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***Research Article***

# Study on feeding of powdery mildew infected mulberry leaves in silkworm rearing and its bioassay

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**Abstract**

Incidence of diseases in mulberry is one of the major problems for successful sericulture in India, of which powdery mildew [*Phyllactinia corylea* (Pears) Karst] is very common and causes significant losses to the farmers. To assess the damage caused by powdery mildew during rearing, silkworms were fed with mulberry leaves (variety $S_1$) carrying different levels of infection. Larval duration was increased by two days when disease infected leaves were used for feeding. Maximum larval weight was recorded in control (3.03 g) and larval weight decreased with the level of infection while none of the silkworms survived till $5^{th}$ instar when leaves with highest level of infection were used for feeding. Average larval length was longest (7.33 cm) in the control. Control also recorded highest single cocoon weight (1.98 g), single shell weight (0.42 g), shell ratio percentage (21.15%), effective rate of rearing- wt (16.09 kg) and effective rate of rearing-no (9266.66). Correlation analysis revealed that Single cocoon weight and single shell weight was positively correlated with larval weight with correlation coefficient of 0.936 and 0.927 respectively. The experiment confirmed that reduction in quality and yield during rearing was proportional to the level of disease incidence in the leaves used for feeding.

## INTRODUCTION

Mulberry is one of the most important commercial crops grown extensively as sole food plant for silkworm(*Bombyx mori*). Mulberry (*Morus* spp.) is a perennial and high biomass producing plant, continues to grow throughout the year in tropics. It is deep rooted perennial plant widely distributed in Asia, Europe, Africa and Latin America. Mulberry leaf is the sole source of nutrients like protein, carbohydrates, vitamins and minerals for the growth of silkworm. The quantity and quality of mulberry foliage is often decreased by the prevalence of pathogens, parasites and insect pests. Pathogens infect mulberry leaves and reduce not only yield but also nutritional values, thus making the leaves unsuitable for silkworm feeding. In India, mulberry contributes to an extent of 38.20 per cent for successful cocoon crop production (Miyashita, 1986). It is known that various microorganisms seriously infect the mulberry leaves and of these microorganisms, fungi are most important because they cause many diseases as a result the mulberry leaves become unsuitable for feeding to silkworm. Dutta *et al.*, (2013) developed a regression model to predict the incidence of Myrothecium leaf spot disease of mulberry in which the climatic factors have shown correlation with disease development. The major foliar fungal diseases in Malda district of west Bengal powdery mildew caused by *Phyllactinia corylea* (Pears)

Karst which affects the normal growth and yield of mulberry. Tang *et al.,* 2006 reported that moisture content, ash, lipid, crude fiber, carbohydrate, vitamins and mineral contents were decreased significantly in powdery mildew infected leaves. Feeding of diseased leaves adversely affects the growth and reduces the marketing quality of cocoons produced (Dandin, 2000). The adverse effect of leaves affected by leaf spot (Sikdar and Krishnaswami, 1980) and rust (Umesh Kumar *et al.*, 1993) on cocoon yield were already reported.

## MATERIALS AND METHODS

Experiment was conducted at Mothabari (Latitude: 25.24145 and Longitude: 88.2509) Malda district of West Bengal during the year 2010. Mulberry variety $S_1$ maintained at farm under recommended agronomical practices (Subba Rao, 1989) was earmarked with standard procedures and allowed to get natural infection of foliar fungal disease. The disease comprised of mainly Powdery mildew. Severity of disease was recorded from five plants of a plot where out of five plants; four from four corners and one from the centre of the plot were considered. On each plant, three branches are randomly selected and tagged. To measure the disease incidence, the total number of leaves and the number of leaves infected with disease were counted on the selected branches. For measuring the percentage of disease index (PDI), all infected leaves were categorized into different grades of infection using the following 0 – 5 grading scale (FAO 1967).

**Grading scale**

| Grade | % leaf lamina covered by the symptom |
|---|---|
| 0 | No infection |
| 1 | 0-5% leaf lamina covered by the symptom |
| 2 | 6-10% leaf lamina covered by the symptom |
| 3 | 11-25% leaf lamina covered by the symptom |
| 4 | 26-50% leaf lamina covered by the symptom |
| 5 | 50% above leaf lamina covered by the symptom |

Percent disease index (PDI) was calculated according to FAO formula (1967).

$$\text{Percent disease index (PDI)} = \frac{\text{Sum of all individual rating}}{\text{Total no. of leaves x Maximum grade (5)}} \times 100$$

For this experiment cross breed N X(NB18 X P5) was selected. Larvae were fed with the healthy leaves as control and powdery mildew infected leaves (Grade I to V) throughout the rearing starting from the 2nd instar of the larvae. Each treatment was replicated three times and each treatment consisted of 50 larvae. Some important rearing, reeling and parameters were studied and data of average of three replications is presented. The observations like weight and length of the mature larvae, and cocoon weight, single shell wt, shell ratio, and mortality percentage were taken. The observations could not be recorded in case of the larva fed with the infected leaves of grade V as there was 100% mortality before they reached the 5th instar.

**Weight and length of mature larvae:**

10 mature larvae of 5th instar were randomly selected from each replication and average weight and length were calculated.

**Single cocoon weight., Single shell weight and Shell ratio:**

10 cocoons were randomly selected five days after cocoon formation from each replication. Shell weight was calculated by deducting pupal weight from cocoon weight. Shell Ratio was calculated by the following formula.

$$\text{Shell Ratio} = \frac{\text{Average Shell weight (g)}}{\text{Average cocoon weight (g)}} \times 100$$

**Effective rearing rate:**

The effect of disease levels on silk worm rearing was determined by effective rearing rate (ERR). ERR was calculated using the following formula.

$$\textbf{ERR (no.)} = \frac{\text{Number of good cocoons harvested}}{\text{Number of silk worms reared}} \times 10{,}000$$

$$\textbf{ERR (wt.)} = \frac{\text{Weight of total cocoon harvested}}{\text{Number of silk warms reared}} \times 10{,}000$$

**Statistical analysis:**

The rearing data was tested statistically with one way ANOVA (Completely Randomized design) with DMRT to determine significant differences among different treatments.

**RESULTS AND DISCUSSION**

The experiment revealed that the quality of mulberry leaves has a predominating influence on the development of silk worm larvae and infection of powdery mildew adversely affected quality of cocoons. Larval duration was 22 days in control, while it was increased by two more days when disease infected leaves were used for feeding. It was also revealed that feeding of diseased leaves significantly reduced the silk worm rearing parameters (ERR wt., ERR no., larval weight, larval length, cocoon weight, shell weight and shell ratio) as a compared to control (Table-1). The reduction in quality and yield was proportional to the level of disease incidence as evident from Table-1. Infection of disease reduces leaf yield qualitatively and quantitatively (Quadri *et al*., 1999a & 1999b) and feeding of infected leaves to silkworm prolongs larval duration ( Noamani *et al* 1970, Umesh kumar *et al* 1993) .

Highest larval weight was recorded in control (3.03 g) and larval weight decreased with the level of infection in the mulberry leaves fed to the silkworms, while none of the silkworms survived till 5$^{th}$ instar when GradeV leaves were used for feeding. Average larval length was longest (7.33 cm) in the control. All other estimated parameters followed the same trend. Control recorded highest single cocoon weight (1.98 g), single shell weight (0.42 g), shell ratio percentage (21.15%), effective rate of rearing -wt (16.09 kg) and effective rate of rearing-no (9266.66). Correlation analysis showed that Single cocoon weight and single shell weight was positively correlated with larval weight with correlation coefficient of 0.936 and 0.927 respectively.

Feeding of powdery mildew affected leaves in the fifth instar worms resulted in 100 percent mortality. The stress condition created by feeding poor quality leaves might have predisposed the larva to diseases as these leaves lack antibacterial and antiviral substances. Present finding strengthen the earlier reports of Krishnaswami *et al.* (1973) who opined that feeding of unsuitable leaves was the major causative factors for flacherie and grasserie. This study highlights the need for feeding silk worms with disease free healthy mulberry leaves to optimize production levels for which proper disease management practices should be adopted by the farmers. Climatic factors like temperature, humidity and rainfall play a crucial role in development and spread of the diseases. Dutta *et al.,* (2013) developed a regression model to predict the incidence of Myrothecium leaf spot disease of mulberry in which the climatic factors have shown high correlation with disease development. Application of 0.1% Carbendazim (BAVISTIN) is recommended as management measure for Powdery mildew (*Phyllactinia corylea*). Considering the severity 2$^{nd}$ spray of fungicide (Carbendazim) is recommended after 15 days of first spray and safe period is considered as 8 – 10 days.

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**Table-1: Effect of feeding Silk worm larvae with powdery mildew infected leaves**

| Treatments | Healthy | Grade I | Grade II | Grade III | Grade IV | Grade V | CD at 1% level of significance | SEm± |
|---|---|---|---|---|---|---|---|---|
| Larval wt.(g) | 3.03[a] | 2.46[b] | 2.13[c] | 1.93[d] | 1.43[e] | 0.00 | 0.222 | 0.156 |
| Larval length (cm) | 7.33 [a] | 6.70 [b] | 6.16 [c] | 5.83 [d] | 5.40 [e] | 0.00 | 0.433 | 0.097 |
| Single cocoon wt.(g) | 1.98 [a] | 1.68 [b] | 1.16[c] | 0.94 [d] | 0.90 [e] | 0.00 | 0.184 | 0.041 |
| Single shell wt (g) | 0.42 [a] | 0.263 [b] | 0.177 [c] | 0.117[d] | 0.12[cd] | 0.00 | 0.081 | 0.018 |
| Shell ratio% | 21.15[a] | 15.58 [b] | 14.71 [b c] | 12.36[c] | 13.21 [b c] | 0.00 | 3.726 | 0.831 |
| ERR (wt.) kg | 16.09 [a] | 10.50 [b] | 8.21 [b] | 3.06 [c] | 0.90 [c] | 0.00 | 3.276 | 0.731 |
| ERR (no.) | 9266.66[a] | 6866.66[b] | 5266.66[c] | 3533.33[d] | 1400.00[e] | 0.00 | 876.184 | 0.000 |
| Mortality% | 4.66[a] | 26.66[b] | 39.33[c] | 59.33[d] | 82.00[e] | 100.00[f] | 3.718 | 0.861 |


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