BIOTYPICAL VARIABILITY AMONG FOUR POPULATIONS OF RED PALM WEEVIL *RHYNCHOPHORUS FERRUGIAEUS* FAB/OLIV. FROM DIFFERENT PARTS OF INDIA

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ABSTRACT

The red palm weevil ***rhpichophorus ferrugineus*** *FAB/OLIV* is a very serious and dreaded pest of coconut, date and other palms. Being an internal feeder the weevil incidence is detected at a very late stage when the tree has succumbed to weevil attack. Hence conventional control operations may not be very effective. The biotypical variability of the four populations collected from different parts of India showed that the populations are genetically different and strainal variability exists between them. Variations in sex ratio and deleterious genetic effect were observed in the crosses and reciprocal crosses. The weevil has a very high fitness due to high production potential and the absence of effective parasites, predators and pathogens. In spite of the high fitness, in endemic areas weevil population tend to remain at certain levels of intensity. This may be due to certain limiting factors.

INTRODUCTION

The importance of misect genetics m genetical methods of control has been recognized very recently. The use of SIRM against screw worms and its success made the scientists to think seriously in this direction on other aspects of genetical methods of pest control. Davidson (1974) reviewed literature on hybrid sterility in some dipterans species. Hybrid sterility in lepidoptera was studied in *Diparopsis* species, Beever et al (1973), *Heliothis* species; Laster (1972) and La chance (l974), *Pyralids;* Brower (l977) interstrainal and intespecific sterility in *Pectinophora gossypiella* and *P. Scutigera;* La chance and Ruud (l979)

Red pahn weevill *rhynchophoru sferrugineus* F. is the most dreaded pest of the coconut, date and other palms. The pest is present throughout the coconut growing tracts of India. The grubs are destructive and adults are harmless. The female weevil scoops out a hole in the soft tissues of the palm especially in cut and damaged tissues and lays a single egg in it with the ovipositor. The eggs are sealed with a cement-like substance. The eggs hatch in 2 to 3 days and the grubs feed on the tissue and tunnel into the stem. When the growing bud of the palm is affected due to the feeding of the grubs, the palm succumbs to weevil attack and the crown topples down. The external symptoms of weevil attack, viz. jutting out of fibre and oozing out of brown liquid through the exit hole, drooping of leaves, wilting of central shoot etc. are seen only at a very late stage. Being an internal feeder, it is difficult to detect the weevil infestation at an early stage of attack. As the pest infestation is noticed at a later stage, generally it is difficult to save the palm by curative treatment. Hence early detection of pest infestation and alternate methods of pest control becomes important in the management of red palm weevil.

Gonzalez *et al* (1979*)* emphasized the m1portance of study of host preference, behaviour, genetic composition, genetic variation etc. in assigning biotypic status to a population. The intensity and extent of damage may vary between population and biotypes. Normally biotypes are studied for sterility or refractoriness. Other than the above, genetical factors like deleterious genes, homozygous lethal, genes that control diapause and sensitivity to temperature, etc. which affect multiplication of the pest can be used to reduce pest population. Since red palm weevil is spread over a larger area under different agroclimatic and ecological conditions the variations can be large. Reported here are the observations on biological parameters of four populations of red palm weevil collected from different parts of India and F_1, and F_2, generations of their crosses.

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MATERIALS AND METHODS

Weevils were collected from four places viz. Chawl (Maharashtra), Arsikare (Karnataka), Mettupalayam (Tamil Nadu) and Kayangulam (Kerala). (Fig. 1). The populations were maintained as four colonies in the laboratory. Sugar cane pieces cut between nods and rind removed from one side were provided as egg laying material. The eggs were collected by pealing the sugarcane piece. The eggs were placed on most absorbant paper kept in petri plates and incubated at room temperature ranging between 23^0C and 34^0C. The newly hatched grubs were transferred to specimen tubes (7.5 x 2.5 cm size) containing artificial diet developed by Rahalkar et al. (1978). After two weeks the grubs were transferred singly into 25 to 30 cm long sugarcane pieces. These pieces were changed every week till pupation. Pupae were collected and kept in plastic containers and were observed for adult emergence. In all the experiments a minimum of 4 pairs of weevils were used and egg collections were continued till a reasonable number of eggs were collected.

The biological parameters observed were egg hatch, incubation period of eggs, larval period, larval mortality, pupal period, pupal mortality, adult emergence, sex ratio of male to female and mortality from egg to adults. The above data were collected from the four populations of F, and F2 of the crosses of Kayangulam x Mettupalayam, Kayangulam x Arsikare, Arsikare x Kayangulam, Chawl x Kayangulam, Kayangulam x Chawl, Arsikare x Mettupalayam, Mettupalayam x Arsikare and Arsikare x Chawl. The F_2 was raised from making among the F_1 progeny.

RESULTS AND DISCUSSION

Data on percentage of hatch, survival at larval and pupal stage and overall survival rate from egg to adults are presented in Table 1. Maximum survival rate from egg to adult of 20.5 percent was in Mettupalayam population and the lowest of 14.3 percent was in Kayangulam population. The sex ratio also varied and highest female ratio of 1.5 was in Kayangulam and the lowest of 0.5 percent m Chawl. In the F, progeny the survival rate did not show any relation to parental survival rates. The F_1, of Klm x Met, Klm x Ars, Ars x Met and Met x Ars showed lesser rates of survival than the parents as a whole. Klm x Chawl gave a higher survival rate than the parents. In the F_2 progeny Klm x Chw, Chw x Klm and Ars x Klm the survival rate was higher than in F_1, and parents. The other F_2 progeny showed lesser survival rate than the parental population.

A comparison of the survival rates between F_1 and F_2 progeny included that there was an overall increase in survival rate in the F_2 progeny except for progeny of Ars and Chw. The sex ratio also showed marked difference among the populations F_1 and F_2. In crosses were Kayangulam females were used an increase in female ratio was observed.

The data on survival at various stages of development of populations and F_1 and F_2 of the different crosses were subjected to chisquare test to test for their independence (Table 2). The four populations examined were more or less similar in survival at the larval and pupal period. In the case of egg hatch the populations showed significant difference. The F_1 generation of the different crosses showed significant difference in egg hatch and survival at larval stage while in F_2 only larval survival rate showed significant difference. When the data was analyzed for parent populations, F_1 and F_2 together significant difference was observed in egg hatch and survival at larval and pupal stage.

The larval and pupal period for the parent populations as well as for F_1 and F_2 generations were subjected to analysis of variance and results are presented mi Table 3 and 4. The larval period for the population ranged between 48.4 to 55.8 days and did not differ significantly. In the case of pupae it was between 14.4 to 19.3 and varied significantly. The larval period for the F_1 progeny ranged between 42.3 and 59.2 days and pupae 14.9 to 21.2 days. Larval and pupal period of F_1 varied significantly. In the case of F_2 the lowest larval period was 39.9 days and highest was 61.6 days while in pupae it ranged between 11.4 to 21.1 days. The data on larval and pupal period for F_2 generation varied significantly.

The four populations were more or less similar in morphological and other characters. When the populations were crossed the F_1 and F_2 progeny showed variations in the different characters tested. Some of the crosses and reciprocal crosses showed variations. The survival rates mi the F_1 and F_2 of Klm x Ars (Fig. II) were 12.2 and 12.1 while in the reciprocal cross it was 24.3 and 23.9 percent. The F_1 of Klm x Chw and its reciprocal cross gave 21.7 and 18.6 percent survival (Fig. II) while in the F_2 the survival were 33.9 and 28.9 percent (Fig. II). The F_1 of Ars x Met and its reciprocal cross the survival rate was 6.7 and 6.5 percent respectively while in F_2 it was 10 and 12.6 percent. The populations tested showed difference in sex ratio and the same was reflected in the F_1 and F_2 crosses (Fig. III). The difference mi sex ratio observed in the populations and variations in F_1 and F_2 progeny may be due to defects in the genetic make up of the populations tested. The variations observed mi the pooled data for the population F_1 and F_2 generations of the different crosses and the varied reaction in the reciprocal crosses indicate that genetical differences exist between the populations tested and can be considered as due to occurrence of different biotypes.

In this context it may be worthwhile to examine the possible factors that regulate weevil attack in field. The insect has a very high fitness due to a high fecundity rate, a favourable male to female ratio, absence of known effective parasites, predators or pathogens with abundant food supply. But in spite of all factors in its favor the insect has never assume such devastating proportions to totally wipe out the coconut industry. Even in endemic areas of pest infestation the pest damage has been reported to be kept at certain level of intensity. The possible factors that limit the weevil population in field may be the non-availability of suitable egg laying sites and the complete utilization of the available sites. Available information suggest that the pest is incapable of laying eggs on surfaces other than cut and injured portions, decayed areas due to bud rot and leaf rot and damaged regions due to *Oryctes* attack, etc. In view of the above observation the pest could be controlled effectively by a realistic and result oriented control programme. In view of the above, it is suggested that in formulating control operations stress should be given to sanitary measures, detection and curative treatment. In this case of pheromone trapping, it is suggested that the males captured in the traps may be re-released to reduce the possibility of development of non-attraction to pheromone in the population. It has been reported that R *ferrugineus* and R. *cruentatus* mate in laboratory. The study of sterility in these populations and its use in population control may be tried.

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Table 1: Data on biological parameters of 4 populations of red palm weevil and F_1 and F_2 Generations of various crosses

Populations/ Crosses & F1	Eggs		Grubs		Pupae		% Survival of egg to adult	Sex ratio Male to Female
	Observed	% Hatch	Observed	% Survival	Observed	% Survival		
Arsikare	217	53	117	37	43	77	15.7	0.83
Chawl	201	75	151	31	47	77	17.9	0.50
Mettupalayam	117	66	77	35	27	89	20.5	0.85
Kayangulam	336	63	711	36	75	64	14.3	1.52
Crosses F_1								
Klm x Met	282	63	177	14	25	84	7.5	1.10
Klm x Ars	196	77	150	23	34	71	12.2	1.40
Ars x Klm	74	72	53	51	77	67	24.3	0.64
Chw x Klm	167	73	122	39	47	66	18.6	0.62
Klm x Chw	83	83	69	52	36	50	21.7	1.25
Ars x Met	269	54	145	16	23	78	6.7	0.64
Met x Ars	139	62	85	13	11	82	6.5	0.80
Ars x Chw	146	48	70	51	36	78	19.2	1.80
F_2								
Klm x Met	218	67	145	20	29	79	10.6	0.92
Klm x Ars	446	59	261	2	66	82	12.1	1.45
Ars x Klm	163	60	98	47	46	85	23.9	0.85
Chw x Klm	259	67	174	55	95	79	28.9	0.92
Klm x Chw	65	69	45	60	27	81	33.9	1.44
Ars x Met	300	61	182	21	38	79	10	0.87
Met x Ars	127	62	79	22	17	94	12.6	1.22
Ars x Chw	258	66	169	54	91	70	13.2	1.00

Table 2: Chisquare analysis of biological parameters of 4 populations and F_1 And F_2 of their crosses

		Survival of			
	Eggs Hatched	Grubs	Pupae	Adults emerged	No. of Females
Arsikare	117	43	33	33	15
Chawl	151	47	36	36	12
Mettupalayam	77	27	24	24	11
Kayangulam	711	75	48	48	29
Crosses: F_1					
Klm x Met	177	25	21	21	11
Klm x Ars	150	34	24	24	14
Ars x Klm	53	27	18	18	7
Chw x Klm	122	47	31	31	13
Klm x Chw	69	36	18	18	10
Ars x Met	145	23	18	18	17
Met x Ars	85	11	9	9	4
Met x Ars	70	36	28	28	18
F_2					
Klm x Met	145	29	23	23	11
Klm x Ars	261	66	54	54	32
Ars x Klm	98	46	39	34	18
Chw x Klm	174	95	75	75	36
Klm x Chw	45	27	22	22	13
Ars x Met	182	38	30	30	14
Met x Ars	79	17	16	16	9
Ars x Chw	169	91	64	34	32
Chisquare values for					
All population Together	94.27**	273.54**	35.1*	133.87**	15.80
Parental population	20.7*	1.4	7.2	3.1	6.20
F_1 generation	63.41**	99.88*	10.93	47.50	5.91
F_2 generation	9.97	120.83**	7.80	76.04**	3.21
Klm and its crosses	42.04**	133.81**	25.49*	88.53	7.91

Ars = Arsikare Met = Mettupalayam
Chw = Chawl Klm = Kayangulam

Table 3: Differences in the larval and pupal period of 4 populations of red Palm weevil

SI NO.	Populations	Mean larval Period	Mean pupal period
1.	Arsikare	55.8	14.8
2.	Chawl	48.6	19.3
3.	Mettupalam	48.4	14.4
4.	Kayangulam	51.0	17.0
	Gen. Mean	51.6	16.5
	CV %	30.4	24.5
	F ratio	1.71	8.96**
	CD (P=0.01)	NS	1.92

** Significant at P = 0.01

Table 4: Differences in the larval and pupal period of F_1 and F_2 generation of The crosses of 4 populations

SI NO.	Crosses	F_1 Populations		F_2 Populations	
		Mean larval Period	Mean pupal Period	Mean larval Period	Mean pupal period
1	Klm x Met	51.4	21.0	56.7	11.4
2	Klm x Ars	52.9	20.7	39.9	12.2
3	Ars x Klm	42.5	16.7	57.8	16.8
4	Chw x Klm	48.7	15.6	50.7	16.9
5	Klm x Chw	42.3	17.9	61.6	15.5
6	Ars x Met	56.5	21.2	59.2	18.5
7	Met x Ars	59.2	19.4	59.2	21.1
8	Ars x Chw	47.8	14.9	40.1	14.5
	Gen Mean	48.6	17.6	48.9	15.4
	CV %	23.0	24.2	29.9	26.5
	F ratio	6.26**	7.57**	14.35**	14.97**
	Critical ifference (P=0.01)	5.96	2.56	6.31	1.94

** significant at P=0.01

Fig 1. Map of India showing areas from where populations collected

Fig 2. Survival rate in four populations of Red palm weevil, F_1 and F_2 of their crosses and reciprocal crosses

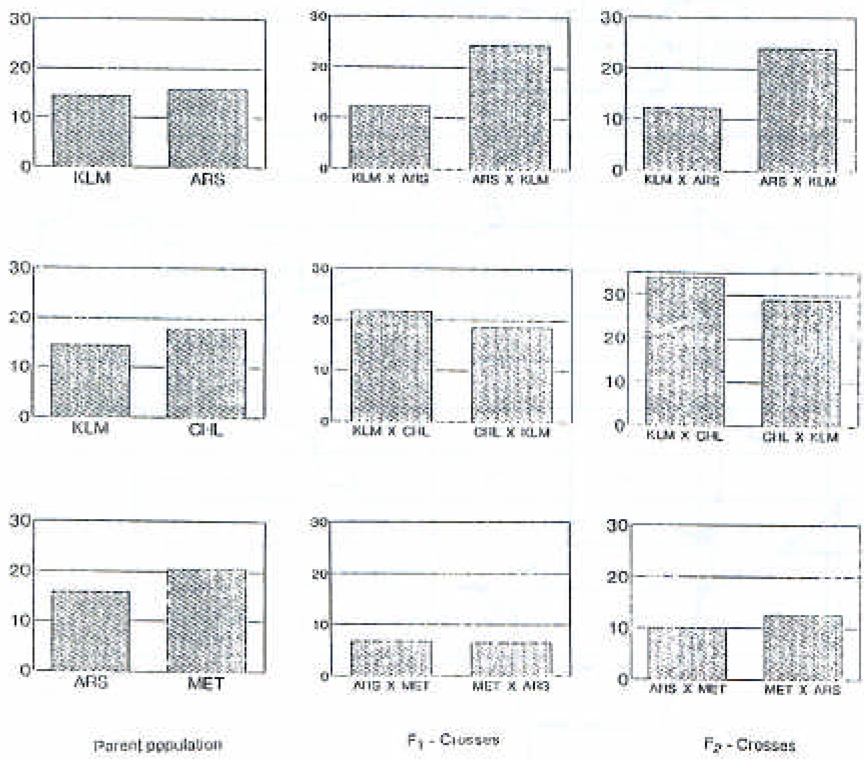

Fig 3. Variations in sex ratio among four populations of Red palm weevil and F_1 and F_2 of their crosses and reciprocal crosses