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Survey for the Occurrence of Root-Knot Nematode (*Meloidogyne incognita*) Inpatchouli Grown in Southern Karnataka

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Abstract A preliminary survey was carried out on the occurrence of root-knot nematode associated in the rhizosphere of major patchouli growing areas of southern Karnataka districts viz., Bengaluru, Hassana, Chikkamagaluru, Kodagu, Shivamogga and Tumakuru. Among the districts, maximum soil and root population of *Meloidogyne incognita* was recorded in Chikkamagaluru district (893 and 377), followed by Hassana district (588 and 345), Bengaluru district (478 and 257), Kodagu district (325 and 162), Shivamogga district (209 and 71) and the least was recorded at Tumakuru district (83 and 49). The survey data revealed that in 26 samples analyzed, *Meloidogyne incognita* was predominant with a maximum total soil and root population of 2576 and 1261 followed by *Helicotylenchus dihystera* (195 and 85), *Rotylenchulus reniformis* (181 and 79) and *Pratylenchus penetrans* (65 and 59).

Keywords *Meloidogyne incognita*, Patchouli, Southern Karnaka, Essential oil.

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Introduction

Patchouli (*Pogostemon cablin* Benth.) belongs to family Lamiaceae or mint family, is the source of aromatic patchouli oil. World's production of essential oil is estimated at about 1, 10,000 tones and India stands at third position with a share of 16 to 17%. In terms of value, India's position is second and its share is 21 to 22% due to the mint revolution in north India. Patchouli is a perennial aromatic herb that yields fragrant leaves containing very sweet smelling oil, attains a height of about 1.2 m. Cultivation in India has been meager but the harvest in the last 5 years is 600 tones with 20 t of oil per annum [1] and the annual demand borders around 220 t. Patchouli is cultivated in Assam, Madhya Pradesh, Tamil Nadu, Kerala and Karnataka. Experiments have revealed that good quality oil can be produced from patchouli grown under Bangalore weather conditions [2]. Currently, India is producing a small quantity of patchouli oil against its requirement of 40 tons of pure oil and about 70 tons of formulated oil. Hence, majority of these oils are being imported from Indonesia [3]. Patchouli crop suffers from fungal and nematode diseases. Among the fungal diseases. Wilt disease (*Fusarium solani*), has become very serious now a days. Leaf and stem gall disease (*Synchytrium pogostemonis* f. sp. *patchouli*) and leaf spot (*Cercospora* spp.) appears to considerable extent. Among plant parasitic nematodes, root-knot nematodes are well known for their global distribution with wide host range and also

involved in disease complexes. They reduce crop yields considerably both qualitatively and quantitatively [4]. Root-knot nematode causes severe yield losses. Efforts in the recent past have been initiated on the management of root-knot nematode through host resistance, bio-agents and chemicals. However, information with regard to the occurrence and distribution of root-knot nematode on patchouli is lacking [5]. Keeping the deficit of research in view, a study was undertaken.

Materials and Methods

A survey was conducted in major patchouli growing areas of southern Karnataka to study the occurrence of different plant parasitic nematodes. Patchouli plots showing uneven patches with yellowing, stunted growth, reduced tillering, delayed flowering and root galling were selected for collection of soil and root samples. Soil and root samples from 5 to 10 spots were collected randomly with the aid of shovel in the root zone of standing patchouli crop. Later, a composite sample of 200 cc soil and 5 g roots were put in a polythene bag with proper labeling. Information pertaining to the crop, locality, soil condition were also collected along with the samples as mentioned below in the data sheet.

Estimation of nematode population in soil samples

Soil sample of 200 cc was washed thoroughly and processed using combined "Cobb's sieving and Baermann's funnel method" as given below. Two hundred cc of soil was taken in 1000 ml beaker and sufficient quantity of water was added to make soil solution. This was stirred thoroughly and allowed to stand for heavier particles to settle down. Then the soil solution was passed through a set of sieves of 100, 250, 325 and 400 mesh sizes, respectively. Residue from 325 and 400 mesh sieves were collected and poured over a tissue paper spread on a wire gauge and placed on Baermann's funnel. Level of water in the Baermann's funnel was maintained to keep the tissue paper wet and left undisturbed for 48 h. After incubation of 48 h, the volume of suspension was made to 200 ml, out of which 10 ml was pipetted out and used for counting of various plant parasitic nematodes present. Nematode population from this was finally estimated for 200 cc soil.

Estimation of nematode population in root samples

Nematode population in 5 g of roots was estimated by root incubation method as explained below. Roots were gently washed to remove adhering soil particles. Washed roots were cut into small bits of 2.5 cm and split longitudinally. Then placed over tissue paper spread on a wire gauge and kept in a Petri plate filled with water. Level of water was maintained in Petri plant and left undisturbed for 48 hours.

Later, the suspension in the Petri plante was collected and observed for nematodes using stereo binocular microscope.

Results and Discussion

A preliminary survey was carried out on the occurrence of root-knot nematode associated in the rhizosphere of patchouli in southern Karnataka districts. The major patchouli growing areas like Bengaluru, Hassana, Chikkamagaluru, Kodagu, Shivamogga and Tumakuru. The soil and root samples collected from all the places were brought to the laboratory and analyzed for the presence of root-knot nematode and the results are presented in Tables 1 and 2. The survey data revealed that in 26 samples analyzed, *Meloidogyne incognita* was predominant with a maximum total soil population of 2576 followed by *Helicotylenchus dihystera* (195), *Rotylenchulus reniformis* (181) and *Pratylenchus penetrans* (65).

In Bengaluru district, maximum soil population of *Meloidogyne incognita* was (187 / 200 cc soil) recorded in GKVK, Bengaluru followed by CIMAP, Allalasandra (105), Himalaya drugs, Malleshwaram (97) and the least population was recorded at IIHR, Hessaraghatta (89). In Hassana district, maximum soil population of *Meloidogyne incognita* was (119 / 200 cc soil) recorded at Kalgane followed by Marathathad (102), Hurudi (102), Hemmaga (97), Kumbarahalli (89) and the least was at Kuppalli (78). In Chikkamagaluru district, maximum soil population of *Meloidogyne incognita* was (120/200 cc soil) recorded at Handi

Table 1. Distribution of plant parasitic nematodes in soil around the root zone of Patchouli in Southern districts of Karnataka.

Place	Locality	Nematode population per 200 cc soil				
		Meloidogyne incognita	*Helicotylenchus dihystera*	*Rotylenchulus reniformis*	*Pratylenchus penetrans*	Total
Bengaluru	GKVK	187	09	05	–	201
	CIMAP, Allalasandra	105	12	06	09	132
	Himalaya drugs, Malleshwara	97	13	–	08	118
	IIHR, Hessaraghatta	89	25	08	–	122
	Total	478	59	19	17	
Hassana	Hemmaga	97	09	05	–	111
	Kumbarahalli	89	07	–	07	103
	Kuppalli	78	04	–	–	82
	Marathathad	103	11	09	08	131
	Hurudi	102	05	12	13	132
	Kalgane	119	07	15	–	141
	Total	588	43	41	28	
Chikkamagaluru	Talamakki	102	04	07	03	126
	Kulkera	114	04	–	–	118
	Kollur	109	10	–	–	129
	Handi	110	03	03	01	127
	Malukudige	109	09	–	04	122
	Batehole	–	12	09	–	21
	Kanahalli	119	15	08	–	142
	Bilchenahalli	112	–	09	–	121
	Kolagama	108	03	–	07	118
	Total	893	60	36	15	
Kodagu	Garvale	125	–	08	02	135
	Badaga	98	04	12	–	114
	Charade	102	04	–	–	108
	Total	325	08	20	02	
Shivamogga	Hulkodu	107	04	09	–	120
	Sagara	102	09	–	03	114
	Total	209	09	03		
Tumakuru	Sira	83	12	05	–	100
	Total	83	12	05	00	
	Grand Total	2576	195	181	65	2988
	Mean	103.04	07.8	07.24	02.60	119.52

followed by Kanahalli (119), Kulkera (114), Bilchenahalli (112), Mulukudige and Kollur (109), Kolagama (108) and the least was recorded at Talamakki (102). In Kodagu district, maximum soil population of *Meloidogyne incognita* was (125/200 cc soil) recorded at Garavale followed by Charade (102) and the least was recorded at Badaga (98). In Shivamogga district, maximum soil population of *Meloidogyne incognita* was (107/200 cc soil) recorded at Hulkodu and the least was recorded at Sagara (102). In Tumakuru district, maximum soil population of *Meloidogyne incognita* was (83/200 cc soil) recorded at Sira.

Among the districts, maximum soil population of *Meloidogyne incognita* was recorded in Chikkamagaluru district (893), followed by Hassana district (588), Bengaluru district (478), Kodagu district (325), Shivamogga district (209) and the least was recorded at Tumakuru district (83) (Table 1). The root samples collected from the rhizosphere of patchouli growing plots of south Karnataka districts were analyzed for

Table 2. Distribution of plant parasitic nematodes in roots of Patchouli in Southern districts of Karnataka.

Place	Locality	Nematode population per 5g of root				
		Meloidogyne incognita	*Helicotylenchus dihystera*	*Rotylenchulus reniformis*	*Pratylenchus penetrans*	Total
Bengaluru	GKVK	87	04	05	–	97
	CIMAP, Allalasandra	67	01	05	04	77
	Himalaya drugs, Malleshwara	54	–	04	04	62
	IIHR, Hessaraghatta	49	–	09	–	58
	Total	257	05	23	08	
Hassana	Hemmaga	38	05	02	01	46
	Kumbarahalli	46	–	02	–	48
	Kuppalli	43	–	03	03	49
	Marathathad	54	09	02	01	76
	Hurudi	86	03	02	04	95
	Kalgane	78	07	04	–	89
	Total	345	24	15	09	
Chikkamaga-luru	Talamakki	78	07	–	–	85
	Kulkera	67	–	03	–	69
	Kollur	39	–	–	–	39
	Handi	20	03	02	01	26
	Malukudige	27	12	03	06	48
	Batehole	45	–	09	02	56
	Kanahalli	57	08	–	–	65
	Bilchenahalli	29	–	09	07	45
	Kolagama	15	–	–	06	21
	Total	377	30	26	22	
Kodagu	Garvale	46	04	05	–	55
	Badaga	57	06	–	–	63
	Charade	59	–	05	04	68
	Total	162	10	10	04	
Shivamogga	Hulkodu	36	04	–	09	49
	Sagara	35	–	09	02	46
	Total	71	04	09	11	
Tumakuru	Sira	49	12	–	05	66
	Total	49	12	00	05	
	Grand Total	1261	85	79	59	1484

nematode population. The samples revealed *Meloidogyne incognita* as a predominant nematode with a maximum total root population (1261) followed by *Helicotylenchus dihystera* (85), *Rotylenchulus reniformis* (79) and *Pratylenchus penetrans* (59). In Bengaluru district, maximum root population of *Meloidogyne incognita* was (87/5 g root) recorded in GKVK, Bengaluru followed by CIMAP, Allalasandra (67), Himalaya drugs, Malleshwaram (54) and the least was recorded at IIHR, Hessaraghatta (49). In Hassana district, maximum root population of *Meloidogyne incognita* was (86/5 g root) recorded at Hurudi followed by Kalgane (78), Marathathad (54), Kumbarahalli (46), Kuppalli (43) and the least was recorded at Hemmaga (38). In Chikkamagaluru district, maximum root population of *Meloidogyne incognita* was (78/5 g root) recorded at Talamakki followed by Kulkera (67), Kanahalli (57), Batehole (45), Kollur (39), Bilchenahalli (29), Mulukudige (27), Handi (20) and the least was recorded at Kolagama (15). In Kodagu district, maximum root population of *Meloidogyne incognita* was (59/5 g root) recorded at Charade followed by Badaga (57) and the least was recorded at Garavale (46). In Shivamogga district, maximum root population of *Meloidogyne incognita* was (36/5 g root) recorded at Hulkodu and the least was recorded

at Sagara (35). In Tumakuru district, maximum root population of *Meloidogyne incognita* was (49/5 g root) was recorded at Sira. The maximum root population of *Meloidogyne incognita* was recorded in Chikkamagaluru district (377), followed by Hassana district (345), Bengaluru district (257), Kodagu district (162), Shivamogga district (71) and the least population was recorded at Tumakuru district (49) (Table 2).

The analysis of soil samples from the patchouli growing areas of southern Karnataka districts revealed that the maximum total soil population of *Meloidogyne incognita* (893) was recorded at Chikkamagaluru district followed by Hassana (588), Bengaluru (478), Kodagu (325) and Shivamogga (209) and least population was recorded at Tumakuru (83). However, the population of *Helicotylenchus dihystera*, *Rotylenchulus reniformis* and *Pratylenchus penetrans* was comparatively very less. The root samples collected from the root zone of patchouli growing areas of southern Karnataka districts revealed that the maximum total root population of *Meloidogyne incognita* (377) was recorded at Chikkamagaluru district followed by Hassana (345), Bengaluru (257), Kodagu (162) and Shivamogga (71) and least population was recorded at Tumakuru (49). However, the population of *Helicotylenchus dihystera*, *Rotylenchulus reniformis* and *Pratylenchus penetrans* was comparatively very less. The present results are in conformity with the findings of survey made earlier [6, 7] who have reported occurrence of plant parasitic nematodes like *Meloidogyne incognita*, *Rotylenchulus reniformis* and *Pratylenchus* spp. nematodes being predominant affecting patchouli and other medicinal and aromatic crops in India (Bengaluru, Tamil Nadu and West Bengal) and several parts of world causing significant yield loss in patchouli production.

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