

Influence of Biotic and Abiotic Factors on Mulberry Mealybug, *Maconellicoccus hirsutus* (Green) during the Summer Season

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Abstract

Objectives: The present study was carried out to investigate the biology of *Maconellicoccus hirsutus* on Alba variety of mulberry under laboratory conditions and comparative infestation of *M. hirsutus* on Alba and purple varieties of mulberry under field conditions. **Methods/Statistical Analysis:** Mean and standard error was used to describe the results. **Findings:** The results indicated that the fecundity of *M. hirsutus* varied from 221 to 232 varied eggs per female. The pest completed its life cycle in 29.08 to 32.51 days. The infestation of *M. hirsutus* on different mulberry variety showed that purple variety was resistant than Alba variety with pest population of 8.43 ± 0.33 mealybugs per 10 cm twig compared with 9.73 ± 0.93 mealybugs on Alba variety. **Application/Improvements:** *M. hirsutus* is a serious polyphagous pest insect of mulberry and other plants. Therefore, it is suggested that detailed studies on population dynamics, natural enemies and population management of this mealybug should be carried out under agroecological conditions of Sindh, Pakistan.

Keywords: Biotic and Abiotic, *Maconellicoccus hirsutus*, Mulberry Mealybug

1. Introduction

Mulberry, *Morus alba* L., (family: Moraceae) is also used for rearing of silkworms and wood around the world, including Pakistan^{1,2}. Mulberry trees in their cultivated form are often trimmed into low bushes to facilitate harvesting of fruits and leaves. In the temperate and subtropical climate, mulberry trees are deciduous; in

tropical highland conditions, they are all leaves all year round³. The mulberry tree is attacked by the impeller *Diaphania pulverulentalis*, the caterpillar *Spillarcia oblique*, the Longhorn beetle *Migdolus fryanus* and the white beetle *Naupactus* spp. Scales *Pseudaulacapis pentagonal* and mealy bug, *M. hirsutus* (green)⁴. Whitefly is one of the most serious pests of mulberry pests, causing qualitative and quantitative damage^{5,6}.

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Mulberry worm, *M. hirsutus* is a small bug. It is located in the local area of South Asia and has spread to all parts of the world, including Africa, North America, the Caribbean and Pakistan and is expanding its scope⁷⁻⁹.

Infestation of *M. hirsutus* on mulberry causes malformation of terminal buds and appearance of small curly leaves on the shoots and top apical^{5,6}. The land Mac (*Maconellicoccus hirsutus*) has become a serious pest of many horticultural and crop crops in the world, causing severe deformation of leaves, sprouts and host plants. Mealybug *M. hirsutus* was originally described in the specimens collected from India¹⁰. *M. hirsutus* is an invasive whitefly species originally from South Asia or Australia^{11,12} and extends to other parts of the world, including the Middle East, Africa, the Caribbean, North and South America (Guyana, French Guiana, Venezuela), Suriname, Colombia^{13,14}. This insect was first discovered in Brazil in 2010 in Roraima, near Venezuela and Guyana in Brazil¹⁵.

Therefore, keeping the importance of pest in view the present studies were carried out to generate knowledge and information for the utilization and management of this pest under agroecological conditions of Sindh, Pakistan.

2. Materials and Methods

Adult females of mulberry worms were collected in plastic bags with the help of camel brushes, from gardening gardens, Sindh Agricultural University, Tandojam and taken to the Entomology Department FCPT for biological research. Adult females were separately released in petri dishes for spawning and a crawler was produced at $25 \pm 2^\circ\text{C}$ under laboratory conditions.

After hatching, a female pup (crawler) of the same age is kept in 10 separate petri dishes and mulberry leaves are provided as food every other day. Unfortunately, if any insect dies due to an unknown factor, another insect of the same age is replaced in the dish. When all females mature and form pockets when they develop monosexually in the abdomen, they are counted.

One week after hatching, each female pouch was removed with the help of needle and camel crushing, and many unhatched eggs (fertility), the percentage of hatching, were recorded under a compound microscope. The number and age of 10 females of different ages (in days) were recorded.

In the research work, male-female ratios and their longevity (in days) at different ages were observed under

a microscope. The morphological characteristics of each age were antenna segments, body segments, filaments, anal parts and bristles. The field data were collected from Horticulture Garden Sindh Agriculture University Tandojam the data were recorded from mulberry varieties. Ten plants from each variety were selected at random for mealybug population study observation was recorded from 2-3 twigs measuring 10 cm each per plant.

3. Results

3.1 Biology

The studies on the biology of *M. hirsutus* under laboratory conditions on mulberry (Var. Alba) indicated that mealybug had an incubation period of 3.12 ± 0.95 . There was three nymphal instars. The duration of nymphal instars was 6.21 ± 1.15 , 5.32 ± 1.97 and 7.61 ± 2.17 days for first, second and third instar, respectively. After completion of third nymphal instar, the male went into pupation, while female became adults. The duration of the pupal stage in males lasted for 3.35 ± 1.38 days. The adult male longevity was 3.47 ± 1.87 days. While the female mealybug lived for 10.25 ± 2.13 days. The duration of the life cycle of male and female was 29.08 and 31.51 days, respectively.

3.2 Survival

The survival of different life cycle stages shown in Table 1 indicated that the highest percentage survival (85%) was recorded in stage, followed by male pupal stage (76%) and second instar (67%). While the lowest survival was recorded in female (33.34%).

Table 1. Biology and survival of mulberry mealybug, *M. hirsutus* on Alba variety under laboratory conditions

Life stage	Duration in days	% survival
Incubation period	3.12 ± 0.95	85
First instar	6.21 ± 1.15	47.05
2 nd instar	5.32 ± 1.97	67
3 rd instar	7.61 ± 2.17	61
Male pupal period	3.35 ± 1.38	76
Male adult period	3.47 ± 1.87	65
Female adult period	10.25 ± 2.13	33.43

3.3 Duration of Life Cycle

Male: 29.08
 Female: 32.51

3.4 Fecundity and Fertility of Egg

The minimum and maximum fecundity of *M. hirsutus* recorded in the present study was 221 and 323 eggs per female. The overall mean fecundity was 261.4 ± 9.69 eggs per female. The fertility of eggs of *M. hirsutus* was quite high, it was more than 90% with an average of 93.75 ± 0.52 (Table 2).

Table 2. Fecundity and fertility of eggs of mulberry mealybug, *M. hirsutus* on Alba mulberry variety under laboratory conditions

Female No.	Eggs Laid	Eggs Hatched	% Fertility
1	251	240	95.62
2	272	260	95.59
3	267	250	93.63
4	281	268	95.37
5	323	303	93.81
6	280	264	94.28
7	225	207	92.0
8	235	221	94.04
9	259	240	92.66
10	221	200	90.50
X ± SE	261.4 ± 9.69	245.3 ± 9.78	93.75 ± 0.52

3.5 An infestation of *M. hirsutum* on Different Varieties of Mulberry

The population of *M. hirsutum* on two varieties of mulberry indicated that purple variety of mulberry was less preferred than Alba. The average population recorded was 8.43 ± 0.33 and 9.73 ± 0.94 mealybug per 10 cm twig on purple and Alba varieties, respectively (Table 3). The mealybug population differences were not significantly different from each other ($t = 1.46$, $DF = 11$, $P = 0.173$).

4. Discussion

Maconelicoccus hirsutus is very important and serious insect pest of mulberry in Pakistan causing damage to mulberry of plants. The severity of this pest has been reported by many authors such as¹⁶ carried out a survey and reported that 15-30% plantation of mulberry was

infested by *M. hirsutus*. This pest caused a disease known as Tukra in mulberry. The pest completed its life cycle in 25-30 days and had fecundity of 100-200 eggs per female. In¹⁷ also reported that *M. hirsutus* was a major pest of mulberry in India and caused a viral disease in mulberry called Tukra. In^{18,19} reported that *M. hirsutus* completed its life cycle in 23-30 days and there were 15 generations in a year. Similarly²⁰ reported that *M. hirsutus* had high reproductive potential and could lay upto 600 eggs per female and produce 15 generations in a year. In²¹ reported that temperature played an important role in the life cycle of *M. hirsutus*. Each female laid 260-300 eggs between 20-27°C but only 100 eggs at 30°C. Male adult longevity decreased as temperature increased, living for 3.5 days at 20°C and 1.4 days at 30°C.

Table 3. Mulberry mealybug, *M. hirsutus* population of two varieties of mulberry plants under field conditions

Date	Alba	Purple
Aug, 9, 12	12.7 ± 5.95	8.3 ± 2.87
Aug 16, 12	11.7 ± 5.65	8.7 ± 4.16
Aug, 23, 12	9.9 ± 4.53	10 ± 3.4
Aug, 30, 12	12.6 ± 4.58	8.6 ± 7.72
Set 6, 12	8.6 ± 3.95	9.8 ± 6.53
Sept 13, 12	11.8 ± 3.97	9.4 ± 5.87
Sept 20, 12	12.4 ± 6.67	9.0 ± 4.92
Sept 27, 12	11.6 ± 5.83	8.9 ± 5.51
Oct 4, 12	12.4 ± 8.11	8.3 ± 6.09
Oct 11, 12	7.1 ± 6.64	6.5 ± 4.9
Oct 18, 12	8.4 ± 3.34	6.9 ± 4.98
Oct 25, 12	9.0 ± 6.82	6.8 ± 6.18
Means ± SE	9.73 ± 0.94	8.43 ± 0.33

$t = 1.46$

$DF = 11$.

$P = 0.173$

In the present study, *M. hirsutus* laid 271 to 323 eggs per female (Table 2). In²² reported that mated *M. hirsutus* produced on average 260-300 eggs when reared on hibiscus cuttings at 20-27°C. In²³ reported a per capita fecundity

of 178 eggs within 8 days when reared on hibiscus plants at 27°C. In²⁴ obtained the highest mean fecundity when the females were reared on Japanese pumpkin (162 eggs) and the lowest on a meridic diet (59 eggs). Other reports of *M. hirsutus* fecundity varied significantly from 84 to 654 eggs as reported in²² and 386-540 eggs reported by²⁵. As was shown by²⁴ the difference in fecundity of *M. hirsutus* in these reports was likely the result of different host plant species or food substrates.

In the present study, there was considerable variation in resistance of mulberry varieties against *M. hirsutus*. The purple mulberry variety was comparatively more resistant than Alba variety. There was a significant difference in population development of *M. hirsutus* on purple variety compared with Alba variety. Evaluated 154 different mulberry genotypes against *M. hirsutus* and found that the majority of indigenous and exotic genotypes exhibited moderate to high susceptibility to mealybug.

Several researchers have reported on variation in biological parameters in herbivores on different hosts. Woets and van Lenteren²⁶. The differences in the populations of the whitefly populations on different host plants were attributed to the effects of host plants on the fecundity, lifespan and developmental rate of the pests. The growth, development and reproduction of the genus *Planococcus citri* (Risso) varies greatly when fed with red, yellow or green leaves (*coleus blumei* (Bentham))²⁷. The data indicated that *M. hirsutus* developmental periods were longer for *M. hirsutus* when cultured on *C. pepo*, *S. tuberosum*, *Hibiscus rosa-sinensis* and *H. sabdariffa*. *M. hirsutus* egg to adult survival was higher for *H. sabdariffa*, *H. rosasinensis*, *S. tuberosum* and *C. pepo* while greater female biased sex ratios and female size occur on *C. pepo*, *H. rosa-sinensis*, *H. sabdariffa* and *S. tuberosum*. Adult *M. hirsutus* females lived longer on *C. pepo*, *H. sabdariffa*, *S. tuberosum* and *H. rosa-sinensis*.

5. Summary

The current study was conducted to find out the biology of *Maconellicoccus hirsutus* on Alba variety of mulberry under laboratory conditions and comparative infestation of *M. hirsutus* on Alba and purple varieties of mulberry under field conditions. The results indicated that the fecundity of *M. hirsutus* variety from 221 to 232 eggs per female. The pest completed its life cycle in 29.08 to 32.51 days. The infestation of *M. hirsutus* on different mulberry variety showed that purple variety was resistant than Alba

variety with pest population of 8.43 ± 0.33 mealybugs per 10 cm twig compared with 9.73 ± 0.94 mealybugs per twig on Alba variety.

6. Conclusions and Suggestions

Maconellicoccus hirsutus is a serious polyphagous pest insect of mulberry and other plants. Therefore, it is suggested that detailed studies on population dynamics, natural enemies and population management of this mealybug may be carried out under agroecological conditions of Sindh, Pakistan.

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