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Influence of biochemical constituents of oil palm (*Elaeis guineensis* Jacq.) leaves on the incidence of invasive whitefly species, Rugose spiralling whitefly (*Aleurodicus rugioperculatus*) and Bondar nesting whitefly (*Paraleyrodes bondari*)

S Sai Tejasri, CH Chinnabbai, ARNS Subbanna, N Emmanuel and K Umakrishna

Abstract
Studies were carried out to assess the influence of biochemical constituents of oil palm on the incidence of invasive whitefly species, Rugose spiralling whitefly, *Aleurodicus rugioperculatus* Martin and Bondar's nesting whitefly, *Paraleyrodes bondari* Peracchi. The biochemical characters *viz*., moisture content (%), total protein content (g/100g), total sugars(%), reducing sugars(%), total phenol (mg/g), fibre content (%), chlorophyll content (SPAD Units) and tannin (mg/g) were studied. It was observed that among all the biochemical constituents moisture (r= 0.929), proteins (r= 0.947), total sugars (r= 0.938), reducing sugars (r= 0.934) and chlorophyll content (r= 0.938) exhibited significant positive correlation with pest intensity and whereas phenols (r= -0.934) and tannins (r= -0.848) showed negative correlation with pest intensity and fibre content (r= -0.053) showed no significant correlation with pest intensity.

Keywords: Biochemical, *Elaeis guineensis*, *Aleurodicus rugioperculatus*, *Paraleyrodes bondari*

Introduction
Oil palm (*Elaeis guineensis* Jacq.) is a native of West Africa and it is the crop of the present and future vegetable oil economy of the world as well as India. Palm oil contributes 70% of total vegetable oil import and is one of the cheapest oil due to high productivity per hectare (Kalidas *et al*., 2013) [6]. In India, oil palm covers an area of about 0.3 million hectares with production of 1.2 million tonnes. Andhra Pradesh covers an area of 0.15 million hectares and production of 1.1 million tonnes. In India, 60 insect species were reported to infest oil palm (Dhileepan, 1991; 1992; Kalidas, 2011) [3, 4, 5] of which many pests were found to cause yield loss.
Recently, severe incidence and infestation of invasive rugose spiralling whitefly (RSW) *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae) was found on oil palm in Andhra Pradesh and Karnataka states in India. The dangerous invasive pest was reported for the first time on coconut (*Cocos nucifera* L.) at Pollachi, Tamil Nadu in India during August 2016 (Sundararaj and Selvaraj, 2017) [11]. Of late in November 2018, another whitefly species *Paraleyrodes bondari* (Bondari nesting whitefly- BNW) was recorded on coconut from Kerala (Invasive pest alert- CPCRI). The Bondar's nesting whitefly, *P. bondari* is associated with rugose spiralling whitefly in most districts of Kerala and Tamil Nadu and also in Andhra Pradesh. In addition to coconut, this whitefly complex was found to be a major threat on other host like oil palm.
Various biochemical compounds present in the oil palm leaves play an important role in offering host plant resistance in suppressing the pest. Thus, the present study was undertaken to investigate the role of bio-chemical constituents, in different oil palm accessions against infestation of RSW and BNW.

Materials and Methods
The present study was conducted in the oil palm accessions available in germplasm block GP VII at ICAR-IIOPR, Pedavegi. A total of twelve oil palm accessions *viz*., EC 869395, EC 869404, EC 869406, EC 869408, EC 869414, EC 869397, EC 869399, EC 869403, EC 869407, EC 869409, EC 869412, EC 869413 were selected for data collection. Per cent pest intensity was calculated by using the following formula

$$\text{Intensity (\%)} = \frac{\text{No. of leaflets infested with whitefly complex per palm}}{\text{Total no. of leaflets per palm}} \times 100$$

Estimation of biochemical constituents were done as per standard protocols and the results were correlated with pest intensity. Moisture content from the leaves of oil palm accessions was estimated by Shimadzu MOC63u infrared moisture analyzer, the total protein content of oil palm leaves was estimated by Lowry's method. Total sugars was estimated by using the Lane and Eynon (1965) [8] method, total phenol and tannin content in leaf samples of oil palm accessions were estimated by using Folin-Ciocalteau method, the fibre content of leaves was estimated by Sulphuric acid method, the chlorophyll content in leaf samples was estimated by using the instrument SPAD chlorophyll meter.

Results and Discussions

The pest intensity in twelve test accessions ranged from 77.65 to 42.12 per cent with maximum intensity recorded in the accession EC 869403 as 77.65 per cent and the minimum intensity recorded in the accession EC 869413 as 42.12 per cent.

The maximum moisture content was recorded in the oil palm accession EC 869403 as 73.96 per cent and minimum moisture content in EC 869413 as 61.79 per cent. Correlation analysis between moisture content and intensity of RSW and BNW intensity revealed that, moisture content was highly significantly and positively correlated (r= 0.929) with the pest intensity. The maximum protein content was seen in the oil palm accession EC 869403 as 14.91 g/100g and the minimum protein content was seen in the oil palm accession EC 869413 as 7.06 g/100g. Correlation analysis between protein content and intensity of RSW and BNW revealed that, the protein content was highly significantly and positively correlated (r= 0.947) with the pest intensity. The maximum total sugar content was seen in the oil palm accession EC 869403 as 5.93 per cent and the minimum total sugar content was seen in the oil palm accession EC 869413 as 2.86 per cent and total sugars was highly significantly and positively correlated (r= 0.938) with the pest intensity. The maximum reducing sugar content was seen in the oil palm accession EC 869403 as 4.02 per cent and minimum in EC 869413 as 1.64 per cent and the amount of reducing sugars was highly significantly and positively correlated (r= 0.934) with the pest intensity. The maximum chlorophyll content was seen in the oil palm accession EC 869403 as 72.84 SPAD units and the minimum chlorophyll content was seen in the oil palm accession EC 869413 as 65.17 SPAD units and was highly significantly (r= 0.938) and positively correlated with RSW and BNW intensity. The maximum phenol content was seen in the oil palm accession EC 869413 as 4.97 mg/g and the minimum phenol content was seen in the oil palm accession EC 869403 as 1.76 mg/g and the phenol content was highly significantly and negatively correlated (r= -0.934) with pest intensity. The maximum tannin content was seen in the oil palm accession EC 869413 as 7.46 mg/g and the minimum tannin content was seen in the oil palm accession EC 869403 as 2.84 mg/g and the tannin content was highly significantly and negatively correlated (r= -0.934) with pest intensity. The maximum fibre content was observed in EC 869409 as 42.20 per cent and the minimum fibre content was observed in EC 869397 as 34.61 per cent and it was non- significantly (r= 0.053) and positively associated with RSW and BNW intensity.

Shah *et al.* (2016) [10] analyzed the correlation between proximate chemical composition and insect pests of maize crop and revealed minimum moisture percentage, minimum protein content, higher ash content in leaves were proved to have a contribution for resistance in maize cultivars against the insect pest attack. Bommesha *et al.* (2012) [1] reported a significant positive correlation between the incidences of leaf hopper, leaf roller with bio chemical characters like total chlorophyll (r=0.73** and 0.87**), protein (0.82** and 0.94**), reducing sugars (0.68* and 0.75**) and total sugars (0.65* and 0.84**) whereas a significant negative relationship with phenols (r= - 0.85** and -0.86**) in leaves of pigeon pea. Kandakoor *et al.* (2013) [7] reported that the incidence of thrips in groundnut was significant negatively correlated with phenols and tannins and positively correlated with total and reducing sugars. Chandrashekhar *et al.* (2008) [2] also reported that fibre, tannin and phenol contents showed significantly negative correlation with per cent fruit infestation in brinjal.

Table 1: Influence of Biochemical constituents of oil palm leaf on the incidence of invasive whitefly species, Rugose spiralling whitefly and Bondar nesting whitefly

Acc. No.	Moisture content (%)	Total protein content (g/100g)	Total sugars (%)	Reducing sugars (%)	Total phenol (mg/g)	Fibre content (%)	Chlorophyll content (SPAD Units)	Tannin (mg/g)	Pest Intensity %
EC 869395	70.36	13.26	5.38	3.96	1.84	37.04	72.13	3.13	72.849
EC 869404	69.12	12.01	4.95	3.37	2.06	38.85	71.45	2.94	66.17
EC 869406	69.03	11.23	4.76	2.85	2.35	38.85	70.86	3.43	62.16
EC 869408	64.13	8.13	3.07	1.85	4.13	40.58	67.03	6.73	56.01
EC 869414	68.56	10.67	4.46	2.76	2.78	40.72	69.76	3.86	61.23
EC 869397	67.02	9.87	3.92	2.49	3.46	34.61	68.79	4.68	58.29
EC 869399	62.14	7.89	2.98	1.77	4.56	35.91	66.46	6.32	42.71
EC 869403	73.98	14.91	5.93	4.02	1.76	37.43	72.84	2.84	77.65
EC 869407	67.78	10.32	4.13	2.54	3.13	40.20	69.13	4.13	59.76
EC 869409	66.12	9.12	3.46	2.12	3.72	42.20	68.25	5.82	57.36
EC 869412	65.97	8.54	3.21	1.98	3.96	35.75	67.76	5.34	44.68
EC 869413	61.79	7.06	2.86	1.64	4.97	42.02	65.17	7.46	42.12
MEAN	67.16	10.25	4.09	2.61	3.22	38.68	69.13	4.72	-
S.D	3.46	2.32	1.01	0.81	1.08	2.53	2.36	1.58	-
Correlation	0.929**	0.947**	0.938**	0.934**	0.934**	0.053NS	0.938**	0.848**	-

* - Significant; ** - Highly significant; NS – Non-significant

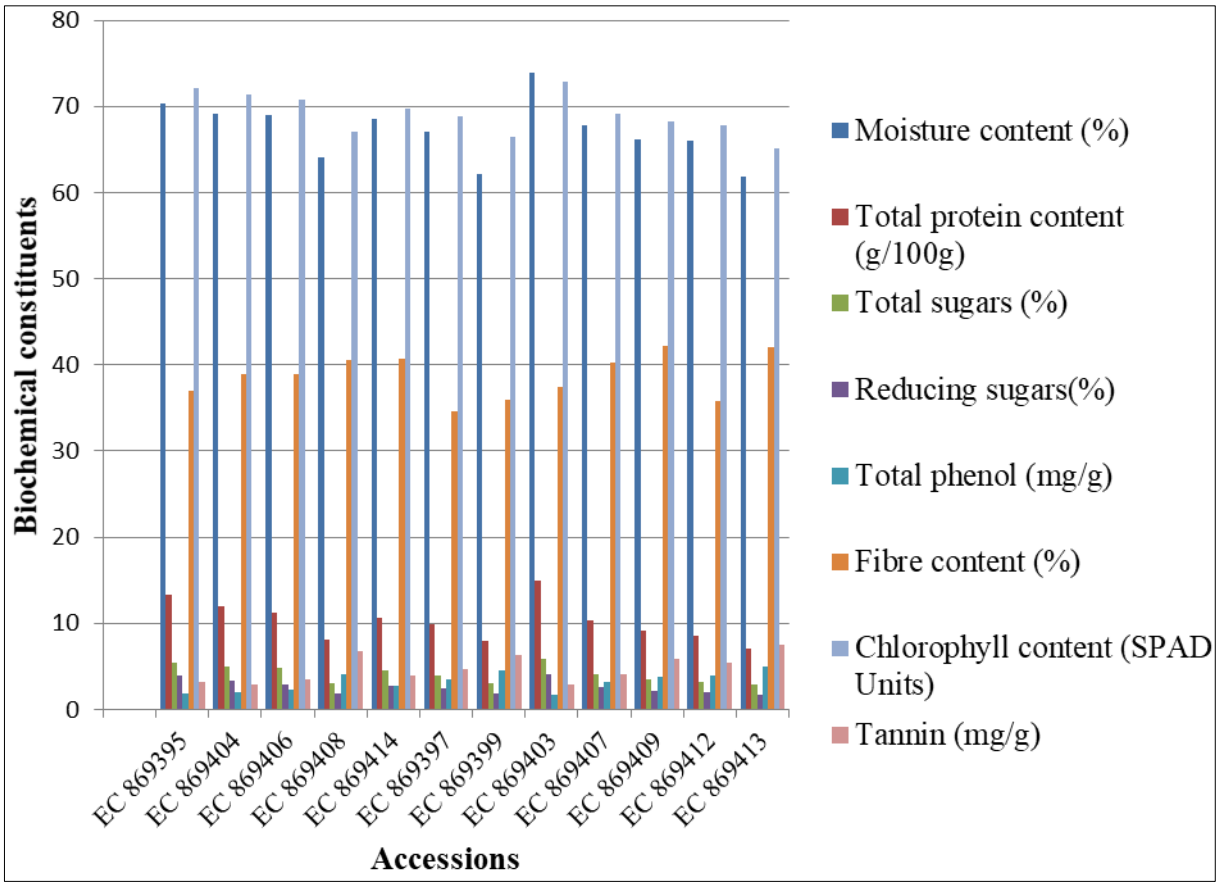

Fig 1: Biochemical constituents like moisture, protein, total sugars, reducing sugars, total phenols, Fibre content, chlorophyll and tannins in oil palm accessions

Conclusion

The accession EC 869399 with lowest pest intensity which was considered to be resistant had lowest amount of moisture, protein, total sugars, reducing sugars, chlorophyll content and highest phenol and tannin contents, whereas the accession EC 869403 with highest pest intensity which was considered to be susceptible had highest amount of moisture, protein, total sugars, reducing sugars, chlorophyll content and lowest phenol and tannin contents. Correlation between the pest intensity and moisture, protein, total sugars, reducing sugars and chlorophyll was significantly positive and the correlation between pest intensity and tannins, phenols was significantly negative.

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