

# Bionomics and management of red palm weevil on coconut

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## Introduction

The red palm weevil *Rhynchophorus ferrugineus* F. is a dreadful pest that attacks coconut palm in India and many countries in South and South East Asia. Besides coconut, it also causes irreparable damage to date palm, oil palm and palmyrah. In both coconut and date palm, the females of red palm weevil lay eggs in the wounds on young palms, mostly those in the age group of 5 to 20 years. The grubs on hatching feed on the surrounding plant tissues often leading to the formation of tunnels. The grubs bore into the tissues, feed internally and ultimately kills the palm. All stages of the pest are completed inside the palm trunk. Hidden nature of this pest makes the early detection of infestation and taking up timely curative control measures very difficult.

The biology of the pest has been studied earlier by Nirula *et al.*, (1953). Rajan and Nair 1997 reported the host plants, life cycle and symptoms of infection of weevil on coconut. Abraham, 1971 reported preventive measures for the entry of red palm weevil into the coconut palm. Several insecticides were evaluated and different methods of

chemical control against this pest was reported (Muthuraman 1984, Abraham *et al.*, 1975). Abraham, 1987 first revealed the presence of Pheromones in male *R. ferrugineus*. Later, Hallet, *et al.*, (1993) isolated male aggregation pheromone ferrolure, a blend of ferrugineol and ferrugineone from male *R. ferrugineus*. An integrated pest management programme (IPM) was first developed on coconut for the control of this pest (Abraham *et al* 1989) in which trapping the weevil using coconut log trap was included as a major component. The bucket trap for setting the pheromone in the field was designed by Oehlschlager *et al* (1993). This trap was suitably modified to enhance weevil capture. Abraham *et al* (1989) incorporated pheromone trapping as an effective contrivance in the IPM of red palm weevil.

The best method of control of red palm weevil is the adoption of preventive measures as an integral part of the routine agricultural practices on all young coconut plantations. Hence a study was conducted with certain repellents as protective agents from egg laying of red palm weevil. Traps and attractants are proved to be effective

**The results of the field experiment conducted to evaluate the height of pheromone traps revealed that the attraction was significantly more at the height of 2½ meters (9.45 weevil/week) followed by the height of 2 meters (7.4 weevil/week).**



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components of IPM. Hence certain parameters related to the use of pheromone trap were studied. In the present study, laboratory experiments were also conducted on the bionomics of red palm weevil on coconut.

## Materials and Methods

### A. Biology of red palm weevil

*In vitro* studies were conducted at Coconut Research Station, Veppankulam on the biology of red palm weevil.

#### 1. Fecundity

Pairs of adult weevils were liberated in separate cages with fresh cut pieces of peeled coconut leaf petiole and about ten such cages were maintained to assess the fecundity. The weevils relished this food and readily laid the eggs. The coconut leaf petioles were cut open daily and number of eggs laid (fecundity) by a single female was worked out.

#### 2. Egg period and fertility

The eggs of red palm weevil were removed from the pieces of peeled coconut leaf petiole and kept separately in holes drilled in similar food material. The holes were plugged with sterilised moist cotton. Everyday the plug was removed and the stage of development observed and finally the egg period and fertility percentage was worked out.

#### 3. Egg laying capacity

The egg laying capacity of female red palm weevil was studied on different host like sugarcane shred; fresh sugarcane; fresh peeled leaf petiole of coconut, palmyrah and oilpalm; cut pieces of coconut crown; coconut frass; banana

pseudostem and banana rhizome. Ten pairs of adults were released separately on different host material to lay their eggs. The host materials were examined daily for the number of eggs laid.

#### 4. Larval period

To determine the rate of development of the larva, the freshly hatched larvae were inserted into the holes drilled in unpeeled petioles of coconut palms. Each larva was put into a separate petiole. Petioles were split open after a week and the larvae were transferred to fresh petioles. Then the rate of development of larva (larval period) was worked out.

#### 5. Pupal period

Pupation took place approximately two days after the cocoon formation. Then the pupal period was worked out.

#### 6. Adult longevity

Laboratory experiment was also conducted to evaluate the longevity of adults on different hosts. Ten pairs of adult immediately after emergence were reared separately on different hosts like coconut petiole, coconut crown, oilpalm petiole, palmyrah petiole and fresh sugarcane. The food materials were changed once in three days and finally the adult longevity was worked out.

### B. Effect of certain repellents against red palm weevil damage

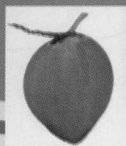
A field experiment was conducted in a farmers' field on ECT variety (6 years old) at Siramelkudi village of Thanjaur district to study the effect of certain coating materials as repellents against the egg laying and attack by red palm weevil. The

different repellent materials were coated on the bole region for 1½ metre height from ground level of 50 trees. Observations were made on the per cent red palm weevil damage after 2 years of treatments.

### C. Behavioural control

Pheromone traps were made as described by Abraham *et al* (1998) using ten litre capacity plastic buckets with lids. Four windows (1.5 cm x 5 cm) were made equidistantly at the top of the bucket just below the upper rim. To provide better grip for the attracted weevils, jute cloth was stuck on the outer side of the bucket. This enables the attracted weevils to get into the bucket. The pheromone lure was hung on the inner side of the lid using a metal wire. In all bucket traps a distance of 25 metres was maintained between treatments and 250 metres between replications. Each bucket contained the food attractant (Tender coconut water) + 5 gm yeast + 5 ml glacial acetic acid + carbaryl 2 gm in sufficient water to form one litre. Yeast, glacial acetic acid and carbaryl were added to the food material for fast fermentation and to kill the trapped weevils respectively.

A field experiment was conducted to work out the optimum height to place pheromone trap in coconut field. Observations were recorded on the attraction of red palm weevil adults in the pheromone trap placed at different heights (1½, 2, 2½, 3, 3½ m). Observations were taken once a week and at the same time the traps were cleaned by washing and replacing the old food bait with fresh ones at 15 days interval. The number of weevils trapped every week were recorded



and the data obtained were statistically analysed using analysis of variance technique after the  $\sqrt{x+0.5}$  transformation of the original values

#### D. Curative Control

##### Evaluation of insecticides

Field trials were conducted in farmers' field at two locations for the management of red palm weevil with different chemicals and botanicals. The trees of five years old showing the fresh symptom of attack in the early stage by red palm weevil were identified and were root fed with the different insecticides and botanicals for two times at an interval of 45 days. Observations on the percent protection of trees by the different chemicals were recorded after six months of treatment.

#### Results and Discussion

The results on the biology of red palm weevil revealed that the total fecundity of single, adult female was 277.6 eggs. The results confirm the earlier findings that the number of eggs laid varied from 50 to 302 for 12 females (Anonymous, 1993). The

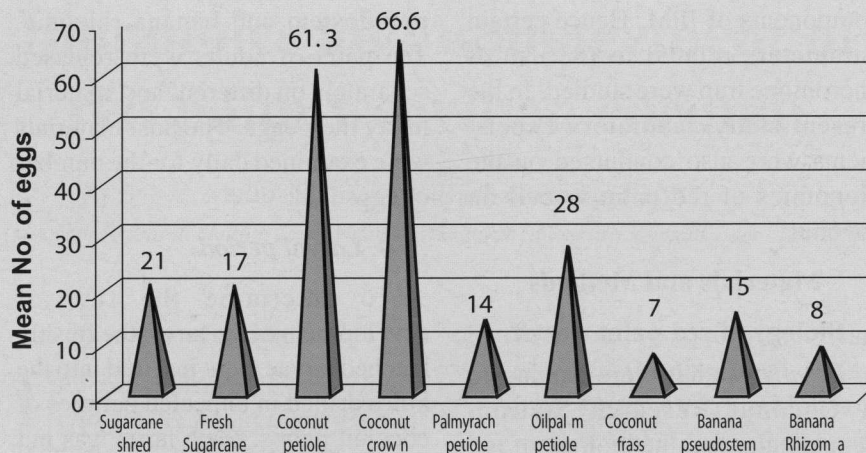


Fig. 2 Effect of different hosts on the egg laying capacity of RPEW

average incubation period of egg was 3.37 days, with the fertility percentage of egg being about 79.3 per cent. The average larval period was about 56.16 days. The average pupal period was about 16.4 days. Earlier it was reported that the pupal period was 12-35 days in the laboratory (Anonymous, 1933).

The adult longevity on different hosts indicated that it was significantly high in coconut crown (56.6 days) followed by coconut petiole (51.03 days) and the longevity varied from 27.6 to 56.6 days on different hosts (Fig. 1).

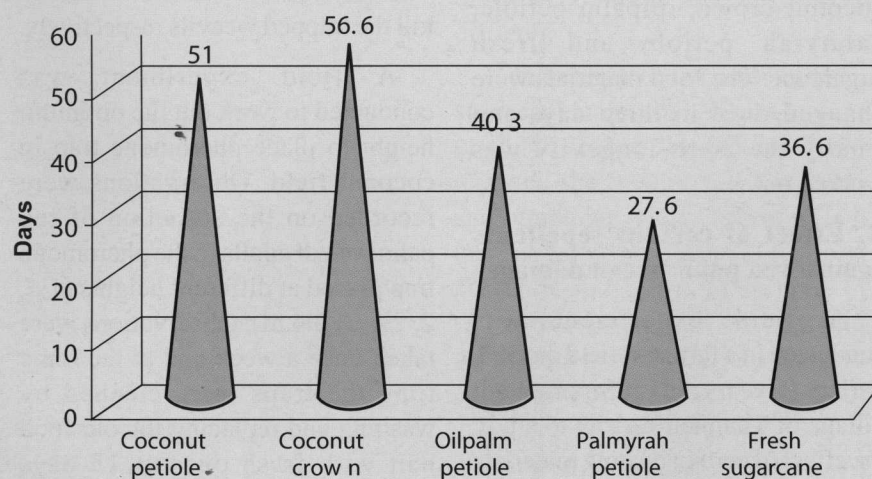


Fig. 1 Effect of different host on adult longevity of RPW

#### Effect of different hosts on the adult longevity of red palm weevil

Treatment	Adult longevity (days)
Coconut petiole	51.0 <sup>b</sup>
Coconut crown	56.6 <sup>a</sup>
Oil palm petiole	40.3 <sup>c</sup>
Palmyrah petiole	27.6 <sup>d</sup>
Fresh sugarcane	36.6 <sup>d</sup>

C.D. = 0.05%

1.99

Among the different hosts studied (Table 1 and Fig. 2) coconut crown attracted more of red palm weevil for egg laying and the number of eggs laid per female adult was significantly maximum (66.6 eggs/female) in coconut crown followed by coconut petiole (61.3 eggs/female). However other than coconut, the weevil also laid their eggs on other hosts like banana, oil palm and palmyrah which act as alternate hosts.

Table 1. Effect of different hosts on the egg laying capacity of red palm weevil

Treatment	Mean No. of eggs
Sugarcane shred	21.0 <sup>d</sup>
Fresh sugarcane	17.0 <sup>e</sup>
Coconut petiole	61.3 <sup>b</sup>
Coconut crown	66.6 <sup>a</sup>
Palmyrah petiole	14.0 <sup>e</sup>
Oil palm petiole	28.0 <sup>c</sup>
Coconut frass	7.0 <sup>i</sup>
Banana pseudostem	15.0 <sup>f</sup>
Banana Rhizome	8.0 <sup>i</sup>

C.D = 0.05%

3.53

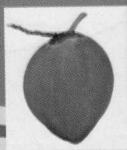


Table 2. Effect of certain repellents against red palm weevil damage

Repellant	No. of trees treated	No. of trees damaged	% of damage	% protection
Tar mixed with Kerosene	50	10	20.00	80.00
Waste oil	50	14	28.00	72.00
Kerosene	50	8	16.00	84.00
Slaked lime	50	2	4.00	96.00
Neem oil 2%	50	4	8.00	92.00
Pungam oil 2%	50	7	14.00	86.00
Neemazal 2%	50	2	4.00	96.00
Control	50	16	32	68.00

The results of the field experiment conducted to study the effect of certain coating materials as repellents revealed that Neemazal 2 per cent and slaked lime provided 96 per cent protection from red palm weevil damage as against 68 per cent in control (Table 2). The result confirms the findings of Brand 1917 that covering of exposed wounds on the trunk with lime mortar is effective. Application of waste oil or tar as a coating material suffered more damage by red palm weevil. Hence slaked lime or Neemazal 2 per cent can be used as a coating material to prevent the damage by red palm weevil in the bole region. The results confirms the findings of Abraham 1971 that tar application alone did not prevent red palm

weevil from laying eggs on wounds on coconut petiole but BHC + Tar was completely effective.

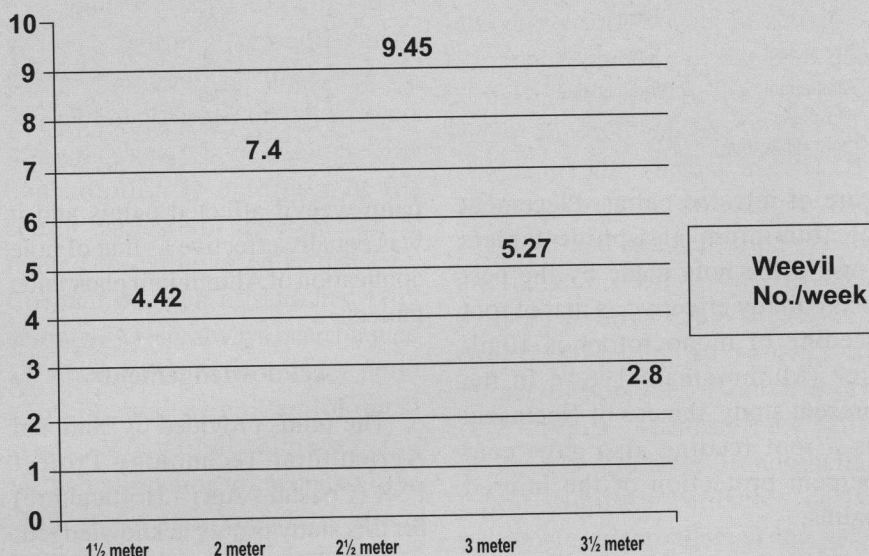


Fig. 3 Effect of Pheromone trap height in the attraction of red palm weevil

Table 3. Effect of Pheromone trap height in the attraction of red palm weevil

Treatments	Mean no. of weevils attracted weeks after					Grand Mean
	1	2	3	4	5	
1/2 metere	3.6 (2.01)	4.75 (3.39)	4.5 (2.23)	4.25 (2.17)	5.0 (2.34)	4.42 <sup>c</sup> (1.96)
2 metere	7.5 (28.2)	7.0 (2.73)	8 (2.91)	8.25 (2.95)	6.25 (2.59)	7.40 <sup>b</sup> (2.45)
2 1/2 metere	12.5 (3.60)	9.75 (3.20)	7.75 (2.87)	9.25 (3.12)	8.0 (2.91)	9.45 <sup>a</sup> (27.3)
3 metere	9.75 (3.20)	5.25 (2.39)	4.0 (2.10)	3.6 (2.02)	3.75 (2.06)	5.27 <sup>c</sup> (2.08)
3 1/2 metere	2.25 (1.65)	3.6 (2.02)	3.0 (1.87)	2.25 (1.65)	3.0 (1.87)	2.8 <sup>d</sup> (1.63)
Sd						0.53
CD (P=0.05%)						1.14

(Figures in parantheses denote transformed values) In a column, means superscribed by a common letter are not significantly different

The results (Table 3 and Fig. 3) of the field experiment conducted to evaluate the height of pheromone traps revealed that the attraction was significantly more at the height of 2 1/2 meters (9.45 weevil/week) followed by the height of 2 meters (7.4 weevil/week).

The results of the above two field experiments conducted at Enathi and Siramelkudi village for the management of red palm weevil with chemicals revealed that, root

feeding of 15 ml Neemazal or monocrotophos + 15 ml water led to cent percent protection and is found to be equally effective as that of hole application of Aluminium phosphide tablets (Table 4). The result confirms the findings of Ganeswara Rao *et al.* 1989 that monocrotophos @ 10 ml / palm diluted with equal quantity of water was found to give optimum lethal dose. Mathen and Kurian 1967 reported that carbaryl, isobenzan and dimethoate gave 93 per cent



Table 4. Effect of root feeding on management of red palm weevil in coconut

Treatment	Location	No. of trees treated	No. of trees survived	% of protection	Mean
Monocrotophos	Siramelkudi	5	5	100	100
	Enathi	10	10	100	
Dichlorvos	Siramelkudi	4	4	100	83.3
	Enathi	3	2	66.6	
Chlorphrifos	Siramelkudi	4	2	50	58.3
	Enathi	3	2	66.6	
Carbosulfan	Siramelkudi	3	1	33.3	49.9
	Enathi	3	2	66.6	
Metasystax	Siramelkudi	4	2	50.0	50.0
Triazophos	Siramelkudi	4	3	75.0	75.0
Neemazal	Siramelkudi	4	4	100	100
	Enathi	3	3	100	
Neemicide	Siramelkudi	4	2	50	50
Aluminium phosphide (hole application)	Siramelkudi	4	4	100	100
	Enathi	6	6	100	

cure of infested palms. Placement of aluminium phosphide tablets (6g) in the hole made by the pest was equally effective as that of root feeding of monocrotophos 10ml/tree (Muthuraman, 1984). In the present study, the use of Neemazal as a root feeding also gave cent percent protection of the injured palms.

It can be concluded from the above study that the total duration of life cycle from oviposition to adult emergence was 75 days with a fertility percentage of 79.3 per cent. The adult longevity on different host varied from 27 to 56 days. Among the different coating material Neemazal 2 per cent or slaked lime provided 96 per cent protection. Setting up of pheromone traps to a height of 2½ metres from ground level significantly attracted more number of adult weevils. Among the various chemicals evaluated root feeding - monocrotophos or Neemazal 15 ml + 15 ml water led to cent percent protection of the red

palm weevil affected palms and it was equally effective as that of hole application of Aluminium phosphide tablets.

#### Acknowledgement

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