EFFECT OF LOW TEMPERATURE STORAGE ON THE FECUNDITY AND PARASITIZING EFFICACY OF *BRACON HEBETOR* (SAY)

Nohad Kadhum Al-Tememi and M. Ashfaq[*]

ABSTRACT

These studies were conducted in the Department of Entomology, University of Agriculture, Faisalabad during 2002. Effect of cold storage periods (1, 2, 3 and 4 weeks) at varying temperatures (5, 10 and 20°C) on late pupal stage of the larval parasitoid *Bracon hebetor* (Say) was studied to measure mean number of adults emergence, sex ratio, longevity of adults, number of larvae developed per one female and number of parasitized larvae of host per female. The results showed that there was negative relationship between number of emerged adults (females and males) and storage period for each tested temperature. The results further showed that sex ratios for males were more than the female for all tested temperatures and within all the periods. On the other hand longevity of the adults (females) was reduced due to low temperature for all the tested periods. It ranged from 23.94-6.81, 23.22 – 9.06, 21.05-14.57 and 21.14 days at 5 to 20°C for all periods, respectively. For males it ranged from 13.36 – 2.88, 15.86 – 4.86, 13.32-10.70 and 14.40 days on the same temperatures and storage periods, respectively.

A negative relationship was observed between the number of larvae that developed from the emerged adults after storage as well as for the number of parasitized larvae of host for all storage periods. These ranged from 76.94 – 47.25, 72.5-53.07, 65.38-54.63 and 61.80 larvae at 5 to 20°C for 1 to 4 weeks and 43.05-19.06, 62.66 - 21.09, 66.77-48.68 and 70.7 parasitized larvae on 5 to 20°C for all storage periods, respectively.

KEYWORDS: *Bracon hebetor*; fecundity; parasitism; Pakistan.

INTRODUCTION

Bracon hebetor (Say) an ecto-larval parasitoid is considered as one of the most important biological control agents. It plays an important role to control almost all the lepidopterous insect pests. This parasitoid has also reported as

[*]Department of Agri. Entomology, University of Agriculture, Faisalabad.

an efficient biological control agent of *Helicoverpa armigera* (Lepidoptera: Noctuidae) (8) and other lepidopterous larvae (5, 11, 13, 15, 16, 17, 19).

When the survivorship and lifetime fecundity patterns of insect parasitoids are investigated in the laboratory, females are observed to die soon after completing reproduction, the obvious exceptions being parasitoids that practice brood guarding (4, 7, 10 and 11). However, *Bracon hebetor* (Say) is a synergistic, gregarious, ecto-parasitic non-brood guarding parasitoid. The female can live for greatly extended periods after the egg-laying phase completed (12).

The objective of this study was to evaluate the fecundity and parasitizing efficacy of this parasitoid after storage of pupae at late age and at low temperatures to recommend suitable storage period for using it successfully in IPM programmes throughout the year.

MATERIALS AND METHODS

This study was carried out in the Department of Entomology, University of Agriculture, Faisalabad, during summer season 2003. The ecto-larval parasitoid *Bracon hebetor* (Say) was collected from berseem crops, *Trifolium alexandrium* (L). during December, 2002. The parasitoid was reared under laboratory conditions 29°C ± 1°C, RH 65 ± 5% and 16:8 L:D by using the greater wax moth, *Galleria mellonella* L. as a host for the mass production of this important parasitoid. Three to four days old pupae of *Bracon hebetor* were isolated from the laboratory culture and distributed in glass-jars, dia. 3 cm x 10 cm depth. These glass jars were sterilized by using an electric oven run at 100°C for four hours to kill all the pathogen before using in this experiment. Each jar includes 50 pupae of the parasitoid, which were stored, at 5, 10, 15 and 20°C for the periods 1, 2, 3 and 4 weeks. Layout system of the trial was CRD with four replications for each treatment. The stored pupae were checked daily to evaluate biological parameters which were included in this experiment.

RESULTS AND DISCUSSION

The results (Table) showed that number of adults (females and males), emerged from the stored pupae, decreased as the storage periods increased, within the same temperature. This was reflected on the emergence percentage

Table Evaluation of fecundity and parasitization efficacy of *B. hebetor* (Say) from its late pupal stage, at different storage periods and temperatures.

Temperature(°C)	Storage periods (week)	No. of stored pupa	No. of adults emergence			Sex ratio		Longevity of adults (day)		No. of larvae developed/female	No. of larvae parasitized/female
			F	M	%	F	M	F	M		
5	1	50	19	28	94	40.42	59.57	17-28	12-18	39-109	25-60
								23.94a±2.71	13.36b±2.01	76.94a±7.82	43.05d±5.24
	2	50	20	25	90	42.22	55.77	12-17	6-8	32-102	25-52
								14.31c±2.09	6.76d±1.05	68.57c±9.86	36.07ef±6.23
	3	50	17	21	76	44.73	55.26	6-9	4-7	35-107	20-39
								7.29d±2.11	5.0e±1.00	64.58d±8.75	27.05g±3.99
	4	50	16	18	68	47.05	52.94	3-6	2-4	23-77	12-25
								6.81d±0.01	2.88f±1.01	47.25g±5.25	19.06h±1.09
10	1	50	18	29	94	38.29	61.70	16-27	13-19	33-103	31-03
								23.22a±5.25	15.86a±2.06	72.5b±9.99	62.66b±8.15
	2	50	19	24	86	44.18	55.81	13-20	13-20	32-107	22-52
								16.05±4.09	14.29ab±2.01	69.73c±9.45	32.94f±2.13
	3	50	16	23	78	41.02	58.97	7-12	6-8	35-93	17-35
								9.06±2.13	6.88d±1.09	59.93e±8.76	27.06g±2.19
	4	50	14	22	72	38.88	61.11	6-8	6-88	32-74	13-27
								17.0b±3.19	4.86e±0.76	53.07f±9.82	21.09h±1.99
15	1	50	19	28	90	39.13	60.86	19-25	9-20	37-92	32-102
								21.05ab±7.1	13.32b±1.07	65.38d±4.79	66.77ab±9.85
	2	50	17	26	86	44.18	55.81	14-20	6-16	38-83	37-73
								14.57c±2.09	10.70c±0.81	54.63f±5.62	48.68cd±7.52
	3	50	-	-	-	-	-	-	-	-	-
	4	50	-	-	-	-	-	-	-	-	-
20	1	50	21	27	93	43.75	56.25	17-27	32-83	32-83	43-92
								21.14ab±2.0	14.40ab±3.15	61.80e±9.12	70.71a±7.73
	2	50	-	-	-	-	-	-	-	-	-
	3	50	-	-	-	-	-	-	-	-	-
	4	50	-	-	-	-	-	-	-	-	-

which ranged from 94 to 68 on 5°C for the periods 1 to 4 weeks, 94 to 72 on 10°C and 90 to 86 on 15°C for first and second weeks, respectively. All the pupae which were stored at 15°C were emerged in second week. So there was no need to continue the experiment beyond second week. At 30°C, all the stored pupae were emerged in first week and the adult emergence reached to 96 percent because this temperature was approximately near to the optimum temperature of rearing this parasitoid (29 ± 1°C). So there was no need to continue the experiment beyound first week. These results have been supported earlier (9, 19) emphasizing that percentage of adults-emerged, from stored pupae of this parasitoid, at low temperature, decreased as the storage period increased within the same temperature.

In case of sex ratio, the data showed that there were significant differences between sex ratio on different temperatures and storage periods. The percentage of males emerged was more than that of females. Previous workers (1, 2, 3 and 14) reported similar results with 1:1.7, 1:3.98, 1:1.3, and 1:1.7 female:male ratio, respectively. This variation was explained by them due to differences in temperature and host density. However, Benson (6) attributes this difference to death factor as the male eggs hatched before the female eggs and due to the season males larvae had better survival with better availability of food around. The present results, however, differ to those of Reinert and King (17), who reported that sex ratio of *B. hebetor* was 2:1 (female, male).

The results further showed that longevity of females and males decreased as the storage periods of pupae increased at the same temperature and within all the temperatures. Some previous workers (9, 18) have supported these findings. In case of number of larvae which were developed from the eggs laid by the females, the data indicated that number of larvae decreased as the storage period of pupae increased. Farghaly and Ragab (9) report similar results. Finally, the data revealed that there was a negative relationship between number of parasitized larvae by the females, which developed from the stored pupae, at various temperatures and different periods. The number of parasitized larvae decreased as the storage period increased for the same temperature. Parasitized larvae were, 43.05 ± 5.24, 36.07 ± 6.23, 27.05 ± 3.99 and 19.06 ± 1.09 per female, at first temperture, for various periods, respectively, whereas they were 62.66 ± 8.15, 32.94 ± 2.13, 27.06 ± 2.19 and 21.06 ± 1.99 per female at second temperature for the same storage periods.

For third temperature where all stored pupae were emerged at second week, number of parasitized larvae per female were 66.77 ± 9.85 and 48.68 ± 7.52 for first and second storage periods, respectively. Finally at 20°C where all the stored pupae of parasitoid *B. hebetor* were emerged at first week, parasitized larvae were 70.71 ± 7.73 per female. These results are supported by Shawkit *et al.* (18) who observed that female which developed from stored pupa at 15°C for 2 weeks, can parasitize 48.16 larvae. These conclusions are further supported by Farghaly and Ragab (9) indicating that number of parasitized larvae per-female developed from stored pupae, at 5°C, 10°C and 15°C for four weeks were; 20.03, 22.01 and 47.86 larvae, respectively.

REFERENCES

1. Ahmad, M.S.H. and A. A. Hussain. 1969. Some biological aspects of the fig moth *Ephestia cautella* (Walk.) and its parasite *Micro Bracon hebetor* (Say). Iraqi J. Agric. Soc. 4(2):27-31.
2. ___. S. K. Al-Maliky, A. A. Al-Taweel, N. F. Jabo and Z. S. Al-Hakkak. 1985. Effects of three temperature regimes on rearing and biological activities of *Bracon hebetor* (Say) (Hymenoptera: Braconidae). J. Stored Prod. Res. 21(2):65-68.
3. Al-Ramahi, R. S. and M. H. Ali. 1983. Biology of *Bracon hebetor* (Hymanoptera: Brconidae), Annual Book for Plant Protection Research. 3(1):17-28.
4. Askew, R. R. 1971. Parasitic Insects. London. Heinemann.
5. Beard, R. L. 1972. Effectiveness of paralyzing venom and its relation to host discrimination of *Braconid wasps*. Ann. Entomol. Soc. Amer. 65:90-93.
6. Benson, J.F. 1973. Intraspecific competition in the population dynamics of *Bracon hebetor* (Say) (Hymenoptera: Braconidae). J. Anim. Ecol. 42(7):105-124.
7. Clausen, C. P. 1940. Entomophagous Insects. New York: McGraw Hill.
8. Davletshina, A. G., 1972. Insect Enemies of the Main Pests of Cotton in Uzbekistan. FAN, Tashkent. Pp.112.
9. Farghaly, H. T. and Z. A. Ragab. 1993. Effect of low temperature storage on pupae of *Bracon hebetor* (Say) (Hymenoptera: Braconidae). Bull. Facu. Agri., Univ. Cairo. 44(3):697-706.

10. Gordh, G. and B., Hawking. 1981. Goniozus emigrates (Rohwen), a primary external parasite of *Paramyelois transitella* (Walker), a comment on bethylids attacking Lepidoptera (Hymenoptera: Betylidae; Lepidoptera: Pyralidae). J. Kansus. Entomol. Soc. 54:787-803.
11. Harakly, F.A. 1969. Biological studies on the cabbage web-worm, *Hellula undalis Fabr.* (Lepidoptera: Crambidae- Pyraustinae). Bull. Soc. Entomol. Egypt. 52:191-211.
12. Jervis, M.A., N.A.C. Kidd and H.E. Almey. 1994. Post productive life in the parasitoid *Bracon hebetor* (Say) (Hymenoptera: Braconidae). J. Appl. Entomol. 177:72-77.
13. Mareis, S.S. 1985. Studies on natural enemies of stored onion and garlic pests. Ph.D. Thesis, Faculty of Agriculture, Cairo University. Pp.78.
14. Mohsin, A. 2001. Some Control Measurement of Fig Moth *Ephestia cautella (*Walk.) (Lepidoptera: Phycitidae). M.Sc. Thesis, University of Baghdad. Pp. 100.
15. Nasrullah, G. 1969. Biological and Morphological Studies on the Parasite *Devorgilla canescens* Grav. (Ichneumonidae: Hymenoptera). Ph.D. Thesis, Faculty of Agriculture, Ainshams University. Pp.203.
16. Press, H.W., L.D. Cline and B. R. Flaherty. 1982. A comparison of two parasitoids, *Bracon hebetor* (Say) and *Venturia canescens* (Hymenoptera: Ichneumonidae) and a predator *Xylocoris flavipes* (Hemiptera: Anthocoridae) in suppressing the population of almond moth, *Eplestia cautella*. J. Kansas Entomol. Soc. 55:-725-728.
17. Reinert, J. A. and E.A. King. 1971. Action of *Bracon hebetor* (Say) a parasite on *Plodia interpunctella* at controlled densities. Ann. Entomol. Soc. Amer. 64:1335-1340.
18. Shawkit, M.A., AA. Al-Taweel and N.K. Al-Tememi. 2000. Effect of low temperature storage on the parasitizing efficacy of *Bracon hebetor* (Say), against dates moth larvae. Iraqi. J. Agric. 5(3):120-122.
19. Soliman, H.S. 1940. Studies in the biology of *Microbracon hebetor* (Say) (Hymenoptera: Braconidae). Bull. Soc. Food. 1-Entomol. (Cairo) 24:215-247.