

Mass Production of *Tetrastichus howardii* on House fly a Pupal Parasitoid of Leaf Roller-A Pest of Mulberry Plant

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Abstract

The findings of the experiment exhibited that mass production of Tetrastichus howardii on house fly pupa did not show any adverse effect for three generations on parasitization rate and progeny production.

Key words: Housefly, mass production, pupa, Tetrastichus howardii.

Introduction

The mulberry plant is attack by 200 insect and non insect pest species due to indiscriminate use of chemicals and fertilizers. Among these, leaf roller (Diaphania pulverulentalis) has been observed as a severe pest of mulberry since 1995 in Karnataka state¹. It has also been spread to the neighbouring states of Tamil Nadu and Andhra Pradesh. This pest has been recorded earlier in Malaysia and Nagaland, India^{2,3}. Diaphania pyloalis (Glyphodes) is reported from Jammu, Kashmir⁴ and Punjab and also from China and Japan^{5, 6.} The average incidence and loss in mulberry leaf yield caused by these pests is estimated to be 34.24% and 4500 kg/ha/yr^7 . To reduce the usage of chemicals for the control of pests population in the crops, IPM method is recommended to control the pests attacks. Tertrastichus howardii is a vital component of IPM against leaf roller. This parasitoid is widely distributed across the Indian sub-continent, the Far East and parts of Australia⁸. *Tertrastichus howardii* is also reported to be an ecto-pupal parasitoid of Uzi fly, Exorista bombycis, a serious pest of silkworm (Bombyx mori L.) larva.

To make use of Tertrastichus howardii as a biocontrol agent of leaf roller in the field, there is a necessity for mass multiplication of this parasitoid. It can be easily reared on its natural host pupa of Uzi fly, Exorista bombycis, in the insectary. However, in recent years the availability of Uzi fly pupa in cocoon markets is drastically declined and required quantity of Uzi fly pupa is not available round the year to meet the field demand of Tertrastichus howardii. Therefore, a need was felt to produce Tertrastichus howardii on a factitious host which can easily be reared in the laboratory at an economical cost throughout the year. It was found in the insectary of Pest Management Lab. That Tertrastichus howardii was able to parasitize the pupa of common housefly Musa domestica, but the parasitisation rate was low. Hence, an attempt was made to ascertain the possibilities of exploiting the pupae of Musa domestica for mass production of Tetrastichus howardii and to

improve its parasitisation rate and adult recovery through directional selection.

Material and Methods

The experiment was carried out in the insectary of the Pest Management Laboratory, CSRTI, Mysore at a temperature $25\pm2^{\circ}$ C and relative humidity 55-75%. Uzi fly maggots were collected from cocoon markets and were allowed to pupate in the insectary. Freshly pupated housefly pupae were attained from stock culture maintained in the insectary. The newly emerged adults (emerged from parasitized pupa of Uzi fly) were obtained from the stock culture maintained in the insectary.

Parasitization of house fly pupa by *Tetrastichus howardii:* Freshly pupated 20ml house fly (800 pupae approx.) were kept in a single layer in a plastic container (6' diameter). One day old *Tetrastichus howardii adults* (200 adults) emerged from parasitized pupa of Uzi fly were released in the ratio (1:4) on housefly pupae. Fifty percent aqueous honey solution was smeared on a plastic paper strip and kept in the container which served as a food for the adults. After pupa and dead flies were collected from container. Dead flies and empty shell were removed from parasitized pupa by winnowing. From each batch of parasitized pupa, 3 replication of 10 pupa each were kept in a test tube plugged with cotton. The remaining pupae were used for continued multiplication for the next generation.

Directional selection: For directional selection in F1 generation, 10 batches of 20ml freshly pupated housefly were parasitized with one day old *Tetrastichus howardii* adults emerged from parasitized pupa of Uzi fly. Based on number of adult recovered/pupa, top five batches were selected for further multiplication in next generation. In F2 to F6 generation, 5 batches of 20ml freshly pupated housefly were parasitized with one day old Tetrastichus howardii adults emerged from parasitized pupa of housefly of previous generation. No

selection was done in 5 parasitized batches of F2 to F6 generations and all the adults emerged from parasitized pupa were utilized for multiplication in next generation. The following observation was recorded *i.e.*, % fly emergence, % parasitization rate, % successful parasitization rate, % pupal mortality, number of adults/parasitized pupa, number of adults/successfully parasitized pupa, sex ratio and development period. The recorded observation was computed and statistically analyzed by following the method⁹.

The formulae used for calculation the following percentage

%	Fly emergence =	$\mathbf{B} \times 100$
		А
%	Parasitization rate=	<u>C×100</u>
		А

- % Successful parasitization rate= $\underline{E \times 100}$
- % Pupal mortality= <u>C×100</u>
- % Female emergence= $\frac{No. \text{ of females emerged}}{\text{Total no. of adults}} \times 100$

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Figure-1 Housefly *Musa domestica* maggots



Figure-2 *T. Howardii* emer ging from Parasitized pupa

Results and discussion

To increase the parasitizing efficiency of *Tetrastichus howardii* on its fictitious host pupa of house fly through directional selection, ten batches of 20ml each (about 800 pupa) of fresh pupa of housefly were parasitized with 1-2 day old adults of *Tetrastichus howardii* emerged from parasitized pupa of Uzi fly in F1 generation. The successful parasitisation rate ranges from 13.33%–46.67%, the number of adults per successfully parasitized pupa ranges from 14.47-23.67 and number of adults per parasitized pupa ranges from 3.23-8.30 in ten batches Table-1. Based on these observations top five batches were selected for further multiplication of *Tetrastichus howardii* on housefly pupa in F2-F6 generations and the results are given below:

House fly emergence: From the table-2, the percent fly emergence of 29.90, 29.70, 32.60 34.0, 35.70, and 36.70 was recorded in F1–F6 generations respectively. It is evident from the results that fly emergence did not vary significantly from F1-F3 generation. However, it was significantly higher from F4 to F6 generation when compared with F1 generation. Thus the parasitisation rate of house fly pupa by *Tetrastichus* howardii, which ranges from 63.3% to 70.35in different generations, is lower as compared to other gregarious parasitoid of house fly pupa by N. thymus.77.3% parasitisation of house fly emergence were considered as parasitized pupae and kept to record successful parasitisation.

Successful parasitization rate: Results of the findings showed that percent successful parasitisation rate of 41.28, 41.98, 40.62, 37.96, 38.98, and 33.32 was recorded in F1-F6 generations respectively table-2. The variation observed did not vary significantly till F5generation but it was significantly lower in F6 generation compared to earlier generations. Thus parasitisation rate of factitious host *i.e.*, house fly pupa by *Tetrastichus* howardii is considerably low as compared to its natural host i.e. pupa of Uzi fly *Exorista bombycis*. 100% parasitisation of 1-4 day old pupa of Uzi fly by *Tetrastichus* howardii which gradually declined to 15% with the advancement of pupal age to 9 days and no parasitisation was recorded with 10 -12 day old pupa¹¹.

A striking observation was the level of host mortality (58.02% to 66.68%) caused by *Tetrastichus howardii* was beyond that caused by actual parasitism (33.32% to 41.98%) Table-2.It appears that high mortality rate may be due to stinging of host pupa by the parasitoid and these stung pupa do not transform themselves into fly, but are killed. Another reason for higher mortality was attributed to partial development of parasitoid inside the host pupa. Dissections indicated that in some of the parasitized puparia *Tetrastichus howardii* has developed but failed to emerge.

Number of adults/successfully parasitized pupa: The date depicted in Table-3, reveals the no. of adults per successfully

parasitized pupa was 19.14, 15.30, 16.60, 17.48, 15.90, and 15.22 in F1-F6 generations respectively. The variations in the parameter were non-significant irrespective of the generation. The number of adults produced per successfully parasitized pupa on factitious host i.e. house fly pupa by T. howardii is considerably low as compared to its natural host *i.e.*, pupa of Uzi fly *Exorista bombycis*. 64.95 adults emerged from 1-day old pupa of Uzi fly parasitized by T. howardii¹². The lower progeny production in house fly pupa compared to Uzi fly pupa may be due to seven times lesser size of the former than the latter. The lesser number adult parasitoids emerging from smaller pupa is due to deficiency of food material for the developing larvae of parasitoid¹³.

Number of adults per parasitized pupa: The no. of adults per parasitized pupa was 7.88, 7.50, 7.0, 6.14, 4.20, and 3.96 in F1-F6 generation respectively Table-3. The variation observed did not vary significantly till F4generation but it was significantly lower in F5& F6 generation compared to earlier generations. The lower progeny production per parasitized pupa is due to higher mortality rate of host pupa by the parasitoid.

Percent female emergence: The percent female emergence was 74.28, 72.30, 73.42, 67.64, 63.08, and 65.68 in F1-F6 generation respectively. The variation observed did not vary significantly till F3 generation but it was significantly lower in F4-F6 generation compared to earlier generations table-3.

Development period: The development period from egg to adult development was 15.20, 15.40, 15.20, 15.40, 15.60, and 15.20 in F1-F6 generation respectively which did not vary significantly table-3.

Table-1
Parasitization rate and progeny production in 10 batches of
house fly pupa parasitized with Tetrastichus howardii
emerged from parasitized pupa of Uzi fly

		No. of	No. of
Batch	%	adults/parasitized	adults/pu
number	parasitization	pupa	ра
1	43.33	18.63	6.83
2	40.00	16.37	6.90
3	46.67	18.00	8.30
4	33.33	18.17	6.30
5	23.33	19.50	4.63
6	36.67	81.33	7.47
7	46.67	14.47	5.57
8	26.67	23.67	7.17
9	13.33	21.23	3.23
10	36.67	15.83	5.87
S.E	6.19	19.41	1.64
CD at	18.41	57.66	4.88
5%			

 Table-2

 House fly emergence and parasitization rate of host pupa by

 Tetrastichus howardii

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~	% fly	%	%	%		
Generati	emergen	parasitizat	successful	pupal		
ons	ce	ion	parasitizat	morta		
			ion	lity		
F1	29.90	70.10	41.28	58.72		
F2	29.70	70.30	41.98	58.02		
F3	34.00	66.00	40.62	59.38		
F4	32.60	67.40	37.96	62.04		
F5	35.70	64.30	38.98	61.02		
F6	36.70	63.30	33.32	66.68		
S.E	3.23	3.23	2.05	2.05		
CD at	3.51	4.91	4.05	5.15		
5%						

Table-3
Progeny production and development period of
Tetrastichus howardii emerged from
narasitized house fly nuna.

	No. of	No. of		Developm	
Generati	adults/success	adults	%	ent period	
ons	fully	parasiti	fema	(in days)	
	parasitized	zed	le		
	pupa	pupa			
F1	19.14	7.88	74.2	15.20	
			8		
F2	15.30	7.50	72.3	15.40	
			0		
F3	16.60	7.00	73.4	15.20	
			2		
F4	17.48	6.14	67.6	15.40	
			4		
F5	15.90	4.20	63.0	15.60	
			8		
F6	15.22	3.96	65.6	15.20	
			8		
S.E	1.51	0.51	2.91	0.26	
CD at	00	1.50	3.58	00	
5%					

Conclusion

Tetrastichus howardii can be mass multiplied on house fly pupa for three generations without any adverse effect on parasitization rate and progeny production and directional selection F1 generation did not improve the parasitization potential of the parasitoid in future generations.

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