Soil Texture effect on Growth of Cowpea Plants under Root-knot Nematode, *Meloidogyne incognita* Infested Conditions

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ABSTRACT

Root-knot nematode (*M. incognita*) constitutes one of the important nematode pests on cowpea (*Vigna unguiculata*). The edaphic factors of soil such as soil texture play vital role in determining the severity of diseases caused by plant-parasitic nematodes.

Screen house studies were conducted in 2013 and 2014 using 15cm size plastic pots (one kg capacity) having soils of five different textures (clay, clay loam, sandy loam, loamy sand and sand) on root-knot nematode (*M. incognita*) at one J₂/g soil in cowpea (c.v. Ife brown) was undertaken. Under each soil type, nematode inoculated and non-inoculated checks were kept. The observations recorded 60 days after nematode inoculation revealed that maximum and significantly higher shoot length, fresh and dry root and shoot weight, number of leaves and buds/plant were in sandy loam soil while these growth parameters were minimum and significantly lower in clay loam soil irrespective of nematization.

The reproduction factor of *M. incognita* based upon galling, fecundity and final soil populations was maximum (30.6) in sandy soil followed by loamy soil (25.8) while it was minimum (3.5) in clay soil making it least favourable for the nematode. With this result it shows that Sandy soil is highly favourable to *M. incognita* reproduction which is followed by loamy soil and the least favourable was clay soil to the nematode reproduction.

INTRODUCTION

Cowpea plants are attacked by a number of insects, pests and diseases including phyto-parasitic nematodes. The annual cowpea yield loss due to damage by plant parasitic nematodes on a world basis is estimated to be 10.7% (Sikora *et al.*, 2005). Root-knot nematodes are serious pests of cowpea on a worldwide basis. *M. incognita* and *M. javanica* are the major species found on cowpea in most growing regions (Olowe, 2004). Adegbite, (2011) reported yield loss of 33 – 39% due to infestation by *M. incognita*. Among the plant parasitic nematodes, root-knot nematode (*M. incognita*) constitute one of the important nematode pests of cowpea in Nigeria (Adegbite *et al.*, 2005). Abiotic components of the soil environment greatly influence the host parasitic relationship. The intensity of root-knot disease caused by *M. incognita* is greatly influenced by various edaphic factors of soil. Idowu, (1991) observed that edaphic factors of soil including soil texture play vital role in deciding the extent and severity of root-knot disease on cowpea and hence are important for evolving effective nematode management strategies/technologies.

O'Baron and Reynolds, (1961) observed that the plant response from soil fumigation to control root-knot nematode on cowpea was directly co-related with soil texture. Therefore, screen house studies were undertaken to see effect of five different textured soils on *M. incognita* in cowpea (c.v. lfe Brown).

MATERIALS AND METHOD

Soils from different locations were collected and analyzed in Soil Physic Laboratory of Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, Ibadan, Nigeria located at E3°54' and N7°30' for their texture and composition in 2013 and 2014 (Table 1).

Five different types of soils were filled in 1kg capacity 15cm size plastic pots after sterilization and recommended dose of fertilizers was mixed before sowing. Basal application of fertilizer using NPK (15:15:15) and a single super phosphate at a rate of 120kg N, 50kg P₂O₅ and 50kg K₂O/ha (Adegbite *et al.*, 2005). Hence five main treatments with 2 sub-treatments under each soil type, nematode inoculated and non-inoculated checks were maintained.

Cowpea seed (c.v. lfe Brown) soaked in water for 2 hours were sown in plastic pots. One week after germination, one seedling/pot was retained. Each plant was then inoculated with freshly hatched second stage juveniles of *M. incognita* at one J₂/g soil (1000J₂/pot). The second dose of N₂ was applied one month after sowing. There were four replications in factorial CRD set up. Sixty days after nematode inoculation, observations on shoot length, fresh and dry root and shoot weight, number of leaves, buds/plants, number of galls, egg masses/plant, eggs/egg mess and final soil population were recorded. Results were analyzed statistically using SAS version 9.1. Means were separated using Duncan Multiple Range Test (DMRT) of 5% level of probability (SAS, 1998).

RESULTS AND DISCUSSION

Table 1 shows the soil type composition and other parameters like pH, % Organic carbon, available P (kg/ha) and K (kg/ha) in different Soil Texture.

Tables 2 and 3 show that all the plant growth parameters of cowpea (cv lfe Brown) such as shoot length, fresh and dry root and shoot weight and number of buds/plants were maximum and significantly higher in non-inoculated as compared to nematode inoculated treatments irrespective of various soil texture indicating damaging potential of *M. incognita* under varied conditions.

However, maximum and significantly higher shoot length (45.9cm), fresh shoot weight (8.5g), dry shoot weight (3.9g), fresh root-weight (7.8g), dry root weight (2.5g), number of leaves (15.5) and number of buds (20.5) were obtained in sandy loam soil followed by loamy sand soil for most of the growth parameters except shoot length, fresh and dry shoot weight as compared to clay loam soil which showed minimum significantly lower plant growth parameters.

The interaction between presence or absence of nematodes and soil type was however, non-significant except for dry shoot weight and number of buds/flowers/plant.

The data on nematode galling and reproduction i.e. number of galls, egg masses, eggs/egg host and final soil population is shown in Table 4.

Maximum and significantly higher number of galls were in sand (420.0) followed by loamy sand (398.0) and sandy loam (345.0), however minimum gall formation (65.0) was in fine textured clay soil followed by clay loam (150.0) soil which differed significantly from the rest of the treatments. As the clay content increased, galling decreased and as sand content increased, galling increased favouring the multiplication of *M. incognita*. Similar trend was observed in respect of number of egg masses/plant and final soil populations, while number of eggs/egg mass showed non-significant differences among various soil texture treatments.

The reproduction factor was maximum (35.6) in sandy soil followed by loamy sand (30.5) while it was minimum (3.9) in clay soil followed by clay loam (10.5).

It was clear that growth of cowpea plants was better in sandy loam soil which contains sand and clay as (65.5), 16.2 percent and 18.3 silt respectively. As the clay content increased beyond 16.2%, the plant growth decreased. Also as clay content decreased below 16.2%, plant growth decreased irrespective of nematization.

Contrary to it, nematode galling and reproduction potential were positively co-related with sand content while negatively co-related with clay content, thus making the sandy soil most favourable, clay soil least while sandy loam soil moderately favourable for *M. incognita*. The findings are in conformity with those of O'Banon and Reynolds, (1961); Huan *et al.*, (1968); Mavlyanov and Abdullaeva, (1988); and Jain *et al.*, (1988) who also reported that population density of *M. incognita* was very high in coarse sandy soil as compared to clay soil in cotton.

Table 1: Texture, composition and other parameters of different soils

Soil Type	% Sand	% Silt	% Clay	pH	% O.C.	Available P (kg/ha)	Available K (kg/ha)
Clay	15.5	24.5	60.0	8.5	0.67	7	255
Clay loam	36.0	2.4	40.0	8.2	0.50	10	275
Sandy loam	65.5	18.3	16.2	8.0	0.62	15	315
Loamy sand	80.1	10.2	9.7	7.9	0.40	15	335
Sand	95.0	2.0	3.0	8.0	0.28	5	325

Table 2: Effect of soil texture on plant growth of cowpea (c.v. Ife Brown) infected with Root-knot nematode (*Meloidogyne incognita*)

Soil-Type	Shoot length (cm)			Fresh shoot weight (g)			Dry shoot weight (g)		
	I	NI	Mean	I	NI	Mean	I	NI	Mean
Clay	43.25	46.80	45.03	7.15	7.52	7.34	3.97	4.10	4.04
Clay loam	35.15	38.65	36.90	6.15	6.90	6.53	3.25	3.75	3.50
Sandy loam	47.33	54.25	50.79	9.95	11.93	10.94	3.95	5.27	4.61
Loamy sand	33.49	42.15	37.82	5.25	8.17	6.71	2.97	3.72	3.35
Sand	34.40	41.95	38.18	5.27	8.05	6.66	2.87	3.72	3.30
Mean	38.72	44.76		6.75	8.51		3.40	4.11	

(P = 0.05)

I/NI 3.21 0.94 0.55

Soil type 4.75 2.22 0.78

Interaction (I/NI vs. Soil type) NS NS NS

I = Inoculated NI = Non-Inoculated.

Table 3: Effect of soil texture on plant growth of cowpea (c.v. Ife Brown) infected with Root-knot nematode (*Meloidogyne incognita*)

Soft Type	Fresh root weight (g)			Dry root weight (g)			No. of leaves/plant			No. of flower bud/plant		
	I	NI	Mean	I	NI	Mean	I	NI	Mean	I	NI	Mean
Clay	2.93	3.20	3.07	0.90	0.85	0.88	8.10	8.35	8.23	2.35	2.35	2.35
Clay loam	2.90	3.35	3.13	0.68	0.86	0.77	7.50	8.00	7.75	3.50	3.75	3.63
Sandy loam	6.30	8.04	7.17	1.06	1.95	1.51	12.50	13.55	13.03	4.00	8.00	6.00
Loamy sand	5.30	6.08	5.69	1.12	1.35	1.24	11.00	12.00	11.50	2.35	3.30	2.83
Sand	5.40	7.26	6.33	0.07	1.26	1.12	10.50	11.50	11.00	2.45	3.45	2.95
Mean	4.57	5.60		0.95	1.25		9.92	10.68		2.93	4.17	

CD at 5% (P = 0.05)

I/NI 0.57 0.23 NS 0.20

Soil type 0.86 0.35 0.38 0.30

Interaction (I/NI vs. Soil type) NS 0.40 NS 0.49

I = Inoculated NI = Non-inoculated

Table 4: Effect of soil texture on galling and reproduction of root-knot nematode (*M. incognita*) infecting cowpea (cv. Ife Brown)

Soil Type	Number of galls/ Plant	Number of egg masses/plant	Number of eggs/ egg mass	Final soil population (J ₂ /kg soil)	R-factor R=Rf/Pc
Clay	56.00	15.00	196.00	98.50	3.5
Clay loam	98.00	38.00	192.00	1035.00	13.5
Sandy loam	345.00	82.00	235.00	2015.00	20.0
Loamy sand	398.00	105.00	230.00	2285.00	25.8
Sand	435.00	125.00	245.00	2350.00	30.6
CD at 5% (P = 0.05)	(2.58)	(2.85)	(NS)	(4.94)	

CONCLUSION

Mechanical and physical factors determine porosity, aeration and water-holding capacity of soils. All of these conditions collectively influence the multiplication and distribution of nematodes in a soil type. Observations recorded 60 days after nematode inoculation revealed that maximum and significantly higher shoot length, fresh and dry root and shoot weight, number of leaves and buds per plant were in sandy loam soil while these growth parameters were minimum and significantly lower in clay loam soil. The reproduction factor was maximum (30.6) in sandy soil followed by loamy soil (25.8) while it was minimum (3.5) in clay soil making it least favourable for the nematode (*M. incognita*).

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