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Field evaluation of selected insecticides against areca nut white grub, *Leucopholis lepidophora* (Blanchard) (Coleoptera: Scarabaeidae)

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ABSTRACT: A field experiment was conducted to evaluate insecticides against areca nut white grub, *Leucopholis lepidophora* Blanchard at two locations *viz.,* Gulukoppa, Hosanagara taluk and Harakere, Shivamogga taluk, Karnataka, India during August-November 2013. The results revealed that 60 days after treatment, chlorantraniliprole 18.5% SC @ 658 ml/ha was effective in reducing the early instar root grub population at both the locations (89.29 % and 87.01 %, respectively). After 105 days of treatment, in one of the locations, imidacloprid 17.8 SL @ 1 l/ha (88.88 %) followed by fipronil 5 SC 2.5 l/ha and chlorantraniliprole 18.5% SC @ 658ml/ha (86.66 %) gave significant reduction over the untreated check. Whereas at Harakere, imidacloprid 17.8 SL @ 1 l/ha chloropyriphos 20EC @ 10 l/ha and fipronil 5 SC @ 2.5 l/ha gave 100 percent reduction in larval population. Pooled analysis indicated that fipronil and imidacloprid gave control of white grub, *L. lepidophora* to the extent of >80 percent over control.

Keywords: Areca nut, insecticides, *Leucopholis lepidophora,* white grub

INTRODUCTION

Areca nut (*Areca catechu* L.) is one of the important commercial crops grown in India. It is also called as betelnut and largely cultivated in the plains and foothills of Western Ghats and North Eastern regions of India. Areca nut is attacked by an array of insect and non-insect pests. Among all the pests, presently, root grub *Leucopholis lepidophora* Blanch. (Coleoptera : Scarabaeidae) is causing greater havoc in arecanut cultivation. Considerable loss due to root grubs reducing in areca nut yield is reported in five districts, Chikmagalur, Uttara Kannada, Udupi, Dakshina Kannada and Shivamogga (Prakash *et al.,* 2011) districts of Karnataka. Kalleshwaraswamy *et al.,* (2015) reported 27.86 to 36.97 percent damage by this species with a yield reduction of 39.79 to 41.60 percent in different districts of hilly and costal regions of Karnataka. The root grubs cause damage to the arecanut tree by directly feeding on roots resulting in symptoms like yellowing of leaves, stem tapering at the crown region, reduced internode length, nut fall and ultimately leads to reduced vigour, yield and death of plant. Under severe infestation, the palms lose their anchorage due to complete loss of roots and when shaken, moved easily or fell with a little jerk (Kumar, 1997). Insecticidal application *viz.,* chlorpyriphos, imidacloprid and phorate to the soil targeting grubs is a widely followed method that provides considerable control (Prakash *et al.,* 2011). However, many of these insecticides have negative effect on the soil micro arthropods and also earthworms (Adarsha *et al.,* 2015). Many newer chemicals have come to market and are recommended for soil insect management in other croping ecosystem which needs to be tested against areca root grubs. Our preliminary studies indicated that early instar grubs are distributed throughout the garden (both in between the palms and around the palms) during July to October (rainy season) and later instars are restricted to root zone (only around the palm) from November onwards (when moisture content in the soil gets reduced). With this basic idea of spatial distribution of grubs, the present study was undertaken to evaluate efficacy of insecticides targeting both early and later instars, under field conditions during 2013-14.

MATERIALS AND METHODS

Field study was carried out in two areca gardens of 15 and 18 year old planted at a spacing of 8ft X 8ft. The gardens had an incidence of about 40 and 20 percent at Harakere (Shivamogga district 13°53′ N; 75°33′ E, 585 msl) and Gulukoppa (Hosanagara taluk, Shivamogga district ;13°52′ N; 75°12′ E, 692 msl) villages, respectively. Insecticidal application was made two times. First application was taken up during August-2013 (Spraying throughout the field per hectare basis) and second treatment (drenching the insecticide around the root zone per tree basis) was done during November-2013. The experiment was initiated with eight treatments by adopting randomized block design (RBD)

with three replications. Each treatment consist 45 palms in which 15 palms were selected for sampling root grubs.

In the first application, recommended quantity of insecticide solution was sprayed on the soil per hectare basis (Volume of the spray solution used was 2250 liters per ha) by using power sprayer except the phorate 10 G, where in, chemical was broadcasted by mixing with sand at 1:10 ratio. During the second spray, aqueous solution of chlorpyriphos 20 EC, emamectin benzoate 5% SG, imidacloprid 17.8 SL, fipronil 5 SC and chlorantraniliprole 18.5% SC were drenched around the palm. The recommended dosage was applied per palm basis *i.e.,* 3 liter insecticidal solution around 1feet distance from the base of palm through hole made by a crowbar. Granular insecticide *i.e*., phorate 10 G (25 g per palm) was applied in a small pit made around the palm and then covered with soil. After first application, the observations were recorded by digging the soil in between the palms in an area of 0.5 X 0.5 m and at base of the tree (around the palm by digging the palm to a depth of 60cm, 30cm away from the base) in randomly selected 15 palms per treatment. Larval counts were taken in between and around the palm before and 60 days after treatment. Second application *i.e.*, drenching of insecticides around the palm targeting root zone was taken at 60 days after first treatment. Observation after second spray was recorded by digging the soil at the base of the tree (around the palm 30cm away from the palm to a depth of 60cm and width of 30 cm) at 105 days after first treatment imposition (*i.e.*, 45 days after second treatment). The data were subjected to square root transformation and means were compared using critical difference (CD p=0.05). Mean data of both the location was pooled and

Table 1. Efficacy of insecticide molecules against *Leucopholis lepidophora* on areca nut under field conditions at location I (Gulukoppa, Hosanagara)

Treatment	Mean number of grubs per sample** (15 samples per treatment)							
	I treatment (in between the palm)*			I treatment (around the palm)*			II treatment (around the palm)*	
	DBT	60 DAT	Reduction (%)	DBT	60 DAT	Reduction (%)	105 DAT	Reduction (%)
Chlorpyriphos 20EC 5 l/ha	0.20 (0.83)	0.20[a] (0.83)	14.29	0.60 (1.03)	0.33[a] (0.90)	44.44	0.13[a] (0.79)	73.33
Chlorpyriphos 20EC 10 l/ha	0.40 (0.94)	0.07[a] (0.75)	85.71	0.47 (0.98)	0.27[a] (0.87)	42.86	0.07[a] (0.75)	83.33
Fipronil 5SC 2.5 l/ha	0.13 (0.79)	0.07[a] (0.75)	64.29	0.60 (1.05)	0.33[a] (0.91)	44.44	0.07[a] (0.75)	86.66
Imidacloprid 17.8SL 1l/ha	0.20 (0.83)	0.07[a] (0.75)	71.43	0.60 (1.03)	0.40[a] (0.92)	33.33	0.07[a] (0.75)	88.88
Emamectin benzoate 5% SG 250g/ha	0.20 (0.82)	0.20[a] (0.83)	14.29	0.47 (0.97)	0.40[a] (0.95)	14.29	0.20[a] (0.83)	66.66
Phorate 10G 25Kg/ha	0.33 (0.89)	0.20[a] (0.83)	48.57	0.33 (0.89)	0.27[a] (0.87)	20.00	0.13[a] (0.79)	66.66
Chlorantraniliprole 18.5%SC 658ml/ha	0.53 (1.01)	0.07[a] (0.75)	89.29	0.53 (1.00)	0.33[a] (0.91)	37.50	0.07[a] (0.75)	86.66
Untreated check	0.40 (0.94)	0.47[b] (0.98)	0.00	0.40 (0.94)	0.40[a] (0.94)	0.00	0.60[b] (1.04)	0.00
CD (p=0.05)	0.20	0.18		0.28	0.19		0.13	
CV%	13.15	12.17		15.96	11.70		9.31	
SEm±	0.07	0.06		0.09	0.06		0.04	

DBT- Day before treatment, DAT - Days after treatment; Figures in the parentheses are $\sqrt{X}$+0.5 transformed value; 3 replications per treatment

*First treatment was given as spray to entire area and second was given only to root zone after 60 days of first treatment

** Area sampled in each replication : for observation in between the palms - 0.5m (L) x 0.5m (B) x 60cm depth in middle of four palms

: for observation around the palm - 30cm away from the palm to a depth of 60cm and width of 30cm

analyzed to further strengthen the results.

RESULTS AND DISCUSSION

In the first location (Gulukoppa, Hosanagara taluk), the results indicated that 60 days after treatment imposition the highest larval reduction in between the palms was observed in chlorantraniliprole 18.5% SC 658ml/ha (89.29%) which was followed by chlorpyriphos 20 EC 10 l/ha. However, observation around the palm, both chlorpyriphos 20 EC 10 l/ha and fipronil 5 SC 2.5 l/ha (44.44%) gave highest larval reduction. Least larval reduction was noticed in emamectin benzoate 5% SG 250g/ha (14.29%). In the second treatment, drenching was done around the palm. Least larval reduction was observed in emamectin benzoate 5% SG 250g/ha and Phorate 10G 25Kg/ha (66.66% each) treated areca nut palm at 105 days after treatment imposition. However, highest larval reduction were noticed in imidacloprid 17.8 SL 1 l/ha (88.88%) over untreated check followed by fipronil 5 SC 2.5 l/ha and chlorantraniliprole 18.5% SC 658ml/ha (86.66% each).

In the second location (Harakere, Shivamogga taluk), the highest larval reduction in between the palms were observed at 60 days after imposition of treatment over untreated check in chlorantraniliprole 18.5% SC 658ml/ha (87.01%). Whereas, phorate 10G 25Kg/ha and chlorpyriphos 20 EC 5 l/ha (52.38% each) gave minimum reduction. Observation around the palm, at 60 days after treatment imposition indicated, maximum reduction in larval population in imidacloprid 17.8 SL 1 l/ha (85.71%). Minimum reduction was observed in emamectin benzoate 5% SG 250g/ha (33.33 %). During second treatment, observation at 105 days after treatment imposition, least percent reduction was observed in emamectin benzoate 5% SG 250g/ha (16.67%). Whereas, imidacloprid 17.8

Table 2. Efficacy of insecticide molecules against *Leucopholis lepidophora* on areca nut under field conditions at location II (Harakere, Shivamogga)

Treatment	Mean number of grubs** (15 samples per treatment)							
	I treatment (in between the palm)*			I treatment (around the palm)*			II treatment (around the palm)*	
	DBT	60 DAT	Reduction (%)	DBT	60 DAT	Reduction (%)	105 DAT	Reduction (%)
Chlorpyriphos 20EC 5 l/ha	0.40 (0.94)	0.13[a] (0.79)	52.38	0.33 (0.90)	0.20[a] (0.83)	40.00	0.07[a] (0.79)	44.44
Chlorpyriphos 20EC 10 l/ha	0.33 (0.91)	0.07[a] (0.75)	71.43	0.60 (1.05)	0.13[a] (0.79)	77.78	0.00[a] (0.71)	100.00
Fipronil 5SC 2.5 l/ha	0.53 (1.02)	0.07[a] (0.75)	82.14	0.47 (0.97)	0.20[a] (0.83)	57.14	0.00[a] (0.71)	100.00
Imidacloprid 17.8SL 1l/ha	0.47 (0.98)	0.07[a] (0.75)	79.59	0.93 (1.19)	0.13[a] (0.79)	85.71	0.00[a] (0.71)	100.00
Emamectin benzoate 5%SG 250g/ha	0.53 (1.00)	0.20[a] (0.83)	46.43	0.40 (0.94)	0.20[a] (0.82)	33.33	0.13[a] (0.79)	16.67
Phorate 10G 25Kg/ha	0.40 (0.92)	0.13[a] (0.79)	52.38	0.67 (1.08)	0.20[a] (0.83)	70.00	0.07[a] (0.75)	44.44
Chlorantraniliprole 18.5%SC 658ml/ha	0.73 (1.11)	0.07[a] (0.75)	87.01	0.60 (1.05)	0.33[a] (0.91)	66.67	0.07[a] (0.75)	44.44
Untreated check	0.67 (1.08)	0.47[b] (0.98)	0.00	0.33 (0.91)	0.40[a] (0.94)	0.00	0.20[b] (0.84)	0.00
CD (p=0.05)	0.23	0.14		0.24	0.22			0.11
CV%	13.07	10.57		13.51	14.45			9.04
SEm ±	0.08	0.05		0.08	0.07			0.03

DBT- Day before treatment, DAT- Days after treatment; Figures in the parentheses are $\sqrt{X}$+0.5 transformed value; 3 replications per treatment

*First treatment was given as spray to entire area and second was given only to root zone after 60 days of first treatment

** Area sampled in each replication : for observation in between the palms - 0.5m (L) x 0.5m (B) x 60cm depth in middle of four palms

: for observation around the palm - 30cm away from the palm to a depth of 60cm and width of 30cm

SL 1 l/ha, fipronil 5 SC 2.5 l/ha, chlorantraniliprole 18.5% SC 658ml/ha, chloropyriphos 20 EC 10 l/ha and phorate 10G 25Kg/ha gave 100 percent reduction (Table 2).

Pooled analysis

At 60 days after first treatment, the lowest of larval reductionin between the palms was recorded in chloropyriphos 20 EC 5 l/ha (36.51%) followed by emamectin benzoate 5% SG 250 g/ha 37.66%) and phorate 10G 25 Kg/ha (48.05%). Highest larval reduction was noticed in chlorantraniliprole 18.5% SC 658ml/ha (87.97%) followed by chloropyriphos 20 EC 10 l/ha (79.22%), imidacloprid 17.8 SL 1 l/ha and fipronil 5 SC 2.5 l/ha (77.14%) (Table 3).

Sixty days after first treatment, the lowest larval reduction around the palm was recorded in emamectin benzoate 5% SG 250g/ha (23.08%) followed by chloropyriphos 20 EC 5 l/ha (42.86%) and fipronil 5 SC 2.5 l/ha (50.00%). Maximum reduction was recorded in imidacloprid 17.8 SL 1 l/ha (65.22%) followed by chloropyriphos 20 EC 10 l/ha (62.50%), phorate 10G 25 Kg/ha (53.33%) and chlorantraniliprole 18.5% SC 658ml/ha (52.94%).

During second treatment, observation of 105 days after treatment imposition, highest larval reduction was recorded in imidacloprid 17.8 SL 1 l/ha and fipronil 5 SC 2.5 l/ha (88.54%) followed by chloropyriphos 20 EC 10 l/ha (84.72%), chlorantraniliprole 18.5% SC 658ml/ha (77.08 %). Lowest larval reduction was observed in emamectin benzoate 5% SG 250g/ha (54.16 %) followed by chloropyriphos 20 EC 5 l/ha (65.62%) and phorate 10G 25 Kg/ha (60.71%) (Table 3).

Table 3. Efficacy of insecticide molecules against *Leucopholis lepidophora* on areca nut under field conditions (Pooled analysis)

Treatment	Mean number of grubs** (15 samples per treatment)							
	I treatment (in between the palm)*			I treatment (around the palm)*			II treatment (around the palm)*	
	DBT	60 DAT	Reduction (%)	DBT	60 DAT	Reduction (%)	105 DAT	Reduction (%)
Chlorpyriphos 20EC 5 l/ha	0.30 (0.89)	0.17[a] (0.81)	36.51	0.47 (0.98)	0.27[a] (0.87)	42.86	0.10[a] (0.77)	65.62
Chlorpyriphos 20EC 10 l/ha	0.37 (0.93)	0.07[a] (0.75)	79.22	0.53 (1.02)	0.20[a] (0.84)	62.50	0.03[a] (0.73)	84.72
Fipronil 5SC 2.5 l/ha	0.33 (0.91)	0.07[a] (0.75)	77.14	0.53 (1.01)	0.27[a] (0.87)	50.00	0.03[a] (0.73)	88.54
Imidacloprid 17.8SL 1l/ha	0.33 (0.91)	0.07[a] (0.75)	77.14	0.77 (1.13)	0.27[a] (0.86)	65.22	0.03[a] (0.73)	88.54
Emamectin benzoate 5%SG 250g/ha	0.37 (0.93)	0.20[a] (0.84)	37.66	0.43 (0.96)	0.33[a] (0.91)	23.08	0.17[a] (0.81)	54.16
Phorate 10G 25Kg/ha	0.37 (0.92)	0.17[a] (0.81)	48.05	0.50 (1.00)	0.23[a] (0.85)	53.33	0.10[a] (0.77)	60.71
Chlorantraniliprole 18.5%SC 658ml/ha	0.63 (1.06)	0.07[a] (0.75)	87.97	0.57 (1.02)	0.27[a] (0.87)	52.94	0.07[a] (0.75)	77.08
Untreated check	0.53 (0.01)	0.47[b] (0.98)	0.00	0.37 (0.93)	0.37[a] (0.93)	0.00	0.40[b] (0.94)	0.00
CD (p=0.05)	0.17	0.11		0.16	0.14		0.08	
CV%	9.96	7.52		9.22	8.81		6.35	
SEm ±	0.05	0.04		0.05	0.04		0.03	

DBT- Day before treatment, DAT- Days after treatment; Figures in the parentheses are $\sqrt{X}+0.5$ transformed value; 3 replications per treatment

*First treatment was given as spray to entire area and second was given only to root zone after 60 days of first treatment

** Area sampled in each replication : for observation in between the palms - 0.5m (L) x 0.5m (B) x 60cm depth in middle of four palms

: for observation around the palm - 30cm away from the palm to a depth of 60cm and width of 30cm

Among the different newer chemicals tested, chlorantraniliprole 18.5% SC 658ml/ha was found to be effective in reducing the early instar root grub population at both the locations. After the 105 days of treatment imposition in both the locations imidacloprid 17.8 SL 1 l/ha and fipronil 5 SC 2.5 l/ha followed by chloropyriphos 20 EC 10 l/ha and chlorantraniliprole 18.5% SC 658ml/ha gave good reduction over the untreated check. That means, these insecticides are effective for later instars also. The efficacy of chemicals such as imidacloprid 17.8 SL, phorate 10G, chlorpyriphos 20 EC and carbofuran 3G have been evaluated against *Leucopholis lepidophora* Blanch and found effective (Channakeshava *et al.*, 2010). They reported that the imidacloprid 17.8 SL @ 6 ml/palm had given maximum mortality of 96.12 and 95.14 percent in the two different location of the experiment. Prabhu *et al.* (2011) reported that, chlorpyriphos 20 EC at the rate of 6 ml per palm was highly effective with 77.36 percent followed by phorate 10G at the rate of 25 g per palm with 68.13 percent mortality of grub. According to the reports of Subaharan *et al.* (2001), chlorpyriphos @ 8 ml/palm and carbosulfan @ 10 g/palm against areca nut root grub, *L. lepidophora* caused > 60% reduction of grub population. However, the methodology they followed was different compared to the present investigation, where they applied chemical only once during September. In our study, up to 80% reduction over control was observed mainly due to different methodology/spray schedule adopted for imposition of treatments.

There was a variation in reduction of larval population across two different locations after insecticidal application. These variations may be due to soil properties, percolation power of the chemicals in soil, residual effect of chemicals and also variation in microclimate of the garden. The study conclusively demonstrated that soil drenching of insecticides twice which is based on the biology of the insect targeting both early instars and later instars was effective than the traditional practice of single time application or untimely application. The study showed that the timing is crucial in reducing the grub population.

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REFERENCES

Adarsha, S. K., Kalleshwaraswamy, C. M., and Pavithra, H. B. 2015. Effect of insecticides on soil arthropods and earth worms in areca nut ecosystem. *International Journal of Agriculture Sciences*, **7**(4): 482-486

Channakeshava, A. 2006. Bio-ecology and management of arecanut root grubs with special reference to *Leucopholis lepidophora* Blanch. M.Sc. (Agri.) Thesis, University of Agricultural Sciences, Bangalore (India).

Prabhu, S. T., Rakesha, H. S. and Balikai, R. A. 2011. Field evaluation of fungal pathogens and plant extracts against arecanut root grub, *Leucopholis lepidophora* Blanchard. *Pest Management in Horticultural Ecosystems*, **17**(2):75-79.

Prakash, K. V., Kumar, A. R. V. and Ravikumar, B. 2011. Pest management practices of arecanut farmers against *Leucopholis* spp. (Coleoptera: Scarabaeidae) in karnataka. (In).Insect Pest Management, A Current Scenario, 2011 (eds) Dunston P. Ambrose, Entomology Research Unit, St. Xavier's College, Palayamkottai, India, pp. 558-563

Kalleshwaraswamy, C. M., Adarsha, S. K., Naveena N. L. and Sharanabasappa 2015. Incidence of arecanut white grubs (*Leucopholis* spp.) in hilly and coastal regions of Karnataka, India. *Current Biotica*, **8**: 423-424

Kumar, A. R. V. 1997. Bioecology and management of arecanut white grubs, *Leucopholis* spp. (Coleoptera: Scarabaeidae) in Karnataka. Ph.D. Thesis, University of Agricultural Sciences, Bengaluru (India).

Subaharan, K., Vidyasagar, P. S. P. V. and Mohammed Basher, B. M. 2001. Bioefficacy of insecticides against white grub, *Leucopholis lepidophora* Blanch infesting Arecanut Palm. *Indian Journal of Plant Protection*, **29**(1 and 2): 25-29.

Veeresh, G. K., Vijayendra, M., Reddy, N. V. M. and Rajanna, C. 1982. Bio-ecology and management of areca nut white grubs (*Leucopholis* spp.*)* (Coleoptera; Scarabaeidae: Melolonthinae). *Journal of Soil Biology and Ecology*, **2**(2): 78-86.

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