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Influence of Prey Species and Age of Prey on the Reproductive Performance of a Predatory Stink Bug (*Eocanthecona furcellata* (Wolff.) (Heteroptera : Asopinae))

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ABSTRACT

The growth and reproductive potential of *Eocanthecona furcellata* (Wolff.) increased when they fed on mature prey stages, while younger prey stages inhibited egg output and longevity drastically. Among the various prey species, *Latoia lepida* (Cramer) supported growth and reproduction better than *Eupterote mollifera* W. and *Pericallia ricini* F. The differential nutritional quality of larval stages / species exhibited considerable nutritional stress on the generalist predatory stink bug, *E. furcellata*. The importance of larval nutritional quality in terms of prey age / species for mass culture of predators in biocontrol programmes is discussed.

Key Words : *Eocanthecona furcellata,* influence of prey species, *Latoia lepida, Eupterote mollifera, Pericalia ricini* age, nutrition

Predatory insects seem highly opportunistic, preferring diverse prey species and habitats (Elton, 1966). The reproductive potential of insects is influenced by a variety of external and internal factors, and amongst them nutrition seems to be the most crucial single factor that affects reproduction and survival (Engelmann, 1970). Specialist entomophages tend to exploit particular prey species upon which they specialize more effectively than generalists (MacArthur, 1972). Reproductive timing in insects is an important phenomenon, since the success and survival of wingless nymphs depends to a larger degree as to when and where they hatch and colonize (Evans, 1982). Entomophagous insects face physical and physiological prey resistance that modify the reproductive performance of entomophages (Senrayan, 1989). In view of the generalist feeding nature of the predatory stink bug, *Eocanthecona furcellata* (Wolff), this study attempts to analyse the role of prey age / species on the developmental and reproductive performance of the predator.

MATERIALS AND METHODS

E. furcellata was collected from host plants such as *Mangifera indica* L., *Cassia marginata* Roxb, *Terminalia cattappa* L. and *Ricinus communis* L. during September through January each year since 1986. A laboratory colony was established using glass troughs (50 x 20cm) with various prey species *viz., Latoia lepida* (Cramer), *Eupterote mollifera* W. and *Pericallia ricini* F. Foliage provided in the rearing troughs served as oviposition substratum. Developmental stages of the prey were determined based on body length and head width. The cultures of predators were maintained at a temperature range of 26 ± 2°C and 12 : 10 photoperiod.

Prey stages / species of experimental interest was supplied to predators in large numbers to prevent starvation among experimental insects. The experiments started with second instar nymphs with different prey stages / species till adult emergence, for evaluation of larval suitability. Fresh adults were maintained in pairs on various prey stages / species to

evaluate prey quality on reproduction. Adult longevity was taken into account in all the experiments with ten replications. The larvae utilized in various treatments consisted of constant age group in all prey species.

The various biochemical profiles of the prey assessed were carbohydrates (Dubois *et al.*, 1956), total proteins (Lowry *et al.*, 1956), lipids (Folch *et al.*, 1957) and total aminoacids (Moore and Stein, 1948). The larval stages for energy estimation were dried in a hot air oven at 60°C before the estimation using a semi-micro bomb calorimeter (Parr Inst.Co., USA). The qualitative fatty acid methyl esters was analysed by a Hewlett Packard HPLC system (Model HP 1090) at 230 nm using Hypersil ODS 5 µm column with water and acetonitrile as solvents at a flow rate of 0.45 ml according to the gradient programme of Schuster (1985). The retention time and area percentage of fatty acid methyl esters were tabulated.

RESULTS AND DISCUSSION

The nymphal duration was considerably reduced when fed on mature stages of *L. lepida* (x = 12.8), while it was delayed considerably when fed on early larval stages of *P. ricini* (x = 24.6) and *E. mollifera* (x = 21.7). Among the prey species, *L. lepida* considerably reduced the nymphal duration compared to *E. mollifera* and *P. ricini*. In general, mature stages of all the three prey species quickened the nymphal development, while maintenance of predators on young prey stages resulted in extended nymphal duration (Table 1). Higher nymphal mortality under early larval stages were observed due to nutritional deficiency, a major factor that prohibit normal laboratory mass cultures. Predators maintained with *L.*

Table 1. Nymphal development, fecundity and adult longevity of *E. furcellata* fed on different prey species/ages

Prey species and instar	Total nymphal duration (days) ($\bar{X}$ ± SD)	Fecundity $\bar{X}$ ± SD	Adult Longevity (days)		Nymphal Survival (%)
			Male	Female	
L. lepida					
I	16.2 ± 0.95	198.0 ± 22.44	16.8 ± 1.52	20.0 ± 1.58	66.5
II	16.0 ± 1.55	212.4 ± 44.86	19.4 ± 1.58	18.2 ± 2.01	73.2
III	15.5 ± 1.64	235.6 ± 31.33	20.3 ± 1.68	23.2 ± 1.92	80.0
IV	12.8 ± 1.45	296.8 ± 42.92	25.8 ± 4.47	33.6 ± 3.92	94.0
V	12.8 ± 0.95	404.0 ± 56.60	36.8 ± 4.48	46.4 ± 6.46	94.5
E. mollifera					
I	21.7 ± 1.01	142.4 ± 34.59	20.5 ± 4.62	22.5 ± 2.45	58.6
II	20.4 ± 1.47	192.8 ± 32.26	19.6 ± 4.66	33.8 ± 2.86	60.0
III	18.4 ± 1.00	244.6 ± 26.60	21.2 ± 1.25	25.5 ± 4.54	68.0
IV	17.7 ± 0.97	291.8 ± 66.00	24.6 ± 3.56	29.3 ± 4.02	72.0
V	17.9 ± 1.15	306.6 ± 48.3	24.4 ± 4.62	31.4 ± 3.40	76.0
P. ricini					
I	24.6 ± 2.37	108.6 ± 20.14	15.3 ± 2.56	19.8 ± 3.66	46.4
II	24.2 ± 2.46	141.6 ± 20.40	17.4 ± 3.22	21.4 ± 4.12	56.2
III	22.6 ± 3.83	166.4 ± 23.50	19.6 ± 4.56	22.8 ± 5.15	59.0
IV	19.4 ± 3.46	181.8 ± 44.30	19.2 ± 3.22	24.6 ± 6.50	66.0

Table 2. Biochemical profile of the body fluid of different prey species at different ages

Prey species and instar	Larval wt. (mg/larva)	Proteins (mg/larva)	Carbohydrates (mg/larva)	Amino acids (mg/larva)	Energy content (mg/larva)	Total lipids (mg/larva)
L. lepida						
I	55.6	10.2	21.3	0.23	97.9	0.50
II	96.5	29.0	31.2	0.34	302.6	0.83
III	185.8	37.1	56.2	1.98	486.2	1.56
IV	289.2	46.4	106.3	2.22	786.2	4.15
V	579.80	58.6	187.8	2.86	925.7	6.42
E. mollifera						
I	104.6	14.2	28.3	0.93	114.2	0.71
II	214.0	26.6	43.0	1.02	326.2	0.92
III	340.6	38.2	69.0	2.24	512.4	1.83
IV	518.0	54.3	124.4	2.92	922.4	4.92
V	998.0	62.4	212.4	3.46	1246.5	8.22
P. ricini						
I	22.6	6.8	4.2	0.06	52.5	0.09
II	77.2	7.13	14.6	0.09	126.3	0.20
III	164.6	20.3	23.0	0.19	202.5	0.72
IV	252.8	28.6	39.2	1.21	306.5	0.98
V	404.5	34.8	56.0-	2.18	506.6	1.04

lepida exhibited higher adult longevity compared to larvae of *E. mollifera* and *P. ricini* (Table 1). Females fed with mature caterpillars of *L. lepida* showed a maximum output of 404.3 eggs followed by *E. mollifera* and *P. ricini* (Table 1). Drummond *et al.* (1987) evaluated the reproductive efficiency of the predatory stink bug, *Oplomus dichrous* with various developmental stages of *Leptinotarsa decemlineata* (Say) and indicated the nutritional quality of mature prey stages for optimal reproductive ability and easy laboratory culture maintenance. Coppel and Jones (1962) and Wadill and Shepard (1975) evaluated different prey species for mass rearing of the predator, *P. maculiventris* and indicated the importance of mature prey species for optimal reproduction and better survival.

Estimation of protein content indicated higher quantity in *E. mollifera* followed by *L. lepida* and *P. ricini*. The estimation of carbohydrates, amino acids and lipids also showed similar trend in all the prey species. The energy content increased with prey stage and the order of increase in energy content being *E. mollifera, L. lepida* and *P. ricini* (Table 2). HPLC analysis of fatty acid methyl esters indicated that mature larvae of *L. lepida* showed the presence of important dietary fatty acids like linoleic, palmitic, oleic and stearic acids. The number of fatty acid fractions identified decreased in early instars, and especially in first instar larvae, no traceable amount of fatty acids was detected (Fig 1 and Table 3). Similarly, the fatty acid sources of early larval stages were found to be poor in terms of number of fractions compared to late larval stages of *E. mollifera* and *P. ricini.* (Fig. 1 and Table 3). Dadd (1975) indicated that among the several saturated moneic fatty acids, oleic acid was most effective for *Bombyx mori* in terms of normal growth and reproduction, while in most insect herbivores and entomophages, a mixture

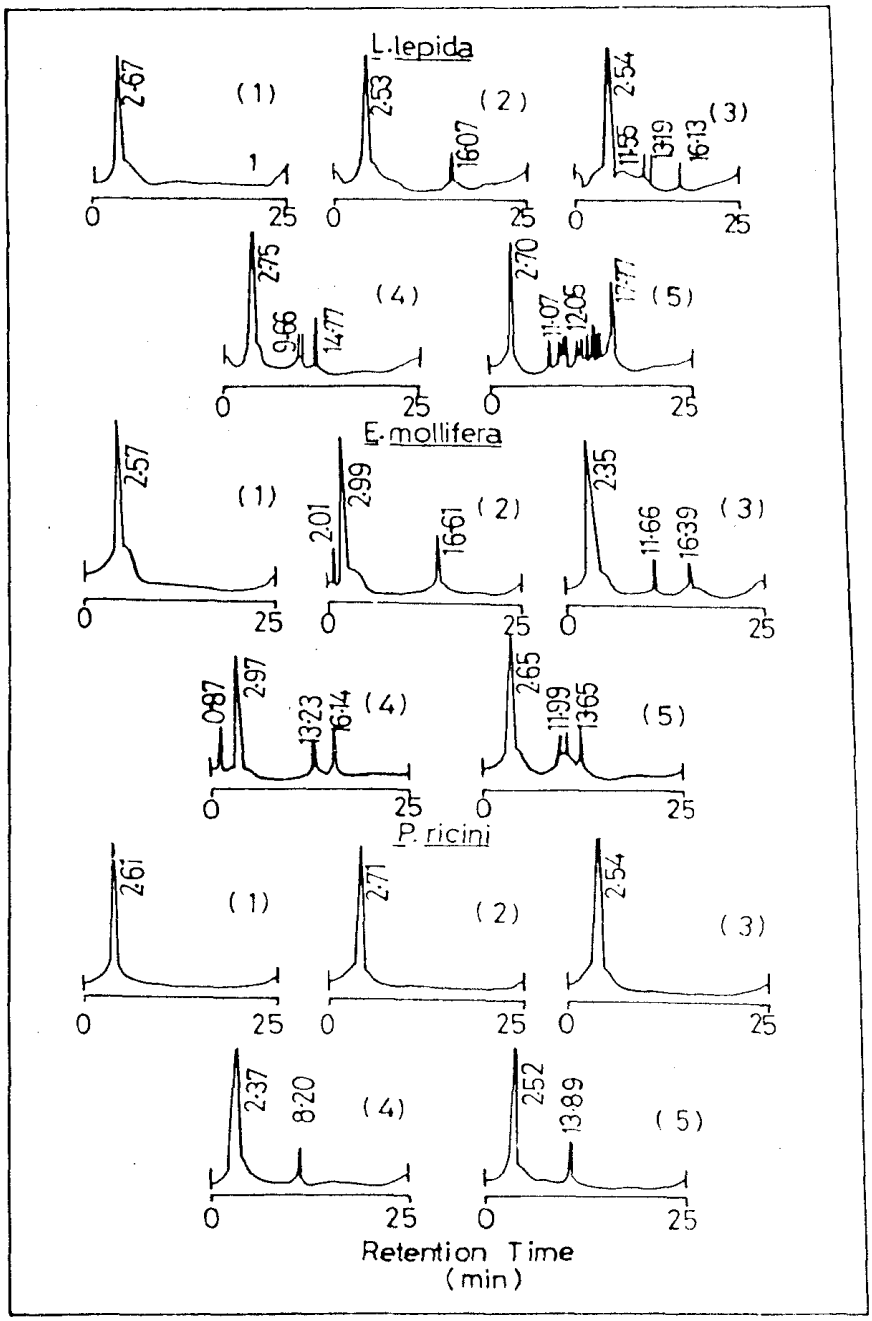

Fig 1. HPLC chromatograms of fatty acid methyl esters of various prey species (Numbers provided in parentheses in each chromatogram indicate larval stage).

Table 3. Retention time and area percentage of fatty acid methyl esters identified in different species/ages

Prey species and instar	Retention time (RT)	Area percentage	Fatty acid
L. lepida			
I	2.62	100.00	-
	2.53	98.77	
II	16.07	1.22	Oleic acid
III	2.54	97.02	-
	11.55	0.19	-
	13.19	1.03	Palmitic acid
	16.13	1.76	Stearic acid
IV	2.75	97.21	-
	9.86	0.60	Linoleic acid
	11.18	1.03	-
	14.77	1.16	Oleic acid
V	2.70	87.01	-
	8.75	1.92	Linoleic acid
	11.07	2.09	-
	12.05	2.66	-
	13.03	1.02	Palmitic acid
	14.07	1.52	Oleic acid
	17.77	3.78	Stearic acid
E. mollifera			
I	2.57	100.00	-
II	2.01	3.10	-
	2.99	73.28	-
	16.61	22.74	Stearic acid
III	2.35	97.06	-
	11.66	1.12	-
	16.39	1.82	Stearic acid
	0.87	14.00	-
IV	2.97	78.00	-
	13.23	1.96	Palmitic acid
	16.14	5.98	Stearic acid
V	2.65	94.98	-
	11.99	3.66	-
	13.65	1.37	Palmitic acid
P. ricini			
I	2.61	100.00	-
II	2.81	100.00	-
III	2.64	100.00	-
IV	2.37	98.13	-
	8.20	1.87	Linoleic acid
	2.52	98.34	-
V	13.89	1.66	Palmitic acid

of fatty acids was found to be superior to any one alone. The higher growth and reproductive potential of *E. furcellata* is largely attributed to the lipid factors mainly involving dietary fatty acids besides being influenced by other diet quality factors of herbivores. The increased food consumption in mature caterpillars by *E. furcellata* also greatly influenced the survival of the predators.

The opportunistic tendencies, diversity of habitats, and polyphagous feeding nature of generalist entomophages made them to be important natural enemy resources in agroecosystems (Huffaker *et al.*, 1976). This study indicated that herbivore age and quality act as two major limiting factors that govern the normal growth and reproductive patterns of entomophagous insects which ultimately leads to several field implications such as population limits and pest control potential of entomophages. An understanding of nutritional quality of larval species / ages for better growth and reproductive performance of entomophages is important in the mass culture of entomophagous insects in biological control programmes.

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