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STUDIES ON PATHOGENICITY OF ROOT-KNOT NEMATODE, *MELOIDOGYNE INCOGNITA* ON SWEET POTATO

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Abstract

Sweet potato, *Ipomoea batatas* (L.) Lam., is a dicotyledous plant that belongs to the family Convolvulaceae. Different quantities of the nematode suspension having a concentration of 100 infective larvae per ml was carefully inoculated to plants (var. Kanhangad local) by pouring into the holes depending upon the number of infective larvae required to be inoculated *i.e.*, 0.1ml, 1ml, 10 ml, 50 ml and 100 ml in order to inoculate 10, 100, 1000, 5000 and 10000 infective larvae, respectively. Three months after inoculation, pots were carefully depotted and the results revealed that, highest reduction of number of leaves per plant, vine length, plant height, root length, fresh weight and dry weight of shoot was observed in plants inoculated with 10000 J_2 per pot (59.00, 117.33 cm, 126.00 cm, 13.00 cm, 46.00 g & 10.67 g) and minimum reduction was recorded in plants inoculated with 10 J_2 per pot (88.00, 139.33 cm, 149.00 cm, 21.11 cm, 100.67 g & 22.33 g), followed by plants inoculated with 100 J_2 per pot (82.67, 134.33 cm, 143.67 cm, 19.24 cm, 94.00 g & 18.33 g).

Key words : Sweet potato, *Meloidogyne incognita*, pathogenicity.

Introduction

Sweet potato, *Ipomoea batatas* (L.) Lam., is a dicotyledous plant that belongs to the family Convolvulaceae. It is originated from Central America and the North Western part of South America. It is an herbaceous perennial crop with edible tuberous root that is usually long and tapered, with a smooth skin whose colour ranges between red, purple, brown and white. It is a vegetable crop with great social, economic and nourishing importance, especially for the poorest regions of the planet, where it is one of the most important food sources (Oliveira *et al*., 2005). Its storage roots are rich in energy and are an important source of carbohydrates, vitamin A and C, fiber, iron, copper, calcium and folic acid, especially the orange-fleshed sweet potatoes (Collins *et al*., 1999). A number of plant parasitic nematodes have been reported to be associated with sweet potato in India and among the species identified, *Rotylenchus reniformis*, *Helicotylenchus dihystera and Meloidogyne incognita* are the one which are economically important (Ramakrishnan and Mohandas, 1996). It also plays the way for the secondary infection by different pathogens like *Pythium*, *Fusarium* and *Ralstonia* in the soil (Udo and Ugwuoke, 2010). Hence, the study on pathogenicity is important to know minimum population causing root-knot infection, which will be helpful in maintaining the population below the economic threshold level.

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Material and Methods

The investigations on the pathogenicity of root-knot nematode on susceptible genotype were studied under glasshouse conditions at the Department of Plant Pathology, Kittura Rani Channamma College of Horticulture and ICAR- AICRP on Fruits, Arabhavi Belagavi district, Karnataka and depicted in plate 1, which is situated in agro climatic Zone-8 and Region-4 of Karnataka state at 15°84' north latitude and 74°51' east longitude.

Estimation of nematode population in soil samples

Soil sample of 200 cc was washed thoroughly and processed using combined "Cobb's sieving and Baermann's funnel method" (Ayoub, 1977) as given below.

1. Two hundred cc of soil was taken in 1000 ml beaker and sufficient quantity of water was added to make soil solution.

2. This was stirred thoroughly and allowed to stand for heavier particles to settle down.

3. Then the soil solution was passed through a set of sieves of 100, 250, 325 and 400 mesh sizes, respectively.

4. Residue from 325 and 400 mesh sieves were collected and poured over a tissue paper spread on a wire gauge and placed on Baermann's funnel.

5. Level of water in the Baermann's funnel was maintained to keep the tissue paper wet and left undisturbed for 48 hr.

6. After incubation of 48 hr, the volume of suspension was made to 200 ml, out of which 10 ml was pipetted out and used for counting of various plant parasitic nematodes present. Nematode population from this was finally estimated for 200 cc soil.

Counting the number of nematodes

The number of nematodes in an aqueous suspension was determined by using a counting dish. A five cm diameter glass Petri plate was used as a counting dish. Squares were made on the outer surface of the bottom of the dish to facilitate counting. A 10 ml volume of aqueous suspension from the beaker was taken and placed into the petriplate. Nematodes were counted in all squares under a stereobinocular microscope. After counting, the suspension was transferred back to the mother container. Counting of each sample was repeated four times in same manner. The mean number of nematodes per 10 ml was determined by averaging the counts taken.

Table 1: Incidence of root-knot nematode was recorded by using the gall index given by (Taylor and Sasser, 1978) which is as follows.

Description	Grade
No galls or egg masses	0
1 to 2 galls or egg masses	1
3 to 10 galls or egg masses	2
11 to 30 galls or egg masses	3
31 to 100 galls or egg masses	4
More than 100 galls or egg masses	5

i. The vine cuttings of Kanhangad Local were raised in plastic pots filled with sterilized soil.

ii. The plants were inoculated after 30 days of planting by making four holes around the base of the plant (2.5 cm depth and 2 cm away from the base).

iii. Different quantities of the nematode suspension having a concentration of 100 juveniles per ml was carefully inoculated to plants by pouring into the holes depending upon the number of larvae required to be inoculated *i.e.*, 0.1 ml, 1 ml, 10 ml, 50 ml and 100 ml in order to inoculate 10, 100, 1000, 5000 and 10000 juveniles,

Plate 1: General view of pathogenicity experiment.

Table 2: Effect of different inoculum levels of root-knot nematode, *M. incognita* on growth parameters of sweet potato cv. Kanhangad Local.

Inoculum level (J_2/plant)	No.of leaves/plant	Vine length (cm)	Plant height (cm)	Root length (cm)	Shoot weight (g)		Root weight (g)	
					Fresh	Dry	Fresh	Dry
0	91.33	142.00	153.67	21.74	106.33	28.00	18.06	8.00
10	88.33	139.33	149.33	21.11	100.67	22.33	18.33	9.20
100	82.67	134.33	142.67	19.24	94.33	18.33	18.67	11.33
1000	73.67	128.33	137.00	16.90	78.33	15.33	19.03	12.33
5000	65.67	120.33	125.33	14.80	65.67	14.33	29.33	13.50
10000	59.33	117.33	122.00	13.00	46.33	10.67	22.00	12.78
S.Em±	**4.79**	**5.01**	**7.23**	**1.09**	**4.39**	**1.17**	**1.45**	**0.82**
CD at 5%	**14.75**	**15.45**	**22.28**	**3.36**	**13.54**	**3.60**	**4.49**	**2.53**
*Replications: 3								

respectively. A set of plants were kept without nematode inoculation which served as control.

iv. Three replications were maintained for each treatment and the plants were watered twice a week and weeding was done when necessary.

Three months after inoculation, the plants were carefully depotted and the roots were washed free of soil under gently running water. The observations were recorded with respect to plant growth like Plant height (cm), Number of leaves, Root length (cm) Fresh root weight (g), Shoot length (cm) and nematodes observations like soil nematode population, number of galls/root system and number of egg mases/root system was recorded.

Results and Discussion

In the present study, the increasing inoculum levels of *M. incognita* were found to reduce the growth of the host by way of reducing the number of leaves, vine length, plant height, fresh weight of shoot and dry weight of shoot. Whereas, fresh weight of roots and dry weight of roots were increased with increasing inoculums levels of *M. incognita*.

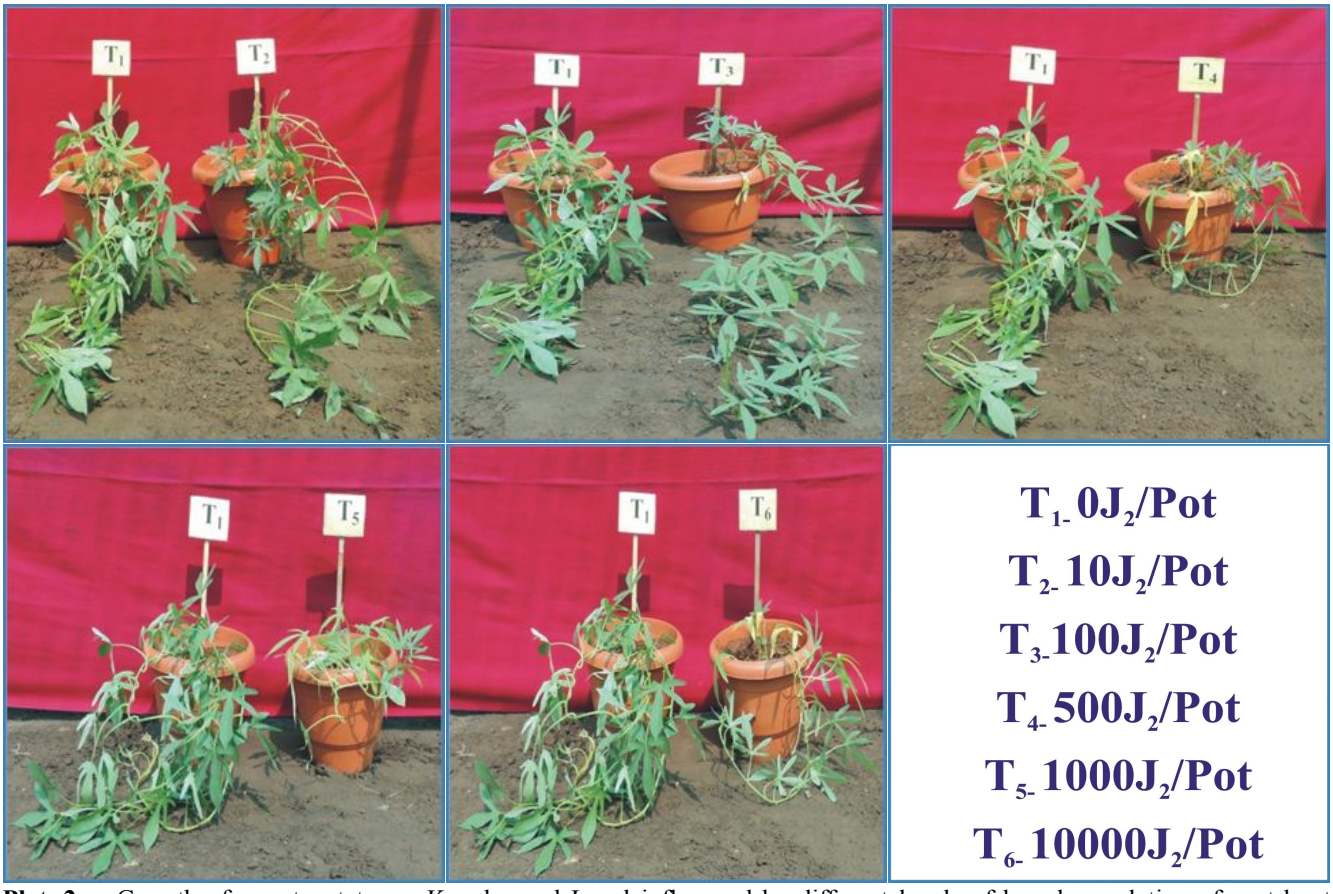

Plate 2a: Growth of sweet potato cv. Kanghangad Local influenced by different levels of larval population of root-knot nematode (*M. incognita*).

Table 3: Effect of different inoculum levels of root-knot nematode, *M. incognita* on population densities of nematode in sweet potato cv. Kanhangad Local.

Inoculum level (J_2/plant)	No. of galls/ root system	Gall Index	No. of egg masses/ root system	Egg mass Index	Soil nematode population (200 cc soil)	Root nematode population (10 g)
0	0.00	0	0.00	0	0.00	0.00
10	5.33	2	3.67	2	87.67	41.33
100	15.67	2	12.33	3	141.33	100.33
1000	26.33	3	31.33	4	1837.33	119.00
5000	91.33	4	79.33	4	2674.00	236.33
10000	113.33	5	106.00	5	2233.00	369.67
S.Em±	**3.07**	**-**	**2.41**	**-**	**102.43**	**13.14**
CD at 5%	**9.48**	**-**	**7.45**	**-**	**315.64**	**40.50**
*Replications: 3						

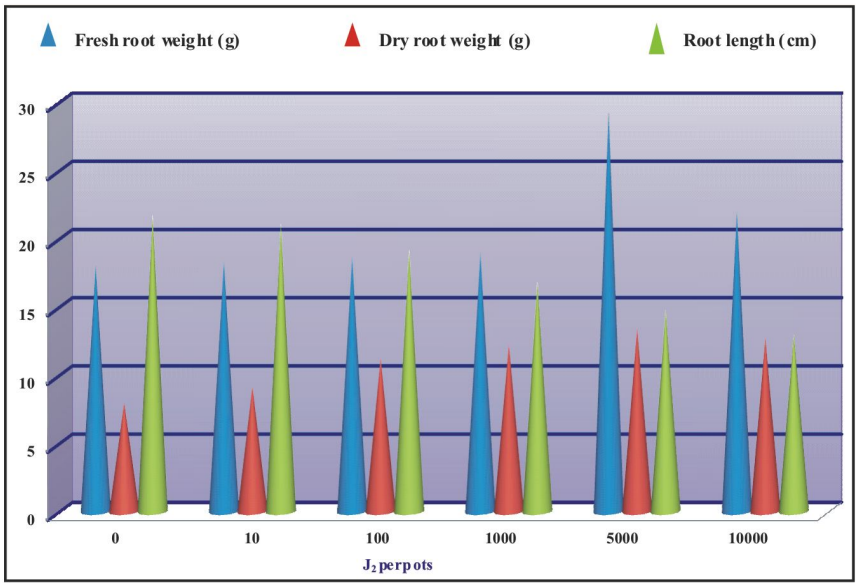

Fig. 1: Effect of different inoculums level of root-knot nematode, *M. incognita* on fresh and dry weight of roots and root length in sweet potato cv. Kanhangad Local.

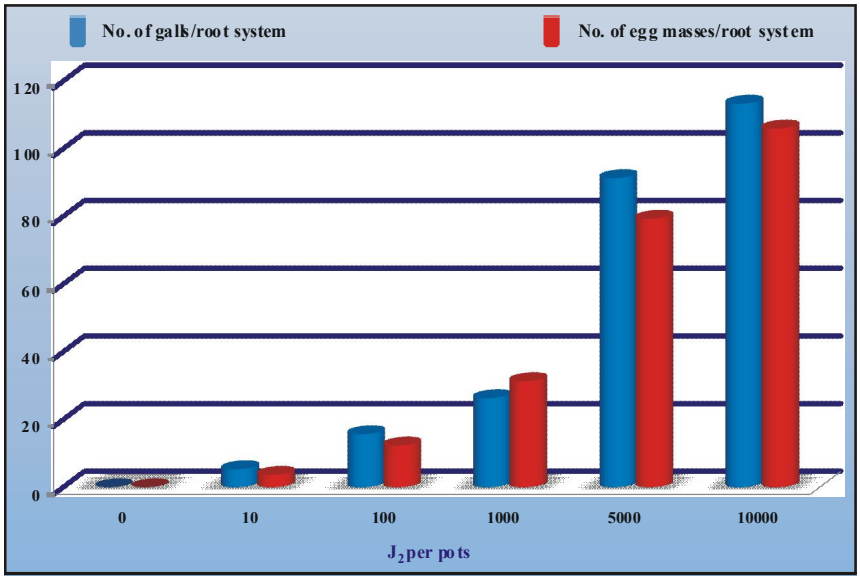

Fig. 2: Effect of different inoculums level of root-knot nematode, *M. incognita* on number of galls and egg masses per root system in sweet potato cv. Kanhangad Local.

The growth parameters *viz.*, number of leaves per plant, vine length, plant height, root length, fresh and dry weight of shoot decreased with the increasing inoculum levels of *M incognita*. Highest reduction of number of leaves per plant, vine length, plant height, root length, fresh weight and dry weight of shoot was observed in plants inoculated with 10000 J_2 per pot (59.00, 117.33 cm, 126.00 cm, 13.00 cm, 46.00 g & 10.67 g) followed by plants inoculated with 5000 J_2 per pot (65.67, 120.33 cm, 129.00 cm, 14.80 cm, 66.00 g & 14.33 g respectively) and minimum reduction was recorded in plants inoculated with 10 J_2 per pot (88.00, 139.33 cm, 149.00 cm, 21.11 cm, 100.67 g & 22.33 g), followed by plants inoculated with 100 J_2 per pot (82.67, 134.33 cm, 143.67 cm, 19.24 cm, 94.00 g & 18.33 g) and 1000 J_2 per pot (73.67, 128.33 cm, 137.00 cm, 16.90 cm, 78.00 g & 15.33 g).

However, fresh and dry weight of root increased with increase in inoculums levels of *M. incognita*. Minimum fresh and dry weight of roots was noticed in plants inoculated with 10 J_2 per pot (18.33 & 9.20 g), 100 J_2 per pot (18.67 & 11.33 g), 1000 J_2 per pot (19.03 & 12.33 g) respectively as against highest in 5000 J_2 per pot (29.33 & 13.50 g).

The reduction of mean shoot weights by root- knot nematodes observed in this work is similar to the findings of Gapasin, (1980) who reported stunting and reduction of root and top weights of cassava as the *M. incognita* population

levels increased. Plants inoculated with 1000 or more nematodes were heavily galled and plant growth was significantly reduced in cucumber (Krishnaveni and Subramanian, 2003). Walters and Barker, (1993) reported that *Rotylenchulus reniformis* restricted storage root growth and increased the root necrosis on 'Beauregard' sweet potato. The growth of tomato and pepper were also reported to be curtailed by *M. incognita,* which reduced the fresh weight of both crops (Mekete *et al.*, 2003).

Reduced top growth could be due to root destruction by root-knot nematode and utilization of nutrients and related resources by the galled roots to the detriment of the tops. This might have resulted from poor absorption of water and mineral salts leading to a decreased growth rate.

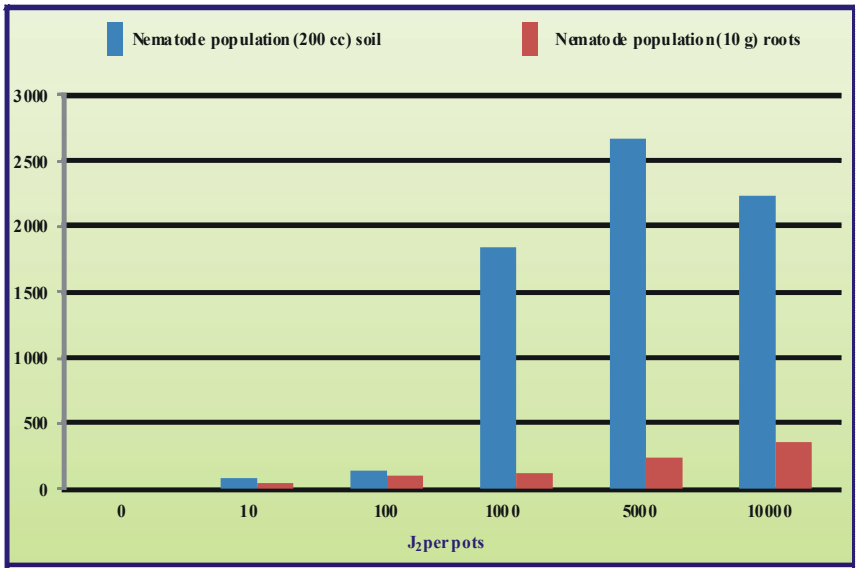

Fig. 3: Effect of different inoculums levels of root-knot nematode, *M. incognita* on population densities of nematode in sweet potato cv. Kanhangad Local.

Plate 2b: Growth of sweet potato cv. Kanhangad Local influenced by different levels of larval population on root-knot nematode (*M. incognita*).

The present readings are in confirmatory with Okechalu and Wonang, (2015) who reported that growth and yield parameters such as number of leaves, length of vines, number of tubers, weight of tubers and weight of vines of sweet potato were higher in the uninoculated (control) plants than the infected plants and also reported that root weight of galled plants generally averaged higher than those of their controls. This can be attributed to gall formation and proliferation of lateral roots. It may also be due to the redirection of nutrients from shoots to roots in galled plants. Darekar and Bele, (1990) also reported that more than 500 J_2 per plant resulted in suppression of shoot and root growth in tomato crop.

In the present study increase in gall indices with increasing inoculum density, is similar to the findings of earlier workers who reported that root-knot gall index increased exponentially with increase in initial population levels of *Meloidogyne* spp. on various crops (Okorocha *et al.,* 2014).

Osunlola and Fawole, (2015) also reported that the gall index and the final root nematode population increased with increase in inoculum density of *M. incognita* on sweet potato. The nematode population in soil increases with increase in inoculum levels as well as nematode reproduction rate was inversely proportional to the nematode inoculum level and this might be due to competition of nematodes for host penetration, food and space. Lesser are the nematodes, lesser is the competition and therefore more nematodes reduced the reproductive rate (Sumitha, 2014). The highest gall index was also recorded

at inoculums levels of 1000 and 10000 respectively (Krishnaveni and Subramanian, 2003).

Conclusion

Reduction in fresh and dry weight of shoot with increasing inoculum levels of *M. incognita* was noticed and least was recorded in plants inoculated with 10000 J_2 per pot (46.33 and 10.67g).The number of galls increased with increase in inoculum levels of *M. incognita*. However, the highest number of galls per plant was observed in plants inoculated with 10000 J_2 per pot (113.33) followed by plants inoculated with 5000 J_2 per pot (91.33). Hence, the study on pathogenicity is important to know minimum population causing root-knot infection, which will be helpful in maintaining the population below the economic threshold level.

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