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Influence of Different larval Instars of *Papilio demoleus* L. on the Development, Oviposition and Sex-ratio of the Parasite *Apanteles papilionis* Viereck

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ABSTRACT

Apanteles papilionis Viereck, a gregarious indigenous larval parasite, preferred the first four larval instars of *Papilio demoleus* L. for parasitization. The female exhibited an arrhenotokous reproduction. The larval development of the parasite was significantly influenced by the various larval instars of the host. The duration of parasitic development decreased with increasing host age (instar) at the time of parasitization. The developmental periods of egg, prepupal and pupal stages were not affected by the host age. Different larval instars of *P. demoleus* had no significant influence on the number of eggs deposited and sex-ratio of the progeny of the parasite.

Key words: *Papilio demoleus*, larval instars, *Apanteles papilionis* development

INTRODUCTION

Field studies had shown that *Apanteles papilionis* Viereck (Hymenoptera: Braconidae) was an important parasite of the larvae of citrus butterflies, *Papilio demoleus* L. and *P. polytes* L. (Lepidoptera: Papilionidae) (Krishnamoorthy and Singh, 1987). *A. papilionis* is a gregarious species which emerges from the final instar of *Papilio* spp. to spin cocoons. Not much information is available on the relative suitability of different host instars for parasitization and development. Hence, a detailed investigation was carried out to determine this, and also the influence of different instars of *P. demoleus* on the length of development, oviposition and sex-ratio of the parasite, *A. papilionis*.

MATERIALS AND METHODS

Cocoons of *A. papilionis* were collected from *P. demoleus* on citrus plants and kept in a ventilated plastic container (11.5 x 8.5 cm) at a temperature of 28 ± 2°C. Females and males emerging from such cocoons were left in the container for mating. Mated females were removed separately from the container with an aspirator. Adult parasites were fed with 40% honey soaked in a cotton wool. A stock culture of *P. demoleus* was maintained from field-collected eggs of *P. demoleus*

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and hatched larvae were fed with fresh citrus leaves.

In the first experiment, a group of ten mated and ten unmated females were kept separately in plastic containers. A total of forty larvae in each instar of *P. demoleus* were exposed individually to the group of mated females held in plastic container, whereas, for the group of unmated females, just three larvae from each instar were exposed mainly to observe the sex of the progeny. Oviposition behaviour, instars parasitized, per cent host larvae yielding parasites, developmental period and sex of the progeny were recorded. Out of 40 larvae parasitized in each instar, 15 larvae were dissected out (3 larvae at an interval of 1, 6, 24, 30 and 48 h after parasitization) to determine the developmental period of stages of the parasites. The larval development was calculated by subtracting the incubation period from the total developmental period.

In the second experiment, the study was pursued by exposing larvae of different instars individually to a mated female held in glass vials. Each parasite was allowed to parasitize as many larvae as one could in 5 minutes and the process was repeated at 30 minutes intervals. Just one attack per larva was allowed to determine the number of progeny and sex-ratio of the parasite on each instar.

All parasitized larvae were fed fresh citrus leaves daily until the parasites emerged. The sex-ratio was computed after adult emergence and an 'F' test was used to analyse the differences in the developmental period, parasite emergence and sex-ratio due to the different instars. All the studies were conducted in the laboratory at 28 ± 2°C and 45-65% RH.

RESULTS AND DISCUSSION

Females of *A. papilionis* were found to oviposit anywhere on the body of the host except head and ventral regions of the host larvae. The female parasite thrusted its ovipositor into the host's body and remained motionless for a few seconds before withdrawing. Superparasitism was common only when fewer larvae were exposed to many females at a time and also for longer periods under laboratory conditions.

Both mated and unmated females were able to parasitize the larvae of *P. demoleus*. *A. papilionis* attacked all the five instars, but successful development of egg and larva was observed only in first four host larval instars. Some females oviposited into the fifth instar also from the lateral sides (in pleural regions). Such occasional oviposition in the fifth instar from lateral sides could be due to fully tanned cuticle on the dorsal side being impenetrable to the wasp's ovipositor. However, oviposition in the final instar was detrimental as the host pupated subsequently suppressing the development of the parasite. Similar observations were also made by Sato (1976) and Beckage and Riddiford (1978) in other parasites and hosts. Parasitized fifth instar though pupated, yielded often crippled adults.

Growth of *P. demoleus* was not suppressed due to parasitization by *A. papilionis* at any age of host, as voracious feeding and moulting by the

host were observed until it reached the final instar. Unlike solitary parasites which have frequently suppressed the growth of host larva (Rahman, 1970; Vinson, 1972; Parker and Pinnell, 1973; Duodu and Antoh, 1984), *A papilionis* had not suppressed the growth of the host larva, a behaviour normal to gregarious parasites (Sato, 1980; Sato and Tanaka, 1984). As reported by Beckage and Riddiford (1978) for *A. congregatus* (Say), in the present study also the fully developed larvae were observed to egress from host body only in the final and fifth instars irrespective of the age of host larvae at the time of parasitization. Prior to emergence of the parasite larvae, the host was found immobile but alive. Larvae egressed from all over the host's body surface and assembled beneath the host for cocooning. Larvae cocooned in about an hour and entered into pre-pupal stage.

Eventhough both eggs and larvae developed internally in the haemocoel, the developmental period of the latter alone was found to be significantly influenced by different larval instars of the host (Table 1). Sato (1980) reported varying degrees of increase in size of eggs deposited by *A. glomeratus* L. in different instars of *Pieris rapae crucivora* Boisduval during an incubation period of 48 h. Similarly, in the case of *A. papilionis*, incubation period was not altered. The parasite larvae took longer time to develop in the first instar of *P. demoleus* than in the other instars. The mean developmental periods of the parasite were 12.09, 10.00, 8.00 and 5.20 days in first, second, third and fourth instar *P. demoleus* respectively. Though very rapid development was observed in fourth instar, highly significant differences were observed between any two instars compared. Decreases in the duration of parasite larval development observed in the present study with increasing age of the host at the time of parasitization have also been recorded by many other workers on different species (Smilowitz and Iwantsch, 1973; Sato, 1980). A possible reason for this might be that gregarious species require a larger quantity of food for completing the development, as pointed out by Smith

Table 1. Developmental period of immature stages of *A. papilionis* on preferred larval instars of *P. demoleus*

Host instar	Mean* developmental period (days) of *A. papilionis*				
	Egg **	Egg + Larva	Pre-pupa **	Pupa **,**	n
I	2.0 ± 0.0	14.1 ± 1.1a	1.0 ± 0.0	4.0 ± 0.1	21
II	2.0 ± 0.0	12.0 ± 0.7b	1.0 ± 0.0	4.0 ± 0.0	19
III	2.0 ± 0.0	10.0 ± 0.6c	1.0 ± 0.0	4.0 ± 0.1	11
IV	2.0 ± 0.0	7.2 ± 1.1d	1.0 ± 0.0	4.0 ± 0.2	10

n = number of hosts observed for parasite development from larval to pupal stage

* Mean values in each column suffixed with same alphabets are not significantly different (P = 0.01).

** Differences between the means are not significant.

Table 2. Influence of different larval instars of *P. demoleus** on the number of progenies and sex ratio of *A. papilionis*

Larval instar	No. observed	Mean* No. of progenies ** /host larva	No. observed	Mean* sex ratio (Male : Female)
I	21	31.05 ± 24.89@	20	1: 5.13 ± 1.54@
II	19	45.63 ± 23.26	18	1: 4.32 ± 1.85
III	11	53.36 ± 33.82	10	1: 5.45 ± 1.68
IV	10	47 80 ± 31.11	10	1: 4.44 ± 1.67

* Differences in the means of different instars are not significant

** Number of parasites egressed from host body

@ Mean ± SE

and Smilowitz (1976) and Slansky (1986). Had the parasites begun feeding earlier voraciously in younger, smaller host larvae, it is likely that both host and parasites would have perished. Thus the slower growth of the parasite in first instar host was probably to avoid such an effect. This might also be one of the reasons why growth of *P. demoleus* was not suppressed by *A. papilionis*. Therefore the quantum of food available in *P. demoleus* when the parasitization took place, played a major role in altering the developmental period of *A. papilionis* as indicated by Miles and King (1975), Smith and Smilowitz (1976) and Nechols and Tauber (1977) with other parasites and hosts. As pre-pupa and pupa of *A. papilionis* develop outside the host body, these stages were unaffected by the different host instars.

In the present study, there were no significant differences in the mean number of progeny or sex ratio due to different instars (Table 2). According to Ikawa and Suzuki (1982), the oviposition time and the time interval between successive ovipositions influenced the number of eggs laid in the host. Sato and Tanaka (1984) and Sato *et al.* (1986) have also pointed out that parasites laid more number of eggs in later-instar than in earlier-instar hosts. Thus the results obtained in the present investigation may be attributed to one of the following reasons : i) less time given between successive parasitization and ii) simple attack by the parasite rather than an attack with prolonged period of oviposition.

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Incidence of *Heliothis armigera* (Hubner) and Parasitism by *Campoletis chlorideae* (Uchida) in Chhattishgarh, Madhya Pradesh

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ABSTRACT

Gram pod borer, *Heliothis armigera* (Hubner) attacks gram crop severely at flowering and fruiting stages and the parasitism by *Campoletis chlorideae* is also higher at the same time. JG-64 and JG-62 were least susceptible and Kheri was the most susceptible gram variety for the pod borer at vegetative stage but at pod stage Gulabi, Ujjain-21 and Ujjain-24 varieties were more heavily attacked. Incidence of the pest and parasite were correlated.

Key words : *Heliothis armigera*, *Campoletis chlorideae*. Parasitisation, gram varieties.