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Biochemical aspects of interaction between jasmine and blister mite, *Aceria jasmini* Chan

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ABSTRACT

The Jasmine blister mite, *Aceria jasmini* Chan. is a serious eriophyid mite infesting jasmine commercially grown in many parts of South India. Due to feeding by this mite results in formation of blister like erineal patches on the jasmine leaves. Irregular patches of cottony white erineal mats seen both on adaxial and abaxial surface of the leaves supports hundred of white coloured worm- like mites. Biochemical investigations carried out in the susceptible Long and Pointed Budded variety revealed that there was non-significant increase in moisture content, decrease in chlorophyll, total sugars, reducing sugars, significant increase in total free amino acids, phenols, crude protein content and peroxidase activity. Among the nutrients tested, nitrogen, phosphorus and potassium contents increased, while non-significant decrease in calcium and magnesium, whereas significant decrease in iron, manganese, copper and zinc were noticed due to mite feeding.

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INTRODUCTION

Jasminum auriculatum Vahl. commonly known as "Mullai" in Tamil Nadu is commercially cultivated in many parts of South India. This ornamental crop is highly prone to attack by blister mite, *Aceria jasmini* Chan. causing an appreciable economic loss in terms of flower production. In jasmine, this mite produces blister like irregular patches of cottony white erineal mats on both surfaces of the leaves. The entire plant is affected by this mite and thereby adversely affect the normal growth and vigour of the bushes. Even though this mite can be controlled by chemical methods, there is a need to explore the possibility of developing resistance varieties. In evaluating the mechanisms of resistance to mites it has been proved by many workers that the nutritional and physiological changes induced by mite feeding are important factors to be considered (Rajagopal *et al*., 1970). Therefore, the present studies were conducted to verify the possible effects of feeding by this mite on

the biochemical and nutrient composition of jasmine leaves.

MATERIAL AND METHODS

Studies were conducted at the Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore during 2011- 2012. Ten random samples of the healthy and mite infested leaf samples were collected from *Jasminum auriculatum* Vahl. (Long and Pointed Budded variety) grown in the Department of Floriculture, Tamil Nadu Agricultural University, Coimbatore.

The initial weight of the samples were recorded and then dried in a hot air oven at 105^0C until a constant weight was obtained and expressed as percentage of moisture content. In the fresh samples chlorophyll a, chlorophyll b and total chlorophyll contents were estimated following the method suggested by Yoshida *et al.* (1971) and expressed in mg g^{-1} fresh weight. Total sugar content was determined by anthrone method (Hegde and Hofreiter, 1962) and expressed in percentage. Reducing sugar was determined following Somogyi (1952) method and expressed in percentage. Total free amino acid was determined following Moore and Stein (1948) method and expressed as mg/g of sample. The method described by Malik and Singh (1980) was followed for the estimation of phenols and expressed as mg /100 g of material. The IAA oxidase activity was estimated following the method described by Gordon and Weber (1951) and expressed as µg of unoxidised auxin g^{-1} hr^{-1}. The method described by (Putter, 1974) was followed for estimation of peroxidase activity and expressed as change in optical density.

The samples were dried in a hot air oven at 60°C, powdered in a Willy Mill and utilized for further analysis. The dried samples were subjected to analysis of macro, secondary micro nutrients and crude protein content. Nitrogen content in the leaf sample was estimated by micro-kjeldahl method as per the procedure given by Bremner (1965). This was expressed as percentage on dry weight basis. Total phosphorus content was estimated by triple acid digestion extract using photoelectric colorimeter with blue filter as described by Jackson (1973). The phosphorus content was determined by referring to a standard curve and computed value was expressed in percentage. Total potassium in the leaf sample was estimated from triple acid extract using flame photometer (Jackson, 1973) and the content was expressed in percentage. Protein content was calculated by multiplying the N content (Humphries, 1956) of leaves with the factor 6.25. Micronutrients *viz*., iron, manganese, copper and zinc were estimated from the triacid extracts using the Atomic Absorption Spectrophotmeter. Percentage analysis and paired 't' test were applied to analyse the data (Gomez and Gomez, 1994).

RESULTS AND DISCUSSION

The moisture content of mite infested jasmine leaves was 34.3 per cent on the basis of leaf weight while the healthy leaves recorded 32.3 per cent. Infested leaves contained 6.7 per cent higher moisture content than healthy leaves which was statistically non- significant. There was significant difference in total chlorophyll content between healthy and mite affected leaves. In the healthy leaves it was 1.74 mg/g, while it was 0.75 mg/g only in mite affected leaves, resulting in a decrease of 56.9 per cent. Chlorophyll a and b of mite infested leaves were 0.51 mg/g and 0.24 mg/g of leaf samples, whereas healthy leaves contained 1.17 mg/g and 0.57 mg/g of chlorophyll a and b, respectively. There was significant reduction of 56.7 per cent and 57.4 per cent of chlorophyll a and b, respectively in the mite infested jasmine leaves (Table 1) compared to healthy leaves. The results are in accordance with the studies by Samsone *et al.* (2012) on *Prunus padus* L. damaged by *Eriophyes padi* Nalepa, wherein, decrease in the

Table 1 : Moisture content, chlorophyll a, b and total chlorophyll content of healthy and *Aceria jasmini* infested jasmine leaves

Particulars	Moisture content (%)	Chlorophyll a (mg g^{-1})	Chlorophyll b (mg g^{-1})	Total chlorophyll (mg g^{-1})
Healthy leaves	32.3	1.17	0.57	1.74
Infested leaves	34.3	0.51	0.24	0.75
% increase (or) decrease	+6.7	- 56.7	- 57.4	- 56.9
S.E. $\pm$	1.70	0.05	0.02	0.05
't' value	1.27^{NS}	13.29*	14.94*	18.81*

* indicates significance of value at P=0.05 NS=Non-significant

chlorophyll content was associated with decreased photochemical efficiency.

Total and reducing sugars showed a decrease in mite infested jasmine leaves. Total sugars in healthy and infested jasmine leaves were 2.28 per cent and 1.85 per cent while reducing sugars were 1.49 per cent and 1.07 per cent, respectively. Reducing sugars were found to be depleted more (28.2 % reduction) in mite infested leaves in relation to the total sugars (18.9 % reduction) (Table 2). A faster breakdown of the sugars serves as

Table 2 : Total sugars and reducing sugars content of healthy and *Aceria jasmini* infested jasmine leaves

Particulars	Total sugars (%)	Reducing sugars (%)
Healthy leaves	2.28	1.49
Infested leaves	1.85	1.07
% increase (or) decrease	-18.9	- 28.2
S.E. ±	0.06	0.05
't' value	6.88*	8.22*

* indicates significance of value at P=0.05

Table 3 : Total free amino acid, phenols and crude protein content of healthy and *Aceria jasmini* infested jasmine leaves

Particulars	Total free amino acid (µg/g)	Phenols (mg $100g^{-1}$)	Crude protein (%)
Healthy leaves	154	505.60	6.625
Affected leaves	235	639.11	10.062
% increase (or) decrease	+52.6	+26.4	+51.9
S.E. ±	9.86	18.10	0.90
't' value	8.22*	7.38*	3.80*

* indicates significance of value at P=0.05

Table 4 : Peroxidase and IAA oxidase activity of healthy and *Aceria jasmini* infested jasmine leaves

Particulars	Peroxidase (ΔOD min^{-1} g^{-1})	IAA oxidase (µg of unoxidised auxin g^{-1} hr^{-1})
Healthy leaves	0.779	0.161
Infested leaves	1.006	0.160
% increase (or) decrease	+29.1	-0.6
S.E. ±	0.044	0.004
't' value	5.05*	0.24^{NS}

* indicates significance of value at P=0.05 NS = Non-significant

Table 5 : Macro nutrient content of healthy and *Aceria jasmini* infested jasmine leaves

Particulars	Total nitrogen (%)	Total phosphorus (%)	Total potassium (%)
Healthy leaves	1.06	0.06	2.17
Infested leaves	1.61	0.08	2.63
% increase (or) decrease	+51.9	+36.6	+21.0
S.E. ±	0.15	0.01	0.13
't' value	3.80*	3.66*	3.58*

* indicates significance of value at P=0.05

Table 6 : Secondary nutrient content of healthy and *Aceria jasmini* infested jasmine leaves

Particulars	Calcium (%)	Magnesium (%)
Healthy leaves	0.42	0.12
Infested leaves	0.40	0.10
% increase (or) decrease	-4.8	-20.0
S.E. ±	0.01	0.01
't' value	1.36^{NS}	1.65^{NS}

NS =Non-significant

Table 7 : Micro nutrient content of healthy and *Aceria jasmini* infested jasmine leaves

Particulars	Iron (ppm)	Manganese (ppm)	Copper (ppm)	Zinc (ppm)
Healthy leaves	47.5	11.2	6.7	1.30
Infested leaves	6.9	5.9	4.6	0.65
% increase (or) decrease	-85.5	-47.3	-31.3	-50.0
S.E. $\pm$	1.99	0.60	0.41	0.08
't' value	20.34*	8.78*	5.10*	8.40*

* indicates significance of value at P=0.05

substrate for the increased respiration or conversion into organic acids which lead to the synthesis of amino acids and phenols. Similar trend was observed by Palanisamy (1984) in brinjal affected by *Tetranychus urticae* Koch. There was significant increase in the total free amino acid (52.6 %), phenols (26.4 %) and crude protein content (51.9 %) of the mite infested leaves. The total free amino acid content of healthy leaves and mite infested leaves were 154µg/g and 235µg/g of the sample, respectively. Phenol content in healthy leaves was 505.60 mg/100g as against 639.11 mg/100g in mite infested leaves. Crude protein contents of healthy and infested leaves were 6.63 and 10.06 per cent, respectively (Table 3).

Reduction in sugar contents, accumulation of free amino acids are the other physiological disorders associated with water stress caused by mite feeding (De Angelis *et al*., 1982). The peroxidase activity measured in terms of change in OD/min/g leaf was 0.779 in healthy sample and 1.006 in mite infested sample (Table 4). IAA oxidase measured in terms of unoxidised auxin/g/hr was 0.161 and 0.160 in healthy and mite infested leaves. Enzyme analysis of mite infested jasmine leaves revealed significant increase in peroxidase activity (29.1 %) due to mite feeding whereas no significant change in IAA oxidase activity was recorded. Spence *et al.* (2007) found that the incidence of *T. urticae* on cotton increased the peroxidase activity in mite damaged plants.

Nutrient analysis of mite infested jasmine leaves showed an increase in the major nutrients and non significant decrease in secondary and micronutrients when compared to healthy leaves. Total nitrogen, phosphorus and potassium contents in healthy leaves were 1.06 per cent, 0.06 per cent and 2.173 per cent, respectively as against 1.61 per cent total nitrogen, 0.082 per cent total phosphorus and 2.630 per cent total potassium in mite infested leaves. There was significant increase in the nitrogen (51.9 %), phosphorus (36.6 %) and potassium (21.0 %) contents in infested leaves (Table 5).

Secondary nutrients *viz*., calcium and magnesium were 0.40 and 0.096 per cent in mite infested leaves and 0.42 per cent and 0.12 per cent in healthy leaves, respectively, recording a marginal decrease of 4.8 and 20.0 per cent in infested leaves which were non-significant (Table 6).

The micronutrient content *viz.*, iron, manganese, copper and zinc were significantly reduced to the tune of 85.5, 47.3, 31.3 and 50.0 per cent, respectively in mite infested leaves when compared to healthy leaves. Iron content was 47.50 ppm in healthy and 6.90 ppm in mite infested leaves. Manganese content was 11.20 ppm in healthy and 5.90 ppm in mite infested leaves. Copper content was 6.70 ppm in healthy and 4.60 ppm in mite infested leaves. Zinc content was 1.30 ppm in healthy and 0.65 ppm in mite infested leaves (Table 7).

These findings agree with Sithanantham *et al*. (1975) who observed increased percentage of nitrogen, phosphorus and potassium in sugarcane leaf sheath affected by *Aceria sacchari* Chan. than healthy leaf sheath and also depletion of secondary nutrients calcium and magnesium to a tune of 18.2 per cent and 75.0 per cent,, respectively in mite affected leaf sheath.

Ghosal and Barman (2012) observed a similar trend in the depletion of micronutrients in guava affected by *Tetranychus pernicis*; depletion of iron and zinc in ribbed gourd due to *Tetranychus ludeni* (Chatterjee and Gupta, 1997); iron and zinc in pineapple affected by *Dolichotetrancyhus floridanus* (Das, 1987).

It is evident from the present studies that the changes in biochemical composition of jasmine leaves due to mite feeding suggest their role in defense mechanism against herbivory. The role of oxidative enzyme activity and changes in the nutrient content in causing phtyotoxaemia require in- depth studies on the mite-host relationship that paves way to overcome the deficiencies caused by mite feeding.

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