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ARTHROSCHISTA HILARALIS: THE BIOLOGY AND EMERGING THREAT TO KADAM (*ANTHOCEPHALUS CADAMBA*) SAPLING IN SYLHET, BANGLADESH

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Abstract: In Sylhet, nursery owner facing a lepidopteran pest problem namely *Arthroschista hilaralis* on kadam saplings. Therefore, our research was articulated to find out the insect biology and damage severity of *A. hilaralis* on kadam saplings. Larvae of *A. hilaralis* folding the kadam leaves and make it entirely skeletonize. Whitish round shaped eggs were laid in cluster at both upper and lower surface of kadam leaves. Eggs were hatched after 6.4±0.2 days and the larval stage remained 12.8±0.3 days which was the main dangerous stage for kadam saplings. The full-grown caterpillars were around 21.5 mm to 25.0 mm in length. Pupal stage required around 6.4±0.6 days to became an adult moth. These insects damaged tender branches and young leaves of kadam saplings in June to October, 2018.

***Key word*:** Kadam (*Anthocephalus cadamba*), *Arthroschista hilaralis,* damage status, pest biology

INTRODUCTION

Anthocephalus cadamba Miq. commonly named Kadam is distributed in South Asia and Southeast Asia, including Indonesia, Thailand and Indo-china and eastward in Malaysian archipelago to Papua New Guinea which belongs to the family Rubiaceae (Budi *et al.* 2015, Krisnawati *et al.* 2011, Dubey *et al.* 2011). This tree is very common from in hill areas of North East Indian states which very near to Sylhet (Gogoi *et al.* 2015). The standing nature in the marshy lands or waterbody make this forest species popular in Sylhet region of Bangladesh. In Bangladesh its major area of plantation is observed in Sylhet and Chittagong hill tracts (Banglapedia 2015). This deciduous tree's bark is generally used to retain tonic, bitter, pungent, sweet, acrid, astringent, which also given to treatment of fever and inflammation (Gautam *et al.* 2012, Dubey *et al.* 2011). The leaves are good for diabetes mellitus, diarrhoea, fever, inflammation, haemoptysis, cough, vomiting, wounds, ulcers, debility and,

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antimicrobial activity (Alam *et al.* 2011 Dubey *et al.* 2011, Alam *et al.* 2008). A variety of insects often infest the kadam leaves. Some unidentified caterpillar's occurred heavy defoliation in plantations in South and East Kalimantan of Indonesia (Selander 1990, Tangketasik 1987). It has been reported that defoliator (*Margaronia* sp.) and white grubs eating the leaves and roots of kadam saplings, respectively (Suratmo 1987, Intari and Natawiria 1973). Forest Department, West Bengal, India has been observed young kadam trees suffered severe defoliation damage by some lepidopteran pest which completing 11-12 generations in a year with 21-26 days of life-span in kadam leaves (Thapa and Bhandari 1976). Pest population on Kadam sapling begins to epidemic after rainfall during July-August. (Thapa and Bhandari 1976, Thapa 1970, Baksha 2000). The large-scale incidence and intensity of *A. hilaralis* on kadam reported at the planting age (Utami *et al.* 2018).

In Bangladesh, major pests which are pernicious for kadam plants are Bengal amond defoliator (*Metanastria hyrtaca*), teak canker grub (*Dihammus cervinus*) and kadam defoliator (*A. hilaralis*), respectively (BFD 2018, Baksha 2000). Recently, nursery owners of Sylhet who supply 3000-3500 kadam saplings (pre surveyed data) are facing a lepidopteran pest problem namely *A. hilaralis.* They are using different insecticides against the infested saplings to recover them. In some nurseries the leaves were severely infested consequently total damage had occurred. Considering the damage severity, there was an urgent need to carry out an experiment on the biology and damage potential of this pest in Sylhet, Bangladesh. Therefore, the research was aimed to find out the infestation level of *A. hilaralis* in different nurseries of Sylhet, Bangladesh and to investigate the biology and nature of damage of *A. hilaralis* in kadam saplings.

MATERIAL AND METHODS

Field observation: *A. hilaralis* infestation in kadam saplings were investigated at different nurseries of Sylhet district (24°36' and 25°11' north latitudes and in between 91°38' and 92°30' east longitudes) of Bangladesh. It had been categories the major nursery areas into three zone for representing the real scenario these areas were Zindabazar, Khadimnagor, South Surma of Sylhet district. The study was done through survey questionnaire and interview with the relevant respondents (nursery owners) from June 2018 to May 2019. Five nursery owners from each location were interviewed randomly and the level of *A. hilaralis* infestation on *A cadamba* leaves, number of insects per leaves, and time of infestation were recorded from those nurseries.

Laboratory Experiment: Laboratory experiment was conducted at the Laboratory of Entomology of Sylhet Agricultural University, Bangladesh to study the biology of *A. hilaralis* in the control conditions during June to October, 2018. Three pairs of adult male and female *A. hilarali*s were kept inside rearing boxes (77×40cm; made of transparent plastic boxes) covered by mosquito nets to observe the life cycle. Honey solution was provided for adults. As the adults laid eggs on the leaves therefore small twigs with some leaves were provided. The young kadam twigs were kept in 5% honey solution inside plastic jar. After hatching eggs cluster were separated and kept inside the petri dishes. Young leaves were provided every day evening for the larvae and observed very carefully until completing its life cycle. Different larval stages were identified carefully by observing the molting of larvae that changed on different instar.

Data Analysis: The collected data of biological stages of *A. hilaralis* (n=15) and number of leaves infestation/plant were analyzed by Microsoft Office Excel 2013 statistical analysis and *A. hilaralis* infestation on kadam saplings were analyzed with 5% level of significant by one-way ANOVA in Statistix 8.1 software package.

RESULTS AND DISCUSSIONS

Biology of A. hilaralis

Egg: After successful couplation of male and female *A. hilaralis,* adult female moths laid whitish color, round shaped eggs in cluster both upper and lower surface of the leaves. Eggs were laid during May to June. Eggs were attached with the leaves by folding the leaves with a sticky substance. After 6.4±0.24 days eggs were hatched (Table 1). According to Susanty *et al.* (2017), *A. hilaralis* eggs hatching time was 2-3 days in Indonesia. In West Bengal (India), egg hatching period required for 3-4 days (Thapa and Bhandari 1976). The egg hatching period might be differed with the environmental condition like temperature, humidity and precipitation. During the infestation time generally, it prevailed high temperature and humidity with heavy rainfall in Sylhet (Table 2).

Larvae: After hatching the egg, the larvae were feeding kadam leaves voraciously. Tha total larval stage was 12.8±0.37 days (Table 1). The larval stage of *A. hilarali* was 12-16 days in Sabah (Malaysia) and 13- 15 days in West Bengal (India) (Thapa 1970, Thapa and Bhandari 1976) which is almost similar in our findings. The larval stage divided into different instar with distinct five molting. The 1st, 2nd, 3rd, 4th and 5th instar larval period were 2.4±0.24, 2.6±0.24, 2.4±0.24, 3±0.45, 2.4±0.24 days, respectively which was almost close to the result of Susanty *et al.* (2017). The full grown of caterpillar was around 21.5 mm to 25.0 mm in length (Figure 1a). Larval body length of *A. hilaralis* was found 20.26 mm in fifth instar in Indonesia (Susanty *et al.* 2017).

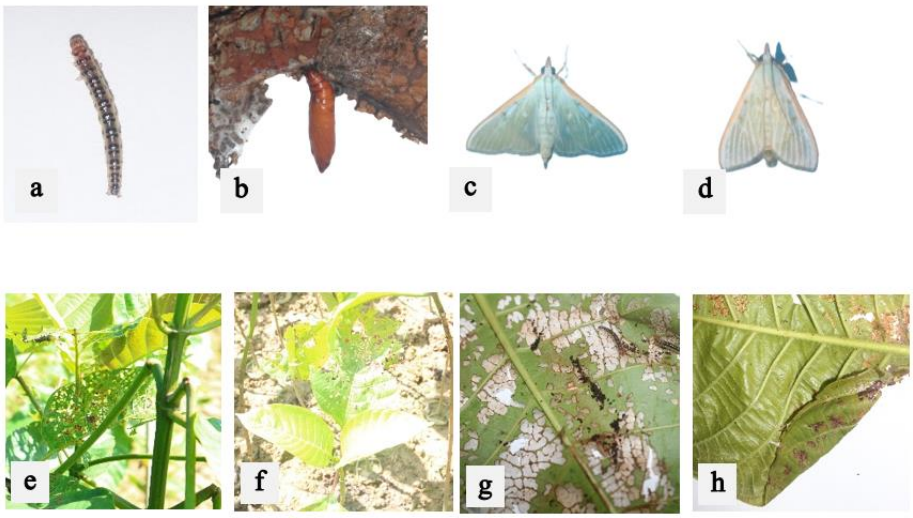

Fig. 1: a) Larval stage of *A. hilaralis,* b) Pupa of *A. hilaralis,* c) Adult (female) of *A. hilaralis,* d) Adult (male) of *A. hilaralis,* e) *A. hilaralis infestation in A. cadamba* leaves, f) *A. cadamba* seedling affected by *A. hilaralis*, g) *A. cadamba* leaf skeletonized by *A. hilaralis,* h) *A. cadamba* leaf folded by *A. hilaralis.*

Pupa: Pupal stage required around 6.4±0.60 days which belonged to obtect type, attached with dead leaves or plant parts of kadam (Figure 1b). The brownish color pupa of *A. hilaralis* was around 13 to 14 mm in length. In West Bengal (India), pupal period took about 5-7 days (Thapa and Bhandari 1976). According to Susanty *et al.* (2017), the pupal stage lasted for an average of 6.9 days in Indonesia. *A cadamba* plant is very common in south Asia and south-east Asia (Budi *et al.* 2015, Krisnawati *et al.* 2011, Dubey *et al.* 2011). Might be the climatic condition of the south-east Asia has similar effects on *A. hilaralis* development in its different region within the similar host.

Table 1. Reproduction biology of *A. hilaralis* under laboratory conditions

Life cycle stages of *A. hilaralis*	**Days (mean±SE) (n=15)**
Egg hatiching period (days)	6.4±0.24
Total larval period	12.8±0.37
First instar larva	2.4±0.24
Second instar larva	2.6±0.24
Third instar larva	2.4±0.24
Fouth instar larva	3±0.45
Fifth instar larva	2.4±0.24
Pupal period larva	6.4±0.60
Adult (female)	6.8±0.73
Adult (male)	5.6±0.68

Adult: *A. hilaralis* adult was bluish green with yellow orange along the wing costa. Adult males and females had different body sizes that were not significantly different. The average body length of the male adult reached 14-15 mm, while the body length of the female imago was 13-14 mm (Figure 1 c-d). The life span of *A. hilaralis* male adult (5.6 days) was shorter than that of female adult (6.8 days) (Table 1). According to Susanty *et al.* (2018), the average length of the male imago life span was 4.0 days, whereas the female imago was 6.9 days. Host plant has a great influence on the longevity of the insect. Might be the *A cadamba* plants has similar effects on the longevity of the *A. hilaralis* male and females *in* the same climacteric zone.

Occurrence and damage severity of A. hilaralis in selected area: Results also indicated that there was no significant variation among the locations for number of infested leaves (*df =14, p value > 0.05*) (Figure 2). Only larval stage of *A. hilaralis* chewing the leaves from the tender branches, petiole of the young leaves of saplings (Figure 1e). Just after hatching, larvae started to chew the young tender of leaves. According to Baksha (2000), Younger kadam plants were most heavily infested in Chittagong hilly forest. The survey reported that *A. hilaralis* infestation was recorded in all the three locations of Sylhet region. Highest infestation was recorded in Khadimnagor (7.6 leaves per sapling) compare to South Surma (7.1 leaves per saplings) and Zindabajar (6.8 leaves per saplings) (Figure 2).

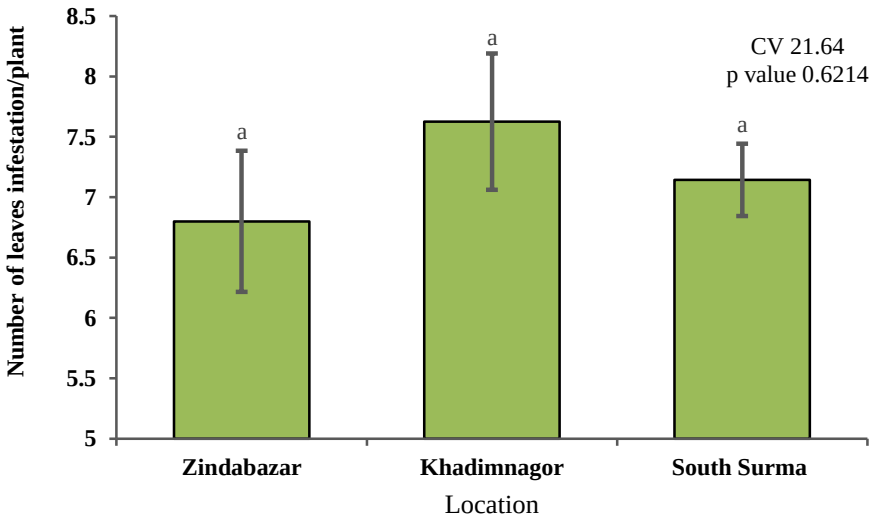

Fig. 2: Level of infestation of *A. hilaralis on A. cadamba* leaves *Temporal mapping of A. hilaralis infestation*

Considering the biology studies and field survey it was confirmed that the *A. hilaralis* severity showed different level in May, 2018 to November, 2018 (Figure 3). Rest of the observation period, it was not found in nurseries of Sylhet region. Almost same results were found in previous study that the peak infestation occurred during August-September in Kadam at evergreen hilly forest of Chittagong (Baksha 2000). The severity differs with the location of the nursery area and the association of alternative host. The severity may also differ with the environmental conditions specially precipitation and temperature. Rainfall may increase the severity and incidence of *A. hilaralis* however sudden flush may reduce the severity of *A. hilaralis* infestation in kadam seedling (Figure 3, Table 2).

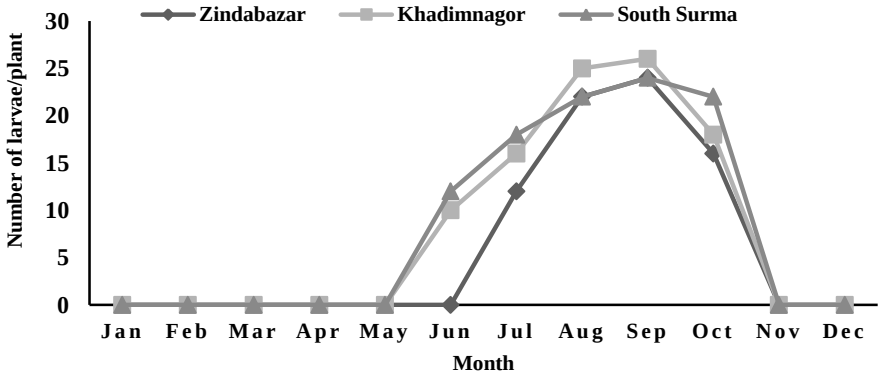

Fig. 3: Infestation time of *A. hilaralis* on *A. cadamba* in June, 2018 to May, 2019.

Table 2: The average temperature and rainfall data of 2018-2019 of Sylhet collected from Sylhet Agricultural University meteorological station

Month	2018		2019	
	Temperature (Celsius)	Rainfall (mm)	Temperature (Celsius)	Rainfall (mm)
January	24.8	0	23.8	0
February	28.5	39	27.4	137
March	31.4	95	29.2	470
April	30.9	393	31.2	687
May	30	505	30.8	556
June	32.5	801	32	919
July	34.1	690	34	712
August	33.6	506	33.4	876
September	32.2	373	31.8	484
October	31.2	103	31.4	301
November	29.6	40	27.9	13
December	27.1	29	24.1	54

CONCLUSION

Considering the recent status and occurrence of *A. hilaralis* in Sylhet district, there is an urgent need for eco-friendly management of *A. hilaralis*. If this devastating pest is not managed as soon as possible, there would be a possibility of the outbreak of this pest which subsequently hinder kadam plantation in evergreen hilly forest and the low laying areas of Sylhet. Consequently, great environmental loss will be happening in near future.

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