Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2016; 4(1): 80-83

Received: 13-11-2015
Accepted: 15-12-2015

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Life cycle of *Dermestes ater* DeGeer (Coleoptera: Dermestidae) on Tasar cocoon

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Abstract
The Tasar silkworm *Antheraea mylitta* D. is reported to be attacked by a host of pests. These pests are broadly categorized as predators and parasitoids. Predators cause damage to Tasar larvae during early instar and parasitoids during late stages to Tasar silkworm larvae. Apart from these pests, of late infestation of the dermestid beetle, *Dermestes ater* was observed in Tasar sericulture. During the first and second crop grainage season of 2013, the infestation of *D. ater* was noticed in the grainage house of Silkworm Breeding and Genetics section of CTR&TI, Ranchi. Both the grubs and adults were found feeding on the pupa and ovipositing moth. The infestation was observed in the open cocoon, ovipositing female moths inside the paper oviposition box, dead moths in the grainage house, and in the debris of the grainage house. The incubation period of eggs was 7.33 days. Developmental duration of grubs lasted for 102 days. Pupal duration was 7.33 days. The adults and grubs of *Dermestes ater* were observed to feed on pupa, moth and silk fiber and cocoon shell of *Antheraea mylitta.* Further, detailed studies are required on the feeding behavior, habit and habitat, and extent of damage caused by these beetles in Tasar sericulture.

Keywords: *Dermestes ater*, *Antheraea mylitta*, grainage, pest

1. Introduction
Tasar silk is produced by *Antheraea myllita* which is polyphagous in nature. However, its primary food plants are *Terminalia arjuna* and *Terminalia tomentosa* commonly known as Asan and Arjuna, respectively. A large number of pests are reported to attack both the host plant pests as well as silkworm [1-7]. Earlier natural forest grown plants were used for the silkworm rearing. As the rearing is conducted outdoor silkworms are exposed to attack by various pests during their life cycle. The major pests of host plants are gall fly (*Trioza flecheri minor* Crawf), vapourer tussock moths, May-June beetle (*Anomala blanchardi* Blanch.), weevils, Red beetle (*Tricliona picea* Jacoby) and stem borers. Major pests of Tasar silkworm are broadly categorized as predators and parasitoids. Predators cause damage to Tasar larvae during early instar and parasitoids during late stages to Tasar silkworm larvae. The major pests of silkworm are Uzi fly (*Blepharipa zebina* Walker), Yellow fly (*Xanthopimpla pedator* Fabricius), Stink bug (*Eocanthcona* furcellata Wolff), Assassin bug (*Sycanus collaris* Fabricius), Wasp (*Vespa orientalis* Linnaeus), Praying mantis (*Hierodulla bipapilla* Serville) and Red ant (*Oecophylla smaragdina* Fabricius).
Various pests are known to attack and cause severe damage to the stored mulberry cocoons rendering them unfit for reeling [8, 9]. Thiaggarajan and Govindaiah (1987) recorded a loss of about 20 percent of the silk production due to Dermestid beetle.
Of late, the infestation of dermestid beetle, *Dermestes ater* was observed in the grainage house of CTR&TI, Ranchi during first and second crop grainage season of 2013. The infestation was more in ovipositing female moths that to when the paper boxes were used for egg laying. The infestation was also observed in the pupae of open cocoons.
Dermestid beetles are small beetles characterized by the presence of tarsi with five- joints, antennae short with a club, and received under the prothorax in a cavity. Head is retractile. The beetles are often clothed with fine hair or scales. *D. ater* belongs to the family Dermestidae of order Coleoptera. These beetles are commonly called as larder beetles or carpet beetles. They are hairy, dark colored, elongated beetles and measures 2 – 5 mm in length. The grubs are light black in color. The life cycle takes about 1 to 3 years. In cold areas they spend the winter in the adult stage. The grubs feed on raw skin and hides, but will also feed on stored meat, cheeses, tobacco, dried fish, dried museum specimens, etc.

The most common recorded species are *Dermestes cadaverinus* and *D. vulpinus.* The larva of D. vulpinus feeds upon the cocoons of silkworms is common in India. Some other Dermestids are also reported infested silkworm cocoons viz. *Dermestes frishchi, Dermestes tesslatocollis, Dermestes coarctatus, Trogoderma versicolor, Anthrenus verbasi, Anthrenus pipinellae, Attagenus piceus (Oliver), Attagenus japonious Reitter*. Among all Dermestid beetles *Dermestes cadaverinus* is very serious and frequently available in sericulture [11]. The smell of stifled cocoon and the dried pupae inside attract the larvae and adult of *D. cadaverinus.* They bore inside the cocoon and eat the dried pupae and sometimes the eggs, the damaged cocoon become unfit for reeling. In mulberry, Dermestid beetles are known to attack pierced cocoon in cocoon storage room. The female beetles lay about 150-250 eggs in the floss of cocoon. The beetles migrate from cocoon storage room to grainage house and attack green cocoons as well as moths. Generally, they attack the abdominal region of the moth. In the present work an attempt was made to study the life cycle of dermestid beetle, *Dermestes ater*.

2. Materials and Methods

The study was conducted in the Laboratory of Entomology Section of Central Tasar Research and Training Institute, Piska Nagri, Ranchi, Jharkhand. The grubs and adults of Dermestid beetles were collected from the Grainage house of Breeding and Genetic, CTR&TI, Ranchi. They were cultured in the laboratory to collect the eggs for experiment to study the life cycle. The eggs were collected from the laboratory culture. The eggs were kept in glass petridishes on blotting paper. The eggs were observed daily for hatching. After hatching the grubs were transferred to clean, transparent plastic jars covered with muslin cloth to facilitate aeration. The dead silk moth, cocoon shell, dead pupa and floss were provided as food for the developing grubs. The jars containing the grubs were observed daily to record the moulting. After emergence of adults longevity was recorded. The data was subjected to one way ANOVA followed by DMRT using Statistical Package for Social Sciences (SPSS) version 20.

3. Results

Egg: The eggs were small, round and creamy white in color when laid latter turns to pale yellow at the time of hatching. The egg incubation period was 7.33 ± 0.33 days.

Grubs: The newly hatched grub was milky white in color with dark bristle and later turned to light brown. The colour of the grubs gradually turned darker after each moult. They fed on silk fiber, dead pupa, dead moth and cocoon shell. The first instars lasted for 3-4 days with an average of 3.33± 0.33 days. After completion of first instar they settled for first molt, the duration of first molt was 03 days. Second instar grubs were reddish brown in color and fed on dead silk moth and cocoon shell. Second instars ranged from 3-5 days with an average of 3.66± 0.66 days. Second molting duration lasted for 3 days. Third instars grubs were bigger in size and dark brownish black in color. The third instar duration ranged from 4-6 days with an average of 4.66± 0.66 days. The third molting duration lasted for 4 days. The fourth instars duration varied from 5 - 6 days with an average of 5.33± 0.33 days. Fourth molt Duration was 5 days. The fifth instar grubs were black in color, the instar duration ranged from 20 - 21 days with an average of 20.33± 0.33 days. The molting duration of fifth instar was 20 days. The sixth instar duration ranged from 29-30 days with an average 29.66+ 0.33 days. The grubs were black in color and fed on dead silk moth, cocoon shell, dead pupa and silk fiber. Sixth instar grubs settled for moult during which it transformed into pupa.

Pupa: The pupa was enveloped by the larval skin, which is not shed, but with a split along the dorsum. The pupa was oval-shaped, light yellow in color and pupal duration was 7-8 days with an average of 7.33 ± 0.33 days. After completion of pupal duration the adult emerged.

Adult: The adult beetle was black in colour and measured 8mm in length and elongate in shape. They were observed to feed on dead pupa, moth, silk fiber and cocoon shell.

Adult longevity: In laboratory the longevity of adult beetle ranged from 8-14 days with an average of 11.33± 1.76 days. (Table 1)

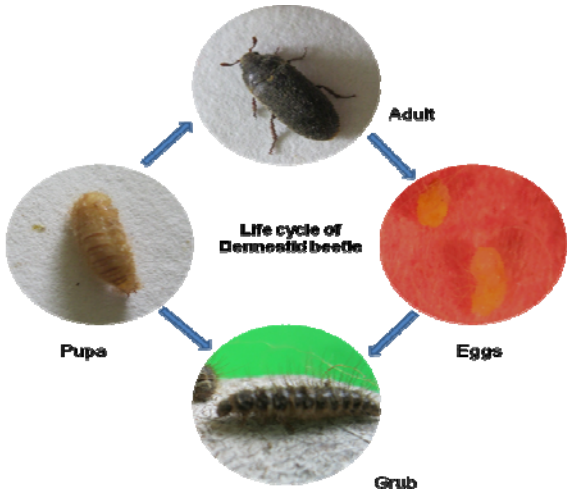

Table 1: Life cycle of Dermestes ater

Particulars	Mean(days)	Particulars	Days
Incubation Period	7.33 ±0.33^{c}	-	-
I Instar	3.33 ±0.33^{d}	I Moult	3.0
II Instar	3.67 ±0.67^{d}	II Moult	3.0
III Instar	4.67 ±0.67^{d}	III Moult	4.0
IV Instar	5.33 ±0.33^{cd}	IV Moult	5.0
V Instar	20.33 ±0.33^{b}	V Moult	20.0
VI Instar	29.67 ±0.33^{a}	-	-
Pupal Stage/ VI Moult	7.33 ±0.33^{c}	-	-
Total duration from egg to adult	143 days	Total Moulting duration	35.0
Adult longevity	11.33±1.76		
F-VALUE	155.089 **	F value	558.150 **

** - Significant at 1%

4. Discussion

Dermestids have a variety of habits. Most genera are scavengers that feed on dry animal or plant material such as skin, pollen, animal hair, feathers, dead insect and natural fibers. Members of *Dermestes* are found in animal carcasses,

while others may be found in mammals, birds and bee wasp nests. *Thaumaglossa* species lives in the egg cases of mantids, while *Thogoderma* species are pests of grain. The infestation of dermestid beetles in sericulture has been reported by many authors [8-10]. *Dermestes vulpinus* which feeds upon the cocoons of silkworms is common in India. It was found feeding through the silk to reach the pupa on which it feeds. Three species of dermestid beetles viz., *D. undulatus*, *Tribolium freemani* and *Trogoderma* sp are reported to attack stored silk cocoons of *Bombyx mori* [12, 13]. Among the dermestid beetles *D. cadaverinus* is very serious and prevalent in sericulture [11].

The infestation of *D. ater* was observed in the open cocoon, ovipositing female moths inside the paper oviposition box, dead moths in the grainage house, and in the debris of the grainage house. However, the infestation was more in moths kept in the paper ovipositon box. The reason might be low intensity of light, insufficient aeration, high humidity, and moisture obsorption by the paper boxes as the paper boxes were piled up in one place. Similar observation of attraction of dermestid beetles towards moist paper was reported by Wong (2012). This property is common in most insects where they prefer to stay at closed and moist environment.

In the present investigation the incubation period of eggs was 7.33 days which is in partial agreement with the reports of Kumar *et al*. (1988) who recorded average 4.5 days of incubation period. The developmental duration of dermestid beetles grubs was observed 102 days which is not in agreement with the results of Roth and Wills (1950) who reported the developmental duration of grubs as 27-28 days. However, the pupal duration of the beetles is in agreement with the reports Roth and Wills (1950). Total life cycle of the beetles at 27-28 ℃ was 6 weeks by Roth and Wills (1950). In our study the beetles completed its life cycle in 143 days which approximately 3 folds longer than the life cycle duration of the beetles reported by Roth and Wills (1950). This longer duration of life cycle may be attributed to the cooler temperature (18 – 22 °C) at which the present experiment was conducted.

In mulberry sericulture *Dermestes ater* has been reported as pest of mulberry silkworm which feeds on pierced cocoons, pupae, dead and egg laying moths (Website CSR&TI, Mysore). The results of the present study are in partial agreement of the report where it was observed that the dermestid beetles (grub and adult) were feeding on the pupae inside the open cocoon and the egg laying moths.

Thiaggarajan and Govindaiah (1987) recorded a loss of about 20% of the silk production due to Dermestid beetles. The estimated loss due to detmestid beetle to green cocoons and moths in mulberry is 16.62 and 3.57, respectively [8]. In Tasar, reports are negligible on the infestation of dermestid beetles and loss due to their infestation. Further, detailed studies are required on the feeding behavior, habit and habitat, and extent of damage caused by these dermestid beetles in Tasar.

5. Conclusion

The infestation of *Dermestes ater* was observed during first and second crop grainage seasons in the grainage house. Both the grubs and adults were found feeding on the pupa and ovipositing moth. The total life cycle of *Dermestes ater* on Tasar commodities was 143 days of which the developmental duration of grubs was 102 days. The infestation of dermestid beetles is neglected in Tasar sericulture this may pave way to attain status of major pest. Further, detailed studies are required on the feeding behavior, habit and habitat, and extent of damage caused by these dermestid beetles in Tasar.

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