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Effect of root-knot nematode infestation on growth and biochemical parameters of *Plectranthus rotundifolius* (Poir.) Spreng

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ABSTRACT: Studies were conducted to assess the crop loss in Coleus, *Plectranthus rotundifolius,* a short duration tuber yielding vegetable, due to infestation of root knot nematode, *Meloidogyne incognita.* Plants inoculated with 5000 J_2 showed 50.78% reduction in the yield of coleus. Five local collections (Alur, Mankada, TCM-9, M-131 and Pulamanthol) and two improved varieties (Sree Dhara and Nidhi) were screened for relative tolerance to *M. incognita*. Local collection, Alur showed significant superiority in reducing the nematode population in soil and root. Lowest root-knot index (1.00) and reproduction factor (0.39) was recorded by the Alur collection compared to improved varieties. Defence enzyme activity and phenolic content in the resistant variety Alur collection was significantly higher than the improved varieties. Considering the ability to resist nematodes and yield potential, the local variety Alur collection can be used in breeding programmes to develop high yielding nematode resistant varieties suitable for cultivation in Kerala.

Keywords: *Plectranthus rotundifolius*, *Meloidogyne incognita*, growth parameters, yield, biochemical parameters, microplot studies.

INTRODUCTION

Chinese potato or coleus, *Plectranthus rotundifolius* (Poir.) Spreng is an under exploited tuber yielding vegetable, with high marketing potential. The tubers are rich in carbohydrates (18-21%), minerals like calcium and iron, vitamins like thiamine, riboflavin, niacin and ascorbic acid. In Kerala, it is mainly cultivated in Northern districts, but nowadays the demand for tubers fuelled the cultivation in Southern district also. The incidence of pests *viz.*, plant parasitic nematodes, rodents, stem borer and leaf folder are major constraints in the cultivation of coleus. The crop losses caused by nematodes in tuber crops are more severe than other cultivated crops as nematodes on these crops not only reduce their yield but also affect quality of the tubers as nematodes feed directly on the tubers. Infested tubers are smaller in size, often malformed with irregular wart like protuberances on the tuber surfaces and all of these reduce the marketability of the tubers. Besides, nematodes continue to multiply inside tuber after harvest during transportation and storage. Root-knot nematode, *Meloidogyne incognita* (Kofoid and White, 1919) Chitwood, 1949 infestation was reported in *P. rotundifolius* from Kerala by Sathyarajan *et al.* (1966) and among the pests, *M. incognita* found to be the serious limiting factor in the production of *P. rotundifolius.* Due to the attack of *M. incognita* in *P. rotundifolius*, conspicuous galls like swellings are formed in the roots and tubers. Heavily infested tubers start rotting while less infested ones shrunk and develop more prominent galls during storage (Mohandas and Ramakrishnan, 1998).

Since coleus is a short duration crop and tubers being the consumable part, application of chemical pesticides in soil results in very high level of pesticide residues in tubers, contamination of ground water and adverse effect on non-target organisms. Crop loss assessment and identification of nematode resistant varieties is highly essential for formulation of environment friendly management strategy. Hence the present study was undertaken to assess the crop loss in *P. rotundifolius* due to *M. incognita,* screen coleus cultivars against *M. incognita* and to estimate the biochemical changes in tolerant and susceptible cultivars due to *M. incognita* infestation.

MATERIALS AND METHODS

Identification of *M. incognita*

M. incognita was identified by preparing the perineal pattern of female nematode ((Taylor and Netscher, 1974) and observing under stereo microscope. Root-knot nematode infected plants were collected from Department of Nematology, College of Agriculture, Vellayani and the roots were gently washed with water. Mature female nematodes (25 no's) were collected from the galls in roots using sterilized forceps and kept in 45% lactic acid. The anterior part of the nematode body was

cut off by using a scalpel and gently pressed to remove the inner tissues. The posterior part of the nematode body was cut and the cut portion was kept in 45% lactic acid. The posterior cuticular part was trimmed into a square shape with the perineal pattern in the centre. The perineal pattern was transferred onto a microscope slide in a small drop of glycerine and was aligned as anus oriented downward. A coverslip was placed over it. The perineal pattern was observed and the species was identified with the help of identification keys given by Eisenback (1985).

Maintenance of pure culture of *M. incognita*

M. incognita juveniles used in this study was collected from pure culture maintained in tomato plants (variety-Vellayani Vijay) kept in the glass house of Department of Nematology, College of Agriculture, Vellayani. Viable egg masses adhering on the root surface were hand-picked from the infested roots and transferred to a beaker containing sterile water. Second stage juveniles (J_2) hatched were collected after 3 to 5 days and inoculation in the root zone was done as per the method of Venkitesan and Sethi (1977). Sub culturing of nematode was done periodically for maintaining the pure culture.

Effect of different inoculum levels of *M. incognita* on crop loss

A microplot experiment was conducted at Department of Nematology, College of Agriculture, Vellayani to study the effect of different inoculum levels of *M. incognita* on growth, yield and quality parameters of *P. rotundifolius*. Microplots of size 1mx1m were filled with denematised potting mixture prepared by mixing soil, sand and farm yard manure in 2:1:1 ratio. Cuttings of coleus raised in nursery were transplanted at a spacing of 30 cm between rows and plants. Fifteen days after planting newly hatched *M. incognita* juveniles (J_2) were inoculated to the rhizosphere of the cuttings @100, 500, 1000 and 5000. Each treatment was replicated four times and the experiment was laid out in Completely Randomized Design. Uninoculated plants served as control. The results were assessed in terms of biometric characters, yield and quality parameters. Growth parameters *viz*. plant height, plant spread, number of branches and leaves were recorded at 1, 2, 3, 4 and 5 months after inoculation (MAI). Yield parameters *viz.* number of tubers/plant (total and marketable), weight of tubers/plant (total, marketable and edible portion), size of tubers in term of diameter and total yield/plot were recorded at the time of harvest. The quality parameters *viz.* protein, starch, sugar and crude fibre of tubers infested with different inoculum levels of *M. incognita* were estimated adopting standard procedures. The tubers were dried in a hot air oven at 70^0C and were ground to pass through 0.5 mm mesh in a willey mill. The protein and starch content were estimated by modified micro-kjeldahl method (Jackson, 1973) and potassium ferry cyanide method (Pigman, 1970). The standard procedure suggested by A.O.A.C (1969, 1975) were followed to estimate sugar and crude fibre content.

Screening of coleus cultivars against *M. incognita*

Five local collections of coleus (Alur, Mankada, TCM-9, M-131, Pulamanthol), one KAU released variety (Nidhi) and one variety released from Central Tuber Crops Research Institute, Sreekaryam (Sree Dhara) were screened against *M. incognita* under pot culture condition in Department of Nematology, College of Agriculture, Vellayani during 2022-2023. Well-developed mature healthy disease-free tubers were selected and washed in running water to remove the soil particles. The cuttings from plants raised in nursery were transplanted in pots containing 5 kg denematized potting mixture prepared by mixing red soil, sand and farm yard manure in 2:1:1 ratio. The trial was laid out in completely randomized design replicated thrice with five plants in each replication. Egg masses of *M. incognita* (pure culture maintained in tomato plants) were picked from roots using needle and transferred to a beaker containing distilled water. The hatched second stage juveniles @2/g soil were inoculated to the rhizosphere of the cuttings fifteen days after transplanting. The plants were watered regularly and kept in glass house at 27-30^0C. Three months after nematode inoculation, the plants were uprooted and observations on number of galls, females, egg masses, eggs/egg mass and nematode population were recorded. Root -knot indexing was done in 0-5 scale of Taylor and Sasser (1978). Nematode population in soil was estimated by Cobb's sieving and decanting technique followed by modified Baermann's funnel technique (Southey, 1986). Five-gram root was collected from each plant and stained using acid fuchsin lactophenol method (Franklin and Goodey, 1949) and number of females present were counted. The number of egg masses in the root (5g) was estimated by immersing the roots in Phloxine B solution (0.15 g Phloxine B in IL water) for 15 minutes to stain egg masses and number of eggs per egg masses were estimated by following the

method of Byrd *et al*. (1983). The reproduction factor (RF) was calculated according to Oostenbrink's formula (RF=Pf/Pi ; Pf-final population; Pi-Initial population) (Oostenbrink, 1966)

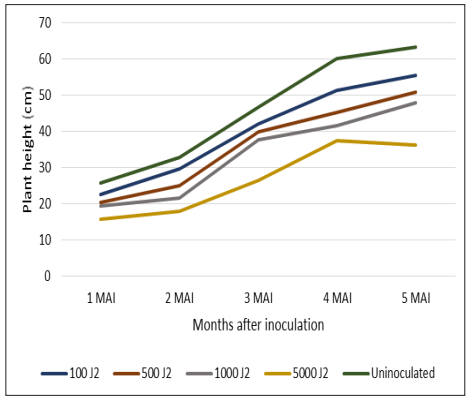
Assessment of biochemical response of coleus cultivars to *M. incognita* infection

Biochemical basis of resistance in the resistant and susceptible cultivars was assessed by estimating changes in total phenols, peroxidase (PO), polyphenol oxidase (PPO) and phenylalanine ammonia lyase (PAL) in the roots and leaves of plants three months after inoculation of nematode. The phenol content was estimated by adopting standard method described by Bray and Thorpe (1954) using Folin- Ciocalteu reagent and measuring absorption at 650 nm in a spectrophotometer. PO activity was assessed using spectrophotometric method described by Srivastava (1987). PPO and PAL activity was assayed according to the procedure described by Mayer *et al.* (1966) and Dickerson *et al.* (1984) respectively. The data generated were subjected to analysis of variance (ANOVA) (Cochran and Cox, 1965).

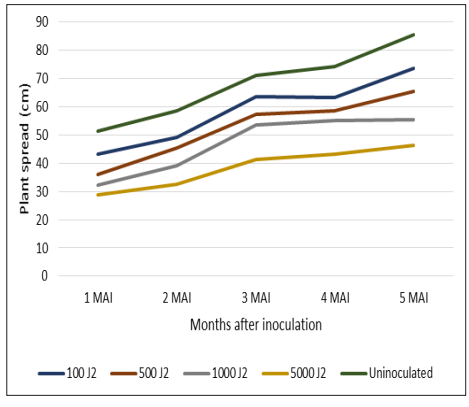
RESULTS AND DISCUSSION

Effect of different inoculum levels on crop loss

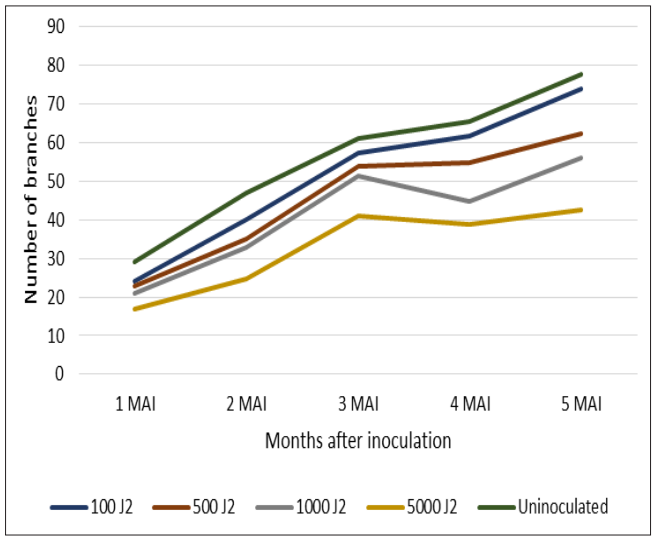
The effect of different inoculum levels of *M. incognita* on the growth parameters (plant height, plant spread, number of branches and leaves) of *P. rotundifolius* showed significant variation compared to the uninoculated control plants (Fig 1). There was significant reduction in plant height from 3 to 5 MAI at lowest inoculum level of 100 J_2. During the second and third month, there was significant reduction in plant height at 500 J2 ranging from 14.44 to 24.24. Highest reduction (37.78 to 45.45 %) was recorded by 5000 J_2 inoculated plants from one to five MAI. This was in accordance with the findings of Abbasi and Hisamuddin (2014) who reported significant reduction in plant height with increasing inoculum levels of *M. incognita* in green gram. Kumar (2004) reported 17.00 to 25.00 % reduction in hight of plants of *Plumbago rosea* at 10000 J_2 level of *M. incognita* six months after inoculation onwards. In this study, even at lowest inoculum of 100 and 500 J_2 significant reduction in plant height was observed indicating the high susceptibility of *P. rotundifolius* to *M. incognita* infestation. Regarding plant spread also, progressive reduction was observed with increase in inoculum levels. At lowest nematode inoculum level of 100 J_2, the plant spread was 43.25 cm at 1MAI while plants inoculated with 5000 J_2 recorded plant spread of 28.75 cm. Similar trend was observed in 2, 3, 4 and 5 MAI also with inoculum levels of 100 J_2 (49.25 to 73.75 cm), 500 J_2 (45.50 to 65.50 cm), 1000 J_2 (39.25 to 55.50 cm) and 5000 J_2 (28.75 to 46.25 cm). Highest reduction in plant spread was recorded in plants inoculated with 5000 J_2 (41.75 to 45.91% over uninoculated) from 1 to 5 MAI. With respect to number of branches and leaves also an increase in percent reduction was recorded from 1 to 5 MAI with increase in inoculum levels. Highest reduction in number of leaves was observed in 5000 J_2 inoculated plants (15.67 to 47.16%). The mean number of branches ranged from 24.25 to 74.00 at lowest inoculum level of 100 J_2 while at highest inoculum level (5000 J_2) it ranged from 16.75 to 42.50. Kumar (2004) reported 24.00 per cent reduction in number of branches of *Plumbago rosea* at 100 J_2 inoculum level at the time of harvest. At 1MAI, lowest number of leaves (275.00) was recorded in plants inoculated with 5000J_2, while in plants inoculated with lowest inoculum level (100 J_2) mean number of leaves was 358.50. Similar findings were reported by Nalinakumari *et al.* (1995) and Kumar (2004) in betel vine (57 to 68 %) and chethikoduveli (16 to 29 %) respectively.



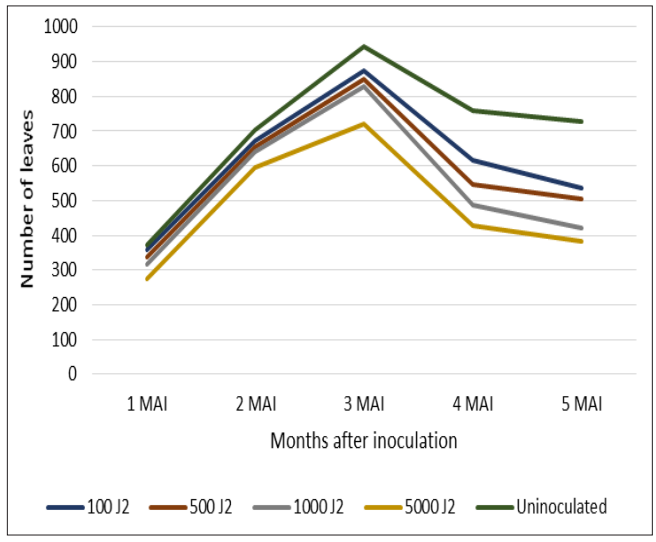
A. Effect on plant height



B. Effect on plant spread



C. Effect on number of branches



D. Effect on number of leaves

Fig.1. Effect of different levels of *M. incognita* on the growth parameters of *P. rotundifolius* at different intervals after inoculation

A progressive decrease in yield parameters was noticed with increase in inoculum levels of *M. incognita*. Statistically significant difference was observed in number and weight of tubers (total and marketable) at different inoculum levels (100, 500, 1000 and 5000). The percentage reduction over uninoculated in number and weight of total and marketable tubers at different inoculum levels ranged from 15.77 to 61.41. The size of tubers also showed significant variation at different inoculum levels. The tuber size in plants inoculated with 100 J_2 was 9.50 cm while in uninoculated it was 15.25 cm. The weight of edible portion ranged from 195.00 to 312.50 g/plant at different inoculum levels while in uninoculated it was 388.75g. Per plot yield was lowest in 5000 J_2 inoculated plants (2.51 kg) while in plants inoculated with lowest inoculum level of 100 J_2 it was 4.71 kg (Table 1). These findings are in accordance to Mohandas and Ramakrishnan (1997) who reported significant reduction in yield of *Dioscorea rotundata* at an inoculum level of 100 J_2.

The quality parameters of tubers (protein, starch, sugar and crude fibre) also differed significantly in tubers of plants inoculated with different inoculum levels of *M. incognita*. An increase in protein content in tubers was recorded with increased inoculum level of *M. incognita*. Highest protein content was observed in tubers of plants inoculated with 5000 J_2 (8.49 g/100 g dry weight of tuber) while in uninoculated control plants it was 7.42 g. The increase in protein content of tubers in different levels of inoculum ranged from 12.94 to 14.42%. This may be due to the function of defense mechanism of the plant. This finding was in line with Paulson and Webster (1972), who reported increased protein synthesis in hypersensitive cells in tomato galls. Arya and Tiagi (1982) reported increased protein content in infested cells of carrot. Higher rate of protein synthesis by plants during invasion of nematodes as means of defence response in bitter gourd was reported by Gautam and Podder (2014). There was significant variation in the starch content of *P. rotundifolius* tubers at different inoculum levels compared to the uninoculated (18.36 g/100 g dry weight of tubers). The effect of 5000, 1000, 500 and 100 J_2 levels was statistically independent with mean starch content of 12.24, 15.62, 16.54 and 17.70 g/100 g dry weight of tuber respectively (Table 1). This decrease in starch content due to increase in inoculum level of *M. incognita* could be due to the increased amylase activity. Orion and Bronner (1973) reported localized strong amylase activity and decreased starch content within the giant cells of the tomato galls. Mahapatra and Nayak (2019) reported significant reduction in starch content of bitter gourd due to *M. incognita* infestation. In the case of sugar content of tubers, there was statistically significant variation between different inoculum levels (3.07 to 3.42 g/100g dry weight of tuber) and uninoculated (3.72 g/100g dry weight of tuber). The tubers of 500 and 100 J_2 inoculated plants showed 15.86 and 8.06% reduction in sugar content over the uninoculated and these effects were statistically on par. The percentage reduction in sugar content at 1000 and 5000 J_2 levels was 17.20 and 17.47 respectively. Roy (1979) reported the localization of invertase in the oesophagus and the intestine of the

Table 1. Effect of different levels of *M. incognita* on yield and quality parameters of *P. rotundifolius* at harvest

Levels of inoculum	Yield parameters (per plant)							Quality parameters (g/100g dry weight of tuber)			
	Total number of tubers	Total number of marketable tubers	Size of tubers (cm)	Weight of total tubers (g)	Weight of total marketable tubers (g)	Weight of edible portion of tubers (g)	Yield per plot (Kg)	Protein	Starch	Sugar	Crude fibre
100 J_2	74.75[b]	60.25[b]	9.50b	425.00[b]	340.00[b]	312.50[b]	4.71[b]	8.38[a]	17.70[b]	3.42[b]	1.28[b]
500 J_2	62.50[c]	51.00[c]	13.50[a]	376.25[c]	320.00[c]	261.75[c]	3.70[c]	8.41[a]	16.54[c]	3.13[c]	1.01[c]
1000 J_2	53.75[d]	39.00[d]	14.75[a]	357.50[d]	260.00[d]	227.50[d]	2.60[d]	8.42[a]	15.62[d]	3.08[c]	0.67[d]
5000 J_2	44.75[e]	28.75[e]	15.50[a]	290.00[e]	223.75[e]	195.00[e]	2.51[d]	8.49[a]	12.24[e]	3.07[c]	0.60[d]
Uninoculated	88.75[a]	74.50[a]	15.25[a]	527.50[a]	405.00[a]	388.75[a]	5.10[a]	7.42[b]	18.36[a]	3.72[a]	1.58[a]
CD 0.05	3.036	3.622	2.767	7.603	6.778	10.256	0.232	0.168	0.083	0.140	0.087

*Mean of four replications

nematode parasite and suggested the possibility of its secretion by the nematode into the host tissue resulting in changed carbohydrate metabolism during the course of host parasite interaction. The finding of these experiments was supported by Pandey *et al.* (2017) who reported significant reduction in total sugar content in green gram due to the infestation of *M. incognita*. Regarding crude fibre content also, there was significant reduction with increase in inoculum levels and the percentage reduction over uninoculated varied from 18.99 to 62.03 %. The decrease in crude fibre content of tubers with increase in inoculum level of *M. incognita* may be due to the poor absorption and storage of nutrients by infested plant roots. This finding was in tune with Sunilkumar (2016) who reported per cent reduction of 5.70, 5.49, 10.71 and 19.01 in the crude fibre content of ginger rhizome after inoculation with 100, 500, 1000 and 10000 J_2 of *M. incognita* respectively.

Screening of coleus cultivars against *M. incognita*

Data on reaction of cultivars of *P. rotundifolius* to *M. incognita* in terms of nematode population characteristics showed statistically significant variation (Table 2). The performance of local cultivar Alur collection was significantly superior to all other cultivars with lowest number of *M. incognita* juveniles in soil (128.33/200cc) and root (10.67/5g). Total nematode population also varied significantly between different cultivars of *P. rotundifolius*. Regarding number of females, eggs and egg masses also, Alur collection recorded lowest number and showed significant superiority to other cultivars. Lowest root-knot index (2.00) and reproduction factor (0.39) was recorded in Alur collection while in susceptible cultivar Pulamanthol collection it was 4.00 and 2.75 respectively. Based on root-knot index and reproduction factor, Alur collection was rated resistant and Sree Dhara, TCM-9 and M-131 were rated as moderately resistant to *M. incognita*. Ankita (2019) evaluated 30 genotypes of *P. rotundifolius* and reported Kenichira local, Suphala, CP-8 and Edayur as resistant to *M. incognita.* Resistance of Alur collection to *M. incognita* infestation was reported first time in this study. The potential of Alur collection to resist the attack of *M. incognita* was directly reflected in the biometric characters and yield also. Regarding plant height, no. of leaves, no. of branches, weight of shoot and root, Alur collection outperformed the other cultivars. Highest number and weight of tubers was recorded in Alur collection with 27.24 to 28.82% increase over susceptible cultivar, Pulamanthol collection (Table 3). This observation in this study is in line with Kanakam *et al*. (2019). The significant difference in nematode population, biometric characters and yield observed between the local collection, Alur and other cultivars may be due to the presence of resistance traits in the resistant cultivar.

Table 2. Population build-up of *M. incognita* in different cultivars of *P. rotundifolius*

Cultivar	Final Nematode Population			Total nematode population	Reproduction factor	No. of egg masses (5g root)	No. of eggs/ egg mass	Gall index	Reaction
	Soil (200cc)	Root (5g)	Females (5g root)						
Nidhi	683.67 (26.09)^{b}	88.67 (9.41)^{a}	90.00 (9.49)^{a}	862.33 (29.33)^{b}	2.16^{b}	32.00 (5.64)^{a}	191.33 (13.83)^{b}	4	S
Alur collection	128.33 (11.33)^{e}	10.67 (3.25)^{d}	16.67 (4.08)^{d}	155.67 (12.48)^{f}	0.39^{e}	8.33 (2.87)^{d}	115.53 (10.74)^{f}	2	R
Pulamanthol collection	921.33 (30.34)^{a}	91.33 (9.56)^{a}	91.67 (9.57)^{a}	1101.00 (33.17)^{a}	2.75^{a}	31.67 (5.62)^{a}	203.33 (14.26)^{a}	4	S
Sree Dhara	775.00 (27.83)^{b}	62.67 (7.91)^{b}	35.67 (5.95)^{b}	873.33 (29.54)^{b}	2.19^{b}	22.67 (4.74)^{bc}	167.00 (12.92)^{c}	3	MR
Mankada	550.67 (23.43)^{c}	93.67 (9.68)^{a}	96.67 (9.83)^{a}	741.00 (27.19)^{c}	1.85^{c}	28.33 (5.32)^{ab}	197.33 (14.05)^{ab}	4	S
TCM-9	361.67 (18.98)^{d}	61.67 (7.85)^{b}	33.33 (5.77)^{b}	456.67 (21.34)^{d}	1.14^{d}	21.67 (4.64)^{bc}	155.33 (12.46)^{d}	3	MR
M131	278.33 (16.65)^{d}	47.33 (6.88)^{c}	22.67 (4.76)^{c}	348.30 (18.64)^{e}	0.87^{d}	17.67 (4.19)^{c}	128.00 (11.31)^{e}	3	MR
CD (0.05)	(2.348)	(0.510)	(0.583)	(2.119)	0.291	(0.833)	(0.402)		

Figures presented in the paranthesis are square root transformed

Table 3. Growth and yield parameters of different coleus cultivars infested with *M. incognita*

Cultivar	*Plant height (cm)	*No. of leaves	*No. of branches	*Weight of shoot (g)	*Root weight (g)	*No. of tubers / plant	*Weight of tubers/plant (g)
Nidhi	35.67^{f}	509.67^{g}	33.00^{e}	208.00^{f}	12.33^{d}	51.67^{d}	370.00^{g}
Alur collection	67.33^{a}	676.67^{a}	49.33^{a}	490.67^{a}	24.33^{a}	73.00^{a}	540.33^{a}
Pulamanthol collection	39.00^{ef}	541.33^{f}	36.00^{d}	232.67^{f}	13.00^{d}	56.67^{c}	424.67^{f}
Sree Dhara	47.67^{d}	597.67^{d}	38.67^{cd}	338.00^{d}	17.00^{bc}	60.33^{bc}	493.00^{d}
Mankada	42.33^{e}	567.33^{e}	37.33^{d}	296.33^{e}	16.33^{c}	58.33^{c}	472.33^{e}
TCM-9	52.67^{c}	614.00^{c}	40.33^{c}	393.00^{c}	17.67^{bc}	63.00^{b}	505.33^{c}
M131	60.33^{b}	638.67^{b}	44.33^{b}	423.67^{b}	19.67^{b}	64.33^{b}	518.33^{b}
CD (0.05)	3.462	8.316	2.849	25.099	3.024	4.317	10.863

*Mean of three replications

Table 4. Variation in phenol, peroxidase, poly phenol oxidase and phenyl alanine ammonia lyase in leaves and roots of different cultivars of *P. rotundifolia* infested with *M. incognita*

Cultivars	Phenol content (mg of catechol/ g tissue)*		Peroxidase (PO) (min/g/fresh weight) *		Phenylalanine Ammonia Lyase (PAL) * (µg of cinnamic acid g/ fresh weight)		Polyphenol oxidase (PPO) * min/g/ fresh weight	
	Leaf	Root	Leaf	Root	Leaf	Root	Leaf	Root
Nidhi	0.63 ^{d}	2.07^{d}	5.81 ^{d}	6.08 ^{d}	12.75 ^{d}	13.01^{d}	6.70 ^{b}	7.88^{e}
Alur collection	1.32 ^{a}	6.50 ^{a}	9.07^{a}	9.64 ^{a}	15.85^{a}	17.44^{a}	9.26 ^{b}	11.30^{a}
Pulamanthol collection	0.47 ^{e}	1.82 ^{d}	5.76 ^{d}	6.01 ^{d}	12.16 ^{d}	12.79^{d}	6.61^{b}	8.41^{de}
Sree Dhara	1.05 ^{b}	5.00^{b}	6.87 ^{c}	7.32^{c}	14.88 ^{b}	15.58^{bc}	7.37^{a}	9.43 ^{c}
Mankada	0.84 ^{c}	3.18^{c}	6.77 ^{c}	7.09 ^{c}	14.21^{bc}	14.65^{c}	7.19 ^{b}	8.89 ^{b}
TCM-9	0.82 ^{c}	3.12^{c}	6.76 ^{c}	7.07 ^{c}	14.09 ^{c}	14.65^{c}	7.01 ^{c}	9.12 ^{cd}
M131	1.21 ^{a}	6.39 ^{a}	7.97 ^{b}	8.28 ^{b}	15.61 ^{a}	16.28^{b}	8.31^{c}	10.34 ^{b}
CD 0.05	0.150	0.334	0.449	0.503	0.715	1.127	0.430	0.869

*Mean of three replications

The biochemical basis of resistance was assessed in terms of phenol content and defence enzyme activity. Alur collection recorded highest phenol content both in leaf (1.32 mg of catechol/ g tissue) and root (6.50 mg of catechol/ g tissue) and it was statistically on par with moderately resistant cultivar M-131 giving 1.21 and 6.39 mg of catechol/ g tissue respectively (Table 4). Regarding defence enzymes viz. PO, PPO and PAL, Alur collection recorded highest activity both in leaf and root compared to other varieties. The percentage increase over the susceptible cultivar, Pulamanthol collection ranged from 21.19 to 60.40. Similar findings were reported Das *et al.* (2011) in banana who reported increased activity of PO, PAL and PPO in roots of resistant banana hybrids compared to susceptible ones.

The present investigation revealed that *M. incognita* infestation in coleus have a significant impact on the growth and yield characteristics of the plant and also on the quality parameters of its tubers. Screening of different cultivars of coleus against *M. incognita* revealed that Alur collection is the resistant variety which performed better in reducing the multiplication of nematodes and increasing the yield and quality parameters. This study concludes that *M. incognita* infestation in coleus could result in significant crop loss and quality deterioration of tubers by directly or indirectly affecting its growth and biochemical parameters. The phenol and defence enzyme activities were found higher in roots and leaves of Alur collection compared to susceptible cultivar, Pulamanthol collection. Alur collection can be utilized in breeding programmes for developing high yielding varieties.

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