EFFECT OF INOCULUM DENSITY ON THE SEVERITY OF ROOT-KNOT DISEASE ON JUTE MALLOW IN NEMATODE INFESTED SOIL

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Abstract: Field trials were conducted in 2014 and 2015 planting season to evaluate the effect of inoculum density of *Meloidogyne incognita* on the severity of root knot disease on Jute mallow (*Corchorus olitorus*) in nematode infested soil. The influence of four inoculum densities *viz;* 1000, 2000, 3000, 4000 of *M. incognita* (root-knot nematode) juveniles was studied. The result shows a significant (P=0.05) reduction in the number of leaves, number of nodes, root length, stem girth and root weight with increase in the amount of *M. incognita* Juveniles. The number of nematodes in 10 g of root and root gall index however, increase significantly with increase in the number of *M. incognita* juveniles. These results reveals that exposure of Jute mallow to higher level of nematode population cause more damage to the crop resulting in reduction in its productive capacity.

Keywords: *Corchorus olitorus*, density, inoculum, *Meloidogyne*, Nematode, root-knot.

Introduction

Corchorus olitorus (Jute Mallow) is a popular vegetable, grown in both dry and semi-arid regions and in the humid areas of Africa, because of its importance in giving the body good nutrients (Schipper, 2000). Jute mallow is an important food for many families in the Middle East, Africa, and Asia. The leaves are a rich source of iron, protein, calcium, thiamin, riboflavin, niacin, folate, and dietary fiber (Ndlovu and Afolayan, 2008). Root scrapings of *C. Olitorus* are used to treat toothache in Kenya whereas in Nigeria concoction prepared from seeds are used as purgative (Fondio and Grubben, 2004). The yield and productivity of crops including *C. Olitorius* is plagued by poor cropping system and pest incidence of the soil, therefore there is always the need to assess their effect on the productivity and growth of the crop.

Meloidogyne species pose a significant threat to crop production in Africa due to the losses they cause on a wide range of agricultural crops. It causes an estimated annual loss of $157 billion globally (Abad *et al*., 2008). Based on the level of nematode populations, *Meloidogyne* spp. can cause high levels of crop loss during growth, increase the cost of production through increased fertilizer application and control programmes, and also significantly reduce post-harvest yields. The leaves of crops become yellowish green to yellow; tend to drop and the plants wilt. The roots become galled and the presence of these galls is the most characteristic symptom of infection. In severe infections, there may be complete loss of plant vigour resulting into heavy yield losses. The influence of nematode numbers on plant growth and yield can often be expressed as a linear regression of growth or yield with nematode numbers. It is possible that competition at high densities of nematodes population for invasion and feeding sites reduces the yield proportionately as the population increases (Wonang and Akueshi, 1990). Therefore, the objective of this study was to assess the effect of inoculum density of *Meloidogyne incognita* (root knot nematodes) on growth and yield of *C. olitorus* in nematode infested soil of Wukari, Taraba State, Nigeria.

Materials and Methods

Preparation of root knot nematodes inocula

Extraction and preparation of nematode inoculum was carried out at Biology laboratory, Federal University Wukari, Taraba state, Nigeria. The eggs and second stage juveniles (J2) were obtained from the nematode infested Celosia plants and soil at the Teaching and Research Farm, Federal University Wukari. Infected roots and soils were collected and used to prepare the inocula. The root maceration method described by Coyne *et al*. (2007) was used to extract nematode eggs and the Juveniles. The roots were gently washed with tap water and cut into 1cm long pieces. 20g of roots were weighed to which, a ratio of 1g of root to 20ml water and 0.5% sodium hypochlorite (NaOCl) was added to the root water mix. The mixture was loaded into a domestic blender and blended for 15 seconds at high speed (Hooper *et al.*, 2005) and the process repeated to obtain the required inoculum. The mixture was sieved and using a dissecting microscope the eggs and the second stage juveniles (J2) were counted to estimate the concentration per milliliter of the fluid from the sieving. The extracted juveniles were used to inoculate experimental plants. The plants were inoculated with inoculum densities of 0, 1000, 2000, 3000, 4000 J2s per plot. The non inoculated plants served as control. Each treatment was replicated three times. The experiment was laid out in a Randomized Complete Block Design (RCBD).

Experimental material

The experiment was conducted at the Teaching and Research farm, Federal University Wukari during 2014 and 2015 cropping seasons. The field was divided into a block system. Three blocks of treatment replication system were used and each block was divided into five plots. Each block is of equal dimension of 10 m x 1.4 m. The land was tilled using disc plough and further pulverized by using light implements to form seed beds. The plots were planted with a spacing of 0.4 m inter row by 0.3 m intra row. The plants were monitored for symptoms such as changes in leaf colour, height, stem size

and growth vigour. Soil and root samples were taken from the rhizosphere of the plants in each treatment by gently removing from the soil. Both roots and soil samples were placed in labeled polythene sample bags and transported to the laboratory where nematode bioassays were conducted. The roots were carefully and gently washed with tap water and they were blotted dry.

Data collection and analyses

Data on the following parameters were recorded and statistically analyzed: Plant height, Number of leaves/plant, Number of nodes, Stem girth, Root length, Number of primary root, Number of root branches, Fresh weight of roots, Number of galls per plant, Number of egg masses/plant, Number of larvae/100g of soil and Number of larvae/1g of root. Root galling index was scored on a 0-5 scale; where 0 = no galls, 1 = slight infection, 2 = moderate infection, 3 = moderately severe, 4= severe, 5= very severe. Number of nematode eggs on roots (10 g) was taken by counting after extraction using the sodium hypochlorite (NaOCl) method. The total number of eggs per plant root was computed by multiplying by the root weight per plant. Number of nematodes (second stage juveniles) in soil (100 cm^3) was also counted after 3 extractions using the modified Baermann pie-pan method; the total number of nematodes in soil was computed by extrapolating the number in 100 cm^3 to the volume of soil. Data were subjected to Analysis of Variance (ANOVA) using the SPSS statistical package and means were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability. Data presented are means of two trials.

Results and Discussion

The result shown in Table 1 revealed that, there was no significant difference in the means of plant height for the various inoculum densities. However, the control gave taller plants than all other treatments. Significant difference was observed in the number of leaves. Jute mallow plants inoculated with 0 Juvenile (control) was found to have significant (P = 0.05) number of leaves than other rates. Similar result was observed in the number of branches for 0 Juvenile (control) producing significant higher number of branches (3.33) than all the other treatments. However, there were no significant differences among the other treatments in the two instances mentioned above. The number of nodes in 0 Juvenile (control) was still found to be highest (28.33) and 4000 Juveniles was found to be lowest (17.40) though it was significantly not different from all other treatments. The result further revealed that the application of 4000 Juvenile inocula gave a significant (P=0.05) lowest stem girth (1.50 cm) while the control gave a significantly higher stem girth (2.60 cm). The control (0 Juvenile) was found to be significantly not different from 1000, 2000 and 3000 Juveniles.

Table 1: Effect of inoculum density of Meloidogyne incognita on some growth and yield parameters of Jute mallow

Number of Juveniles	Plant Height (cm)	Number of Leaves	Number of Branches	Number of Nodes	Stem Girth (cm)
4000	35.20	17.20b	1.00b	17.40b	1.50b
3000	40.67	28.00b	1.20b	20.67ab	1.90ab
2000	41.67	32.33b	1.67b	21.67ab	2.20ab
1000	42.00	55.33b	1.67b	22.67ab	2.53a
0	54.33	103.67a	3.33a	28.33a	2.60a
	NS				

NS = Not Significant; Means followed by the same letter(s) along the same column are not statistically different at 5% probability level

The result in Table 2 revealed that the number of Juveniles has significant effect on the root length. Plants treated with 1000, 2000, 3000, 4000 Juveniles were significantly not different from each other, but gave significant shorter roots (cm) than the control (0 Juvenile). There is also a significant (P=0.05) difference in the number of root branches obtained in the various treatments. Zero Juvenile (control) gave significantly higher number of root branches than 4000 and 3000 Juvenile inocula. However, there was no significant difference in the number of branch obtained in plants treated with 1000 and 2000 Juveniles. Similar result was observed in the root weight but there was no significant difference (P=0.05) in the root weight of plants treated with 1000 Juveniles and the untreated (control). The result in Table 2 showed that application of 4000 Juveniles was found to be significantly higher in terms of number of nematodes in 10 g of root and Root gall index than all other treatments. All the rates also gave significantly higher number of nematodes in 10g of roots and Root gall index than the control. However, the 2000 and 3000 rates were consistently not different from each other statistically in the two parameters.

Table 2: Effect of inoculum density of Meloidogyne incognita on the root and root gall index of Jute mallow

Number of Juveniles	Root Length (cm)	Number of Root Branch	Root Weight (g)	Number of Nematodes in 10 g root	Root Gall Index
4000	9.26b	2.67b	1.10b	3364.80a	5.0a
3000	11.30b	4.00b	1.29b	2463.66b	4.1b
2000	12.50b	5.33ab	1.37b	2258.33b	3.7b
1000	12.53b	5.33ab	1.52ab	1530.67c	2.2c
0	17.83a	10.67a	2.31a	703.66d	1.1d

Means followed by the same letter(s) along the same column are not statistically different at 5% probability level

All the inoculum levels of *M. incognita* caused significant reductions in the growth and yield parameters compared to the control. At higher infection levels growth was suppressed. It was observed that at higher inoculum levels of *M. incognita*, the production of lateral roots was suppressed and this accounts for the decreased root weight of the plants and possibly decreased nutrient uptake. The results of influence of inoculum density on root-knot disease of Jute mallow are in conformity with the works of Khan *et al.* (2000) and Philis (1990) where a significant reduction in the plant height, number of leaves, fresh and dry weight of shoot and root was observed as initial inoculum level was increased. Also, the increase in inoculum density caused significant increase in number of galls on inoculated Jute mallow plants and increase in the inoculum density.

Conclusion

Based on these experimental results which showed a varied reaction of Jute mallow to varied root knot nematode infestation it can be concluded that increased root knot infestation caused higher galls, deformed roots, yellowing and wilting of plants leading to low biomass yield required for consumption. Knowledge generated from this work can be expanded by development of strategies that can control the growth of nematodes in the soil to achieve higher yield.

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