

## Studies on the Effect of Different Larval Diets of Rice Meal Moth on its Egg Parasites *Trichogramma australicum* Gir., and *T. japonicum* Ashm.

By

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### ABSTRACT

Detailed laboratory investigations were made on the effect of the eggs of *Corcyra cephalonica* St., bred on sorghum grains, greengram seeds and groundnut kernels on the parasites *Trichogramma australicum* Gir., and *T. japonicum* Ashm. It was observed that the development of the parasite was influenced by the size and nutrient contents of the host eggs. The larger size of the parasites from eggs of moths bred on groundnut was ascribed to the higher levels of growth promoting amino acids in such eggs. Further, the maximum level of nutrients, viz., calcium, phosphorus, total nitrogen, glycogen and total soluble carbohydrates present in eggs of moth bred on greengram was attributed to the higher rate of fecundity, longer developmental period, and maximum longevity in both the species of parasites. The different larval diets of the host had no effect on the sex ratio of the parasites.

### INTRODUCTION

The host of an insect can render that insect either favourable or unfavourable for successful parasitisation (De Bach, 1970). This aspect has not been investigated in greater detail with reference to the egg parasites. Katiyar (1962) studied the effect of nutrition on the fecundity, longevity and sex ratio of the egg parasite *Trichogramma australicum* using *Corcyra cephalonica* as its host reared on various synthetic diets. In the present study, an attempt has been made to evaluate the effect of the nutrient status of the different larval diets of the host *C. cephalonica* on its two egg parasites, viz., *T. australicum* and *T. japonicum*.

### MATERIALS AND METHODS

The eggs of rice meal moths reared separately on broken sorghum grains, groundnut kernels and greengram seeds were used for the study. The size of the eggs of the moth as also the size of the parasites that emerged out of such eggs, the total development period of the parasites, the number of parasites emerged out of 100 parasitised eggs, sex ratio, longevity and fecundity of the parasites were observed in relation to the different larval diets of *C. cephalonica*.

The nutrient contents of the three larval diets and that of the eggs of *C. cephalonica* reared on these diets were analysed in the laboratory. The

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free amino acid contents of the sorghum grains, greengram seeds, groundnut kernels and the host insect eggs were estimated by unidimensional paper chromatography (Block *et al.*, 1958). The protein bound amino acids in the grain food samples were estimated by the method of Block *et al.* (1958). The total nitrogen content of both insect eggs and host food was estimated by the method described by Humphries (1956) and expressed in percentage. The total water soluble carbohydrates in host eggs were estimated following the method of Crompton and Birt (1969). Using the perchloric acid extract, glycogen was estimated following the method of Crompton and Birt (1969) and expressed in percentage. Total water soluble sugar content in the grain samples was estimated by the method described by McCready *et al.* (1950) and expressed in percentage. The residue left in the sugar extraction was used for the estimation of starch in the grain samples as described by McCready *et al.* (1950).

The mineral contents of both the host eggs and grain samples were estimated with the triple acid extraction method of Jackson (1958). Calcium was estimated by the method reported by Jackson (1967). The venadomolybdophosphoric yellow colour method of Jackson (1962) was employed for the estimation of total phosphorus. Potassium was estimated using an EEL-Flame Photometer as described by Jackson (1962).

## RESULTS AND DISCUSSION

i. **Effect of larval diets on the host:** The data gathered on the size of the eggs of *C. cephalonica* with reference to different larval diets are given in Table 1. The nutrient contents of the larval diets and the eggs of *C. cephalonica* bred on these diets are presented in Tables 2 and 6. The size of the host eggs obtained from the different diets varied greatly. Eggs obtained from the adults of *Corcyra* reared on groundnut diet were comparatively larger than those from greengram and sorghum diets. Seshagiri Rao (1954) observed a similar phenomenon in the pupae of *Corcyra cephalonica* St., reared on different diets. The eggs of *Corcyra* reared on groundnut kernels had appreciable quantities of growth promoting amino acids (House, 1954) like glycine, alanine and tyrosine when compared with the amino acid contents in the eggs of moths reared on the other two diets. The essential amino acid content in the case of greengram diet and in the eggs of *Corcyra* bred on this diet was the highest. The minerals were also found to be present in differential quantities both in the diets and eggs of *Corcyra* reared from these diets. The phosphorus content in the eggs of *Corcyra* reared on greengram was higher (0.450 per cent) while it was minimum (0.093 per cent) in greengram grains as compared with a higher content (0.412 per cent) in groundnut kernels. The reason for a lower level of phosphorus in the eggs of *Corcyra* bred on groundnut kernel may probably be due to the variation in the feeding activities of

the larvae of *Corcyra* and due to the physical and chemical properties of the diet as suggested by House (1962). The total soluble carbohydrate content was higher in greengram diet (5 per cent) as also in the eggs of *Corcyra* 40.84 per cent) obtained from this diet. The total nitrogen content was also high in the eggs of *Corcyra* bred on greengram.

ii. Effect of larval diet of *Corcyra* on the parasites (a) Size:

The size of the adult parasites emerged out from the eggs of *Corcyra* reared on groundnut kernels was the biggest in both the species and it was the smallest when reared on eggs of *Corcyra* bred on sorghum grains. The size of the individuals of the parasite is possibly influenced by the content of the growth promoting amino acids in host eggs. The bigger size of both the species of *Trichogramma* reared from the eggs of *Corcyra* bred on greengram in spite of the comparatively low quantity of growth promoting amino acids present in these eggs may be ascribed to a higher phosphorus content in these eggs. The growth inducing nature of phosphorus has been discussed by House and Barlow (1965).

(b) Total Developmental Period: The total developmental period of both the species of *Trichogramma* was the longest on eggs of *Corcyra* bred from greengram diet (Table 4). The longer developmental period of the parasite may be due to the big sized eggs (Table 1) and also due to the relatively small quantities of growth promoting amino acids present in the diet (Table 3). It was also seen that the

adults of the parasites from the eggs of *Corcyra* bred on sorghum diet were comparatively smaller in size than those from the eggs of moths bred on the other two diets (Table 1). The above findings agree with the observations of House (1958, 1961) who indicated that even slight changes in the composition of food may have marked effect on growth and development of an insect. Similarly longer developmental period was observed in the case of *Trichogramma evanescens* on the eggs of *Agrotis C. - nigrum* (L.) which was attributed to greater quantity of food present in the comparatively big sized host eggs (Salt, 1950).

(c) Longevity: The longevity of the adults of both the species of *Trichogramma* varied when reared on the eggs of *Corcyra* bred on the three different diets. In both the species, the females lived longer when reared on the eggs of *Corcyra* bred on the greengram diet (Table 4). This may possibly be due to the higher proportion of essential amino acids present in the relatively bigger sized eggs of *Corcyra* bred on greengram diet. This is in agreement with the report of Salt (1940) who had stated that the adults of *Trichogramma evanescens* Westw., reared on the eggs of *Stalis lutaria* (Fab.) lived for a very short period due to the insufficiency of food in the host eggs. The total nitrogen content was high in the eggs of *Corcyra* bred on greengram. The presence of higher content of nitrogen might have also influenced the longevity of both species of *Trichogramma* as reported by Cook and Scott (1933) in termites.

TABLE 1. Effect of the larval diet of *Corcyra cephalonica* St., on the size of the host eggs and the parasites

Larval diet	Size of the egg in $\mu$		T. australicum				T. japonicum			
	Length	Breadth	MALE		FEMALE		MALE		FEMALE	
	Length	Breadth	Length	Breadth	Length	Breadth	Length	Breadth	Length	Breadth
Sorghum	510.4	325.6	369.6	132.0	409.2	171.6	382.8	145.2	457.6	158.4
	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$
	9.72	7.18	7.18		17.41	4.39	11.45	6.72	11.73	7.18
Groundnut	558.8	321.2	382.8	140.8	466.4	176.0	409.2	140.8	501.6	180.4
	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$
	6.72	6.72	9.38	5.86	7.18		16.13	5.86	11.73	7.89
Greengram	545.6	356.4	374.0	136.4	448.8	171.6	413.6	154.0	484.0	180.4
	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$	$\pm$
	7.18	4.39	7.33	7.18	8.79	4.39	9.73	7.33	13.11	10.26

TABLE 2. Nutrient contents in the diets and eggs of *Corcyra cephalonica*

Materials	NUTRIENT CONTENTS (%)					
	Calcium	Potassium	Phosphorus	Total Nitrogen	Total Soluble carbohydrates	Glycogen
<b>Diets:</b>						
Sorghum	0.3	1.0	0.2375	1.96	2.00	—
Greengram	0.4	0.50	0.0937	4.20	5.00	—
Groundnut	0.4	0.75	0.4125	5.04	3.00	—
<b>Eggs obtained from:</b>						
Sorghum diet	1.4	0.90	0.312	2.80	26.67	12.50
Greengram diet	1.65	2.00	0.450	3.08	40.84	19.17
Groundnut	1.5	1.00	0.300	2.80	29.17	17.50
						—

TABLE 3. Amino acid contents in the diets and eggs ( $\mu$ g/g)

Amino acid	Groundnut			Greengram			Sorghum		
	Grains Free	Grains Bound	Egg Free	Grains Free	Grains Bound	Egg Free	Grains Free	Grains Bound	Egg Free
Cystine	60	5200	—	220	3600	1000	—	2000	—
Histidine / Lysine	—	8800	5200	640	8000	4800	640	T	—
Glycine	360	8800	6200	—	—	—	—	7200	5200
Alanine	280	10800	6200	—	6800	5600	—	320	5400
Tyrosine	380	13600	4400	840	10000	4600	800	13600	4200
Proline	—	1600	—	—	2400	—	—	1600	—
Methionine	—	24000	9200	2200	24000	T	1200	11200	5600
Valine	—	11600	—	280	8800	—	—	6000	—
Phenylalanine	100	11600	600	200	5600	400	40	4000	400
Isoleucine	—	6400	T	—	6000	—	—	5200	—
Leucine	T	1200	T	T	400	T	T	2000	T
Threonine	840	—	—	480	—	5600	520	9600	5600
Tryptophan	140	—	—	—	—	—	—	—	—
Arginine	T	—	T	760	10400	7600	—	—	—
Total	2160	103600	31800	5620	86000	29600	3200	62720	27400

T = Traces

TABLE 4. Effect of the larval diets on the parasites *T. australicum* and *T. japonicum*

Larval diet	Development period in hours		Number of parasites emerged		Sex ratio Male / Female		Longevity in hours				Fecundity	
	a	b	a	b	a	b	Male	Female	a	b	a	b
Sorghum	170	193.5	97	87	1 : 1.204 (0.830)	1 : 2.78 (0.359)	12	28.8	12	26.4	14.5	13.5
Greengram	174	204	79	90	1 : 1.821 (0.549)	1 : 2.92 (0.343)	12	40.8	12	32.4	39.3	23.4
Groundnut	172	200	100	73	1 : 1.08 (0.923)	1 : 2.84 (0.351)	12	26.4	24	26.4	30.8	12.9

a = *Trichogramma australicum*. b. *Trichogramma japonicum*.

*Yumio scia*

Yumio scia contents in the diet and eggs (a 50)

(d) **Fecundity:** The fecundity of of the parasites obtained from the eggs of *Corcyra* bred on different diets showed remarkable differences. Highest fecundity of the parasites was noticed in both the species reared in the eggs of *Corcyra* bred on green-gram diet. As already indicated the adult parasites were also relatively bigger in size. Flanders (1935) stated that larger individuals of *Trichogramma* may be over five times as prolific as smaller ones. Salt (1943) proved that the bigger individuals of *Trichogramma evenescens* Westw., obtained from the bigger eggs of *Sitotroga cerealella* Oliv., were more fecund than those from smaller eggs.

(e) **Sex Ratio:** Even though the different larval diets of the host had influence on the size and nutrient content of the eggs of *Corcyra* used for parasitisation, these had no effect on the sex ratio of both the species of *Trichogramma*.

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