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Life History Characteristic and Larval-Pupal Parasitoids of the Dolichandrone Weevil, *Cionus* sp. (Coleoptera:Curculionidae)

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Abstract: Mangrove trumpet trees (*Dolichandrone serrulata* (Wall. ex DC.) Seem are popular in Thailand and used as edible plants and ornamental trees. *Cionus* sp.(Dolichandrone weevil) feeds on Mangrove trumpet trees but data on its life history is very limited. Based on field collection from the Mangrove trumpet tree from public parks in Nonthaburi province, Thailand and laboratory studies, it provides the morphological description of larvae and adults, new data on growth and development of *Cionus* sp. as well as its larval-pupal parasitoids. The insect species has four different life stages: egg, larva, pupa and adult. After adult emergence for 5-7 days, mating will occur during daytime and the copulation lasts for 5-10 hours. The female laid eggs in a group of 3-7 eggs. A minimum of 14.71 days is required for passing through the egg, larval and pupal stages. Females live slightly longer than males (82.35 and 81.20 days, respectively). Upon the completion of larval development, it will build a cocoon, pupate in there and attach to the ventral or dorsal part of leaf surface. The adults normally emerge in the morning. It exibits death-feigning behaveior when being disturbed. In nature, both adults and larvae are commonly found in the rainy season. These insect larvae feed on leaves and young twig surface of Mangrove trumpet trees whereas adults prefer young leaves. Heavy infestation can stunt the tree's growth and cause dieback. The larvae and pupae were observed parasitized by the hymenopteran parasitoid, *Entedon* sp. The parasitization occurrence during May, 2017 to July, 2018 was 6.25-24.19% in larvae and 0.00-62.50 % in papa. Further studies should be conducted to evaluate the efficacy of *Entedon* sp. as the potential biological control agent for *Cionus* sp population reduction in home gardens and residential areas.

Keywords: Death-feigning behavior, *Entedon* sp., Growth and development, Lifespan, Natural control

Introduction

Mangrove Trumpet Tree (*Dolichandrone serrulata* (Wall. ex DC.) Seem is a small to medium-sized trees up to 10-20 meters and a species of plant in the Bignoniaceae family, order Lamiales. It is widely distributed in Bangladesh, Myanmar, Thailand, and Vietnam. It has a straight, robust and cylindrical trunk with a large, broadly conical and shady crown. Compound leaves are composed of 5-7 pairs of leaflets arranged opposite one another. White trumpet-shaped flowers are found in cluster 3-7 flowers(Veesommai and Kavduangtain, 2004). Fruits is flatten and has a characteristic flat like a bean pod which the pods are flat, parallel, curved, twisted, up to 1 m long These deciduous trees are found throughout all parts of Thailand. It is popular as boiled vegetable for local consumption and herbal drink. Currently, it is planted as ornamental plants because of the beautiful shrubs. In Thailand, there are 3 species of plants in a genus *Dolichandrone*: *D. columnaris*, *D. spathacea*, and *D. serrulata*. Regarding *D. serrulata*, are found in the forest, fields, mixed deciduous forest, flowering during March to June.

Insect pest of *D. serrulata* are the lesser death's head hawkmoth (*Acherentia styx*), dark bordered hawk moth (*Psilogramma increta*). Both of them are leaf feeders(Bangpai et al.,2017; Namee, 2017). Leaf beetle (*Alticini* sp.) and *Dolichandrone* weevil (*Cionus* sp.) also found attacked *D. serrulata*. Dolichandrone weevils are an

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important insect pest of the Mangrove trumpet tree. Cunningham (1979) described the development of *Cionus* sp. and indicated that the mortality of young instars was quite high. The larvae have muscous, hyaline covering to protect them from desiccation and against cannibalism. Upon fully development the larvae, chitinous strands secretion from the peritrophic membranes, and mixed with glutinous material of the hyaline coat flows around the larval body, covering the ventral surface. Then, it turns into an ovoid cocoon(Rather,1989). The larvae feed on the surface of young twigs near the young shoots whereas the adults are leaf feeders. Rather (1989) noted that during the development of different life stages of the *Cionus* weevil prefer and attack different parts of its host plant.

Entedon sp. is a parasitic wasp of beetles in the families Curculionidae, Brentidae, Anobiidae, Chrysomelidae, Buprestidae, Cerambycidae, Mordellidae, and Nitidulidae (Askew and Kopelke 1989, Gumovsky, 2006; Rasplus, 1991). *E. cionobius* is a parasitoid of *Cionus* spp. (Alford, 2019). The larvae and cocoons of *C. hortulanus* and *C. tuberculosis* are attacked by a gregarious, internal parasitoid, the eulophid *Entedon cionobius* (Thomson) (Rather,1989). The solitary, *Habrocytus cioni* (Thomson) is external pteromalid also common in the area and known as an ectoparasite of both species including *Gelis* spp. and two ichneumonids: *Itoplectis alternans* (Grav.) and *Agrothereutes abbreviator* (Fabr.). There were no parasitoids of the eggs or adults of Cionini species. However, *Entedon* sp. is an egg parasitoid of *Cirina forda* (Odebiyi et al., 2003).

Previous studies indicated that very few information on the Dolichandrone weevils is available. Therefore, the biology and morphology of this insect should be investigated to find best available methods for further management program. This research will focus on life history, morphology of all stages of insect growth and its parasitoids.

Methods

Morphological Characteristics of Dolichandrone Weevil

All life stages of Dolichandrone weevil was investigated under a stereomicroscope (Olypus SZX 10). Color, size and characteristic body of egg, larva, pupa and adult was recorded, measured and photographed.

Life History of Dolichandrone Weevil

The studies on general biology, host infestration and devolpment of *Cionus* both in the field and in the laboratory.

Field Experiment

Larvae, cocoon and adults of Dolichandrone weevil were collected monthly (May, 2017 and July, 2018) from public parks in Muang District of Nonthaburi, Thailand for life history. The difference of host infestation caused by both larvae and adults was evaluated.

Rearing in the Laboratory

Collected cocoons were placed in plastic boxes (14x19x6 cm). After adult emergence, the fresh leaves of *D. serrulata* is provided as food. The copulation time is recorded. Number of egg laid in a petiole cavity was counted. The growth and development of different life stages is investigated including coccoon building and related information.

Parasitization of Dolichandrone weevil by *Entedon* sp.

Larvae and pupa of Dolichandrone weevil were collected from public parks in Muang District of Nonthaburi from May, 2017 to July, 2018. These insects were kept in rearing containers under the laboratory condition (30 ^{o}C and 70%RH). Young leaves of *D. serrulata* is provided as food for the larvae until they underwent the pupation process. Whereas the collected coccoons were placed in a small plastic glass(1 cocoon/cup). Parasitization was investigated including sex ratio of male to female. Rate of parasitization was calculated in paercentage.

Results and Discussion

Morphological Characteristic of Dolichandrone weevil

Description of Immature Stage

The detailed of size dimension was described in Table 1.
Egg: round, oval, light yellow, 0.49 mm wide and 0.86 mm long
Larva: 3 immature stages, legless, slug-like larva**,** mucus secretion to cover body to prevent the body surface from drying out or natural enemy protection.
1st instar larva: small sized, body length 1.89 mm and 1.01 mm wide, brownish black head 0.30 mm wide, thorax and abdomen pale yellow and being dark color with mucous.
2nd instar larva: body 3.46 mm long and 1.77 mm wide, head width 0.51 mm, head slightly black color, black body with mucous cover**.**
3rd instar larva: body 6.62 mm long and 3.21 mm wide, head width 0.82 mm, without mucous body brownish yellow, head black or brown, fat and short body, legless, not clearly segmented, exuviae retaining in cocoon.
Pupa: Exerate pupa, 4.80 mm long and 3.37 mm wide**.**

Description of Male

Geniculate clubbed antennae with scape (first longest segment), funiculus(second segment) and club (third segment), black compound eyes, black color, small white spots scattering on elytra,body length 5.06 mm, wing with longitudinal grooves, narrow at anterior end and broader at posterior end of a black pronotum with white spots all over it, black rostrum slightly curved, pronotral length 1.52 mm, 3 pairs of leg appendages covered with elongated white setae directed downward, foreleg femur with a triangular tooth (Figure 1), forewing length 2.13 mm, membranous blackish hindwing, dorsum of the 2nd and 3rd thorax and abdomen dark brown, ventral abdomen black (Table 2).

Description of Female

Similar to male characteristics, slightly larger than males (Table 2), body length 5.36 mm long, rostrum 1.79 mm long, forewing 2.40 mm wide and 4.31 mm long, hindwing 2.60 mm wide and 7.51 mm long.

Table 1 Dimension in millimeter of different life stage of *Cionus* sp.

Stage of insect	width	length
Egg	0.48±0.1	0.86±0.04
1st instar	1.01±0.06	1.89±0.20
2nd instar	1.79±0.04	3.46±0.57
3rd instar	3.21±0.49	6.62±0.84
pupa	3.37±0.16	4.80±0.20

Table 2 Dimension in millimeter of adults

Size	male	female
Body length	5.06±0.08	5.36±0.06
Rostral length	1.52±0.04	1.79±0.03
Forewing width	2.13±0.04	2.40±0.01
Forewing length	4.02±0.06	4.31±0.02
Hindwing width	2.50±0.01	2.60±0.01
Hindwing length	7.50±0.02	7.51±0.02

Figure 1 A triangular tooth on a foreleg femur

Life History of Dolichanndrone Weevil

Adult emerged from cocoon in the morning. Mating occurred after adult aged for 5-7 days. Copulation can last for 6-10 hours during day and night and several times (Figure 2). The female laid eggs in group of 3-7 egg/groove on a young petiole (Figure 3) and it could produce on an average of 109 eggs in a lifetime. The female of *C. tuberculosus* spent 90 mins for groove building, oviposition and cavity sealing (Rather, 1989: Read,1977). It took 3-4 days for a first instar larva to hatch (Table 3). There were 3 immature stages of larva which lasted for 6.26 days. These larvae fed on young leaves. Larvae are slug-like and Cunningham (1979) stated that the muscous, hyaline covering of the insect larvae could protect them from desiccation. When the larvae were fully grown, it would pupate at the leaf surface of host plants (*D. serrulata*). The last instar larvae would make up the cocoon during the night, one cocoon/leaf. The pupal period was 5.19 days. Adult emergence from cocoon mostly in the morning using rostrum to make a wider hole for exit (Figure 4). When being disturbed, adults turned death-feigning. Adult's lifespan under laboratory condition was 82.35 days for the female and 81.20 days for the male. The results agreed with Peng et al.(2009) on *C. latefasciatus* female's life expectancy longer than the male. Males develop faster because of they are smaller, whereas females had longer development due to larger bodies and increase fecundity by more feeding (Dank, 2000). In nature, both larvae and adults are commonly found in rainy season. The female can lay eggs up to 60-152 egg for its lifespan.

Figure 2. Mating copulation of *Cionus* sp.

Figure 3. Egg deposition of *Cionus* sp. in a young petiole

Table 3 Duration time of *Cionus* sp.

Developmental stage	n	Duration time(Day)	
		mean±SD	range
Egg	30	3.26±0.43	3.00-4.00
Larva	30	6.26±0.38	5.75-6.83
Pupa	30	5.19±0.19	4.50-5.55
Adult			
male	20	81.20±41.85	35-180
female	20	82.35±28.63	40-154

Infestation of Dolichandrone weevil

Larvae feed on the ventral part of young leaves and surface of young twigs near the young buds(Figure 5). Adults chew irregular shaped holes all over young and old leaves of host plants(Figure 6). The damaged leaves would dry up and turn brown. During egg laying, the female use a snout to make a groove on young petiole for egg deposition and result in leaf petiole folded down and wilted. Damage is caused by both larvae and adults of *Cionus* sp from May to November when large number of all active stages appeared on their host plants.

Parasitization of *Entedon* sp. on Dolichandrone Weevil

Entedon sp. is an important parasitoid of Dolichandrone weevil(figure 7)**.** It is a small parasitoid which the males is smaller than the female(1.80 and 2.40 mm, respectively). Sexual fitness might be correlated with body size (Ode and Heinz, 2002). Females of *Entedon* sp. oviposit their eggs into various instar larvae and cocoons of *Cionus* sp. Parasitization rate of this eulophid parasitoid species on the instar larvae and pupa of Dolichandrone weevil which were collected from the field was assessed. The parasitization occurrence during May, 2017 to July, 2018 was 6.25-24.19% in larvae and 0.00-62.50 % in papa (Table 4). The laboratory data indicated that sex ratio of *Entedon* sp (male to female) is between 1: 0.11 and 1: 3.64 (n=21).

Figure 4. Fully matured *Cionus* sp.emerged from the cocoon

Figure 5. Larvae feed on surface of a young twig

Figure 6. Adults chew on *D. Serrulata*'s leaf

Figure 7. *Entedon* sp.

Table 4 *Cionus* sp. attacked by *Entedon* sp. in 2017-2018

Collection date	*Cionus* larva		*Cionus* pupa	
	n	parasitization(%)	n	parasitization(%)
May 2017	84	19.05	5	40.00
June 2017	61	19.39	3	33.33
July 2017	96	6.25	4	50.00
August 2017	62	24.19	8	62.50
September 2107	53	16.98	6	50.00
November 2017	70	8.57	12	16.67
May 2018	102	21.57	9	33.33
June 2018	47	8.51	2	0.00
July 2108	12	16.67	2	50.00

Conclusion

The Dolichandrone weevil is a small sized insect in the family Curculionidae, order Coleoptera. Both adult and larvae are heavy leaf feeder of *D. serrulata*. In addition, it caused multiple lesions on the leaf stalk a petiole folded and young leaf at the tip of the petiole wilt and dieback. Dolichandrone weevils are easily regconized by their unique white spots scaterring all over the pronotal dorsum and elytra. The adult did faking death to protect itself from its predators. All stages of larval instar are slug-like and fully grown larvae build cocoons for pupation. Their successive immature stages has a relatively short lifespan as being compared with the adults The females are slightly bigger and live longer than the male. Both adults and larvae of *Cionus* sp live in the same habitat. *Entedon* sp is commonly found attacked on both larva and pupa of *Cionus* sp. from May to November. Moreover, the method of mass rearing *Entedon* sp. in the laboratory could be further studied..

Recommendations

D. serrulata is an ornamental plant grown in residential areas and public parks, thus it is not safe to use insecticides to control the Dolichandrone weevil. The precaution should be taken when the larvae were frist found during field survey to prevent long lived adult emergence. Therefore weevil trap and a biological control agent with *Entedon* sp. would be fit for the control management.

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