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HOST SUITABILITY STUDIES AND REPORTING OF RESISTANCE TO ROOT-KNOT *NEMATODE (MELOIDOGYNE INCOGNITA)*

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ABSTRACT

Efficient and improved agripreneurship cannot be attained if measures are not put in place to curtail crop losses due to nematode damage. This research was conducted to look at the level of resistance and susceptibility of selected annual crops to guide agripreneurs on what crops to adopt for planting in meloidogyne infested soils and in crop rotation as a method of cultural control. Five crops namely were randomly selected from different crop families and soillorganic manure medium in a 3:1 ratio was used as the planting medium. Nematode inoculum containing about 1000 larvae of the root knot nematode Meloidogyne incognita in 30ml of nematode slurry was used to inoculate the test crops with the control left un-inoculated. Data were collected on plant height, fresh root weight, fresh top weight and number of galls/plant. The data were analyzed using genstat and the mean separation done using Fisher's least significant difference. The results showed that maize was resistant to the inoculum and a good control crop in nematode infested soils while the other four test crops (water-melon, green beans, tomato and green amaranthus) showed varying degrees of susceptibilities from the effect of the inoculum on all the parameters measured. Maize being immune to the inoculum can be used in rotation programmes as a cultural control crop in M. incognita infested plots to reduce the pest's population and boost the yield of the follow-up crop.

Keywords: Infestation, Nematode inoculum, *Meloidogyne incognita*, Resistance and Susceptibility,

INTRODUCTION

Provision of adequate affordable food and agricultural raw materials for both local consumption and foreign exchange earnings is a crucial part of the Agricultural transformation agenda of the Nigerian government With increasing food crisis in the world and mostly in the developing countries, there is an urgent need to devise means of mitigating losses of agricultural produce arising from pest attack.

The international food research institute (IFRI) impact projections in 2001 estimated that the number of malnourished children in sub-Saharan Africa is expected to increase rather than decrease by the year 2020 and according to Food and Agricultural Organization (FAO) 2001 statistics an estimated 33 million children are malnourished. This malnourishment is not just caused by low interest in agriculture by young agripreneurs (that results to under-utilization of arable lands and labour need for increased agro-productivity), it is also caused by losses in the field and during storage. These losses are predominantly caused by pests and disease attacks in the field and during storage. One of the plant pests and disease causing agents is the plant nematode. plant parasitic nematodes as pathogenic organisms affecting cultivated crops has been on the increase over the last few decades. Hidden most times in the soil or in the roots and often lacking characteristic symptoms on the aerial parts of plants, their roles as the real cause of decrease in yield are often masked. In certain cases nematodes are involved in disease complexes with fungi, bacteria, and viruses.

Extensive research in developed countries: the international meloidogyne project (IMP) and in the crop nematode research and control project (CNRCP), documented the destructive nature of plant nematodes. Reducing nematode induced losses is therefore very important in increasing crop productivities and will equally encourage crop farming and interest in it by young entrepreneurs. Among the plant parasitic nematodes the genus most implicated in crop yield losses is the *Meloidogyne spp (*root-knot nematode*)* three have been found in Nigeria and they includes *Meloidogyne incognita* (Kofoid and White) chitwood, *M. arenaria*(Neal) chitwood, *M. javanica* (Treub) Chitwood. *M. incognita* is the most parasitic of these nematodes. The IMP classified root-knot nematodes into different species using differences in their perennial pattern, and distinguished between races using differential host range studies. Wilson (1967) indicated that market gardens in Zaria, Northern Nigeria were often heavily infested with root-knot nematodes, mostly *M. incognita*, making the production of vegetables such as tomatoes, carrots and beans very difficult and discouraging to crop entrepreneurs. *M. incognita* alone accounts for over 64% of root-knot nematode distribution in over 95% of world agricultural soils (Sasser, 1979). Ogbuji (1976) also observed that it is the most common specie of root-knot nematode in cultivated and uncultivated soils in Nsukka and in the eastern states of Nigeria. According to Hague (1980), *M. incognita* is a sedentary endoparasite that reproduces parthenocarpically. The infective second juvenile stage (J_2) hatch from the eggs, invade the roots in the region of elongation and migrate between or through cells till they position themselves with the head in the vascular tissue and as they feed continuously in the roots, several cells near the head region begins to enlarge and becomes multinucleate. These are called giant cells. At a temperature of 70^{O}F (21.11^{O}C), the entire life-cycle is completed within 20-25 days. Considering the economic importance of root-knot nematodes and there wide host range, this study focuses on the suitability (susceptibility-level) and non-suitability (level of resistance) of five test crops to root-knot nematode with the following objectives:

1. To advice crop farmers (entrepreneurs) on what crops to grow in *meloidogyne* infested soils.
2. Identify resistant crop(s) that can be used in rotation programs with other susceptible crops so as to help in reducing (culturally) *M. incognita* in cultivated farmlands.
3. Reduce yield losses in susceptible crops through the use of various root-knot nematode control methods in an integrated control approach.

MATERIALS AND METHODS

The study was carried out in a screen-house in the Department of Crop Science, Faculty of Agriculture, University of Nigeria Nsukka between April- June, 2011 to test the level of resistance and susceptibility of different crops to the nematode pests *M. incognita*. Top soil sterilized in an autoclave was mixed with poultry manure after they were allowed to air dry for seven days in a 3:1 ratio to form the planting medium. Well perforated black poly-bags were each filled with 2kg of the planting medium and five crops each from a distinct crop family which included *Amaranthus hybrids* (green), *Citrullus lanatus* (watermelon), *Phaseolus vulgaris*(green beans), *Zea mays* (maize) and *Lycopersicum lycopersicon* (tomato). The seeds sourced from the Department of Crop Science, University of Nigeria Nsukka seed store were surface sterilized using 10% Clorox solution for 2minutes. The tomato and amaranthus seeds were raised in the nursery before transplanting to the planting media as the other test crops were planted. The nematode inoculum sourced from the roots of the highly susceptible Begonia flower was prepared by first harvesting the infected roots. Washing and chopping the root into tiny pieces using a scalpel, blending of the chopped roots using a warring blender and diluted in a1000ml beaker by filling the slurry with clean water to 700ml of the beaker. The number of active juveniles in 30ml of the diluted slurry was counted and approximated to 1000 juveniles. Thoroughly mixed 30ml of the diluted inoculum was placed just on the base of the roots to ensure proper contact with the roots. The controls were left un-inoculated. The plants were watered as and when necessary for 6 weeks. Data were collected on plant height at one week intervals for six weeks, starting at one week after inoculation. After a month and two weeks the fresh top weight and the fresh root weight of both the control and inoculated using a weighing balance (accuracy 0.01g). Analysis was done using genstat and means separation done using fisher's least significant difference. The number of galls was counted and rated using the international meloidogyne project galling index (IMP GI) The experimental design is completely randomized design.

RESULTS AND DISCUSSION

Green beans, watermelon and tomato with an average gall rating of 4.5, 4.5 and 4.25 respectively showed the highest level of susceptibility to *M. incognita* followed by amaranthus with a gall rating of 3.75. they were all considered susceptible since any gall rating that is above 2 is considered susceptible, only maize with a gall rating of 0 was immune to the inoculum as shown in Table 1. The fresh top weight of the inoculated maize, tomato and watermelon showed significant difference from their respective controls (P>0.05) in Table 2. The control plants were taller than the inoculated. The fresh top weight of amaranthus and green beans did not differ significantly with the inoculated and un-inoculated showing that the use of fresh top weight as a measure of susceptibility is not always a reliable index. This is consistent with the work of onyeigwe (1980). The fresh root weight of the inoculated amaranthus and tomato differed significantly from the control (P > 0.05) with the inoculated amaranthus having a higher average root weight whereas in tomato the control weighed more than the inoculated. This finding was in agreement with the earlier work done by Ezekwesili and Ogbuji (1978), they observed that as galls are formed in the roots some plants shootout new roots as existing ones are being attacked. Accumulated foods are also present in the giant cells within the galls, all of these add to increase the root weight of an infected plant. Apart from maize in Table 4, all the test crops differed significantly with the inoculated and control in the mean height of the crops (P = 0.05) this is because maize was immune to the root knot nematode inoculum and therefore was not affected. Fresh top weight was therefore a better index for detecting root knot nematode effect in most crops and this finding agrees with earlier works done by Christie (1969), Anekwe (1974), Nwafor (1974) and Onyeigwe (1986) , they variously observed stunted growth, early senescence, wilting and yellowing of leaves on the affected plants

GALL RATING. The standard galling index (1978) issued by the international *meloidogyne* project (IMP)

the international meloidogyne galling index	
number of galls	Rating
zero galls(0)	immune
(1-2) galls	1
3-10 galls	2
11-30 galls	3
31-100 galls	4
>100 galls	5

Increasing susceptibility

Table 1 Average number of galls per treatment (of the inoculated plants) rated using the international *meloidogyne* project galling index

amaranthus green		**green beans**		**Watermelon**		**tomato**		**maize**	
number of galls	rating	number of galls	rating	number of galls	rating	number of galls	rating	number of galls	rating
40	4	94	4	101	5	71	4	0	0
59	4	83	4	119	5	77	4	0	0
28	3	133	5	38	4	82	4	0	0
39	4	125	5	87	4	112	5	0	0
average rating	3.75	average rating	4.5	average rating	4.5	average rating	4.25	average rating	0

Table 2 Mean fresh top weight of the inoculated and un-inoculated plant at six weeks after inoculation

Host plant	**Treatment** Control	Inoculated	**Mean**
Amaranthus	36.5	45.2	40.8
green beans	44.4	42.1	43.2
Maize	79.9	85.2	82.5
Tomato	101.7	44.3	73.0
Watermelon	33.1	12.9	23.0
Mean	59.1	45.9	52.2

F-LSD $_{(0.05)}$ for comparing any two host-plant = 21.67
F-LSD $_{(0.05)}$ for comparing any two treatments = 13.7
F-LSD $_{(0.05)}$ for comparing any two host/treatment interaction =30.65

Table 3 Mean fresh root weight of the inoculated and un-inoculated plants at six weeks after inoculation

Host plant	Treatment		Mean
	Control	inoculated	
Amaranthus	4.6	9.3	6.9
green beans	2.3	2.9	2.6
Maize	29.6	29.7	29.6
Tomato	14.6	7	10.8
Watermelon	1.6	0.5	1.1
Mean	10.5	9.9	10.2

F-LSD $_{(0.05)}$ for comparing any two host-plant = 6.74
F-LSD $_{(0.05)}$ for comparing any two treatments = 4.26
F-LSD $_{(0.05)}$ for comparing any two host/treatment interaction = 9.53

Table 4 Mean height of the inoculated and un-inoculated plants at six weeks after inoculation

host plant	Treatment		Mean
	Control	Inoculated	
Amaranthus	57	51	54
green beans	41	34.1	37.6
Maize	47	43.7	45.3
Tomato	60.1	37.1	48.6
Watermelon	103	60.7	81.9
Mean	61	45.3	53.3

F-LSD $_{(0.05)}$ for comparing any two host-plant = 7.35
F-LSD $_{(0.05)}$ for comparing any two treatments = 4.65
F-LSD $_{(0.05)}$ for comparing any two host/treatment interaction = 10.40

This study showed the devastating effect of the root – knot nematode *M. incognita* on most crops and on four of the five crops used in carrying out this study. The results obtained showed that four of the test plants were highly susceptible to M. incognita as shown by their galling rates and other above ground visual symptoms like yellowing (chlorosis), stunted growth, wilting and early senescence. These are all among the main causes of low productivity in most of our cultivated crops which in turn discourages agricultural entrepreneurs from investing in agriculture. Apart from root galling, reduced vegetative growth and chlorosis, the susceptible crops equally showed many physiological deformities which led to reduced vigor and general poor appearance. Root galling forms the main basis for rating a plant as being susceptible or resistant to *M. incognita*. From the results of this study we can conclude that:

1. Four of the five test crops are suitable hosts of the root-knot nematode *M. incognita*
2. *M. incognita* is capable of causing reduction in yield of tomato, green beans and watermelon. It would therefore be un-economical to grow these crops in *meloidogyne* infested soils without arranging for an effective control method whose costs in most instances are not justifiable

). Plant pathology. New york, ,629 pp

3. Amaranthus, though susceptible has a special mechanism of producing to its optimal level in *meloidogyne* infested soils and therefore can be said to be tolerant but can serve as a retaining host in infested soils thereby rendering it unsuitable in crop rotation programmes aimed at reducing nematode populations in the soil.
4. Maize is an unsuitable host and showed maximum level of resistance (immune) to *M. incognita*. It would therefore be profitable for a crop entrepreneur to use this crop in rotation with other susceptible crops in *M. incognita* infested soils to reduce the pest population and increase crop yield for greater profitability. This will help promote entrepreneurial interests in agriculture and help in driving the transformation agenda of the country towards a food secured natio

REFERENCES

Allen, M. W. (1952). Observations on the genus Megoeldi 1887. proc. helm. soc wash Anon, J. (1977). Cocoa research institute of Nigeria news 3 (6 & 7). 19:44-51.

Berkeley, M. J. (1855). "Vibrio forming excrescence as on the roots of cucumber". *Gardn. Chron* (14): 20.

Bridge, J.(2004). plant parasitic nematodes of irrigated crops in northern state of Nigeria. samaru miscellaneous paper 42-p. 4.

Chitwood B. G. (1949B) "root-knot nematodes part 1. A revision of the genus *Meloidogyne*" proc. Helminthes

Christie, J. R. and Albin F.E. (1944). Host parasite relationship of the root-knot nematode, *Heterodera marioni* I, the question of races proc. Helminth soc. Wash. 11 (1): 31-37

Christie, J. R.(2004). The root-knot nematode. Plant nematodes their bionomics and control chapter 3

Ezekwesili, N. O. and Ogbuji, R. O. (1978). “effect of population density of meloidogyne incognita on growth of Amaranthus hybridus. *Nigerian journal of plant protection*. 4: 69-73.

Gillard, A. (1961). “distribution of root-knot nematodes meloidogyne spp.” *Journal of agronomic research*, 26(2) 515-646.

Godfrey, G. H. and Olivera, J. H., (1932). The development of root-knot nematodes in relation to root tissues of pineapple and cowpea. *Phytopathology*. 22 (4): 325-348

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nternational institute of tropical agriculture (IITA). “grain legumes improvement programme.” 1973 reports, IITA, Ibadan Nigeria

Ogbuji, R. O. (1971). “Studies on northern root knot nematode., (*meloidogyne hapla* chitwood 1949), biotypes and some factors associated with the biology and pathogenicity” a Ph.D thesis (Oregon State university)

Ogbuji, R. O. (1977). Root knot nematode reproduction on a tropical weed. PANS 239(2) 216 (Abstract).

Raski, D. J. (1952). The host range of the sugar beet nematode in California. *Plant Dis. Reptr*. 36 (1), 5-7.

Sasser, J. N. and Nusbaum C. J. (1955). Seasonal fluctuationsand host specificity of root-knot nematode populations in two year tobacco rotation plots. *Phytopathology*. 45: 540-545.

Sasser, J. N. and Jenkins, W. R., (1960). Nematology, fundamental and recent advances with emphasis on plant parasitic and soil forms. Chapel hill, university of norther California press, XV 480pp.

Taylor, A. L., Dropkin, V. H. and Martin, G. C. (1955). “perineal patterns of the root-knot nematodes.”*Phytopathology* 45:26-34

Taylor, A. L. (1969). “In introduction to research in nematology.” Food and agricultural organization guide to study and control of plant parasitic nematodes (new edition)

Taylor, D. P. (1957) Observations on resistant and susceptible varieties of tomatoes in a field infested heavily with meloidogyne in Senegal. *Laboratoire nematogie.* 10 (3) 239-245

Wallace, H. R. (1963). The biology of plant parasiti\ nematodes. Edward Arnold LTD., London 250pp