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Impact of *Raoiella indica* Hirst (Acari: Tenuipalpidae) Infestation on Nitrogen Concentration of *Areca catechu* L.

Prabheena P [a++*] and Ramani N [a#]

[a] Department of Zoology, The Zamorin's Guruvayurappan College, Kerala-673014, India.
[b] Division of Acarology, Department of Zoology, University of Calicut, Kerala-673635, India.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Different tenuipalpid phytophagous mites might infest the foliage and nuts of the areca palm and cause significant damage. *Raoiella indica* (Hirst), has been known as a serious pest of areca palm. In the present study, concentration has been fixed on exploring the feeding impact of *R. indica* through the quantitative estimation of nitrogen concentration of mite-infested and uninfested leaves by 'Kjeldahl method (1883)'. Results of the study have exposed that the feeding activity of the mite on the leaves of *A. catechu* has induced severe reduction in the levels of 'total nitrogen'. The percentage loss of 'total nitrogen' was estimated to be 37- 62% in RPM-infested Areca leaves. Loss of nitrogen content as evidenced during the present study disclosed the potential of *R. indica* on *A. catechu.*

[++] Assistant Professor;
[#] Former Professor;
**Corresponding author: Email: p.prabheena@gmail.com;*

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Keywords: Raoiella indica; areca catechu; tenuipalpidae; total nitrogen; kjeldahl method.

1. INTRODUCTION

'Red Palm Mite' (*Raoiella indica*) a member of the family Tenuipalpidae causes severe damage to a variety of economic crops like coconut (*Cocos nucifera*), arecanut (*Areca catechu*) and banana (*Musa* spp.) reported by Welbourn, [1], Sudheendrakumar et al. [2]. RPM feeds on the lower surface of the palm fronds of the family Arecaceae and Musaceae as discussed by Flechtmann and Etienne, [3]. "Palm tree, Arecanut is an important tropical commercial crop grown all over in South East Asia and it belongs to the Arecaceae family. Primarily it was cultivated in India, Bangladesh and China for its dried nut obtained from the fruit. India is the largest producer of arecanut. Some 90 species of pests are known to infest the stem, leaves, inflorescence, roots and nuts of the areca palm as reported by Puttarudraiah & Channabasavanna," [4]. "Of these, one of the important arthropod pests is *R. indica*. It is an important phytophagous pest of young palms, especially in dry weather" (Patel & Rao, [5]). A higher population density of RPM has been recorded on areca palm in April/May as reported by Yadavababu & Manjunatha, [6], Nagesha Chandra & Channabasavanna, [7]. This is the first mite species observed, feeding through the stomata of host plants reported by Ochoa et al. [8] and this specialized feeding habit, *R. indica* interferes with photosynthesis and respiratory processes of host plants. However, the damages caused by this species to most of its host plants have not yet been characterised. Considering this, the present work has been taken up to estimate the extent of loss of total nitrogen contents of infested and uninfested leaves of areca palms by RPM which cultivated in Kerala state, India. Nitrogen is a core component of many plant structures such as chlorophyll. Insufficient nitrogen and proteins lead to severe plant disorders. In the present study, an attempt has been made to estimate the loss in total nitrogen contents of the leaves of *A. catechu* as a result of feeding by the false spider mite, *R. indica*.

2. MATERIALS AND METHODS

Mite-infested leaves were collected randomly from areca plantations in the Malappuram district of Kerala state, where palms belonging six to seven years of age were cultivated in separate gardens from 10 various localities. The results were based on the analysis of 10 samples collected from 10 various localities during the period of two months, April and May 2015. "Samples were transported to the laboratory for subsequent microscopic observation under a Stereo Zoom Microscope (MVNSZ - 450) to record the presence of various life stages and damage symptoms of *R. indica"* [13].

"Qualitative and quantitative estimation of the damage induced by *R. Indica* on the leaves of *A. catechu* was performed by raising the species in the laboratory. Rearing of mites was carried out in the laboratory by placing live mites on leaf discs of 2.5 cm length X 2.5 cm width placed on moistened cotton pads kept in Petri dishes. Live specimens comprising 20–25 adults of *R. indica* were transferred to fresh uninfested leaves of *A. catechu"* [9]. Regular observations were carried out under a microscope to record the development of feeding symptoms on the leaf samples. After 2 - 3 weeks the decayed leaf discs were removed and analysis continued with fresh leaves.

"Qualitative analysis of feeding damage at different life stages of *R. indica* was made by observing the development of chlorotic and necrotic areas on the lower surface of the leaf lamina. Regular observations were made for 2 months (April–May) for confirmation of results. Quantitative analysis of feeding damage was made by estimating the loss of 'total nitrogen' contents in the leaf tissues of *A. catechu* infested by *R. indica* following the method of 'Kjeldahl (Rack) AOAC 984.13 (1883) method". [9] The percentage of nitrogen loss in the mite-infested leaves was calculated by comparing the total nitrogen value of infested and uninfested samples. Statistical analysis of the data on nitrogen loss was carried out by following the test to evaluate the significance (Statistical Package used: SPSS, ver-12).

3. RESULTS AND DISCUSSION

"Results of the field studies helped to recognize RPM infestation on the lower surface of the leaves of areca palm, near the midrib or veins. On Stereo-zoom microscopic observation, the infested leaves collected from the field disclosed the presence of a large number of yellow-coloured spots. Similar damage symptoms were found developed by this species on various palms" earlier as discussed by Beard et al. [10].

Feeding of a large number of different life stages of the mite resulted in the formation of yellow colour on leaf lamina (Figs. 1 & 2).

Later these feeding punctures were found coalesced to form light brown coloured areas (Fig. 3) leading to the ultimate drying up of the leaves. Symptoms of yellowish areas on the leaf lamina were obvious when the population of the mites were high on the plants. When subjected to quantitative analysis, such heavily infested leaf tissues showed a drastic reduction in nitrogen content (Table 1; Fig. 4).

As shown in Table 1 and Fig. 4, heavily infested leaves have 9.50 mg/gm of total nitrogen content. The per cent reduction of 'total nitrogen' in infested leaves could be recorded as 51.92±0.72% when compared to uninfested leaves and also the infested leaves disclosed 12.18±0.24 mg of total nitrogen/gm (Table1 & Fig.4.) when subjected to statistical analysis (the *t*-test at 0.05% of significant level- see Table 2). Earlier studies on *Coleus* owing to infestation by another species of tenuipalpid mite viz. *Brevipalpus obovatus* by Meena and Sadana [11] also could establish similar loss in

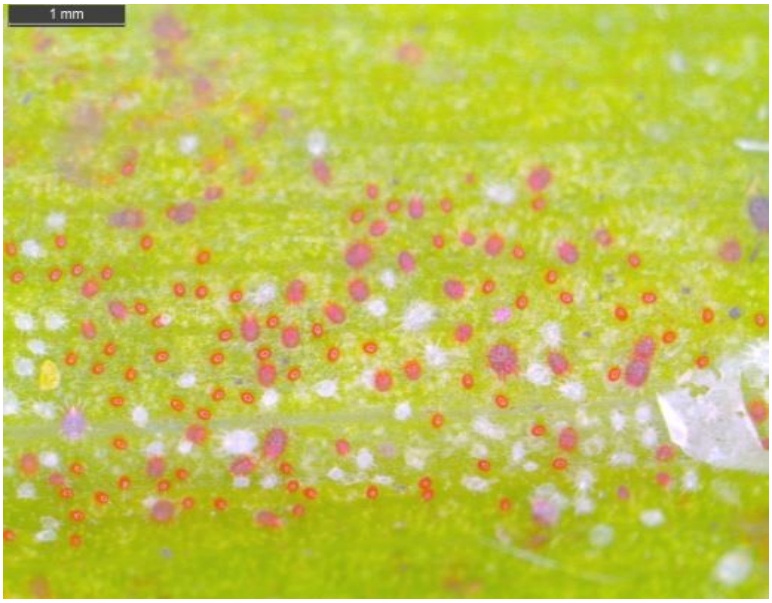

Fig. 1. *R. indica* colony on leaf lamina

Fig. 2. Yellow colouration on leaf due to infestation

chlorophyll contents. The feeding activity of *Tetranychus ludeni* on *Luffa acutangula* also was reported to induce loss of nitrate and nitrite to the tune of 21.20 and 37.68% respectively by Chatterjee and Gupta, [12]. Studies of *Schizotetranychus schizopus* by Vibija C.P. & Ramani Neravathu, [13] on bamboo leaves revealed that there was a 21.02 % reduction of total protein contents. The results of the present study support the earlier findings.

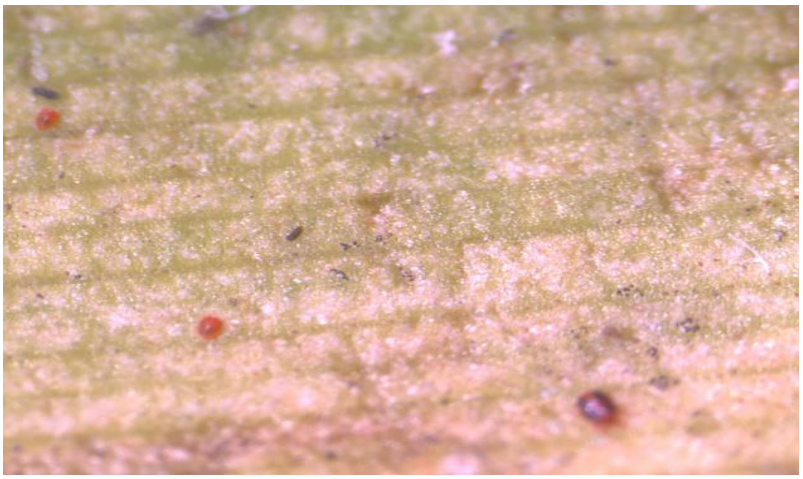

Fig. 3. Heavily infested leaf lamina

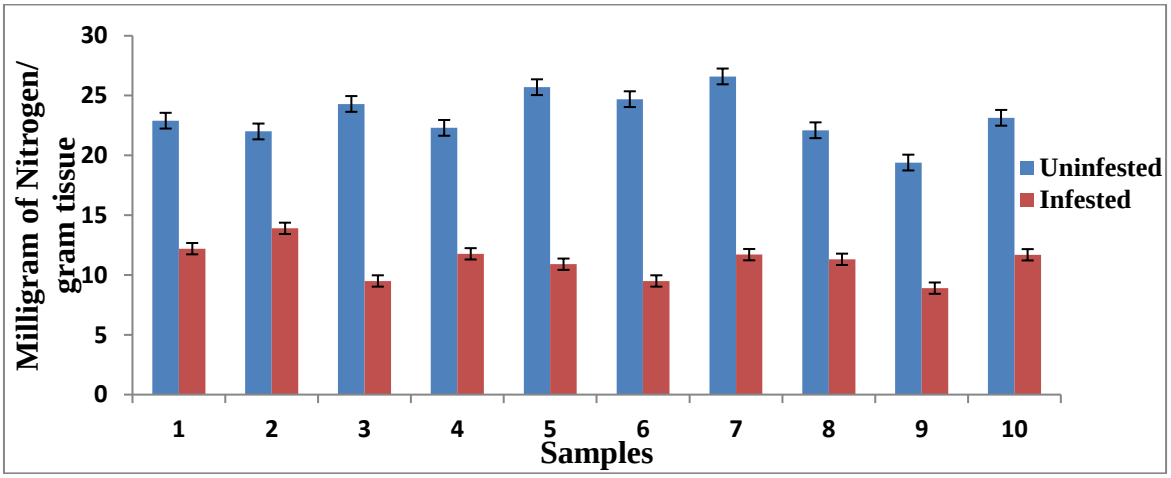

Fig. 4. Amount of Total nitrogen in *R. indica* infested and Uninfested *A. catechu* samples

Table 1. Quantitative loss in Nitrogen contents induced by the feeding activity of *R. indica* on *A. catechu*

S.No.	Milligram Nitrogen/gram tissue		Nitrogen loss in mg	% loss
	Uninfested	Infested		
1	22.90	12.20	10.70	46.72
2	22.00	13.90	8.10	36.82
3	24.30	9.50	14.80	60.91
4	22.30	11.77	10.53	47.22
5	25.70	10.90	14.80	57.59
6	24.70	9.50	15.20	61.54
7	26.60	11.70	14.90	56.02
8	22.10	11.31	10.79	48.82
9	19.40	8.90	10.50	54.12
10	23.14	11.69	11.45	49.48
Mean ± Sem	23.31± 0.20	11.14 ± 0.14	12.18 ± 0.24	51.92 ± 0.72

Table 2. Statistical analysis

		Levene's Test for Equality of Variances		t-test for Equality means						
		F	Sig	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the df	
									Lower	Upper
Nitrogen	Equal Variance assumed	.936	.346	14.993	18	.000	12.17700	.81221	10.470	13.883
	Equal Variance not assumed			14.993	16.344	.000	12.17700	.81221	10.458	13.896

4. CONCLUSION

Nitrogen is an important vital element needed for the survival of living species and it is a major component of amino acids, the building blocks of protein. A significant loss of total nitrogen as evidenced during the present study disclosed the potential of *R. indica* to affect adversely the general health, growth rate and biomass of the host plant, *A. catechu* and thereby leading to the reduction in every aspect of plant growth and development. This study forms the first work on *R.indica* associated with the areca plantations of Kerala. Even-though these mites cause severe damage to crop plants, studies on the *R .indica* are still in infant stage in India.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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