Journal of Entomology

ISSN 1812-5670

Academic Journals Inc.

www.academicjournals.com

Journal of Entomology 10 (2): 110-114, 2013
ISSN 1812-5670 / DOI: 10.3923/je.2013.110.114

Relationship Between *Kilifia acuminata* (Signoret) and Chlorophyll Percentage Loss on Mango Leaves

H.A. Nabil
Plant Protection Research Institute, ARC, Dokki, Egypt

ABSTRACT

Feeding injury caused by mango shield scale, *Kilifia acuminata* (Signoret) (Hemiptera: Coccidae) reduced leaves chlorophyll content significantly between infested and uninfested leaves. Quantification of chlorophyll loss caused by *K. acuminata* feeding on mango leaves is vital importance for photosensitize and later on crop yield. The uninfested leaves had higher levels of chlorophyll in comparison with infested ones. The study was conducted in Plant Protection Research Institute, ARC, Egypt from April to June 2012 on mango shield scale, *K. acuminata* to calculate chlorophyll percentage loss on mango leaves variety Shmama. Simple correlation and partial regression were done between numbers of insect and chlorophyll loss percentage in infested and uninfested unites (inch^2). Positive highly significant effect was recorded between numbers of insect and percentage of chlorophyll loss. Chi-square (χ^2) was used to calculate economic threshold and economic injury levels for *K. acuminata* that causes economically damage in disk chlorophyll content. Economic threshold and economic injury levels were 3 and 8 individuals per disk, respectively.

Key words: Insect, *Kilifia acuminata*, chlorophyll percentage loss, mango, economic threshold level, economic injury level

INTRODUCTION

Soft scale insects (Hemiptera: Coccidae) are one of the largest families of scale insects classified together with armored scales and mealybugs. There are one thousand species distributed all over the world and these comprise one hundred genera (Hamon and Williams, 1984). Soft scale insects occur all over the world in all geographic regions (Ben-Dov, 1993). In Egypt Soft scale insects comprise about 23 species included 10 genera (Abd-Rabou, 2003). Scale insects can be done their damage sucking the plant sap that give low photosynthesis and respiration which leads to curling, yellowing, dropping to leaves, so malformations, dwarfing and decreasing fruit production (quality and quantity) (Moffit, 1999).

Kilifia acuminata (Signoret) (Hemiptera: Coccidae) considered as one of the most important soft scale insects in Egypt. It attacks mango, *Mangifera indica* L., *Psidium guajava* L., *Pyrus communis* L., *Citrus* spp. and other hosts of fruit trees and ornamental plants (Ezzat and Hussein, 1967; Hamon and Williams, 1984; El-Dash, 1997; El-Dash *et al*., 2002; Soliman *et al*., 2007). According to its economic importance in Egypt especially on mango trees, the present study was aimed to determine the concentrations of photosynthetic pigment (chlorophyll a and b) in uninfested and infested mango leaves to calculate economic threshold and economic injury levels for *K. acuminata* on mango leaves. Economic threshold and economic injury level numbers were very important numbers because between those chemical control must be took place.

Few studies have been conducted to assess the effect of feeding insects on chlorophyll levels such as aphids (Golawska *et al*., 2010). Whoever, till now no similar studies have been conducted to assess the effect of feeding by *K. acuminata* on chlorophyll levels, this research represents an initial effort to characterize the effect of *K. acuminata* on chlorophyll a and b loss in mango leaves.

MATERIALS AND METHODS

Insects and plant materials: Studies were carried out on mango leaves, *Mangifera indica* L. (Varity Shmama) to determine the loss of chlorophyll content in mango leaves by infestation with *K. acuminata*.

The study was carried out from April to June 2012, in an area of about one feddan of mango variety Shmama. For sampling, mature leaves were picked up randomly and put in black polyethylene bags and transferred into the laboratory (Plant Protection Research Institute, Sharkia Branch). The leaves were divided into disks (inch^2) were examined in the same day by the aid of stereomicroscope. The adult females of *K. acuminata* were counted and recorded.

Chlorophyll determination: The chlorophyll content average (chlorophyll a and chlorophyll b) in 50 disks (inch^2) of mango leaves for every level of infestation and uninfested disks as control was extract and determine spectrophotometrically according to Moran (1982) as following:

The immersion leaflet disks in 5 mL of N, N-Dimethylformamide at least 48 hrs. Concentration of chlorophyll a and b were determined spectrophotometrically from absorbance at 647 and 664 nm, respectively. The pigment concentrations were calculated using the following equations:

$$\text{Chlorophyll a (mg/inch}^2\text{)} = 12.64\times E664 - 2.99\times E647$$

$$\text{Chlorophyll b (mg/inch}^2\text{)} = 23.26\times E647 - 5.6\times E664$$

$$\text{Total chlorophyll (mg/inch}^2\text{)} = \text{Chlorophyll a} + \text{Chlorophyll b}$$

Chlorophyll loss percentages were calculated by using the following equations:

$$\text{Chlorophyll loss (\%)} = \frac{\text{Chlorophyll loss per disk (mg/square inch)}}{\text{Chlorophyll content in uninfested disk (control)}}$$

Statistical analysis: Simple correlation (r) between number of insects per disk and percentage of chlorophyll loss was studied using COSTAT (2005).

According to Hendy (1969), Hosny *et al*. (1972), Little and Hills (1972), Salem and Zaki (1985) and Hassan (1998), the partial regression formula "C-multipliers" independent variance (X) represented the scale insects per disk, the dependent variance (Y) represented percentage of chlorophyll loss per disk. Simple correlation (r) and simple regression (b) were calculated. The slope (b) of the straight regression line was carried out to obtain the corrected values for the percentage of chlorophyll loss.

Chi-square (χ^2) was used to calculate economic threshold and economic injury levels for *K. acuminata* that causes economically damage in disk chlorophyll content.

RESULTS AND DISCUSSION

Data given in Table 1 revealed that percentage of chlorophyll content loss per unit was declined significantly with increasing of insect numbers. Scale infestation significantly reduced the level of chlorophyll a and b of the disks the reduction average from 6.41 to 62.24% as the infestation occurred from 1 to 30 insects per disk, respectively.

There was positive highly significant difference between number of insects per disk and percentage of chlorophyll loss where (r) value was 0.967**.

Simple correlation and partial regression and chi square were used to calculate economic threshold and economic injury levels, Chi-square analysis was applied for mathematic determination of the point at which the increase of insect number caused a significant effect on chlorophyll loss percentage. Results revealed that economic threshold and economic injury levels were 3 and 8 insects per disk, respectively.

Results showed that there was positive highly significant between number of females and percentage of chlorophyll loss. This result was agreed with Fanizza *et al.* (1991) who reported a drop in chlorophyll content under a different stress treatment. Leaves of stressed plants apparently synthesized less chlorophyll pigment. Other studies also show that responses differ. Rafi *et al.* (1996) found that *Diuraphis noxia* (Mordvilko) (Hemiptera: Aphididae) reduced chlorophyll levels in resistant cereals. Heng-Moss *et al.* (2003) reported that total chlorophyll and carotenoid concentrations differed among Betta wheat isolines in response to *D. noxia* feeding. Infested Betta-Dn2 plants had higher levels of chlorophylls and carotenoids than uninfested plants, but infested Betta-Dn1 plants had the same chlorophyll and carotenoid levels as uninfested plants.

Burd and Elliott (1996) found a significant decline in chlorophyll concentration in infested leaf tissue of *D. noxia* susceptible wheat and barley, whereas total chlorophyll concentration was not significantly affected by *D. noxia* in resistant wheat or barley. Golawska *et al.* (2010), determined the chlorophyll a and b levels in uninfested leaves and in leaves after 7 and 17 days of aphid infestation in four Fabaceae species (*Pisum sativum* L., *Vicia faba* L., *Trifolium pretense* L., *Medicago sativa* L.). Feeding by pea aphids *Acyrthosiphon pisum* Harris (Hemiptera: Aphididae) caused significant loss of chlorophyll a and b in the infested plants. Uninfested leaves on both short and long-infestation plants had significantly higher chlorophyll a and b than infested leaves. In this study the amount of chlorophyll differed between infested and uninfested mango leaves. The chlorophyll a+b concentration in uninfested leaves was significantly higher than infested ones.

Table 1: Numbers of insect, *Kilifia acuminata* (Signoret) and percentage of chlorophyll loss on mango leaves per disk and chi square values

No. of females /inch^2(X)	Chlorophyll content (mg/inch^2)	Chlorophyll loss (mg/inch^2) (Y)	% Chlorophyll loss (Yob)	Calculated (YEx) %	(YEx-YOb)^2 YEx	$\Sigma\chi^2$
1	4.09	0.28	6.41	15.54	5.360	5.360
2	3.71	0.66	15.10	17.37	0.300	5.660
3	3.36	1.01	23.11	19.20	0.800	6.460
8	2.91	1.46	33.41	28.35	0.900	7.360
14	2.42	1.95	44.62	39.33	0.710	8.070
20	2.18	2.19	50.11	50.31	0.001	8.071
21	2.03	2.34	53.55	52.14	0.040	8.111
23	1.83	2.54	58.12	55.80	0.100	8.211
30	1.65	2.72	62.24	68.61	0.590	8.801
Control	4.37					

r = 0.967**, Y = 13.71 +1.83 x, YOb: Observed values of chlorophyll percentage loss, YEx: Expected values of chlorophyll percentage loss

Overall results indicated that economic threshold and economic injury levels were 3 and 8 insects per square inch, respectively. Hassan (1998) also reported that economic threshold and economic injury levels for olive parlatoria scale, *Parlatoria oleae* (Colvée) on olive trees in Egypt were 8.5 and 12.06 individuals/twig.

CONCLUSION

There was positive highly significant difference between number of insects per disk and percentage of chlorophyll loss. Simple correlation and partial regression and chi square were used to calculate economic threshold and economic injury levels. Chi-square analysis was applied for mathematic determination of the point at which the increase of insect number caused a significant effect on chlorophyll loss percentage. Results revealed that economic threshold and economic injury levels were 3 and 8 insects/inch^2, respectively.

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