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Pesticidal effect of leaf, root and bark extracts of multipurpose trees and cashew nut shell liquid on coconut root grub (*Leucopholis coneophora* Bur.)

Keywords: Ailanthus, cashew nut shell liquid, coconut root grub, extract, mortality, phenol, tannin

Plant protection against pests continues to rely heavily upon pesticides. The use of botanicals for protecting crops from insect pests has assumed great importance in recent years due to the growing awareness of harmful effects of indiscriminate use of pesticides like toxicity to non-target organisms, development of insecticide resistance in pests and consequent pest resurgence, environmental pollution and health hazards associated with pesticide residues.

The coconut root grub (*Leucopholis coneophora*), also known as white grub or cockchafer beetle, has become a serious pest of agricultural crops in different parts of India. Instances of the *Leucopholis* species being destructive in coconut and arecanut growing areas in South India have been recorded (Kurian and Abdulla, 1974; Yadava and Mathur, 1987). At present, the control measure recommended (KAU, 2007) and widely adopted against the coconut root grub is repeated application of insecticides. Alternate and safer methods of controlling the pest have evoked interest recently. Effective control of several insect pests using botanicals have been reported (Chiu, 1993; Krishnaprasad *et al*., 1993). The multipurpose trees planted in coconut based farming systems contain several phytochemicals with insecticidal properties (Duke, 1992). The allelopathic effect of multipurpose trees on crops has already been revealed (Suresh and Rai, 1988). The present study was undertaken to assess the influence of leaf, bark and root extracts of certain multipurpose trees and cashew nut shell liquid in curtailing the attack of coconut root grub at the College of Agriculture, Padannakkad, Kasaragod, North Kerala during August to November 2003. The average ambient temperature during the period ranged from a minimum of 21.0 ^{o}C to a maximum of 32.3 ^{o}C.

For preparing extracts, fresh green leaves, bark and roots of fully-grown mature trees viz., jack (*Artocarpus heterophyllus* Lam.), mango (*Mangifera indica* L.), *Ailanthus*/matty (*Ailanthus triphysa* Dennst.), cashew (*Anacardium occidentale* L.), tamarind (*Tamarindus indica* L.), teak (*Tectona grandis* L.F.), portia (*Thespesia populnea* (L.) Soland.), *Casuarina* (*Casuarina equisetifolia* J.R. & G. Forst.), Glyricidia (*Gliricidia sepium* (Jacq.) Steud.) and *Strychnos* (*Strychnos nux-vomica* L) were collected, cleaned and air-dried to uniform moisture content. Leaves were selected from different parts of the tree (lower, middle and top portions) to get a representative sample of the entire tree canopy. The bark was collected by scraping from the intact mature trees. Fresh roots were collected by excising from the trees. Contaminants like adhering soil/dust particles etc. were removed from the plant sample by carefully wiping with a cloth. Roots collected from the field were washed gently with tap water only for few seconds, followed by quick rinsing in distilled water. Thereafter, it was dried by shaking vigorously with hand and then wiped gently dry with absorbent paper.

Extracts of leaf (10, 20, 25, 40 and 50 %), bark (10 and 20 %) and root (10 and 20%) of the trees were prepared by blending the plant material (leaf/bark/root) with distilled water in required weight/volume ratio in blender (eg. for preparing 10 % extract, ratio of weighed plant material to distilled water is 1:10 w/v). The extracts were filtered through Whatman Number 1 filter paper.

Rectangular plastic containers (15 cm length, 12 cm breadth and 5 cm depth) capable of holding 750 g air-dry soil were filled with sandy soil (in which the coconut root grub inhabited normally in the study area)

exposed to sunlight for one week to eliminate any allelochemicals (especially volatile) present (Patil *et al*., 2002). Before filling, the soil was sieved and checked to ensure that it was free from root grub larvae or any other insects.

The second instar larvae of root grub was collected from the field and in each container one larva was introduced and reared. Small pieces of sweet potato tuber, incorporated in the soil, served as source of food for the larva. The grub was allowed to stabilize for 2-3 days. Before applying the treatments, it was ensured that the introduced larva was alive.

In each container, the soil containing the grub was drenched with 50 ml of the filtered extract solution (leaf, bark, root i.e. according to the objective of experiment). In addition, a treatment with raw Cashew Nut Shell Liquid (CNSL) solution (5, 10, 20 and 25 % v/v) was also tried. The CNSL used for the study was collected in its raw form from the cashew-processing factory. While preparing the CNSL solution, a small piece of soap was added to ensure proper mixing with water. In the control, distilled water alone was added. Each treatment was replicated six times. The soil in the containers was examined everyday for ascertaining the mortality of the root grub. The data were subjected to analysis of variance for completely randomized design. The leaf, bark and root of the test trees were analysed for phenol and tannin content using standard procedures (Sadasivam and Manickam, 1992).

Leaf extracts of trees, at higher concentrations, caused severe mortality of root grub (Table 1). The mortality increased with increasing concentration of the extracts. At lower concentration (10%) portia, tamarind and *Strychnos* were most effective. At higher concentrations, all the trees cause high root grub mortality. *Ailanthus* leaf extracts (50 % concentration) resulted in mortality as high as 71 % and was on par with cashew, strychnos, mango, portia and tamarind. Cashew nut shell liquid (5–25 % concentration) caused 100 % mortality of the root grub larvae.

Table 1. Effect of leaf extract of trees and CNSL on mortality of coconut root grub larva (Concentration which gave highest mortality is only shown)

Treatments	Mortality (%)*	Treatment	Mortality (%)*
Ailanthus 40 %	49.84	Strychnos 40 %	54.69
Ailanthus 50 %	71.06	Strychnos 50 %	60.30
Cashew 40 %	49.84	Mango 40 %	54.69
Cashew 50 %	60.30	Mango 50 %	60.30
Casuarina 40 %	40.12	Portia 40 %	54.69
Casuarina 50 %	44.99	Portia 50 %	60.30
Gliricidia 40 %	35.24	Tamarind 40 %	44.96
Gliricidia 50 %	40.12	Tamarind 50 %	60.30
Jack 40 %	40.12	Teak 40 %	44.99
Jack 50 %	40.12	Teak 50 %	54.69
Control	1.15	Control	1.15
CNSL (5 - 25 %)	100 % mortality at all concentrations		
CD (P = 0.05)	16.57		

*CNSL: Cashew Nut Shell Liquid * values after angular (arc sine) transformation*

The effect of 10 % bark extract of all trees was on par with the control (Table 2). However, the 20 % bark extract of all trees, except portia, mango and *Strychnos*, resulted in significant larval mortality. Bark extract of *Ailanthus* at 20 % resulted in the highest mortality.

Table 2. Effect of bark and root extract of trees on mortality of coconut root grub larva

Treatments	Mortality (%)*	
	Bark	Root
Ailanthus 10%	24.08	24.08
Ailanthus 20%	44.99	35.24
Cashew 10%	12.61	12.61
Cashew 20%	40.12	24.08
Casuarina 10%	24.08	24.08
Casuarina 20%	35.24	35.24
Gliricidia 10%	24.08	24.08
Gliricidia 20%	35.24	49.84
Jack 10%	24.08	1.15
Jack 20%	35.24	12.61
Strychnos 10%	24.08	35.24
Strychnos 20%	24.08	40.12
Mango 10%	24.08	1.15
Mango 20%	29.66	35.24
Portia 10%	24.08	1.15
Portia 20%	24.08	24.08
Tamarind 10%	29.66	35.24
Tamarind 20%	35.24	77.38
Teak 10%	24.08	35.24
Teak 20%	40.12	44.99
Control	24.08	12.61
CD (P = 0.05)	9.971	15.364

**Angular (Arc sin) transformation*

The 10 % root extract of only tamarind, teak and *Strychnos* caused significant larval mortality (Table 2). However, at 20 %, root extract of all the trees, except cashew, jack and portia, caused significant larval mortality. Tamarind root extract caused maximum larval mortality (77 %) followed by *Gliricidia* (49 %) and teak (45 %).

The phenol and tannin content in leaf, bark and root of the test trees is furnished in Table 3. In general, the phenol and tannin content is relatively higher in leaves. In the present study, there is no significant correlation between the tannin/phenol content and the pesticidal effect. The pesticidal effect of *Ailanthus*, cashew, *Strychnos*, mango, portia and tamarind leaf extract was on par, despite the large variation in phenol and tannin content. Similarly, though root extract of tamarind shows high mortality (77 %) compared to *Ailanthus* (35 %) at 20 % concentration, the phenol and tannin content are almost equal in both trees. Hence, the pesticide activity is not exclusively due to the tannins or phenols, but perhaps due to numerous other phytochemicals present in the plant parts.

Table 3. Phenol and tannin content in leaf, bark and roots of the test trees

Tree	Phenol (%)			Tannin (%)		
	Leaf	Bark	Root	Leaf	Bark	Root
Ailanthus	16.8	0.62	0.49	6.20	1.44	0.59
Cashew	15.9	2.00	0.87	5.81	3.58	1.79
Casuarina	7.75	5.65	2.50	4.20	5.79	1.81
Gliricidia	0.79	0.75	0.32	2.18	1.13	0.59
Jack	3.80	0.64	0.85	3.58	1.21	0.80
Strychnos	2.80	0.86	0.50	3.30	1.89	0.84
Mango	7.79	2.70	11.5	4.99	5.84	3.73
Portia	2.30	1.15	1.35	1.86	1.20	1.21
Tamarind	3.25	5.75	0.49	1.88	4.33	0.47
Teak	0.93	1.65	1.00	1.78	2.44	0.80

Several phytochemicals have been identified in various plant parts of *Tamarindus indica* viz., alpha-terpineol, cinnamaldehyde, ethyl-cinnamate, galacturonic-acid, geraniol essential oil, limonene, linoleic acid, myristic acid, oleic acid, palmitic acid, pantothenic acid, phenol, pipecolinic acid, tannin and tartaric acid (Duke, 1992). Some of the chemicals present in *A. occidentale* plant include alpha-linolenic acid, anacardic acid, anacardol, beta sitosterol, capric acid, caprylic acid, cardanol, cardol, gadoleic acid, gallic acid, lauric acid, limonene, linoleic acid, naringenin, palmitic acid, squalene, tannin, and threonine (Duke, 1992). Tyman and Morris (1967) described the composition of cashew nut shell liquid (CNSL) as anacardic acid (71.7%), cardol (18.7%), cardanol (4.7%), novel phenol (2.7%), and two unknown minor ingredients (2.2%). The phytochemicals betulin and betulinic acid are present in teak plant (Duke, 1992). Fifteen toxic allelochemicals viz., gallic acid, protocatechuic acid, p-hydroxybenzoic acid, gentisic acid, beta-resorcyclic acid, vanillic acid, syringic acid, p-coumaric acid, m-coumaric acid, o-coumaric acid, ferulic acid, sinapinic acid (trans and cis forms), coumarin, and myricetin were identified in plant extracts of *Gliricidia sepium* (Ramamoorthy and Paliwal, 1993). Some of these chemicals present in the different plant parts of the trees are likely to be present in varying quantities in their leaves, bark and roots also. Considering the potential of leaf extracts of trees in root grub control, studies should be extended to isolation, and fractionation guided bioassays. The CNSL, traditionally obtained as a by-product during the isolation of cashew kernel by roasting the raw cashew nuts, is cheaply available. The non-phytotoxicity of CNSL (5 %) in pot culture with cowpea has been reported (Jacob *et al*., 2004).

The results highlight the potential of tree leaf extracts and CNSL for controlling the root grub, which is a major problem in several coconut and arecanut growing areas. The test trees are commonly planted in the coconut-based home gardens and hence, its leaves are readily available. However, further confirmatory field evaluation studies on potted coconut seedlings and in coconut gardens are needed, for which the results of this study will serve as a base.

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