

Impact of release of oil palm pollinating weevil, *Elaeidobius kamerunicus* (Faust) (Coleoptera : Curculionidae) and the status of weevil population and fruit set in the various oil palm plantations in India*

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Abstract

The red oil palm, *Elaeis guineensis* Jacq. is an introduced crop in India and is extensively cultivated in India under rain fed and irrigated conditions. *Elaeidobius kamerunicus* is the most efficient oil palm pollinating weevil. They were introduced in the oil palm plantations of National Research Centre for Oil palm, Palode (Kerala) during 1985. The weevils multiplied and got established in all the plantations of introduction. An attempt was made to assess the impact of the introduction of pollinating weevils on fruit set and the status of weevil population and fruit set in the various oil palm plantations under varied agro-climatic conditions. Studies revealed that the release of the weevils enhanced the fruit set and the bunch weight. The weevils had multiplied in the introduced oil palm plantations under various agro-climatic conditions, enhanced the fruit set and thereby revolutionized the oil palm industry in India.

Key words: *Elaeis guineensis*, *Elaeidobius kamerunicus*, pollinating insects, fruit set

Introduction

The red oil palm, *Elaeis guineensis* Jacq. is an introduced crop in India and is one of the cheapest and richest sources of vegetable oil. Oil palm is an entomophilous crop and out of several species of pollinating insects, *Elaeidobius kamerunicus* (Plate 1) is the most efficient and predominant species (Syed, 1979 and 1981). The weevils seldom feed on the pollen grains, instead they chew the anther filament, lay eggs in the feeding pits (Plate 2) and multiply at the expense of spent male inflorescence. The weevils thrive very well in dry as well as in wet seasons. *E. kamerunicus* was introduced in the oil palm plantations of National Research Center for Oil palm (NRCOP) Palode (Trivandrum District, Kerala) during 1985 from Malaysia (Ponnamma *et al.*, 1986) and got established.

Being the lead center in oil palm research in India introduction of weevils in various oil palm plantations in Andhra Pradesh, Karnataka, Tamil Nadu, West Bengal, Goa, Maharashtra and Andaman & Nicobar Islands was undertaken by NRCOP, Palode. *E. kamerunicus* was reared for seven generations under laboratory conditions and were introduced in the oil palm plantations (Table 2) in the various states (during the third year of planting). The weevils multiplied and got established in all the plantations of introduction. An attempt was made to assess the status of weevil population and fruit set in the various oil palm plantations under varied agro-climatic conditions.

Materials and Methods

a. Introduction of pollinating weevils in oil palm plantation and its impact on fruit set:

E. kamerunicus was introduced in an oil palm plantation in Orakkadu village, Cholapuram, Chennai, having 1800 four-year-old oil palms. Pre-

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release data on fruit set (before the release of weevils) was collected from ten ripe bunches. After assessing the bunch weight, the bunches were cut into individual spikelets. Count of the fruits, parthenocarpic fruits and unpollinated flowers was taken and weight of individual spikelets was also assessed.

Before releasing the weevils, ten anthesising female inflorescences in the receptive stage were marked. On an average, 10,000 adult weevils were released. Spikelets from two spent male inflorescences harbouring larvae and pupae of the pollinating weevils were also kept in the leaf axils of various palms (on an average 10,000 weevils emerge from an inflorescence). The marked bunches were harvested after six months (period taken for the development and ripening of a bunch) to assess the fruit set.

b. Assessment of population of weevils in various oil palm plantations:

Two spikelets each from bottom, middle and top of the inflorescences were covered with nylon net (40 mesh/cm²) bags (30cm x 15cm) along with weevils and abscessed. Sampling was done before 12 noon before the weevils become active (Ponnamma, 1999). Samples were brought to laboratory, killed with chloroform and position wise count was taken.

At oil palm plantations of NRCOP, Palode (Trivandrum Dist., Kerala) sampling was done during January 2000 to December 2001. From Oil Palm India Limited (OPIL), Chithara (Quilon Dist., Kerala) weevil population was assessed during October 1999 to September 2000 and count of weevils in the bottom, middle and top spikelets were recorded separately. Population of weevils was assessed from oil palm plantations of NRCOP, Pedavegi (W.Godavari dist., Andhra Pradesh) during May, 2000, Tamil Nadu Rice Research Institute (TRRI), Aduthuri (Thanjavor Dist., Tamil Nadu) during November 2000, Plantation Corporation of Kerala Limited.(PCKL), Vettilappara Estate(Trichur dist.,Kerala) during January, 2000, Oil Palm India Limited.(OPIL), Seed Garden, Thodupuzha, (Idukki dist.,Kerala) during June, 2000, Farmer's Gardens, Mysore (Karnataka) during August, 2000 and Shimoga, (Karnataka) during December 2002 and farmers' garden Kuttanadu (Kottayam Dist., Kerala) during January 2003.

c. Assessment of fruit set:

Ten ripe bunches each were collected from the above oil palm plantations. After assessing the weight, the bunches were cut into individual spikelets. Count of the fruits, parthenocarpic fruits and unpollinated

flowers was taken. The initial weight of the bunch and weight of individual spikelets were also assessed (same methodology was adopted in all the locations).

Fruit set was assessed from the oil palm plantations of NRCOP, Regional Station, Palode from January 2000 to December 2001. Data on weevil population for six months prior to bunch analysis (period taken for the development and ripening of a bunch) was taken into account for correlation with fruit set. From the oil palm plantations of OPIL., Chithara, fruit set was assessed from March 2000 to February, 2001 at monthly intervals. From various other plantations fruit set was assessed during the sampling of the population of *E. kamerunicus*.

Results and Discussion

a. Impact of introduction of pollinating weevils:

The introduced weevils multiplied and got established in the oil palm plantation at Orakkadu, Chennai. Pre-release fruit set and bunch weight ranged from 3.26 to 55.69 per cent (mean 24.08 per cent) and 0.9 kg to 3.3 kg/bunch (mean 1.9 kg) respectively. Post-release bunch analysis revealed that the percentage fruitset was enhanced and ranged from 62.9 to 95.9 per cent. Ultimately, bunch weight had increased and it ranged from 2.2 to 10.93 kg / bunch (mean 5.63 kg). As a result the percentage increase in fruit set and bunch weight due to weevil introduction was 48.89 and 66.25 respectively. Fruit to sterile or unpollinated flower ratio also increased to 2.7:1 from 1:3 under the post - release condition (Table 1). The above results indicated the positive impact of the introduction of weevils in oil palm plantation with increased fruit set.

b. Assessment of weevil population:

(i) NRCOP, Palode:

Monthly sampling was continued from January 2000 to December 2001 from the oil palm plantations of NRCOP, Regional Station, Palode (Fig.1). The population per spikelet was very low (32.2 per spikelet) during January 2000 and build up of population was noticed during April and May followed by a decline

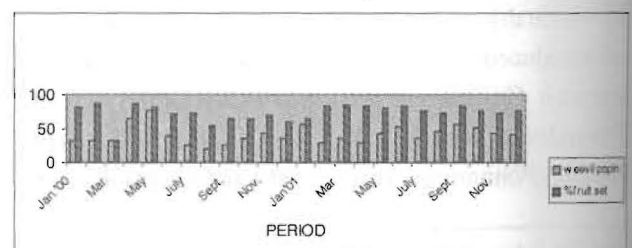


Fig.1. Weevil population and % fruit set in NRCOP, Palode

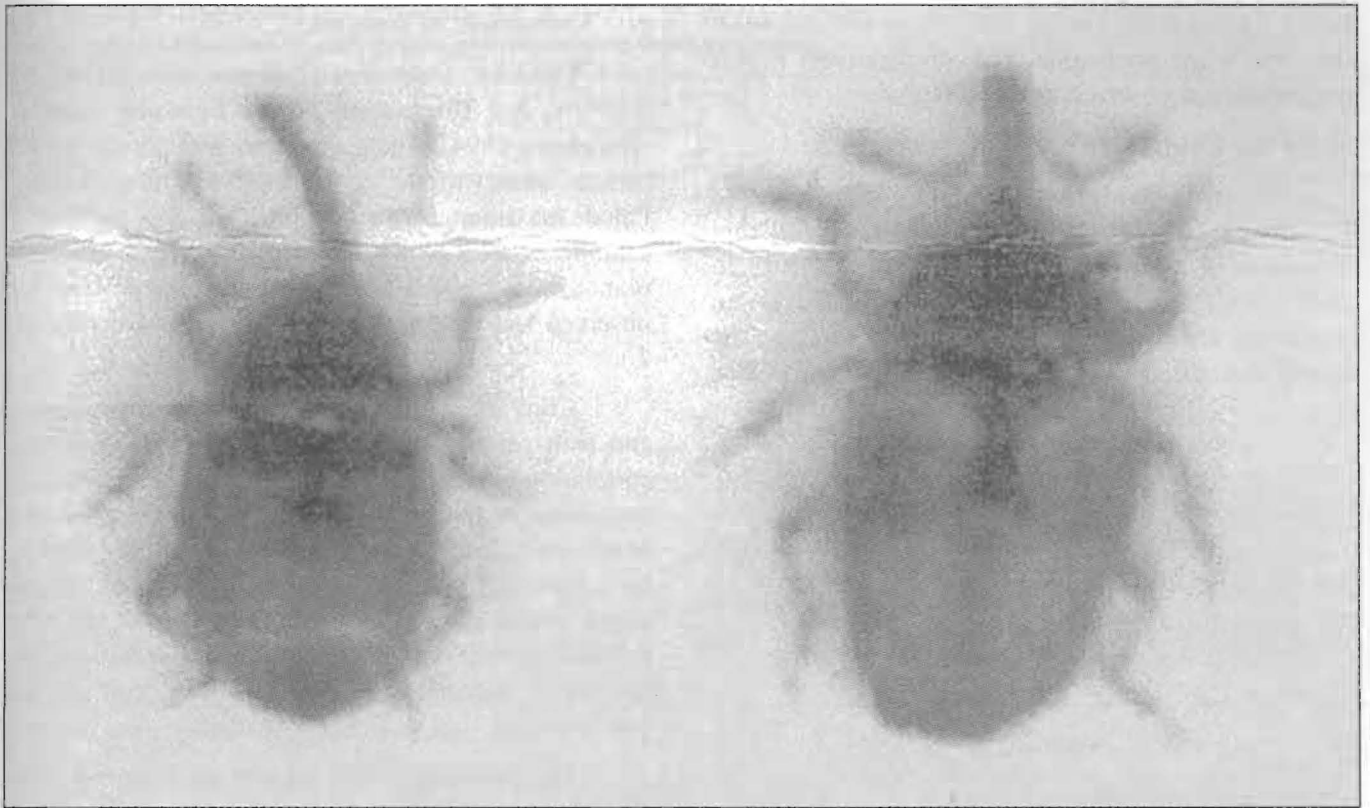


Plate 1. Oil Palm Pollinating Weevil, *Elaeidobius Kamerunicus*

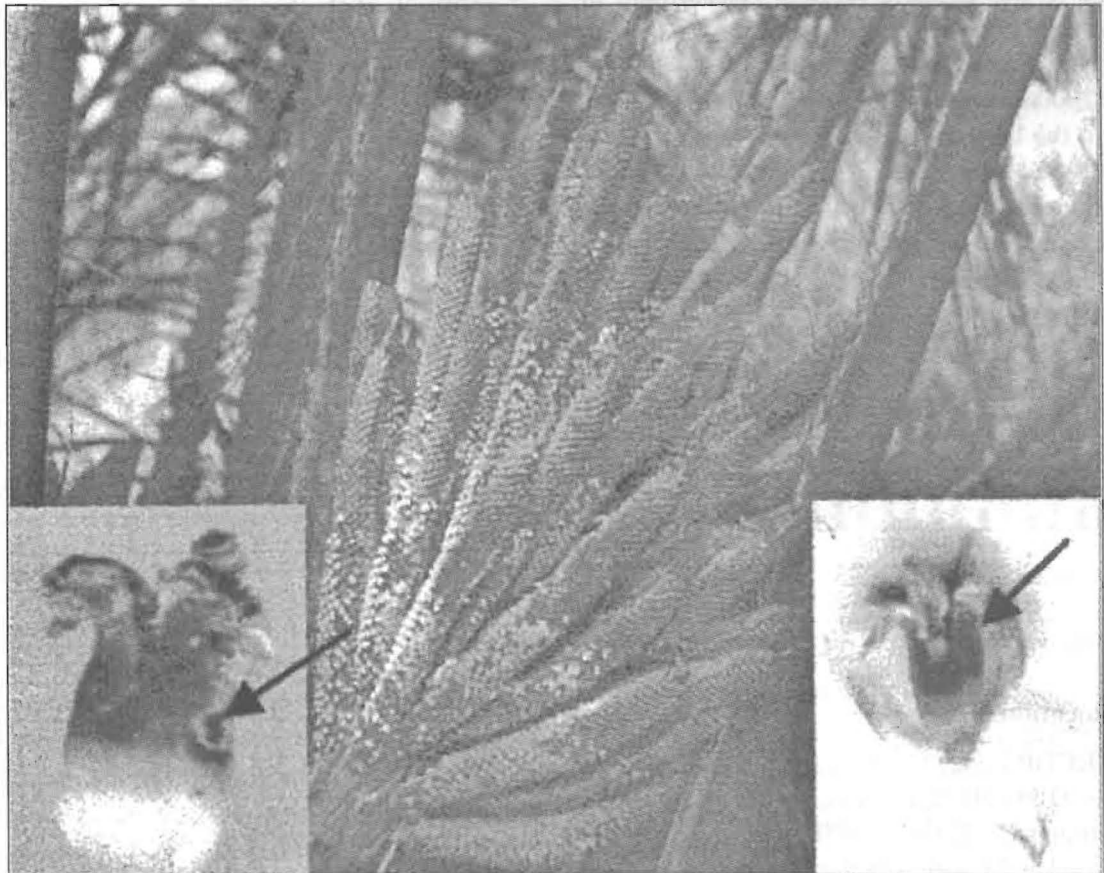


Plate 2. Male Inflorescence - male flower with egg

during August 2000. During 2001, there was not much variation in the population, but comparatively higher population was observed during wet season.

(ii) OPIL, Chithara:

Monthly sampling from October 1999 to September 2000 at OPIL, Chithara revealed that population of weevils per spike-let ranged from 13.36 (Sept., 2000) to 126.41 (May, 2000). Maximum population was noticed during May 2000 (Fig.2). The weevil population per spike-let was low compared to

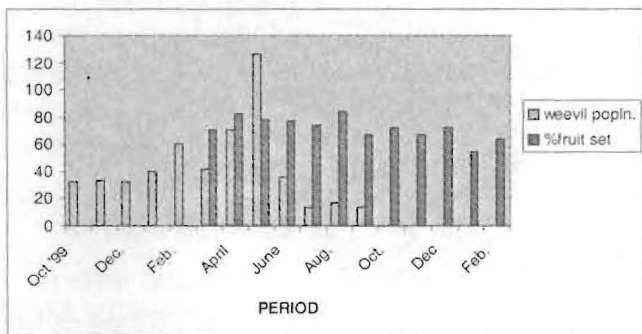


Fig.2. Weevil population & % fruit set in OPIL, Chithara

Palode. Variations in the population at the two locations may be due to the climatic factors. Assessment of population density of weevils in the bottom, middle and top spike lets was assessed from October 1999 to September 2000 revealed that the population of weevils was more in the bottom spike lets (617.94) especially during April and May (Fig.3). Here also minimum number of weevils were observed in the top spike lets (376.81). The reasons can be attributed to the tendency for avoiding high temperature in the exposed portions and the tendency for hiding.

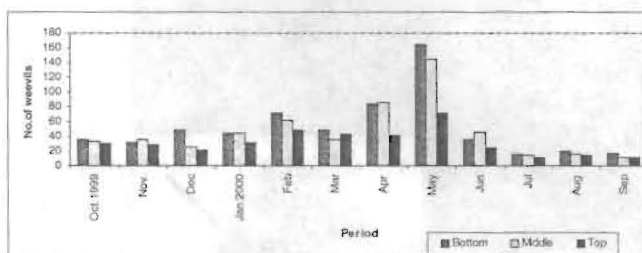


Fig 3. Comparative evaluation of the weevils in top, middle and bottom spikelets

(iii) Other locations:

At NRCOP, Pedavegi, the number of weevils per spikelet was 21.96, 30.22 at TRRI, Aduthurai, 87.36 at PCKL, Vettilappara, 42.05 at OPIL Thodupuzha, 8.59 at farmers' garden, Mysore, 128.9 at Shimoga, and 14.59 at Kuttanadu (Table 2).

c. Assessment of fruit set :

Fruit set increased after the introduction of weevils, but fluctuated widely between seasons (Dhileepan 1994). The same trend was noticed in the present observations. At NRCOP, Regional Station, Palode maximum fruit set obtained was 86.7 per cent in a range of 32.2 to 86.7 per cent. At the oil palm plantations of OPIL., Chithara, maximum fruit set observed was 84.1 per cent (range: 54.7-84.1) (Fig.1 & 2).

Correlation analysis, between weevil population and fruit set at NRCOP, Palode revealed significant correlation between percentage fruit set and total weevil population in general ($n=120$; $r = 0.24$). When the total bunch weight was correlated to the weevil population, the correlation was significant ($n=10$; $r=0.24$). All the above results showed that, the occurrence of oil palm pollinating weevils in the plantations enhances the pollination percentage leading to higher fruit set and bunch weight.

The percentage fruit set was 64.37 in oil palm plantations of NRCOP, Pedavegi during May, 2000, 64.08 in TRRI, Aduthurai during November 2000, 64.3 in PCKL, Vettilappara Estate during January 2000, 84.64 in OPIL, Seed Garden, Thodupuzha, during June, 2000, 64.79 during Jan., 2001 and 60.69 during March 2001, 73.9 in Farmer's Gardens, Mysore during August 2000, 71.27 in Shimoga during December 2002 and 75.95 in farmers' garden Kochuchekka (Kuttanadu, Kerala) during January 2003. Even though in Mysore (in the banks of river Kaveri) and Kochuchekka (Kuttanadu) the population of weevils was very low, comparatively high fruit set was observed. The heavy wind available in the riverbank and backwater areas enhanced the dispersal of pollen grains leading to high rate of fruit set (73.9 per cent in Mysore and 75.95 per cent in Kuttanadu) (Table.2).

Adverse factors affecting the weevil population and fruit set:

In the oil palm plantations (Varietal reaction studies) of NRCOP, Pedavegi, fruit set was only 64.37 during May, 2000. The average number of weevils per spike let was 21.96. One of the reasons for the low weevil population and fruit set was observed to be due to the spiders residing in the spider webs on oil palms which feeds on the weevils trapped in the webs. Spider webs were found more on palms having more anthesising male inflorescences. Studies revealed that, weevils emerging (progenies) from the spent inflorescences and weevils attracted towards the anthesising male and female

Table 1. Impact of the release of weevils in the oil palm plantations at Orakkadu, Chennai

Bunch No.	Total Fruits(No.)		Total flowers (No.) (unpollinated)		% fruit set		Wt.of bunch (kg)	
	A	B	A	B	A	B	A	B
1	81	511	771	210	9.51	70.87	1.8	8.1
2	63	719	971	181	6.09	79.89	1.8	6.0
3	439	373	464	132	48.62	73.86	3.0	2.2
4	268	449	462	246	36.71	64.6	3.3	2.5
5	324	480	442	283	42.29	62.91	2.0	2.8
6	440	757	350	320	55.69	70.28	2.8	4.3
7	54	904	439	350	10.95	72.08	1.5	10.9
8	36	882	631	385	5.39	69.61	1.0	6.3
9	36	1042	351	44	9.30	95.94	1.0	8.4
10	23	539	682	315	3.26	63.2	0.9	4.8
Total	1764	6656	5563	2466	24.08*	72.97*	19.1	56.32
Range					3.3-55.7	62.9-95.9		

* Mean; A= Pre release data; B= Post release data

Table 2. Weevil population and fruit set in various oil palm plantations

l.No	Period of release	Plantations District /State	Period of assessment	No.of weevils /spikelet	Fruit set(%)
1	1995	PCKL,Vettilappara,Trichur dist. Kerala	Jan.,2000	87.36	64.3
2	1986	OPIL, Seed gardenIdukki dist, Kerala	Jun,2000	42.05	84.64
3	1990	NRCOP,West Godavari DistAndhra Pradesh	May,2000	21.96	64.37
4	1991	Farmer's Garden Mysore Dist., Karnataka	Aug,2000	8.59	73.90
5	1992	TRRI,Aduthurai,Thanjavoor Dist., Tamil Nadu	Nov 2000	30.22	64.08
6	1990	Farmer's GardenShimoga Dist.,Karnataka	Dec.2002	128.9	71.27
7	1992	Farmer's GardenKochuchekka,Kuttanadu Kottayam dist.Kerala	Jan.,2003	14.59	75.95

inflorescences were trapped in spider webs. Different species of spiders were observed. Some species feed on the weevils as soon as they were trapped in the webs. Another species inactivate the weevils using web materials and then feed on them. Twenty palms having spider webs were selected randomly and observed. Average number of spider webs per palm was 14.2. On an average 7.82 weevils per palm were trapped in a spider web. In every ten minutes on an average 1.24 weevils per spider web were trapped (Table 3). Spiders as a hindrance for fruit setting was observed in Oil palm Seed Garden, Thodupuzha and in one of the farmer's gardens at Aduthurai.

Table 3 .Number of Spider Webs and the number of weevils trapped in the webs NRCOP,Pedavegi

Details	No.
No. of palms observed	20
Total spider webs	284
Mean no. of Spider Webs /palm	14.2
Mean no. of weevils trapped in the spider web/palm	111.1
Mean no. of weevils trapped/ spider web	7.82
Mean no. of weevils trapped in the webs/palm in every 10 minutes	17.7
Mean no. of weevils trapped/spider web in every 10 minutes	1.24

In Oil Palm plantations of PCKL, Vettilappara, fruit-set was only 64.3 per cent. The plantation is in a forest area with red soil. Infestation by termites was very high on male and female inflorescences and also on immature fruit bunches. The soil of the termatoria on the female inflorescences prevents the entry of weevils to the interior portions of the inflorescences, thereby preventing the pollination and fruit-set. In such bunches, fruit-set was observed only on the outer exposed region. The same problem was noticed in a farmer's garden in Karissery, Trichy District, Tamil Nadu.

In oil palm Seed Garden, Thodupuzha and at NRCOP, Palode during the dry season (January to May) the population of honeybees, *Apis indica* was found to be more in oil palm plantations. Honeybees were found collecting large quantities of pollen grains from the anthesising male inflorescences. They mostly swarm around the upper and outer exposed portions of the inflorescences, and in such male inflorescences the population of weevils were found to be very low or even absent. During March, the population of weevil was 21.84 /spikelet. Due to the swarming of bees, the pollen grains are dispersed in large quantities to the atmosphere, thereby increasing the pollen density in the atmosphere. Probably this may be one of the reasons for the high percentage of fruit-set during summer months even though weevil population was very low. Observations revealed that honeybees seldom visit female inflorescences probably due to lack of honey in female flowers of oil palm.

The earwig, *Chelisoches moris* F. (Dermaptera : Forficulidae) was found harboring on male inflorescences in large numbers. Studies under laboratory conditions revealed that the earwigs were predating even on the immature stages of the weevils. Under field conditions, the garden lizard, *Calotes versicolor* (Squamata: Agumidae) was found to feed an weevils. In addition to the above-mentioned predators monkeys and

mynahs were found predating on the weevils. Eventhough, the above reported animals hinder the breeding of *E.kamerunicus* in the oil palm, the activities of honeybees had not affected the extent of fruit set.

Conclusion

The above observations clearly revealed that the introduced weevil is flourishing very well in the oil palm plantations under various agro climatic conditions and enhanced the fruit set and thereby increased the overall productivity of oil palm in India.

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