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EFFICACY STUDIES OF INSECTICIDES AGAINST ROOT MEALYBUG, *PLANOCOCCUS LILACINUS* (HOMOPTERA: PSEUDOCOCCIDAE) INFESTING COFFEE

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ABSTRACT
Coffee is one of the major commodities in the global market and provides a source of revenue for millions of people concerned with cultivation, marketing, export and processing of the crop. Among the pest issues, the infestation of the mealy bug, *Planococcus lilacinus* Cockerell (Homoptera: Pseudococcidae), is a severe problem in the coffee nursery, which causes considerable damage to young coffee plants. The present study was conducted to evaluate the toxic effect of different insecticides *viz.*, Chlorpyrifos 20 EC, Dimethoate 30 EC, Imidacloprid 17.8 SL, Thiamethoxam 12.6 + Lambda Cyhalothrin 9.5 ZC, Profenofos 50EC, Thiacloprid 21.7 SC, Fipronil 5SC, Spirotetramat 11.01 + Imidacloprid 11.01 SC against root mealy bug. Mortality data for mealy bugs were recorded at weekly intervals and the percentage reduction in population was compared to pre-treatment. Maximum per cent mortality was observed for Chlorpyrifos 20EC (90 percent) followed by Imidacloprid 17.8 SL (86 percent) at 3 weeks post-treatment, while Fipronil 5SC and Spirotetramat 11.01 + Imidacloprid 11.01 SC were the least effective to root mealybug population.

KEY WORDS: Coffee, insecticides, mealybug, mortality, nursery, *Planococcus lilacinus*.

INTRODUCTION

Coffee is one of the most important commercial crop and livelihoods for a number of people in the hilly areas of India, particularly in the Western Ghats of Karnataka, Kerala and Tamil Nadu. As a commercial crop, the demand for coffee seeds and clones has increased over the years due to expansion and replanting programmes. Hence, protecting the seedlings/ clones in the nursery from pests and diseases therefore plays an important role in maintaining the saplings quality to sustain the industry. The pests often found in coffee nurseries are mealy bugs, grasshoppers, aphids, cutworms, root-lesion nematode, and other caterpillars that feed the leaves.

Planococcus spp. (Homoptera: Pseudococcidae) is considered one of the most serious coffee mealybugs. *Planococcus citri* Risso (Coleman and Kannan, 1918; Ayyar, 1940) and *Planococcus lilacinus* Cockerell (Sekhar, 1964; Bhat and Shamanna, 1972) are the most frequently found species of mealybugs in India's coffee plantations that infest commercially grown coffee varieties, *Coffea arabica* Linnaeus (Arabica coffee) and *C. canephora* Pierre ex Froehner (Robusta coffee). Such mealybugs are spread all over India's coffee tracts and seen very regularly during the summer months. *Planococcus lilacinus* is predominantly found in Kodagu district of Karnataka, while *P. lilacinus* and *P. citri* are found in equal proportion in Wayanad district of Kerala in India (Abdul Rahiman *et al.*, 1995). They infest both shoots and roots of coffee by sucking sap from nodes, leaves, flowers buds, tender shoots and roots (Chacko, 1978; and Shekar, 1964). Symptoms of infestation on aerial parts of plants are obvious, while sub-soil attacks by root mealy bugs are only identified when drying starts. Root mealybugs are thus the major troubling pest in the nurseries. Careful inspection may show white and cotton like masses adhering to the roots that have been infested. Root mealybugs are congregated at lateral and main root junctions. They suck sap from host plant roots and rootlets leading to slow growth, stunting, yellowing and loss of vigor. Damage is usually visible when plants are infested with a large population. Heavy infestation causes the plant to rot, and eventually saplings to die. After sucking sap, mealybugs on the root secrete honey dew which later results in the production of fungus (Diacanthodes sp.) and hinders nutrient absorption. Root mealybugs are usually spread by crawling or growing medium debris, equipment used and phoresy ants. If the population is lower, it does not have a significant effect on plant health. However, a rapid multiplication rate leads to severe infestation within a short period of time if proper control measures are not taken.

Increased infestation of root mealy bugs has recently been reported across coffee growing areas, particularly in nurseries and field transplanted young plants. A soil drench with an organophosphate insecticide, Dimethoate 30EC at 3.3 ml / L of water (Vinod Kumar and Prakasan, 1992) is currently used by growers to minimize infestation. Since 1992, Dimethoate 30EC has been recommended and used for the management of root mealybugs. In view of this, an alternative insecticide is necessary to avoid the development of insecticide resistance and resurgence in mealybug. Hence, the present study was aimed to find out an alternative chemical for Dimethoate 30EC by evaluating the efficacy of few

insecticides and insecticide mixtures for the effective management of root mealybug.

MATERIALS AND METHODS

The experiment was conducted to evaluate the insecticidal activity of various commercial insecticides against coffee root mealybugs of coffee at Central Coffee Research Institute, Balehonnur, Chikkamagaluru nursery during the year 2019. One-month old C×R robusta clones (5" × 8" bags) infested with root mealybugs were selected for the study. The selected insecticides and their dosage are listed in the Table 1.

TABLE 1. Details of Insecticides and their dosages used for the study

T.No	Insecticides	Dosage/L
T1	Chlorpyrifos 20 EC	2 ml
T2	Dimethoate 30 EC	2 ml
T3	Imidacloprid 17.8 SL	0.6 ml
T4	Thiamethoxam 12.6 + Lambda Cyhalothrin 9.5 ZC	0.6 ml
T5	Profenofos 50 EC	2 ml
T6	Thiacloprid 21.7 SC	0.25 ml
T7	Fipronil 5 SC	3 ml
T8	Spirotetramat 11.01 + Imidacloprid 11.01 SC	1 ml
T9	Control	Water

Water drenched clones were maintained as control. Treatments were assigned to experimental units in an RCB design with five replications and 20 plants for each replication. Prior to the treatment application, 2 plants were selected randomly from each replication and counted for number of live mealybugs by carefully removing the nursery bag, inspect roots and soil media with minimal disruption to the root area and exposure to sunlight. Using a 10X hand lens, the mealybugs were observed with a zero-sized paint brush and examined their movement to determine whether they were alive or not. *Planococcus lilacinus* was the only species of mealybug observed in the trial plot. Pre-treatment counts of live mealy bugs were made and recorded. 30 ml of insecticide solution was drenched in the base of each nursery bags. Live counts were made at weekly intervals following the same procedure and compared with pre-treatment counts to assess the efficacy of the treatments. The difference between the mean mortality of selected insecticides was compared using ANOVA and the means were separated using DMRT.

RESULTS AND DISCUSSION

Planococcus lilacinus, is an emerging threat to coffee plantations in India, particularly in nurseries for the recent times. Severe infestation of root mealy bugs in the nurseries reduces the quality of seedlings. Hence, growers have been using different insecticides for mitigating this devastating pest with mixed control success. The present study was aimed to evaluate the comparative efficacy of different insecticides against root mealybug in order to find out the most effective insecticide and its concentration to be suggested to farmers as chemical control option. The pre-treatment population of the mealybug had a range from 9.6 to 10.9 per 10 plants. Differences in the mealybug population between the treatments were not statistically significant one day before imposition of the treatments. The results on the efficacy of different insecticides against *P. lilacinus* are presented in Table 2.

TABLE 2. Efficacy of insecticides against root mealybug, *P. lilacinus*

T. No	Mean No. of mealy bugs in PTC/10 plants	Mean No. of mealybugs after spray / 10 plants			Population reduction after spray (%)		
		7 DAT	14 DAT	21 DAT	7 DAT	14 DAT	21 DAT
T1	10.2 ± 0.76 a	5 ± 0.58 c	1.5 ± 0.34 f	0.3 ± 0.15 d	50.98	85.29	94.00
T2	10 ± 0.54 a	5.8 ± 0.42c	3 ± 0.21def	1.2 ± 0.20 cd	42.00	70.00	79.31
T3	9.9 ± 0.80 a	5 ± 0.86c	2.1 ± 0.46 ef	0.7 ± 0.21 d	49.49	78.79	86.00
T4	10.9 ± 1.12 a	5.8 ± 0.59c	3.2 ± 0.61 def	2.2 ± 0.53 cd	46.79	70.64	62.07
T5	10.5 ± 1.08 a	6.7 ± 0.63c	4.8 ± 0.49 cde	3.6 ± 0.48c	36.19	54.29	46.27
T6	9.6 ± 0.96 a	6.3 ± 0.75c	4 ± 0.56 cd	2.2 ± 0.42 cd	34.38	58.33	65.08
T7	10.1 ± 0.80 a	6.8 ± 1.0 c	5.2 ± 0.85 c	3.8 ± 0.84 c	32.67	48.51	44.12
T8	10.2 ± 1.05 a	9.3 ± 0.86 b	7.9 ± 0.62 b	6.6 ± 0.52 b	8.82	22.55	29.03
T9	10.4 ± 1.08 a	12.5 ± 0.82 a	18.7 ± 1.17 a	31.3 ± 2.31 a	-20.19	-79.81	-150.40

Pre treatment count (PTC); Days after treatment (DAT); Mean followed by same letter (s) in a column are not significantly different by DMRT (P=0.05)

The chemical insecticides were evaluated based on number of surviving individuals and the same data was also expressed as per cent population reduction. Statistically, all insecticide treatments significantly reduced the root mealy bug population, when compared to the untreated control. No substantial difference was observed in mortality between the insecticides tested during the first week, whereas the insecticides showed significant difference during 14 and 21 days after testing. Chlorpyrifos was observed superior with 85 and 94 percent population reduction followed by Imidacloprid with 78 and 86 percent after 14 and 21 days of treatment

respectively. Dimethoate was found to reduce population by 79 per cent after 21 days of treatment. The application of Thiamethoxam + Lambda Cyhalothrin, Profenofos, Thiacloprid, Fipronil and Spirotetramat + Imidacloprid, on the other hand, resulted in mortality rates that were lower than Chlorpyrifos and Imidacloprid but still substantially higher than the control treatment. Also, after 21 days, the least decline in population (29%) was observed in Spirotetramat + Imidacloprid. Both chlorpyrifos and Imidacloprid were significantly superior to the Dimethoate recommended at present.

The present study on the effect of chlorpyriphos agrees with the report of Smitha *et al.,* (2010) who reported chlorpyriphos resulted in better control of root mealybugs *Geococcus* Spp. in Banana. Bekele (2001) reported Chlorpyrifos found to be effective against enset root mealybug, *Cataenococcus ensete.* Hara *et al.,* (2001) also reported that drenching chlorpyriphos twice at a two-week interval controlled the coffee root mealy bug *Geococcus coffeae* in Hawaii. Rajagopal and Krishnamoorthy (2003) recommended the use of persistent insecticide like chlorpyriphos @ 2- 3 ml/L for the control of root mealybugs. Sreerag and Jeyaprakas, 2012 reported Chlorpyrifos produced 90 percent mortality of *Rhizoecus amorphophalli* mealybugs in tubers, *Amorphophallus paeoniifolius.* Our findings are also in conformity with the results of, Kumar *et.al*., 2012. and Lanjar *et al*., (2014) who also demonstrated that Chlorpyrifos is the most effective insecticide against mealybug infestation.

CONCLUSION

The present investigation specifically indicated that Chlorpyrifos 20 EC (2ml / L) and Imidacloprid 17.8 SL (0.6ml / L) were significantly higher in root mealybug suppression under nursery conditions. The same conclusion was drawn from a number of workers, both in India and abroad, as evidenced by field and laboratory studies against root mealy bugs of different crops. Chlorpyrifos may therefore be the best option and, in its absence, Imidacloprid may be an alternative for the management of Coffee root mealybug *P. lilacinus*.

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