INFLUENCE OF VARIOUS HOSTS ON THE DEVELOPMENT AND REPRODUCTION OF THE PUPAL PARASITE, *TETRASTICHUS ISRAELI* M. AND K. (EULOPHIDAE: HYMENOPTERA)

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FOR the successful utilisation of natural enemies in the control of several pests of crop plants, the knowledge of their host specificity or polyphagy, host selection, prolificacy, etc., is of vital importance. This information is particularly useful in the mass multiplication of the parasite on alternate hosts in the laboratory and subsequent release in the field. With this in view, studies were made on an eulophid pupal parasite, *Tetrastichus israeli* M. and K., which is mass produced in South India for the control of coconut caterpillar, *Nephantis serinopa* M. In testing the suitability of hosts, the effect of eight species of lepidopterous insects, *viz., N. serinopa, Plusia peponis* F., *Margaronia indica* S., *Corcyra cephalonica* St., *Spodoptera litura* (F.), *Chilo infuscatellus* S., *Phycodes radiata* O. and *Orthaga exvinacea* W. on the development and reproduction of the parasite has been observed.

Five gravid females of equal size and age were inoculated in a tube and fresh *C. cephalonica* pupa was supplied. The parasites that emerged from the pupa were used to parasitise different hosts for studying the development and fecundity of *T. israeli.*

Effect on development : Among the hosts studied, *N. serinopa* and *M. indica* hastened the parasite development in 13·2 and 13·8 days respectively. Delayed development was observed in the pupa of *O. exvinacea* (16·2 days), and the other hosts were medium in their effect (Table I). Similar influence of host on the rate of development of parasite was noted in *Microbracon gelechiae* Ashm. on different hosts[1] and in aphid parasites[2,3]. Arthur and Wylie[4] proved that the rate of development was much longer in larger hosts than in smaller ones. These results have been confirmed in the present studies : In the pupa of *P. peponis, S. litura, O. exvinacea* and *C. infuscatellus,* where the quantity of food is more, the total embryonic and post-embryonic development period was prolonged. House[5] noted reduction in the rate of growth of the tachinid, *Agria affinis* (Fall.) when the growth-promoting amino acids like glycine, serine, alanine and tyrosine were deleted from the artificial diet. In the pupa of *N. serinopa* and *M. indica,* the above-mentioned amino acids are abundantly present (Table II). The ratio of these amino acids to the total content was 0·3 in *M. indica* and *N. serinopa* as against 0·1 to 0·2 in *P. peponis* and *C. cephalonica,* and 0·01 in *O. exvinacea,* where the total development period of the parasite was prolonged.

House and Barlow[6] reported the importance of concentration of potassium in the growth of the tachinid, *A. affinis* as it helped in the rapidity of growth. A low content of 1·9% of K is found in *O. exvinacea* where the development was markedly delayed (Table II). The high content found in *N. serinopa, M. indica* and *P. peponis* is apparently favourable for the development of the parasite. However, the high content observed in *S. litura* is somewhat erratic in that it has not favoured the parasite development probably due to the total absence of growth-promoting amino acids. The same authors have also reported that K in high concentration was toxic to the parasite. This is in accordance with the present findings on *C. cephalonica* and the highest K content present in this host may be detrimental to the parasite. Chen[7] reported about the importance of arginine, cystine, glycine, proline, tryptophan, tyrosine and phenylalanine either for moulting, differentiation, pupation or adult emergence. Most of these are present in the favoured hosts (Table II).

Effect on fecundity.—Increased number of parasites emerged from the pupa of *P. peponis* (162·6) and *S. litura* (153·0) which were the most favourable hosts. The other hosts like *C. cephalonica, M. indica, N. serinopa* and *P. radiata* gave rise to minimum number of parasites ranging from 33·2 to 38·8 (Table I). There was a positive relationship between the weight of host pupae and the number of parasites emerged (Fig. 1). This is in accordance with the report of Rao *et al.*[8] in *Bracon brevicornis* W. The process of oviposition was reported to last more time when the parasite attacked big sized aphids and so more eggs could be laid[9,10]. In the present observations, *T. israeli* took more time when ovipositing in *P. peponis* pupae which are big sized.

Effect on sex ratio and adult longevity.—Greater proportion of females was noted among the parasites emerged from *N. serinopa, M. indica* and *C. cepha-*

TABLE I

Effect of various hosts on development period, fecundity, sex ratio, adult longevity and size of Tetrastichus israeli
(Mean of 5 observations)

Hosts	Development period (days)	Fecundity	Sex ratio ♂/♀	Longevity (days)		Size (mm)	
				♂	♀	♂	♀
Nephantis serinopa ..	13·2	35·0	0·07	2·0	15·2	1·44×0·41	1·70×0·46
Plusia peponis ..	14·2	162·6	0·11	2·4	10·0	1·51×0·38	1·94×0·48
Margaronia indica ..	13·8	37·0	0·08	2·0	9·0	1·27×0·37	1·56×0·43
Chilo infuscatellus ..	15·0	94·8	0·19	1·3	6·0	1·40×0·36	1·54×0·39
Phycodes radiata ..	14·8	33·2	0·16	3·4	6·6	1·67×0·40	2·00×0·58
Orthaga exvinacea ..	16·2	102·2	0·15	1·5	6·6	1·26×0·37	1·61×0·42
Spodoptera litura ..	15·6	153·0	0·18	1·3	6·2	1·46×0·42	1·94×0·51
Corcyra cephalonica ..	14·4	38·8	0·08	1·5	8·2	1·03×0·28	1·44×0·37
Mean ..	14·7	82·1	0·13	1·9	8·5	1·38×0·37	1·72×0·46
C.D. (P=0·05) ..	0·9	25·6	0·03	0·5	1·3	0·12 0·03	0·14 0·05

* Body length × breadth at thorax.

TABLE II

Amino acid and potassium contents in various hosts of Tetrastichus israeli

Content	*N. serinopa*	*P. peponis*	*M. indica*	*C. cephalonica*	*S. litura*	*O. exvinacea*
AMINO ACIDS (μg/pupa)						
Aspartic acid ..	..	..	..	451·7	..	..
Glutamic acid ..	77·6	202·3	67·8	16·7	115·2	85·2
Glycine and/or Serine ..	15·9	76·0	24·5	28·2	..	..
Lysine ..	29·1	..	..	..	..	..
Glutamine ..	29·1	..	..	..	..	..
Threonine ..	17·4	..	15·4	8·8	..	403·9
Alanine ..	16·8	..	29·8	..	..	6·7
Tyrosine ..	77·6	259·7	83·8	..	..	..
Histidine ..	58·1	..	42·8	55·7	..	..
Arginine ..	..	..	29·1	..	..	..
Proline ..	19·0	..	Trace	..	..	52·4
Methionine ..	63·6	138·3	18·8	..	237·0	36·4
Valine ..	29·9	27·3	42·3	11·1	118·2	102·1
Leucine and/or isoleucine	..	875·0	126·7	24·2	120·0	33·3
Total No. of amino acids	12	8	13	9	5	8
Total quantity ..	434·1	1578·6	481·0	596·4	590·4	720·0
Potassium % ..	2·9	2·1	2·8	3·3	2·9	1·9

lonica (Table I). This influence of hosts confirm the earlier observations of Flanders[11] that fertilised eggs were laid in suitable hosts and unfertilized eggs in unsuitable hosts resulting in more of males. The male parasites reared from *C. infuscatellus* and *S. litura* lived shorter (1·3 days), while the female longevity was upto 15·2 days in the case of parasites from *O. exvinacea, P. radiata, S. litura* and *C. infuscatellus* (Table I).

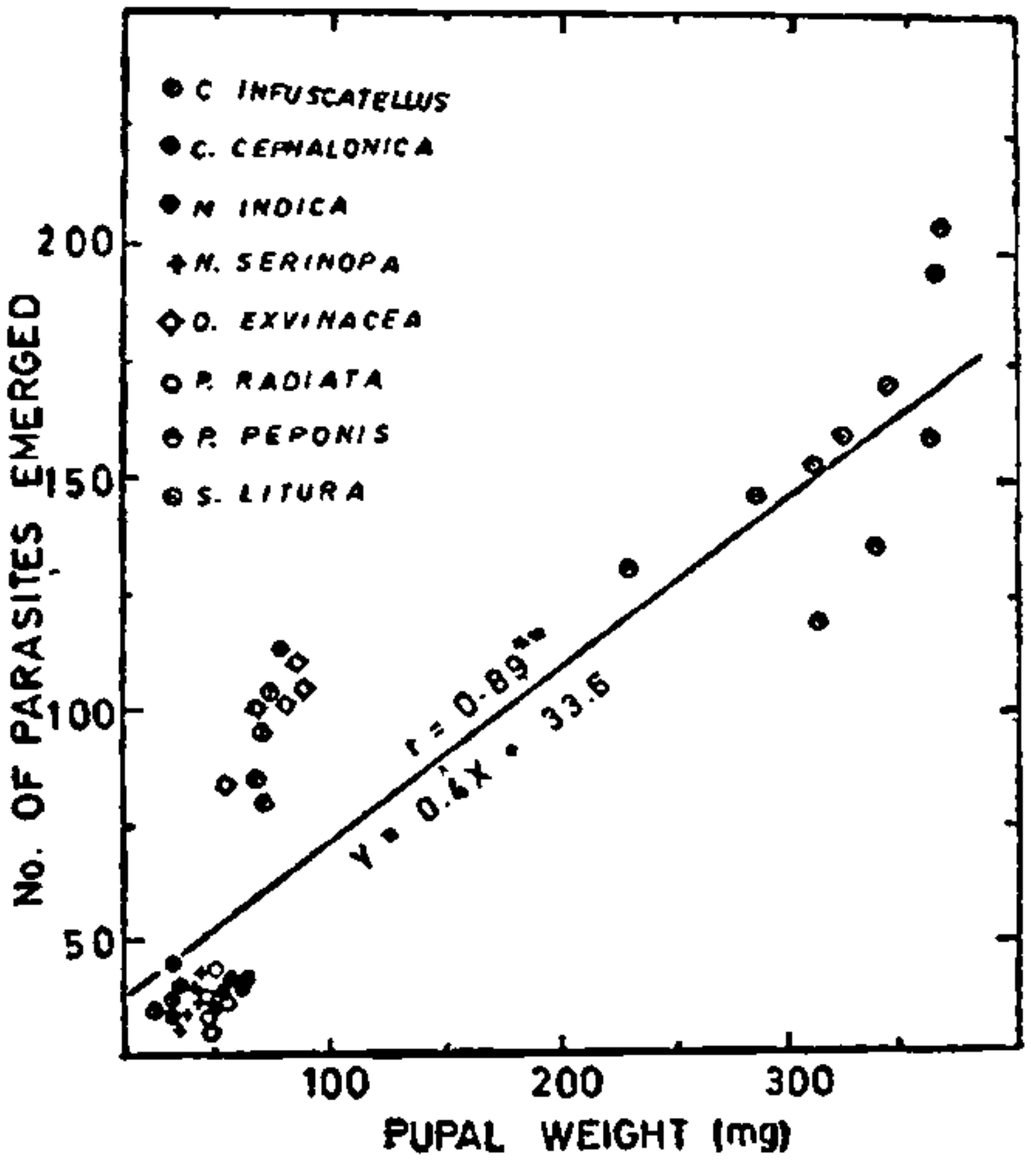

FIG. 1. Correlation between weight of pupa and total number of parasites emerged from different hosts.

Effect on size of the parasite.—Influence of host on the size of parasite was seen in all the cases. Larger females were noted from the pupae of *P. peponis, S. litura* and *Orthaga exvinacea* as against the smallest size from *C. cephalonica*; *N. serinopa* and *M. indica* produced females of medium size (Table I). Fecundity of the parasite seems to be influenced by a host species by affecting the size of the parasite as observed by Hafez[12] in the case of *Aphidius rapae* (Curtis), a parasite of the cabbage aphid.

The amino acids related to the morphogenic events during insect development were arginine, histidine, threonine, leucine, isoleucine and valine. They were found to be essential for insect growth[13,14]. The total quantity of these amino acids was more in the case of *P. peponis, S. litura* and *O. exvinacea* (Table II) from which bigger parasites emerged. The size was correspondingly reduced with the reduction of these amino acids in the host pupa. The least content in *C. cephalonica* was associated with the smallest size of the parasites emerged from this host. The length of abdomen was positively correlated with the total number of parasites emerged from *C. cephalonica* ($r = 0{\cdot}87^{**}$; $Y = 105{\cdot}1\,X - 41{\cdot}3$) and so the fecundity would be increasing with the increase in abdomen size.

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