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Impact of root knot nematode on *Coleus forskohlii* and *Ocimum sanctum*

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Abstract
The aim of the present investigation was to check the impact of Root-Knot Nematode **(***Meloidogyne incognita***)** on two medicinal plants belonging to family*lamiaceae* i.e. *Coleus forskohlii* and *Ocimum sanctum.* The plants of *Coleus forskohlii* and *Ocimum sanctum*were grown in pots. Three concentrations of Root-knot nematode i.e. 10,100 and 1000 juveniles were added. The maximum number of galls were observed in the roots of C*oleus forskohlii*and *Ocimum sanctum* where 1000 juveniles of root-knot nematode were added followed by 100 and 10 juveniles of root-knot nematode. The result showed decrease in the plant growth and biomass which were inoculated with high concentration of root-knot nematode.

Keywords: *Coleus forskohlii*, *Ocimum sanctum*, root-knot nematode, gall count, *Meloidogyne incognita*

Introduction

Coleus forskohlii and *Ocimum sanctum* are the medicinal plants from the Lamiaceae family that are also utilized in Ayurveda for a variety of ailments. These two medicinal plants are also used to treat a variety of conditions, such as rashes, asthma, bronchitis, diabetes, indigestion, headaches, respiratory syndrome, fever, indigestion, diarrhoea, cough, glaucoma, and some types of cancer (Ahmad & Ansari 2020; Plenchette et. al., 1983; Simtha et. al., 2019) [2, 5, 7]. Farmers in India are now cultivating them commercially because of their high demand in the medicinal and industrial areas (Seenivasan, 2010; Padalia *et al*., 2017) [6, 3]. The commercial yield of *Coleus forskohlii* and *Ocimum sanctum* is heavily threatened by the infestation of different species of *Meloidogyne* (Seenivasan, 2010; Gupta *et al*., 2015; Pandey *et al*., 2016; Tiwari *et al*., 2021) [6, 1, 4, 12]. Root-knot nematodes are one of the plant parasites that belong to the genus *Meloidogyne.* The most common symptoms of root-knot nematodes are the formation of galls on the roots, which decrease the uptake of water and minerals. Heavy nematode infection results in typical aboveground symptoms, which include wilting, stunting, chlorosis, a decrease in yield production, and a shortening of the productive life of infected plant (Singh and Chahar, 2021) [8].

Materials and Methods

Experimental methodology: The cuttings of *Coleus forskohlii and Ocimum sanctum* seeds were surface sterilized with sodium hypochlorite, planted in 2:1 ratio of sterile soil: sand in 3 kg capacity pots. After the cuttings and seedlings turned fifteen days old, 10, 100 and 1000 juveniles of *Meloidogyne incognita* were added in the respective pots near the rhizosphere and the plants were watered every alternate day till 60 days (Fig.1). Triplicates were taken for control (non-infected) and for different inoculum level of *Meloidogyne incognita* sets. The *Meloidogyne incognita* juveniles, used in the experiment were isolated from cucumber roots and were confirmed by its perineal pattern (Singh and Chahar, 2021) [8]. Observations of different plant parameters were taken after 60 days of inoculation. Plant height and number of branches and leaves was recorded before uprooting the plants. Number of galls and egg masses per root were counted. Similarly, fresh weight of shoot and roots were taken.

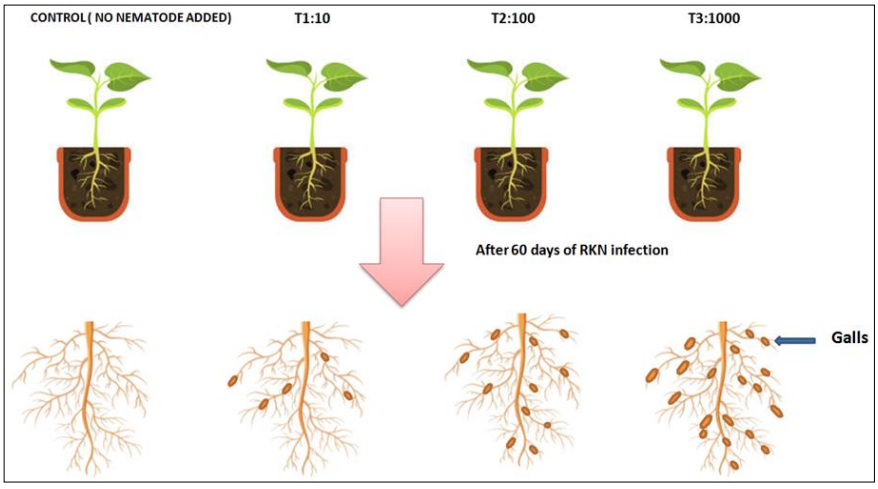

Fig 1: Diagrammatic representation of the experiment

Results and Discussion

The impact of different concentrations of root knot nematode, *M. incognita* on growth of *Coleus forskohlii* and *Ocimum sanctum* are presented in Table 1, 2 and 3. After 60 days of infection, it was noted that there was a progressive decline in plant growth parameters like plant height, fresh shoot and root weight of both *Coleus forskohlii* and *Ocimum sanctum* plants from the initial inoculum level to the highest. At the highest inoculum level (i.e at 1000 juveniles / kg) plants showed heavy chlorosis, stunted growth and very few branches. Root system of the infected plant with highest inoculum was reduced and showed presence of increased number of galls and egg masses (Table 1). The non-infected plants (control) showed a healthy growth and were free from galls. There was significant loss in fresh weight of shoot and root and in plant height with the increasing inoculum level from 10 to 1000 juveniles/kg of soil (Table 2 & 3). Similar results were observed by Singh, T (2011) [10] in bottle gourd plant. Growth of *Coleus forskohlii* and *Ocimum sanctum* plants were severely affected with the increasing number of juveniles which might have caused destruction in the root system resulting in less uptake of nutrient and water. The results also proved that there was decrease in root weight with increasing number of gall and egg masses as the inoculum level of *Meloidogyne incognita* increased. These findings showed similarity with Singh et.al (2022) [9] on papaya and Sonowal et.al (2020) [11] on ivy gourd.

Table 1: Effect of different inoculum levels of *Meloidogyne incognita* on number of galls and egg masses on *Coleus forskohlii and Ocimum sanctum*after 60 days of inoculation

Inoculum levels (Juvenile/Kg soil)	No. of galls / root		No. of Egg masses / root	
	Coleus forskohlii	***Ocimum sanctum***	***Coleus forskohlii***	***Ocimum sanctum***
Control	0.0^{d}±0.0	0.0^{d}±0.0	0.0^{d}±0.0	0.0^{d}±0.0
T1 :10	8.3^{c} ± 1.53	8.67^{c} ± 2.08	6.3^{c}± 3.21	4.7^{c} ± 1.15
T2:100	25.7^{b} ± 2.52	23^{b} ± 4.36	14.3^{b} ± 1.53	11.67^{b} ± 2.52
T3:1000	57.7^{a} ± 2.08	52.33^{a} ± 3.06	47.0^{a} ± 2.65	42^{a} ± 2.65

*Mean±S.D. Mean value with different alphabet in the same column is significantly different at $p \leq 0.05$.

Table 2: Effect of different inoculum levels of *Meloidogyne incognita* on plant growth parameters of *Coleus forskohlii*

Inoculum levels (Juvenile/Kg soil)	Plant Height (cm)	Fresh Shoot weight (g)	Fresh root weight (g)
Control	63.3^{a} ± 1.52	22.00^{a} ± 2.65	10.33^{a} ± 0.58
T1 :10	60.33^{b} ± 2.52	17.33^{b} ± 1.53	8.33^{b} ± 1.53
T2:100	45.67^{c} ± 4.04	13.00^{c}±2.0	7.33^{c} ± 2.08
T3:1000	38.67^{d} ± 1.53	10.67^{d}± 2.08	4.67^{d} ± 1.15

*Mean±S.D. Mean value with different alphabet in the same column is significantly different at $p \leq 0.05$.

Table 3: Effect of different inoculum levels of Meloidogyne incognita on plant growth parameters of*Ocimum sanctum*

Inoculum levels (Juvenile/Kg soil)	Plant Height (cm)	Fresh Shoot weight (g)	Fresh root weight (g)
Control	57.63^{a}± 0.60	18.5^{a} ± 0.55	9.0^{a} ± 0.21
T1 :10	47.30^{b} ± 0.87	14.0^{b} ± 0.26	7.1^{b} ± 0.17
T2:100	38.73^{c} ± 0.45	10.9^{c}± 0.40	5.8^{c} ± 0.25
T3:1000	30.07^{d} ± 0.7	9.6^{d}± 0.32	3.6^{c} ± 0.56

*Mean±S.D. Mean value with different alphabet in the same column is significantly different at $p \leq 0.05$.

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