# Assessment of chlorophyll loss due to infestation by Aceria pongamiae Kiefer 1966 (Acari: Eriophyidae) on Pongamia pinnata (L.)

# P.N.M. Nasareen, Niravath Ramani

#### Division of Acarology, Department of Zoology, University of Calicut, 673635, Kerala, Email: nazreenpnm@hotmail.com

### ABSTRACT

Aceria pongamiae is a highly host specific eriophyid mite, producing varying number of finger like galls on *Pongamia pinnata*. *P. pinnata* is well known for its use in traditional system of medicine for the treatment of varied human diseases like bronchitis, whooping cough, rheumatism, diarrhea, gonorrhea, leprosy and even tumors. Feeding of *A. pongamiae* on *P. pinnata* results in the formation of innumerable number of finger like galls on the leaves, thereby adversely affecting the quality of the leaves as well as economic utility of the plant for the preparation of Ayurvedic medicines. The present study deals with the quantitative level of damage estimation by making a comparative assessment of chlorophyll content of the normal vs. galled leaves of *P. pinnata*. The amount of chlorophyll 'a' and 'b' present in the experimental and control samples was estimated separately by adding 80% of acetone, following Ekanayaka and Adeleke, 1996 method. Data obtained on chlorophyll analysis were analysed statistically. A decrease in the amount of both 'a' and 'b' pigments was observed with increasing number of galls. The percent loss of total chlorophyll 'a' and 'b' a result of mite infestation ranged from 47.36% to 94% for chlorophyll 'a' and 26.35% to 89.9% for chlorophyll 'b'. The results were found significant at 5% level, thereby establishing the potential of *A. pongamiae* in damaging the leaf tissue of *P. pinnata* through chlorophyll depletion and subsequent drying.

Keywords: Aceria pongamiae, Pongamia pinnata, galls, chlorophyll depletion

# **INTRODUCTION**

Eriophyid mites represent an exclusively phytophagous group with vermiform body (1), (2) exhibiting high host specificity (1), (3),(4) inducing diverse forms of abnormalities like galls, blisters, erinea, big buds, leaf rolling, stem and foliar deformation, silvering and bronzing of leaves etc. on their respective host plants (5). *Aceria pongamiae* is an eriophyid species which feeds exclusively on *P. pinnata*. Historically, *P. Pongamia* has been used as folk medicinal plant, particularly in Ayurvedic and sidda systems of Indian medicine and (6) for the treatment of varied human diseases like bronchitis, whooping cough , rheumatism , diarrhea, dyspepsia, gonorrhoea, leprosy and even tumours. Recent recognition of the importance of the seeds of this plant as a source for bio-fuel production (7) extends the economic utility of the plant to industrial purposes as well. The continuous feeding of *A. pongamiae* on the leaves of this plant leads to the production of number of elongate finger like/pouched galls of varying dimensions on both surfaces of the leaves. Quite often individual galls become fused to form complex, irregular, massive structures, covering

the entire laminar area including the midrib, veins and vein lets. This in several occasions results in severe distortion and subsequent drying up of leaves.

Considering the economic utility of the plant and the severity of mite infestation, the present study was undertaken to analyse the percent loss of chlorophyll a and b induced by *A. pongamiae* so as to assess the damage potential of mite.

## **MATERIALS AND METHODS**

The present study was carried out in the Calicut University campus which formed the principal collection site in the Malappuram district of Kerala. The intensity and rate of damage induced by *A. pongamiae* on its host plant, *P. pinnata* were assessed through estimation of chlorophyll contents of leaf samples. 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, >60 galls respectively were weighed out separately and the leaf area was measured graphically. Each samples cut in to small pieces and then ground in to a fine pulp in a clean mortar with the addition of 10 ml of 80% acetone. The pulp prepared of each sample was then centrifuged individually at 5000rpm for 5 minutes and the supernatant was transferred separately to volumetric flasks and made up to 100ml with 80% acetone. The procedure was repeated until the residue became colorless. The absorbance of each solution was measured at 645nm and 663nm 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 (8):

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. Photographs of leaf samples were taken by an Olympus Digital Camera. Morphological details of the mite were studied by taking scanning electron micrograph (HITACHI SU6600-FESEM). The data obtained on chlorophyll loss were tabulated and presented graphically through pie diagrams.

## **RESULTS AND DISCUSSION**

Mite infested leaves of *P. pinnata* appeared highly distorted, bearing finger like galls developed both on the abaxial and adaxial surfaces (Figure 1). Results of quantitative analysis through comparative estimation of chlorophyll 'a' and 'b' pigments present in the normal healthy (Figure 2) and galled leaves provided substantial evidence to establish the damage potential of *A. pongamiae* on its host plant, *P. pinnata*. The data obtained on chlorophyll estimation (Table 1) showed a marked reduction in both 'a' and 'b' contents due to the feeding activity of the mite. As shown in table 1, a decrease in the % loss of chlorophyll 'a' content of leaves with 20 galls was 51/gm tissue. The percent loss in chlorophyll 'a' content of the leaves bearing 30 numbers of galls was 73.60%, where as that of leaves with 40 numbers of galls was 84.6%/gm. Leaf samples bearing more than 60numbers of galls (Figure 4) showed up to 94% 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 (9) and proved that the mite affects the growth of *P. pinnata*.

Exp. Sample No.	Total No. of galls	Area of Leaf/gm.	Chlorophyll a Milligram/gm	Chlorophyll b Milligram/gm	% Loss of chlorophyll a	% Loss of chlorophyll b
1	10	46.98	5	2.93	47.36	26.35
2	20	45	4.65	2.71	51.00	31.90
3	30	24.5	2.51	1.63	73.60	59.00
4	40	5.3	1.46	0.97	84.60	75.60
5	>60	3.28	0.57	0.4	94.00	89.90
Mean					70.11	56.55

Table 1. Quantitative difference in chlorophyll content and % loss in chlorophyll of *P.pinnata* leaves (mg/gm tissue) due to feeding by *A. pongamiae*.

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 26.35/gm tissue while as that in leaves with 20 numbers of galls was 31.90/gm tissue. Thus percent loss of chlorophyll 'b' content induced by A. pongamiae on leaves with 30 and 40 number of gall/leaf tissue was 59% and 75.60% respectively. A remarkable loss in chlorophyll 'b' (in %) content could be recorded in leaves with more than 60 gall (89.9%). Another study (3) 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, an increasing degree of infestation with eriophyid mite galls progressively decreased photosynthetic performance in leaves of prunus padus (10). Eriophyid mite infestation not only lead a decrease in chlorophyll a/b ratio and but also low levels of photosynthetic pigments (11). 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 (12). The mean percent loss of chlorophyll 'a' and 'b' contents could be recorded as 70.11% and 56.55% respectively as represented in Figure 5 and 6. Studies also revealed that presence of galls reduced not only the photosynthetic rate of infested leaves, but also the photosynthesis of neighbouring ungalled leaves on the shoot (13). When analysed statistically through "t" test were proved significant at 5% level.



Figure 1. Elongated finger like galls covering the entire leaf of Pongamia pinnata.

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Figure 2. Control sample.



Figure 3 Exp. Sample 1 With 10 galls.



Figure 4. Exp. Sample 4 with >60 galls.



Figure 5. Average quantitative loss in chlorophyll a due to infestation by A. pongamiae on P. pinnata.

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Figure 6. Average quantitative loss in chlorophyll b due to infestation by A. pongamiae on P. pinnata.

In the present study it is observed that galls often fused to form complex, irregular massive structure which very commonly showed drying symptoms. This is a clear indication that galled leaves suffer heavy chlorophyll loss; thereby the photosynthetic machinery would also get affected drastically. This in turn would lead to subsequent drying and defoliation and loss of biomass. Being a plant of varied economic utility, this mite infestation should be considered seriously as it causes heavy loss in biomass. The results of quantitative analysis of damage potential showed heavy loss of chlorophyll from the leaf tissue of *P. pinnata* owing to gall formation. The chlorophyll 'a' and 'b' contents of the leaves got decreased with increasing number of galls.

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