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ECO-FRIENDLY MANAGEMENT OF SMALL CARDAMOM ROOT GRUB INHILLY TRACTS OF IDUKKI, KERALA

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ABSTRACT: The present study was carried out to test the infectivity of three native EPNs namely, *Heterorhabditis indica* (strain ICAR-NBAIR), *Heterorhabditis bacteriophora*, *Steinernema carpocapsae* powder formulation against cardamom root grub. The attachment to and rate of penetration of these EPNs into tested insect was also undertaken. Penetration of the IJs of *Heterorhabditis indica* Showed highest penetration and was superior to *Heterorhabditis bacteriophora*. and *Steinernema carpocapsae* never the less the rate of penetration is also depending on the IJs infection strategies. EPN application involves implanting novel powder formulation at plant base that can be done with ease and fast and saves a lot of labour The WP formulation was found very effective in root grub management that reduced the cost of production and mitigated the use of pesticides (fipronil, chlorpyriphos, phorate) in small cardamom.Therefore, it is concluded that cardamom root grub was susceptible to tested EPNs, there were differences among these EPNs in their ability to kill the insect. Among test EPNs, *Heterorhabditis indica* (strain ICAR-NBAIR) and *Heterorhabditis bacteriophora*(strain ICAR- NBAIR) appears to be the most promising EPN against root grub. EPN is ecologically safe, effective, sustainable and on-farm recyclable green technologies for small cardamom. EPNs constitute a cost-effective, value-added approach to promote sustainable agriculture in small cardamom plantation.
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Introduction:

Cardamom root grub (*Basileptafulvicorne*: Chrysomelidae) is a major pest damaging roots of small cardamom (*Elettariacardamomum*Maton) causing 29 to 66 percent crop loss under variouslevels of infestation. Chemical control with agrochemicals viz. Chlorpyrifos and Phorate, though help in managing the pest, repeated application of such chemicals is deleterious to soil microbes that contribute to the health of soils. The application of agrochemicals disrupts the agroforestry ecosystem in the Western Ghat region that support the cultivation of several spices including small cardamom. Moreover, these chemicals are banned for use in cardamom cultivation. Nematodes are unsegmented roundworms that occupy a wide variety of ecological niches all across the globe. More than 30 nematode families contain species that are associated with insects and other invertebrates (Lacey et al., 2001). These associations range from ‘casual’ (i.e. phoretic, commensal) to obligate parasitism and pathogenesis (Stock & Hunt, 2005). The insect-associated nematodes showing most promise as biological control agents are the entomopathogenic nematodes (EPN) in the genera Steinernema and Heterorhabditis. These soil-dwelling nematode genera possess many attributes of parasitoids and pathogens. They are analogous to parasitoids because they have chemoreceptors and can actively search for their hosts. They are similar to pathogens because of their association with pathogenic bacteria (Lacey et al., 2001).

Natural damage and symptoms of attack of root grub:

Soil insect pests including white grubs, cutworms, termites and root grubs cause 24–40% yield losses in sugarcane, corn, arecanut, cardamom, groundnut, potato, banana, guava, turmeric, pulses, vegetables, grasses, etc. with direct plant loss to the tune of 20–60%. The larvae of root- feeding insects remain underground near the root zone of the plant, feeding upon the roots resulting in yellowing, wilting of leaves and drying of the entire plant. Due to continuous depletion of forest cover, organic carbon, soil microbial activities, antagonistic potential and ecological services of natural soil summarily attributed to anthropogenic and geological events, the soil-borne insect pests are increasingly invading the crops and causing a serious threat. Root grub is a serious pest damaging the roots of cardamom. Nutrient uptake is reduced due to root damage leading to yellowing of leaves; the pest problem is severe in less shaded area. Adult of the pest is a small beetle four and six mm length shiny metallic blue, green or greenish brown colour. Females are bigger than males. They are seen on cardamom leaves during morning and evening hours but do not feed on cardamom. The beetles feed on leaves of jack (*Artocarpusheterophylla*, mango (*Mangiferaindica*), guava (*Psidiumguajava*), dadeps (*Erthrypinalithosperma*), etc. Beetles occur in March, April and August-September. Females lay about 124-393 eggs in batches of 12-63 on dry cardamom leaves or mulches. The minute creamywhite grubs hatch out from eggs, fall on the ground, reach root zone and start feeding the roots. Grubs have two periods of occurrence, the first during April-July and the second during September to January. Grubs (larvae) feed on roots, become mature in 45-60 days; they are short and stout, C shaped. Pupation takes place in an earthen cocoon. The pest completes life cycle in 65-102 days during first generation (March- August) and 73-111 days during second generation (September-February).

Materials and Methods:

Nematodes are amenable to mass production and their application is compatible with standard agrochemical equipment, including various sprayers and irrigation systems. Under in vivo mass production, wax moth (*Galleria mellonella*) larvae are inoculated with the infective juveniles (IJs) of respective EPN and are allowed for infection and mass multiplication. The IJs are harvested later from the dead cadavers of *G. mellonella*. Field experiments were carried out at Santhanpara and Vandanmedu village in Idukki district of Kerala command area during 2021- 2023. The small cardamom varieties, Njallani and Bhoomi were rationed during last week of June 2021 with plot size of 3m x 3m was selected and all the recommended packages of practices were adopted except for root grub management. There were five treatments along with untreated check as listed in table 1 were replicated thrice in a randomized block design Soil application EPN power formulation @ 5gm per L of water in soil at the base of small cardamom plant (@5L of EPN Liquid per plant which mean two lakh to four lakh IJs of EPN) the IJs of EPN comes out from the cadaver in the soil, search for root grub and kill them (During May / June and September and October). Observations on the number of root grubs per plant (25 plants each treatments) in the root zone were recorded a day before and 15, 30 and 45 days after treatment. The data on the number of grubs were subjected to statistically analyzed as per Gomezand Gomez, (1984).

Results and Discussion:

The results presented in table 1 and 2 were revealed that the highest (12.05 % & 20 %) grub population reduction was recorded *Heterorhabditis indica* on 15th day after application followed by *Heterorhabditis bacteriophora* (5.65 % &15.0%) and *Steinernema carpocapsae* (4.15 % &6.75%) as compared to untreated check. On 30 days after application, *Heterorhabditis indica* , *Heterorhabditis bacteriophora* and *Steinernema carpocapsae* were significantly effective in reducing root grub population to the tune of 35 %,25 % and 10% respectively as compared to untreated. On 45 days after application, *Heterorhabditis indica* , *Heterorhabditis bacteriophora* and *Steinernema carpocapsae* were significantly effective in reducing root grub population to the tune of 65 %,36 % and 32% respectively as compared to untreated. On 60 days after application, *Heterorhabditis indica* , *Heterorhabditis bacteriophora* and *Steinernema carpocapsae* were significantly effective in reducing root grub population to the tune of 95 %,65.75 % and 45.70 % respectively as compared to untreated. In conclusion the soil application of *Heterorhabditis indica* / ha in May and September would significantly effective in reducing root grub population (more than 87%) within 60 days of application and recorded highest yield of 6.20 t/ha with accounted for 37.28% higher yield than untreated control. Biological control of root grub is a suitable alternative; Entomopathogenic fungi such as Beauveria bassiana (on beetles of root grub) and Metarhizium anisopliae (on grubs) are pathogenic to the pest, but controlling under field condition is not highly effective. Entomopathogenic nematode (EPN), a native isolate *Heterorhabditis indica* (ICAR-NBAIR EPN) is highly effective in controlling the pest under field conditions. The technology of mass production and application of EPN, which are user-friendly, in the field, has been standardized. Several farmer groups, NGOs, a commercial firm, and KVK were trained on the technology; more than 500 farmers used EPN in their fields, and root grub problem were effectively controlled in Kerala.

Table.1 Effect of eco-friendly treatments on root grub population-2021-2022

Treatments	Dose / ha	Percentage of reduction over pretreatment				Percentage of reduction over untreated control			
		15 DAT	30 DAT	45 DAT	60 DAT	15 DAT	30 DAT	45 DAT	60 DAT
T1-ICAR-NBAIR EPN(*Heterorhabditis indica*)	8 x 109 nematodes /ha	12.05	20.68	39.40	65.65	8.10	29.0	50.0	67.80
T2-ICAR-NBAIR *Heterorhabditis bacteriophora*	8 x 109 nematodes /ha	5.65	14.25	26.70	45.25	7.90	32.5	61.0	64.0
T3-ICAR-NBAIR *Steinernema carpocapsae*	8 x 109 nematodes / ha	4.15	20.10	24.0	31.50	9.0	30.10	60.0	67.0
Untreated control		-	-	-	-	-	-	-	-

Table.2 Effect of eco-friendly treatments on root grub population-2022-2023

Treatments	**Dose / ha**	**Percentage of reduction over pretreatment**				**Percentage of reduction over untreated control**			
		15 DAT	30 DAT	45 DAT	60 DAT	15 DAT	30 DAT	45 DAT	60 DAT
T1-ICAR-NBAIR EPN(*Heterorhabditis indica*)	8 x 109 nematodes /ha	20.00	30.0	65.00	95.00	10.0	40.0	60.0	87.0
T2-ICAR-NBAIR *Heterorhabditis bacteriophora*	8 x 109 nematodes /ha	15.00	25.00	36.00	65.75	15.0	38.0	75.0	79.0
T3-ICAR-NBAIR *Steinernema carpocapsae*	8 x 109 nematodes /ha	6.75	10.20	32.00	45.70	20.0	32.00	65.0	70.0
Untreated control		-	-	-	-	-	-	-	-

Table.3 Effect of eco-friendly treatments on yield parameters of Small cardamom

Treatments	**No. of panicle increased per plant**	**Percentage increaseover control**	**Production in kg(ha)**	**Productivit y(qtl./ha)**
T1-ICAR-NBAIR EPN(*Heterorhabditis indica*)	65-70	65.25	150 2	6.20
T2-ICAR-NBAIR *Heterorhabditis bacteriophora*	41-52	40.01.	912	4.68
T3- ICAR-NBAIR *Steinernema carpocapsae*	38-46	30.23	824	3.94
Untreated control	-			

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References:

[1]. Abd-Elgawad, M.M.M. 2017. Toxic secretions of Photorhabdus and their efficacy against crop insectpests. In: Abd-Elgawad MMM, Askary TH, Coupland J (edn.) Bio-control agents: entomopathogenic and slug parasitic nematodes. CAB International, UK, pp 231–260. [2].

[2]. Askary, T. H. and Ahmad M. J., 2017. Entomopathogenic nematodes: mass production, formulation and application. In: AbdElgawad MMM, Askary TH, Coupland J (edn.) Biocontrol agents: entomopathogenic and slug parasitic nematodes. CAB International, UK, pp 261–286. [3].

[3]. Dillman, A. R., Chaston, J. M., Adams, B.J., Ciche, T.A., Goodrich-Blair, H., Stock, S.P. and Sternberg, P.W. 2012. An entomopathogenic nematode by any other name. PLoS Pathogens, 8(3), p.1002527. [4].

[4]. Kaya, H.K. and Gaugler, R. 1993. Entomopathogenic nematodes. Annual review of entomology, 38(1), pp.181-206. [5]. Varadarasan S, 1993. Consolidated report on integrated management of cardamom root grub, Basileptafulvicorne (Jacoby). Kerala, India: Indian Cardamom Research Institute.Bhagat, R.M., Gupta, R.B. L. and Yadav C.P.S. 2003. Field evaluation of two entomopathogenic fungal formulations against white grubs in Himachal Pradesh. Indian Journal of Entomology, 65: 76-81.

[5]. Chroton, P. 2007. Insect pest control by entomopathogenic fungi. Mycologia, 16 (2): 23-27.

[6]. David, H., Nandagopal, V. and Anantha Narayana, K. 1986. Recent studies on the control of white grubs, Holotrichia serrata Blanch infesting sugarcane. Journal of Soil Biology and Ecobiology, 6: 117-127.

[7]. Gomez, K.A. and Gomez, A.A. 1984. Statistical Procedures for Agricultural Research, 2nd edition.

[8]. John Wiley and Sons, New York, 680 PP. Keller, S. 1998. Use of fungi for pest control in sustainable agriculture. Phytoprotection, 99:56-60.

[9]. Keller, S., David-Henriet, A.I. and Schweizer, C. 2000. Melolontha melolontha control sites in the canton Thuragau. In: S. Keller (ed.). Integrated control of soil pest subgroup “Melolontha” Proceedings of the meeting, IOBL, Switzerland, 19-21 October 1998.

[10]. IOBC/wprs bulletin, 23: 73-78. Keller, S., Schweizer, C., Keller, E. and Brenner, H. 1997. Control of white grubs bytreating adults with the fungus Beauveria brongniartii. Biocontrol Science and Technology, 7: 105-116.

[11]. Kulye, M.S. and Pokharkar, D.S. 2009. Evaluation of two species of entomopathogenic fungi against white grub, Holotrichia consanguinea infesting potato in Maharastra, India. Journal of Biological Control, 23(1): 1-4.

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