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RESEARCH PAPER

Management of root mealybugs, *Formicococcus polysperes* williams in black pepper

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Abstract : Field experiment conducted with the best chemical insecticides and botanical against black pepper root mealybug, *formicococcus polyspere*s. Results revealed that, Among the insecticides tested at 5 days after treatment, chlorpyriphos 20EC @ 0.5ml/L, imidacloprid 17.8SL @0.5ml/L and chlorantriniliprole 0.4G @ 20g/ vine recorded mortality with 0.70, 0.83 and 1.14 root mealy bugs/ 15cm root length, respectively. At 30 days after treatment, per cent reduction over control with treatments showed, imidacloprid 17.8 SLwith 97 per cent and treatments with chlorpyriphos 20EC and phorate 10G showed 93 per cent mortality, respectively. While, the botanical treatment with *Neem* cake recorded 58 per cent mortality over control. Almost all treatment showed maximum reduction of root mealybugs. Application of chlorpyriphos gavethe highest benefit cost ratio of 2.81 followed by imidacloprid (2.61).

Key Words : Pepper, *Formicococcus* spp., Root mealybug, Botanicals, Insecticides

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INTRODUCTION

Root mealy bugs are small species found below the soil surface, and feed on root and root hairs in numerous plants. They are also called soil mealy bugs and subterranean mealy bugs. Infestations frequently are not detected as the pests occur in the soil, and populations are quite slow to develop, with three to six months occurring before infestations are easily visible. Careful examination of infested roots will reveal white, cotton-like masses. These white masses contain both mature females and egg masses. Infected plants become wilted and stunted with yellowing of leaves or chlorosis (Beltra *et al.,* 2013 and Khan *et al.*, 1998). These mealybugs were associated with six ant species infesting black pepper. During last few decades, the mealybugs have emerged as noxious pest infesting on stored tubers of elephant foot yam (Palaniswami and Pillai, 1979 and Rajamma *et al.,* 2006).

Root mealybug *viz*., *Formicoccus polysperes* Williams was found infesting the roots of black pepper in Karnataka (Devasahayam *et al.*, 2010). The adults and crawlers suck sap from the lateral roots and as a

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result, the roots turn brownat the site of colonization and later dry up. Such roots cannot absorb water and nutrients from the soil. In severe case, the plants will topple down in wind due to destruction of anchoring roots.The normal aerial symptom in black pepper vine was yellowing and discolouration of the leaves. The leaf colour was found pale green to dark yellow. Similar symptoms of leaf yellowing were observed by root mealy bug infestation in banana (Smitha (2007)) and on black pepper (Devasahayam *et al.*, 2010)). Infested vines were also colonized by different species of ants in rhizosphere by which the infestation could be easily identified. Whereas, the mealy bug distribution found colonize on roots, runners, on soil at nodal region and in severe infestation on the adventitious roots at nodes on standard especially during October month. Similarly, the root mealy bugs infestation on roots and basal stem region of pepper was observed (Devasahayam *et al.* (2010)). *Cyperus kyllinga* Endlicher, *C. pangorei* Kunth, *Ludwigia parviflora* Roxb., *Centella asiatica* (L.), *Axonopus compressus* (Swartz), *Commelina bengalensis* L., *Colocasia antiquorum* Schott are recorded as collateral hosts for this mealy bug (Smitha *et al.*, 2005). Considering the wide occurrence of the pest and damage caused to the commercial cultivation of black pepper in Karnataka, a detailed study was conducted on the management of this pest.

MATERIAL AND METHODS

The investigation on the management of root mealybug was carried out in a farmers' field at Koppa taluk, Chikkamagaluru district, Karnataka during the period from October 2018. The treatment materials under different category were screened under field condition. After the initial field screening, a field trial was laid outselecting the best treatment and these treatments were evaluated individually.

Newer chemical insecticides and *Neem* cake (Table 1) were evaluated under field conditions against root mealybug. The experiment was laid out in Randomized Block Design with three replications. Control plots were maintained separately where plants were drenched with water. Fifteen plants were maintained per replication. The trials were conducted during the period from October 2018. The observations on mealybug population from a soil block of size 15×15×15cm^3 from the root zone ofthe plant were recorded for one month at 5 days, 15 days and 30 days after treatment. The colony count before the application of the treatments was also recorded.The quantity of the solution used was three litres per plant.

Table 1 : Treatments tested against root mealybug

Tr. No.	Treatment details	Strength of the chemicals	Dosage
T_1	Chlorpyriphos	20EC	5.0ml/l
T_2	Carbosulfan	25EC	2.0ml/l
T_3	Imidacloprid	17.8SL	1.5ml/l
T_4	Phorate	10G	10g/vine
T_5	Carbofuron	3G	10g/vine
T_6	Chlorantriniliprole	0.4G	20g/vine
T_7	*Neem* cake	-	500g/vine
T_8	Control	-	-

Botanical insecticides :

Neem cake @500g/vine was applied as basal application at peak infestation period during October and observed for mortality of mealy bugs.

Chemical insecticides :

Chemical insecticides *viz*., chlorpyriphos 20EC @ 5ml/L, carbosulfan 25EC @ 2.0ml/L, imidacloprid 17.8SL @ 1.5ml/L, phorate 10G @ 10g/vine, carbofuron 3G @ 10g/vine, chlorantriniliprole 0.4G @ 20g/vine (Table 1) were screened. The insecticide solutions were drenched in the basin of the plant.

Field experiment :

A field trial was conducted in a root mealybug infested black pepper field at koppa area of Chikkamagaluru district with the best treatments selected from the screening experiment. Eight treatments with 3 replications were designed and the experiment was laid out in a Randomized Block Design. *Neem* cake was applied at 500g per vine. Three replications were maintained foreach treatment and fifteen plants were maintained per replication. Three litres of solution was applied perplant. One control plot was also maintained, which was drenched with three litres of water. Observations on mealybug intensity were recorded. Observations on colony count were made for a month and per cent reduction in population over control were calculated. The colony count before the application of the treatments was also recorded. The average of fifteen plants gave the intensity for one replication.

Data observation and statistical analysis :

Mealybug intensity was recorded bycounting the number of colonies per 15 cm root length. Sampling was started from 5 days after treatment. The average of five plants gave the intensity for one replication of a treatment. The intensity was recorded as number of colonies per sample. The data onpopulation were transformed and subjected to Randomized Block Design (RBD) ANOVA. Data on root mealy bug mortality were subjected to ANOVA.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Botanical insecticide :

Neem cake @ 500g per vine was effective at 30 days after treatment in reducing the mealy bug population compared to control with 2.27 mealybugs per 15cm root length (Table 2). There is no information on the effect of botanicals on root mealybugs but the effectiveness of Neem cake at 5 and 15 days after treatment on first instar nymphs of *Maconellicoccus hirsutus* Green after 24 and 48 hours of treatment (Verghese, 1997). While laboratory test in Denmark also reported that the cassava leaves treated with NSKE were less attractive to first instar nymphs of cassava mealybug, *Phenacoccus manihoti* (Mat. Ferr.) and those, which fed on the treated leaves, died during the second instar stage (Mourier (1997). They also reported that in green house studies, the application of NSKE at weekly intervals protected cassava against established early instar nymphs of cassava mealybug. There was no significant difference in concentrations *viz.*, 1, 10 and 25 per cent. The efficacy of five per cent NSKE on *Maconellicoccus hirsutus* in Karnataka. Observations on mortality recorded at 5, 15 and and 30 days after treatment showed highest per cent mortality of 23, 39 and 58, respectively (Satyanarayana *et al.*, 2003). Similarly, Drenching the soil with seed water suspension of 10 per cent *Millettia ferruginea* caused

Table 2 : Bio efficacy of insecticides against root mealy bug in black pepper

Sr. No.	Treatments	Dosage	Level of incidence (mealybugs/15cm root length)				
			Before treatment	5days after treatment	15days after treatment	30days after treatment	Per cent reduction over control (%)
1.	Chlorpyriphos 20EC	5.0 ml/l	13.33 (3.71)	0.00 (0.70)	0.13 (0.79)	0.33 (0.91)	93
2.	Carbosulfan 25EC	2.0 ml/l	12.60 (3.61)	2.80 (1.81)	0.73 (1.10)	0.40 (0.94)	92
3.	Imidacloprid 17.8SL	0.5ml/l	13.40 (3.72)	0.20 (0.83)	0.07 (0.75)	0.13 (0.79)	97
4.	Phorate 10G	10 g/vine	10.93 (3.38)	2.53 (1.74)	1.33 (1.35)	0.33 (0.91)	93
5.	Carbofuron 3G	10 g/vine	12.60 (3.61)	3.60 (2.02)	1.80 (1.51)	1.00 (1.22)	81
6.	Chlorantriniliprole 0.4G	20 g/vine	14.40 (3.86)	0.80 (1.14)	0.27 (0.87)	0.47 (0.98)	91
7.	*Neem* cake	500g/vine	14.60 (3.88)	9.73 (3.19)	8.33 (2.97)	2.27 (1.66)	58
8.	Control	-	14.20 (3.83)	12.7 (3.63)	13.8 (3.78)	5.47 (2.44)	-
S.E.±			1.16	0.62	0.77	0.49	
C.D. (P=0.05)			3.51	1.89	2.33	1.49	

* Significant at 5% probability Figures in the parentheses are ?x+0.5 transformed

Table 3: Effect of different chemicals on yield of black pepper

Treatments		Dosage/ vine	Yield (kg/ vine)	Gross cost/ acre	yield kg/ acre	Total income (Rs.)	net income (Rs./ac)	CB
T_1	Chlorpyriphos 20EC	15 ML	3.99[a]	42650	399	119700	77050	2.81
T_2	Carbosulfan 25EC	6 ML	2.63[c]	42930	263	78900	35970	1.84
T_3	Imidacloprid 17.8SL	1.5 ML	3.75[a]	42510	375	112500	69990	2.65
T_4	Phorate 10G	10G	2.97[c]	42210	297	89100	46890	2.11
T_5	Carbofuron 3G	10G	2.87[c]	42170	287	86100	43930	2.04
T_6	Chlorantriniliprole 0.4G	20G	3.20[c]	42525	320	96000	53475	2.26
T_7	Neem cake	500G	2.60[c]	42950	260	78000	35050	1.82
T_8	Control	-	1.74	41150	174	52200	11050	1.27
S.E.±			0.27					
C.D. (P=0.05)			0.82					

a higher level of mortality (66%) compared to the other botanicals *Azadirachta indica, Melia azadirachta, Phytolaca dodecandra* and *Schinus molle* with mortality of 18, 21, 18.5 and 18.1 per cent, respectively against enset root mealybugs (Tadesse *et al*., 2010).

Chemical insecticides :

Field screening of chemical insecticides revealed the superiority of chlorpyriphos, Imidacloprid and chlorantriniprole as effective in controlling the root mealybug. At 30 days after treatment, significantly less number of mealybug colonies was observed in treatment imidacloprid (0.13) followed by chloropyriphos and phorate as the next effective chemical with 0.33 colonies followed by chlorantriniprole (0.47) and these treatments were on par. All the treatments were found effective in reducing the mealy bug population. Drenching of chlorpyriphos twice at two weeks interval controlled root mealybugs (Kumar and Prakasan, 1992 and Hara *et al.,* (2001).

The per cent reduction in mealybug population over control showed that Imidacloprid recorded higher per cent reduction (97) of root mealybug during different intervals of observation. The treatments which recorded higher per cent reduction of root mealybug was chlorpyriphos and phorate (93), followed by chlorantriniprole 0.4G with reduction of 91 per cent. This effect might bedue to the fumigant action of chemicals. Several workers reported the use and effectiveness of chlorpyriphos in controlling root mealybugs (Kumar and Prakasan, 1992, Hara *et al*., 2001 and Rajagopal and Krishnamurthy, 2003) while, management of Almond mealy bug, *Drosicha dalbergiae* Stebbing revealed that among soil insecticides applied in March, carbaryl (10% dust) showed maximum cumulative mortality per cent of 51.2, followed by chlorpyrifos (10 G) to the extent of 47.7 per cent (Gul 2014).

No significant association could be observed between per cent reduction in mealybug population and yield parameters in the field experiment at 30 days after treatment. However all the treatments yielded significantly more than control (Table 3). Highest yield was recorded in the treatment, chlorpyriphos alone (3.99 kg /vine) followed by Imidacloprid (3.75 kg). Benefit: Cost (B:C) ratio for different treatments indicated chlorpyriphos as the most economical with the highest total benefit (Rs. 1,19,700/acre) and B:C of 2.81 followed by imidacloprid with total benefit 1,12,500 and B:C of 2.75. Though the treatment, *Neem* cake recorded atotal benefitsof Rs.78000/acre with B:C ratio of 1.82 compared to control (1.27:1). From the resultsobtained in this study, it can be concluded thatthe application of Imidacloprid,chloropyriphos, phorate and chlorantriniprole at the time of infestation can effectively and economically manage root mealybugs in black pepper (Mourier, 1997).

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