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Neem oil based formulation is effective for the management of whitefly, *Aleurocanthus arecae* David & Manjunatha and wax scale, *Chrysomphalus aonidum* (Linnaeaus) on arecanut

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ABSTRACT: The efficacy of different insecticides were evaluated against whitefly, *Aleurocanthus arecae* David & Manjunatha (Hemiptera: Aleyrodidae) and wax Scale, *Chrysomphalus aonidum* (Linnaeaus) (Hemiptera: Diaspididae) in arecanut during 2019-2020 at two different locations. Among the different insecticides tested for the management of *A. arecae* and *C. aonidum,* the neem oil based formulation 10,000ppm @ 2ml/l showed maximum per cent reduction against the whiteflies (72.92) and wax scales (81.60). This treatment was followed by chlorpyriphos 20 EC (62.09 %) for whiteflies and dimethoate 30 EC (66.51 %) for wax scales compared to other treatments. Considering that arecanut palms require high insecticidal solution to drench the foliage, inflorescence/nuts, the results provide important insight to use this economically viable insecticide to avoid negative environmental impact.

Keywords: *Areca catechu*, insecticide, neem oil, sucking pests

INTRODUCTION

Arecanut is one of the major commercial plantation crops in India. Arecanut is majorly cultivated in the plains as well as in the hills of Western Ghats and North Eastern part of India. In India, arecanut is extensively grown in states like Karnataka, Kerala, Assam and West Bengal. Among all the arecanut growing states, Karnataka alone produces 70.33 per cent of arecanut (6.00 lakh tonnes) from an area of 2.79 lakh hectare (Anonymous, 2019). Among the districts of the Karnataka state, Shivamogga stands first in both area (21.06%) and production (21.30%) followed by Davanagere, Dakshina Kannada, Tumkur, Chikkamagaluru and Chitradurga. These districts together account 83.63 per cent of the total area and 82.10 per cent of the total production of arecanut in the state (Anonymous, 2018).

The arecanut crop is infested by more than 102 insect and non-insect pests (Nair and Daniel, 1982). Among the pests, white grub, *Leucopholis lepidophora* Blanchard (Scarabaeidae: Coleoptera), spindle bug, *Carvalhoia arecae* Miller and China (Miridae: Heteroptera), inflorescence caterpillar, *Tirathaba mundella* Walker (Pyralidae: Lepidoptera) and mite, *Raoiella indica* Hirst (Tenuipalpidae: Acarina) are important in causing economic damage (Nair and Menon, 1963; Kalleshwaraswamy *et al.,* 2015 ; Kalleshwaraswamy *et al*., 2016). Different species of wax scales, soft scales, aphids, mealybugs and whiteflies infest the under surface of the arecanut leaves. Honeydew secreted by these insect pests leads to the formation of the sooty mould fungus, which interfere with the photosynthetic activity of the crop. These insects suck the sap with the help of stylets from the leaves, inflorescence, nuts and causing the severe economic damage in arecanut plantation. If the infestation will be severe in young seedlings, results in blotching and drying of leaves (Daniel, 2003). Scales, mealybugs, whiteflies and aphids occupy important places with possibilities of becoming severe pests of plantation crops. The most important sternorrhynchan insect pests in arecanut are wax scales *Chrysomphalus aonidum* (Linnaeaus) and whiteflies *Aleurocanthus arecae* David & Manjunatha. These insects are becoming the major pests in arecanut growing areas of Karnataka causing severe economic losses to the farmers. In order to find the better insecticide for the management of these pests, field experiments were conducted and the results are reported here under.

MATERIALS AND METHODS

Experiment was conducted to evaluate the different insecticides against whitefly, *A. arecae* and wax scale, *C. aonidum* on arecanut. The field experiment was laid out in a Randomized Complete Block Design (RCBD) in two different locations *viz.,* College of Agriculture, Shivamogga (13°54' N latitude and 75°40' E, 611 msl) and Holehatti village (13°53' N latitude and longitude of 75°42' E ;518 msl) near Shivamogga in farmer fields. Twenty-four labeled infested palms were randomly selected in each plot and eight treatments comprising with different insecticides were applied with three

Table 1. Efficacy of selected insecticides for the management of whitefly, *Aleurocanthus arecae* David & Manjunatha (Pooled data of 2 sprays)

Treatment		Mean number of whiteflies/5cm² leaf area				Mean	Reduction over untreated control (%)
		1 DBS	7 DAS	14 DAS	21 DAS		
T1	Dimethoate 30% EC @ 1.7 ml/l	27.33 (5.27)	18.83 (4.39)^{c}	13.50 (3.73)^{cd}	10.67 (3.34)^{c}	14.33 (3.84)^{cd}	46.26
T2	Imidacloprid 17.8% SL @ 0.5 ml/l	25.33 (5.06)	19.67 (4.48)^{bc}	15.00 (3.93)^{c}	11.67 (3.48)^{c}	15.44 (3.99)^{c}	42.10
T3	Spinosad 45% SC @ 0.5 ml/l	25.17 (5.04)	19.50 (4.46)^{bc}	15.50 (3.99)^{c}	11.83 (3.50)^{c}	15.61 (4.00)^{c}	43.15
T4	Buprofezin 25% SC @ 1.0 ml/l	24.83 (5.01)	17.16 (4.19)^{cd}	11.00 (3.38)^{de}	7.50 (2.79)^{d}	11.89 (3.51)^{de}	55.41
T5	Chlorpyriphos 20% EC @ 2.0 ml/l	23.33 (4.87)	14.83 (3.89)^{de}	9.33 (3.12)^{ef}	6.16 (2.57)^{d}	10.11 (3.24)^{e}	62.09
T6	Neem oil based formulation 10,000ppm @ 2.0 ml/l	26.00 (5.14)	13.16 (3.67)^{e}	7.00 (2.71)^{f}	1.50 (1.40)^{e}	7.22 (2.71)^{f}	72.92
T7	Sulphited fish oil @ 4.0 ml/l	25.83 (5.12)	23.50 (4.89)^{ab}	21.33 (4.67)^{b}	19.50 (4.46)^{b}	21.44 (4.67)^{b}	19.61
T8	Untreated control	25.67 (5.10)	26.67 (5.19)^{a}	26.83 (5.21)^{a}	26.50 (5.19)^{a}	26.67 (5.20)^{a}	-
F value		NS	*	*	*	*	-
SEM±		0.15	0.16	0.14	0.13	0.15	-
CD(P=0.05)		0.46	0.48	0.42	0.41	0.45	-
CV%		5.22	6.32	6.33	7.05	6.70	-

*Significant at (P≤0.05); NS-Non significant; Figures within the parentheses indicates √x+0.5 transformed values; Mean followed by the same letter do not differ significantly by DMRT (P=0.05); DBS= Day before spray; DAS= Day after spray

replications. Before each application the sprayer was calibrated with the help of water. The treatments were imposed with the help of Knapsack sprayer. Observation on number of insects were made a day before spraying, seven days, 14 days and 21 days after treatment on selected plants of 5×1cm^2 leaf area. The leaf samples were brought to the laboratory and examined for nymphal population using stereo binocular microscope at 10x to 40x. Efficacy were computed as reduction in number of insects as compared to untreated check. The data on the mean number of insect pests were considered for statistical analysis after square root transformation by using the software Statistical Package for social science (SPSS) V. 18.

RESULTS AND DISCUSSION

Efficacy of insecticides against whitefly, *Aleurocanthus arecae*

The mean number of whiteflies was found uniform in all the treatments at one day before spraying, as indicated by non-significant differences among all the treatments which ranged from 23.33 to 27.33/5cm^2 leaf area. The perusal of the pooled data indicated that the mean number of whiteflies in different treated plots reduced significantly compared to untreated control. Neem oil 1% (72.92%) revealed highest per cent reduction of the whiteflies population compared to other treatments. The next best effective insecticides were chlorpyriphos 20 EC (62.09 %), which was on par with buprofezin 25 EC (55.61 %). The sequence of moderately effective insecticides was dimethoate 30 EC (46.26 %), spinosad 45 SC (43.15 %) and imidacloprid 17.8 SL (42.10 %). The sulphited fish oil (19.61 %) was least effective against whiteflies compared to untreated control (Table 1).

Efficacy of Insecticides against wax scale, *Chrysomphalus aonidum*

A day before spraying, the mean number of wax scale population was uniform in all the treatments as showed by non-significant differences among the different treatments which ranged from 15.33 to 18.33/5 cm^2 leaf area. The pooled data on the efficacy of different insecticides from both the locations after seven days after spraying and 14 days after spraying for the effective management of wax scales indicated that, the mean number of wax scales reduced significantly in all the treatments compared to untreated control. Among all the treatments, neem oil 1% (81.60%) showed highest per cent reduction of wax scales population compared to all other treatments. The next best effective insecticides were dimethoate 30 EC and chlorpyriphos 20 EC with 66.51 and 57.49 per cent reduction, respectively. The order of moderately effective insecticides based on per cent reduction were spinosad 45 SC (41.62%), imidacloprid 17.8 SL (39.05%) and buprofezin 25 EC (35.60%). The sulphited fish oil (22.72 %) showed minimum efficacy against wax scales compared to untreated control (Table 2).

From the results, it can be inferred that, the neem oil 1% is the best chemical compared to other tested insecticides against whitefly, *A. arecae*. The present results corroborate with the findings of Mohan *et al.* (2017) and Ranjith *et al.* (1996). Neem oil and organophosphorus insecticides are highly effective against whiteflies, which is in accordance with Bandyopadhyay *et al.* (2000). Buprofezin 25 EC was also effective in reducing the whiteflies population, similar kind of results were obtained by Kumar *et al*. (2018). Neem oil and chlorpyriphos 20 EC are highly effective insecticides against whiteflies, which is in harmony with Dubey and Sundararaj, 2004.

Neem oil based formulation (81.60) showed highest per cent reduction of wax scales compared to other treatments. The next best effective insecticides were dimethoate 30 EC and chlorpyriphos 20 EC with 66.51 and 57.49 per cent reduction, respectively. The supremacy of the neem oil 1% against wax scale, *C. aonidum,* which is in harmony with Basavaraju *et al.* (2013) and Singh and Rao, (1997). Dimethoate 30 EC is the next best effective insecticide, which is in agreement with Ibrahim *et al.* (2019).

Among the different insecticides tested against whitefly, *A. arecae* and wax scale, *C. aonidum* the neem oil 1% was the most effective insecticide against these two sucking pests. This may be due to formation of coating layer over the insect body which block the respiratory system (spiracle) and insect will die due to asphyxiation (Locke, 1994). Considering the bio efficacy and eco –friendly benefits, neem oil can be used for the effective management of these pests in Arecanut.

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Table 2. Efficacy of selected insecticides for the management of scale, *Chrysomphalus aonidum* (Linnaeus) (Pooled data of 2 sprays)

Treatment		Mean number of scales/ 5cm² leaf area			Mean	Reduction over control (%)
		1 DBS	7 DAS	14 DAS		
T1	Dimethoate 30% EC @ 1.7 ml/l	16.83 (4.14)	7.83 (2.82)^{de}	5.16 (2.36)^{e}	6.50 (2.61)^{e}	66.51
T2	Imidacloprid 17.8% SL @ 0.5 ml/l	15.33 (3.95)	12.00 (3.50)^{b}	11.67 (3.480^{c}	11.83 (3.49)^{c}	39.05
T3	Spinosad 45% SC @ 0.5 ml/l	16.83 (4.16)	11.50 (3.46)^{bc}	11.16 (3.41)^{c}	11.33 (3.43)^{c}	41.62
T4	Buprofezin 25% SC @ 1.0 ml/l	15.67 (4.01)	12.33 (3.58)^{b}	12.67 (3.62)^{c}	12.50 (3.60)^{bc}	35.60
T5	Chlorpyriphos 20% EC @ 2.0 ml/l	16.33 (4.10)	8.67 (3.00)^{cd}	7.83 (2.88)^{d}	8.25 (2.94)^{d}	57.49
T6	Neem oil based formulation 10,000ppm @ 2.0 ml/l	17.00 (4.18)	5.67 (2.47)^{e}	1.83 (1.44)^{f}	3.75 (2.04)^{f}	81.60
T7	Sulphited fish oil @ 4.0 ml/l	17.16 (4.20)	14.33 (3.83)^{b}	15.67 (4.02)^{b}	15.00 (3.93)^{b}	22.72
T8	Untreated control	18.33 (4.34)	19.16 (4.43)^{a}	19.67 (4.489)^{a}	19.41 (4.46)^{a}	-
F value		NS	*	*	*	-
SEM±		0.14	0.15	0.12	0.10	-
CD(P=0.05)		0.42	0.46	0.37	0.32	-
CV%		5.86	7.74	6.72	5.66	-

*Significant at (P≤0.05); NS-Non significant; Figures within the parentheses indicates √x+0.5 transformed values; Mean followed by the same letter do not differ significantly by DMRT (P=0.05); DBS= Day before spray; DAS= Day after spray

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