Monitoring and Management of Coleopteran pests of Coconut through Pheromone traps in Andhra Pradesh

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ABSTRACT

Among the insect pests of coconut, the red palm weevil *Rhynchophorus ferrugineus* and rhinoceros beetle, *Oryctes rhinoceros* are reckoned as important. Roving survey made in eight coconut growing districts of Andhra Pradesh during the years 2000 to 2008 showed low to medium incidence of rhinoceros beetle in all the districts and severe incidence of red palm weevil in East Godavari district. This information on relative severity of the two pests was useful to guide in suitable interventions for integrated pest management. Efficacy of pheromone lures of rhinoceros beetle (Ethyl 4-methyl octonoate) and red palm weevil (4 methyl - 5 - nonanol) from different sources were tested. There were distinctly high catches of rhinoceros beetle recorded in rhino lure during April, May, June, September and October months, while red palm weevil lures recorded higher catches of weevils in March, April, May, June and July months. Among the sources compared, rhino lure appeared superior for trapping rhinoceros beetle, while the red palm weevil lure from CPCRI, Kayangulam proved superior against red palm weevil. Trapping and destruction of rhinoceros beetle through pheromone traps resulted in the reduction of leaf and spindle damage by 27.3 and 59.9%, respectively. Use of pheromone trap for red palm weevil was found to effectively reduce the palm damage by 78% and 93% dead palms.

Kew words: Coconut, *Oryctes rhinoceros, Rhynchophorus ferrugineus*

Two coleopterans *viz.*, red palm weevil, *Rhynchophorus ferrugineus* (Oliver) and rhinoceros beetle, *Oryctes rhinoceros* Lin. are important enemies of coconut palm which affects the productivity of the crop. The red palm weevil is a tissue borer ultimately causing the death of the palm while rhinoceros beetle causes damage to unopened leaves, spathes and bud region in the crown reducing the yield up to 10% by both the pests are serious threat to young coconut gardens. The left over dead palms due to red palm weevil attack will attract rhinoceros beetle for egg laying and serves as breeding sites for rhinoceros beetle. Some times partially damaged palms by red palm weevil attack also attracts rhinoceros beetle and enhances the decaying of damaged portion of the palm. Occasionally rhinoceros beetle damaged palms also attracts red palm weevil due to the tissue rotting in the crown. Knowledge about the pest status and extent of damage are basic steps of effectively and timely management of the pests. Periodical field surveys and monitoring of pests will provide the first hand information about the pest status which is essential for implementation of pest management measures. The mass-trapping of rhinoceros beetles and red palm weevils; through lures help to capture and destroy a sizeable amount of floating beetles and weevils and thus, help in reducing the population levels of the pest. Owing to its merits; use of pheromone traps has become an important eco-friendly tool of IPM. Hence, this study was undertaken.

Materials and Methods

A random and roving survey were conducted in eight coconut growing districts of Andhra Pradesh *viz.*, East Godavari, West Godavari, Visakhapatnam, Srikakulam, Krishna, Guntur, Prakasam and Nellore to record the incidence and intensity of rhinoceros beetle and red palm weevil. In each district, major coconut growing mandals were selected, in each mandal five villages and in each village five gardens were selected for recording the pest. In each unit garden of 2.0 ha area, the total number of palms and the number of damaged and dead palms due to red palm weevil and total number of leaves, damaged leaves, spindle damage on 10% in case of rhinoceros beetle were counted and the damage is expressed in percentage. Survey was conducted two times in a year i.e., during April-May and October-November to record the intensity of pests.

The study with lures of rhinoceros beetle were conducted during the years 2000, 2002, 2006-2008, carried out three times in three distinct pest infested gardens each time in an area of 10 acres in each location. Pheromone traps having male aggregation pheromone of Oryctorus rhinoceros (Ethyl 4 – Methyl Octanoate) i.e., rhinolure supplied by Chem Exports Pvt. Ltd., Trichur, Kerala and Pest Control India Pvt. India Ltd., were arranged (bucket & vane type) in selected gardens @1 / 5 acres Chemtica lure and @ 1 / 1 acre for PCI lure at 8 m height on a bamboo stand to coincide with the crown height. The traps were inspected at weekly interval for counting trapped beetles. Data on pest status i.e., total number of leaves, number of leaves damaged and spindle damage by rhinoceros beetle was recorded prior to treatment and further at quarterly intervals till the pheromone exhausted and also after exhaustion of pheromone up to three months, thereby % reduction in leaf and spindle damage was assessed.

After noticing the efficacy of rhinoceros pheromone lures in the reduction of damage levels, an experiment was conducted with various components of IPM for rhinoceros beetle, pheromone traps as one of the components along with other measures which were proved effective in individual evaluation. The experiment was conducted in three different pest infested gardens in three villages. Data on damage levels of rhinoceros beetle to leaf and spindle were recorded prior to implementation of IPM and at periodical intervals (3 months) after implementation of IPM. The package consisted of : Release of baculovirus @10-15 beetles / ha; Spraying of *Metarhizium* solution on manure heaps @ 1 ltr/3 mt^3; Rhinolure traps as per the recommended by the firm (@1 trap/ 2 ha – Chem Tica); Mechanical hooking of beetles and Sanitation.

Aggregation pheromone lures of Red Palm Weevil *i.e.*, "Ferrolures" (Ferrugineol *i.e.*, 4-methyl-5-nonanol and 4-methyl-5-nonanone) (arranged in 5 litres plastic buckets by placing lures sachet to the lid inside and keeping food bite in the bucket supplied from CPCRI, Chem Tiaca Pvt. Ltd., and PCI Pvt. Ltd.) were placed in pest infested coconut gardens as per the recommendation. The experiments were conducted in three different pest infested gardens in three villages. The lures supplied from different sources were tested for their efficacy under field conditions. The studies were carried out for four years i.e., 2005, 2006, 2007 and 2008. Traps were regularly monitored at weekly intervals for servicing and destruction of collected weevils. Data was collected periodically on number of weevils were trapped / trap / month. Assessment of red palm weevil infestation in the experimental gardens was done before and after imposing the treatments at 3 months interval by counting the number of healthy palms and the number of damaged / dead palms.

Results and Discussion

The survey revealed that 5 – 40% palms were damaged due to rhinoceros beetle whereas dead palms due to red palm weevil attack was ranged from 1.0 to 33.3% and partially damaged palms ranged from 2.0 to 28.0% (Table 1). The status of rhinoceros beetle in the surveyed districts was in the low to medium intensity. Highest damage to palms i.e., leaf as well as spindle damage (60-70%) was

Table 1. Intensity of Rhinoceros beetle and Red palm weevil in Andhra Pradesh.

District	No. of villages survey-ed	Pest intensity (%)		
		Rhino-ceros beetle	Red palm weevil	
			Dead palms	Infested palms
East Godavari	245	20-40	1-33.3	1.0 to 28.0
West Godavari	94	30.0	4.3	14.3
Srikakulam	27	5-20	1.5	5.0
Krishna	2	10.0	1.0	2.0
Guntur	5	10.0	1.0	2.0
Nellore	2	5.0	1.0	2.0
Prakasam	24	30.0	2.0	2.0
Visakhapatnam	55	10-40	1.0	2.0
Total	454			

recorded in the gardens which were nearby coir industries. This clearly indicated that the gardens were in the vicinity of coir factories suffered more because of plenty of beetle population from the breeding sites available in the coir factories. It is also observed that the younger gardens i.e., less than 10 years age were more prone to the attack of rhinoceros beetle as well as red palm weevil. Among the districts surveyed, more number of villages and gardens were infested with RPW in East Godavari district and the highest damage was also recorded in East Godavari only (dead palms - 33.3% and infested palms – 28%). 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 1996 cyclone in East Godavari district which was the preferable age for red palm weevil attack. Based on the survey information, it is inferred that the gardens in East Godavari district with special reference to 1996 cyclone affected gardens were found to be with highest % of infestation as well as dead palms due to red palm weevil which can be referred as hot spot area for RPW infestation.

East Godavari district being a major share holder of coconut area in the state of Andhra Pradesh (1.02 lakh ha), was suffering with highest infestation of red palm weevil; which required an immediate attention of farmers as well as extension personel to adopt control measures.

Perusal of data from four years on average monthly trap catches of rhinoceros beetle in the study period revealed that average number of beetles / trap / month ranged from 0.65 to 7.5 with highest catches in the month of April, May, June and again in September and October months under east coast conditions (Table 2). The study proved that Chem tica lure was more efficacious with the range of 0.3 to 7.3 beetles / trap/ month with 7.5 number of beetles as highest catch against the range of 0.1 to 2.6 beetles/trap/month with highest catch of 2.6 beetles with PCI lure. Bhullar *et al.* (2005) reported insect trapped in February-March month. which was correlated with abiotic factors.

Table 2. Average monthly Rhinoceros beetle trap catches in 2000, 2002, 2007 & 2008.

Months	No. of beetles trapped in different lures		Average no. of beetle / trap
	T_1–Chemtica Lure (3 traps) Av.	T_2 – PCI Lure (10 traps) Av.	
Jan	3.00	0.5	3.02
Feb	1.33	0.3	1.67
Mar	0.33	0.1	2.5
Apr	1.66	0.7	5.49
May	7.0	1.2	7.5
Jun	7.0	0.33	6.5
Jul	2.67	0.50	2.67
Aug	6.0	2.6	4.8
Sep	7.3	1.8	7.15
Oct	7.3	1.5	7.15
Nov	4.0	0.4	3.50
Dec	0.3	0.6	0.65

Observation of total number of beetles trapped /year, in different years revealed the fact, that there was a gradual decrease in the catches i.e., 152 < 151 < 115 in the years 2002, 2007 and 2008, respectively which indicated the reduction in the floating population of the beetles year by year because of elimination of beetle population through pheromone lures. Similar trend was observed in the average catches / month / year also i.e., 14.7, 4.2 and 3.4 in the year 2002, 2007 and 2008, respectively.

Through the studies for four times in four years, it was recorded that trapping and destruction of rhinoceros beetles through rhinolure traps in pest infested gardens resulted in the reduction of leaf and spindle damage in all the gardens during the study period, (Table 3). The reduction of damage ranged from 8.3 to 55.2% in leaf and 45.1 to 73.1% in spindle damage with an average of 27.3 and 59.9% in leaf and spindle damage, respectively. While the leaf and spindle damage increased by 10.7 and 10.5%, respectively in control plots. It is evident that the pheromone traps were effective in the reduction of floating beetles population through catching inturn decreasing the damage by the beetles to the palm. Rajamanikyam *et al.* (2002) also conducted the studies on rhinolure traps and found effective for monitoring and mass trapping of the beetles. These studies indicated that there was a potential for using rhinolure traps as one of the steps in IPM programme of rhinoceros beetle in coconut plantations as these are ecofriendly.

The data obtained in the IPM demonstration plots, it was observed that, a progressive decrease of leaf and spindle damage over a period after implementation of IPM could be achieved. The % decrease in leaf and spindle damage (48.0 & 76. 0; 61 & 69; 61 & 43) was recorded in Ambajipeta, Gangalakurru and Munganda villages in a period of 18 months. An average reduction of 56.5 and 62.8% in leaf and spindle damage, respectively could be achieved in the three villages within a period of 18 months. Whereas in leaf and spindle damage 63.0 and 13.0%, respectively were recorded in untreated plots (Table 4). Kant *et al.*, (2004) also found similar impact of traps on the crop damage and recorded reduction in the leaf, petiole and spindle damage from the execution of IPM.

These results offered a good scope for implementation of IPM strategy for the management of rhinoceros beetle in coconut plantations. Future thrust may be focused on commercial availability of rhinolure trap on a wider scale and at a lower cost to large number of farmers making the technique more feasible. From these on farm trials, it can be concluded that, implementation of IPM technology for the management of rhinoceros beetle offered promising results in terms of reduction in leaf and spindle damage. Hence, the following IPM schedule can be followed for the effective and ecofriendly management of rhinoceros beetle in coconut plantations:

Table 3. Effect of rhinoceros beetle trap catches on leaf and spindle damage.

	Pre treatment		Post treatment		% reduction		Control					
							Pre treatment		Post treatment		% increase	
	Leaf	Spindle	Leaf	Spindle	Leaf	Spindle	Leaf	Spindle	Leaf	Spindle	Leaf	Spindle
2000	26.1	40.3	26.3	13.3	8.5	68.0	38.8	51.0	45.7	59.3	17.4	16.3
2002	26.4	47.0	24.5	11.9	8.3	73.1	56.1	77.8	63.1	84.4	12.4	8.5
2006-07	84.6	76.7	37.6	42.1	55.2	45.1	89.9	75.0	95.5	85.0	5.5	13.3
2007-08	69.5	83.5	43.5	28.0	37.0	53.5	70.0	80.0	75.0	83.0	7.5	4.0
Average	**38.5**	**61.9**	**33.0**	**23.8**	**27.3**	**59.9**	**63.7**	**70.9**	**69.8**	**77.9**	**10.7**	**10.5**

Table 4. Impact of IPM Technology of rhinoceros beetle on leaf and spindle damage.

Particulars	Leaf		Spindle	
	Pre-release (% damage)	Post-release (% decrease)	Pre-release (% damage)	Post-release (% decrease)
Ambajipeta Garden-1	15.0	48.0	47.0	76.0
Gangalakurru Garden-2	10.0	61.0	27.0	69.0
Munganda Garden-3	14.0	61.0	23.0	43.0
Average	56.5	62.8		
Amalapuram (Control)	56.0	63.0*	78.0	13.0*

* % increase

- Release of baculovirus @10 – 15 inoculated beetles/ha.
- Spraying of *Metarrhizium* solution on manure heaps @ 1 ltr/3mt^3
- Establishment of rhinolure traps @ 1 / 2 ha (Chem tica)
- Mechanical hooking of beetle and
- Sanitation.

Mean number of weevils trapped / trap /month, among the three different lures i.e, CPCRI, Chem Tica and PCI; the Chem Tica lure was found superior with highest mean number of weevils (30.95) followed by CPCRI lure (27.48) and PCI (14.12). Highest number of weevils were trapped during the months of March, April, May, June and July (Table 5). Similar high catches of red palm weevil in the month of April were reported by Abdulaziz and Abdulsalam (2005) in Saudi Arabia in date plantations. Similar results were also reported by Faleiro and Satarker (2003). Even though the Chem Tica lure catched more number of weevils / trap/month in certain months; when cost and working period of lure is considered; the CPCRI was found to be the best as it was working for about two years under east coast conditions against 8 months period of Chem Tica lure and the cost of CPCRI lure is more economical i.e., Rs.40 / 85 – 100 micro litres whereas Chem Tica lure costs Rs.345/800 mg. The PCI lure is working for a period of three months and costing Rs.350/each. Hence, owing to its merits and nearly with equal trap efficiency the CPCRI lure can be used for monitoring / mass trapping of weevils in the pest infested gardens.

Table 5. Number of Red palm weevils trapped in different RPW lures.

Months	No. of weevils trapped / trap / month		
	CPCRI	Chem tica	PCI
Jan	20.6	21.4	9.2
Feb	27.0	39.1	8.2
Mar	32.2	42.0	8.0
Apr	53.6	63.1	21.8
May	39.5	45.0	12.3
Jun	34.3	29.5	18.5
Jul	33.7	51.0	16.1
Aug	31.3	14.2	16.5
Sep	17.3	12.9	12.8
Oct	9.4	14.0	13.0
Nov	15.0	20.8	19.3
Dec	15.9	18.4	13.8
Range	9.4 to 53.6	12.9 to 63.1	8.0 to 21.8
Average	27.48	30.95	14.12

Table 6. Trend of Red palm weevil catches in different years.

	2005	2006	2007	2008
Total number	1734	1312	357	198
Highest number	112	77	18	24
Average / month	48.14	36.16	9.9	10.9

Table 7. Pre and post treatment infestation levels of red palm weevil in experimental gardens.

Garden	Pre treatment		Post treatment		% reduction	
	Infe-sted	Dead palms	Infe-sted	Dead palms	Infe-sted	Dead palms
G1	2.83	4.83	0.4	0.0	85.8	100.0
G2	1.66	4.33	0.2	0.0	87.9	100.0
G3	4.16	3.16	0.65	0.48	84.3	84.8
G4	1.5	2.4	0.5	0.5	66.6	79.1
G5	2.0	1.5	0.7	0.1	65.0	99.9
Average	2.43	3.2	0.49	0.22	78.0	92.7
Control	3.08	4.83	6.00	6.00	96.0	24.2

When the trend and total number of weevils trap in different years i.e. from 2005 – 2008 years were observed, it is evidence that there was a progressive decrease in total number of weevils trapped /year from 1734 to 198; highest number of weevils trapped in the year from 112 to 24 as well as yearly average catch / month from 48.14 to 10.9 (Table 6). This data clearly showed that there was a definite reduction of weevil population in the experimental area which inturn indicated in the reduction of palm damage levels.

By establishing red palm weevil pheromone traps in the red palm weevil infested gardens, a sizable number of adult weevils could be trapped and destroyed during the study period in the five different infested gardens.

When the pre and post infestation levels were observed in the experimental gardens, the average infested palms % had come down from 2.4 to 0.5 (78% decrease) and 3.2 to 0.2 % (92.8% decrease) in dead palms on an average in all the gardens (Table 7). Removal of floating population of weevils from the gardens resulted in the reduction of palm damage not only in the experimental garden but also in the village in which experimental gardens were situated. This clearly emphasized that use of pheromone lures in the RPW infested coconut gardens could curtail the infestation of RPW. Rajamanickam *et al.*, (2002) and Faleiro and Rangnekar (2002) also reiterated through their studies that the 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 red palm weevil in coconut gardens. The use of semiochemicals as a tool of BIPM of palm weevils was thoroughly discussed and recommended by Singh and Rethinam (2005). As these can be used as pest monitoring tools, as well as for mass trapping and killing of adults population with out leaving any harmful effects the pheromone lures can be included as one of the components of IPM. But one has to be very much cautious while using pheromone traps in monitoring of traps; destruction of trapped adults and should keep the palms without mechanical injuries which attracts adults for ovi-position in the garden. Attending for controlling of rhinoceros beetle damage in the crowns is also an important precaution, in this regard, thorough knowledge and education about the pest strategy is highly essential to the farming community. Prasad (1996) used sex pheromone trap for monitoring adults population of insect which could serve as warming for taking up mass releases of exotic parasites or spraying of safe insecticides.

With the outcome of these experiments, the following sustainable ecofriendly IPM can be suggested for the successful management of red palm weevil in coconut gardens.

- Removal and destruction of pest affected and dead palms.
- Avoiding injuries to the palm by farm tools and implements.
- General phytosanitary measures like timely treatment of palms affected by rhinoceros beetle or bud rot or lightening (leaf axil filling with mixture of neem seed kernel powder 100g + 150 g of sand)
- Root feeding of Azadirachtin 5% WSC 10 ml + 10 ml water.
- Use of pheromone (Ferrolure) traps @1 trap / 4 acres.

- Chiseling of damaged portion of the trunk and smearing with coal tar or Japan black on the surface of the wound.
- Sealing of hallow portion of the trunk with cement concrete to support the palm.

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References

Abdul Aziz, M. Al-Dajlan and Khaled, S. Abdulsalam (2005). Efficacy of two pheromone types on red palm weevils *Rhynchophorus ferrugineus* under Saudi Arabian conditions. *Ind. J. Pl. Prot.* **33**: 222.

Bhullar, Navdeep, Kalpna Varshney and Sudha Kanaujia (2005). Effect of replacement of septa on trapping efficiency of phemone traps for *Helicoverpa armigera*. *Ann. Pl. Protec. Sci.* **13**: 482-483.

Falerio, J.R. and V.R. Satarkar (2003). Ferrugineol based pheromone lures for red palm weevil. *Ind. J. Pl. Prot.* **31**: 84-87.

Kant, Krishan, K.R. Kanaujia and S. Kanaujia (2004). Population assessment of *Helicoverpa armigera* moth through sex pheromone trap. *Ann. Pl. Protec. Sci.* **12**: 431-432.

Prasad, C.S. (1996). Monitoring of *Helicoverpa armigera* population behaviour through sex pheromone traps in lower Kumaon Hills of U.P. *Ann. Pl. Protec. Sci.* **4**: 55-58.

Rajamanickam, K., K. Ramaraju, D. Pachiaraj, H. Hameed Khan and Subaharan. (2002). Effect of ferrolure+ in the management of red palm weevil (*Rhynochoporus ferrungineus* F.) infesting coconut. *Proceeding* of *Placrosym* XIV 447-448.

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