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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(7): 1101-1105

www.thepharmajournal.com
Received: 01-04-2022
Accepted: 04-05-2022

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Study of biochemical basis of preference of mango leaf hoppers

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Abstract
Present investigations entitled "Varietal preference of mango leaf hoppers and its management through biopesticides" was conducted at the Horticultural mango orchard, B.T.C. College of agriculture and research station, Sarkanda, Bilaspur, Chhattisgarh during November-2020 to May-2021.
Five varieties of mango *viz*. Langra, Amrapali, Himsagar, Sunderja and Alphonso were tested for biochemical preference to mango leaf hoppers. Overall average minimum moisture percentage was recorded in leaf of varieties Sunderja (49.18%) followed by Himsagar (50.21%) and Langra (51.28%). The maximum moisture percentage was recorded in leaf of varieties Alphonso (53.82%) followed by Amrapali (52.47%).Overall average minimum total chlorophyll was recorded in leaf of varieties Sunderja (2.38 mg) followed by Himsagar (2.51 mg) and Langra (2.61 mg). The maximum total chlorophyll was recorded in leaf of varieties Alphonso (2.91 mg) followed by Amrapali (2.79 mg). Similarly, Overall average minimum chlorophyll-a was recorded in leaf of varieties Sunderja (1.69 mg) followed by Himsagar (1.75 mg) and Langra (1.81 mg). The maximum chlorophyll-a was recorded in leaf of varieties Alphonso (1.94 mg) followed by Amrapali (1.89 mg).and Overall average minimum chlorophyll-b was recorded in leaf of varieties Sunderja (0.69 mg) followed by Himsagar (0.76 mg) and Langra (0.81 mg). The maximum chlorophyll-b was recorded in leaf of varieties Alphonso (0.95 mg) followed by Amrapali (0.90 mg). In case of wax content in leaf average minimum wax content was recorded in leaf of varieties Alphonso (2.42 mg) followed by Amrapali (2.53 mg) and Langra (2.57 mg) and maximum wax content was found in leaf of varieties Sunderja (2.81 mg) followed by Himsagar (2.62 mg).
In correlation with important biochemical parameter, moisture percentage is significantly positive correlated with leaf hopper population with r value 0.945, similaraly Total Chlorophyll, chlorophyll-a and chlorophyll-b had significantly positive correlated with leaf hopper population with r value 0.944, 0.960, 0.952. respectively. Whereas wax content of leaf had significantly negative correlation with leaf hopper population with r value -0.907.

Keywords: Mango leaf hopper, biochemical, wax, moisture, chlorophyll, correlation

Introduction
Mango (*Mangifera indica* L.) is an important fruit crop of India which is cultivated extensively under two different climates that is tropical and sub tropical climate. The mango has been cultivated in our country since last 4000 years and it is called as the "Pride amongst the fruit''
Mango (*Mangifera indica* L.) is national fruit of India which is known as the "King of fruits" for its delicious taste, flavor, aroma, highly nutritive value, attractive color, shape and popularity among the masses. Mango fruit occupies the same place in the tropical region fruit as it enjoyed by Apple in temperate region. Mango fruit belongs to the genus *Mangifera.* The immature green mango is used for making chutney, aachar & amchoor in Chhattisgarh. The ripped mango is used for preparing some beverages like nectars, syrup, squashes, and some processed product like jelly. In shortage of food mango seed which is known as 'Stone' can also eat. mango timber is used for furniture, making boats and flooring in home. Besides of this applications mango have a good source of Vit. - A, Beta carotene, Vit. - B complex, Vit. - C, minerals and some digestible sugars and micro nutrients. The ripped mango flesh is very sweet, with a delicious taste. It contains approx 10-15% digestible sugars and 1% protein. Green mango contains about 81.6% water 0.5%, 0.3%, 0.5% proteins, fat and ash respectively. 100gm green mango has about to 65 calories. Mangoes helps to stop blooding and provides strengthen heart and its benefits to brain. Fresh mango and pulps are agriculturally important for export purpose. Mango seed contains 9-10% unsaturated fat, which can be used for soap making.

India, China, Pakistan, Mexico, Thailand, Indonesia, Brazil, and Philippines are the major mango producing countries in the world. Among all, India ranks first in mango production in the world. As per the data of 2017-18, the area under mango cultivation in India is 2258 million ha. with production of 21822 million tons (Anonymous, 2018) [1].

Mango tree suffers a closer loss regularly due to infestation of pests, which is serious threat for mango industry. Mango attacked by about to 492 species of insects, 26 species of nematodes and 17 species of mites at world level. Over this 188 species of insects have been reported in India. (Verghese and Tandon.1985) [15].

Mango orchards are subjected to the attack of several insect pests, among them hopper infestation is major yield limiting factor which affect the productivity and quality of mango fruits, the three important species of mango hoppers *viz*., *A. atkinsoni*, *I. clypealis* and *I. niveosparsus* out of which *A. atkinsoni* is most predominant species in southern part of Andhra Pradesh (Bhaskar, 2007) [2]. The mango hoppers mainly suck the sap from tender shoots; leaves and inflorescence (Das *et al*. 1969) [5] which causes panicles shrivel, turn brown and finally fall off, honey dew excreting from hoppers and causes sooty mould on the leaves. The affected panicles will not fruit set and yield loss can be 100% under heavy infestation (Butani, 1979; Sohi, 1990; Rahman and Kuldeep, 2007) [3, 14, 11]. The activity of leaf hopper was at peak during the emergence of new shoots and inflorescence in Mango (Zagade and Chaudhari, 2010) [17]. Mango hopper nymph and adults feed on sap of tender leaves, buds, flowers, panicles, and fruits by sucking. In heavy infestation leaves get twisted and inflorescence gets dried known as hopper burn.

Material and method

Five variety of mango *viz*., Langra, Amrapali, Sunderja, Alphonso and Himsagar were selected for the biochemical analysis of leaf for the varietal preference of Mango leaf hoppers. From each tree, single leaf from each direction was collected for each replication and transfer to the lab for the analysis purpose.

Determination of Wax content: - One gram leaf of each variety of Mangos was taken and immersed in 50ml chloroform in glass conical flask which was weight initially. The solvent containing wax was filtered by centrifuging at 1000 rpm. (Freeman *et al*., 1979) [7] After centrifugation, the clear solution was again poured in same conical flask which were kept in water bath at 46 ^{0}C and finally in hot air oven at 36 ^{0}C for complete evaporation of chloroform. The flask containing total dry wax was weight at room temperature separately. Wax content was determined by subtracting the initial weight from the final weight of conical flask and expressed in mg/gm of leaf.

Determination of chlorophyll content: The total chlorophyll as well as chlorophyll 'a' and chlorophyll 'b' content of the leaves was determined by active extraction procedure given by Mahadevan *et al.*, (1979) [10]. Fresh leaves (1gm) was chopped and macerated in leaf crusher flask with 80% acetone, until a homogenized mixture was obtained and extracted with 80% acetone and centrifuged at 2000 rpm for 10 minutes. The clear green supernatant was made up to 10 ml by adding 80% acetone and the total optical density was measured on spectrophotometer at 645 nm, 663 nm and similarly the blank with 80% acetone was also measured with same wavelength.

$$\text{Chlorophyll 'a'} = \frac{12.7 \times A663 - 2.69 \times A\ 645}{A \times 1000 \times W} \times V$$

$$\text{Chlorophyll 'b'} = \frac{22.9 \times A645 - 4.68 \times A\ 663}{A \times 1000 \times W} \times V$$

$$\text{Total Chlorophyll mg /gm tissue} = \frac{20.2 \times A645 + 8.02 \times A\ 663}{A \times 1000 \times W} \times V$$

The obtained values will be expressed as mg chlorophyll per gram fresh weight of sample.

Where,

A= Length of light path in cell (usually 1 cm)

W= Fresh weight of sample (gm)

V= volume of extract in ml

Estimation of moisture percentage: Fresh leaf of mango varieties were collected for moisture determination and weight 5 gm accurately in a paper packet and the packets were placed in a hot air oven at 105 ^{0}C for 5 hours. After drying the sample dry weight were taken and put the values in following formula.

$$\text{Moisture \%} = \frac{\text{Fresh weight (gm)} - \text{Oven dry weight (gm)}}{\text{Wt. of fresh leaf sample (gm)}} \times 100$$

Results and discussion

Moisture percentage

Five varieties of mango namely Alphonso, Amrapali, Langra, Sundarja, and Himsagar were tested for their relationship between moisture percentage of leaf and incidence of mango hopper. The moisture percentage is ranges from 49.18% to 53.82%. The lowest moisture percentage was recorded in variety Sunderja (49.18%)**,** followed by Himsagar(50.21%). The intermediate moisture percentage was found in variety Langra (51.28%) followed by Amrapali (52.47%), whereas highest moisture percentage found in leaf of variety Alphonso (53.82%). The incidence of hopper population was correlated with moisture percentage, which plays an important role in the incidence of insect population. The results (Table-1) indicated that leaf moisture (r=0.945) have positive and significant correlation with the preference of mango leaf hoppers. and tended to be linear as indicated by regression line equation Y = 1.516x + 48.07. The regression equation indicated that with the increase in 1% of moisture in leaf there will be infestation increases by 1.156 percent.

Almost similar trend was observed by Halder *et al*. (2017) [8] & Reddy *et al*. (2020) [12] who reported that higher moisture content (80.8%) showed significant positive correlation with sucking pest population (r = 0.830). Sanaa *et al.* (2018) [13] also recorded that there is a positive correlation between the population densities of sucking pest with moisture percentage. Similarly, Laichattiwar *et al*. (2018) [9] found that moisture percentage of leaf showed non-significant positive relation with the sucking pest. Vasudha *et al.* (2013) [16] found that moisture content (72.50 and 72.34%) is positively correlated with the sucking pest, which is support to our findings.

Chlorophyll content

Total chlorophyll

The total chlorophyll content ranges from 2.38 mg to 2.92 mg. The lowest total chlorophyll content was recorded in leaf of variety Sunderja (2.38mg)**,** followed by Himsagar(2.51 mg). The intermediate total chlorophyll content was found in leaf of variety Langra (2.61 mg) followed by Amrapali (2.79 mg), whereas highest total chlorophyll content found in leaf of variety Alphonso (2.92 mg).The incidence of hopper population was correlated with total chlorophyll content which plays an important role in the incidence of insect population. The results (Table 4.2.2) indicated that total chlorophyll(r=0.944) have positive and significant correlation with the preference of mango leaf hoppers. and tended to be linear as indicated by regression line equation Y = 0.176x + 2.254. The regression equation indicated that with the increase in 1 mg of total chlorophyll in leaf there will be infestation increases by 0.176 percent.

Chlorophyll- a

The chlorophyll-content ranges from 1.69 mg to 1.94 mg. The lowest chlorophyll-a content was recorded in leaf of variety Sunderja (1.69mg)**,** followed by Himsagar(1.75 mg). The intermediate chlorophyll-a content was found in leaf of variety Langra (1.81 mg) followed by Amrapali (1.89 mg), whereas highest chlorophyll-a content found in leaf of variety Alphonso (1.94mg). The incidence of hopper population was correlated with chlorophyll-a content which play an important role in the incidence of insect population. The results (Table 4.2.2) indicated that chlorophyll-a (r=0.960) have positive and significant correlation with the preference of mango leaf hoppers. and tended to be linear as indicated by regression line equation Y = 0.085x + 1.629 The regression equation indicated that with the increase in 1 mg of chlorophyll-a in leaf there will be infestation increases by 0.085 percent.

Chlorophyll - b

The chlorophyll-b content ranges from 0.69 mg to 0.95 mg. The lowest chlorophyll-b content was recorded in leaf of variety Sunderja (0.69mg)**,** followed by Himsagar(0.76mg). The intermediate chlorophyll-b content was found in leaf of variety Langra (0.81mg) followed by Amrapali (0.90mg), whereas highest chlorophyll-b content found in leaf of variety Alphonso (0.95mg).

The incidence of hopper population was correlated with chlorophyll-b content which play an important role in the incidence of insect population. The results (Table 4.2.2) indicated that chlorophyll-b (r=0.952) have positive and significant correlation with the preference of mango leaf hoppers. and tended to be linear as indicated by regression line equation Y = 0.087x + 0.630 The regression equation indicated that with the increase in 1 mg of chlorophyll-b in leaf there will be infestation increases by 0.087 percent.

Our findings are in agreement with Halder *et al*. (2017) [8] who reported that biochemical parameters, chlorophyll B (r = 0.785), and total chlorophyll (0.848) showed significant positive correlation with sucking pest incidence. Similarli Vasudha *et al.* (2013) [16] also support our findings who reported biochemical constituent like chlorophyll-a (0.61 and 0.62mg/g), chlorophyll- b (0.81and 0.83 mg/g), is positively correlated with the sucking pest. Similarly, Laichattiwar *et al*. (2018) [9] & Sanaa *et al.* (2018) [13] who also reported that moisture percentage and chlorophyll content of leaf showed significant positive correlation with the pest population.

Wax content

The wax content is ranges from 2.42 mg to 2.81 mg The lowest wax content was recorded in variety Alphonso (2.42 mg) followed by Amrapali (2.53 mg). The intermediate wax content was found in variety Langra (2.57 mg) followed by Himsagar (2.62 mg), whereas highest wax content was found in leaf of variety Sunderja (2.81mg). The incidence of hopper population was correlated with wax content and results (Table 4.2.2) indicated that wax content of leaf (r= -0.907) had negative correlation with the preference of mango leaf hoppers. and tended to be linear as indicated by regression line equation Y = 1.516x + 48.07The regression equation indicated that with the increase in 1 mg of wax in leaf there will be infestation decreases by 1.156 percent.

Similar findings is also found by Dragan *et al*. (2008) [6], Vasudha *et al.* (2013) [16] & Bohinc *et al.* (2014) [4] who reported that biochemical constituent wax content (6.60 ug/cm2) had negatively correlated with the pest infestation. Present finding is according to Vasudha *et al*. (2013) [16] who found that biochemical constituent like chlorophyll-a (0.61 and 0.62mg/g), chlorophyll- b (0.81and 0.83 mg/g), and moisture content (72.50 and 72.34%) is positively correlated with the sucking pest whereas, wax content (6.60 ug/cm2) had negatively correlated with the pest infestation.

The correlation coefficient (r) between preference of mango leaf hoppers and different biochemical contents was also worked out and summarized in Table-1

Table 1: Correlation co-efficient between biochemical contents in leaf of mango and incidence of hoppers

S. No.	Biochemical contents	Correlation coefficient 'r' value
1	Moisture (%)	0.945*
2	Wax content (mg/gm)	-0.907*
3	Total chlorophyll (mg/gm)	0.944*
4	Chlorophyll-a (mg/gm)	0.960*
5	Chlorophyll-b (mg/gm)	0.952*

* CD at 5% level of significance

Table 2: Biochemical contents in leaf of various mango varieties.

S.N.	Variety	Moisture (%)	Wax (Mg/gm)	Total chlorophyll (Mg/gm)	Chlorophyll-a (Mg/gm)	Chlorophyll-b (Mg/gm)
1	Langra	51.28	2.57	2.61	1.81	0.81
2	Amrapali	52.47	2.53	2.79	1.89	0.90
3	Himsagar	50.21	2.62	2.51	1.75	0.76
4	Sunderja	49.18	2.81	2.38	1.69	0.69
5	Alphonso	53.82	2.42	2.91	1.94	0.95

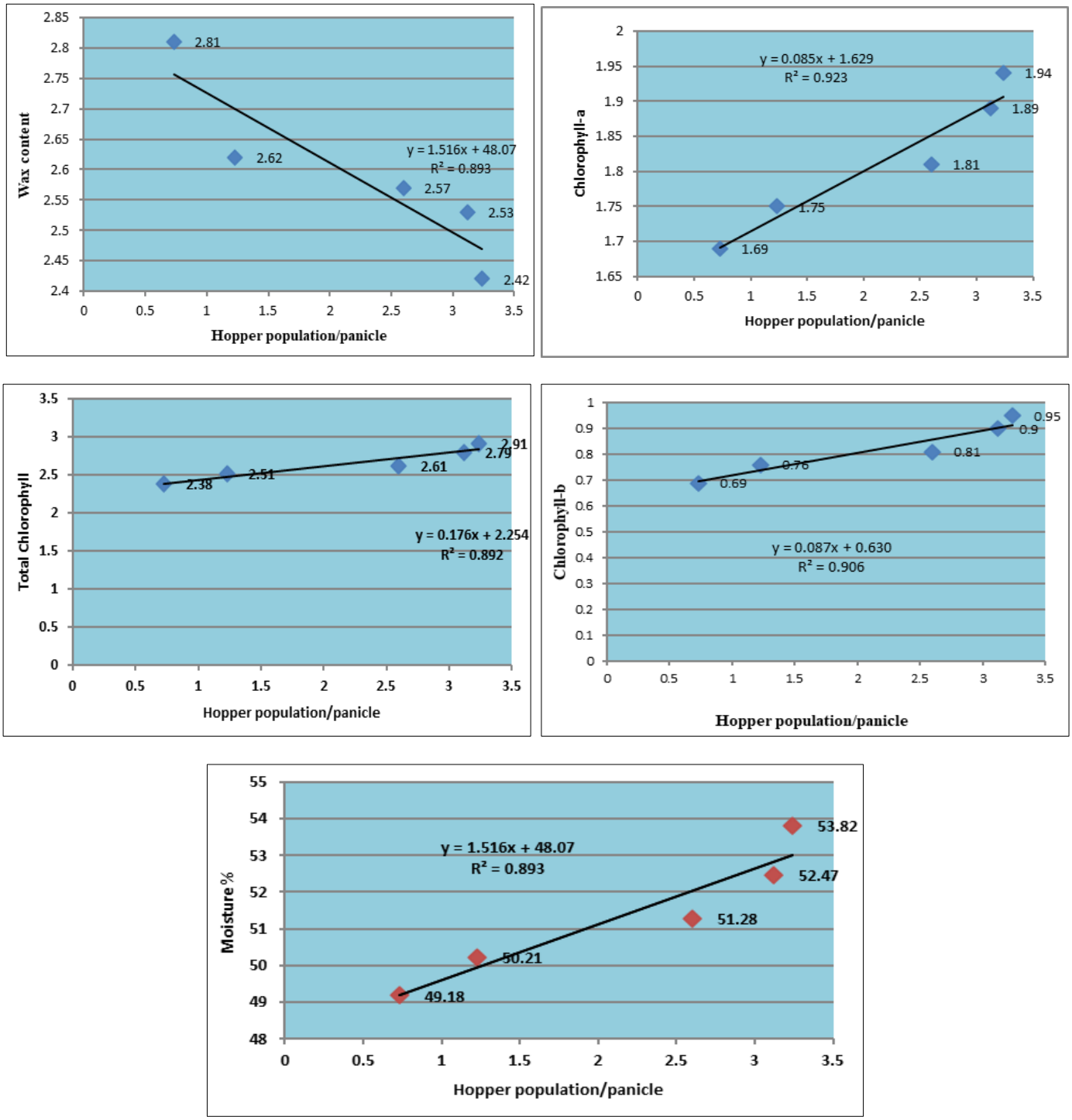

Fig 1: Regression equation between hopper population and biochemical content of leaf

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