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Status of red palm weevil damage in East Godavari district and strategies for control with ecofriendly methods

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Abstract

A roving survey conducted during 2003 and 2004 to assess the damage level of red palm weevil in four major coconut growing districts of Andhra Pradesh i.e., East Godavari, West Godavari, Visakhapatnam and Srikakulam revealed East Godavari district as the hot spot area for the pest. Root feeding with Azadirachtin 5 % WSC was found effective in preventing further damage and spread of red palm weevil in the garden. The study confirmed that azadirachtin 5 % WSC can be a suitable botanical substitute for monocrotophos 36 % SL through root feeding against this pest. Aggregation pheromone lures deployed in various infested gardens decreased the damage levels of red palm weevil. A sustainable IPM for red palm weevil was suggested with ecofriendly components.

Keywords: Azadirachtin, ferrugineol, pheromone lures, red palm weevil, root feeding

Introduction

Red palm weevil, *Rhynchophorus ferrugineus* (Oliver) is the most destructive pest of palms in all coconut growing countries of the world (Abraham *et.al*., 1998). It is a serious threat to young coconut gardens (< 15 years age) causing wide spread damage especially in banana inter cropped gardens (Ganeswara Rao *et al.*, 1989). The apodus grub is an internal tissue borer of the stem and ultimately causes toppling of the crown or falling of palm. Owing to the seriousness and concealed nature of the pest, it is necessary to curtail the pest at the early stage of infestation. Abraham *et al*. (1998) suggested an effective IPM package for red palm weevil involving the measures like field sanitation, prophylactic treatments besides preventive and curative measures *etc.* Tallness of palm is a major constraint for implementation of pest control measures in coconut gardens.

To overcome this constraint, root feeding with 10 ml of monocrotophos + 10 ml of water was recommended as a preventive as well as curative method against red palm weevil (Ganeswara Rao *et al.,* 1989). Even though root feeding with monocrotophos proved effective against red palm weevil, its residual effects and a proposal to ban this insecticide limits its use and hence, it is necessary to evaluate other suitable alternatives for monocrotophos. Many azadirachtin formulations were proved as toxic to insects as well as growth inhibitors, besides reducing the fecundity. Though various measures are available to tackle this pest, sufficient information is not available on the efficacy of botanical pesticides specially azadirachtin formulation through root feeding.

With the characterization and artificial synthesis of aggregating pheromones of red palm weevil, a new era has started in deploying the pheromone lures for monitoring as well as mass trapping of weevils. Mass-trapping of red palm weevil through lures helps to capture and destroy a sizable amount of floating weevils and thus, helps in reducing the population levels of the pest and damage to palms. Owing to its merits, use of pheromone traps has become an important eco-friendly tool of Integrated Pest Management.

Keeping in view of the above factors, evaluation of the status of red palm weevil infestation in different districts of Andhra Pradesh to identify the hot spot region

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for the pest, assessment of efficacy of botanical pesticide i.e., azadirachtin 5 % WSC through root feeding and use of pheromone lures for mass trapping to manage the pest was taken up during 2003-2007 in pest infested coconut gardens of East Godavari district.

Materials and Methods

A random and roving survey was conducted during 2003-04 in four major coconut growing districts of Andhra Pradesh *viz.*, East Godavari, West Godavari, Visakhapatnam and Srikakulam on the incidence and intensity of red palm weevil. In each district, major coconut growing mandals, and in each mandal five villages, and in each village five gardens were selected for recording the pest incidence. A total of 1305 holdings in 261 villages were surveyed in four districts of Andhra Pradesh. In each unit consisting of 2.0 ha area, total number of palms and total number of palms damaged due to red palm weevil were counted and the damage was expressed in percentage. Survey was conducted twice a year *i.e.*, during April-May and October-November.

The effectiveness of root feeding of botanical pesticide (azadirachtin 5 % WSC) was compared with that of synthetic insecticides like Carbosulfan 25 % EC and Monocrotophos 36 % SL. The treatments T_1: Carbosulfan 25 % EC, T_2: Azadirachtin 5 % WSC and T_3: Monocrotophos 36 % SL (all @10 ml + 10 ml water) were imposed in three different gardens with 3-5 years old palms which are severely infested with red palm weevil. Twenty ml of water without any pesticide was given as control treatment. The treatments were replicated thrice and each treatment consisted of five palms and the data was subjected to analysis under completely randomised design. Pre- and post-treatment data were collected on the incidence of the pest and recovery of palms at three months interval in the first year and at six months interval during the 2nd year. Pooled data for two years for respective months are presented.

Root feeding was done by selecting a dark brown matured root at the base of the stem. After cutting the selected root with a sharp knife, the cut end was inserted into a small empty polythene cover (15 x 20 cm). Later, the required dose of chemical with equal quantity of water was placed into the cover. The polythene cover with chemical was adjusted in such a way that the cut end of the root was immersed in the chemical solution. The solution was absorbed within a day or two. Root feeding was applied once in a year. The experiment was conducted for two years.

Aggregation pheromone lures of red palm weevil *i.e.,* 'Ferrolures' (Ferrugineol *i.e.,* 4-methyl-5-nonanol and 4-methyl-5-nonanone) (arranged in five litres plastic buckets) were placed in pest infested coconut gardens as per the recommendation *i.e.*, one trap/4 acres (Chem Tica lure) and one trap/one acre (CPCRI Lure) (incidence of red palm weevil - 2.4 % dead palms, 1.5 % infested palms in experimental gardens). The experiment was conducted with two different lures namely Chem Tica and CPCRI in an area of 4 ha each. Traps were monitored at weekly intervals for servicing and destruction of collected weevils. Assessment of red palm weevil infestation in the experimental garden was done before and after imposing the treatments at three months interval by counting the number of healthy palms and the number of damaged / dead palms.

Results and Discussion

Identification of hot spot areas of red palm weevil

During the survey, the percentage of dead palms recorded ranged from 0.5 to 33.3 (Table 1) whereas, the percentage of partially damaged palms ranged from 1.0 to 27.8. Among the districts surveyed, more number of villages and gardens were infested with RPW in East Godavari district. The highest damage was also recorded in this district only (Table 2). An intensive survey conducted in East Godavari district revealed that the incidence of red palm weevil was severe in all the replanted young palms (6 to 8 years old) after the 1996 cyclone in the area, which is the preferable age for red palm weevil attack. The highest weevil infestation was recorded in Pedapudi village (27.8 %) followed by Avidi

Table 1. Incidence and damage levels of red weevil in coconut gardens of Andhra Pradesh

Sl.No.	Name of the district	Number of villages surveyed	Number of villages with RPW infestation	Number of gardens with RPW infestation	% of infestation	
					Dead	Partial damage
1	East Godavari	134	87	101	0.5 to 33.3	1.0 to 27.8
2	West Godavari	54	42	50	4.3	14.3
3	Visakhapatnam	53	1	1	1.0	2.0
4	Srikakulam	20	4	4	-	1.5
Total		261	134	156	-	-

Table 2. Incidence of red palm weevil in different villages in East Godavari district

Sl. No.	Name of the village	No. of gardens	Area (acres)	% infestation	
				Dead	Partial damage
1.	Avidi	2	12.5	11.5	26.0
2.	Ambajipeta	4	11.5	2.1	3.2
3.	Esukapudi	1	4.0	20.8	--
4.	Erusumanda	4	46.0	8.2	6.8
5.	Gangalakurru	4	18.0	7.4	1.6
6.	Kothapeta	--	0.5	--	3.0
7.	Kandikuppa	1	40.0	2.1	2.1
8.	Kotivari Agraharam	1	1.5	2.0	3.0
9.	Mosalapalli	2	16.0	27.8	5.6
10.	Nagullanka	1	2.0	0.8	17.0
11.	Pedapudi	2	6.0	0.5	27.8
12.	Pulletikurru	14	56.4	2.0	1.0
13.	Potayalanka	2	10.0	3.3	15.0
14.	Pallavaripalem	1	3.5	1.5	0.5
15.	Sanipallilanka	1	5.0	3.0	3.0
16.	Totapeta	1	2.0	--	12.5
17.	Tatipakamatam	1	1.5	3.0	4.0
18.	Vakadavaripalem	--	10.0	1.5	--

(26.0 %), whereas the highest percentage of dead palms was noticed in Mosalapalli village (27.8) followed by Esukapudi (20.8). Based on the survey information, it could be inferred that gardens in East Godavari district (with special reference to 1996 cyclone affected gardens) are found to be with the highest percentage of infestation as well as dead palms due to red palm weevil and hence could be considered as hot spot area for RPW infestation (Fig. 1).

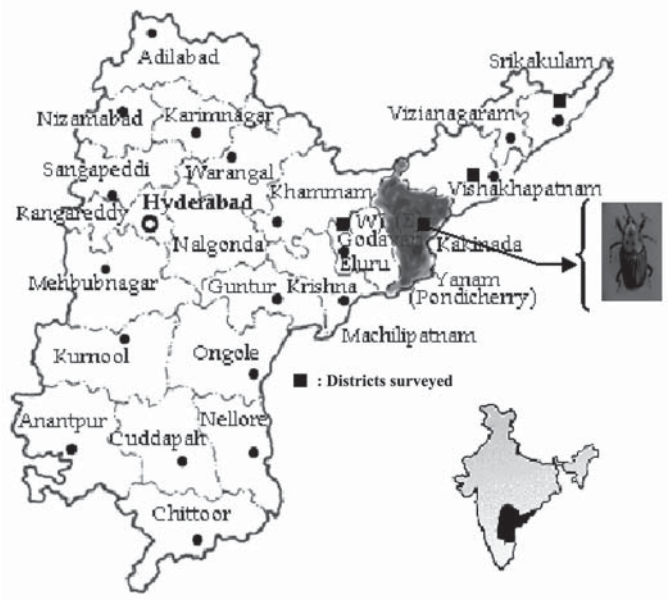

Fig. 1. Hot spot areas of red palm weevil in Andhra Pradesh

Evaluation of pesticides for the control of red palm weevil (RPW) through root feeding

Among the three insecticides (carbosulfan 25 % EC, azadirachtin 5 % WSC and monocrotophos 36 % SL) tested against RPW, root feeding of monocrotophos @ 10 ml + 10 ml water was found to be the best with 100 % recovery of infested palms followed by azadirachtin 5 % WSC with 76.7 % recovery two years after root feeding (Table 3, Fig. 2 and 3). Whereas in the control garden, an increase in both damaged and dead palms was recorded and no recovery was noticed. Data on pre-and post-infestation levels of RPW in treated gardens revealed that there was 25.0 % decrease in partial infestation level where azadirachtin 5 % WSC was given as root feeding whereas infestation level was increased in the other gardens and control plots. azadirachtin 5 % WSC was found to be the best which recorded the highest decrease in percentage of dead palms (91.7) followed by monocrotophos (89.5) when compared to the other treatments i.e., carbosulfan 25 % EC (31.3 %) and control which showed an increase of 3 % (Table 4). Root feeding with azadirachtin could reduce further attack of RPW and this treatment is found to be on par with root feeding of monocrotophos upto a period of six months. Hence, it is evident that root feeding with azadirachtin was effective in reducing the population build up of RPW upto six months.

Fig. 2. Root feeding of Azadirachtin 5 % WSC

The studies conducted with three chemicals viz., carbosulfan, azadirachtin and monocrotophs as root feeding against RPW in different locations for a period of two years proved that further spread of pest infestation can be checked within the garden through azadirachtin 5 % WSC root feeding. The pesticidal property of

Table 3. Efficacy of pesticides against red palm weevil through root feeding

Treatment	Particulars	Per cent recovery after					% decrease in dead palms after 12 months
		3 months	6 months	9 months	12 months	Mean	
T1	Carbosulfan 25 % EC	77.8	55.5	33.3	33.3	50.0	31.3
T2	Azadirachtin 5 % WSC	86.7	86.7	66.7	66.7	76.7	91.7
T3	Monocrotophos 36 % SL	100.0	100.0	100.0	100.0	100.0	89.5
T4	Control	0.0	0.0	0.0	0.0	0.0	0.0
CD (P = 0.05)		19.87	20.50	24.31	24.31		16.50

Fig. 3. Recovery of the palm after root feeding (after two years)

'azadirachtin' i.e., an active ingredient content in neem seeds which varies from 0.19 to 0.92 % was well established by many workers under varied conditions. Satya Vir (2007) in his studies highlighted the growth regulatory effects of neem bio pesticide on pests like *Helicoverpa armigera*, termites, white grubs, leafhoppers, white flies, red hairy caterpillar, bruchids in stored grains when applied in different forms under different conditions. Chandrika Mohan *et al.* (2000) reported the highest efficacy of azadirachtin 5 % WSC against red palm weevil (in terms of grubs, pupae and adults of the pest mortality) under laboratory conditions among the seven commercial formulations of botanical pesticides tested. However, further investigations on growth retardant/deterrent/ antifeedant action of azadirachtin in particular against red palm weevil population to observe the ill effects on life stages like larval pupal intermediates, deformed larvae and pupae, pupal adults intermediates, deformed adults, effect on fecundity or mortality, etc. are to be conducted.

Though root feeding of azadirachtin recorded 23 % less recovery of palms when compared to monocrotophos treatment, azadirachtin can be used against RPW through root feeding instead of

Table 4. Pre- and post-treatment infestation levels of red palm weevil in the experimental gardens (Root feeding of pesticides)

Treatment / Name of the village	Particulars	Totalno. of palms	Partially infested palms		Dead palms	
			Pre-treatment (%)	Post-treatment increase/ decrease (%)	Pre-treatment (%)	Post-treatment increase/ decrease (%)
T1 (Ambajipeta)	Carbosulfan 25 % EC	575	3.3	6.1	1.6	31.3*
T2 (Nagullanka)	Azadirachtin 5 % WSC	620	2.4	25.0*	8.4	91.7*
T3 (Mosalapalli)	Monocrotophos 36 % SL	600	6.5	12.3	1.9	89.5*
T4 (Erusumanda)	Control	600	2.5	100.0	3.3	3.0

*Per cent decrease

Note: Four treatments were implemented in four different gardens in four villages as per the availability of infested palms

monocrotophos as azadirachtin, being a safe botanical pesticide, eliminates ill effects of synthetic pesticide. Hence, root feeding of azadirachtin 5 % WSC can be one of the IPM components of RPW as an ecofriendly item.

Studies on the impact of ferrolure traps on damage levels of RPW

By establishing red palm weevil pheromone traps, a sizable number of adult weevils could be trapped and destroyed during the study period in the two different infested gardens (Fig. 4). A total of 1865 weevils were captured in a period of 230 days where ferrolure from M/s. Chem Tica (T_1) was placed while 2003 weevils were attracted in the garden where CPCRI lure was placed in a period 438 days from an area of 4 ha of each treatment from total traps.

When the pre-and post-infestation levels were observed in the gardens and the villages in which experiment was conducted, the dead palms percentage has come down from 2.4 to 0.5 (79 % decrease) and 1.5 to 0.1 (99.99 % decrease) in both the gardens. The level of pest incidence in the respective villages as a whole has also decreased by 81.48 and 93.75 per cent, respectively (Table 5). Removal of this much (around 1800 to 2000 weevils) floating population of weevils from the gardens has resulted in the reduction of palm damage not only in the experimental garden but also in the village in which experimental gardens were situated. Reduction of dead palms could be recorded ranging from 79 - 100 per cent by using pheromone lures (Table 5) in the experimental gardens. This clearly emphasizes that use of pheromone lures in the RPW infested coconut gardens could curtail the infestation of this pest.

Fig. 4. Arrangement of red palm weevil trap

Kalleshwaraswamy (2002) has also recorded a decrease of red palm weevil incidence level from 5.6 to 2.9 % during the trapping period. Rajamanickam *et al.* (2002) and Faleiro and Rangnekar (2002) also reiterated through their studies that pheromone traps would be a potential aid for monitoring and controlling of red palm weevil and can be a part of IPM to combat the menace of this pest in coconut gardens. Use of semiochemicals as a tool of biointensive integrated pest management of palm weevils was thoroughly discussed and recommended by Singh and Rethinam (2005). Ajlan and Abdulasalam (2000) suggested the use of pheromone traps for controlling red palm weevil in date palms under Saudi Arabian conditions. The above research observations strongly support the present investigation i.e., use of pheromones as one of the IPM components to control the red palm weevil. As these can be used as pest monitoring tools as well as for mass trapping and killing of adult population without leaving any harmful effects, pheromone lures can also be included as one of the components of IPM.

Conclusion

By considering the results of the above experiments, it can be stated that the root feeding of azadirachtin 5 % WSC @ 10 ml + 10 ml water and use of pheromone lures (Ferro lures) could form the two

Table 5. Pre- and post-treatment infestation levels of red palm weevil in the experimental gardens (Pheromone lures)

Treatments		Working period	Total numbers of weevil trapped	Total no. of palms	Per cent dead palms		Per cent decrease over pre treatment
					Pre-treatment	Post-treatment	
T1 - Chem Tica	a) Experimental garden	230 days	1865	840	2.4	0.5	79.16
	b) Mosalapalli village	-	-	--	2.7	0.5	81.48
T2 - CPCRI lure	a) Experimental garden	438 days	2003	840	1.5	0.1	99.99
	b) Erusumanda village	-	-	--	1.6	0.1	93.75
T3 - Control		-	-	840	2.0	3.2	60.0*

*per cent increase

strong bio safe pillars in the IPM of red palm weevil. With the outcome of these experiments, root feeding of azadirachtin 5% WSC 10 ml + 10 ml and use of pheromone (Ferrolure) traps @1 trap / 4 acres water can be suggested for the successful management of red palm weevil as part of IPM in coconut gardens.

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References

Abraham, V.A., Alshuaibi, M.A., Faleiro, J.R., Abuzuhairah, R.A. and Vidyasagar, P.S.P.V. 1998. Integrated pest management of red palm weevil *Rhynchophorus ferrugineus* Oliv. a key pest of date palm in the Middle East. *Sultan Qabus University Journal for Science Research Agricultural Sciences* **3**: 77-84.

Ajlan, A.M. and Abdulasalam, K.S. 2000. Efficiency of pheromone traps for controlling the Red Palm Weevil, *Rhynchophorus ferrugineus* Oilv. Coleoptera: Curculionidae), under Saudi Arabia conditions. *Bulletin of Entomological Society Egypt, Economics Ser.* **27**: 109-120.

Chandrika Mohan., Nair, C.P.R. and Rajan, P. 2000. Scope of botanical pesticides in the management of *Oryctes rhinoceros* L. and *Rhynchophorus ferrugineus* Oilv. affecting coconut palm. In: *Entomocongress 2000*. An International meet organized on the Association of Entomology at Trivandrum, India. 5-8th November, 2000. Sl-O-17.

Faleiro, J.R. and Rangnekar, P.A. 2002. Sex ratio of pheromone trap captured red palm weevils *Rhynchophorus ferrugineus* Oliv. in coconut gardens of Goa. pp. 449-451. In: *Proc. PLACROSYM-XIV – Plantation Crops Research and Development in the New Millennium (2002)*. (Eds). P. Rethinam, H.H. Khan, V.M. Reddy, P.K. Mandal and K. Suresh. Published by Chairman, Coconut Development Board, Kera Bhavan, Kochi, Kerala.

Ganeswara Rao, A., Rama Mohanarao, P. and Lakshminarayana, K.L. 1989. Studies on the effect of systemic insecticide in the control of red palm weevil *Rhynchophorus ferrugineus* (Oilvier) in coconut. *Indian Coconut Journal* **19**(9): 1-5.

Kalleshwaraswamy, C.M. 2002. Biology, comparative development and pheromone lure efficacy on red palm weevil, *Rhynchophorus ferrugineus* Oilv. Coleoptera: (Curculionidae). *M.Sc. (Ag.) Thesis* submitted to UAS, Bangalore.

Rajamanickam, K., Ramaraju, K., Pachiaraj, D., Hameed Khan, H. and Subaharan. 2002. Effect of ferrolure+ in the management of red palm weevil (*Rhynochoporus ferrungineus* F.) infesting coconut. pp. 447-448. In: *Proc. PLACROSYM-XIV – Plantation Crops Research and Development in the New Millennium (2002)*. (Eds). P. Rethinam, H.H. Khan, V.M. Reddy, P.K. Mandal and K. Suresh. Published by Chairman, Coconut Development Board, Kera Bhavan, Kochi, Kerala.

Satya Vir. 2007. Neem: Genetic diversity in India and its Use as Biopesticide and Biofertilizer. *Indian Journal of Plant Protection* **35**(2): 185-193.

Singh, S.P. and Rethinam, P. 2005. Semio chemicals as a valuable tool in BIPM of palm weevils. *Cocoinfo International*. **12**(1): 17-22.