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# Studies on pathogenicity of root-knot nematode, *Meloidogyne incognita* on pea

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**Abstract**
Root-knot nematode is a major threat to pea cultivation. The pest causes a significant reduction in plant growth parameters that ultimately results in loss of yield. The experiment was carried out to study the pathogenicity of *Meloidogyne incognita* on plant growth parameters and nematode development of pea (Cv. Kashi Nandini) under glass house conditions by inoculating different inoculums levels *i.e.* 0 (control), 10, 100, 1000, 10,000 second stage juveniles ($J_2$) of *M. incognita* along with supernatant. The results revealed that the increase in inoculum level of *M. incognita*, there was a progressive decrease in growth parameters of the crop as the levels of inocula increased. Significant reduction in plant height, root length and fresh and dry weights of roots and shoots were declined. Maximum galls, egg masses and eggs per egg mass were recorded more pronounced and significant reduction was observed at higher inoculum levels *i.e.* 1000 and 10,000 $J_2$/pot.

**Keywords:** Growth parameters, pathogenicity, reproduction, root knot nematode

## Introduction
Pea (*Pisum sativum* L.) is one of the major annual pulse crops of temperate region of the world. Pea are rich in starch and high in fiber, protein, vitamins like A, B6, C & K, phosphorus, magnesium and iron (Pownall *et al*., 2010) [19]. This crop suffers from various pathogens attacking pea plants, the root knot nematode, *Meloidogyne incognita*, is the most important one that attacks the roots (Anwar and Mcknery, 2010) [6]. The root-knot nematode *M. incognita* is an economically important plant parasite with a wide host range of crops including pea, and abundant field populations can develop quickly under appropriate conditions (Grunwald *et al*., 2004) [14]. This rapid population growth is mainly due to the completion of several generations during a single growing season, combined with the high female fecundity. The exact number of eggs produced varies depending on environmental conditions. Under favorable conditions, a single female may produce 400–500 eggs (Abuzar 2003; Sharma *et al*., 2006) [1, 20]. Among various obstacles in cultivating pea, the root-knot nematode, (*M. incognita*) has been reported to cause severe yield losses of up to 20-56 per cent in pea (De *et al*., 2000; Mahapatra and Swain, 2001) [11, 18]. *M. incognita* alters metabolic processes of the host which are manifested in the form of cellular, physiological and biochemical changes occurring in the infected host. There is hardly any contribution on root knot nematodes infecting these groups of pulses. In the present studies on pathognicity are important to know minimum population causing root-knot infection, which will be helpful in maintaining the population below the economic threshold level.

## Materials and Methods
**Pathogenicity study:** The experiment was conducted under glass house condition. The good, bold and healthy seeds of pea (Cv. Kashi Nandini) surface sterilized with sodium hypochloride (1%) and were sown in ten-centimeter earthen pots containing 500 g sterilized soil. Each pot received two seeds and after germination one was retained. Seven days old seedlings were used for inoculation. The treatment consisted of an uninoculated control and five different levels of inocula as 10, 100, 1000, 10,000 second stage juveniles ($J_2$) of *M. incognita* and supernatant. The extraction of nematodes was carried out by Cobb's sieving and decanting method followed by modified Baermann funnel technique (Christie and Perry, 1957) [9]. The plant was inoculated by gently removing the soil around the seedlings in a circumference of four centimeters and then dispersing inoculum over the area. After appropriate inoculation, the roots were covered by fresh sterilized soil. Each treatment was replicated five times and arranged on glasshouse bench following complete randomized block design (CRBD).

The pots were irrigated with 100 ml fresh water every day if needed and thereafter with equal quantity of water per day as and when required. Adequate plant protection methods were adopted to grow healthy plants. The observations on plant height, fresh and dry shoot and root weight, number of galls, egg masses, eggs and nematode population were recorded 45 days after inoculation. The entire root system along with the soil was tapped out of the pot and the roots were washed in a container with a gentle stream of water. For obtaining fresh weight, the roots were pressed gently between two pads of blotting paper and then their weights were recorded. This was followed by drying in an oven at 60°C±1°C until constant weights are recorded. The first experiment was laid out 2017 and second trail conduct in 2018. The glasshouse temperature during this period ranged between 21°C to 26°C. The data was analyzed statistically using ANOVA.

**Results and Discussion**

The data presented in Table-1 revealed that with the increase of inoculum level there was a corresponding decrease in plant growth with increase in levels of inocula. Gradual stunting of plants was noted when inoculated with *M. incognita*. Maximum (37.69 cm) plant height was noted in control and minimum (14.61 cm) in 10,000 $J_2$/plant followed by1000 inoculum level (22.91 cm). Similar trend was also noted in root length. The plant height and root length reduction were gradual up to 1000 level but declined sharply when 10,000 larvae were added. The results are in accord with the findings of Bhagwati and Phukan (1991) [7] and Siddiqui *et al* (1995) [22] significant reduction in plant growth with an initial inoculum of 1000 larvae of *M. incognita* per 500 g of soil on pea. Khan *et al*., (2010) [16] reported that inoculum level of 1000 and 10,000 juveniles/kg soil of *M. incognita* showed a significant decline in plant growth on broccoli. Ganaie *et al*., (2011) [13] reported a significant reduction in plant growth parameters in okra plant with an inoculum level of 1000 $J_2$/plant.

There was a decline fresh and dry weight of shoot as the level of inoculums increased. Maximum (4.38g and 1.16g) fresh and dry weights were noted in control and minimum (0.89g and 0.199g) in 10,000 inoculum level. At 1000 inoculum level, the weights were recorded to be 1.22 and 0.27g. Similar trend was again noted when the fresh and dry weights of root were observed. Similar findings were also brought forward by Sharma and Bhatt (2006) [21] who reported that fresh and dry weight of root and shoot were declined at 1000 and 10,000 inoculum level of *M. incognita* applied per 500 g of soil on egg plant. Similarly, Abuzar (2012) [2] reported that the significant reduction in root-shoot fresh and dry weights at minimum initial inoculum level (500 $J_2$/pot) as compared to uninoculated plants. Reduction in growth parameters was increased with the corresponding increase in initial inoculum levels (10,000 $J_2$/pot).

Maximum number of root galls (146.30) were recorded at 10,000 inoculum level which declined drastically at 1000 (67.30) and 100 inoculum level (41.30) against no galling in un-inoculated control (Table-1). There was increase in the number of egg masses with the increase in inoculum levels. Maximum number of egg masses (10.26) was recorded with 10,000 inoculum level followed by 1000 inoculum level (7.29). Minimum (3.61) egg masses were recorded with supernatant followed by 10 inoculum level (4.29) against no egg masses in control. Significantly maximum (258.34) eggs/egg masses were recorded with 10,000 inoculum level followed by 1000 inoculum level (213.91). Minimum (100.33) eggs were recorded with supernatant followed by 10 (118.06) and 100 inoculum level (143.17) against uninoculated control (0.00). Minimum nematodes population was (165.62 N) recorded with supernatant followed by 10 inoculum level (583.92) and increased with increase in the inoculum level. The nematode population (root + soil) was maximum (19890.63 N) at 10,000 inoculum level followed by 1000 (7457.42 N) and 100 inoculum level (3048.22 N) against control where no nematodes were incorporated. The results are also in accord with the findings of Sumita (2014) [23] who reported that the highest galling, egg masses and nematode population of *M. incognita* (up to 1000 to 10000 $J_2$/plant). Hisamuddin and Azam (2010) [15] reported that maximum root galls, egg masses and nematode population was observed with the increasing levels of nematode inoculums up to 1000 to 4000 $J_2$/plant. Similarly findings were also brought forward by Agwu and Ezigbo (2005) [3] on okra, Anwar *et al*., (2007) [5] on cotton and Dhurwey *et al*., (2019) [12] on wheat.

They reported that on inoculum level of two larvae per g of soil was found to be the damaging threshold level of *M. incognita* on pea in accordance with the above findings in the present study also 1000 nematode juveniles per 500g of soil were found to be the damaging threshold level of this nematode on pea (Cv. Kashi Nandini).These results are also in accord with the findings of Das (2008) [10] reported that initial inoculums levels of 1 $J_2$/g soil was found to be pathogenic for pea plants. Similarly findings were also brought forward by Chandra *et al*., (2010) [8] on cucurbits, Ahmed *et al*., (2014) [4] on chilli and Mahalik and Sahoo (2016) [17] on okra.

**Table 1:** Influence of different levels of inocula in plant growth parameters and reproduction factors of *M. incognita in* pea (pooled data of two years)

| S. No. | Treatments | Plant height (cm) | Root length (cm) | Fresh weight (g) | | Dry weight (g) | | No of galls/plant | No. of egg masses/galls | No. of eggs/ egg mass | Nematode population (root + soil) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Shoot | Root | Shoot | Root | | | | |
| 1 | Control | 37.69** | 20.92 | 4.38 | 3.41 | 1.16 | 0.50 | 0.00 (1.00***) | 0.00 (1.00) | 0.00 (1.00) | 0.00 (1.00) |
| 2 | Supernatant | 36.88 | 19.06 | 3.68 | 3.15 | 1.002 | 0.43 | 10.20 (4.19) | 3.61 (2.90) | 100.33 (11.01) | 165.62 (13.86) |
| 3 | 10 N* | 31.37 | 17.71 | 2.73 | 2.32 | 0.73 | 0.35 | 20.30 (5.50) | 4.29 (3.07) | 118.06 (11.86) | 583.92 (25.16) |
| 4 | 100 N | 27.17 | 16.99 | 1.89 | 1.76 | 0.45 | 0.27 | 41.30 (7.42) | 5.08 (3.25) | 143.17 (12.96) | 3048.22 (56.21) |
| 5 | 1000 N | 22.91 | 13.99 | 1.22 | 0.98 | 0.27 | 0.114 | 67.30 (9.20) | 7.29 (3.70) | 213.91 (15.62) | 7457.42 (87.35) |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 10000N | 14.61 | 8.29 | 0.89 | 0.71 | 0.199 | 0.069 | 146.30 (13.09) | 10.26 (4.20) | 258.34 (17.07) | 19890.63 (142.03) |
| S. Em ± | | 0.570 | 0.398 | 0.181 | 0.149 | 0.029 | 0.015 | 4.298 (3.07) | 0.305 (1.55) | 5.509 (3.34) | 6.919 (3.63) |
| CD (p=0.05) | | 1.674 | 1.169 | 0.531 | 0.436 | 0.086 | 0.045 | 12.620 (4.55) | 0.895 (1.94) | 16.175 (5.02) | 20.315 (5.50) |

*N= Nematodes, ** Mean of five replications, *** Figure in Parentheses are √ n+1 transformed values

## Conclusions

From the results obtained after two years experimentation plants are highly suceptible to root knot nematode. It is concluded that reduction in plant growth parameters with the increase in levels of inocula. The pathogenic potential of *M. incognita* on pea was noted to be 2 $J_2$/g soil. The research should be encouraged in relevant areas of study so that lay men can have knowledge on identifying root knot nematode on pea crops.

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