Assessment of Chlorophyll Loss due to Infestation of Gall Mite in Bay Leaf

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ABSTRACT

The field experiment was conducted at Spices Research Centre, Shibganj, Bogura, Bangladesh during May, 2018 to analyse the percent loss of chlorophyll a and b induced by Aceria doctersi and to assess the damage potential of gall mite within the leaf galls of Cinnamomum tamala. The highest chlorophyll a (8.26 milligram/g) and chlorophyll b (2.31 milligram/g) content was recorded from control sample containing no gall tissue and the lowest chlorophyll a (2.20 milligram/g) and chlorophyll b (0.66 milligram/g) content was recorded from the sample containing ≥50 gall /1g leaf sample. Eriophyid mite galls were negatively correlated with chlorophyll a (r= -0.98245**) and chlorophyll b (r= -0.95525**) content of bay leaf.

Key Words: Assessment, Chlorophyll, Infestation, Gall mite and Bay leaf

INTRODUCTION

Bay leaf (Cinnamomum tamala) commonly known as Tejpata is an important aromatic spices crops in Bangladesh. It grows throughout Bangladesh but cultivated more in southern region as spices as well as for medicinal value. Since ancient time it was used as condiments, medicinal and culinary uses. The leaves give off a sweet aroma when broken and added to dishes. When slightly wilted and dried, they are strongly aromatic. It contains many notable derived compounds, minerals and vitamins that are essential for good health. Though bay leaf is a hardy
plant, is subjected to attack by a variety of insects, mites and microbes during its development. These insect pests are responsible for considerable reduction in yield of leaf. This tree is severely infested by a number of insect which produce gall in new leaves and thus damage the leaf. Most of the galls are caused by mites, aphids and their relatives, gall midges and gall wasps (Royer and Arnold, 1914). Eriophyid mites are the smallest phytophagous mites ranging in size from 0.15 to 0.3 mm. Most of them are host specific and induce varying abnormalities such as gall formation, russeting, stunted growth; witches broom effect, erineal formation, leaf/shoot defoliation etc. in host plants. Within host plants, seasonal changes in the morphology of plant parts, nutritional quality of plant tissues and mites limited dispersal from overwintering sites affect gall density (Burgess and Thompson, 1985). Cycles in insect populations are usually attributed to delayed density–dependent interactions between insects and their food, competitors, or natural enemies (Berryman, 1994)). A second potential source of population cycles that has received less attention is periodic fluctuations in biotic factors (Burroughs, 1992). If weather patterns are both cyclic and major determinants of insect population change, then weather can generate insect population cycles (Williams and Liebhold, 1997)). Aceria doctersi is an eriophyid mite which feeds exclusively on C. verum and C. tamala an important economic crop of multiple utility in medicine (Lu et al. 2012). The mite while sucking the sap from the leaves, inflorescence and tender stem of C. tamala, stimulates the formation of innumerable number of pouched galls of varying dimensions, covering the entire leaf, often resulting in severe distortion and subsequent drying up of leaves. An increasing degree of infestation with eriophyid mite galls progressively decreased photosynthetic performance in leaves of Prunus padus (Samson et al., 2012). Eriophyid mite infestation not only lead a decrease in chlorophyll a/b ratio and but also low levels of photosynthetic pigments (Agnese et al., 2005). Insect induced galled eucalptus leaves had significant reduction in chlorophyll ‘a’ and ‘b’ level as well as carotenoids observed as compared with the healthy one (Khattab and Ibrahim, 2005). Available scientific literature shows that not much information is available especially on A. doctersi in bay leaf. However, there are no reports of studies done in Bangladesh on loss of chlorophyll due to gall mite in Cinnamomum tamala. This study was therefore undertaken to analyse the percent loss of chlorophyll a and b induced by Aceria doctersi and to assess the damage potential of gall mite within the leaf galls of Cinnamomum tamala.

**Materials and Methods**

The study was conducted at Spices Research Centre, Shibganj, Bogura, Bangladesh (geographic coordinates 25.0167° N, 89.3167° E) during May, 2018 to analyse the percent loss of chlorophyll a and b induced by Aceria doctersi and to assess the damage potential of gall mite within the leaf galls of Cinnamomum tamala. BARI Tejpata-1 variety was used for the study. For this, two sets representing the experimental and control samples were selected. The experiment was carried out in May when the gall formation was found maximum in the field. For quantitative assessment of chlorophyll, 1 gram tissue each from the normal and galled leaves tissues bearing 10, 20, 30, 40, >50 galls, respectively were weighed out separately. Each sample cut into small pieces and then ground into a fine pulp in a clean mortar with the addition of 10 ml of 80% acetone (Nasareen and Ramani, 2014). The pulp prepared of each sample was then centrifuged individually at 5000 rpm for 5 minutes and the supernatant was transferred separately to volumetric flasks and made up to 100 ml with 80% acetone. The procedure was repeated until the residue became colorless. The absorbance of each solution was measured at 645 nm and 663 nm against the solvent blank in a UV-VIS spectrophotometer.
The amount of chlorophyll ‘a’/ gram tissue was calculated based on the following formula Ekanayaka and Adeleke, 1996:

Milligram chlorophyll ‘a’/ gram tissue = 20.2 (A 645) (50/1000) (100/5) (1/2)

and

Milligram chlorophyll ‘b’/ gram tissue = 8.02 (A 663) (50/1000) (100/5) (1/2)

Where A= Absorbance at specific wavelength.

The experiment was repeated 5 times with the normal and control samples for the confirmation of results.

Data on chlorophyll a (Milligram/g) and chlorophyll b (Milligram/g) were recorded. Percent loss of chlorophyll a and chlorophyll b content of bay leaf were calculated from chlorophyll a (Milligram/g) and chlorophyll b (Milligram/g) over control sample, respectively. The recorded data were analyzed and mean values were adjusted and separated by Duncan’s Multiple Range Test (DMRT) according to Gomez and Gomez (1984). Percent chlorophyll a and chlorophyll b reduction over control was calculated using following formula of Dutta et al. (2014).

Percent thrips population reduction over untreated control

\[
\text{Percent reduction} = \frac{\text{Mean value of control} - \text{Mean value of the treatments}}{\text{Mean value of control}} \times 100
\]

RESULTS AND DISCUSSION

Quantitative difference in chlorophyll content and percent loss in chlorophyll of bay leaf

Quantitative difference in chlorophyll content and percent loss in chlorophyll of bay leaf are presented in Table 1. The data obtained on chlorophyll estimation showed a marked reduction in both ‘a’ and ‘b’ contents due to the feeding activity of the mite. The highest chlorophyll a (8.26 milligram/g) and chlorophyll b (2.31 milligram/g) content was recorded from control sample containing no gall tissue and the lowest chlorophyll a (2.20 milligram/g) and chlorophyll b (0.66 milligram/g) content was recorded from the sample containing more than 50 gall /1g leaf sample. As shown in Table 1, a decrease in the % loss of chlorophyll ‘a’ content of leaf tissue bearing 10 numbers of galled leaf samples was 6.54/g tissue and that of leaves with 20 galls was 30.02/g tissue. The percent loss in chlorophyll ‘a’ content of the leaves bearing 30 numbers of galls was 42.62%, where as that of leaves with 40 numbers of galls was 71.07%/g. Leaf samples bearing more than 50 numbers of galls showed up to 73.37% loss of chlorophyll ‘a’ content. This very clearly indicates that the mite drastically affects the photosynthetic activity of the plant, in turn leading to a reduction of biomass, as reported earlier by Sahadev et al. (2009) and proved that the mite affects the growth of P. pinnata.

Similarly, the chlorophyll ‘b’ content also was found decreased with increasing number of galls on leaves. As shown in the Table 1 and the % loss of chlorophyll ‘b’ content leaves bearing 10 numbers of galls was 35.06/g tissue while as that in leaves with 20 numbers of galls was 39.83/g tissue. Thus percent loss of chlorophyll ‘b’ content induced by A. doctersi on leaves with 30 and 40 number of gall/leaf tissue was 48.05% and 61.90%, respectively. A remarkable loss in chlorophyll ‘b’ content could be recorded in leaves with more than 50 galls (71.43%). Another study Weis et al (1988) reported that the leaf Galls would reduce the
photosynthesizing area of the plant and also act as nutrient sinks for providing resources to gall formers. Further, Samson et al. (2012) reported that an increasing degree of infestation with eriophyid mite galls progressively decreased photosynthetic performance in leaves of *Prunus padus*. Eriophyid mite infestation not only lead a decrease in chlorophyll a/b ratio but also low levels of photosynthetic pigments (Agnese et al., 2005). Khattab and Ibrahim (2005) reported that insect induced galled eucalptus leaves had significant reduction in chlorophyll ’a’ and ‘b’ level as wells as carotenoids observed as compared with the healthy one.

Table 1: Quantitative difference in chlorophyll content and percent loss in chlorophyll of bay leaf

<table>
<thead>
<tr>
<th>Samples</th>
<th>Chlorophyll a (Milligram/g)</th>
<th>Chlorophyll b (Milligram/g)</th>
<th>% loss of chlorophyll a</th>
<th>% loss of chlorophyll b</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 gall/1g leaf</td>
<td>7.72a</td>
<td>1.50b</td>
<td>6.54</td>
<td>35.06</td>
</tr>
<tr>
<td>20 gall/1g leaf</td>
<td>5.78b</td>
<td>1.39b</td>
<td>30.02</td>
<td>39.83</td>
</tr>
<tr>
<td>30 gall/1g leaf</td>
<td>4.74c</td>
<td>1.20c</td>
<td>42.62</td>
<td>48.05</td>
</tr>
<tr>
<td>40 gall/1g leaf</td>
<td>2.39d</td>
<td>0.88d</td>
<td>71.07</td>
<td>61.90</td>
</tr>
<tr>
<td>≥50 gall/1g leaf</td>
<td>2.20d</td>
<td>0.66e</td>
<td>73.37</td>
<td>71.43</td>
</tr>
<tr>
<td>Control (no gall)</td>
<td>8.26a</td>
<td>2.31a</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CV (%)</td>
<td>7.30</td>
<td>3.08</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Level of sigf.</td>
<td>**</td>
<td>**</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Data represent mean of three observations, Mean followed by the same letter (s) in the same column did not differ significantly from each other at 1% level by DMRT.

**Relationship between number of eriophyid mite galls and chlorophyll content of leaf**

Relationship between number of eriophyid mite galls and chlorophyll a content of leaf is presented in Figure 1. There was negative correlation between number of eriophyid mite galls and chlorophyll a content of leaf. The regression equation was $y = 61.984 - 7.1375x$ and the correlation coefficient was $r = -0.98245**$. The figure indicated that Chlorophyll a content was decrease with the increased of eriophid gall. Samson et al (2012) reported that an increasing degree of infestation with eriophyid mite galls progressively decreased photosynthetic performance in leaves of *Prunus padus*.

![Figure 1: Relationship between number of eriophyid mite galls and chlorophyll a content of leaf](image_url)
Relationship between number of eriophyid mite galls and chlorophyll b content of leaf is presented in Figure 2. There was negative correlation between number of eriophyid mite galls and chlorophyll b content of leaf. The regression equation was \( y = 66.032 - 31.007x \) and the correlation coefficient was \( r = -0.95525^{**} \). The figure indicated that Chlorophyll b content was decrease with the increased of eriophid gall.

**Figure 2:** Relationship between number of eriophyid mite galls and chlorophyll b content of leaf

**CONCLUSION**

From the study, it may be concluded that the highest chlorophyll a (8.26 milligram/g) and chlorophyll b (2.31 milligram/g) content was recorded from control sample containing no gall tissue and the lowest chlorophyll a (2.20 milligram/g) and chlorophyll b (0.66 milligram/g) content was recorded from the sample containing more than 50 gall /1g leaf sample. Number of eriophyid mite galls is negatively correlated with chlorophyll a and chlorophyll b content of bay leaf.

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