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Population Fluctuation of *Meloidogyne incognita* Infecting Cucumber in Poly-house

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A B S T R A C T

Population fluctuations of root-knot nematode, *Meloidogyne incognita* during crop season were studied on cucumber in two poly-houses of different locations. For the observations plant and soil samples were taken at fifteen days intervals throughout the crop season up to 120 days. Results showed that lowest 2.60 and highest 74.00 galls/5g roots of cucumber found at 15 and 120 days after sowing. No egg masses observed just 15 days after sowing of crops due to root-knot nematode complete their entire life cycle within 25 to 30 days. While, maximum 63.70 egg masses/5 g roots produced 120 days after sowing. The maximum 317.40 and minimum 264.20 eggs and larvae per egg mass was observed at 30 and 120 days after sowing in cucumber It was observed that egg mass contain found maximum when the population level is lowest and the egg mass contained reduced with increasing in the population of root-knot nematodes. Results also showed that minimum 1347.90 and maximum 2256.90 juveniles per 100 cc soil was found at 15 and 120 days after sowing of cucumber in poly-house.

Introduction

The cucumber (*Cucumis sativus*) is a climbing plant, originated in India. It is well grown throughout the world. The cucumber fruit is eaten raw or is served as a salad or cooked as a vegetable. Cucumber is an excellent source of minerals and vitamins. Mostly cucumbers grown in poly-houses are parthenocarpy and they are high yielding. The crop production under protected cultivation represents the best option to increase the production of cucumber, by promoting controlled environmental conditions for the better growth and development of the plants than the one that occurs in the open field (Smitha and Sunil, 2016). Cucumber grow in a controlled environment, which promotes a lower incidence of pests and diseases, facilitates the harvest and allows the use of higher densities of population to obtain high yields of fruits with better quality (Olalde *et al.*, 2014).

The impact of abiotic and biotic stresses under the present changing climate decreased

the crop production and quality. The most constraints in cucumber production in North Indian condition are the extremes of temperature, sunlight, wind velocity, unavailability of quality water, relative humidity, weeds, carbon dioxide concentration and diseases and insect pest incidence including plant parasitic nematodes. Protected cultivation means to grow with improved quality out of season under protected structures, thereby increasing the profitability for the farmer especially in adverse climatic conditions. This technology has a potential to supply of high quality vegetables in the peri-urban areas.

The crop of such an economic importance is suffered from several biotic and abiotic factors. Among biotic factors, insect pests and diseases are the most important ones including plant parasitic nematodes. Plant parasitic nematodes *viz.*, *Meloidogyne* spp., *Pratylenchus* spp., *Rotylenchulus reniformis*, *Tylenchorhynchus* spp., *Hoplolaimus* spp., *Helicotylenchus* spp. and *Xiphinema* spp. have been found in poly-houses (Chandel *et al.*, 2010; Sharma, 2010; Manju and Subramanian, 2015; Singh *et al.*, 2015). Among nematodes, root-knot nematode (*Meloidogyne* spp.) is considered as most important pest of cucumber under protected cultivation. Root-knot nematode cause great losses in different crops (Bhatti and Jain, 1977; Sharma and Baheti, 1992; Baheti and Bhati, 2017).

The degree of damage depends on the pathogenic potential of population growth of nematodes which are greatly influenced by the population densities. Generally humidity and temperature reported to affect the nematode population in a particular crop. The fluctuation in nematode population was depends on major divergences in temperature and moisture (Norton, 1978). Poornima and Sivagami (1998) studied the population fluctuation of phyto-nematodes in turmeric and recorded that the population of *M. incognita* increased with increase in age of the crop and diminished as the age of the crop advances. A study on population dynamics of root knot nematode (*Meloidogyne* spp.) in cardamom revealed the occurrence of high number of second stage juveniles during Mar-Apr. Crop phenology appears to be the major factor in the fluctuation of nematode population than ecological factors like rainfall and soil temperature (Eapen, 1993). Information's were available on nematodes population and their fluctuations in different crops and soils. Nowadays protected cultivation is gaining importance in quality production. However, this work has been carried out on the status of nematode population fluctuation in poly-houses and it will be helpful for calculate the timing of applications of nematode management measures.

Materials and Methods

Collection of samples

The soil and root samples of cucumber were collected from poly-house, during crop season at fifteen days interval up to 120 days. Soil and root samples were collected from rhizosphere in poly-house and brought to the laboratory and kept in refrigerator till processing. Observations on initial nematode population/100 cc soil, no. of galls/5 g roots, no. of egg masses/5 g roots, no. of eggs and larvae/egg mass and no. of larvae/100 cc soil were recorded.

Identification of root-knot nematode species

Root samples were brought to the laboratory and washed carefully in running tap water to remove adhering soil particles. Egg masses with females were detached from roots with

the help of teasing needle and forcep under stereoscopic binocular microscope. Egg masses were kept in water for 24 hours for hatching and females were picked up for identification of species. Perineal patterns of these females were cut with the help of scaples and the body contents were removed gently with camel brush No. 1 (Taylor and Netscher, 1974). Observation of such several patterns was recorded and the nematode species was identified as *M. incognita* (Eisenback *et al.*, 1981).

Counting of galls and egg masses

After harvesting, root samples were collected from each experiment, labelled properly and brought to the laboratory. Roots were gently washed in running tap water to remove adhering soil particles. Well cleaned roots were cut into small pieces and 5g samples were taken and observed thoroughly under microscope for counting of galls and egg masses.

Counting of eggs and larvae per egg mass

Roots were stained with 0.1% acid fuchsin lactophenol solution, rinsed in water to remove excess amount of stain and kept in clear lactophenol at least for 24 hours before examination (McBeth *et al.*, 1941). Egg masses were randomly selected and detached from stained roots and put in a drop of clear lactophenol on glass slide, covered with cover slip and press gently so that contents of egg mass spread thoroughly. Thereafter, eggs and larvae were counted under stereoscopic binocular microscope.

Estimation of initial and final nematode population

For estimation of initial nematode population, soil samples collected from the polyhouse were brought to the laboratory and thoroughly mixed by using coring and quartering method, 100 cc soil was taken and processed by using Cobb's sieving and decanting technique (Cobb, 1918) followed by Baermann's funnel technique (Christie and Perry, 1951). After 24 hours, the nematode suspension was drawn from the funnel in a beaker and kept for some time as such to allow the nematodes to settle down at the bottom. 100 ml suspensions was maintained with the help of measuring cylinder and 2 ml suspension was drawn with the help of a pipette after thoroughly bubbling and poured over a counting disc. Population was counted under stereoscopic binocular microscope.

Results and Discussion

The root-knot nematode species, *Meloidogyne incognita* were studied with regard to their population fluctuations on cucumber, growing under protected cultivation at two different locations. The findings of results are described and discussed below.

Number of galls per 5g roots

In the crop season results showed that minimum 2.60 galls/5g roots of cucumber found just 15 days after sowing of cucumber during 2016 and 2017. The highest 74.00 galls/5g roots of cucumber found 120 days after sowing of cucumber during both years. It was happened due to exposure of root-knot nematode population with the increasing in time of well-established crop. When the root-knot nematode population increased with the time, the penetration of juveniles increased and the number of galls also increased.

Number of egg masses per 5g roots

On the basis of table no. 1 results revealed that no egg masses observed just 15 days after sowing of crops due to root-knot nematode complete their entire life cycle within 25 to 30

days. Therefore, minimum 3.90 egg masses/5 g roots found 30 days after sowing of cucumbers under protected cultivation in 2016 and 2017. It was also observed that maximum 63.70 egg masses/5 g roots produced 120 days after sowing in both years on cucumber under protected cultivation.

Number of eggs and larvae per egg mass

In the experimental results, it was recorded that no egg masses found 15 days after sowing of cucumber. The maximum 317.40 eggs and larvae per egg mass were observed at 30 days after sowing of cucumber under protected cultivation in 2016 and 2017. The minimum 264.20 eggs and larvae per egg mass in cucumber at 120 days after sowing of crop was recorded in 2016 and 2017. It was observed that the egg masses contain, number of eggs and larvae found maximum when the population level is lowest and the eggs contain reduced with increasing in the population of root-knot nematodes.

Final nematode population per 100 cc soil

Results showed that final nematode population was found maximum 2256.90 per 100 cc soil in cucumber crop during 2016 and 2017 under protected cultivation at 120 days after sowing. It was also obtained that the minimum 1347.90 juveniles per 100 cc soil found at 15 days after sowing of cucumber in poly-houses during both years.

The results of this experiment were similar to Vincx (1989), Lucas (1992), Eapen (1993) and Cerevkova *et al.,* (2010). Vincx (1989) find out the seasonal fluctuations of the nematode community, based on the monthly samples. The mean density of the total 32 species were found between 55 IJs/l0 cm2 (Feb. 1983) and 5610 IJs/10 cm2 (Jun. 1985.) and increase in reproductive activity appeared in spring and autumn. Lucas (1992) reported that population of root-knot nematodes, *Meloidogyne incognita, M. arenaria* and *M. hapla* fluctuated little in soil, but there was a trend toward reduced numbers at the end of the study, with higher numbers in winter than in summer in kiwi orchard, its similar trends found in both the years. Eapen (1993) found that ecological factors like rainfall and soil temperature mostly influencing the fluctuations in population of *Meloidogyne* spp. in a cardamom field for three years. Number of J_2 in soil was highest during March-April. Nematode population in roots increased rapidly during the post monsoon period, declined gradually during summer and was lowest in monsoon months.

A study on the seasonal fluctuation of nematode population was conducted from 2005 to 2007 at different soil depth in a hop garden and found that seasonal fluctuation of the nematode population was related to temperature and rainfall. At 20 cm soil depth of each year, the largest nematode population was recorded in July and the smallest from July to October.

At 40 cm soil depth, a decrease of nematode flow was observed from May to October (Cerevkova *et al.,* 2010). Ghonaimy *et al.,* (2015) also conducted an experiment based on two cropping sequences and found that the population density of root-knot nematode fluctuated with respective plants in both two sequences after 2 and 4 months from planting each crop. Cucumber and common bean in the first sequence were found to be best hosts for root knot nematode. The least number of nematodes were found on sesame. No galls or egg masses were found on onion.

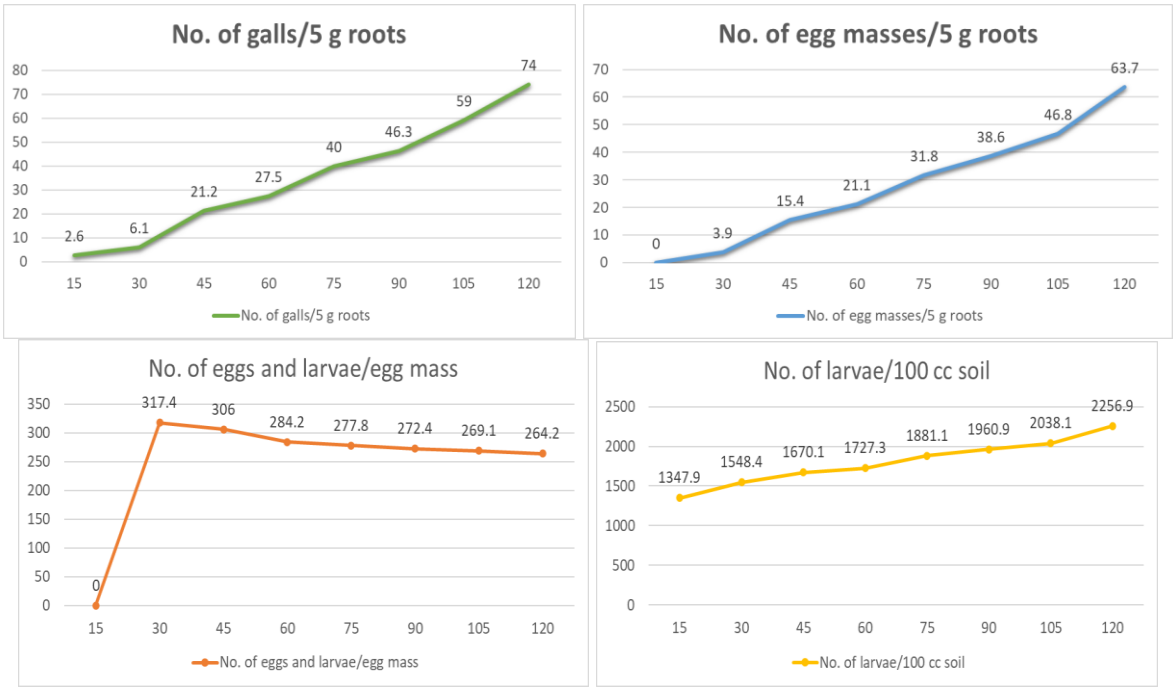
Surega and Ramakrishanan (2017) conducted experiment on turmeric to find out the effect of seasonal changes on the population of plant parasitic nematodes and monitored at monthly intervals (Fig. 1).

Table.1 Population fluctuation of root-knot nematode, *M. incognita* on cucumber in poly-house

Days after Sowing	No. of galls/5 g roots			No. of egg masses/5 g roots			No. of eggs and larvae/egg mass			No. of larvae/100 cc soil		
	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled
15	2.20	3.00	2.60	0.00	0.00	0.00	0.00	0.00	0.00	1350.60	1345.20	1347.90
30	5.00	7.20	6.10	3.20	4.60	3.90	313.60	321.20	317.40	1540.20	1556.60	1548.40
45	19.60	22.80	21.20	14.40	16.40	15.40	304.20	307.80	306.00	1667.80	1672.40	1670.10
60	26.40	28.60	27.50	21.80	22.40	21.10	282.80	285.60	284.20	1720.20	1734.40	1727.30
75	38.80	41.20	40.00	30.40	33.20	31.80	277.20	278.40	277.80	1885.40	1876.80	1881.10
90	44.20	48.40	46.30	37.60	39.60	38.60	270.60	274.20	272.40	1956.60	1965.20	1960.90
105	58.40	59.60	59.00	45.20	48.40	46.80	267.80	270.40	269.10	2032.80	2043.40	2038.10
120	72.80	75.20	74.00	64.80	62.60	63.70	262.60	265.80	264.20	2245.20	2268.60	2256.90
SEm	1.782	2.041	1.911	1.297	1.523	1.410	13.501	15.560	14.530	68.502	67.420	67.961
CD 5%	5.161	5.912	5.536	3.759	4.413	4.086	39.111	45.076	42.093	198.443	195.309	196.876

Data are the average value of five replications

Fig.1 Population fluctuation of root-knot nematode, *M. incognita* on cucumber in poly-house



The predominant genera *Meloidogyne incognita, Pratylenchus delattrei, Radopholus similis, Longidorus elongatus, Xiphinema elongatum, Hoplolaimus seinhorstii, Helicotylenchus multicinctus, Tylenchorhynchus martini* and *Rotylenchulus reniformis* recovered from rhizosphere. Among all, root-knot nematode population gradually started to build up right from the time of planting of turmeric and reached its peak around sixth month and declined towards crop maturity. Sen (2017) carried out work in a guava orchard and reported that the maximum population of nematodes were observed during monsoon with a population of 4169 IJS/250 gm soil in the month of July. During monsoon low soil temperature (30.10^0C – 31.80^0C) and high soil moisture (20% - 26%) in the month of July were also observed. The minimum population (204 IJs/250 gm soil) of soil nematodes was observed during pre and post-monsoon with a wide range of low to high soil temperature (18^0C - 34^0C) and low soil moisture (10% - 13%).

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