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Relationship Between the Host Age and the Fitness components of *Hyposoter didymator* Thunb. (Hymenoptera : Ichneumonidae)*

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ABSTRACT

Hyposoter didymator Thunb. was found to parasitise 0-6 day old *Spodoptera litura* (F.) larvae in the laboratory at 24.5 ± 1°C and 65 per cent RH. Effect of host age on developmental period of immature stages, sex ratio of adults, size of the progeny and degree of successful parasitism (survivorship) of the parasitoid were investigated. There was a significant negative correlation between the host age and the parasitoid developmental period, while the size of the progeny was observed to increase with the age of the host. Maximum parasitism was observed in 5-day-old host larvae.

KEY WORDS : *Hyposoter didymator*, host age, developmental period, sex ratio, size of the progeny, degree of parasitism, *Spodoptera litura*.

There exists a complex interaction between the physiology of host and parasitoid. Host size influences the size (Charnov *et al.*, 1981), sex (Luck and Podoler, 1985) and developmental period (Salt, 1941 and Vinson, 1972) of the parasitoid. Usually a parasitoid may attack a host in different age groups some of which may not be optimum for their progeny.

Hyposoter didymator Thunb. was imported into India from the Commonwealth Institute of Biological Control, European Station, Switzerland for trials against *Heliothis armigera* (Hb.). In our laboratory, the parasitoid was found to parasitise 0-6 day old *Spodoptera litura* (F.) larvae. As we used the alternate laboratory host, the knowledge of effect of host on the parasitoid is essential for its mass production and colonisation.

MATERIALS AND METHODS

Laboratory culture of *S. litura* was raised on artificial diet developed by Nagarkatti and Satya Prakash (1974). The neonate larvae were fed on castor leaves. Synchronously developing 100 larvae of each age group *viz.*, 0, 1, 2, 3, 4, 5 and 6 days old were individually allowed to be parasitised by the mated female. The parasitised larvae were reared individually on castor leaves in 10 x 2.5 cm glass vials. Fresh castor leaves were provided every day until the parasitoid larvae spun their cocoons. Developmental period from oviposition to cocoon formation for each parasitoid was recorded. In the case of six day old host, 30 parasitised larvae were found to be in moribund state for 22 days. They were dissected out after death to know the cause. From all the 30 larvae almost fully developed parasitoid larvae were recovered. The length and diameter of the cocoons were measured using centimetre graph paper and their volume worked out. Cocoons were kept for adult emergence and sex ratio of adults emerged from each age group was recorded. The above study was conducted under laboratory conditions at 24.5 ± 1°C and 65 per cent R.H.

RESULTS AND DISCUSSION

Developmental period

Developmental period was found negatively correlated with the age of the host. A polynomial (quadratic equation) regression clearly explains the relationship ($F = 41.9 : df = 5 : P < 0.01$) (Fig. 1).

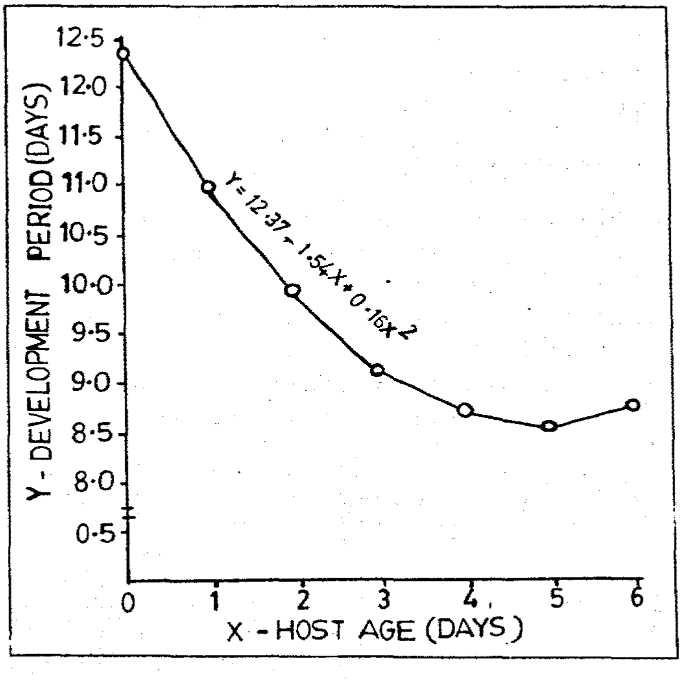

Fig. 1. QUADRATIC REGRESSION OF DEVELOPMENT PERIOD OF *H. didymator* ON HOST AGE

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The time required for the parasitoids to develop from egg to cocoon was 12.4 days in neonate host larvae. The developmental period progressively shortened to eight days as the host age increased up to five days, after which it increased. Salt (1941) reported that there should be optimum amount of food available during the most rapid period of parasitoid development and that smaller or larger quantity increased the developmental time. In the latter case where excessive amount of food was present, a good proportion of it may have to be consumed to enable the parasitoid to escape from the confines of the host cuticle. Our study was in conformity with the observation of Salt (1941). In 6 day old larvae, by the time the parasitoids were ready to emerge, the host cuticle perhaps thickened so much that it took a longer time for the parasitoid to emerge through the cuticle. Of the 100 insects, 30 parasitoid larvae failed to escape. A slower developmental rate, where the parasitisation occurred in the early stage of host has also been observed by Jones and Lewis (1971) in *Microplitis croceipes* (Cresson); Puttler (1961) in *Hyposoter exiguae* (Vier.) and Vinson and Barras (1970) in *Cardiochiles nigriceps* Vier. Corbet (1968) reported that the rate of development of *Nemeritis canescens* (Gravenhorst) depended on the length of time the parasitoid remained in the first instar, which in turn was regulated by host age. In our experiment, when 0 - 1 day old larvae were parasitised, the development period was prolonged; perhaps the parasitoid on hatching, remained in the first stage until the host assumed the optimum size or because of the insufficient food more time was needed for the parasitoid to acquire sufficient nutrients to complete development.

Size of the progeny

Significant linear correlation was observed between host age and the volume of the cocoon ($r = 0.9$; $P < 0.01$). Mean volume of cocoons recovered from 0 and 6 day old parasitised larvae were 34.8 and 48.2mm^3 respectively (Table 1). Smaller host species or individuals yield smaller parasitoid progeny and larger ones, bigger parasitoids. This phenomenon was also observed by Salt (1941) in *Trichogramma evanescens* Westwood; Arthur and Wylie (1959) and Sandlan (1979) in *Coccygomimus (Pimpla) turineollae* (L.) and Susan *et al.* (1986) in *Aphytis melinus* DeBach and *A. lingnanensis* Compere.

Degree of successful Parasitization

Formation of parasitoid cocoon from the parasitised larvae was considered as successful parasitization. Cocoon formation was observed from all the age groups of host larvae parasitised (Table 1). The degree of successful parasitism increased with the increase of host age up to five days but for the decrease in 3-day old host. The most suitable host age for successful parasitization was found to be five days in which 60 per cent cocoon formation was recorded.

The poor parasitization observed in 6 day old larvae was perhaps due to the inability of the parasitoid to escape from the thick cuticle of the host. Lewis (1970) observed that the effective parasitism of *Heliothis zea* (Boddie) by *M. croceipes* followed a parabolic curve with the most acceptable host age being the third instar. Several other investigators have also reported host age as a factor determining the degree of parasitoid success. Lingren *et al.* (1970) noted that *Campoletis sonorensis* (*perdistinctus*) (Viereck) preferred five host species of lepidopterous larvae when they were about 3 - 4 days old. Smilowitz and Iwantsch (1975) observed that the success of parasitism of *Trichoplusia ni* (Hb.) by *H. exiguae* was correlated with host age.

The poor parasitization in 3-day old host larvae may be due to the fact that the host larvae at this time were undergoing ecdysis. The physiological changes in the host during ecdysis seems to be infavourable for parasitoid survivorship. Since maximum percentage of female progeny was observed in this age group, it may be likely that male parasitoids are more susceptible to the physiological changes during ecdysis. No relation was observed between age of host and the sex ratio of the progeny.

TABLE 1 : Host age and fitness components of *H. didymator*

Host age (days)	% success in parasitization	% non-parasitised larvae	Developmental period (days)	Cocoon size (mm^3)	% female progeny
0	28	50	12.4	34.8	22.2
1	44	12	10.9	35.8	18.2
2	48	12	9.8	37.2	6.2
3	24	48	9.4	35.8	66.7
4	48	10	9.0	40.2	41.7
5	60	26	8.0	47.6	31.5
6	16	40	9.0	48.2	0.0

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