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Incidence of *Heortia vitessoides* Moore (Crambidae: Lepidoptera) on *Aquilaria malaccensis* Lamk. and Its Control

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Abstract

Agar defoliator, *Heortia vitessoides* Moore (Crambidae:Lepidoptera) is a major defoliator of agar tree (*Aquilaria malaccensis* Lamk.) in Bangladesh. The larva of this pest causes partial or complete defoliation affecting the growth of the plant seriously. The pest has five to six overlapping generations in a year. The peak infestation occurred during May-June. The mean percentage of trees infested ranged from 48-72 %. The intensity of attack was more in the trees grown in the open than under shade. Chemical pesticides Malathion 57 EC (malathion), Ripcord 10 EC (cypermethrin) and botanical pesticide Neem oil were applied to control the pest both in the laboratory and field conditions. Among these, Malathion 57 EC showed best performance followed by Ripcord 10 EC and Neem oil respectively.

সারসংক্ষেপ

বাংলাদেশে *Heortia vitessoides* Moore (Crambidae : Lepidoptera) নামক পাতাভোজী পোকা আগর গাছের প্রধান ক্ষতিকর পোকা। এ পোকার শুককীট গাছের আংশিক বা সম্পূর্ণ পাতা খেয়ে গাছের বৃদ্ধি মারাত্মকভাবে ব্যাহত করে। বছরে পাঁচ ছয় বার এই পোকা বংশবিস্তার করে। মে-জুন মাসে এই পোকার ব্যাপক আক্রমণ দেখা যায়। শতকরা ৪৮-৭২ ভাগ গাছ আক্রান্ত দেখা গেছে। পার্শ্ব ছায়াযুক্ত গাছ অপেক্ষা খোলা বাগানতলে আক্রমণের তীব্রতা বেশি পরিলক্ষিত হয়েছে। তিন ধরনের কীটনাশক গবেষণা কক্ষে ও মাঠ পর্যায়ে প্রয়োগ করা হয়েছে। এগুলোর মধ্যে ম্যালাথিয়ন ৫৭ ই সি, রিপকর্ড ও নিম তৈলের চেয়ে ভাল কার্যকারিতা প্রদর্শন করেছে।

Keywords: Agar defoliator; *Heortia vitessoides*; *Aquilaria malaccensis*; Peak infestation

Introduction

Agar tree (*Aquilaria malaccensis* Lamk.) is an evergreen tropical tree species. In the past, it occured naturally in the forests of Sylhet, Chittagong and Chittagong Hill Tracts of Bangladesh (Rahman and Basak 1980). This tree is also found in Nepal, Bhutan, North Eastern India (Assam, Meghalay, Nagaland, Monipur and Tripura), Myanmar, Thailand, Laos, Vietnum, Combodia, Indonesia, Malaysia, South-Eastern China, Brunai Darus-salam, The Philippines, Papua New Guinea and islands of East India (Baksha *et al.* 2009, Burkhill 1966). For the last few decades, natural stocks of agar tree have been largely depleted in Bangladesh. Recently, Forest Department has implemented Agar Plantation Project during 1998 to 2005. About 800 hectares of lands have been planted under this project. Among these plantations 324 hectares are in Sylhet, 282 in Chittagong, 189 in Cox's Bazar and 5 hectares in Chittagong Hill Tracts (North) (Baksha *at al.* 2009). Besides, it has also been planted in different areas of Bangladesh by the Government, non government organizations and private planters. However, the objectives of all these efforts were to increase the extension of agar plantations, to save the species from extinction and also to combat environmental degradation and finally to produce agar. Economically agar tree is a valuable tree for its highly priced agar wood. Its oil is used as perfume (agar–attar) and agar wood with heavy oleoresinous deposits is used as incense and medicine (Parvin *et al.* 2012).

A serious insect pest *Heortia vitessoides* Moore (Crambidae : Lepidoptera) causing defoliation in these agar plantations and nurseries has been reported in recent years. It was first reported by Baksha (2008) from Sylhet. It is a major and destructive insect pest causing severe damage by complete defoliation of agar trees and nurseries (Baksha 2008). Review of literature revealed that the information regarding this insect pest is very scanty. Due to the demand of Forest Department and private planters, a study was undertaken to know the biology, ecology, nature and extent of damage and control of the pest.

Materials and Methods

Extensive field surveys were undertaken on agar plantations of Fasiakhali (Cox's Bazar North), Lathitila (Juri, Moulvibazar) and Bagaihut (Chittagong Hill Tracts North) during May to December in 2011. These plantations were established during the year 1999-2000. The intensity of infestation was assessed in terms of percentage of trees infested. The number of defoliated leaves was also assessed. Infested leaves with eggs and larvae were collected from the field and were reared in the Entomology laboratory of BFRI, Chittagong at room conditions (27.5±3.7 °C and 78.6±4.2% r.h.). Fresh leaves of agar trees were provided as food to larvae, and debris was cleaned regularly. After each molt the larvae were transferred to bigger petri-dishes with new leaves. Observations on the larval development, measurement, color, molting and feeding habit were recorded. Field and laboratory notes on the biology and ecology of the pest were also taken. Similar number and aged plantations were used to compare the infestation intensity at different locations.

Three insecticides namely Malathion 57 EC (malathion), Ripcord 10 EC (cypermethrin) and Neem oil (azadirectin), each @ 2 ml/l were applied to control the pest both in laboratory and field conditions in order to screen out suitable one. Insecticides were collected from local market in Chittagong, Bangladesh. From these, concentration of insecticides (@ 2 ml/l) was prepared by diluting with water. For controlling the pest under laboratory condition agar leaves were dipped in each insecticide for 30 minutes and then left to dry for an hour. The larvae of *H. vitessoides* were confined with treated leaves in glass jars covered with muslin cloth for 48 hours. Test also included a non- treated control in which leaves were dipped in water (as a check). Four replications (each of 10 larvae) were tested for each treatment. Mortality percentages were recorded after 1, 2, 3, 4, 8, 24 and 48 hour intervals for all the treatments. Insecticide application under field condition against *H. vitessoides* was carried out during May, 2012 at Fasiakhali, Chittagong, Bangladesh. Twenty-five infected agar plants were randomly selected and the total larval population of *H. vitessoides* was counted per plant. Pretreatment observation was taken 12 hours before application of insecticides. In addition, post treatment observation was recorded 24, 48 and 72 hours after application of insecticides. A treatment with tube well water was used as control. Spraying was done with knapsack compression air sprayer. After spraying of one insecticide, the sprayer was washed thoroughly with water twice before applying the next insecticide.

All the collected data were statistically analyzed with the help of the computer package programme SPSS (SPSS Inc., Chicago, IL, USA) and also tested by LSD and DMRT.

Results and Discussion

Description

The adult insect is a brownish black moth with a wing span of 27-35 mm. The moth has a yellow and a black banded abdomen. The fore wing is primrose yellow with bluish black spots and bands. The hind wing is white with bluish black marginal band. The larvae are pale green with broad blackline along each side. The head and thorax of the adult is yellowish. The full-grown larva measure about 5 mm in length. When mature, the larva descends and pupates in the soil, and the cocoon is made out of soil litters.

Distribution

The pest is generally found in south-east Asia. The pest is distributed in Fiji, Hong Kong, Thailand, North Queensland (Australia) and Malaysia (Sajap 2013). On the other hand, the distribution in Bangladesh has been reported by Baksha *et al.* (2009).

Nature and extent of damage

The pest starts infestation both nurseries and young plantations whenever new flush of leaves are available. The newly hatched larvae feed gregariously on the tender leaves (Figure 1a). The entire leaf excluding the major veins and vein- lets is eaten. Sometimes larva of advance stage consumes soft tissues and making it skeletonized. The infestation occurs in discrete patches. But during an epidemic a large area of plantation is affected and all the trees are infested resulting in complete defoliation. In a week or so the green parts of all leaves of the trees are consumed. The intensity of attack is more in the trees grown in open than under shade. Repeated defoliation sometimes causes even death of 20% tree (Baksha *at al.* 2009). The uneaten portions of leaf remain on the tree for some days and dry up and look burning from a distant place.

Biology

The insect has five to six overlapping generations in a year. Adults are short lived. Eggs are laid in cluster on the ventral surface of the leaf and are arranged like a fish scale. Each female lays as many as 350-550 eggs (Figure 1b). Incubation period ranges from 10-11 days. There are five larval instars, and total larval duration is 23-24 days (Figure 1c, Figure 1d). Pupation takes place below the soil surface, and pupal duration is 8-9 days (Figure 1e). The life cycle is completed in 41-42 days (Figure 1f). In a similar study, Kalita *et al*. (2012) reported that the life cycle of *H. vitessoides* was completed in 45-46 days.

Seasonal abundance

The larval activity is more pronounced from March to mid- November. The pest is found to cause defoliation twice in a year being first in May-June and second in August-September. This is probably due to minimum rainfall and favorable climatic conditions. The intensity of attack is more severe during May-June. Repeated defoliation may cause mortality of trees.

Host range

There is no host record of *H. vitessiodes* other than A. *malaccensis* in Bangladesh. In India, *A. agallocha* is also a principal host of this pest (Gurung *et al.* 2010).

Impact of damage

The infested trees are not killed outright but the growth and fruiting are definitely affected that have not yet been quantified. The specific loss caused by the pest to host tree was not critically evaluated. However, it can cause significant loss of volume increment. Heavy defoliation in nurseries and young stands may cause die-back of the leading shoot, resulting in epicormic branching and even death of seedlings. Consequently, there will be poor growth of agar trees that will be the cause of low yield of agar oil.

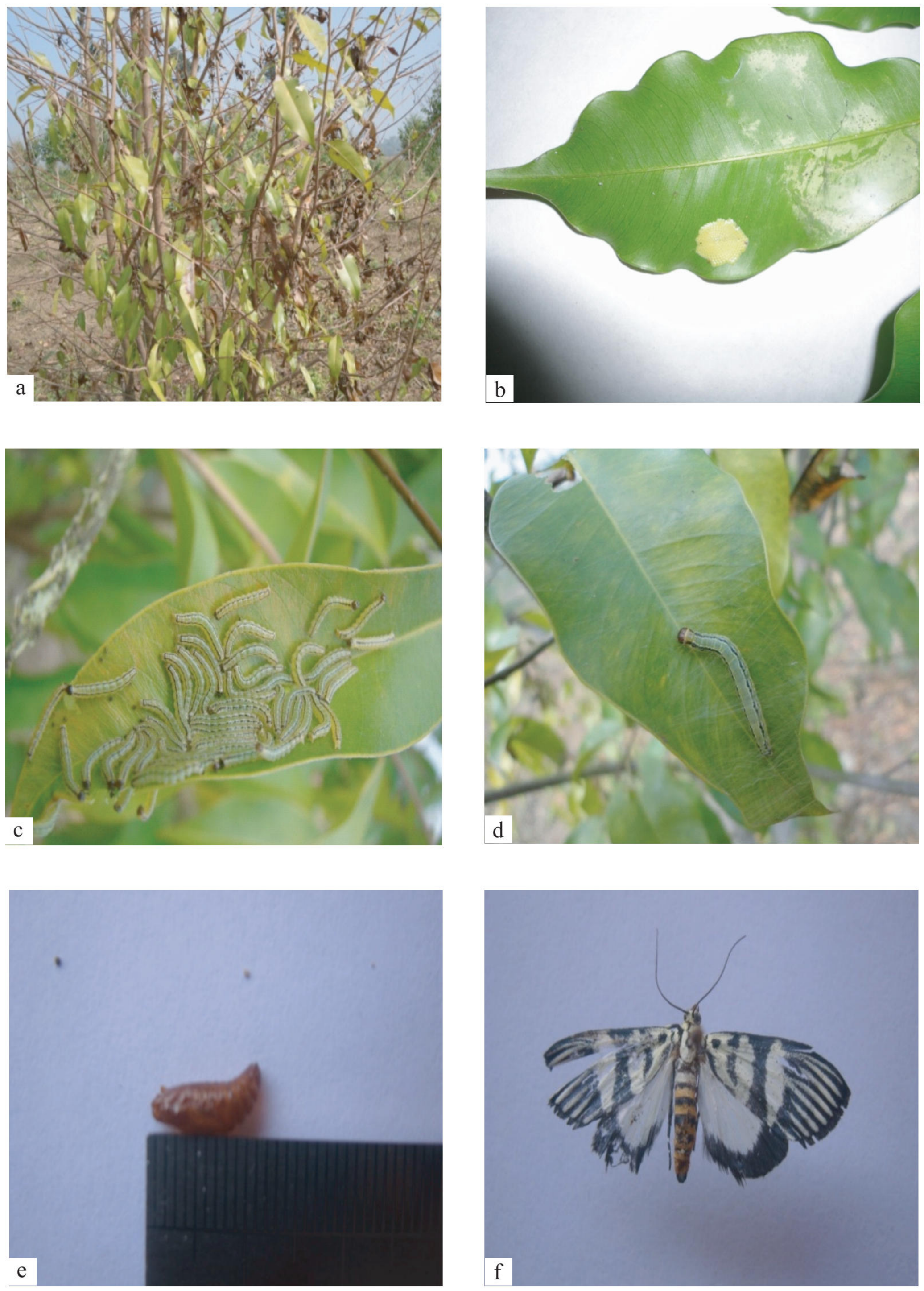

Figure 1. a. Infested Agar trees, b. Egg mass, c. Initial stage, d. Matured Larva, e. Pupa, f. Adult moth

Pest incidence at different locations

The intensity of infestation on agar tree by *H. vitessoides* differed significantly at various locations. The plantation of Fasiakhali was the worst (72%) and Lathitila was the least (48%) affected (Table 1). The number of defoliated leaves was comparatively higher at Fasiakhali agar plantation (70%−100%) than that of Lathitila (40%−60%). On the other hand, the diameter at breast height (dbh) was lesser at Fasiakhali (40.76 cm) and greater at Lathitila (44.28 cm). The intensity of infestation at Bagaihat was significantly different to that of Fasiakhali.

Control measures

Biological

This was the initial and very primary study of Forest Protection Division. Baksha *et al.* (2009) observed that the larvae of this pest are attacked by the polyhedrosis virus that causes severe mortality. Virus infected larvae were crushed into water, kept for seven days and when sprayed over the infested trees, 60−80% larval mortality was observed (Baksha *et al.* 2009). A bug, *Canthecona furcellata* predates on the larvae (Baksha *et al.* 2009). It was also observed that ant and birds (Finga/Black Drongo (*Dicrurus macrocercus*), Moyna/Hill Myna (*Gracula religiosa*) and Salik/Pied Myna (*Sturnus contra*) were found to predate on the larvae.

Table 1. Intensity of infestation by *H. vitessoides* on *Aquilaria malacensis* at three locations

Locality	No. of trees examined	Average dbh(cm)	No.of trees infested	% of infestation	% of leaf defoliation
Fasiakhali	50	40.76±0.45 b	36	72±0.48 a	70 - 100
Bagaihat	50	42.55±0.48 ab	32	64±0.37 b	60 - 70
Lathitila	50	44.28±0.49 a	24	48±0.38 c	40 - 60
LSD	-	1.99	-	2.48	
CV (%)	-	3.38	-	16.27	

Values are mean ± SE of three replicates

Chemical

The results obtained after application of insecticides revealed that there was significant variation in the efficacy of insecticide against *H. vitessoides*. In laboratory condition, Malathion 57 EC was the most effective insecticide followed by Ripcord 10 EC and Neem oil with the larval mortality percentages of 100, 70 and 50, respectively at 8 hours after treatment. The mortality of *H. vitessoides* increased over time (Table 2). In field condition there was a significant variation in the efficacy of insecticides against *H. vitessoides*. Malathion 57 EC was also the most effective insecticide followed by Ripcord and Neem oil with pest population reduction percentages of 96.97, 92.21 and 71.36, respectively at 72 hours after treatment (Table 3). In the present study both in the laboratory and field experiments, Malathion 57 EC gave better control of *H. vitessoides* compared to other insecticides. These findings are fully in agreement with Baksha *et al*. (2009), who found that Malathion 57 EC was most effective against *H. vitessoides*. Irianto *et al*. (2010) investigated pest management strategy to control the population of *H. vitessoides* in field condition. They found that application of a mixture of systemic and contact insecticides with addition of leaf fertilizer and plant sticker effectively controlled high population of the pest. Borthakur and Rajarishi (2011) carried out a study to evaluate the aqueous benzene and hexane extracts of three botanicals such as *Azadirachta indica*, *Acorus calamus* and *Melia azedirach* at 2.5, 5 and 10 % concentrations respectively against *H. vitessoides* and found promising results. These observations have been supported by many workers on different plant bugs in different areas like cereal jassid (Sandhu *et al*. 1975), cotton aphid and brinjal jassid (Borle *et al.* 1980; Subbraratnam and Butani, 1984). In a similar study Tewari and Moorthy (1989) evaluated the effectiveness of nine insecticides against *Epilachna vigintioctopunctata* on brinjal and found that malathion was moderately effective against the pest followed by carbaryl. Shanmugapriyan and Kingsly (2001) reported the effects of neem oil at 0.25, 0.5 and 1.5% on larvae of *Epilachna vigintioctopunctata*. Neem oil at 1.5% concentration caused the highest mortality of third (95.23%) and fourth instars (76.19%) larvae. Neem oil at 0.25 and 0.5% concentrations resulted in 57.1 and 85.7 % of second instar, 47.6 and 85.7 % of third instar and 57.1 and 80.9% mortality of fourth instar larvae.

Table 2. Efficacy of some chemical and botanical pesticides against larval population of *H. vitessoides* under *in vitro* condition

Treatments	Number of larva	Larval mortality % after						
		1 h.	2 h.	3 h.	4 h.	8 h.	24 h.	48 h.
Malathion	10	20 a	30 a	50 a	80 a	100 a	100 a	100 a
Ripcord	10	0 b	20 b	30 b	40 b	70 b	100 a	100 a
Neem oil	10	0 b	0 c	0 c	20 c	50 c	80 b	100 a
Control	10	0 b	0 c	0 c	0 d	0 d	0 c	0 b

Values within a column followed by the same letter(s) are not significantly different by DMRT at 5 % level.

Table 3. Efficacy of some chemical and botanical pesticides against larval population of *H. vitessoides* under field condition

Treatments	Total number of plant	Pretreatment	Post treatment		
		Total larval Population	Larval population reduction (%) after		
			24 h	48 h	72 h
Malathion	5	367 c	79.97 a	87.52 a	96.97 a
Ripcord	5	375 b	73.32 b	79.43 b	92.21 b
Neem oil	5	359 d	49.28 c	67.29 c	71.36 c
Control	5	385 a	2.54 d	5.32 d	7.53 d

Values within a column followed by the same letter(s) are not significantly different by DMRT at 5 % level.

Physical

No experiment was done on this aspect, but it is possible to collect and destroy larvae by hand picking and by shaking the trees or branches from the nurseries and young plantations.

Conclusion

The present finding indicates that the pest has five to six overlapping generations in a year. The intensity of attack is more in the trees grown in open than under shade and during drier season (March/April). Among the chemical pesticides Malathion 57 EC was the most effective to control the pest followed by Ripcord and Neem oil. The present study also suggests that the botanical pesticide, Neem oil, has less residual toxicity than the other two chemical insecticides. Though Neem oil had low mortality rate, its use could be considered safe for man, animals and non-target fauna if good practices are followed. However, a field evaluation would also be required to fully investigate the field efficacy and side-effects of chemical pesticides to determine their performance and IPM compatibility in natural ecosystem.

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