Rec. zool. Surv. India : **105** (Part 1–2) : 127-132, 2005

DEPLETION OF ORGANIC COMPOUNDS IN THE LEAVES OF BANI (*AVICENNIA ABLA* BLUME), GUAVA (*PSIDIUM GUAJAVA* LINN.), JUTE (*CORCHORUS CAPSULARIS* LINN.) AND PUMPKIN (*BENINCASA CERIFERA* SAVI) DUE TO FEEDING OF MITE

SANJIB GHOSHAL, S.K. GUPTA AND B. MUKHERJEE*

S. D. Marine Biological Research Institute, Sodepur, Kolkata-700 110, India

INTRODUCTION

Infestation of various pests including mites is known to cause depletion of organic compounds in plants leading to their physiological and morphological changes (Hervert & Butler, 1973; Golek, 1975; Shree and Nataraja, 1993). Since nothing is known as to what extent the feeding of different species of mites influence changes in the biochemical components of leaves of bani, guava, jute and pumpkin, it was thought desirable to undertake a preliminary study on this aspect and the results thereof are presented in this paper.

MATERIALS AND METHODS

Heavily infested leaves as well as uninfested healthy leaves of bani (*Avicennia alba* Blume), guava (*Psidium guajava* Linn.), jute (*Corchorus capsularis* Linn.) and pumpkin (*Benincasa cerifera* Savi) were collected from field at Bamankhali, Sagar Island, South 24-Paraganas (S) district of West Bengal and tested separately for estimating depletion or increase of organic components like chlorophyll, total protein, total carbohydrate and total phenol.

The estimation of chlorophyll was done following Arnon (1949). Total carbohydrate was estimated using Anthrone reagent. Phenol was estimated following Spies (1955) while the estimation of total protein was done by the method suggested by Lowry and Folin (1951). The entire study was made during August, 2000 to July, 2003. All experiments were repeated five times. The results thus obtained were subjected to statistical calculation and given in Table 1.

**Department of Pharmaceutical Technology, Jadavpur University, India*

RESULTS AND DISCUSSION

As per Table 1, a marked depletion in percentage content of organic compounds was recorded excepting in case of total phenol, where percentage increase was recorded. The percentage of depletion in case of chlorophyll, total protein and total carbohydrate contents were 3.25 ± 0.33, 16.28 ± 0.41 and 9.44 ± 0.84 respectively in case of Bani, 20.25 ± 0.22, 30.25 ± 0.59 and 26.00 ± 0.28, in case of guave, 13.45 ± 0.17, 42.0 ± 0.25 and 56.22 ± 0.93, in case of jute and 52.55 ± 1.03, 28.36 ± 0.98 and 40.54 ± 0.84 respectively in case of pumpkin. But in case of phenol, the percentage increase wes 1.12 ± 0.26 in case of bani, 0.75 ± 0.06 in case of guava, 8.20 ± 0.27 in case of jute and 4.36 ± 0.67 in case of pumpkin.

Table 1. : Increase or decrease of organic compounds in the leaves of different plants due to mite feeding.

Name of organic components	Control (Average amount ± SD) [n = 5]	Infested (Average amount ± SD) [n = 5]	Percentage of decrease or increase (Average amount ± SD) [n = 5]
In case of Bani (*Avicennia alba*) infested with *Schizotetranychus hindustanicus*			
Chlorophyll	9.00 ± 0.47 mg/gm	8.70 ± 0.59 mg/gm	3.25 ± 0.33 (d)
Total Protein	78.00 ± 1.25 µg/gm	65.30 ± 0.98 µg/gm	16.28 ± 0.41 (d)
Phenol	0.436 ± 0.35 µg/gm	0.445 ± 0.49 µg/gm	1.12 ± 0.26 (i)
Total Carbohydrate	1.8 ± 0.68 mg/100 mg sample	1.63 ± 0.39 mg/100 mg sample	9.44 ± 0.84 (d)
In case of Guava (*Psidium guajava*) infested with *Eotetranychus hicoriae*			
Chlorophyll	3.20 ± 0.33 mg/gm	2.25 ± 0.02 mg/gm	20.25 ± 0.22 (d)
Total Protein	120.00 ± 2.36 µg/gm	83.70 ± 1.86 µg/gm	30.25 ± 0.59 (d)
Phenol	0.262 ± 0.21 µg/gm	0.290 ± 0.25 µg/gm	0.75 ± 0.06 (i)
Total Carbohydrate	2.50 ± 0.81 mg/100 mg sample	1.60 ± 0.67 mg/100 mg sample	26.00 ± 0.28 (d)
In case of Jute (*Corchorus capsularis*) infested with *Polyphagotarsonemus latus*			
Chlorophyll	5.6 ± 0.33 mg/gm	4.84 ± 0.89 mg/gm	13.45 ± 0.17 (d)
Total Protein	55.00 ± 0.08 µg/gm	31.90 ± 0.53 µg/gm	42.0 ± 0.25 (d)
Phenol	1.31 ± 0.61 µg/gm	1.40 ± 0.74 µg/gm	8.20 ± 0.27 (i)
Total Carbohydrate	4.50 ± 0.56 mg/100 mg sample	1.97 ± 0.37 mg/100 mg sample	56.22 ± 0.93 (d)
In case of Pumpkin (*Benincasa cerifera*) infested with *Tetranychus urticae*			
Chlorophyll	2.10 ± 0.16 mg/gm	0.99 ± 0.14 mg/gm	52.55 ± 1.03 (d)
Total Protein	85.00 ± 0.63 µg/gm	60.89 ± 0.89 µg/gm	28.36 ± 0.98 (d)
Phenol	0.124 ± 0.08 µg/gm	0.129 ± 0.02 µg/gm	4.36 ± 0.67 (i)
Total Carbohydrate	3.70 ± 0.68 mg/100 mg sample	2.20 ± 0.77 mg/100 mg sample	40.54 ± 0.84 (d)
(i) = Percentage increase, (d) = Percentage decrease, n = number of experiments.			

The decrease in chlorophyll level is due to mechanical damage of chloroplasts of leaves caused by mite feeding or it may be due to decolouration of chloroplasts. According to Tomezyk and Kropzynska (1985) the water stress induced by mite feeding may have an influence on chlorophyll metabolism of injured cells or may be due to cell disturbances and removal of chloroplasts. Kolodoziej *et. al.*, (1979) indicated positive correlation between increases in mite density with decrease of chlorophyll. Contrary to this, Poskuta *et. al.*, (1975) and Sances *et. al.*, (1979, 1982) indicated that damage to chlorophyll due to mite feeding was quite low even in high mite density. Chatterjee and Gupta (1997) reported chlorophyll damage to the extent of 33.62% on *Luffa acutangula* due to infestation of *Tetranychus ludeni* while Nangia *et. al.*, (1999) reported chlorophyll loss on different varieties of mulberry due to feeding of *Eotetranychus suginamensis* as 153.75% on MS variety, 185.00% in S-54 variety, 74.50% in Mysore local variety and 12.60% in RFS 175 variety. Goyal and Sadana (1983) reported chlorophyll loss as 63.12% mg/m^2 on *Coleus* sp. infested by *Brevipalpus obovatus* and Sumangala and Haq (1995) reported it as 47% over uninfested leaves in case of *Eichhornia crassipes* due to feeding of *Eutetranychus orientalis*. Therefore, in view of the above reports, the chlorophyll loss as was seen in the present case was low. Chlorophyll loss due to mite feeding was also reported by Van de Vrie *et. al.*, (1972) and Atanosov (1973).

In the present study, the increase in phenolic compounds was observed as 1.12 ± 0.26% in case of bani, 0.75 ± 0.06% in case of guava 8.20 ± 0.27% in case of jute and 4.36 ± 0.67% in case of pumpkin. Similar observation towards increase of phenolic compounds was also reported by Kielkiewiez (1981) and according to this author the increase was noticed in upper and lower epidermis after mite feeding though its reduction was observed in palisade parenchyma.

As regards total protein, the reduction was seem to be 16.28 ± 0.41% in case of bani, 30.25 ± 0.59% in case of guava, 42.0 ± 0.25% in case of jute and 28.36 ± 0.98% in case of pumpkin which were indeed very high. Similar observation was recorded by Nangia *et. al.*, (1999) where depletion varied from 57.50% in Mysore local variety of mulberry leaves to 38.80% in RFS-175 variety, due to feeding of *Eotetranychus suginamensis*. They attributed this depletion due to their breakdown by proteolytic enzymes secreted by mites and subsequent utilization of that by the concerned mite. Agarwal *et. al.* (1982), Zukova (1963), Goyal and Sadana (1983) also made similar observations *i.e.* reduction of protein due to feeding by different species of mites.

Regarding total carbohydrate, the percentage decrease was alarmingly high *i.e.*, 9.44 ± 0.84 in case of bani, 26.00 ± 0.28 in case of guava, 56.22 ± 0.93 in case of jute and 40.54 ± 0.84 in case of pumpkin. Similar observation was made by Nangia *et. al.* (1999) where the decrease was reported to be 12.30% in MS variety, 17.55% in S-54 variety, 19.10% in Mysore local variety and 12.70% in RFS-175 variety of mulberry due to feeding on *Eotetranychus suginamensis*. Usha *et. al.* (1999) reported changes in the level of total sugar, reducing sugar and non-reducing sugar due to mite infestation. Non-reducing sugar reduced significantly in plants infested by mites but reducing sugar content did not differ significantly between infested and uninfested leaves.

The changes of organic compounds of leaves because of mite feeding brought about changes in physiological functioning of leaves producing the characteristic damage symptoms on leaves in the form of yellowing and browning of leaves, curling and crinkling specially on young leaves, *etc.* All such leaves dried up, plants suffered defoliation and all these contributed towards reducing the yield.

SUMMARY

Due to feeding of *Schizotetranychus hindustanicus* (Hirst) on bani leaves (*Avicennia alba* Blume), *Eotetranychus hicoriae* Megregor on guava leaves (*Psidium guajava* Linn.), *Polyphagotarsonemus latus* (Banks) on jute leaves (*Corchorus capsularis* Linn.) and *Tetranychus urticae* Koch on pumpkin leaves (*Benincasa cerifera* Savi), biochemical changes with regard to organic compounds were observed which in case of chlorophyll, total protein and total carbohydrate contents among organic compounds were reduced by 3.25 ± 0.33, 16.28 ± 0.41 and 9.44 ± 0.84 respectively in case of Bani, 20.25 ± 0.22, 30.25 ± 0.59 and 26.00 ± 0.28, in case of guava, 13.45 ± 0.17, 42.0 ± 0.25 and 56.22 ± 0.93, in case of jute and 52.55 ± 1.03, 28.36 ± 0.98 and 40.54 ± 0.84 respectively in case of pumpkin. But in case of phenol, the mite feeding induced their increase by 1.12 ± 0.26 in case of bani, 0.75 ± 0.06 in case of guava, 8.20 ± 0.27 in case of jute and 4.36 ± 0.67 in case of pumpkin respectively.

ACKNOWLEDGEMENTS

The authors are thankful to the Ministry of Environment and Forests, Government of India for funding the research project and to Prof. Amalesh Choudhury, Secretary, S.D. Marine biological Research Institute for providing the laboratory facilities. The authors are also thankful to the authorities of Jadavpur University for extending help in analysis of organic components of leaves.

REFERENCES

Agarwal, M.L., Kumar, S., Goel, A.K. and Tayal, M.S. 1982. *Indian phytopathol*, **35** : 438-441.

Arnon, A. 1949. Analysis methods of total carbohydrate in plants. *Annul. Biochem.*, **3** : 41-57.

Atanasov, M. 1973. Physiological functions of plants as affected by damage caused by *Tetranychus atlanticus* McGregor, In : *Proc. 3rd int. Congr. Acarol, Prague*, : 183-186.

Chatterjee, Koel and Gupta, S.K. 1997. Depletion of mineral, inorganic and organic compounds in leaves of sponge gourd (*Luffa acutangula* Roxb) due to feeding of mite *Tetranychus ludeni*. *J. Ent. Res.*, **21**(3) : 233-235.

Golek, Z. 1975. A study of the destruction of the fruit tree red spider mite *Panonychus ulmi* (Koch) on apple. *Zesz. Probl.* Postepow. Nouk. Rola., **171** : 15-34.

Goyal, Meena and Sadana, G.L. 1983. Quantitative changes in some biochemical components of *Coleus* sp. in response to infestation by *Brevipalpus obovatus* (Tenuipalpidae : Acarina) and factors affecting its suitability as host. *Indian J. Acar.*, **8**(1) : 22-30.

Herbert, H.J. and Butler, K.P. 1973. Influence of two spotted spider mite population on photosynthesis of apple leaves. *J. Econ. Entomol.*, **105** : 263-269.

Kielkiewiez, M. 1981. Physiological, anatomical and cytological changes in leaves of two strawberry varieties (*Fragaria grandiflora* Duch) resulting from feeding by two spotted spider mite (*Tetranychus urticae* koch). *Dissertation, Agricultural University of Warsaw*, pp. 95.

Kolodziej, A., Krospezynska, D. and Postkuta, J. 1979. Comparative studies on carbon dioxide exchange rates of strawberry and chrysanthemum plants infested with *Tetranychus urticae* Koch. In : E. Piffl (Ed). *Proc. 4th int. Congr. Acarol. Saalfeden*, : 209-214.

Lowry, W. and Folin, J. 1951. Estimation of total protein. *Ann. Biochem.*, **14** : 15-32.

Nangia, N., Jagadish, P.S. and Nageschandra, B.K. 1999. Biochemical changes in different varities of mulberry infested by *Eotetranychus suginamensis. J. Acarol.*, **15** : 29-31.

Poskuta, J., K.olodziej, A. and Kropczynska, D. 1975. Photosynthesis, photo-respiration and respiration of strawberry plants as influenced by infestation with *Tetranychus urticae* (Koch). *Fruit Sci. Rep.*, **2** : 1-17.

Sances, F.V., Tosceno, N.C., Hoffinan, M.P., Lafre, L.F., Johnson, M.W. and Bailey, J.B. 1982. Physiological responses of avocado leaves to avocado brown mite feeding injury. *Environ. Ent.*, **11** : 516-518.

Sances, F.V., Wyman, J.A. and Ting, J.P. 1979. Physiological responses to spider mite infestation on strawberry. *Environ. Entomol.*, **8** : 711-714.

Shree, M.P. and Nataraja, S. 1993. Infectional biochemical and physiological changes in mulberry. *Curr Sci.*, **65** : 337-346.

Spies, J.R. 1955. In : *Methods of enzymology.* Colonick, S.P. and Kapan, N.P.O. (eds) **Vol. III** : 461-477.

Summangala, K. and Haq, M.A., 1995. Chlorophyll depletion in *Eichhornia crassipes* due to feeding and colonization by *Eutetranychus orientalis*, *Abst. V National Symp. Acarol. Bangalore*, : 40-41.

Tomezyk, A. and Kropzynska, D. 1985. Effect on the plant, their biology. Natural enemies and control. In : Spider mites, (Eds. W.B. Helle & W.M. Sabelis). *Elserer. Amasterdam.* : 317-329.

Usha, R.V., Mallik, B. and Kumar Harish. 1999. Biochemical changes in french bean plant grown under different water stress levels and their effect on population of *Tetranychus urticae* (Acari : Tetranychidae). *J. Acarol.*, **15** : 25-28.

Van de Vrie, M., McMurtry, J.A. and Huffaker, C.B. 1972. Ecology of tetranychid mites and their natural enemies. A review III. Biology, ecology and pest status and host plant relations of *Tetranychus. Hilgardia*, **41** : 343-432.

Zukova, V.P. 1963. Feeding mechanisms of the spider mite *Tetranychus telarias Tr. Nauchno-Iseleb. Inst. Zoshch. Rast. Uzb SSR.*, **6** : 13-18.