



## Field evaluation of fungal pathogens and plant extracts against arecanut root grub, *Leucopholis lepidophora* Blanchard.

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**ABSTRACT :** Field evaluation of bioagents and plant products was carried out for three consecutive years during 2006-08 against root grub, *Leucopholis lepidophora* Blanchard at Sirsi, Karnataka, India. The results revealed that, chlorpyrifos 20 EC at the rate of 6 ml per palm was highly effective treatment with 77.36 per cent mortality of grubs and was significantly superior over all other treatments. The next best treatment was phorate 10G at the rate of 25 g per palm with 68.13 per cent mortality of grubs. Among the plant products, aqueous mixture of soapnut and neem oil at the rate of 10 percent emerged as next best treatment with 53.71 per cent mortality and was on par with its lower dosage *i.e.*, aqueous mixture of soapnut and neem oil (5%) with 49.93 per cent mortality. The results of the large scale trials conducted over two locations during 2009 revealed that, the eco-friendly treatment *viz.*, aqueous mixture of soapnut and neem oil at the rate of (5%) recorded 53.55 per cent mortality as compared with the best chemical treatment *viz.*, chlorpyrifos 20 EC at the rate of 6 ml per palm (63.95 % mortality). Thus, this botanical could be used in field to combat the pest and it will be effective up to 60 days. Among the two mycopathogens under study at two different dosages, *Metarhizium anisopliae* with  $2 \times 10^8$  conidia per g at the rate of 20 g per palm recorded the mortality (31.38%) similar to that of aqueous strychnine seed extract at the rate of 5 percent (31.64 %). As there is a overlapping of generations in field, it is advisable to incorporate the fungus culture with the onset of monsoon, when beetles emerge in large numbers and lay eggs.

**Keywords:** Arecanut, *Leucopholis lepidophora*, Soapnut and neem oil (5%), *Metarhizium anisopliae*, Strychnine seed extract

### INTRODUCTION

Arecanut (*Areca catechu* L.) or betelnut is mainly used for masticatory purpose and as a consecratory product in several religious ceremonies. Apart from that arecanut is being used in ayurvedic medicines. 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. 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, 1999). Padmanaban and Daniel (2003) reported the natural incidence of *Metarhizium* spp. and other entomopathogenic fungus on 1, 2, 3<sup>rd</sup> instar grubs and pre pupae of *Leucopholis burmeisteri* Brenske and *L. coneophora* Burmeister in endemic areas of Kerala. To combat this pest usually insecticides are recommended, prolonged dumping of chemical not only

causes soil pollution but also has deleterious effect on soil fauna and flora. Hence, a study was undertaken under field conditions during 2006-08 to evaluate environment friendly approaches to tackle this pest with entomopathogens like *Metarhizium anisopliae* (Metsch.) Sorokin and *Beauveria brongniartii* (Saccardo) Petch and plant products like soapnut (*Sapindus emarginatus* Vahl: Sapindaceae) with neem oil (*Azadirachta indica* A. Juss.) and strychnine (*Strychnos nux-vomica* L.: Loganiaceae, commonly used as fish bait).

### MATERIALS AND METHODS

Field trials on evaluation of bioagents and plant products were carried out for three consecutive years during 2006-08 in already infested arecanut garden at Mavinakoppa village near Sirsi. The trials were laid out in Randomized Block Design with eleven treatments (Table 1) replicated thrice. In each treatment three arecanut trees of eighteen years old were selected and labelled on tree trunks with paint. Each tree was observed for the larval population in the root zone and it was regulated to ten grubs per palm either by releasing or removing the grubs artificially.

## Fungal pathogens and plant extracts against arecanut root grub

Fungal pathogen treatments were applied at the root zone of arecanut palm along with vermicompost according to the respective dosages. *M. anisopliae* was procured from the Department of Agricultural Entomology, College of Agriculture, University of Agricultural Sciences, Dharwad. Another fungal pathogen, *B. brongniartii* was procured from a private firm, Pest Control of India, Bangalore.

Both plant product extracts were prepared afresh before imposition of treatments. Aqueous extract of Strychnine seeds was prepared in two concentrations of five and ten per cent. Required quantity of Strychnine seeds were ground into coarse powder and the powder was tied in a thin cotton cloth and immersed in water for twelve hours at room temperature. Solution was filtered and applied to the root zone of arecanut by drenching the soil around the tree trunk.

Aqueous extract of soapnut was first prepared separately by soaking the dry soapnut fruits in water for 72 hours. Later, the soaked fruits were squeezed thoroughly to get profuse frothing. The solution was filtered and readily available neem oil was mixed and stirred well. Two concentrations of five and ten per cent solutions were prepared. To prepare five per cent solution, 500 g of dry fruits were soaked in 2.5 litres of water and mixed with 500 ml of neem oil and volume made up to 10 litres. Ready solution was applied to the soil in root zone of arecanut tree by drenching around the tree trunk.

In case of Chlorpyrifos 20 EC, 3 ml of insecticide formulation in one litre of water was prepared and such two litres of solution was drenched to the soil around the tree. Phorate 10 G granules were applied at the rate of 25 g per palm by broadcasting at the base of the tree.

Observation on larval mortality was recorded by digging the soil at the base of tree and counting the grubs. Observations were recorded at 60 days after imposition of treatments. Data on per cent mortality was subjected to Arcsine transformation. The treatment means were compared by using Duncan's Multiple Range Test (DMRT).

Further, two large scale trials were conducted during 2009 one each on 1.5 acre area at Devanalli and Mavinakoppa villages near Sirsi with two treatments. Based on the results of three years trial, the eco-friendly treatment *viz.*, aqueous mixture of soapnut and neem oil at the rate of 5 percent was compared with the best chemical treatment *viz.*, chlorpyrifos 20 EC at the rate

of 6 ml per palm. Each treatment comprised of 0.75 acre plantation.

## RESULTS AND DISCUSSION

Chlorpyrifos 20 EC at the rate of 6 ml per palm proved to be highly effective treatment with 83.33 and 78.67 per cent mortality of grubs during 2006 and 2007, respectively and was significantly superior over all other treatments. During 2008 also, chlorpyrifos 20 EC at the rate of 6 ml per palm recorded highest mortality of 69.30 per cent but was on par with phorate 10 G at the rate of 25 g per palm with 62.85 per cent mortality (Table 1). Among the plant products, aqueous mixture of soapnut and neem oil at the rate of 10 percent emerged as next best treatment with 58.33, 52.67 and 50.46 per cent mortality and was on par with its lower dosage *i.e.*, aqueous mixture of soapnut and neem oil at the rate of 5 percent with 50.00, 52.33 and 45.70 per cent mortality during 2006, 2007 and 2008, respectively. Aqueous mixture of soapnut and neem oil at the rate of 5 percent was superior to aqueous strychnine seed extract at the rate of 10 percent during 2006 and 2007 while both were on par with each other during 2008.

The results over three years were almost consistent. The mean pooled data reveals that, chlorpyrifos 20 EC at the rate of 6 ml per palm was highly effective treatment with 77.36 per cent mortality of grubs and was significantly superior over all other treatments. The next best treatment in this respect was phorate 10G at the rate of 25 g per palm with 68.13 per cent mortality of grubs. The results are in line with Subaharan *et al.* (2001) who reported that chlorpyrifos at the rate of 8 ml per palm and carbosulfan at the rate of 10 g per palm caused more than 60 per cent reduction in grub population during both the years of study. Further, they also reported that the standard check insecticide phorate at the rate of 10 g per palm caused a mean reduction of 36.43 and 44.00 per cent during first and second years of study respectively. The results of the present investigation also corroborate with the reports of Channakeshavamurthy *et al.* (2010) who documented that chlorpyrifos 20 EC at the rate of 12 ml per palm (93.71 and 93.10 % mortality) and phorate at the rate of 25 g per palm (88.69 and 90.77 % mortality) were effective against arecanut root grubs, *L. lepidophora* in both the test locations. Similarly, Kumar (1999) reported 62.39 and 75.22 per cent reduction in third instar grubs of *L. lepidophora* population with the application of chlorpyrifos 20 EC at the rate of 5 litre per ha and phorate 10 G at the rate of 30 kg per ha, respectively. Similar results were

reported by Rakesha *et al.* (2011) under laboratory conditions.

Among the plant products, aqueous mixture of soapnut and neem oil at the rate of 10 percent emerged as next best treatment with 53.71 per cent mortality and was on par with its lower dosage *i.e.*, aqueous mixture

of soapnut and neem oil at the rate of 5 percent with 49.93 per cent mortality. Another plant product *viz.*, aqueous strychnine seed extract at the rate of 10 percent (43.97% mortality) was superior to its lower dosage *i.e.* aqueous strychnine seed extract at the rate of 5 percent (31.64% mortality) and was on par with aqueous mixture of soapnut and neem oil at the rate of 5 percent (49.93%

**Table 1. Efficacy of biopesticides and plant extracts in the management of arecanut root grub, *Leucopholis lepidophora***

Tr. No.	Treatment	Larval mortality at 60 DAT (%)			
		2006	2007	2008	Mean
1	<i>Metarhizium anisopliae</i> with 2 x 10 <sup>8</sup> conidia/g at the rate of 10 g/palm	3.33 (9.61)g	4.43 (12.15)fg	5.41 (13.45)e	4.24 (11.84)g
2	<i>Metarhizium anisopliae</i> with 2 x 10 <sup>8</sup> conidia/g at the rate of 20 g/palm	26.67 (31.06)e	28.00 (31.95)e	39.71 (39.06)c	31.38 (34.06)e
3	<i>Beauveria brongniartii</i> with 2 x 10 <sup>8</sup> conidia/g at the rate of 10 g/palm	8.33 (16.59)f	8.67 (17.14)f	10.73 (19.13)d	9.19 (17.64)f
4	<i>Beauveria brongniartii</i> with 2 x 10 <sup>8</sup> conidia/g at the rate of 20 g/palm	4.67 (12.76)fg	10.67 (19.07)f	11.39 (19.72)d	8.78 (17.25)f
5	Aqueous Strychnine seed extract at the rate of 5%	33.33 (35.24)de	29.00 (32.57)e	32.63 (34.84)c	31.64 (34.22)e
6	Aqueous Strychnine seed extract at the rate of 10%	40.00 (39.20)d	45.67 (42.52)d	46.31 (42.88)b	43.97 (41.53)d
7	Aqueous mixture of Soapnut and neem oil at the rate of 5%	50.00 (45.94)c	52.33 (46.33)c	45.70 (42.53)b	49.93 (44.97)cd
8	Aqueous mixture of Soapnut and neem oil at the rate of 10%	58.33 (49.78)c	52.67 (46.53)c	50.46 (45.26)b	53.71 (47.12)c
9	Chlorpyrifos 20EC at the rate of 6 ml/palm	83.33 (65.93)a	78.67 (62.49)a	69.30 (56.35)a	77.36 (61.59)a
10	Phorate 10G at the rate of 25 g/palm	73.33 (58.91)b	68.00 (55.55)b	62.85 (52.44)a	68.13 (55.63)b
11	Untreated Check	0.00 (0.00)h	0.67 (4.70)g	0.79 (5.10)f	0.43 (3.46)h
	S.Em.±	2.83	2.38	2.54	1.80
	C.D. at 5%	8.50	7.03	7.50	5.31
	C.V. (%)	12.85	11.99	12.91	10.32

Figures in the parentheses are arc sine values

Means showing similar alphabets in a column do not differ significantly by DMRT  
DAT – Days after treatment

**Table 2. Results of large scale trials on the management of arecanut root grub, *Leucopholis lepidophora***

Tr. No.	Treatment	Per cent larval mortality		Mean per cent larval mortality
		Area: 1.5 acre Farmer: Divakar Village: Devanalli (Taluk- Sirsi)	Area: 1.5 acre Farmer: Shripathy Bhat Village: Mavinakoppa (Taluk- Sirsi)	
T <sub>1</sub>	Aqueous extract of soapnut + neem oil at the rate of 5%	55.80	51.30	53.55
T <sub>2</sub>	Chlorpyriphos 20EC at the rate of 6 ml/palm	65.60	62.30	63.95

mortality) (Table 1). Similarly, Rakesha *et. al.* (2011) reported that, aqueous mixture of soapnut and neem oil at the rate of 5 and 10 percent recorded 59.26 and 70.37 per cent mortality, respectively and differed significantly from each other. Further, Aqueous strychnine seed extract at the rate of 5 and 10% recorded 48.14 and 66.66 per cent mortality, respectively and differed significantly from each other under laboratory conditions. Subaharan *et al.* (2001) reported that field evaluation of neem cake at the rate of 1000 kg/ha against arecanut root grub, *L. lepidophora* caused reduction of 21 and 34 per cent. According to the reports of Channakeshavamurthy *et. al.* (2010) the neem cake at the rate of 1 kg per palm was not satisfactory with 17.39 and 14.21 per cent mortality of arecanut root grubs in both the test locations. Padmanaban *et al.* (1997) reported that Karanj oil cake and leaf powder of *Vitex negundo* L. treatments gave the highest mortality *L. burmeisteri*.

Among the two mycopathogens under study at two different dosages, *M. anisopliae* with  $2 \times 10^8$  conidia per g at the rate of 20 g per palm recorded the mortality (31.38%) similar to that of aqueous strychnine seed extract at the rate of 5 percent (31.64 %). Among the bio agents *M. anisopliae*  $2 \times 10^8$  conidia/g at the rate of 20 g per palm recorded 31.38 per cent mortality of third instar grubs. As there is a overlapping of generations in field, it is advisable to incorporate the fungus culture with the onset of monsoon, when beetles emerge in large numbers and lay eggs. As the early instar feeds on decaying matter and more susceptible to the pathogen, will be easily infected and further the pathogen multiplies in the soil because of early infection and helps to build up the soil inoculums. This will help to take care of older larvae which require higher inoculums. Samson *et al.* (1999) reported that the number of white grubs (*Dermolepida* spp.) on sugarcane were consistently

reduced by more than 50 per cent when spores of *M. anisopliae* (F1-1045) together with rice medium were applied at the rate of 33 kg per ha. Further, a granulated formation of *M. anisopliae* (ZBW 9501) when applied at the rate of  $8.3 \times 10^{12}$  conidia per ha had no major impact on the pest and it was concluded that, the poor efficacy of fungus in field was mainly because of poor virulence and poor epizootic potentiality of the isolate. Hajeri (2003) reported that field evaluation of *M. anisopliae* (Ma-1) at the rate of  $2 \times 10^{13}$  conidia per ha recorded 60.06 per cent reduction in third instar grub population at 60 DAT in arecanut ecosystem was next best to chlorpyriphos 20EC drenching at the rate of 5 l/ha. Rachappa (2004) reported that among different dosages of *M. anisopliae* evaluated against sugarcane root grub at Sankeshwar, Karnataka the higher dosage of *M. anisopliae* (Ma-2) at the rate of  $1 \times 10^{13}$  conidia per ha was found as effective as chlorpyriphos at the rate of 5 litre per ha. Channakeshava (2006) reported that *M. anisopliae*  $2 \times 10^8$  conidia per gram at the rate of 1.1 kg per acre gave 50.97 per cent mortality of *L. lepidophora* in arecanut ecosystem. Channakeshavamurthy *et. al.* (2010) reported that the fungus, *M. anisopliae* was moderate in causing mortality of arecanut white grubs, *L. lepidophora* (60.94 and 50.97 %) in both the locations tested. Similar results were reported by Rakesha *et. al.* (2011) under laboratory conditions.

The ineffective treatments included *B. brongniartii* with  $2 \times 10^8$  conidia/g at the rate of 10 g/palm, *B. brongniartii* with  $2 \times 10^8$  conidia/g at the rate of 20 g/palm and *M. anisopliae* with  $2 \times 10^8$  conidia per g at the rate of 20 g per palm with 9.19, 8.78 and 4.24 per cent mortality, respectively (Table 1).

The results of the large scale trials conducted over two locations revealed that, the eco-friendly treatment viz., aqueous mixture of soapnut and neem oil at the rate

of 5 percent recorded 53.55 per cent mortality as compared with the best chemical treatment *viz.*, chlorpyrifos 20EC at the rate of 6 ml per palm (63.95 % mortality) (Table 2). Thus, this botanical could be used in field to combat the pest and it will be effective up to 60 days. Apply this aqueous extract once during 1<sup>st</sup> week of July and second time during September last week based on the grub load in the field.

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