Life Science Informatics Publications

Research Journal of Life Sciences, Bioinformatics, Pharmaceutical and Chemical Sciences

Journal Home page http://www.rjlbpcs.com/

RJLBPCS ISSN 2454-6348

Original Research Article **DOI: 10.26479/2018.0403.28**

XANTHOPIMPLA PEDATOR- A PUPAL PARASITOID OF *ANTHERAEA MYLITTA DRURY*

Lakshmi Marepally

Department of Zoology, Kakatiya University, Warangal, Telangana, India.

ABSTRACT: In the first, second and third crops *Antheraea mylitta drury* cocoons were found attacked by *Xanthopimpla pedator* a serious pupal parasitoid causing a reduction in cocoon yield. In this study preference of the parasitoid *Xanthopimpla pedator* to different ages of *Antheraea mylitta drury (Daba TV)* pupae had been studied. The results showed that *Xanthopimpla pedator* parasitized pupae of all ages, and the rate of parasitism was high for 4 to 6 days-old pupae especially during second crop rearing. This pupal parasitoid was investigated for its biological characters. It is observed that the life cycle of *Xanthopimpla pedator* was 21±1.55 days, 21.2±2.1 and 21.3±2.7respectively at 28±2˚C temperature, 78±4% humidity and photoperiod of 12L: 12D during first, second and third crops. Type of food also had an influence on longevity of *Xanthopimpla pedator.* Female *Xanthopimpla* fed with 10% honey, 20% honey and 10% sucrose solution lived for 4.0±0.6, 12.5±1.6 and 16.2±1.6 days in first crop, 4.2±0.5, 12.6±1.2 and 16.3±1.5 in second crop, 4.2±0.5, 12.5±1.6 and 16.3±1.3 in third crops respectively. Whereas male *Xanthopimpla* lived for 4.2±0.4, 13.4±1.4 and 16.3±1.4 in first crop, 4.3±0.4, 13.6±1.6 and 16.5±1.4 in second crop, 4.3±0.4, 13.4±1.6 and 16.4±1.5 in third crops respectively. Thus males lived longer than females and *Xanthopimlpla* preferred 10% sucrose solution as food source.

KEYWORDS: *Xanthopimpla pedator, Antheraea mylitta drury* pupae, host age, food source.

Corresponding Author: Dr. Lakshmi Marepally Ph.D.

Department of Zoology, Kakatiya University, Warangal, Telangana, India.

Email Address: lakshmi.velide@gmail.com

Peer review under responsibility of Life Science Informatics Publications

1.INTRODUCTION

In the life history of insect parasitoid, the female lays its eggs within or on the body of other insects. The reproductive success of a female depends on host species, host age, host nutritional quality, host mortality risks, diet at parasitism, and host physiological condition [1-3]. This ability of parasitoid helps to decide whether to accept or reject parasitizition on the given host. The ability of an ovipositing female to discriminate between different quality hosts is critically important and directly related to the fitness of the offspring [4]. The ability of a parasitoid to distinguish between different age hosts can enhance its performance by preventing wastage of eggs, by avoiding loss of hosts due to multiple attacks, and by saving time of laying eggs [5]. Host discrimination can be used as an important criterion for evaluation of natural enemies used as biological control agents [6-7]. Host age affects host preference and host suitability of parasitoids [8]. In addition, host age has a greater effect on sex ratio of their progeny [9-10]. 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 [8]. 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 [11]. 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 [8]. The tasar silk is produced by *Anthereae mylitta Drury* (*Lepidoptera: Saturnidae*), a wild polyphagous tropical sericigenous insect distributed over central India.Rearing of tasar silkworm, *Anthereae myliia drury* on forest grown plantation like *Terminalia arjuna, Terminalia tomentosa and Shorea robusta* results in 80-90% crop loss due to parasites, predators and vagaries of nature [12]. It has been estimated that in hibernating stock about 20 to 30% loss of seed cocoons was due to pupal mortality and unseasonal emergence which in turn reduces the multiplication rate of tasar cocoons. *Ichneumon fly, Canthecona bug, reduvid bug, Hicrodulla bipapilla (Praying mantis)* etc., are natural enemies in the rearing field which cause maximum crop loss [13]. The cumulative effect of these pathogens results in 30%-40% of Tasar crop loss. *Ichneumons* are important endoparasitoids of insects mainly larvae and pupae of Lepidoptera. Among *Ichneumonidae Xanthopimpla* is the richest genus which includes pupal parasitoids [14]. *Ichneumonidae* was also the dominant pupal parasitoid of the painted apple moth [15]. A pupal parasitoid, *Xanthopimpla stemmator*, was recorded from Maharashtra and Andhra Pradesh [16]. It was also recorded that *Xanthopimpla* predators have sexual preference for male cocoons in parasitism [17]. 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)* and understanding the host-parasitoid relationship.

2. MATERIALS AND METHODS

2.1. Collection and rearing of *Xanthopimpla*: *Xanthopimpla* emerged out of infested *Daba TV* cocoons were collected from the forest patches of Chennoor, Adilabad District, Telangana. Male and female *Xanthopimpla pedator* of 100 pairs was kept in a cage of size 2ft×2ft×2ft with water and honey for further mating. Experiments were conducted at a temperature of 28±2˚C, humidity of 78±4% and photoperiod of 12L:12D. During the month of April 150 *Daba T.V* cocoons were collected from the forest patches of Jakaram, Warangal District, Telangana as per the standard norms like cocoon color, cocoon shape, cocoon weight and peduncle length. For the first crop, the cocoons were accommodated separately in wire mesh cages of size 2ftX2ftX2ft. Cages were disinfected with 2% Formaldehyde [18]. From April to May 42±2% relative humidity and 30±2˚C room temperature were maintained. In the month of June temperature has been reduced to 29±1˚C and relative humidity increased to 72±3 % to get uniform moth emergence. The emerged moths were tested for microsporidiasis [19]. Eggs from healthy moths were prepared and incubated. The hatched larvae were reared on fresh tender leaves of *Terminalia Arjuna* till cocooning following standard procedure. The cocoons harvested from first crop and second crop were subjected for selection for second and third crops and repeated the same above process. To determine the effects of host age on the development of *Xanthopimpla*, 2 days-old mated female *Xanthopimpla* were exposed to *Daba TV* cocoons of all the three crops. Each experiment cage of size 2ft×2ft×2ft contained 50 cocoons containing pupae of a particular age and 10 mated female *Xanthopimpla*. After 24h, the exposed cocoons containing pupae were placed individually in 100 ml bottles until *Xanthopimpla* emerged. Cotton pieces saturated with 10%honey, 20% honey and 10% sucrose solution placed on the walls of bottles which provides food to the adult emerged *Xanthopimpla*. The pupae used for the experiment were of 2-8 days old. Experimental trials were replicated thrice.

The effect of food on longevity of *Xanthopimpla* was evaluated using 10% honey, 20% honey and 10% sucrose solution as the treatments. The treatments were measured at 28±2˚C temperature, humidity of 78±4% and photoperiod of 12L:12D. Each treatment included 20 male and 20 female *Xanthopimpla* in all the three crops.

2.2 Statistical analysis

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

3. RESULTS AND DISCUSSION

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 [20]. The parasitoids can discriminate 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.

Present results show that *Xanthopimpla pedator* had parasitized host pupae at all stages (Table 1). However, the rate of parasitism varied significantly among various host age classes. The parasitism was higher in 4 days-old pupae and lowest in 7 days old pupae. 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 [21]. It was observed that there was no significant variation in parasitisation by *Xanthopimpla* among 4, 5 and 6 days-old age pupae during first and third crops whereas much variation in parasitisation was recorded in second crop. It was also observed that parasitisation % was highest in second crop rearing in 4th day pupae (58%) followed by first (53%) and third crop rearing (50%). In parasitoid *P.vindemmiae* the most suitable age of host for parasitization is 3 day old pupae followed by 5 and 7 days [22]. *Asobara tabida* is more successful in attacking younger larvae than older larvae of Drosophila [23]. The higher number of collections of individuals of major important lepidopteran pest species during periods of cooler temperatures and lower precipitation is reported [24]. In case of *E.argenteopilosus* the parasitization and further emergence of the parasitoid is high in early instar larvae as smaller hosts defending themselves against parasitization probably cause lesser injury to the parasitoid than older ones [25]. Table 2 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. There is no significant variation in the developmental period of *Xanthopimpla* in all the three crops. The total life cycle averaged about 21 days in all the three crops. 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 (Table 3). Female *Xanthopimpla* fed with 10% honey, 20% honey and 10% sucrose solution lived for 4.0±0.6, 12.5±1.6 and 16.2±1.6 days in first crop, 4.2±0.5, 12.6±1.2 and 16.3±1.5 in second crop, 4.2±0.5, 12.5±1.6 and 16.3±1.3 in third crops respectively. Whereas male *Xanthopimpla* lived for 4.2±0.4, 13.4±1.4 and 16.3±1.4 in first crop, 4.3±0.4, 13.6±1.6 and 16.5±1.4 in second crop, 4.3±0.4, 13.4±1.6 and 16.4±1.5 in third crops respectively. Thus males lived longer than females and *Xanthopimlpla* preferred 10% sucrose solution as food source. The carbohydrate maximizes the survival rate of *D.trioni* in laboratory [26]**.** Pre-release feeding of *D.tryoni* particularly with sugar enhances the impact of released parasitoids on *B.tryoni* [27]. Carbohydrate composition can affect reproductive success of parasitoids by influencing host searching, egg maturation, fecundity and longevity [28].The presence of sugar sources can increases the density and diversity of parasitoids in crops [29]. 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 [30].

4. CONCLUSION

In conclusion *Xanthopimpla pedator* has host age preference in parasitism and the infestation rate on the pupae of *Daba TV* was high in second crop followed by first and second crops. This causes production of damaged cocoons; a control over the infestation will reduce the economy loss in cocoon reeling sector. It was found that egg duration was longer among all other stages in the life cycle of *Xanthopimpla pedator*. Male *Xanthopimpla* lived longer than females and preferred sucrose solution 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.

5. ACKNOWLEDGEMENT

The author would like to thank UGC- New Delhi for providing financial assistance in the form of Post -Doctoral Fellow for Women.

6. CONFLICT OF INTEREST

Author declares no conflict of interest.

REFERENCES

1. Dover B,Vinson S. Stage-specific effects of *Campoletis sonorensis* parasitism on *Heliothis virescens* development and prothoracic glands. Physiology Entomology. 1990;15: 405-414.
2. Mironidis GK, Savopoulou-soultani M. Development, survival and growth rate of the *Hyposoter didymator-Helicoverpa armigera* parasitoid host system: Effect of host instar at parasitism. Biological Control.2009; 49: 58-67.
3. Pennacchio F, Strand MR. Evolution of developmental strategies in parasitic Hymenoptera. Annual Review of Entomology.2006; 51: 233-258.
4. Babendreier D, Hoffmeister TS. Superparasitism in the solitary ectoparasitoid *Aptesis nigrocincta:* the influence of egg load and host encounter rate. Entomologia. Experimentalis et Applicata. 2003;105(2): 63-69.
5. Van Lenteren JC. Host discrimina tion by parasitoids. In: Semio chemi cals: Their role in pest control (eds D.A. Nordlund, R.L. Jones and J.W. Lewis), Wiley, New York, USA, 1981, pp. 153-179.

6. Luck RF. Evaluation of natural enemies for biological control: a behavioral approach. Trends in Ecology Evolution.1990; 5:196-199.
7. Zappalà L, Hoy MA. Reproductive strategies and parasitization behavior of *Ageniaspis citricola*, a parasitoid of the citrus leafminer *Phyllocnistis citrella*. Entomologia. Experimentalis et Applicata Ent Exp Appl. 2004;113: 135-143.
8. Vinson SB, Iwantsch G. Host suitability for insect parasitoids. Annual Review of Entomology. 1980; 25: 397-419.
9. Islam W. Effect of host age on rate of development of *Dinarmus basalis (Rond.) (Hym., Pteromalidae)*.Journal of Applied Entomology.1994;118: 392-398.
10. Ueno T. Host-size-dependent sex ratio in a parasitoid wasp. Researches on Population Ecology.1999; 41: 47-57.
11. Mackauer M, Sequeira R. Parasites (Beckage NE,Thompson SN, Federici BA), 1993; Academic Press Inc., San Diego. pp. 1–17.
12. Mathur SK, Shukla RM. Rearing of tasar silkworm. Indian Textile Journal. 1998; 86: 68-77.
13. Sinha USP, Siha AK, Srivastava PP, Brahmachari BN. Studies on the variation in chemical constituents in relation to maturity of leaves in three primary food plants of tropical tasar silkworm *Antheraea mylitta D*.Indian Journal of Sericulture. 1992;31(1):83-86.
14. Babendreier D. Life History of *Aptesis nigrocincta* (Hymenoptera: Ichneumonidae) a cocoon Parasitoid of the Apple Sawfly, *Hoplocampa testudina* (Hymenoptera: Tenthredinidae)," Bulletin of Entomological Research.2000;90(4):291-297.
15. Gerard PJ,Charles JG,McNeill MR,Hardwick S,Malipatil MB,Page FD. Parasitoids of the painted apple moth *Teia anartoides Walker* (Lepidoptera:Lymantriidae) in Australia. Australian Journal of Entomology. 2011; 50(3):281- 289.
16. Duale AH, Nwanze KF.Incidence and distribution in sorghum of the spotted stem borer *Chilo partellus* and associated natural enemies in farmers' fields in Andhrapradesh and Maharashtra states. International Journal of Pest management.1999;45(1):3-7.
17. LakshmiVelide,M.V.K.Bhagavanulu (2012). Study on infestation of *Xanthopimpla pedator* on the cocoons of tropical tasar silkworm *Anthereae mylitta drury*. International journal of plant animal environmental sciences. 2(3):139-142.
18. Jolly MS,Sen SK,Ashan MM.Tasar culture Ambika publishers, Bombay, 1974;pp:203.
19. Pasteur L. Etudes sur la maladie des vers a soie, Gauthier-Villars. 1870; Paris,Tome I, pp.322 Tome II, pp.327.

20. Bradleigh SV. Host selection by insect parasitoids. Annual review of Entomology.1976; 21:109-133.
21. Harvey J,Thompson D. Some factors affecting host suitability for the solitary parasitoid wasp, *Venturia canescens (Hymenoptera:Ichneumonidae).*Norwegian Journal of Agriculture Science Supplementary. 1994;16: 321-327.
22. Hai-Yan Zhao, Ling Zeng, Yi-Juan Xu, Yong-Yue Lu, Guang-Wen Liang. Effects of Host Age on the Parasitism of *Pachycrepoideus vindemmiae (Hymenoptera: Pterom alidae*), an Ectoparasitic Pupal Parasitoid of *Bactrocera cucurbitae (Diptera:Tephriti dae).*Florida Entomologist. 2013; 96(2):451-457.
23. Alphen Van J, Drijver R. Host selection by *Asobara tabida (Braconidae: Alysiinae),* a larval parasitoid of fruit *Drosophilidae* species: Host selection with Drosophila melanogaster as host. Netherlands Journal of Zoology.1982;32:215-231.
24. Zanuncio JC, Zanuncio TV, Lopes ET, Ramalho FS.Temporal variations of Lepidoptera collected in an Eucalyptus plantation in the State of Goiás, Brazil.Netherlands journal of zoology.2001. 50:435–443.
25. Leonardo T, Pascua, Miriam E, Pascua .The Preference acceptability and suitability of Ichneumonid Wasp, *Eriborusarge nteopilosus Cameron (Hymenoptera:Ichneumonidae)* on the different larval stages of cotton bollworm, *Helicoverpa armigera Hubner (Lepidoptera:Noctuidae)*.Philippine Journal of Science. 2004; 133(2):103-108.
26. Stuhl C, Sivinski J, Teal P, Aluja M. Response of multiple species of tephritid (Dipter) fruit fly parasitoids (Hymenoptera:Braconidae):Opiinae) to sympatric and exotic fruit volatiles . Florida entomologist. 95: 1031-1039.
27. Ashley Louisa Zamek,Olivia Louise Reynolds, Sarah Mansfield,Jessica Louise Micallef, Geoff Michael Gurr. Carbohydrate diet and reproductive performance of a fruitfly parasitoid, *Diachasmimorpha tryoni*. Journal of insect science. 2012;13:1-11.
28. Petra Hogervorst AM, Jorg Romeis, Felix Wackers L.Suitability of honeydew from potato infesting aphids as food source for Aphidius ervi Proceedings of experimental applied entomology. 2003;14:87-90.
29. Jacob HS, Evans EW.Influence of different sugars on the longevity of Bathyplectes curculionis (Hymenoptera:Ichneumonidae). Journal of applied entomology. 2004; 128(4): 316-320.

30. Hichem Azzouz, Philippe Giordanengo, Felix Wackers L, Laure Kaisera. Effects of feeding frequency and sugar concentration on behavior and longevity of the adult aphid parasitoid: Aphidius erv (Haliday) (Hymenoptera: Braconidae).Biological Control.2004; 31:445–452.

SUPPLIMENTARY FILES:

Table 1. Host pupal age preference for parasitism and emergence of Xanthopimpla pedator during three crops

First crop				Second crop			Third crop		
No. cocoons (per crop)	**Mated female (Number)**	**Pupa Age (Day)**	**Para sitism (%)**	**Mated female (Number)**	**Pupa Age (Day)**	**Para sitism**	**Mated female (Number)**	**Pupa Age (Day)**	**Para sitism**
30	8	3^{rd}	28±1.54	8	3^{rd}	28± 1.63	8	3^{rd}	26± 1.26
30	8	4^{th}	53±2.14	8	4^{th}	58± 2.78	8	4^{th}	50± 1.28
30	8	5^{th}	52±2.55	8	5^{th}	55± 2.24	8	5^{th}	49± 1.88
30	8	6^{th}	51±2.25	8	6^{th}	54± 2.36	8	6^{th}	48± 1.65
30	8	7^{th}	16±0.85	8	7^{th}	17± 0.54	8	7^{th}	14± 0.78

Table 2. Developmental period of *Xanthopimpla pedator* in Tasar cocoons

Development stage	No. of cocoons tested Per crop	First crop			Second crop			Third crop		
		Development duration (days, hours)			Development duration (days, hours)			Development duration		
		Min	Max	Mean ±SD	Min	Max	Mean ±SD	Min	Max	Mean ±SD
Egg	8	5days 4hrs	7days 5hrs	6.1± 0.25	6days 4hrs	7 day 5hrs	6.2± 0.5	6days 5hrs	7days 5hrs	6.4± 0.5
Larva	8	4days 3hrs	6days 4hrs	5.1± 0.3	5days 3hrs	6days 3hrs	5.3± 0.6	4days 4hrs	6days 5hrs	5.2± 0.8
Pupa	8	4days 4hrs	5days 4hrs	4.7± 0.4	4days 5hrs	5days 5hrs	4.5± 0.4	4days 5hrs	5days 4hrs	4.6± 0.6
Pre oviposition	8	4hrs	6hrs	5.1± 0.6	5hrs	6hrs	5.2± 0.6	4hrs	6hrs	5.1± 0.8
Total life cycle	8	13 days 15hrs	18 days 19hrs	21± 1.55	15 days 17hrs	18 days 19hrs	21.2± 2.1	14 days 18hrs	18 days 20hrs	21.3± 2.7

Table 3. Effect of food on longevity of *Xanthopimpla pedator*

Crop	Food	No. adults tested	Longevity of adult *Xanthopimpla* (days)					
			Female			Male		
			Min	Max	Mean ±SD	Min	Max	Mean ±SD
First crop	10%Honey	20	3	5	4.0±0.6	4	5	4.2±0.4
	20%Honey	20	11	14	12.5±1.6	2	13	13.4±1.4
	10%Sucrose solution	20	14	18	16.2±1.6	13	18	16.3±1.4
Second crop	10%Honey	20	4	5	4.2±0.5	4	6	4.3±0.4
	20%Honey	20	12	14	12.6±1.2	12	14	13.6±1.6
	10%Sucrose solution	20	14	19	16.3±1.5	14	17	16.5±1.4
Third crop	10%Honey	20	4	5	4.2±0.5	4	6	4.3±0.4
	20%Honey	20	11	14	12.5±1.6	13	14	13.4±1.6
	10%Sucrose solution	20	15	18	16.3±1.3	13	17	16.4±1.5