ZIBELINE INTERNATIONAL PUBLISHING

ISSN: 2521-5051 (Print)
ISSN: 2521-506X (Online)
CODEN: ASMCCQ

Acta Scientifica Malaysia (ASM)

DOI: http://doi.org/10.26480/asm.01.2020.27.33

RESEARCH ARTICLE

BIONOMICS OF THE JUTE YELLOW MITE, POLYPHAGOTARSONEMUS LATUS (BANKS) (ACARI: TARSONEMIDAE) IN JUTE (CORCHORUS OLITORIUS L.) AT DIFFERENT TEMPERATURE-HUMIDITY

Md. Nazrul Islam[a], Khandakar Shariful Islam[b], Mahbuba Jahan[b] and Md. Sohanur Rahman[c*]

[a] *Principal scientific officer, Department of Entomology, Bangladesh Jute Research Institute, Manik Mia Avenue, Dhaka-1207.*
[b] *Professor, Department of Entomology, Bangladesh Agricultural University, Mymensingh-2202.*
[c] *Scientific officer, Department of Entomology, Bangladesh Jute Research Institute, Manik Mia Avenue, Dhaka-1207.*
**Corresponding Author Email: sohanbau2010@gmail.com*

ARTICLE DETAILS

Article History:

Received 16 July 2020
Accepted 18 August 2020
Available online 07 September 2020

ABSTRACT

The jute yellow mite Polyphagotarsonemus latus constitutes one of the major pests of jute crop in Bangladesh. The objective of this work was to study the biology of the P.latus, to determine its temperature-humidity responces in jute (Corchorus olitorius L.) var. O-9897. Bionomics of jute yellow mite, Polyphagotarsonemus laenerationtus (Banks) were studied in the laboratory of Bangladesh Jute Research Institute during March 2013 to September 2013. The incubation period of yellow mite on the variety O-9897 was 1.95 days for female and 1.90 days for male; larval period of 1.00 days for female, 0.75 days for male ; pupal period of 0.70 days for female and 0.71 days for male ; egg-adult period of 3.65 days for female and 3.44 days for male were highest in the 1st generation with 25.55±0.15°C and 56±1.47% relative humidity among three generations. pre-oviposition and oviposition period was o.65 days and 12.25 days. The highest longevity 13.45 days for female and 8.50 days for male. The daily mean of eggs were 2.20, 1.91 and 1.75 eggs in three successive generations. The number of eggs laid per female in her life time was 28.6, 24.8 and 12.2 eggs.

KEYWORDS

biology, yellow mite, jute.

1. INTRODUCTION

The genus Corchorus belonging to the family Tiliaceae, is commonly known as jute. There are 2 species of jute namely; Corchorus capsularis L. and C. olitorius L. Jute is most important cash crop and one of the foreign currency earning sources of Bangladesh as the culture of higher expression of economy. Jute is attacked by various insect and mite pests. More than 40 species of insects and mites are considered to be the pests of jute in Bangladesh (Kabir, 1975). Among the non-insect pests yellow mite, Polyphagotarsonemus latus (Banks) (*Acari: Tarsonemidae*) is one of the most common and destructive pests of both the cultivated species of jute (*C.capsularis L. and C. olitorius L.*). It was first described by Banks in 1904 as Tarsonemus latus from the terminal buds of mango in a greenhouse in Washington, D.C., USA (Denmark, 1980). The yellow mite is commonly known as yellow tea mite which is also called as the broad mite. In India and Sri Lanka, it is called yellow tea mite.

However, some parts of the South America, it is called tropical mite or the broad rust mite (Anonymous, 2005a). Yellow mite is extremely polyphagous and attack more than 60 plant families worldwide (Karuppuchamy and Mohanasundaram, 1987; Moutia, 1958; Nemesthoty et al., 1982; Iacob, 1978). Yellow mite infestation in jute normally begins on the young apical leaves and causes damage by sucking of the plant sap resulting in wrinkle and curly appearance of tender leaves. Gradually, the colour of the leaves change to coppery or purplish, finally dry up and fall down (Siddique and Kabir, 1978). The vertical growth of the internodes is suppressed thereby side branches are enhanced (Kabir, 1975). The infested plant remains stunted and fibre yield is reduced. It has been reported that about 38% of fibre yield is reduced due to attack of yellow mite under field condition (Anonymous, 1990). Yellow mite also attacks flower buds and young seed pods. The infested flower buds cannot bloom properly. The floral parts become crinkled and the colour changes yellow to a blackish. The seed pod fails to develop which results in reduced seed production (Siddique and Kabir, 1979). The damage caused by the yellow mite is often termed as "Telenga" or "Telchita" disease in Bangladesh (Kabir, 1975).

Reports show that due to attack of broad mite, Hedera helix and Fatshendera lizei leaves become callous and sank into the leaf surface while in the surrounding tissues formed crystals. Tissue differentiation failed and appears disorganized. These symptoms could result from local damage to the meristematic tissue in the apical shoot, but could also be explained as a systematic plant response to mite feeding (Nemesthoty et al., 1982). However, detailed histological changes due to attack of yellow

Quick Response Code	Access this article online	
	Website: www.actascientificamalaysia.com	DOI: 10.26480/asm.01.2020.27.33

Cite the Article: Md. Nazrul Islam, Khandakar Shariful Islam, Mahbuba Jahan and Md. Sohanur Rahman (2020). Bionomics Of The Jute Yellow Mite, Polyphagotarsonemus Latus (Banks) (Acari: Tarsonemidae) In Jute (Corchorus Olitorius L.) At Different Temperature-Humidity. *Acta Scientifica Malaysia, 4(1): 27-33*.

mite in jute was not reported so far. Early sown jute crop is more susceptible to damage than lately sown crop (Kabir, 1975; Jalil and Sultana, 1983). Infestation of yellow mite occurs in mid-May and the population reaches is highest in June and in late July. Dry period is suitable for rapid multiplication of the mites while damp weather and heavy rainfall are unfavorable for the infestation (Kabir, 1975). It is very difficult to measure the population of P. latus in the field due to rapid change in the factors affecting the environment (Chatterji et al., 1978). Recent information regarding the seasonal incidence of yellow mite under field conditions is not available. Nevertheless, some authors studied the effects of temperature, water and relative humidity on the growth of P. latus population.

The biology of P. latus was studied in various host plants including lime (*Citrus sp.*), pepper (*Capsicum annuum L.*), cotton (*Gossypium hirsutum L*) and lemon (*Citrus limon Burmman*) (Hugon, 1983; Vieira and Chiavegato, 1999; Silva et al. 1998; Vieira and Chiavegato, 1998). Few studies were also done in jute (*Corchorus sp.*) in Bangladesh. Tossa jute, Corchorus olitorius occupies 80 per cent of jute growing area as opposed to 20 per cent by the white jute, Corchorus capsularis but unfotunately the incidence of major pests is more on *C. olitorius* than on *C. capsularis*. As a result, and to permit take appropriate measures for their control, are necessary detailed studies of its biology, to avoid the loss of production, where frequent use of pesticide to increase the cost of cultivation. In this work, held to study the bioecology.

2. Materials and Methods

The duration of developmental stages of jute yellow mite, P. latus was studied on the leaf of jute variety O-9897 in the laboratory of the Department of Entomology, BJRI. Excised leaves were made with mite free fresh jute leaf. Each of the excised leaf pieces was square in appearance with 2cm^2 area. The leaf pieces were placed on cotton bed in petri dish (10cm diameter) facing under surface upward. Adult male and quiescent female pupa of P. latus was collected from stock culture. One male and one quiescent female pupa of P. latus were transferred to each piece of leaf for laying eggs. The leaf squares containing male and quiescent pupa were checked after two hours of their release. The mite individuals were removed if at least one egg was found. More than 30 eggs were collected on excised leaf square. One leaf square was maintained in each petri dish with a single egg. The petridishes were covered and excess moisture was removed. The petridishes containing leaf square with egg was placed on the shelf and checked every 6 hrs interval until the emergence of the larvae.

Then, they were transferred individually to new excised leaf square by camel hair brush and observed at an interval of 6 hrs for determining the duration of the larval and pupal stages. The cotton beds were moistened with distilled water at each observation for moistening the excised leaves. Excised leaves were replaced by a new one at every two days. After emergence, males were observed separately at every 24 hr for determining their longevity. The females were allowed to mate with males obtained from the laboratory culture and observed at the same interval for studying pre-oviposition and oviposition period, longevity, fecundity, sex ratio and mating behavior. Males that died were replaced by fresh ones from the stock in excised leaf square. The room temperature and relative humidity were recorded at 9.00 am and 5.00 pm. Measurement of different stages of living and dead P. latus were recorded using an occular micrometer. The duration of different developmental stages was recorded for three generations and corresponding temperature and RH were noted.

3. Results

3.1 Study on the biology of yellow mite

3.1.1 Morphometric description

3.1.1.1 Egg

The egg is oval in shape and measures on an average 0.08 mm in length and 0.06 mm in breadth at the broadest region (Table 1). The color of egg is white and transparent. The ventral surface of the egg is flat and smooth while the dorsal surface is sculptured having beautiful small rounded white tubercles of range from 27 to 37(Plate 1).

Plate 1: Eggs of yellow mite

3.1.1.2 Larva

The egg hatches into almost egg-shaped larva having three pair of legs. It is very small, measures on an average 0.14 mm in length and 0.07mm in breadth (Table 1). As it grows the more or less whitish larva turns from egg shape to pear shape (Plate 2).

Plate 2: Larva of yellow mite

3.1.1.3 Pupa

The larva increases in size with aging and ultimately it reaches into maximum body size ready for undergoing moulting process. At this stage the body becomes spindle shaped (Plate 3). It measures on an average of 0.21 mm in length and 0.08 mm in breadth at the broadest region (Table 1). The body is opaque with a pale white band on the dorsal surface. It has 3 pair of legs. At this stage they are often carried by adult males. Gadd also observed this stage and designated as pupa (Gadd, 1946).

Plate 3: Pupa of yellow mite

3.1.1.4 Adult

The adult male and female mites differ in size and shape. The female is oval and the ventral surface is flat while the dorsal surface is curved (Plate 4). There is a distinct dusky white band corresponding to the mid dorsal line of the body. The average length and breadth of the full-grown female is 0.20 mm and 0.11 mm (Table 1) respectively. Females have four pair of legs and the last pair differs from other three pair of legs in being whip like. The color is deep brown. The longevity of the adult female varies from 7.30 to 13.45 days (Table 1) in the laboratory conditions.

Plate 4: Adult female yellow mite

The male is smaller in size as compared to the female (Plate 5) and the body is broadest near the 3rd pair of legs and gradually tapers towards the posterior end. They have four pair of legs and the hind pair is stout than the other three pairs. From the tip of the 4th pair legs many hair-like projections arise. The adult males measure on an average 0.17 mm in length and 0.08 mm in breadth (Table 1). The color of the newly emerged male is whitish or pinkish with a whitish stripe on the dorsal surface. The longevity of the adult male varies from 4.7 to 8.5 days under laboratory condition respectively. Comparative measurement and life span of each stage was presented in (Table 1).

Plate 5: Adult male yellow mite

Table 1: Comparative length, breath of different stages of jute yellow mite

Developmental stages	Average length (mm) (Mean±SE)	Average breath (mm) (Mean±SE)
Egg	0.08±0.01	0.06±0.00
Larva	0.142±0.01	0.072±0.01
Pupa	0.21±0.01	0.08±0.01
Adult male	0.17±0.00	0.08±0.07
Adult Female	0.20±0.01	0.11±0.01

3.2 Developmental stage of Yellow mite

Developmental stages of Jute yellow mite are egg, larva, pupa or quiescent nymph and adult. The duration of different developmental stages of yellow mite in three generations on the jute variety O-9897 are presented in Tables 2 & 3.

3.2.1 Incubation period

3.2.1.1 Female egg

The mean incubation period of female yellow mite, P. latus egg was 1.95±0.01, 1.51±0.007 and 1.76±0.01 days in the 1st, 2nd and 3rd generations, respectively. When mean room temperature and relative humidity were 25.55±0.15°C and 56.2±1.47%, 28.25±0.07°C and 65.8±0.18%; and 30.5±0.08°C and 60.5±0.74% during 1st, 2nd and 3rd generations, respectively. There were significant differences (Table 2, P= 0.05) in the incubation period among the three generations. It was observed that the incubation period of P. latus decreased with the increase of temperature. The incubation period of yellow mite also decreased with the increase of relative humidity.

3.2.1.2 Male egg

The incubation period of male yellow mite egg was 1.97±0.01, 1.37±0.01 and 1.68±0.008 days in the 1st, 2nd and 3rd generations, respectively. When mean room temperature and relative humidity were 25.55±0.15°C and 56.2±1.47%, 28.25±0.07°C and 65.8±0.18%; and 30.5±0.08°C and 60.5±0.74% during 1st, 2nd and 3rd generations, respectively. There were significant differences (Table 3, P= 0.05) in the incubation period of male egg among the three generations.

Table 2: The developmental duration of immature stages and egg-adult of female Polyphagotarsonemus latus in three generations under laboratory condition

Generation	Laboratory environmental condition		Developmental time in days ± SE			
	Temp.(°C) (Mean±SE)	RH (%) (Mean±SE)	Egg	Larva	Pupa	Egg-adult
1st	25.55±0.15	56±1.47	1.95±0.01a	1.00±0.01a	0.70±0.01a	3.65±0.01a
2nd	28.25±0.07	65.80±0.18	1.52±0.01c	0.82±0.05b	0.65±0.04b	2.99±0.01c
3rd	30.5±0.04	60.6±0.03	1.76±0.01b	0.65±0.03c	0.64±0.01b	3.05±0.03b

Means followed by the same letter (s) in a column are not significantly different

Table 3: The developmental duration of immature stages and egg-adult of male Polyphagotarsonemus latus in three generations under laboratory condition

Generation	Laboratory environmental condition		Developmental time in days ± SE			
	Temp. (°C) (Mean±SE)	RH (%) (Mean±SE)	Egg	Larva	Pupa	Egg-adult
1st	25.55±0.15	56.2±1.47	1.9±0.02a	0.75±0.00a	0.71±0.01a	3.44±0.01a
2nd	28.25±0.07	65.8±0.18	1.37±0.01c	0.69±0.00b	0.64±0.01b	2.70±0.01c
3rd	30.5±0.03	60.5±0.74	1.68±0.00b	0.67±0.00c	0.59±0.01c	2.94±0.01b

Means followed by the same letter (s) in a column are not significantly different

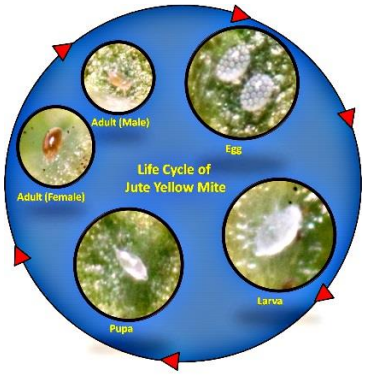

Plate 6: Life cycle of jute yellow mite

3.2.2 Female larval developmental period

There was a significant difference in the larval period of female yellow mite in different generations (Table 2, P=0.05). The larval period of female P. latus was 1.00±0.01, 0.82±0.05 and 0.65±0.03 days in the 1st, 2nd and 3rd generations when mean room temperature and relative humidity were 25.55±0.15°C and 56.2±1.47%, 28.25±0.0°C and 65.8±0.18% and 30.5±0.08°C and 60.5±0.74% respectively. The duration of female larval period was significantly higher in 1st generation compared to that of 2nd and 3rd generation. The time of larval period of female P. latus decreased with the increase of temperature 25.55±0.15°C to 28.25±0.07°C and 30.5±0.08°C (Table 2). The larval developmental period of P. latus also decreased with increasing relative humidity from 56.2±1.47% to 65.8±0.18 and 60.5±0.74%.

3.2.3 Male larval development period

The larval period of male P. latus varied significantly in different generations. In 1st, 2nd and 3rd generations the duration was 0.75±0.00, 0.69±0.00 and 0.67±0.00 days respectively. The mean room temperature and relative humidity were 25.55±0.15°C and 56.2±1.47%, 28.25±0.07°C and 65.8±0.18% and 30.5±0.08°C and 60.5±0.74% during 1st, 2nd and 3rd generations, respectively. The duration of larval period was significantly higher in 1st generation compared to that of 2nd and 3rd generation (Table 3, P= 0.05). The time for larval development of male P. latus was decreased with the increasing temperature relative humidity.

3.2.4 Pupal period of female mite

The pupal period of female P. latus was 0.70±0.01, 0.65±0.04 and0.64±0.01 days in the 1st, 2nd and 3rd generations, respectively when the mean room temperature and relative humidity were 25.55±0.15°C and 56.2±1.47%, 28.25±0.07°C and 65.8±0.18% and 30.5±0.08°C and 60.5±0.74% in three consecutive generations. The duration of female pupa was higher in 1st generation which differed significantly from 2nd and 3rd generation (Table 2, P = 0.05) no significant difference between those of 2nd and 3rd generation was observed. The pupal period of female P. latus was decreased with the increase of temperature and relative humidity.

3.2.5 Pupal period of male mite

The male pupal period of P. latus was 0.71±0.01, 0.64±0.01 and 0.59 ±0.01 days in the 1st, 2nd and 3rd generations, respectively. The mean room temperature and relative humidity were 25.55±0.15°C and 56.2±1.47%, 28.25±0.07 °C and 65.8±0.18% and 30.5±0.08°C and 60.5±0.74% during 1st, 2nd and 3rd generations, respectively. There was a significant difference in the developmental period of male yellow mite. It was higher in 1st generation which differed significantly from 2nd generation and 3rd generation and significant difference between 2nd and 3rd generation was also observed (Table 3, P= 0.05). The pupal period of male P. latus decreased with the increase of temperature (Table 3). The male pupal period of p. latus also decreased with the increase of relative humidity from 56.2±1.47% to 65.8±0.18 and 60.5±0.74 % RH (Table 3).

3.3 Developmental period from egg to adult

3.3.1 Egg to adult for female

The total duration from egg to adult in case of female P. latus was 3.65±0.01, 2.99±0.01 and 3.05±0.03 days in the 1st, 2nd and 3rd generations, respectively. The mean room temperature and relative humidity were 25.55±0.15°C and 56.2±1.47%, 28.25±0.07°C and 65.8±0.18 %and 30.5±0.08°C and 60.5±0.74% during 1st, 2nd and 3rd generations, respectively. The duration of egg to adult for female was higher in 1st generation which differed significantly (Table 2, P= 0.05) from 2nd generation and 3rd generation. The duration from egg to adult in female development decreased with the increase of temperature from 25.55±0.15°C to 28.25±0.07°C and 30.5±0.08°C and with increasing relative humidity (Table 2).

3.3.2 Egg to adult for male

The total developmental duration from egg to adult in case of male P. latus was 3.44±0.01, 2.70±0.01 and 2.94±0.01 days in the 1st, 2nd and 3rd generations, respectively when the average temperature and relative humidity were 25.55±0.15°C and 56.2±1.47%, 28.25±0.07°C and 65.8±0.18% and 30.5±0.08°C and 60.5±0.74% during 1st, 2nd and 3rd generations of the mite, respectively. Significant difference was found (Table 3, P=0.05) in this period among three generations. The duration between egg to adult of male P. latus was found to decrease with the increase of temperature from 25.55±0.15°C to 28.25±0.07°C, 30.5±0.08°C and this developmental period was also decreased with the increase of relative humidity.

3.4 Pre-oviposition period

There was a significant difference in the preoviposition period of different generations of the yellow mite, P. latus showing 0.65±0.01, 0.92±0.01 and 0.90±0.01 days in the 1st, 2nd and 3rd generations, respectively. The mean temperature and relative humidity were 25.55±0.15°C and 56.2±1.47%, 28.25±0.07°C and 65.8±0.18% and 30.5±0.08°C and 60.5±0.74% during 1st, 2nd and 3rd generations, respectively. The pre-oviposition period in 2nd and 3rd generation was identical but differed significantly from 1st generation (Table 4). The duration of pre-oviposition period of P. latus increased with the increase of temperature from 25.55±0.15°C to 28.25±0.07°C, 30.5±0.08°C (Table 4).

3.5 Oviposition period

The oviposition period of P. latus varied significantly (P=0.05) in three consecutive generations which was 12.25±0.18, 11.00±0.23 and 5.35±0.17 days when the mean temperature and relative humidity were 25.55±0.15°C and 56.2±1.47%, 28.25±0.07°C and 65.8±0.18% and 30.5±0.08°C and 60.5±0.74% in 1st, 2nd and 3rd generations, respectively (Table 4). The oviposition period was much higher in first and second generation than the third generation. The period decreased to almost half in third generation.

3.6 Longevity

3.6.1 Female yellow mite

The longevity of female P. latus was 13.45±0.28, 12.45±0.26 and 7.30±0.34 days obtained in the 1st, 2nd and 3rd generations when the respective mean room temperature and relative humidity were 25.55±0.15°C and 56.2±1.47%, 28.25±0.07°C and 65.8±0.18% and 30.5±0.08°C and 60.5±0.74%. The longevity of female yellow mite differed significantly in different generations (Table 4, P=0.05). The individuals of first generation lived almost double than the third generation.

3.6.2 Male yellow mite

The longevity of male yellow mite was 8.50±0.06, 7.95±0.06 and 4.7±0.27 days in the 1st, 2nd and 3rd generations, respectively. The mean room temperature and relative humidity were 25.55±0.15°C and 56.2±1.47%, 28.25±0.07°C and 65.8±0.18% and 30.5±0.08°C and 60.5±0.74% during 1st, 2nd and 3rd generations, respectively. The longevity varied significantly in different generations (Table 4, P= 0.05). It was almost half in the last generation than that of the first. The longevity of male P. latus was decreased with the increase of temperature.

Table 4: Pre- oviposition, oviposition period and longevity of yellow mite in three generations under laboratory condition

Generation	Laboratory environmental condition		Preoviposition, oviposition period and longevity (days ± SE)*			
	Temperature (°C)	RH (%)	Pre-oviposition period	Oviposition period	Female Longevity	Male Longevity
1st	25.55±0.15	56.2±1.41	0.65±0.00b	12.25±0.18a	13.45±0.28a	8.50±0.06a
2nd	28.25±0,07	65.8±0.19	0.92±0.01a	11.00±0.23b	12.45±0.26b	7.95±0.06b
3rd	30.5±0.04	60.5±0.74	0.90a	5.35±0.17c	7.30±0.34c	4.70±0.27c

* Means followed by the same letter (s) in a column are not significantly different.

3.7 Fecundity of Polyphagotarsonemus latus

The mean number of eggs laid by a female and the daily fecundity for three generations of P. latus are shown in Figure 1. In the 1st generation the mean number of eggs laid by a female on the first through 13th days were 2.45±0.15, 2.40±0.13, 2.6±0.18, 2.35±0.20, 2.70±0.16, 2.65±0.18, 2.55±0.17, 2.2±0.15, 2.2±0.14, 1.85±0.17, 1.65±0.13, 1.65±0.11 and 1.35±0.15, respectively. In the 2nd generation the mean number of eggs laid by a female on the first through 11th days were 2.40±0.13, 2.4±0.11, 2.35±0.13, 2.55±0.11, 2.6±0.11, 2.55±0.11, 2.25±0.12, 2.35±0.10, 2.2±0.16, 1.75±0.16 and 1.40±0.17 respectively. In the 3rd generation the mean number of eggs laid by a female on the first through 7th days was 1.55±0.11, 1.65±0.11, 1.9±0.14, 2.10±0.16, 2.15±0.18, 1.5±0.14 and 1.45±0.13, respectively. Fecundity of the female was studied at mean temperature of 26.56±0.40°C and relative humidity of 59.96±1.45%. The daily mean of eggs was 2.20, 1.91 and 1.75 eggs in three successive generations.

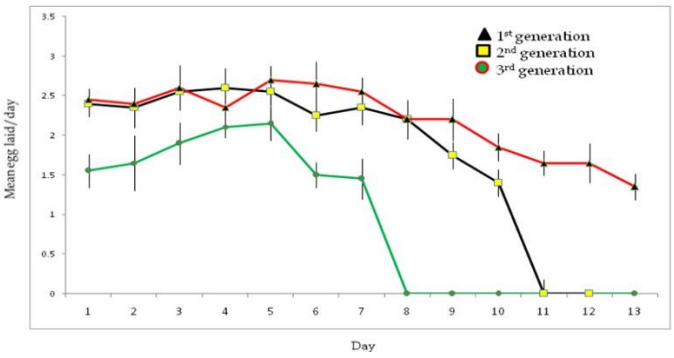

Figure 1: Age specific fecundity of Polyphagotarsonemus latus in three generation on excised leaf square of jute under laboratory condition

The fecundity of yellow mite P. latus varied significantly in different generations (Figure 2). The number of eggs laid per female in her life time was 28.6, 24.8 and 12.2 eggs.

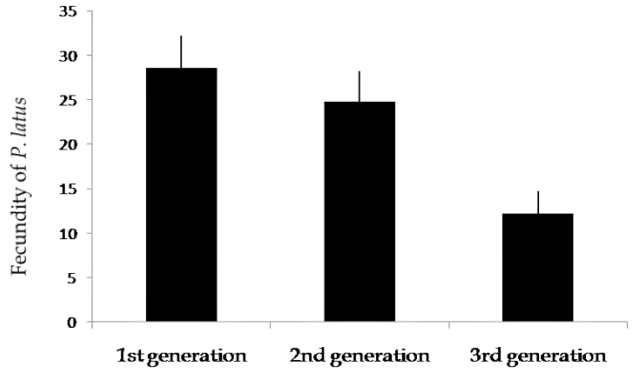

Figure 2: Fecundity of Polyphagotarsonemus latus in three generations on excised leaf of jute of under laboratory condition

4. Discussions

4.1 Study of morphometrics

4.1.1 Egg

The egg was oval in shape measuring 0.08 mm length and 0.06 mm breadth at the broadest region. The ventral surface of the egg was flat and smooth while the dorsal surface was sculptured having many beautiful small rounded white bumps called tubercles. Similarity of the size and shape of the eggs was described by many authors (Lavoipierre, 1940, Denmark, 1980, Hill, 1983, Pena and Campbell, 2005, Baker, 1997). The white and transparent elliptical shaped eggs of yellow mite are laid singly on the undersides of newly grown leaves. Hill reported similarity of egg colour and deposition pattern of eggs on the undersides of fresh leaves (Hill, 1983).

4.1.2 Larva

Eggs were found to hatch into a very small almost egg-shaped whitish larva which measures 0.14- and 0.07-mm length and breadth respectively having three pair of legs. The larva then turns to pear shape. The presence of three pairs of legs was reported (Pena and Campbell, 2005). They are slow moving and appear whitish due to minute ridges on the skin. Kabir observed that larva has three pair of legs and a distinct white stripe on the dorsal surface of the body (Kabir, 1979). As they grow the size ranges from 0.1 to 0.2 mm long. Baker reported the quiescent stage appears as an immobile, engorged larva (Baker, 1997).

4.1.3 Pupa

The larva after reaching into maximum body size showed a moulting process to form a spindle shaped pupa which measures 0.21- and 0.08-mm length and breadth at the broadest region. The pupal body is opaque with a pale white band on the dorsal surface. At this stage they are often carried by adult males. Gadd observed this stage and designated as pupa (Gadd, 1946).

4.1.4 Adult

There was difference in the size and shape of adult male and female yellow mites. The male is smaller in size as compared to the female. The deep brown female is oval with flat ventral surface and curved dorsal surface with a distinct dusky white band corresponding to the mid dorsal line of the body. The size is almost the same as pupa. Four pair of legs is visible and the last pair being whips like. The adult males are even smaller than the pupae. The male is whitish or pinkish with a whitish stripe on the dorsal surface and the body is broadest near the 3rd pair of legs and tapers posteriorly. Out of four pair of legs the hind pair is stout than the other three pairs and used to pick up the female nymph and place her at right angles to the males' body for later mating (Pena and Campbell, 2005). The fourth pair of legs are fringed with many hairs like projections.

4.2 Developmental stage of Yellow mite

Four developmental stages of Jute yellow mite such as egg, larva, pupa or quiescent nymph and adult were visible. There were some differences in duration required for completion of specific developmental stage of yellow mite in three consecutive generations.

4.2.1 Incubation period

The incubation period of female eggs of P. latus ranged from 1.51 to 1.95 days while the male egg incubation range was 1.37 to 1.97 days in three generations. The male and female eggs of second generation completed incubation in minimum time of 1.37 and 1.51 days respectively. The variation of incubation period in different generations could be for the existing environmental condition which influenced the development of the eggs of P. latus. The increased temperature and relative humidity enhanced the development of the eggs. A group researcher observed incubation period of 2.4, 1.6 and 1.8 days for females and 2.2, 1.5 and 1.8 days for male in grape at 25, 28 and 32°C, respectively with relative humidity of 65±10% (Rodrigo et al., 2006). Some researcher observed longer incubation period of yellow mite as 2.17 days for female and 1.98 days for male in jute at 24.92°C and 46.78%RH (Kamruzzaman et al., 2013). Therefore, the environmental temperature around 28 °C and the relative humidity of 65% could be considered very congenial for incubation of yellow mite eggs.

4.2.2 Larval period

The larval period of female P. latus ranged from 0.65 to 1.00 days while the male larval period range was 0.67 to 0.75 days in three generations. Both the male and female larva of third generation completed its stage in minimum time of 0.67 and 0.65 days respectively. The time required for larval stage of the individuals of both sexes was found to decrease with the increase of environmental temperature. It clearly indicates that the larval development of yellow mite is influenced by the abiotic factors of the environment. The variation of larval period of P. latus in different generations could be explained in this way that the increased temperature and relative humidity enhanced the development. In a study, recorded that larval period of 1.0, 0.9 and 0.9 days for females and 0.8, 0.7 and 0.7 days for males, respectively at 25, 28 and 32°C, with relative humidity of 65±10% (Rodrigo et al., 2006). In other study, researchers observed the larval period of yellow mite as 0.98 days for female and 0.80 days for male in jute at 24.92°C and 46.78%RH (Kamruzzaman et al., 2013). The data on the larval development of present study indicates that in favorable environmental condition the yellow mite could complete its larval development faster. Therefore, the temperature around 28°C and the relative humidity of 65% could be considered favorable environmental condition for larval development of yellow mite.

4.2.3 Pupal period

Pupa of yellow mite completes its life stage in very short period of time. The male and female pupa required 0.71, 0.64 and 0.59 days and 0.75, 0.69 and 0.67 days in the 1st, 2nd and 3rd generations respectively. Although no remarkable variation was found in different generations, it showed a significantly higher time in first generation than the other two generations. This difference could also be related to the existing environmental conditions. The lower temperature in the first generation than the later generations probably caused a little slowing down of the development of the pupa. A group researcher observed the pupal period of yellow mite as 0.81 days for female and 0.70 days for male in jute at 24.92°C and 46.78%RH (Kamruzzaman et al., 2013). In other study, researchers also reported that pupal period as 0.8, 0.7 and 0.6 days for females and 0.7, 0.6 and 0.6 days for males, respectively at 25, 28 and 32°C with relative humidity of 65 ± 10% (Rodrigo et al., 2006). The present

findings are in agreement with the above authors.

4.2.4 Egg to adult period

The total duration from egg to adult in case of male P. latus was 3.44, 2.70- and 2.90-days female was 3.65, 2.99 and 3.05 days in the 1st, 2nd and 3rd generations, respectively. The total development from egg to adult in different generations was found to vary probably for the difference in environmental temperature and humidity. Lower environmental temperature during the first generation influenced the life of the yellow mite resulting in prolonged duration for its completion. A group researcher found the egg to adult stage being 3.48 days for male and 3.93 days for female and was highest in the 1st generation in jute at 24.92°C and 46.78%RH (Kamruzzaman et al., 2013). Vieira in young fruits of lemon (*Citrus limon*) obtained values of 3.6 days for males and 3.7 days for female development from egg to adult respectively at 27.2°C temperature and 68.2%RH (Vieira, 1995). In pepper, the duration of egg-adult was 6.33, 4.18 and 2.67 days at 20, 25 and 30°C, respectively (Li and Li, 1985). In citrus, Hugon obtained a length of 4.08 days at a temperature of 30°Cand 8.5 days at 25°C (Hugon, 1983). In cotton Vieira & Chiavegato obtained durations of 4.1 days on cotton at 28.5°C (Vieira and Chiavegato, 1998). A group researchers found reduction of duration between egg to adult for males and female's P. latus infesting peppers with increasing temperature from 20 °C to 30 °C (Silva et al., 1998). In the present study almost all the developmental stages and egg-adult development of yellow mite differed significantly in three generations. These findings are similar to those obtained by above authors.

4.2.5 Pre-oviosition period

The pre-oviposition period of P. latus was 0.65, 0.92 and 0.90 days in the 1st, 2nd and 3rd generations, respectively. It reveals that preovposition period of the two later generations is higher than that of the first generation which was studied at relatively lower temperature of 25.55°C. It is very difficult to explain the reason of shorter preoviposition period in first generation. A higher and similar pre-oviposition period of the yellow mite was found at moderately higher temperature of 28.25 and 30.5°C. a group researcher reported the pre-oviposition period of yellow mite as 0.99 days in the 2nd generation in jute at 28.25°C and 65.8% (Kamruzzaman et al., 2013). Vieira found pre-oviposition period of 1.1 and 0.9 days (Vieira, 1995). A group researchers found higher pre-oviposition period of the mite as 1.8, 1.3 and 1.1 days at similar environmental temperature of 25, 28 and 32°C respectively in grape and relative humidity of 65±10% (Rodrigo et al., 2006). Higher preoviposition period reported by Rodrigo than the present study might be due to difference in host plant as well as other environmental factors.

4.2.6 Oviposition period

The oviposition period of P. latus greatly varied from 5.35 to 12.25 days in three succesive generations. The oviposition duration was higher in 1st generation which differed significantly from two other generations. It revealed much higher oviposition period in the first and second generation than the third generation. The period was found to decrease to almost a half in the third generation. The increasing temperature in the later generations might be the reasons for shorter oviposition period. A similar oviposition period of the yellow mite of jute was recored (Kamruzzaman et al., 2013). They observed the highest oviposition period as 12.68 days in the 1st generation in jute at 24.92°C and 46.78%RH. Vieira found oviposition duration of 6.8 and 8.9 days (Vieira, 1995). In contrast to the the report and the findings of present study oviposition period as 26.3, 14.5 and 5.8 days, respectively at 18, 25 and 32°C in grape with relative humidity of 65±10% (Kamruzzaman et al., 2013; Rodrigo et al., 2006). The possible reasons for this variation are for the difference in the host plant species and environmental temperature regime of very low to high range.

4.2.7 Longevity

Difference in the longevity between male and female yellow mite was evident in the experimental findings. Females always lived longer than that of the males. There occurred a marked variation in the longevity of both the sexes of yellow mite depending of the generations. The longevity of the female was 13.45, 12.45 and 7.30 days and the male was 8.50, 7.95 and 4.7 days in the 1st, 2nd and 3rd generations, respectively. In general the longevity was higher in 1st generation which differed significantly from other two generations. The individuals of first generation of both sexes lived almost double than those of third generation. The variation of longevity in different sex is quite common and a higher female longevity is found in many species.

The difference in life duration could be for the exposure of the species in different abiotic conditions. The longevity of both male and female P. latus was found to decrease with increasing of temperature and relative humidity. The result of the present study has similarity with the findings of other reseachers. A group researcher reported the highest longevity of 14.35 days for female and 10.44 days for male in the 1st generation in jute at 24.92°C and 46.78%RH (Kamruzzaman et al., 2013). Vieira obtained the longevity of female as 10.0 and 13.6 days; male as 8.8 and 12.0 days when P. latus was grown on leaves of cotton and young fruits respectively (Vieira, 1995). In lemon Scilian, at 27.1°C, the longevity of male and female mite was 12.0 and 13.4 days respectively (Vieira and Chiavegato, 1999). Therefore, all the findings clearly indicate that the longevity of male and female is lower and there exists a significant influence of environmental temperature.

4.2.8 Fecundity of P. latus

Fecundity of the yellow mite was found to vary with the generation. The mite laid 28.6, 24.8 and 12.2 eggs in 1st 2nd and 3rd generation respectively. The average daily fecundity ranged from 1.75 to 2.20. The fecundity of yellow mite was found to be related to the oviposition period. In the earlier generations the fecundity was higher than the later ones as oviposition period was longer. A group researcher observed the mean number of eggs laid per female in life time was 29.86 with daily mean of 2.30 eggs, 26.14 with daily mean of 2.38 eggs and 13.86 with daily mean of 1.98 eggs in the 1st, 2nd and 3rd generations respectively (Kamruzzaman et al., 2013). In other study, researchers found peak oviposition of 4.9 eggs/female for ninth days (Schoonhoven et al., 1978). In pepper at 25°C, the maximum oviposition of 5.0 eggs was obtained on the eighth day (Silva, 1995). In cotton at 28.5°C, found 6.5 eggs/female on 5th days (Vieira and Chiavegato, 1998). In lemon zest, Vieira and Chiavegato found 6.5 eggs/female on the 4th days (Vieira and Chiavegato, 1999). In many cases there are similarities of fecundity of the yellow mite as reported by other authors. A few variations in the fecundity could be for the host plants and the environmental conditions.

5. Conclusion

Bionomics of jute yellow mite led to the generation of good number of scientific information. It can easily be controlled if its biology is known. Biological parameters of yellow mite such as development, fecundity, longevity was influenced by the environmental temperature and humidity as evident in the study of different generations. Variation of different life parameters in different generations probably varied in different environmental conditions. From the study, it can be concluded that this research work will be helpful to take effective measures for controlling jute yellow mite considering loss of production, cost effectiveness and environmental issues.

Acknowledgement

The author takes an opportunity to express his gratefulness to Ministry of Agriculture, The People's Republic of Bangladesh for awarding the National Agriculture Technology Phase-I (NATP-I) Fellowship which had the financial contribution on the successful completion of this research work.

References

Anonymous, 1990. Annual report of Bangladesh Jute Research Institute, Manik Miah Avenue, Dhaka-1207. Pp. 234.

Anonymous, 2005a. Broad mite. Insect and Related pests of Flowers and Foliage Plants. Htt://mrec.ufl.edu/lso/entomol/ncstate/mitel.htm (13 September 2005).

Baker, J.R., 1997. Cyclamen mite and broad mite. Ornamental and Turf Insect Information Notes. Das LK, Singh B 1988: Life history of yellow mite, Polyphagotarsonemus latus (Banks) on jute crop. Ann. of Agric. Res., 9, Pp. 20-25. https://doi.org/10.17221/71/2009-cjgpb

Banks, N., 1904. Class III, Arachnida, Order 1, Acarina, four new species of injurious mites. J. of New York Entomol. Soc., 12, Pp. 53-56.

Chatterjee, D.K.P.V., Rao, P.V., Singh, B., Tripathi, R.I., Das, L.K., Battachryarya, S.P., 1978. Effect of environmental factors on the incidence of major pests of jute, Corchorus olitorius. Ent. Res., 2, Pp. 163-166.

Denmark, H.A., 1980. Broad mite, Polyphagotarsonemus latus (Banks). FDACS-DPI Bureau of Entomol. Circular, 213, Pp. 2.

Gadd, C.H., 1946. Observation on the yellow Tea mite, Hemitarsonemus latus (banks) Ewing. Bull. Ent. Res., 37 (2). https://doi.org/10.1017/s0007485300022100

Hill, D.S., 1983. Polyphagotarsonemus latus (Banks). pp. 504. Agricultural Insect Pests of the Tropics and Their Control. Cambridge University Press. Pp. 746.

Hugon, R., 1983. Biologie et ecologie de Polyphagotarsonemus latus Banks, ravageur sur citrus aux Antilles. Fruits., 38, Pp. 635-646.

Iacob, N., 1978. New Mite Pests on Greenhouse Crops and on Grapevine (abstract only). Rev. Appl. Entomol. Ser. A., 67 (12), Pp. 595-596.

Jalil, A.F.M.A., Sultana, N., 1983. Jute insects pest management paper presentd in seminar on Expert consultation on jute and Kenaf improvement. Pp. 5-15.

Kabir, A.K.M.F., 1975. White mite, Hemitarsonemus latus (Banks) Ewing. In jute pests of Bangladesh. Bangladesh Jute Research Institute. Dhaka, Bangladesh, Pp. 28-33.

Kabir, A.K.M.F., 1979. Bioecology and behavior of yellow jute mite. In:J.G.Rodriguez (Editor), Recent Advances in Acarology, 1, Pp. 519-523. https://doi.org/10.1016/b978-0-12-592201-2.50073-7

Kamruzzaman, A.S.M., Alam, M.Z., Mia, M.R.U., 2013. Impact of jute yellow mite, Polyphagotarsonemus latus (Banks) density on hosts (*Corchorus olitorius L.*) Phenology and assessment of yield loss under field condition. Mun entomol Zool., 8 (1), Pp. 361-368.

Karuppuchamy, P., Mohanasundaram, M., 1987. Bioecology and control of chilli muranai mite. P. latus (Banks). Int. J. Plant Prot., 15, Pp. 1-4.

Lavoipierre, M.M.J., 1940. Hemitarsonemus latus (Banks) (Acarina), a Mite of Economic Importance New to South Africa. J. Entomol. Soc. Southern Africa., 3, Pp. 116-123.

Li, Y.R., Li, L.S., 1985. Studies on the fluctuation population of the broad mite. Acta Entomol. Sin., 29, Pp. 41-46.

Moutia, L.A., 1958. Contribution of the study of some phytophagous Acarina and their predators in Mauritius. Bull. Entomol. Res., 49, Pp. 59-75.

Nemesthoty, K., Volcsansky, E., Simon, N., 1982. Influence of damage of the mites Tarsonmus pallidus and Polyphagotarsonemus latus Banks (Acari:tarsonemidae) on the morphological properties of fashedera and hedera leaves. Novenyvedelem, 10, Pp. 437-442.

Pena, J.E., Campbell, C.W., 2005. Broad mite. EDIS. htt://edis. Ifas.ufl.edu/CH.

Rodrigo, C.F.F., Deliveira, J.V., Haji, F.N.P., Manoel, G.C., Gondim, J.R., 2006. Biology and Thermal Requirements table of life fertility mite, Polyphagotarsonmus latus (Banks) (Acari: Tarsonemidae) in vine (Vitis vinifera L.) cv. Italy. Neotropical Entomology, entomology, 35 (1), Pp. 126-132. https://doi.org/10.1590/s1519-566x2006000100017

Schoonhoven, A., Piedrahita, J., Valderrama, R., Galvez, G., 1978. Biology, dano Y control del tropical mite, Polyphagotarsonemus latus (Banks) (Acarina: Tarsonemidae) en frijol. Turialba, 28, Pp. 77-80.

Siddique, M.A.B., Kabir, A.K.M.F., 1979. Mating behavior, infestation and alternate hosts of jute mite. Bangladesh J. Agric., 4, Pp. 121-126.

Silva, E.A., Oliveira, J.V., Gondim, J.M.G.C.C., 1998. Biology Polyphagotarsonemus latus Banks (*Acari:tarsonemidae*) in pepper. Soc. Entom. Brazil, 27, Pp. 223-228. https://doi.org/10.1590/s0301-80591998000200008.

Vieira, M.R., 1995. Biology studies Polyphagotarsonemus latus (Banks, 1904) (*Acari: Tarsonemidae*) in cotton (*Gossypium hirsutum L.*) and Lemon (*Citrus lemon Burm*). Thesis ESALQ-USP, piracicaba,1 Pp. 7.

Vieira, M.R., Chiavegato, L.G., 1998. Biology of Polyphagotarsonemus latus (Banks, 1904) (*Acari: Tarsonemidae*) on cotton. Pesquisa Agropecuaria Brasileira, 33 (9), Pp. 1437-1442.

Vieira, M.R., Chiavegato, L.G., 1999. Biology of Polyphagotarsonemus latus (Banks, 1904) (*Acari: Tarsonemidae*) in lemon (*Citrus limon*). Entomol. Brazil., 28, Pp. 27-33.