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# COCONUT RUGOSE SPIRALING WHITEFLY *ALEURODICUS RUGIOPERCULATUS* MARTIN NUTRIENT DEPLETION AND YIELD LOSS

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**ABSTRACT**

**The study was conducted to find out the yield limiting nutrients in coconut palms a result of infestation of invasive rugose spiraling whitefly *Aleurodicus rugioperculatus* Martin through understanding the relationship between the leaf nutrient status and yield. The nitrogen levels were negatively and highly significantly correlated with yield loss (%) in Godavari Ganga hybrid (r = - 0.997**) and East Coast Tall (ECT) palms (r = - 0.999**). The phosphorus (P), potassium (K), calcium (Ca), boron (B) and magnesium (Mg) were found to be ideal in the leaflets of hybrid and ECT palms, with optimum critical levels of P, K, Mg, B ranging from 0.12, 0.80, 0.25, 0.30% and 10 mg/ kg. It can be concluded that the impact of *A. rugioperculatus* incidence was noticed on nitrogen content of coconut leaflets and reflected in the form of nut yield reduction in Godavari Ganga hybrid and ECT coconut palms at Kalavalapalli plantations.**

**Key words:** *Aleurodicus rugioperculatus*, coconut, nutrient analysis, Godavari Ganga hybrid, East Coast Tall, nitrogen, yield loss,leaf nutrient status, phosphorus potassium, magnesium, boron

Coconut, *Cocos nucifera* L., (Arecaceae) regarded as "Tree of Life" or "Kalpavriksha" providing livelihood to billions of people (Ahuja et al., 2014). It is grown in 2.18 million ha in India, with a production of 21,206.74 million nuts and a productivity of 9,687 nuts/ ha (Bhagavan et al., 2021). In the present scenario of climatic change this valuable palm is devastated by incidence of several pests and diseases that not only deteriorate the quality of nuts but also reduced the vigour and yield of palms (Neeraja et al., 2020). In the recent times, coconut palms are damaged with invasion of many new invasive insect pests viz*.,* rugose spiraling whitefly (RSW) *Aleurodicus rugioperculatus* Martin has been reported from India in for the first time in Tamil Nadu (Sundararaj and Selvaraj, 2017) and Andhra Pradesh (Selvaraj et al., 2018). Its unique nature of egg laying in a typical spiral pattern can be identified. Adults and nymphs of the pest remain in spirals on the under surface of leaves and sucking the sap of the leaves leading to chlorosis, defoliation and stunted growth. The profuse white waxy secretion by *A. rugioperculatus* is readily spread by wind and honey dew excreted by these insects fall on the upper surface of the lower leaves which becomes a medium for developing "sooty mould" which reduces the productivity. This leads to deterioration in the nutritional quality of leaf and further nut yield reduction. It was reported that Godavari Ganga hybrid coconut palms infested with low, medium and high incidence of *A. rugioperculatus* resulted in nut dropping of 5.50, 28.11 and 36.01% at Kalavalapalli coconut plantations, whereas in case of local East Coast Tall (ECT) variety dropped nuts was 4.68, 23.49 and 30.58% (Kalavalapalli) (Raghuteja et al., 2023). Hence, a study was conducted to find out the primary yield limiting nutrient as a result of *A. rugioperculatus* infestations through understanding the relationship between the leaf nutrient status and coconut yield.

## MATERIALS AND METHODS

The nutrient analysis of healthy and variable infestation of *A. rugioperculatus*/ leaflet viz*.,* low (< 10 spirals/ leaflet), medium (10-20 spirals/ leaflet) and high (> 10 spirals/ leaflet) in Godavari Ganga hybrid (13 years old) and local East Coast Tall (ECT) variety (20 years) was undertaken at the ICAR - Indian Institute of Oil Palm Research (IIOPR), Pedavegi (16°81'02" N, 81°10'65" E) Eluru district, Andhra Pradesh. The middle three leaflets of both sides of the index leaf (14th

frond) (Selvamani and Duraisamai, 2018) of all sampled palms were collected from Kalavalapalli plantations (16°94'82" N, 81°63'98" E) and analysed for nutrient composition. The nutrient content was estimated in 10 leaflets of both healthy and infested leaflets under varied intensities. Total nitrogen (N) content in coconut leaf was determined by Kjeldahl's method as described by Humphries (1956). Total phosphorus (P) content in coconut leaf was determined by vanadomolybdate yellow colour method as described by Piper (1966) and Jackson (1973). The leaf potassium (K) content was estimated by flame photometry method as described by Stanford and English (1949). Total leaf calcium (Ca) content and magnesium (Mg) contents were estimated by versenate titration method as described by Diehl et al. (1950). The leaf boron content was estimated by azomethane H reagent method as described by Berger and Troug (1939). The leaf sulphur (S) content was estimated by turbidimetry method as described by Chaudry and Cornfield (1966). Data on number of harvested nuts/ palm was noted as and when harvesting was carried out in each of the five selected palms of Godavari Ganga hybrid and local ECT variety under varied intensities of *A. rugioperculatus* infested Kalavalapalli plantations. The observations were also obtained on nut yield/ palm for preceding three years (2018-20) from yield record registers maintained in the farmer's field as to compare the yield and to calculate the yield loss (%) at Kalavalapalli village. Correlation analysis was employed to evaluate the functional relationship between leaflet nitrogen content and yield loss (%) in low, medium and high incidence palms of Godavari Ganga hybrid and local ECT variety using OP STAT software.

## RESULTS AND DISCUSSION

The nutrient analysis of healthy and *A. rugioperculatus* infested leaflets (sample size 10 leaflets in each intensity) of Dr. YSRHU - Godavari Ganga hybrid and ECT variety was undertaken at the ICAR-IIOPR, Pedavegi. The results are presented hereunder respective headings. The nut yield reduction (%) was observed to be comparatively less at 8.03% in Dr. YSRHU-Godavari Ganga hybrid palms with low *A. rugioperculatus* incidence (< 10 spiral/ leaflet), while in medium (10-20 spiral/ leaflet) and high incidence of *A. rugioperculatus* (> 20 spiral/ leaflet) there was a reduction in nut yield of 27.64 and 32.88%, respectively, at Kalavalapalli. The yield loss from 2018 to 2021 was 6.49% in ECT palms with low incidence, whereas in medium and high incidence the nut yield reduction was 25.65 and 30.38%, respectively. Dr. YSRHU - Godavari Ganga hybrid, the nitrogen levels showed highly significant and negative correlation with % yield loss (r = - 0.997**). Similarly, with 5, also revealed that East Coast Tall (ECT) variety, the nitrogen levels showed highly significant and negative correlation with% yield loss (r = - 0.999**). These findings collaborate with those of Amin and Younis (2017) who recorded nitrogen reduction of grape leaves with leaf hopper *Arboridia kurdistani* infestation by 2.699, 2.531 and 2.063% (July, August and September, 2016). Likewise, Mahadeva and Nagaveni (2012) also noticed decrease in nitrogen content of mulberry leaves var. $S_{36}$ and $S_{54}$ (0.23 to 0.95%) in spiraling whitefly infested leaf samples (Table 1, 2).

The ideal nitrogen concentration in coconut leaflets was greater than 1.80% and anything below suggests a deficiency (Selvamani and Duraisami, 2018; Magat, 2003). Phosphorus (P), potassium (K), calcium (Ca), boron (B) and magnesium (Mg) were found to be ideal in the leaflets of ECT palms, with optimum critical levels of P, K, Mg, B ranging from 0.12, 0.80, 0.25, 0.30% and 10 mg/ kg, as determined by Selvamani and Duraisami (2018); *A. rugioperculatus* nymphs and adults suck the sap from the leaflets, and the excess sap drains out as honeydew on the palm's lower leaves, attracting the sooty mould fungus *Leptoxyphium* spp., which inhibits photosynthesis resulting in yield loss in hybrid and ECT palms. In the present study, the laboratory analysis of *A. rugioperculatus* infested leaf analysis has been proven to be a more accurate means of diagnosing nutrient shortage. The yield relationship with leaf nutrient status and its deficiencies, that are site specific, are more appropriate to define the limiting nutrients and yield response due to the *A. rugioperculatus* infestation.

Nitrogen is essential for the growth and metabolism of palms. It increases button setting and improves nut production/ year (Selvamani and Duraisami, 2018). For the button setting though potassium is more important, nitrogen is also one of the equally important sources. This could be a reason that, significant and negative correlation was observed in this study pertaining to *A. rugioperculatus* incidence and immature nut fall, harvested nut yield. Nitrogen is an essential macronutrient for tree function and is a key component of amino acids, which form the building blocks of plant proteins and enzymes facilitate the vast array of biochemical reactions within a plant. Nitrogen is also a component of the chlorophyll molecule, which enables

Table 1. Impact of *A. rugioperculatus* infestation on yield loss and nutrient composition in coconut

Yield loss

| Mean yield | Nut yield/ palm | | Yield loss (%) due to infestation |
|---|---|---|---|
| | Before infestation | During infestation | |
| | 2018 | 2021 | |
| Godavari Ganga hybrid | | | |
| Low | 164.20 | 151.00 | 8.03 |
| Medium | 152.60 | 110.40 | 27.64 |
| High | 150.80 | 101.20 | 32.88 |
| East Coast Tall (ECT) | | | |
| Low | 130.40 | 122.00 | 6.49 |
| Medium | 120.20 | 89.40 | 25.65 |
| High | 119.00 | 82.80 | 30.38 |

| S. No. | Incidence | Nitrogen (N%) | Phosphorus (P%) | Potassium (K%) | Calcium (Ca%) | Sulphur (S%) | Magnesium (Mg%) | Boron [B (mg/ kg)] |
|---|---|---|---|---|---|---|---|---|
| Godavari Ganga | | | | | | | | |
| 1 | Low (0-10 spirals/ leaflet) | 2.21 | 0.26 | 1.67 | 0.80 | 0.08 | 1.73 | 12.77 |
| 2 | Medium (10-20 spirals/ leaflet) | 1.70 | 0.28 | 1.97 | 1.44 | 0.09 | 1.87 | 16.02 |
| 3 | High (> 20 spirals/ leaflet) | 1.50 | 0.25 | 1.49 | 1.04 | 0.09 | 1.92 | 18.75 |
| 4 | Control (no spirals/ leaflet) | 2.73 | 0.16 | 0.95 | 0.60 | 0.28 | 0.36 | 22.40 |
| East Coast Tall (ECT) | | | | | | | | |
| 1 | Low (0-10 spirals/ leaflet) | 2.37 | 0.27 | 1.96 | 1.33 | 0.07 | 1.60 | 13.50 |
| 2 | Medium (10-20 spirals/ leaflet) | 1.78 | 0.50 | 1.70 | 1.65 | 0.09 | 1.75 | 20.15 |
| 3 | High (> 20 spirals/ leaflet) | 1.65 | 0.14 | 1.80 | 1.54 | 0.09 | 1.81 | 16.23 |
| 4 | Control (no spirals/ leaflet) | 2.79 | 0.17 | 1.05 | 0.70 | 0.32 | 0.39 | 23.65 |

Leaf critical limits- N (%) <1.8 Deficiency; P (%) <0.12 Deficiency; K (%) <0.80 Deficiency; Ca (%) < 0.25 Deficiency; Mg (%) <0.30 Deficiency; S (%) <0.15 Deficiency, 0.25-0.35 Optimum, >0.60 excess; B (mg/kg) <10 Deficiency, 15-25 Optimum, > 40 excess. (Selvamani and Duraisami, 2018; Magat, 2003)

Table 2. Correlation coefficient- leaflet nitrogen content vs % yield loss in Dr. YSRHU

| S.No. | *A. rugioperculatus* Incidence | Nitrogen (N%) | % Yield loss | East Coast Tall (ECT) | |
|---|---|---|---|---|---|
| Godavari Ganga hybrid | | | | | |
| 1 | Low (< 10 spirals/ leaflet) | 2.21 | 8.03 | 2.36 | 6.49 |
| 2 | Medium (10-20 spirals/ leaflet) | 1.70 | 27.64 | 1.78 | 25.65 |
| 3 | High (> 20 spirals/ leaflet) | 1.50 | 32.88 | 1.65 | 30.38 |
| Correlation coefficient (r) | | | -0.997** | | -0.999** |

**Correlation significant p= 0.01

the plant to capture sunlight energy for photosynthesis, during its growth and yield (Singh et al., 2016).

These results are in harmony with those of Maheswarappa et al., (2014) and Selvamani and Duraisami (2018) who also expressed that nitrogen is the most important nutrient for coconut yield. Singh et al., (2016) also reported that increased dose of nitrogen was significantly correlated with growth and yield attributing characters of guava. The results of present study revealed that there exists a negative and significant correlation between leaflet nitrogen content and yield loss both in Dr. YSRHU - Godavari Ganga hybrid and ECT palms. Hence, management operations should be undertaken at low (< 10 spirals / leaflet) incidence of *A. rugioperculatus* instead of medium and high incidence for effective control. The aim is to reduce the number of spirals / leaflet below 10 (low) since there will be a negligible yield loss (%).

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**AUTHOR CONTRIBUTION STATEMENT**

The experiments were conducted and undertaken by P. Viswanadha Raghuteja at Kalavalapalli. Nagulapati Butchi Venkata Chalapathi Rao was the chairman and participated in monitoring of experiment and refining the manuscript. K Ramachandrudu and Kamireddy Manorama helped during nutrient analysis of coconut leaflets. Ede Padma, Nathala Emmanuel, Alwala Kireeti also reviewed the work. Kavuru Umakrishna and Vallabhapuram Sekhar extended all possible help in statistical analysis. All the authors read and approved the manuscript.

**CONFLICT OF INTEREST**

No conflict of interest.

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