	35.09[b]	29.70[b]	31.39[b]	58.89[b]	25.81[b]	18.69[b]	8.01[b]	4.68[b]	3[b]	0.781[b]	3.876[b]
Neem cake	42.79[c]	35.90[c]	39.90[c]	79.94[c]	29.10[c]	28.33[c]	9.07[b]	4.95[b]	2[c]	0.862[b]	4.997[b]
Castor cake	37.87[b]	28.01[b]	29.79[b]	60.78[b]	25.04[b]	18.99[b]	6.73[b]	4.45[b]	3[b]	0.747[b]	3.823[b]
N.P.K. (20.10.10)	33.74[b]	30.21[b]	30.21[b]	60.06[b]	25.39[b]	18.74[b]	7.31[b]	4.62[b]	3[b]	0.749[b]	3.772[b]

Mean of seven observations. Means with same letters in same column are not significantly different at 5% according to Duncan's multiple range test. PLH-Plant height, NL- Number of leaves, NP- Number of pods, FSW- Fresh shoot weight, DSW-Dry shoot weight, RNI- Root nodule index, GI-Galling index, NRA- Nitrate reductase activity, CHL- Chlorophyll, CN- Control

There were significant differences at 5% between the treated plots and untreated control plots in all the growth parameters (plants height, number of leaves, number of pods, fresh and dry shoot weight of shoot and root total chlorophyll content of leaves) measured in both 2003 and 2004 experiments. The increased in the growth parameters was more in deeply ploughed plots treated with neem than the other treatments. Also the increased was even more pronounced in deeply ploughed plots in 2004 than in 2003. The untreated control plots recorded lower growth parameters in both normal and deeply ploughed plots due to increased in nematodes populations which affected the growth of cowpea plants. The increased in the growth parameters in amended soils was due to the reduction of the population of the plant parasitic nematodes (Table 1 and 2) by the amendments that contained nitrogen. The decayed amendment was due to the decomposers, which help in the stimulating of nitrate reductase in the soil (Table 3-6). It has been reported that microbial activities in amended soil is known to bring about increased conversion of nitrogen to nitrate (Gunnar, 1963). The result obtained is similar to those obtained by Sartaj and Alam (1994) when they used oil seed cakes in nematodes control on mung bean and chickpea.

The depth of ploughing in both treated and untreated plots were significantly different at 5% for both 2003 and 2004. In normal ploughed plots, there was little reduction of plant parasitic nematodes populations compared with deeply ploughed treated plots (Table 1 and 2). The results indicated that nematodes control with soil amendments would better be achieved in deeply ploughed than under normal ploughing. Khan *et al.* (1990) reported that deep ploughing reduces plant parasitic nematodes population. The number of galls counted in the treated plots was drastically reduced than in the untreated plots (Table 3-6). The unamended control plots had more galls because there was high activity of nematodes at the root zone of cowpea, on the other hand, the activity of nematodes at the root zone of cowpea was drastically reduced due to the efficacy of the amendments, which reduces their penetration into the roots of cowpea. Among the treated plots, neem cake amended plots gave the best results, followed by castor and groundnuts cakes in that order. The N.P.K. (20:10:10) fertilizer also reduced the population of plant parasitic nematodes in the soil but not as high as those of the amendments. The results are line with those of Darekar *et al.* (1990), Bertrand and Lizot (2000), Sartaj and Alam (1994) using different crops.

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