



Novel frond injection method using cartap hydrochloride for the management of *Opisina arenosella*

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ABSTRACT

The present study was carried out at farmer's field at Halebudanur village in Mandya district in Karnataka, India during 2017–18. Frond injection method, a novel approach of insecticide administration into the coconut palm was applied using an eco-friendly and animal origin insecticide cartap hydrochloride (50% SP) against *Opisina arenosella* Walker. The results on absorption showed that all the dilutions of cartap hydrochloride (50% SP) injected to fronds were absorbed completely within 24 h and recorded 100 % larval mortality, 7 days after imposing injection and found superior over control. This method showed quicker and accurate absorption of insecticides into the coconut palm and did not cause any secondary infection of pathogen or mechanical injury to the frond tissues and can be useful on coconut palms.

Keywords: Cartap hydrochloride, Coconut palm, Frond injection

Coconut (*Cocos nucifera* L.), is a member of the family Arecaceae. It forms a regular part of diet in the tropical and sub-tropical countries. Coconut palm is reported to be infested by more than 100 of pest species (Nirula 1955). The caterpillar feeds by scarping the lower epidermis of the leaflets which results in reduction in chlorophyll, infested leaves turn brown and appear scorched. Mohan *et al.* (2010) reported the nut yield of infested coconut palms could be reduced by as much as 45.4% in the year following severe pest incidence and also that the number of flower bunches and leaves could be reduced by 21 and 13.8%, respectively. Considering the importance of coconut as a plantation crop and the potentiality of *Opisina arenosella* Walker which cause moderate to heavy damage, several studies have been undertaken for the management by several methods, viz. use of conventional pesticides, biopesticides, natural enemies, etc. However, the present available management practice consists of mainly topical sprays, systemic application using root administration and trunk injection

method of synthetic pesticides. However, among the different insecticides studied, monocrotophos has been effectively exploited in the management of *O. arenosella* (Nadarajan and Channabasavanna 1981, Shivashankar 1999). Though, monocrotophos being an organophosphate with severe environmental impact, the chemical has restricted use and also banned in several countries. Therefore, the present study proposes to identify an alternative insecticide which is less toxic to non-target fauna and have good solubility potential in the management of *O. arenosella* and new method of insecticide application which does not cause injury to the coconut palm.

MATERIALS AND METHODS

Experimental site and design: The present study was carried out at farmer's field of Halebudanur village in Mandya district in Karnataka, India during 2017–18. Mandya is situated in Southern dry region (Zone-VI) of Karnataka, India between 12° 32' N latitude, 76° 53' E longitude and 690 M above mean sea level. The field experiment was laid out in a randomized complete block design. The study site consisted of 125 younger coconut palm of 8-10 years old age with *O. arenosella* infestation. The experiment consisted of six treatments with five replications in each (Table 1). For each treatment five different coconut palms were selected. A coconut frond was considered as a replication in each palm. The frond was used for insecticide administration into the coconut palms. Base of the middle frond was selected for injection hole and inserting syringe with loaded insecticides solution on each palm. For injection hole, hand drill machine

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Table 1 Effect of cartap hydrochloride 50% SP on *O. arenosella* larvae

Treatment	Dilution (%)	Dose per frond (ml)	Absorption rate (Mean $\pm$ SD) after 24 hours	Larvae per infested leaflet (Mean $\pm$ SD)			
				1 DBT	3 DAT	7 DAT	15 DAT
Cartap hydrochloride 50% SP	1	10	10.00 $\pm$ 0.00	3.14 $\pm$ 0.25	1.48 $\pm$ 0.41	0.76 $\pm$ 0.43	0.44 $\pm$ 0.17
Cartap hydrochloride 50% SP	2.5	10	10.00 $\pm$ 0.00	3.44 $\pm$ 0.47	0.72 $\pm$ 0.23	0.20 $\pm$ 0.14	0.00 $\pm$ 0.00
Cartap hydrochloride 50% SP	5	10	10.00 $\pm$ 0.00	3.22 $\pm$ 0.46	0.60 $\pm$ 0.32	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00
Cartap hydrochloride 50% SP	10	10	10.00 $\pm$ 0.00	3.28 $\pm$ 0.69	0.12 $\pm$ 0.18	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00
Check- 1 (Water injection)	-	10	10.00 $\pm$ 0.00	3.48 $\pm$ 0.41	3.80 $\pm$ 0.32	3.60 $\pm$ 0.32	1.08 $\pm$ 0.36
Check- 2 (Control)	-	-	-	3.44 $\pm$ 0.38	3.96 $\pm$ 0.78	3.72 $\pm$ 0.46	1.16 $\pm$ 0.48
F				NS	*	*	*
SEm $\pm$				0.19	0.07	0.05	0.04
CD@ 5%				0.56	0.19	0.13	0.13

(NS: non-significant; *: Significant ($p=0.05$), SD: Standard deviation, DBT: Day before treatment; DAT: Day after treatment)

with 0.3 cm of diameter or designed fabricated drill bit (0.3 cm diameter) was used to make a hole at 45-degree angle to a depth of 1.5 cm on the base of the coconut frond (at selected injection site). The syringe loaded with 10 ml of insecticide solution was placed into each hole and the apical point of syringe was sealed with wax to avoid leakage of the solution. Consequently, the placed syringe was covered with polythene cover to avoid the entry of inert material into insecticidal solution. The time of imposing injection was noted down in each replication.

Observations: The observations on absorption were recorded of the quantity of insecticides solution placed into syringes and absorbed by the coconut fronds after 24 h. For the insecticidal efficacy, the observations on the number of live larvae of *O. arenosella* were recorded from randomly selected five infested leaflets from each replication including check-1 and check-2, a day before injection (pre-treatment counts), 3, 7 and 15 days after injection (post-treatment counts). Furthermore, after 25 days of treatments, 30 infested leaflets were clipped and number of pupae in each infested leaflet were counted from each treatment. Each collected pupa was weighed and kept for *O. arenosella* adult and parasitoid emergence. In each treatment the number of emerged adult moth and parasitoids from reared pupae were recorded. Routinely, the observations on the fate of injected holes on fronds was visually observed at different intervals for any secondary infections by pathogen and mechanical injury to the frond. A total of 30 fronds (30 injected holes on fronds) were observed up to six months. The visual observations such as oozing from the injected holes, softening of tissues, secondary infection by pathogens, etc., at different intervals were recorded for the entire period.

Statistical analysis: Mean and standard deviation were calculated for the collected data. The data obtained from field experiments were analyzed statistically to know the efficacy cartap hydrochloride (50% SP) on larval mortality of *O. arenosella* on treated fronds using Analysis of

Variance (ANOVA).

RESULTS AND DISCUSSION

Absorption rate of cartap hydrochloride into coconut frond: The results on absorption of dilutions of cartap hydrochloride 50% SP injected to coconut fronds showed that the complete absorption of insecticides solution by the coconut fronds was recorded in all dilution of cartap hydrochloride 50% SP (10.00 ml) and check-1 (water) (10.00 ml) within 24 hours (Table 1). The absorption rate could also be attributed to the water-soluble potential of active ingredients, water soluble potential of non-active ingredients components in the insecticide, the anatomic point of injection site on the coconut frond and other environmental variables like humidity, temperature, rainfall etc. The coconut palm has a very unique stem anatomy with xylem and phloem confined to vascular bundles scattered throughout the central cylinder of the stem or frond and in most species, these bundles are concentrated near the periphery of the stem and interspersed within a matrix of thin-walled undifferentiated parenchyma cells. Moreover, palm stem xylem, phloem, and even parenchyma cells remain alive for the life of the palm, which can be hundreds of years in some species (Tomlinson and Huggett 2012). However, upon making an incision the syringe loaded with the appropriately diluted insecticide formulation and is plugged into the incision, a very unique micro environment can be created in which the diluted insecticide formulation can be directly fed into the vascular bundles. In coconut palm, though the vascular bundles are unified with different types of tissues, it is believed that a major portion of the insecticide solution is taken by the xylem vessels. However, the possibility of the entry of the insecticide formulation on other types of vascular tissue cannot be ruled out and further studies are required to quantify the same. The absorption of insecticide solution using frond injection into the palm can be confirmation with petiolar wells method on frond used by Parera *et al.* (1989)

and found a complete absorption of insecticides through petiole injection in palm. However, the petiolar method does not give accurate details of absorption, time taken for absorption. The present method of use of syringe on fronds results in accurate measurement of quantity of insecticides solution absorbed and the time taken for absorption.

Efficacy of cartap hydrochloride 50% SP against larvae of *O. arenosella*: The pre-treatment counts of mean live larvae per leaflet ranged between 3.16 and 3.60. The post-treatment observations on mean live larval counts per leaflet showed that dilutions of cartap hydrochloride 50% SP found significantly superior compared to check-1 and check-2 on 3, 7 and 15 days after imposing treatments (Table 1). The reduction in mean larval counts after 3 days of imposing treatments was observed in highest in 10% (0.12 larvae) followed by 5% (0.60 larvae), 2.5% (0.72 larvae) and 1% (1.48 larvae) dilutions of cartap hydrochloride 50% SP compared to check-1 (3.80 larvae) and check-2 (3.96 larvae). However, no larvae were observed after 7 days of imposing treatments in 10% and 5% followed by 2.5% (0.20 larvae) and 1% (0.76 larvae) dilutions of cartap hydrochloride 50% SP compared to check-1 (3.60 larvae) and check-2 (3.72 larvae). After 15 days of imposing treatments no live larva was observed in 10%, 5%, and 2.5% dilutions. Cartap hydrochloride is an analogue of nereis toxin which is a neurotoxic substance and initially isolated from the marine annelid *Lumbriconereis heteropoda*. It has been observed that the application of cartap hydrochloride found most effective on lepidopteran pest, viz. rice stem borer, *Scirpophaga incertulas* in paddy crop (Ghulam *et al.* 2013) and diamondback moth, *Plutella xylostella* in Cruciferae vegetables (Selvaraj and Kennedy 2017) through spraying method respectively. However, the present study of using cartap hydrochloride 50% SP against *O. arenosella* through frond injection method is studied for the first time in coconut palms. Therefore, these could be in confirmation that cartap hydrochloride 50% SP can be effective against lepidopteran pests such as *O. arenosella*.

Impact of cartap hydrochloride 50% SP on the pupation, pupal weight, adult and parasitoid emergence of *O. arenosella*: After 25 days of imposing treatment, 10% dilution of cartap hydrochloride 50% SP had not recorded emergence from pupae (Table 2). The lowest number of pupae were recorded in 5% dilution (3) followed by 2.5% dilution (5) and 1% dilution (6) over check-1 (23) and

check-2 (26). The lowest mean pupal weight was recorded in 5% dilution (15.17 mg) followed by 2.5% dilution (17.56 mg) and 1% dilution (19.08 mg) compared to check-1 (40.00 mg) and check-2 (40.68 mg). No adult emerged from 5% dilution followed by lowest adult emerged 2.5% dilution (1), 1% dilution (2) compared to check-1 (18) and check-2 (20). The lowest number of parasitoid emergence was observed in 5% dilution (1), 2.5% dilution (2), and 1% dilution (1) compared to check-1 (5) and check-2 (6). The reduction in number of pupae, pupal weight, adult emergence, parasitoid emergence and mortality of pupae could be attributed to the antifeeding and poor feeding efficiency by larvae due to the presence of the insecticides in the leaflets. However, these also might be the natural cause such as natural enemies and abiotic stresses. The present finding is in agreement with similar finding by Shivashankar *et al.* (2000) with the use of solunee insecticide against *O. arenosella* using stem injection method in coconut palm. This entire paragraph can be rewritten for smooth reading

Time taken to administer insecticides through syringe method: The time taken by operators to apply insecticides via frond injection method was an average of 4 to 7 minutes duration. This includes climbing to palm drilling hole, placing the loaded syringe with insecticides solution and covering the syringe with polythene cover at site of injection. However, the present syringe method of insecticide administration is comparatively less time consuming with existing root feeding method which takes 38-50 minutes per palm (Ganeswara *et al.* 1980).

Post effect of drilling on the plant tissue under syringe method: The injection holes from drilling during course of study on fronds and on base of the coconut palm were observed for any secondary infections by pathogen and mechanical injury by syringe method. Up to six month of injection hole, no visual symptom was observed such as secondary infections by pathogen, oozing or softening of tissues all around injection holes. This is in confirmation with the study by Parera *et al.* (1989). They reported that drilling petiolar wells on fronds for administering pesticides was not caused any mechanical damage. Similarly, studies by McCoy (1977) found that leaf petiole injection (petiole injection technique) to control lethal yellowing disease in coconut palms was significant in eliminating the permanent injury associated with trunk injections and found that such injections did not produce a permanent injury to fronds.

Table 2 Impact of cartap hydrochloride 50% SP on pupation, pupal weight, adult and parasitoid emergence of *O. arenosella*

Treatment	Dilution (%)	Dose per frond (ml)	Pupae per 30 infested leaflets	Pupal weight (mg) (Mean $\pm$ SD)	Adult emerged	Parasitoid emerged
Cartap hydrochloride 50% SP	1	10	6	19.08 $\pm$ 2.55	2	2
Cartap hydrochloride 50% SP	2.5	10	5	17.56 $\pm$ 2.71	1	2
Cartap hydrochloride 50% SP	5	10	3	15.17 $\pm$ 3.00	0	1
Cartap hydrochloride 50% SP	10	10	0	0.00 $\pm$ 0.00	0	0
Check-1 (Water)	-	10	23	40.00 $\pm$ 6.60	18	5
Check-2 (Control)	-	-	26	40.68 $\pm$ 10.07	20	6

The present study of injecting frond is easy in implementation, less time consuming for insecticidal absorption and not causes any mechanical damage to the coconut palm tissues and can be useful on coconut palm in managing *O. arenosella*. However, further studies can be conducted to evaluate the efficacy of cartap hydrochloride in taller coconut palms, metabolic and dynamics of transformation in coconut palm vascular tissue and evaluation of accumulation of cartap hydrochloride in edible portion of coconut.

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