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Suitability of pumpkin (*Cucurbita moschata* Duchesne ex Poir) fruits for laboratory rearing of two strains of (Coccoidea : Tachardiidae) Indian lac insect, *Kerria lacca* (Kerr.)

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ABSTRACT : The two strains i.e., *rangeeni* and *kusmi* of Indian lac insect, *Kerria lacca* (Kerr.) were successfully grown on fruits of pumpkin (*Cucurbita moschata*). Life period was favourably reduced from 184.9 and 109.6 to 154.3 and 100.9 days, respectively for *kusmi* and *rangeeni* strains. Amount of resin secreted by the insects decreased on pumpkin. The reduction was more in *kusmi* (36.9%) as compared to *rangeeni* (27.5%). Mortality of lac insects on pumpkin was almost doubled. Also, proportion of males in the cultures increased sharply. The insect completed its life cycle satisfactorily providing viable progeny without much affecting its fertility. The two strains showed differential behaviour in respect of amount of resin secreted, mortality inflicted and total life period when cultured on pumpkin.

The Indian lac insect, *Kerria lacca* (Kerr.) is sedentary and phytosuccivorous in habit and requires plant host for its propagation. The two strains of lac insect are characterised as *rangeeni* and *kusmi* mainly on the basis of hosts on which they are cultivated (Kapur, 1962). *Flemingia macrophylla* (*bhalia*) is one such plant on which both the strains can be cultivated (Krishnaswami, Purkayastha and Chauhan, 1962) and is used widely as lac host for laboratory experiments on lac insect. However, lac insect is not amenable to certain experimentation techniques when grown on plant hosts. Successful attempt was made to grow lac on fruits of pumpkin to facilitate certain laboratory studies (Sharma, 1991). This contribution reports on the continuation of these studies to compare the performance of lac insect reared on pumpkin with those maintained on potted plants of *bhalia*.

MATERIALS AND METHODS

Laboratory maintained cultures of *rangeeni* and field collected lac insects of *kusmi* strain were propagated on 6-8 month old shoots of *bhalia* and detached ripened pumpkin fruits during rainy season in the month of July. The insects cultured on *bhalia* were covered by fine muslin cloth sleeves to prevent losses due to parasitoids and predators, while the cultures on pumpkin were maintained in rectangular wooden boxes fitted with fine wire gauge mesh. The cultures were sprayed with 0.05% fungicide Indofil M-45, as and when required, to guard against the attack of fungi.

Since the lac insects settle in close proximity and resin secreted by them coalesce

to form a continuous encrustation, the cultures were periodically thinned manually with the help of a needle to obtain single female insects at the time of maturity. The following parameters were scored : (i) initial mortality after 30 days of propagation of cultures, (ii) sex ratio close to the time of sexual maturity, (iii) total weight of the female lac insect cell after larval emergence was over, (iv) fecundity, and (v) total time taken by the female lac insect to complete one generation.

Five cultures of each strain were maintained on both *bhalia* and pumpkin. Ten females were collected from each culture when yellow spot (indicating maturity) appeared on the cell and were put in 5 ml glass vials separately. Total number of larvae emerged were counted after a month of collection. The same cells were weighed for recording amount of resin secreted. Remaining insects on *bhalia* / pumpkin were used for recording the time taken to complete one generation. Average values were taken as representatives of each replicate. Split plot design was employed to analyse the data taking hosts as main and strains as secondary factor.

RESULTS AND DISCUSSION

Resin : The two strains of lac insect differed significantly in the amount of resin secreted when reared on the conventional laboratory host *bhalia* (Table 1). Resin produced by *kusmi* strain was more as compared to *rangeeni*. However, when cultured on pumpkin, amount of resin secreted was drastically reduced in both ($P < 0.01$). The reduction was more in *kusmi* (36.9%) in comparison to *rangeeni* (27.5%). The quantity of resin secreted by the female lac insect did not differ significantly between strains on pumpkin.

Fecundity : Number of larvae produced by individual female lac insect of *rangeeni* strain was more as compared to *kusmi* on conventional laboratory host (Table 1). When reared on pumpkin, fecundity of both the strains was affected ($P<0.05$).

Sex ratio : Significant deviations were observed in sex ratio which tended to increase sharply in favour of males when lac insect was cultivated on pumpkin. Both strains behaved similarly (Table 1). No inter-strain differences were observed on either of the host. Intra-strain variation in sex ratio was high on pumpkin as evidenced from wider ranges.

Mortality : Survival of lac insect was affected severely on pumpkin (Table 2) and there was significant decrease in insect survival until sexual maturity was attained. The increase in mortality observed was 67.2% and 104.9% for the *kusmi* and the *rangeeni* strains, respectively. The two strains reacted differently as the mortality inflicted was higher in *rangeeni* when cultivated on pumpkin.

Life period : Total time taken by individual female lac insects of both strains to complete one generation was significantly reduced ($P < 0.01$) (Table 2). The decrease was comparatively higher in *kusmi* (30.6 days, 16.5%) as compared to *rangeeni* strain (8.7 days, 7.9%) indicating different physiological behaviour of the two strains.

The quantity and quality of food available to an insect is important in determining

Table 1. Comparative statistics of amount of resin secreted, fecundity and male proportion in two strains of *K. lacca* on two different hosts during rainy season

Statistical parameter	Resin (mg)				Fecundity (no.)				Males (%)			
	C. moschata		*F. macrophylla*		*C. moschata*		*F. macrophylla*		*C. moschata*		*F. macrophylla*	
	rangeeni	*kusmi*	*rangeeni*	*kusmi*	*rangeeni*	*kusmi*	*rangeeni*	*kusmi*	*rangeeni*	*kusmi*	*rangeeni*	*kusmi*
Mean	8.61	8.85	11.87	14.04	446.6	346.7	496.3	374.6	70.05	62.65	39.76	37.28
Sample size	50	50	50	50	50	50	50	50	350	355	609	505
Range	5.54-14.06	4.54-12.91	7.30-15.79	8.79-18.78	235-750	237-470	274-790	204-551	59.04-84.37	48.65-70.43	36.49-44.64	36.67-38.48

	Factors					Factors					Factors				
	A	B	I	$A(B_1-B_0)$	$B(A_1-A_0)$	A	B	I	$A(B_1-B_0)$	$B(A_1-A_0)$	A	B	I	$A(B_1-B_0)$	$B(A_1-A_0)$
S.Em.±	0.11	0.14	0.20			6.7	6.7	9.4			0.22	2.89	4.08		
F - calculated	687.6**	35.8**	23.0**			17.9*	136.0**	1.59ns			7889.4**	1.47ns	0.36ns		
C.D. at 5%	0.32	0.33	-	0.46	0.45	18.5	15.4	-	ns	24.0	0.62	ns	-	ns	6.70

A = host; B = strain; I = interaction; ns = non significant

* = $P<0.05$; ** = $P<0.01$

Table 2. Comparative statistics of mortality inflicted and total life period in two strains of *K. lacca* on two different hosts during rainy season

Statistical parameter	Mortality (%)				Total life period (days)			
	C. moschata		*F. macrophylla*		*C.moschata*		*F.macrophylla*	
	rangeeni	*kusmi*	*rangeeni*	*kusmi*	*rangeeni*	*kusmi*	*rangeeni*	*kusmi*
Mean	66.59	62.74	32.50	37.50	37.43	100.9	154.3	109.6 184.9
Sample size	1219	979	816	713	86	55	166	186
Range	64.08-69.08	57.08-68.75	28.78-33.64	33.26-40.37	92-111	146-180	100-120	172-209

	Factors					Factors				
	A	B	I	$A(B_1-B_0)$	$B(A_1-A_0)$	A	B	I	$A(B_1-B_0)$	$B(A_1-A_0)$
S.Em. ±	0.11	0.68	0.96			1.27	0.74	1.04		
F - calculated	35328.2**	0.32ns	21.2**			119.1**	3801.5**	111.5**		
C.D. at 5%	0.31	ns	-	2.21	1.59	3.54	1.71	-	2.41	3.92

A = host; B = strain; I = interaction; ns = non significant

* = P<0.05; ** = P<0.01

its survival and reproduction rate. This is particularly true for phloem sap feeding insects such as lac insect. It has been observed in similarly feeding aphids that a considerable flux of sieve tube sap down to stylet and in the aphid gut can occur solely as a function of turgor pressure as evidenced by the severed end of a stylet from which the aphids had been cut (Auclair, 1963; Dixon, 1975). This passive exudation of sap from phloem through intruded stylet as a function of phloem turgor has a substantial role in the supply of pholem sap to the insect.

Lac insect is sedentary in habit and once settled it never moves from the feeding site and thus requires incessant supply of sap for survival. Its gregarious nature further compounds the problem of availability of food constantly. While feeding on plant, *F. macrophylla*, the continuous and active flow of sap ensures requisite amount of nutrients, whereas on pumpkin limited and passive availability of food must be one of the factors causing heavy mortality of the lac insect sitting in close proximity. Whether lac insect is just a passive channel for this pressure driven flow is, however, not known. It was also observed that survival of lac insect per unit area on pumpkin was lower. No more than five insects in close proximity survived while on *bhalia* shoot it formed a continuous encrustation.

Although large number of plant species have been reported to support lac insect on them, its various biological attributes as survival, resin production and fecundity differed greatly with the host used (Choudhary, Gokulpure and Bhattacharya, 1982). Quantitative and qualitative differences in the nutrition available on pumpkin could be the probable cause of poor resin secretion, reduced fecundity, higher mortality and shorter life span on pumpkin.

Progeny size and sex ratio vary widely in lac insect. All male progenies from single mother are not uncommon (Chauhan, 1985). This wide fluctuation in sex ratio is poorly understood. It has been observed to vary with (i) season (Glover, 1937); (ii) sequence of emergence (Chauhan, 1970); (iii) site of colonisation (Chauhan, 1970); (iv) density of settlement (Krishnaswamy, Purkayastha and Mazumdar, 1963; Purkayastha and Krishnan, 1964); and (v) host species variety (Srivastava and Kumar, 1985). Chauhan (1988) reported that sex ratio in Meghalaya (India) stock of lac insect differed significantly between the host species used. It was observed to be 72% in favour of males on *F. macrophylla,* 82% on *Cajanus cajan,* and 98% on *Zizyphus mauritiana.* Choudhary *et al.* (1982) observed that the two strains of the lac insect differed significantly in their sex ratio which was not affected by the host and is contrary to present findings.

Inter-strain behavioural differences with respect to resin secreted, mortality and life period as is evident from host strain interaction may be attributed to the two strains differing in their nutritional requirements (Chauhan and Mishra, 1970).

Viable progeny from the lac insect without much affecting its fertility when reared on pumpkin clearly showed that the fruit contains all the essential nutrients of food required for successful completioin of life cycle by the lac insect. However, inadequate availability of food is a limiting factor which affects the various biological attributes of lac insect.

Evidently, pumpkin can not to exploited for commercial cultivation of lac, but can be satisfactorily used for laboratory rearing in view of its amenability to conducting certain laboratory experiments which may be difficult when lac is cultured on a plant host.

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