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Determination of Chlorophyll and Carotenoid Loss in *Dalbergia sissoo* caused by *Aonidiella orientalis* (Newstead) [Homoptera: Coccoidea: Diaspididae]

Haresh Kumar, Shashank Sharma

ABSTRACT

Aonidiella orientalis is a worldwide pest of fruits, commercial and ornamental plants and removes phloem sap, resulted in the reduction of chlorophyll content. Quantification of Chlorophyll and Carotenoid loss caused by the above insect feeding on *Dalbergia sissoo* is of vital importance. The chlorophyll and carotenoid contents of uninfested and infested leaves of guava by using 118-spectrophotometer was found to be reduced by 31 and 35% respectively.

Keywords: *Aonidiella orientalis*, Carotenoid, Chlorophyll, *Dalbergia sissoo.*

1. Introduction

Aonidiella orientalis (Newstead) is a common armored scale insect which infests on fruit plants, commercial and ornamental trees and plants all over the world. It sucks the plant juice and feeding sites are usually associated with discoloration, depressions and other host tissue distortion. Increasing evidence indicates that under certain conditions, plants can compensate for the adverse effects of herbivores through changes in physiological features. Numerous brown-yellow spots on the infested leaves that can affect leaf physiology are noticed. Reduction of chlorophyll due to herbivore populations may negatively affect the photosynthetic capacity of plants. Photosynthetic pigments are essential for plant development. Quantifying these pigments in great extensions of agricultural crops is an important objective in remote sensing for agricultural purposes. This information can be used to produce a more accurate estimation of the physiological state of the vegetation, species discrimination and productivity estimation.

The objective of the present study is to find out the reduction of total chlorophyll as well as carotenoid content in uninfected and infested guava leaves.

2. Materials and Methods

The study was conducted in the Department Of chemistry, St Johns College, Agra in February 2008. During the present investigation, uninfected and infested guava leaves were plucked from different trees of Etmadpur Region of Agra .Six plant samples were taken. Uninfected and infested leaves were taken from the same branch of each tree. These leaves were collected carefully, kept in polythene bags and brought to the laboratory for the analysis. These leaves were carefully washed with tap water to eliminate the adhering soil and other contaminants and the extraction processes were carried out.

3. Extraction Processes

40 mg of fresh leaves were taken in 10 ml of 80% (v/v) acetone and kept it in refrigerator for 4-5 days. After 5 days the supernatant was collected & the intensity of colour was measured at 480, 510 and 652 nm on UV-VIS 118 spectrophotometer. The amount of chlorophylls as mg/l was calculated by using the following formulae ------

Total Chlorophyll
= (O.D. at 652 nm) * 1000/34.5

Carotenoids
=7.6*(O.D. at 480 nm)–1.49(O.D. at 510 nm)

The amount of total Chlorophyll and carotenoids was calculated according to the formulas of [1]. The formulas were showed above.

4. Results and Discussions

Chlorosis is the most obvious plant injury symptom on green leaves after scale feeding and is indicative of chlorophyll loss. Chlorosis is a condition in which leaves produce insufficient chlorophyll, turning them yellow. Such effect may be cleared by the significant reduction in total chlorophyll contents as well as carotenoids determined in the infested guava leaves (Table 1 & 2).

Table 1: Total Chlorophyll Contents of Uninfested and Infested Guava Leaves

Plant No.	Uninfected	Infected	df	% df
1	11.20	9.46	1.74	15.54
2	10.09	8.74	1.35	13.38
3	8.86	7.04	1.82	20.54
4	10.02	8.12	1.90	18.96
5	10.24	7.10	3.14	30.66
6	9.36	7.01	2.35	25.10
Average	**9.96**	**7.91**	**2.05**	**20.7**

Table 2: Carotenoid Contents of Uninfested and Infected Guava Leaves

Plant No.	Uninfected	Infected	df	% df
1	1.86	1.54	0.32	17.20
2	2.74	2.53	0.21	7.66
3	1.97	1.36	0.60	30.46
4	1.39	0.92	0.47	33.81
5	1.33	1.26	0.07	5.26
6	1.23	1.19	0.04	3.25
Average	**1.75**	**1.48**	**0.27**	**16.27**

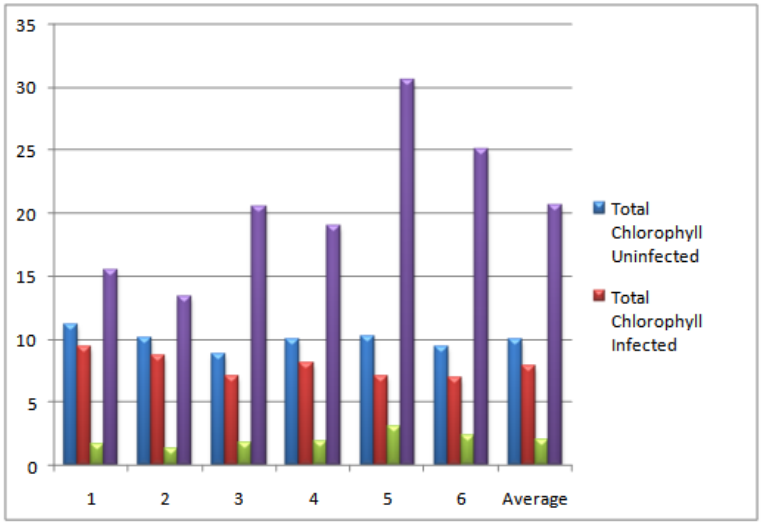

Fig 1: Total chlorophyll contents of uninfested and infested guava leaves.

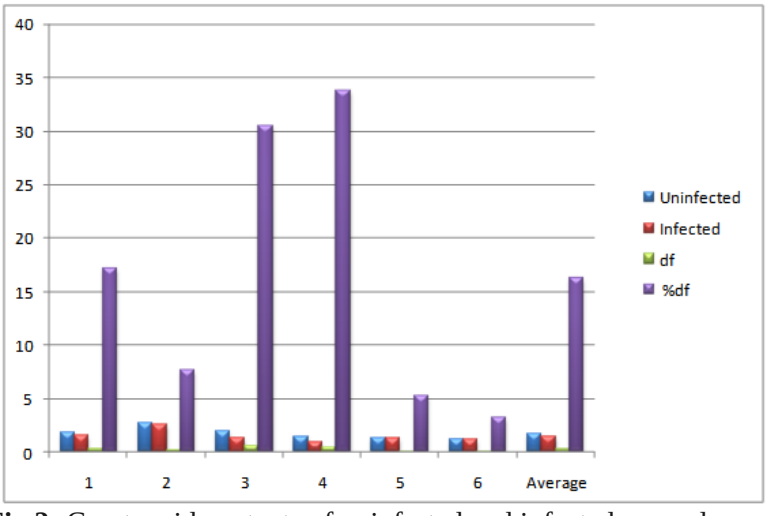

Fig 2: Carotenoid contents of uninfested and infected guava leaves.

Vechetal *et al*. (1992) [10] in their studies determined that carotene pigments were the most important photosynthetic pigments, and they prevented chlorophyll & thylakoid membrane from the damage of absorbed energy by photo-oxidation. The decrease in the photosynthetic pigments might be due to the inhibition of pigment biosynthesis which resulted from the alteration in mineral nutrition or lack of assimilates drain towards the insect or to the effect of reactive oxygen on these pigments. These results are in consonance with the findings of Stacey and Keen (1996). T.M. Heng Moss *et al* (2003) [7, 9] provided essential information on the effect of Russian wheat aphid, *Diuraphis noxia* feeding on chlorophyll and carotenoid concentrations for Betta wheat. The chlorotic symptoms were also observed on wheat plants infested by aphid (Heng-Moss *et al*; 2004, Wang *et al*. 2004) [11] which was interpreted to be due to unbalanced chlorophyll biosynthesis and degradation [11].

The phloem – feeding aphid continually controls and/or modifies the metabolic substances levels of the surrounding tissues. It was reported that strong and persistent flow of host assimilates created by the continual removal of metabolites and breakdown of insoluble reserves by insects (Kattab, 2005). John Diaz-Montano *et al.* (2007) [3, 4] explained that *Aphis glycines* removes phloem sap, which can result in a reduction of chlorophyll content. Hemmat Khattab (2007) [5] showed the defence mechanism of cabbage plant against phloem sucking aphid. The levels of antioxidant compounds (like carotenoids) were changed in response to aphid feeding.

In our study, the difference in chlorophyll as well as carotenoid content between uninfested and infested leaves have been significantly found out. The reduction percentage (% df) of chlorophyll and carotenoid contents were found up to 31% and 35%, respectively. In addition, the average loss in chlorophyll and carotenoid content between uninfested and infested leaves were up to 13% and 16%, respectively. Chlorophyll and carotenoid % reduced with the insect damage, if damage is more there will be more depletion of chlorophyll content, similarly, the carotenoid content.

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