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Inspection, Certification and Bionomics of Mealy Bug, *Pseudococcus virgatus* on Kenaf (*Hibiscus cannabinus* L.) and Mesta (*H. sabdariffa* L.)

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Abstract: The study was conducted to Survey, documentation and bionomics of Mealy bug, *Pseudococcus virgatus* on Kenaf (*Hibiscus cannabinus* L.) and mesta (*H. sabdariffa* L.) in different jute growing regions and in the laboratory of Entomology Department, BJRI during the jute growing 2017 and 2018 season with 10 replications following CRD design. The highest infestation of Mealybug (80.49%) was found in HC-95 of kenaf variety at Narayanganj sub-station and the lowest infestation of Mealybug (11.34%) was found in HS-24 of Mesta variety at Patuakhali sub-station of BJRI. Most infested part of plant was twig. The egg is oval in shape and measures on an average 0.315mm in length and 0.135mm in breadth. The average length of newly hatches nymphs were 0.495±0.022 mm and average wide in 0.213±0.008 mm. The first moulting occurred within 4-5 days with an average of 4.6±0.163days. The second moulting occurred within 6-9 days after first moulting with an average of 7.50±0.268 days. The third moulting occurred within 7-9 days after second moulting with an average of 8.00±0.388 days. The average length of adult male is in 1.60±0.459 mm and average breath is in 0.68±0.078 mm. The average length of adult female is in 4±0.86 mm and average breath is in 2.40±0.516 mm. The incubation period varied from 3-5days with an average of 4.7±0.94 days. The total nymphal period of *pseudococcus virgatus* was with an average of 20.1±1.05 days. The duration of adult male and female was an average 15.8±0.388 and 35.9±0.348 days respectively.

Keywords: Survey, Documentation, Biology, Mealy Bug, Kenaf & Mesta

1. Introduction

Kenaf (*Hibiscus cannabinus* L.) and mesta (*H. sabdariffa* L.) are the most promising soft bast fibre of the jute substitute belongs to Malvaceae family. Mealybug belongs to Hemiptera: *Pseudococcidae* is one of the most destructive pests causing considerable economic concern in the production of kenaf and mesta as well as other crops such as papaya, mango, jackfruit etc. in Bangladesh. Mealybug, *Pseudococcus virgatus* is one of the most highly polyphagous, attacking plant species belonging to some 150 genera in 68 families [1]. Mealybugs are severe agricultural pests with 158 species of mealybugs being recognized as pest worldwide [2].

Mealybug feeds on phloem, tissues attacks the growing points and young twigs of plants and injects salivary toxins, which cause characteristic distortion of stems, leaves and fruits, curling of leaf and shorten internodes resulting resettling or “bunchy top” [3]. Heavily infested leaves, flowers and fruits often abscise prematurely if infestation is not eliminated. Additional damage may be caused by sooty mold growing on the secreted honeydew, reducing photosynthesis and affecting market value. However during growing stage, mealybugs can establish colonies in twig but are initially restricted to a few plants along the border rows, adjacent to the source of infestation and thus can be effectively managed through early detection and initiation of interventions to control early stages of infestation. If timely

scouting and appropriate control measures are not initiated kenaf crop is likely to be severely damaged with mealybugs. Mealybugs (Hemiptera: Pseudococcidae) are plant sap-sucking insects that constitute a family with about 2000 species, some of which are major pests of agricultural plants [3, 4]. Mealybugs are small insects that develop and feed continuously on plant tissue by sucking plant sap. Also, they can vector plant viruses and inject toxins into plant tissue resulting in chlorosis, stunting, deformation and death of plants [5]. Mealybugs feed by sucking the plant sap and causing leaf senescence and premature leaf fall, as well as reduced growth and even plant death [6]. Mealybugs can also cause indirect damage because they can vector plant pathogens such as viruses [6]. In addition, the honeydew favors the development of black sooty mold fungus, which affects plant development and results in stick lint, causing problems in the spinning process at the textile mills [7]. Live mealybugs are small soft-bodied, sap-sucking insects with an oval, elongated to rounded body, often dorsoventrally compressed, pinkish to grayish in color, covered with a white powdery wax (the source of their common name) [8]. They frequently have waxy filaments, those on the head being shorter than those close to the anus [9].

The intensity of insect pest infestation varies from variety to variety and region to region. Survey on Mealybugs of Kenaf and Mesta is needed to obtain record on this time of appearance, peak period of infestation and to take necessary control measures at proper time specially to know the percentage of different Mealybug incidence in different kenaf and mesta varieties at different agro ecological zones and comparative assessment of incidence of Mealybug in experimental plots and farmers' fields.

Life table is an important tool in understanding the changes in population of insect pests during different developmental stages throughout their life cycle. It is a particularly useful approach in entomology, where developmental stages are discrete and mortality rates may vary broadly from one life stage to another [10]. It is very useful to analyze the mortality of insect population, to determine key factors responsible for the highest mortality within population. Moreover, various mathematical formulas also indicated for the appropriate evaluation of life fecundity tables, stable age distribution and life expectancy [11]. On being a polyphagous pest, mealybug of is feeding on many plants with divergent variation in development and bio ecology [12]. Hence, the present research was conducted to study the life cycle of Mealy bug on host plant and it reported in the current study.

2. Materials and Methods

2.1. Survey and Collection of Samples of Mealybug from Different Places

During first Half year i.e. from June, 2017 to November, 2017 Survey programs were conducted at Chandina, Cumilla; regional Station, Rangpur; regional Station, Kishoreganj; Sub-Station, Monirampur, Jashore; Sub-Station, Patuakhali and Sub-Station, Tarabo, Narayanganj and Farmers field of kenaf and mesta at Tangail, Jamalpur and Kishoreganj from time to time to get idea about the incidence of Mealybug. Survey data were collected following Randomized Complete Block Design (RCBD) with 3 replications. Collected specimens of Mealybug were brought to laboratory at Entomology Department, BJRI for identification and sorting.

2.2. Biology

Study on biology of mealy bug was carried out in the laboratory of Entomology Department, BJRI, Dhaka April-October, 2018, following CRD design with 10 replications. Twigs of kenaf and mesta plants infested with reproducing females of mealy bug were brought to the laboratory; individual females were separated, and fed on kenaf and mesta leaves in Petri dishes. Individual kenaf and mesta leave with petiole were collected from the plant terminal of the *Hibiscus* sp. grown in net house without insecticidal spray and free from mealybug infestation, washed with tap water and shade dried and used as food source. Since parthenogenetic reproduction of mealybug*was* observed under field conditions, individual neonate crawlers emerging from females were used as to start the biology study. The laboratory mean temperature and mean relative humidity of the study area were recorded. Observations on survival and molt of the crawlers are recorded daily under stereoscopic microscope until they became adults. Three Petri dishes with missing crawlers were discarded and excluded from the final data. As the eggs or neonate crawlers were counted and discarded, the individual adults that produced them were transferred to new Petri dishes for further observations. When eggs were observed they were separated along with the leaf disc and observed until they hatched.

3. Results and Discussions

3.1. Survey and Collection of Samples of Mealybug from Different Places

Surveillance and Monitoring of pest is essential for pest forecasting which will also provide correct timing of management of insect's pest population. The intensity of insect pest infestation varies from variety to variety and region to region. Survey on Mealybugs of Kenaf and Mesta is needed to obtain record on this time of appearance, peak period of infestation and to take necessary control measures at proper time specially to know the percentage of different Mealybug incidence in different kenaf and Mesta varieties at different agro ecological zones and comparative assessment of incidence of Mealybug in experimental plots and farmers' fields.

From the table 1, it was observed that the height infestation of Mealybug (80.49%) was found in HC-95 of kenaf variety at Narayanganj sub-station and the lowest infestation of Mealybug (11.34%) was found in HS-24 of Mesta variety at Patuakhali sub-station of BJRI. Most

infested part of plant was twig. No Mealybug infestation was found in Dhonbari and Gopalpur of Tangail region. On the other hand, in Cumilla and Faridpur Mealybug infestation was found in jute plant especially in O-9897 and O-795 variety.

Table 1. *Incidence of Mealybugs in Kenaf and Mesta plant in different locations.*

Date	Location	Surrounding existing crop	Crop/Variety	Plant No./m^2 Or PP/plot	Infested plant/m^2 Or plot	% infestation	Plant age	Infested part (Twig=T, Leaf=L, Stem, Base=B)
	Patuakhali	Fellow	HC-95	31.5	8.5	38.96	95	T, S
30.07.17			Bot kenaf-3	39.5	18.5	49.35	95	T
			HS-24	29	3	10.34	95	T, B
	Faridpur	Lentil	HC-95	39	25	37.22	100	T, L
			Jute	50	1	0.5	120	T
13.09.17	Narayanganj	Jute	HC-95	41	33	80.49	91	T
			HS-24	44	30	73.08	91	T
			Bot kenaf-3	37	15.67	42.41	91	T
	Comilla	Kenaf	HC-2	63.25	25.75	40.74	100	T, L
25.09.17			Bot kenaf-3	59.67	28.67	49.68	100	T
			HC-95	34	13	38.24	100	T
			Jute	49	8	17.67	50	T, L
	Dhonbari	Rice	HC-95	36.75	0	0	90	T
17.08.17	Gopalpur	Rice	HC-95	35	0	0	95	-
	Madupur	Fellow	HC-95	31.4	4.8	15.57	100	T

Some pictorial view of mealybug infested fields in locationwise are given below:

Figure 1. *Mealy bug infested field of kenaf at Central station, Dhaka, BJRI.*

Figure 2. *Mealy bug infested field of jute at Faridpur regional station, BJRI.*

Figure 3. *Mealy bug infested plant at Madhupur, Tangail region.*

Figure 4. *Mealy bug infested kenaf plant at Rangpur regional Station.*

Figure 5. *Mealy bug infested kenaf plant at Chandina regional Station.*

Figure 6. *Mealy bug infested jute plants at Chandina Regional Station, Cumilla, BJRI.*

Figure 7. *Mealy bug infested kenaf and Mesta plants at Tarabo, Narayanganj, BJRI.*

Figure 8. *Mealy bug infested Mesta plants at Patuakhali sub-Station.*

3.2. Biology of Mealy Bug

3.2.1. Morphometric Description

i. Egg

The egg is oval in shape and measures on an average 0.315mm in length and 0.135mm in breadth (Table 2). The colour of egg is orange, smooth and translucent. The eggs are deposited in a compact, cottony and waxy sack (Figure 9).

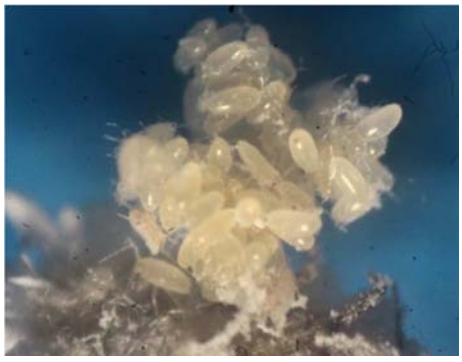

Figure 9. *Egg masses of mealy bug (3.5 X).*

ii. Nymph

The newly hatches nymphs were light yellow in colour, oval and average length in 0.495±0.022 mm and average wide in 0.213±0.008 mm (Table 2). They remain in the cottony nest for a short time. Subsequently, they become very active and crawl over the plants. They insert rostrum into the plant tissues and suck sap from the apical bud and young leaves. As feeding continues, a white waxy powder begins to exude from their body. They pass through tree nympal instars.

First instar or first moulting

The first moulting occurred within 4-5 days with an average of 4.6±0.163days (Table 3). The body color changed from light yellow to brown. After some hours they secreted white powder and waxy powder which gradually became dense. According to Kabir [13] the duration of the first instar was 5-10 days.

Figure 10. *First molting of neonatecrawler (3.5 X).*

Second instar or second moulting

The second moulting occurred within 6-9 days after first moulting with an average of 7.50±0.268 days (Table 3). They secreted dense cottony fibres which over their bodies. According to Kabir [13], the duration of second moulting was 6-8 days. The present findings are in close conformity with the report of Kabir [13].

Figure 11. *Second instar (3.5 X).*

Third instar or third moulting

The third moulting occurred within 7-9 days after second moulting with an average of 8.00±0.388 days (Table 3). They secreted again waxy fibres and white powder. At the end of the third instar the female moult into the sexually mature adult form. The present study is in close conformity with the report of Kabir [13], as he reported that the third moulting occurred within 8-10 days.

Figure 12. *Third instar (3.5 X).*

Figure 13. *Adult (3.5 X).*

iii. Adult

The adult males are elongate. The average length is in 1.60±0.459 mm and average breath is in 0.68±0.078 mm (Table 2). They have one pair wings with reduced venation. The adult female is deep brown, soft-bodied, elongate oval. The average length of adult female is in 4±0.86 mm and average breath is in 2.40±0.516 mm (Table 2). The adult females are wingless. The abdomen bears a pair of waxy filaments. The antennae of male are much longer than those of female. The male dies soon after copulation. At the end of the third instar the female moult into the sexually mature form. Males begin constructing a coccon at the onset of the second instar and continue feeding and maturing while inside [14]. The third instar in males is a prepupa stage after a puparia is formed. The male reaches sexual maturity upon the molt from puparia to the winged adult stage.

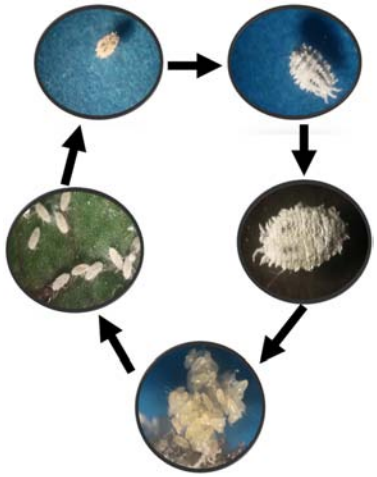

Figure 14. *Life cycle of mealybug.*

Table 2. *Comparative length, breath of mealy bug, Pseudococcus virgatus.*

Developmental stages	Average length (mm) (Mean±SE)	Average breath (mm) (Mean±SE)
Egg	0.315±0.066	0.135±0.024
Nymph (Newly hatches nymph)	0.495±0.022	0.213±0.008
Adult male	1.60±0.459	0.68±0.078
Adult female	4±0.86	2.40±0.516

Table 3. *Different nymphal stages of Meay bug, Pseudococcus virgatus under laboratory condition.*

Nymphal stages	Days ±SE
1st instar nymph	4.6±0.163
2nd instar nymph	7.50±0.268
3rd instar nymph	8.00±0.388
Room Temp (°C)	28.3 ±0.425
% RH	64.15±0.224

3.2.2. Developmental Stages of Mealybug

Developmental stages of Mealybug are egg, nymph and adult. The duration of different developmental stages of Mealybug on Kenaf and Mesta are presented in Tables 4.

i. Incubation period

The observations on incubation period of Mealybug, Pseudococcs virgatus were started immediately after the egg laying and continued up to hatching. The incubation period varied from 3-5days with an average of 4.7±0.94 days (Table 4). Result of the present investigation on incubation period of Pseudococcus virgatus was in close agreement with the result of Kabir [13] as he reported that the incubation period of eggs were 4-9 days.

ii. Nymphal Instars

The observations were made on duration of different instars of *Pseudococcus virgatus*. It was found that the nymph passed through three instars on kenaf and mesta plant leaves under the laboratory condition. The total nymphal period of *pseudococcus virgatus* was with an average of 20.1±1.05 days. The biology of *Ferrisia virgata* was investigated by Lapis [15] in Philippine on several vegetables and ornamental plants under laboratory condition showed that there were three nymphal instars and that the total nymphal period was 45-64 days. Awadallah et al., [16] reported that the total duration of the nymphal stage in females average 43.2 days. Kabir [13] reported that the average three nympal periods of *Pseudococcus virgatus* was 24.5 days. Ghose and Paul [17] stated that female and male nymphs moulted 3 and 4 time respectively and the developmental period varied from 26-47 days and 31-57 days repectively.

iii. Adult

The duration of adult male was an average 15.8±0.388

days. In case of female adult, the duration was an average 35.9±0.348 days. The present findings are in close conformity with the report of Lapis [15] in which he informed that the life span of the adult female was 12-31 days.

Table 4. *The developmental duration of immature stages and egg-adult of Meay bug, Pseudococcus virgatus under laboratory condition.*

Developmental stages	Days ±SE
Egg	4.7±0.94
Nymph	20.1±1.05
Adult male	15.8±0.388
Adult female	35.9±0.348
Egg-adult male	20.5±1.328
Egg-adult female	40.6±1.296
Room Temp (°C)	28.3 ±0.425
%RH	64.15±0.224

4. Conclusion

It can be concluded that the highest infestation of Mealybug (80.49%) was found in HC-95 of kenaf variety at Narayanganj sub-station and the lowest infestation of Mealybug (11.34%) was found in HS-24 of Mesta variety at Patuakhali sub-station of BJRI. Most infested part of plant was twig. The average length of newly hatches nymphs were 0.495±0.022 mm and average wide in 0.213±0.008 mm. The average length of adult male is in 1.60±0.459 mm and average breath is in 0.68±0.078 mm. The incubation period varied from 3-5days with an average of 4.7±0.94 days. The total nymphal period of *pseudococcus virgatus* was with an average of 20.1±1.05 days. The duration of adult male and female was an average 15.8±0.388 and 35.9±0.348 days respectively. Researchers/farmers will be adopted to take appropriate control measures on the basis of these findings. Further research is highly appreciated for more accuracy of the results.

Conflict of Interest

All the authors do not have any possible conflicts of interest.

Authors' Contribution

Mohammad Nazrul Islam and Sultan Ahmmed designed the experiment, conducted the research and analyzed the data. Mohammad Sahin Polan provided help in research conduction and data collection. Mohammad Sohanur Rahman contributed in research conduction, data collection, data presentation, data analysis, searching journal for publication and finally manuscript writing & processing of this article. This article was read and approved by all authors for final Publication.

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