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Studies on the biology of *Xanthopimpla pedator* a serious pupal parasitoid of *Anthereae mylitta drury (Daba TV)* a tropical tasar silk worm.

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ABSTRACT

In the first, second and third crops *Anthereae mylitta drury* cocoons were found attacked by *Xanthopimpla pedator* a serious pupal parasitoid causing a reduction in cocoon yield. This pupal parasitoid was investigated for its biological characters. It is observed that the life cycle of *Xanthopimpla pedator* was 15.1±1.2 days at 27±4°C temperature, 75±2% humidity and photoperiod of 16L: 8D. Type of food also had an influence on longevity of *Xanthopimpla pedator. Xanthopimpla* fed with water, honey and white sugar syrup lived for 3.1±0.5, 10.3±1.3 and 15.2±1.4 days in females and 3.8±0.3, 12.3±1.2, 15.3±1.4 days in males. Thus males lived longer than females and *Xanthopimlpla* preferred white sugar syrup as food source. Present study shows that *Xanthopimpla pedator* has sexual preference for males in parasitism. It was also found that female *Xanthopimpla* preferred to infest 90% of one day old pupa, 75% of four day old pupa whereas only 5% infestation was found with eight day old pupa. During the three crops, larval duration and larval weight of *Anthereae mylitta drury* were found increased from first to third crops as 33, 36 ,42 days and 31.5,32.8, 28.6 gm. The effective rate of rearing of *Anthereae mylitta drury* was also increased from first to third crop as 72%, 84% and 88%.

Keywords: *Anthereae mylitta drury,* cocoons, *Xanthopimpla pedator*, infestation, lifecycle, food, longevity

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INTRODUCTION

Parasitisation by insect parasitoids depends on host habitat identification, host acceptability and host suitability. Host age plays an important role in host acceptance and suitability by parasitoids [1]. Host killed by female parasitoid for oviposition results in physiological and morphological variations in host and finally improves the acceptability and suitability of host and parasitoid [2]. Host defense mechanism, host toxins, host toxins, pathogenic infection, host sensitivity, competition with other parasitoids also plays an important role in successful development of parasitoid [1].

The tasar silk is produced by *Anthereae mylitta Drury* (Lepidoptera: Saturnidae), a wild polyphagous tropical sericigenous insect distributed over central India. The insect feeds primarily on, *Terminalia tomentosa, Shorea robusta* and *Terminalia arjuna* in addition to secondary and tertiary food plants [3]. The species has wide distribution over diverse ecological niche as forty four ecoraces but only a few are semi-domesticated and applied commercially for seed (egg) and silk production [4]. The physiological potential of life performance of the insect is always challenged by abundance of food and its quality, various abiotic factors, presence of predators, parasites and diseases which affect the cocoon yield. Tasar rearing being out door, there is a certain extent of cocoon loss due to parasites, predators and vagaries of nature. It has been estimated that in hibernating stock about 20-30% loss of seed cocoons due to pupal mortality and unseasonal emergence which in turn reduces the multiplication rate of tasar cocoons.

Ichneumons are important endoparasitoids of insects mainly larvae and pupae of Lepidoptera. Among *Ichneumonidae Xanthopimpla* is the richest genera which includes pupal parasitoids [5]. *Ichneumonidae* was also the dominant pupal parasitoid of the painted apple moth [6]. Studies on biological studies of *Xanthopimpla pedator* are very limited. So, the present research work has taken up to study the biology of *Xanthopimpla pedator* infecting cocoons of *Anthereae mylitta drury (Daba TV).*

MATERIALS AND METHODS

Daba TV cocoons were collected as per the standard norms such as weight, colour, size of cocoons and length of the peduncle from the forest patches of Jakaram, Warangal District, Telangana, India. The cocoons were preserved in the wire mesh cages of size 2 ft x2 ft x2 ft under temperature of 29±1ºC and humidity 70±1%.Cages were disinfected with 2% Formaldehyde [7]. From April to May 42 ±2% relative humidity and 30±2°C room temperature was maintained. The emerged moths were tested for pebrine disease by a method derived from that used in sericulture [8].

During the first, second and third crops, the eggs laid by healthy moths were collected and incubated for hatching. In each crop about 500 newly hatched larvae of *Anthereae mylitta (DabaT.V.)* were reared on *Terminalia arjuna* plantation available in the field till cocooning. To study the impact of season on *Xanthopimpla* infestation and host sex preference, the cocoons obtained from first, second and third crops were divided into three batches of 300 each, as T1-First crop, T2-Second crop and T3-Third crop. Infested cocoons were collected during the first, second and third crops for the estimation of percentage of *Xanthopimpla* infestation. An electric balance of Dhona-make was used to measure the weight of fifth instar larvae in three crops. Larval duration was also recorded in three crops. The effective rate of rearing in first, second and third crop was recorded as follows

ERR% = (Total number of cocoons produced / Total number of larvae brushed) X 100.

Rearing and life cycle of *Xanthopimpla pedator*:

Third crop season cocoons of around 200 were collected from the Tasar plantation and kept under laboratory conditions of 27±2°C temperature and 75±2% humidity to study the life cycle. Emerged adult *Xanthopimpla* were kept in Mica boxes and fed with sugar syrup.10 male and 10 female uninfected cocoons were placed in 10 mica boxes. Every time five couples of *Xanthopimpla* were released into the mica boxes. Experiments were conducted at 27±4°C temperature, 75±2% humidity and photoperiod of 16L: 8D.Infested cocoons during 6am to 6pm were removed hourly and host pupae were dissected to observe the pre-oviposition stage. Every time ten cocoons were dissected and observed the developmental stages like egg, larvae pupa daily under binoculars till adult stage. Infested cocoons were replaced with fresh uninfected

cocoons. Number of cocoons infested, the sex of infested cocoons and age of host pupa at which infestation occurred were also identified.

Statistical analysis:

Each assay was replicated three times. Values were expressed as Mean±SD at p≤ 0.05.

RESULTS AND DISCUSSION

Table 1 explains the rearing performance of *Daba T.V*. The larval duration recorded during first, second and third crops were 33, 36 and 42 days and thus increased from first crop to the third crop. Fifth instar larval weight also increased from first crop to the third crop and it was 31.5, 32.8 and 38.6gm (Figure 1). Larval duration and weight increases from first crop to third crop [9]. Number of cocoons harvested, increased from first crop to the third crop and so the effective rate of rearing found increased from 72%-88%.

Table (1): Rearing performance of *Anthereae mylitta drury(Daba TV)*.

Crop	Total number of larvae reared	Larval duration	Larval weight (gms)	Number of Cocoons produced	Effective rate of rearing (%)
First crop (T1)	500	33	31.5	360	72
Second crop (T2)	500	36	32.8	420	84
Third crop (T3)	500	42	38.6	440	88

Figure (1): Fifth Instar larvae of *Anthereae mylitta drury (Daba TV).*

Table 2 shows the outdoor rearing of cocoons in all the three crops and infestation by *Xanthopimpla.* The percentage of cocoons infested by *Xanthopimpla* was high (16.66%) in third crop compared to second (11.33%) and first crops (7.66%) (Figure 2). It is also found that the percentage of female cocoons infested was less than the male cocoons in all the three crops. *Xanthopimpla* has sexual preference for males in parasitism of hosts [10]. In the first and second crops the frequency of parasitoids obtained were lower than in the third

crop. In the summer season the weather conditions are better for both hosts and parasitoids and parasitoids have accumulated from generation to generation resulting in high frequency of parasitoids [11].

Table (2): Infestation of *Xanthopimpla pedator* in all the three crops in out-door rearing.

Crop	No. cocoons reared	No. female cocoons infested	No. male cocoons infested	Total number of cocoons infested
First crop (T1)	300	2	21	23
Second crop (T2)	300	2	32	34
Third crop (T3)	300	4	46	50

Figure (2): *Xanthopimpla pedator* attacking *Anthereae mylitta drury* cocoons with its tail.

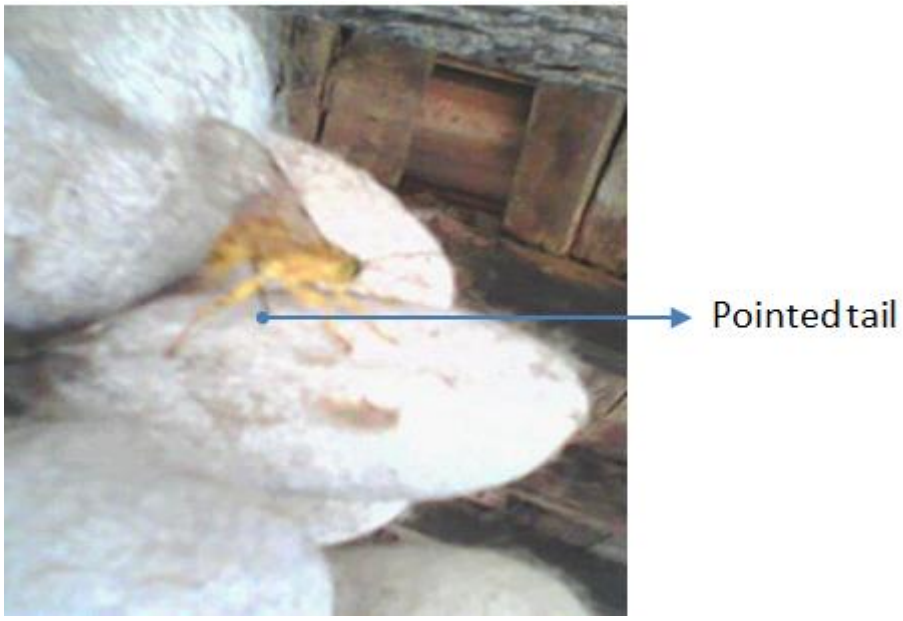

Table 3 shows the duration of *Xanthopimpla* development. In the total developmental period egg duration was longer followed by larva and pupa. Least duration was recorded in pre oviposition ranged between 3-5 hrs while the total life cycle averaged about 15.1±1.2 days. Figure 3 shows the emergence of *Xanthopimpla pedator* after completion of its development in *Anthereae mylitta drury* pupae.

Table (3): Developmental period of Xanthopimpla *pedator* on Tasar cocoons.

Development stage	No. of cocoons/ individuals tested	Duration of development(days and hours)		
		Minimum	Maximum	Mean ±SD
Egg	20	5 days 2hrs	7 days3hrs	6.1±0.25
Larva	20	4days 4hrs	6 days 2 hrs	5.1±0.15
Pupa	20	3days 3hrs	4 days 5 hrs	3.7±0.25
Pre oviposition	20	3hrs	5 hrs	3.9±0.16
Total life cycle	20	12 days 12 hrs	17 days 15 hrs	15.1±1.2

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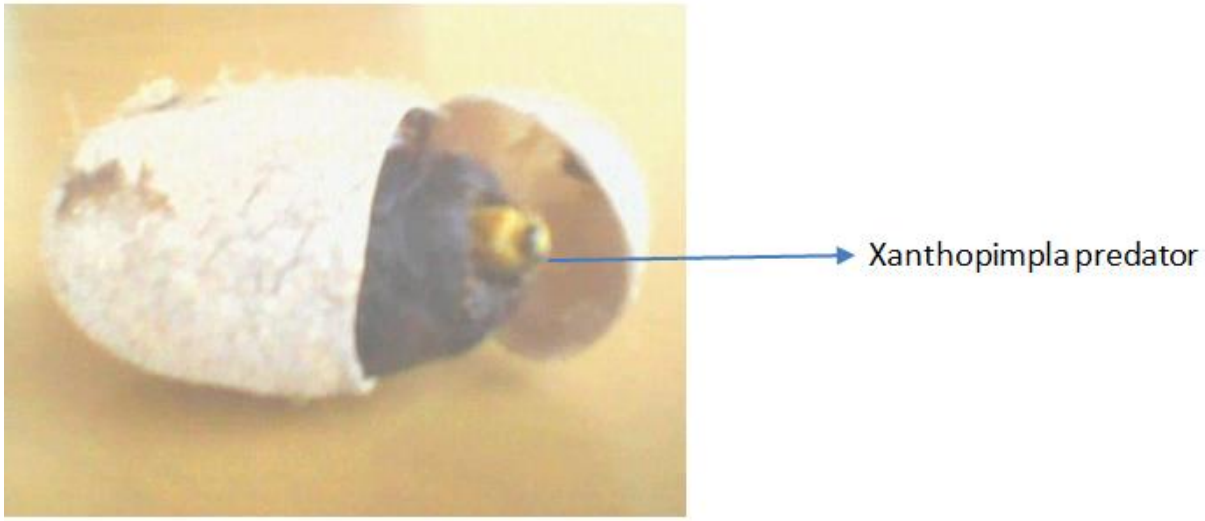
Figure 3 *Xanthopimpla pedator* emerging out of infected pupa inside *Anthereae mylitta drury* cocoon.



In the development of parasitoids host age plays an important role. So it is important for the parasitoid to choose appropriate age of the host for its development and also vigor [12]. Tests were conducted to determine host age preferences (Table 3).It was found that egg duration was longer followed by larva and pupa than 4th day (75%) and 6th day (40%). Pupa of 8th day old has least preference for parasitisation by *Xanthopimpla.* It was also seen that *Xanthopimpla* infestation was limited to male Tasar cocoons only in all the stages. The parasitoids can discriminate the different ages of host pupae, and choose the most suitable host ages for parasitization, and this offers an apparent advantage for the survival of the parasitoid population. In parasitoid *P.vindemmiae* the most suitable age of host for parasitization is 3 day old pupae followed by 5 and 7 days [13]. *Asobara tabida* is more successful in attacking younger than older larvae of Drosophila [14]. In case of *E.argenteopilosus* the parasitization and further emergence of this parasitoid is high in early instar larvae as smaller hosts defending themselves against parasitization probably cause lesser injury to the parasitoid than older ones [15]. Larger hosts can defend themselves better than smaller hosts [16].Preference of younger hosts for parasisitization might be based on the ease to oviposit, resulting in shorter duration of oviposition which is critical for time limited parasitoids [17].

Table (4): Preferred age and sex of pupa for infestation of *Xanthopimpla pedator*.

Age of pupa	Number of cocoons used	Attacked Sex	Number of cocoons infested	Infestation %
Day 1	20	Male	18	90
Day 4	20	Male	15	75
Day 6	20	Male	8	40
Day 8	20	Female	1	5

The longevity is important for parasitoids as it improves host searching ability and waits for suitable stage of host. Food quality and quantity has strong effect on longevity and productivity of parasitoids. *Xanthopimpla* fed with water, honey and white sugar syrup lived for 3.1±0.5, 10.3±1.3 and 15.2±1.4 days in females and 3.8±0.3, 12.3±1.2, 15.3±1.4 days in males. This shows males lived longer than females and *Xanthopimlpla* preferred white sugar syrup as food source. The carbohydrate white sugar maximizes the survival rate of *D.trioni* in laboratory [18]. Pre-release feeding of *D.tryoni* particularly with white sugar enhances the impact of released parasitoids on *B.tryoni* [19]. Carbohydrate composition can effect reproductive success of parasitoids by influencing host searching [20],egg maturation[21] fecundity[22] and longevity [23-24]. The presence of sugar sources can increases the density and diversity of parasitoids in crops [25]. Experiments conducted on the effect of sugars in the development of *Aphidius ervi* had increased the life time in both the sexes in increasing sugar concentration [26].

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Table (5): Effect of food on longevity of *Xanthopimpla pedator*.

Food	No.adults tested	Longevity	of adult	*Xanthopimpla*			
			Female		Male		
		Minimum	Maximum	Mean ±SD	Minimum	Maximum	Mean ±SD
Water	20	2	5	3.1±0.5	3	5	3.8±0.3
Honey	20	10	13	10.3±1.3	11	14	12.3±1.2
White Sugar	20	13	17	15.2±1.4	12	19	15.3±1.4

CONCLUSION

Thus in conclusion, larval duration, larval weight and effective rate of rearing of *Anthereae mylitta drury* had increased from first crop to third crop. *Xanthopimpla* infestation was limited to male Tasar cocoons showing sexual preference. It was found that egg duration was longer among all other stages in the life cycle of *Xanthopimpla predator*. Male *Xanthopimpla* lived longer than females and preferred white sugar syrup as food source. However, more research on control methods of infestation is required so that silk yield can be increased which in turn improves the economy of sericulture industry.

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