International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 02-10-2021, Accepted: 17-10-2021, Published: 01-11-2021
Volume 6, Issue 6, 2021, Page No. 1-4

Effect of root knot nematode (*Meloidogyne incognita*) on the growth of cucumber plant

Sunita Chahar*, Nalini Singh, Poonam Yadav
N.E.S Ratnam College of Arts, Science & Commerce, Bhandup (West), Mumbai, Maharashtra, India

Abstract
Root knot nematode, *Meloidogyne incognita*, is one of the biggest problems in the production of cucumber. This plant parasitic nematode depends on root sap to survive, which causes improper supply of water and minerals to the plant. Some of the basic symptoms of these nematodes on plants are galling of roots, yellowing of leaves and stunted growth in plants. In the present study, a pot experiment was conducted to study the effect of root knot nematode on the growth of the cucumber plant. The infected plants showed decreased leaf size, shoot weight, nutrients and chlorosis of leaves as compared to the control.

Keywords: cucumber, root knot nematode, *Meloidogyne incognita*, root galls

Introduction
Root-knot nematodes (*Meloidogyne* spp.) are one of the most destructive pathogens of vegetables, even low nematode levels can cause high yield losses. The most important species of root-knot nematodes are *M. javanica*, *M. arenaria*, *M. incognita* and *M. hapla* that cause high economic damages in different crops (Khalil, 2013) [8]. Root- knot nematodes are one of the limiting factors in cultivated crops like fig, pomegranate, carrot, pigeon pea, cucumber and cotton in Maharashtra causing considerable yield losses (Lavhe *et al* 2019) [16]. The nematode damages plant by direct feeding from induced large galls throughout the root system of infected plant and alters uptake of water and nutrients, interfering with translocation of photosynthates.(Thangamani *et al*. 2018) [13]. The nematode spends most of their active life within plant roots. The infestation stage is the second-stage juvenile (J2), which penetrates the root and migrates to the vascular tissue to establish a permanent feeding site (Williamson and Hussey, 1996) [14]. Incidence of *M. incognita* can result in a 25% annual yield loss in field grown cucumber (Anwar and McKenry, 2012) [1]. The present experiment was carried out to study the effect of *Meloidogyne incognita* on the growth of cucumber.

Materials & Methods
Experimental methodology
Cucumber seeds (*Cucumis sativus*-Dasher-II hybrid variety) were surface sterilized with sodium hypochlorite, germinated and planted in 2:1 ratio of sterile soil: sand (total 3 kg) in pots. After the seedlings turned 10 days, approximately 1000 juveniles of *Meloidogyne incognita* were added in the soil near the rhizosphere and the plants were watered every alternate day till 45 days. Triplicates were taken for control (non-infected) and infected sets.

Nematode inoculum
The root-knot nematode, *Meloidogyne incognita*, used in the experiment was isolated from infected cucumber roots and was confirmed by its perineal pattern (Nalini and Chahar, 2021) [12].
The nematode was multiplied from a single egg mass on chilly plant. The eggs of *Meloidogyne incognita* were collected and juveniles were extracted and concentrated.
Observations on different plant parameters were taken after 45 days of inoculation. Plant height and number of leaves were recorded before uprooting the plants. Number of galls and egg masses per root were counted. Similarly, fresh weight of shoots and roots were taken.

Chlorophyll estimation (Arnon, 1949) [2]
Carried out by grinding 1gram of finely cut fresh leaves in 80% acetone, centrifuging at 5000 rpm for 5 minutes and measuring absorbance at 645nm and 663nm against the solvent (acetone) blank. The concentrations of chlorophyll a, chlorophyll b and total chlorophyll were calculated using the following equation:

$$\text{Mg of Chlorophyll a/gm tissue} = [12.7(\text{O.D. at } 663) - 2.69 (\text{O.D. at } 645)]\frac{V}{1000 \times W}$$

$$\text{Mg of Chlorophyll b/gm tissue} = [22.9 (\text{O.D. at } 645) - 4.68 (\text{O.D. at } 663)]\frac{V}{1000 \times W}$$

$$\text{Mg of Total Chlorophyll /gm tissue} = [20.2 (\text{O.D. at } 645) + 8.02 (\text{O.D. at } 663)]\frac{V}{1000 \times W}$$

Where V= the final volume of the 80% acetone chlorophyll extract W= the fresh weight in grams of the tissue extracted

Nitrogen estimation (Kjeldahl's method, 1883) [10]
By digestion, distillation and titration method.

Phosphorus estimation (Fiske and Subbarow method, 1925) [4]
By Ammonium molybdate blue coloured complex colorimetrically.

Results and Discussion
The plants were uprooted after 45 days and examined for the shoots, roots, Nitrogen, phosphorus, chlorophyll a, b, total chlorophyll and root knot nematode infection. The results are shown in Table 1, Fig 1, Fig 2. *Meloidogyne incognita* affected the growth of cucumber significantly. Shoot length, root length and weight of the plants were reduced as a result of nematode infection. Chlorophyll a, b

and total Chlorophyll was much less in the infected plants. The leaves of infected plants showed reduced Nitrogen and phosphorus content compared to the control plants. (Fig 1.) The infected plants showed yellowing and curling of leaves after one month (Fig 3). This was due to nematode entry and feeding resulting in impaired and disrupted water absorption by the infected root systems. After entry into roots, the root-knot females induce gall formation and giant cells in the stelar region and cause severe disruption of xylem tissues. Due to extensive disruption of xylem vessels, the upward uptake of water and nutrients is greatly reduced. The root-knot infection also greatly affects permeability of roots to water. Due to the induction of nurse cell systems by females of root-knot nematodes for incessant feeding in infected roots, there is greater translocation of photosynthates towards these infection sites, while the aboveground parts experience acute deficiency of nutrients [Wyss 2002 [15], Di Vito *et al*. 2004 [3]]. As the infected plants face insufficient supply of nutrients, photosynthates, energy, water etc., development and growth of leaf tissues and their essential constituents, particularly chlorophyll pigments, are greatly hampered (Khan and Khan 1997 [9]). The stunted and reduced growth of foliar parts subsequently results in reduced biomass and productivity [Hussain *et al*. 2016 [6], Kayani *et al*. 2013 [7]]. The root gall index on a scale of 1-5 was found to be 4 (> 30) (Hema and Khanna, 2018[5]) which explains the infection is significantly high and the plant showed immediate symptoms of infection. The root galls, egg mass, sedentary female, eggs and juveniles isolated from the infected roots are shown in Fig.4.

Conclusion

Cucumber is susceptible to *Meloidogyne incognita* infection. The infection occurs within a months period and galls are seen. The infection and root knots increase in number in 45 days. The plant shows symptoms of chlorosis, wilting, curling of leaves and stunted growth as shown in Fig. 3. The analysis showed decrease in shoot weight, shoot length, root length, reduced chlorophyll content, Nitrogen and Phosphorus content in the aerial parts of the plant, 45 days after harvest. The root gall index of 4 indicates the infection in 45 days is significantly high.

Table 1: Effect of *Meloidogyne incognita* infection on growth of Cucumber plant (after 45 days).

Parameter	Control	Infected
Shoot length (cm)	53.4±3.14	46.35±4.45
Shoot fresh weight (g)	20.40±2.02	15.34±2.7
Root length (cm)	19.03±2.4	12.9±1.96
Root Fresh weight (g)	10.60±0.69	5.05±0.155
No. of leaves	13.33±2.51	9.66±2.08
No. of root galls/root system	0	103.33±6.11
No. of egg masses/ root	0	51.33±4.16
Root gall Index	0	4

*Mean ±S.D. (Mean of 3 replications)

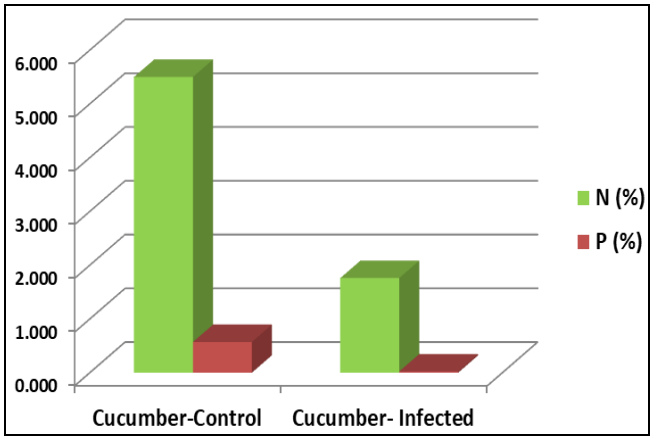

Fig 1: Comparison of Nitrogen and Phosphorus content of leaves between control and infected (*Meloidogyne incognita*) plants of cucumber.

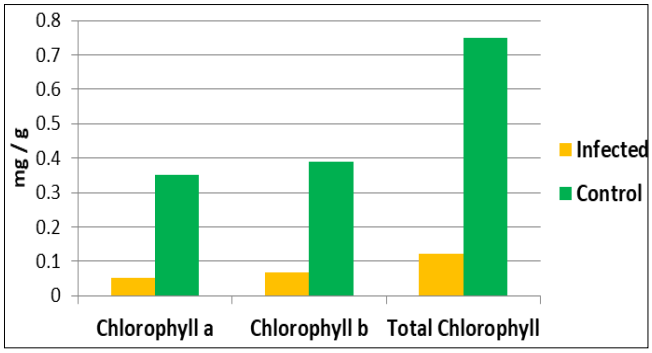

Fig 2: Comparison of Chlorophyll content between control and infected plants (*Meloidogyne incognita*) of cucumber.

Control after 45 days

Infected after 45days

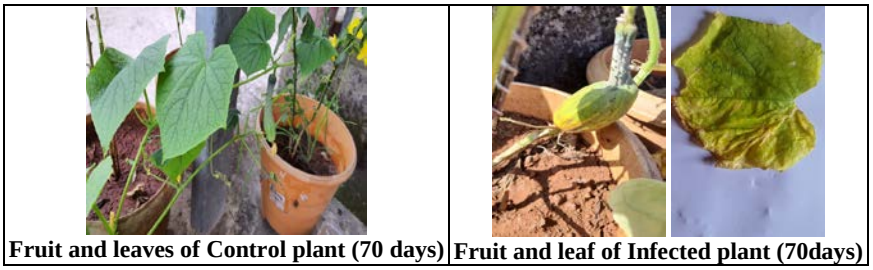

Fig 3: Control and Infected plants

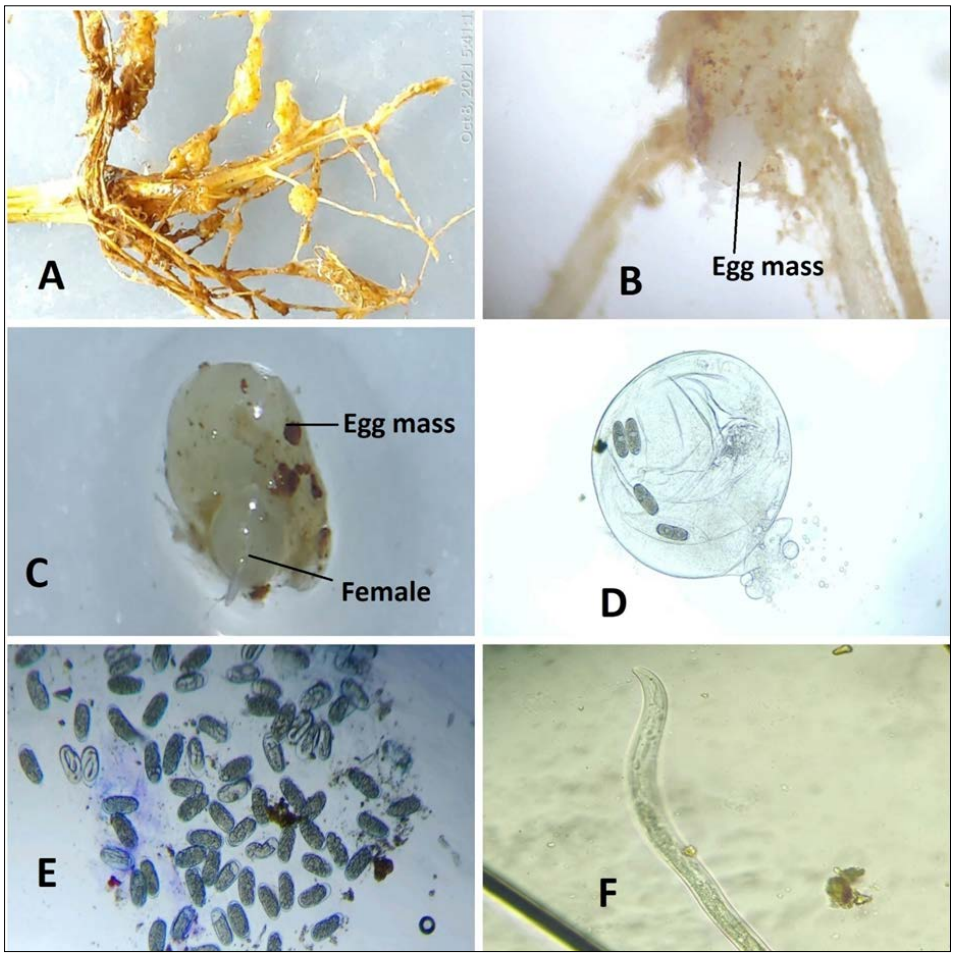

Fig 4: Roots of cucumber showing infection

A: Roots showing root knots
B: Egg mass showing eggs released-under stereo zoom microscope
C: Female with egg mass under stereo zoom microscope
D: Female with eggs inside-under compound microscope 20X
E: Eggs in different stages under compound microscope 10X
F: Juvenile J2 stage 20X

Acknowledgement
The authors thank Department for Biotechnology-Star-Status scheme for the financial support and the College for the required facilities.

References

1. Anwar SA, McKenry MV. Incidence and population density of plant-parasitic nematodes infecting vegetable crops and associated yield losses in Punjab, Pakistan. Pakistan Journal of Zoology,2012:44(2):327-333.
2. Arnon D. Copper enzymes isolated chloroplasts, polyphenol oxidase in Beta vulgaris. Plant Physiology,1949:24:1-15.
3. Di Vito M, Vovlas N, Castillo P. Host-parasite relationships of Meloidogyne incognita on spinach. Plant Pathol,2004:53:508-514.
4. Fiske CH, Subba Row Y. Journal of Biol. Chem,1925:66:375.
5. Hema, Anju S Khanna. Yield loss assessment of tomato through *Meloidogyne incognita* (kofoid and white) chitwood, in Himachal Pradesh, India.Journal of Entomology and Zoology Studies,2018:6(5):448-451.
6. Hussain MA, Mukhtar T, Kayani MZ. Reproduction of *Meloidogyne incognita* on resistant and susceptible okra cultivars. Pak. J. Agri. Sci,2016:53:371e375.
7. Kayani MZ, Mukhtar T, Hussain MA, Haque MI. Infestation assessment of root-knot nematodes (*Meloidogyne* spp.) associated with cucumber in the Pothowar region of Pakistan. Crop Prot,2013:47:49e54.

8. Khalil MS. Alternative Approaches to Manage Plant-Parasitic Nematodes. Journal of Plant Pathology-Microbiology,2013:4(1):e105.
9. Khan MR, Khan MW. Effects of root-knot nematode, *Meloidogyne incognita*, on the sensitivity of tomato to sulphur dioxide and ozone. Environ. Exp. Bot,1997:38:117-130.
10. Kjeldahl J. Neue Methode zur Bestimmung des Stickstoffs in organischen Körpern. Fresenius J. Anal. Chem,1883:22:366-382.
11. Ekaun Alvin A, Agboola Festus O, Olomola A. Effect of different growing media on the early growth of Cucumis sativus (Cucumber) Seedlings. Int. J Agric. Extension Social Dev 2019;2(1):32-35. DOI: 10.33545/26180723.2019.v2.i1a.21
12. Nalini Singh, Sunita Chahar. Isolation and morphological identification of root knot nematode from cucumber roots. International Journal of Botany Studies,2021:6(5):547-550.
13. Thangamani CL Pugalendhi, Punithaveni V. Screening wild and cultivated cucurbits against root knot nematode to exploit as rootstocks for grafting in cucumber J. Hortl. Sci,2018:13(1):32-41.
14. Williamson VM, Hussey RS Nematode pathogenesis and resistance in plants. Plant Cell,1996:8:1735-1745.
15. Wyss U. Feeding behaviour of plant parasitic nematodes. In: The biology of nematodes, Lee, D.L. (ed.). Taylor and Francis, London, 2002, 233-260.
16. Lavhe NV, Undirwade DB, Gokte N, Borkar SL. Locating Areas of High Density of Plant Parasitic Nematode, *Rotylenchulus* spp. in Vidarbha Region of Maharashtra State. International Journal of Current Microbiology and Applied Science, 2019:8(12):142-151.