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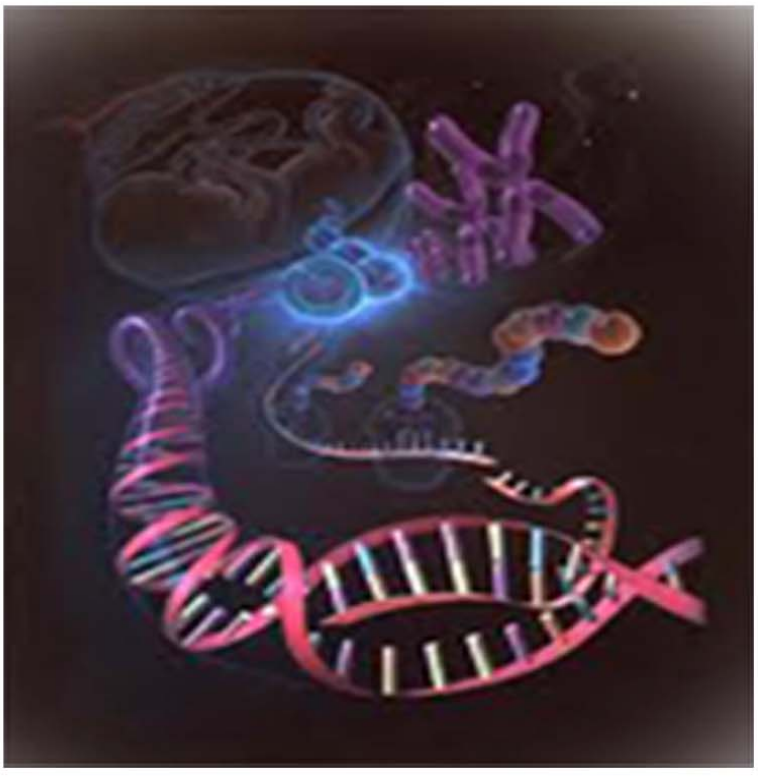

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Research Paper

POPULATION DYNAMICS AND BIOCHEMICAL FLUCTUATIONS IN RELATION TO THE INFESTATION OF *TETRANYCHUS NEOCALEDONICHUS* ANDRE ON THE LEAVES OF TULSI (*OCIMUM SANCTUM*)

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The present study showed that the significant depletion of important organic, minerals and inorganic compounds occurred due to mite infestation in the leaves of Tulsi. Among organic compounds, chlorophyll, total protein, phenol and total carbohydrates were selected for the study. Among minerals, Mg. Zn, Cu and Fe were selected and among inorganic materials nitrate and nitrite were selected for the study. It was found that amount of chlorophyll, total protein, total carbohydrate, Mg, Zn, Cu, Fe, nitrate and nitrite were reduced by 30.33, 25.62, 24.32, 21.32, 26.43, 25.22, 21.02, 15.32 and 19.98%, respectively. It was found that the amount of phenol increased by 32.02% due to mite feeding. It was found that maximum population of *Tetranychus neocaledonichus* was reported during May, when the average temperature, average relative humidity and average rainfall were 32.07^{O}C, 73.75% and 0.95 mm, respectively. The minimum population density was found during September, when the average temperature, average relative humidity and average rainfall were reported to be 28.55^{O}C, 84.76% and 12.64 mm, respectively.the correlation coefficient of the mite density was found to be positive with temperature while it is negative with relative humidity and rainfall.

Keywords: Mite infestation, Ocimum sanctum, Biochemical fluctuations, Organic compounds

INTRODUCTION

Mites are the most important and significant pests of crops causing serious yield losses. Insect pests have received sufficient attention in India, mites have remained neglected probably due to their microscopic size, even though they have the potentiality of causing extensive damage to the agricultural and horticultural crops.

A good number of plant mites are injurious pests of agricultural and horticultural crops causing considerable yield loss to the farmers. 27-39% on Tulsi due to *Polyphagotarsomenus latus;* 15-30% in red gram due to *Aceria cajani*; 5-11% on tea due to *Oligonychus caffeae*; 10-15% in vegetables due to spider mites; 20-25% in paddy due to *Oligonychus oryzae* and 20-30%

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in sugar cane due to *Oligonychus indicus*. The financial loss due to mite feeding in one instance may be as high as Rs 8616.63 per ha in case of brinjal (Gupta 2003). During the entire study period (November, 2009 to October, 2011) *Tetranychus neocaledonichus* was found to be one of the important dominant species on Tulsi plants throughout the year. Since very little or nothing is known as to what extent the feeding of this mite influences changes in the biochemical components of leaves of Tulsi, it was thought desirable to undertake a study on this aspect and the results thereof are as follows.

MATERIALS AND METHODS

Total carbohydrates was estimated using anthrone reagent following the method of Hedge *et al.* (1962). Phenol was estimated following the method of Spies (1955). The estimation of chlorophyll was done following the method of Arnon (1949). Before analysis, fresh uninfected leaves were collected to serve as control and those were processed separately for analysis. The control plants have to demite, by using a mild dose of malathion throughout the entire period of study.

Quantitative estimation of minerals like Mg, Cu, Zn, will be made by digesting the oven-dried samples in concentrated HNO_3. Before analysis, fresh uninfected healthy leaves (treated with acaricide) were collected to serve as control and those were processed separately for analysis.

Heavily infested leaves as well as uninfested healthy leaves of Tulsi were collected. Out of those leaves (both uninfested and infested), 20 g each of uninfested leaves and heavily infested leaves are subjected to oven drying for about 3 h at 45^0C for complete drying of leaves. Infestation status of the leaves can be easily concluded by the examination of damage symptoms, due to mite feeding, by hand lens.

The whole experiments were repeated five times. The results obtained during the study were subjected to statistical analysis for inference. For population dynamics, 10 Tulsi (*Ocimum sanctum*) plants were selected and tagged. On every occasion, leaves were plucked at monthly interval from those tagged plants only. From each plants, 10 leaves of about same age and size were plucked from all around the plants and population of phytophagous mites were counted (6.25 sq. cm area on each leaves). A 2.5 x 2.5 cm area was cut out from a card board and put on each of the leaf whatever mite population was seen. Thereafter, total 10 x 10 = 100 leaves were examined under stereo-binocular microscope in the field. Initially, whatever mites were encountered, were preserved in 70% ethyl alcohol and brought to the laboratory for species identifications. The data thus collected was subjected to statistical analysis to find out the influence of abiotic and biotic factors on population fluctuation of these mites.

RESULTS

It was found that the 30.33% decreasement occurred in case of amount to total chlorophyll (Table 1). In case of total protein, the control showed 28.04 ± 0.33 µg/g while the infested leaves showed 20.85 ± 0.73 µg/g of sample. Therefore, the percentage of depletion in case of total protein was recorded as 25.62. In case of phenol, the uninfested healthy leaves showed 5.63 ± 0.75 µg/g while infested leaves showed the value of 3.82 ± 0.86 µg/g. Therefore, the percentage of increase in case of phenol was 32.02.

In case of total carbohydrate content, the uninfested healthy leaves showed 21.23 ± 0.08

Table 1: Increase or Decrease of Organic Compounds in the Leaves Of Tulsi Leaves Due To Mite Feeding (10-20 mites per 6.25 sq.inch Leaf Area)

Name of Organic Components	Control (Amount ± SD) [n=5]	Infested (Amount ± SD) [n=5]	Percentage of decrease or increase (percentage ± SD) [n=5]
Chlorophyll	10.32 ± 0.12 mg/gm	7.18 ± 0.93 mg/gm	30.33 (d)
Total Protein	28.04 ± 0.33 μg/gm	20.85 ± 0.73 μg/gm	25.62 (d)
Total Carbohydrate	21.23 ± 0.08mg/100 mg sample	16.06 ± 0.89 mg/100 mg sample	24.32 (d)
Phenol	5.63 ± 0.75 μg/gm	3.82 ± 0.86 μg/gm	32.02 (i)

Note: (i) = Percentage increase, (d) = Percentage decrease,n = number of experiments

mg/100 mg sample while infested leaves showed 16.06 ± 0.89 mg/100 mg sample. Therefore, the percentage of decrease in case of total carbohydrate content in Tulsi leaves due to mite feeding was 24.32.

So far as the depletion of minerals is concern, marked depletion was observed. In case of magnesium (Mg) the uninfested healthy leaves showed 15.32 ± 0. 63 µg/ml while infested leaves showed the value of 12.05 ± 0.79 µg/ml. Therefore, the percentage of decrease in case of magnesium was 21.32 (Table 2).

In case of zinc (Zn), the uninfested healthy leaves showed 5.23 ± 0.44 µg/ml while infested leaves showed the value of 3.84 ± 0.29 µg / ml. Therefore, the percentage of decrease in case of zinc was 26.43. In case of copper (Cu), the uninfested healthy leaves showed 3.32 ± 0.36 µg/ml while infested leaves showed the value of 2.48 ± 0.43 µg/ml. Therefore, the percentage of decrease in case of copper was 25.22.

In case of iron, the uninfested healthy leaves showed 9.32 ± 0.39 µg/ml while infested leaves showed the value of 7.36 ± 0.63 µg/ml. Therefore, the percentage of decrease in case of iron was 21.02.

In case of nitrate compounds, the uninfested healthy leaves showed 4.32 ± 0.52 µg/g while infested leaves showed the value of 3.65 ± 0.29 µg/g. Therefore, the percentage of decrease in case of nitrate compounds was 15.32. In case of nitrite compounds, the uninfested healthy leaves showed 5.99 ± 0.53 µg/g while infested leaves showed the value of 4.79 ± 0.68 µg/g. Therefore, the percentage of decrease in case of nitrite compounds was 19.98.

In *Oscimum sanctum*, population of this mite was found in peak during May, of both the years (29.66 ± 0.19 mites / 6.25 sq. cm) when mean temperature (n=60), rh (n=60), rainfall (n=60) were 32.07 ± 1.00 ^{0}c, 73.75 ± 3.76 % and 0.95 ± 0.36 mm, respectively. The population started declining thereafter becoming minimum during September (of both the years), when mean temperature (n=60), rh (n=60), rainfall (n=60) were 28.55 ± 2.72 ^{0}c, 84.76 ± 3.39%, and 12.64 ± 5.32 mm, respectively.

Reasonable, good rain during July and August of both the years, probably acted adversely on the population of this mites. From September onwards, the population again started increasing, becoming fairly high during later months, (Table 3).

The correlation coefficients of the mite density with the temperature was positive, while, with

Table 2: Changes Of Minerals And Inorganic Components Of Tulsi Leaves Due To Mite Feeding. (10-20 mites per 6.25 sq. inch leaf area)

Name of the Minerals and Inorganic Components	Control (Amount ± SD)[n=5]	Infested (Amount ± SD) [n=5]	Percentage of decrease or increase(percentage ± SD) [n=5]
Mg (Magnesium)	15.32 ± 0.63 μg / ml	12.05 ± 0.79 μg / ml	21.32 (D)
Zn (Zinc)	5.23 ± 0.44 μg / ml	3.84 ± 0.29 μg / ml	26.43 (D)
Cu (Copper)	3.32 ± 0.36 μg / ml	2.48 ± 0.43 μg / ml	25.22 (D)
Fe (Iron)	9.32 ± 0.39μg / ml	7.36 ± 0.63 μg / ml	21.02 (D)
Nitrate	4.32 ± 0.52 μg/ gm	3.65 ± 0.29 μg /gm	15.32(D)
Nitrite	5.99 ± 0.53 μg / gm	4.79 ± 0.68 μg / gm	19.98 (D)

Note: (D)= Percentage decrease, n= Number of experiments.

Table 3: Population Dynamics of *Tetranychus neocaledonichus* on Tulsi plant per 6.25 cm² leaf area recorded form Nov. 2009 to Oct. 2011. Data are mean ± SD

Months	Average of Mite population (in 2 years)	Average Temp (^{0}C) 2 years	Average Humidity (%) (in two years)	Average Rainfall (mm) (in two years)
Nov	12.30 ± 0.12	26.31 ± 2.50	76.56 ± 4.72	0.81 ± 0.78
Dec	09.40 ± 0.03	22.90 ± 1.56	68.71 ± 5.85	0.2 ± 0.0
Jan	11.12 ± 0.09	20.42 ± 1.73	70.34 ± 4.69	0.24 ± 0.67
Feb	13.60 ± 0.63	21.73 ± 1.61	68.08 ± 4.82	0.1 ± 0.0
Mar	25.71 ± 0.67	28.79 ± 1.39	65.37 ± 3.01	0.02 ± 0.01
Apr	26.37 ± 0.52	29.66 ± 2.01	68.92 ± 3.70	1.07 ± 0.76
May	29.66 ± 0.19	32.07 ± 1.00	73.75 ± 3.76	0.95 ± 0.36
Jun	26.20 ± 0.43	30.01 ± 1.40	82.95 ± 2.45	0.35 ± 0.22
July	4.22 ± 0.03	30.68 ± 2.92	79.88 ± 5.46	16.08 ± 3.98
Aug	2.50 ± 0.76	29.23 ± 2.51	84.78 ± 3.09	17.91 ± 7.53
Sep	1.02 ± 0.32	28.55 ± 2.72	84.76 ± 3.39	12.64 ± 5.32
Oct	1.22 ± 0.72	26.29 ± 2.07	75.52 ± 6.28	4.77 ± 2.83

rainfall and relative humidity it was found to be negative but correlation with temperature and relative humidity was found to be non-significant, while it was significant with rainfall (Table 4).

Table 4: Correlation Between the Mite Density and Three Environmental Variables

	Temperature	Relative Humidity	Rainfall
mite population	0.209	-0.301	- 0.563 *

Note: * = significant, according to the J.P Guilford's product moment coefficient of correlation table.

DISCUSSION

Many early workers reported that infestation of mites caused various biochemical changes including changes in minerals, inorganic and organic compounds in plants leading to their physiological and morphological changes (Golek,1975 and Shree and Nataraja,1993).

The decrease in chlorophyll level is due to mechanical damage of chloroplasts of leaves caused by mite feeding or it may be due to decoloration of chloroplasts. Kolodoziej *et al.* (1979) indicated positive correlation between increases in mite density with decrease of chlorophyll. Chatterjee and Gupta (1997) reported chlorophyll damage to the extent of 33.62% on *Luffa acutangula* due to infestation of *Tetranychus ludeni*. In the present study, the increase in phenolic compounds was observed as 32.02%. Similar observation towards increase of phenolic compounds was also reported by Kielkiewiez (1981). Ghoshal, Gupta and Mukherjee (2005) reported increasement of phenol compounds as 8.20 ± 0.00% in case of jute (*Corchorus capsularis* Linn.) due to the infestation of mite *Polyphagotarsonemus latus* (Banks).

In case of total protein, the reduction was 25.62% which was less than the previous observations. Nangia *et al.* (1999) reported the 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*. Many early workers also made similar observations, i.e., reduction of protein due to feeding by different species of mites.

Regarding total carbohydrates, the decrease was alarmingly high, i.e., 24.32%. Usha *et. al.* (1999) reported reduction of total sugar content, in plants due to mite infestation.

In case of iron and zinc, the depletions were by 66.4% and 70% on *Luffa acutangula* due to feeding of *Tetranychus ludeni* (Chatterjee and Gupta, 1997) which were much higher as compared to the present observations.

In case of nitrate and nitrite, the percentage reductions were 15.32% and 19.98%, respectively as compared to 51.1% and 3.12% in case of *Luffa acutangula* by feeding of *Tetranychus ludeni* (Chatterjee and Gupta, 1997). Ghoshal, Gupta and Mukherjee [2005] reported depletion of nitrate and nitrite as 25.73 ± 0.00% and 19.35 ± 0.00%, respectively in case of jute (*Corchorus capsularis* Linn.) due to the infestation of mite *Polyphagotarsonemus latus* (Banks).

Since no study has been made on seasonal fluctuation of this phytophagous mites on *Ocimum sanctum* either in India or elsewhere, it is not possible to compare the present results with those published earlier. Some earlier workers reported that in case of *Raoiella indica* Hirst on coconut, population was positively correlated with temperature and negatively correlated with RH and rainfall (Nageschandra and Channa Basavanna, 1984) which is similar to the present study. However, Gupta *et al.* (1976) reported negative correlation with Temperature, positive correlation with RH and rainfall in case of *Tetranychus telarius* on castor. Kumari and Sadana (1995) reported peak population of *Brevipalpus phoenicis* on guava during November-December.

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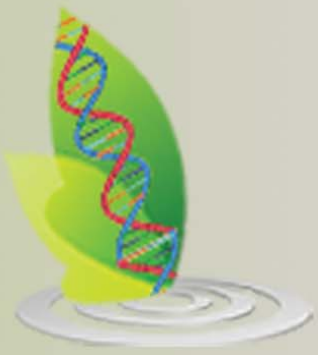
REFERENCES

1. Aron A (1949). "Analysis methods of total carbohydrate in plant", *Ann. Biochem.*, Vol. 3, pp. 41- 57.
2. 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., Vol.* 21, No. 3, pp. 233-235.
3. Ghoshal Sanjib, Gupta S K and Mukherjee B (2005), "Depletion of minerals, inorganic and organic compounds in the leaves of Jute, *Corchorus capsularis* Linn., due to infestation of the mite, *Polyphagotarsonemus latus* (Banks)", *Proc. Zool. Soc., Calcutta*, Vol. 58, No. 1, pp. 39-41.
4. Golek Z (1975). "A study of the destruction of the fruit tree red spider mite *Panonychus ulmi* (Koch) on apple", *Zesz, Probl. Postepow. Nauk. Rola*., Vol. 171, pp. 15-34.
5. Gupta S K (2003). "Mite pests of agricultural crops in India, their management and identification, In Yadav P R, Chauhan R, Putatunda B N, Chhillar B S (Eds.), *Mites, their identification and management,* pp. 48-61.
6. Gupta S K, Dhrooria M S and Sandhu A S (1976). "Seasonal abundance of *Tetranychus talarius* (Linn.) on castor in the Punjab", O*ilseeds Journal,* Vol. 6, pp. 16-18.
7. Hedge J E and Hofreiter B T (1962), In *Carbohydrate Chemistry* 17, Whistler R L and Miller J N, Academic Press New York, p. 28.
8. Kielkiewiez M (1981), "Physiological, anatomical and cytological changes in leaves of two strawberry varieties resulting from feeding by two spider mites. (Dissertation, Agricultural University of Warraw), p. 9522.
9. Kolodziej A, Krospczynska D and Postkuta J (1979), "Comparative studies on carbon di-oxide exchange rates of strawberry and chrysanthemum plants infested with *Tetranychus urticae* Koch", *Proc. 4th int. Congr. Acarol. Saalfeden,* pp. 209-214.
10. Kumari M and Sadana G L (1995), "Seasonal population of *Brevipalpus phoenicis* and *Amblyseius alstoniae* (Acari: Tenuipalpidae and Phytoseiidae) on *Psidium guajava*", *Journal of Acarology*, Vol. 13, pp. 55-62.
11. Nageshchandra B K and Channa Basavannna G P (1984), "Studies on seasonal fluctuation of the population of *Raoiella indica* Hirst (Acari: Tenuipalpidae) on coconut with reference to weather parameters", *Indian Journal of Acarology*, Vol. 8, pp. 104-111.
12. Nangia N, Jagadish P S and Nageschandra B K (1999), "Biochemical changes in different varieties of mulberry infested by *Eotetranychus suginamensis", J. Acarol.,* Vol. 15, pp. 29-31.
13. Shree M P and Nataraja S (1993),

"Infectional biochemical and physiological changes in mulberry", *Curr Sci.*, Vol. 65, pp. 337-346.

14. Spies J R (1955), In *Methods in Enzymology.* Colonick S P and Kapan N P O (Eds.), Vol. III, pp. 461-477.

15. 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.*, Vol. 15, pp. 25-28.



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