

Report on association of plant parasitic nematodes in large cardamom (*Amomum subulatum* Roxb.) at Sikkim Himalaya region of India

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Abstract

Large cardamom (*Amomum subulatum* Roxb.), is a major cash crop grown in Sikkim Himalaya region. The crop is found to be affected by many pests (insects and diseases); which hinders the production, productivity as well as quality of the produce. Based on symptoms in this crop, similar to nematode infestation, soil and root samples were collected from the rhizosphere of different large cardamom fields and analyzed for presence of nematodes. Laboratory analysis revealed the association of six nematode species with large cardamom viz., *Meloidogyne incognita*, *Helicotylenchus* spp., *Hoplolaimus* sp., *Tylenchorhynchus annulatus*, *Pratylenchus* sp. and *Macroposthonia* spp., of which *Meloidogyne incognita* and *Pratylenchus* sp. were recorded in roots also and the percentage of occurrence was 59.09. Apart from *Meloidogyne incognita*, all other five nematode species were recorded for the first time in large cardamom. *Helicotylenchus* spp. was the dominant genera among the six genera with 50% occurrence, 61.56 % relative abundance and 60 nematodes per 200 cc soil.

Keywords: Nematode, large cardamom, association, soil and root

Large cardamom (*Amomum subulatum* Roxb.) popularly known as “Bada elaichi or black cardamom” belonging to family *Zingiberaceae*, is an important cash crop of Sikkim Himalaya region (Gupta and Chhetri, 2013). Large cardamom is native to the state of Sikkim and state has already obtained geographical indication (GI) for the crop as “Sikkim Large Cardamom” in 2015 (Anonymous, 2015). Since time immemorial, large cardamom is cultivated

in the state of Sikkim and hilly districts of West Bengal viz., Darjeeling and Kalimpong districts (Gudade *et al.*, 2015). At present owing to its high price compared to other crops grown in North East India, large cardamom is cultivated extensively as a major cash crop in Arunachal Pradesh, Nagaland and Manipur. Apart from India, large cardamom is also grown extensively in neighboring countries of Nepal and Bhutan. This crop prefers humid subtropical, semi

evergreen forest of sub-Himalayan region. It grows well at altitude ranges from 1000 to 2200 above msl with well distributed rainfall spread around 200 days with a total of about 3000-3500 mm/year (Rao *et al.*, 1993 and Gudade *et al.*, 2014). Among Indian states, Sikkim is the largest producer of large cardamom with a production of 4970 MT out of total Indian production of 8803 MT during the year 2020-21 which accounts 56.45 percent whereas, production in West Bengal was 1100 MT during same period (Spices Board, 2022). Like other spices crop, large cardamom production has also been affected by many diseases and insects causing considerable amount of monetary loss (Thakur and Sachan 1987; Varadarasan and Biswas 2002; Deka *et al.*, 2016 & Raj *et al.*, 2021). Earlier days, in Sikkim, large cardamom was cultivated under partial shade in forest ecosystem but recently farmers have shifted their cultivation to open areas nearer to household mostly in their maize and vegetable growing areas leading to change in status of disease and insects. Large cardamom fields with plants showing peculiar symptoms *viz.*, poor and stunted growth with reduced leaf size, rosette appearance, leaf thickening, crinckling, yellowing and chlorosis resembles nematode infestation paved the way to think about probable infestation of nematode. It was decided to conduct a survey to find possible association of plant parasitic nematodes with large cardamom in Sikkim Himalayan region as no study on nematode association with large cardamom was carried out except a report of infestation of root knot nematode (*Meloidogyne incognita*) by Varadarasan and Biswas (2002).

Accordingly, roving survey was carried out in six districts of Sikkim (Gangtok, Mangan, Namchi, Geyzing, Soreng and Pakyong) and two districts of West Bengal (Kalimpong and Darjeeling) where large cardamom was cultivated as major cash crop during 2019-2022. Altogether 22 large cardamom fields in these districts were surveyed and soil and root samples were collected for analyzing the nematode association. Collection of soil and root samples were carried out in 4- 6 spots in a cardamom field randomly in 2.25 m² area around rhizosphere of large cardamom plants exhibiting one or more typical nematode infestation symptoms. Thereafter, a composite sample of 300 cc was prepared containing soil and root from each large cardamom field and samples were put in polythene bag with proper labeling. For determination of nematode in soil samples Cobb's decanting and sieving technique (Christie & Perry, 1951) and Baermann's funnel method (Ayoub, 1977) were followed using thoroughly mixed 200 cc of soil, whereas, for determination of nematode in root samples root incubation method (Ayoub, 1977) was used where 10 g roots was used from each sample. For identification of different nematodes genera was carried out by studying the morpho-anatomical features of the nematodes using stereo-binocular microscope and based on morphological characters of adult form as described by Goodey and Goddey (1963) and Mai and Lyon (1975) and their counting was done using counting slide under a compound microscope. Frequency of occurrence (FO), relative abundance (RA) and population density

(PD) of the identified nematodes was carried out following Norton (1978).

Study revealed the presence of six plant parasitic nematode genera under 5 families viz., *Meloidogyne incognita*, *Helicotylenchus* spp., *Hoplolaimus* sp., *Tylenchorhynchus annulatus*, *Pratylenchus* sp. and *Macroposthonia* spp. in large cardamom soil, whereas *Meloidogyne incognita* and *Pratylenchus* sp. were recorded in root samples. Association of *Helicotylenchus* spp., *Hoplolaimus* sp., *Tylenchorhynchus annulatus*, *Pratylenchus* sp. and *Macroposthonia* spp. in large cardamom is a new finding as earlier Varadarasan and Biswas (2002) mentioned only about association of *Meloidogyne incognita* in large cardamom. Presence of nematodes were recorded in 13 samples out of total 22 samples, the percentage of occurrence was 59.09 (Table 1). Percentage of occurrence of nematode was on higher side, which might be due to the fact that samples were collected from field where plants exhibited peculiar symptoms resembling to nematode infestation. Percent occurrence, relative

abundance and population density among the six genera of nematodes found in association with large cardamom presented in Table 2. Percent occurrence of *Helicotylenchus* spp. was highest (50%) among all the nematode species as it was found in 11 locations whereas it was least in case of *Hoplolaimus* sp. and *Tylenchorhynchus annulatus* with 9.09 per cent. Relative abundance was maximum for *Helicotylenchus* spp. (61.56) followed by *M. incognita* (24.44) and minimum in case of *Hoplolaimus* sp. (1.95) (Table 2). *Helicotylenchus* spp. recorded maximum population density (60.0), followed by *M. incognita* (43.66) while, minimum population density (7.33) was recorded in *Macroposthonia* spp.. Thus, the present study reflect that *Helicotylenchus* spp. was the most dominant genera found associated with large cardamom followed by *M. incognita*. This being a preliminary survey, further study is required to know the status of the nematodes in different large cardamom growing areas and their influence on yield and other factors and management strategies to tackle the nematodes.

Table 1. District wise occurrence of nematode genera associated with large cardamom.

District	Number of samples	Percentage of occurrence of nematode genera					
		<i>H. spp.</i>	<i>M. incognita</i>	<i>P. sp.</i>	<i>T. annulatus</i>	<i>H. sp.</i>	<i>M. spp.</i>
Gangtok	3	100.0	0.0	66.66	33.33	16.66	0.0
Mangan	6	83.3	33.33	16.66	16.66	16.66	16.66
Namchi	5	40.0	60.00	40.00	0.0	0.0	20.20
Geyzing	1	0.0	0.0	0.0	0.0	0.0	0.0
Soreng	1	0.0	0.0	0.0	0.0	0.0	0.0
Pakyong	1	0.0	0.0	0.0	0.0	0.0	0.0
Kalimpong	4	0.0	0.0	0.0	0.0	0.0	0.0
Darjeeling	1	100.0	100.0	0.0	0.0	0.0	0.0

Table 2. Frequency of occurrence (FO), relative abundance (RA) and population density (PD) of nematode genera associated with large cardamom in Sikkim Himalaya.

Nematode genera	Frequency of occurrence (FO) %	Relative abundance (RA) %	Population density (PD) per 200 cc soil
<i>Helicotylenchus spp.</i>	50.0	61.56	60.00
<i>Meloidogyne incognita</i>	27.27	24.44	43.66
<i>Pratylenchus sp.</i>	22.72	5.50	11.80
<i>Hoplolaimus sp.,</i>	9.09	1.95	10.5
<i>Macroposthonia spp</i>	13.63	2.05	7.33
<i>Tylenchorhynchus annulatus</i>	9.09	4.47	24.0

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