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Research Article

Response of Leafhoppers against the Biochemical Constituents of Inflorescence from Different Varieties of Mango

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ABSTRACT

The highest quantity of phenol was observed in Mallika, Totapari, Mulgoa. The least was observed in Rasapuri and Baneshan. Maximum total sugar was recorded in Dasheri, Baneshan, Mulgoa and Totapari. Comparatively low quantity was recorded in case of Rasapuri, Mallika and Neelum. Less quantity of organic acid were observed in inflorescence Totapari, Baneshan and Mallika. The maximum quantity was observed in Alphanso, followed by Neelum, Mulgoa and Dasheri. As per as the total soluble protein was concern, maximum quantity was recorded in Alphanso, Mulgoa and Neelum varities. The lowest was recorded in Baneshan, Mallika and Totapari. Similarly, the total amino acid was lowest in Totapari and Mallika. Comparatively, more was recorded in Alphanso, Dasheri and Neelum. Uniquely, there was comparatively less of the organic acid, protein, amino acids and more quantity of total phenols were recorded in the resistant varieties compared to susceptible.

Keywords: *Mango, Leafhopper, Total sugar, Phenol, Organic acid, Total soluble protein, Total amino.*

INTRODUCTION

The crop mango is called as a King of fruits and it most prevalent prime choice crop in India. The crop distributed across the world as best fruit and it is rich source of sugar, vitamin A and C, calcium and phosphorus (Mukheerjee, 1972). It is deeply enjoyed for its succulence, best flavour and pleasant taste. India is the major producer of the larger quantity of the table fruits of Mango verities and nearly 1000 mango varieties are in cultivation with varied shape, size and taste in India (Singh, 1990). On this crop approximately 37 species of Auchenorrhyncha under the seven families are reported all over the world and believed as major pest groups in India. In those nearl seven families under six subfamilies of 26 species from Cicadellidae were identified to infest on leaves and inflorescence (Viraktamath, 1989).

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In this family the hoppers species such as *A. atkinsoni, A. brevistylus, I. nagpurensis, I. nitidulus, Amrasca splendens* and *I. clypealis* are the more important in India (Dalvi et al., 1992; Viraktamath et al., 1994; & Bana et al., 2018). These species alone can cause inflorescence loss up to 20-100 per cent. The nymphs cause active and more damaging stage compared to adults. The colonisation was observed at vegetative and reproductive phases of the crop. Huge number of nymphs and adults cluster at the lower part and puncture tender shoots, inflorescences and leaves of mango tree and suck the sap (Tandon & Verghese, 1985; Pingale & Patil, 1988; Rahman & Kuldeep, 2007; & Kaushik et al., 2014). Apart from direct damage, they ooze honeydew, which stimulate the growth of black sooty mold (*Capnodium mangiferae* Ek.), that affect the photosynthetic activity of the plant. Which leads to non-setting of flowers and dropping of immature fruits, finally leads to greater yield loss because harmed panicles do not set the fruit. On trunk, the hoppers remain active all over the year by hiding in cracks and crevices (Haseeb, 2006; Rahman & Kuldeep, 2007; & Kaushik et al., 2014). The pest infestation, activity abundance and severity is influenced by various biochemical factors of varieties besides environmental factors (Dhaliwal & Singh, 2004; & Kaushik et al., 2014).

By considering the above mentioned fact, there are lacunae in our knowledge related to pest activity against varietal influence and biochemical composition. The previous work related to the biochemical characteristics of mango crop and their relationship with the leafhoppers incidence are scanty. Looking all these breaches the present investigations have been conducted to conclude the influence of the biochemical component on the pest.

MATERIALS AND METHODS

Analysis of the biochemical constituents of the mango inflorescence done by collecting the samples of inflorescence material from the varieties and hybrids cultivated at the research farm of College of Horticulture, Bidar

Estimation of biochemical constituent

The inflorescence at full bloom stage was selected from the flowering season of the mango crop and approximately 10 gm of the sample was considered for the study taken from the all the six varieties (Alphanso, Totapuri, Rasapuri, Mulgoa, Baneshan and Neelum) and four of hybrid (Mallika, Dasheri, Langra and Kesar) of the mango.

Sample preparation

Two grams of the oven dried inflorescence was weighed and chaffed into small pieces, ground thoroughly in a mortar with pestle by adding 20 ml of 80 per cent alcohol. The solute is filtered twice using muslin cloth twice. The collected filtrates were pooled and re-filtered through Whatman No. 41 filter paper and made up the volume to 20 ml by adding 80 per cent alcohol. Later the extracted samples were stored in a refrigerator at 4^{o}C for further analysis (Manjunath, 2014).

Clarification of alcoholic extracts

Appearance of the dusky coloured alcohol extracts poses a more problem in analysis procedure. The interfering colours such as chlorophyll, carotene and xanthophylls are enormous in the sample extracts and those need to be removed prior to analysis. Employing the heavy metals and salts were tackled the problem and excess of these colour were precipitated by using disodium hydrogen phosphate. The saturated lead acetate solution of 2 ml was added drop by drop to 25 ml of the coloured alcoholic extract along with three ml of saturated disodium hydrogen phosphate solution till the completion of precipitation process. The above mentioned solutions were properly mixed and incubate for overnight. A very next day, it was filtered by using Whatman No. 41 filter paper and made up the volume to 25 ml with 80 per cent alcohol and kept in the refrigerator at 4^{o}C for further analysis.

Estimation of total phenols

The estimation of total phenols present in inflorescence samples was done by following Folin-Ciocalteau Reagent Method (Sadasivam & Manickam, 1992).

In a test tube one ml of each alcohol extract was taken, to which one ml of Folin-Ciocalteau reagent, followed by two ml of 2 per cent sodium carbonate solution were added. The test tubes were shaken well and heated in a hot water bath for one minute and then cooled using running tap water. The developed blue colour was diluted to 25 ml with double distilled water and its absorbance was read at 650 nm in UV spectrophotometer. The present of total phenols in a sample was analysed from a standard curve prepared from Catechol.

Estimation of total sugars

The same clarified filtrate sample was used for estimating the total sugars by following Nelson-Somogyi's method (Nelson, 1944). Working standard was prepared with concentration ranging from 10 to 100 µg ml^{-1}. A blank reagent maintained with 1 ml distilled water. Alkaline copper reagent of one ml was added to all the tubes and placed in boiling water bath for 20 minutes and then allowed to cool. Then one ml of Arsenomolybdate reagent was added to each tube and made up volume to 20 ml with distilled water. The absorbance readings of the standards and samples against reagent blank, at 540 nm were documented using a spectrophotometer. The total sugar in the sample was analysed by the similar protocol as that of reducing sugar after inversion. The clarified extract of one ml was hydrolyzed with equal volume of 1N HCl on water bath at 49^{o}C for 45 minutes. The neutralization of the hydrolyzed mixture was done by adding 1N NaOH with methyl red as an indicator and was made up the volume to 5 ml. The sugar in the hydrolysate was assessed by following Nelson Somogyi's method (Nelson, 1944).

Organic acid

eigh the inflorescence accurately and remove the debris if any. Ground them into small pieces using pestle and mortar by adding distilled water. Filter the sample with muscline cloth and make up the volume to required quantity. Take suitable aliquot of the filtrate into a 100 ml conical and add phenolphthalein indicator and titrate against 0.05N sodium hydroxide from the burette. Calculate the amount of organic acid in percentage based on the formula.

$$\text{Per cent Organic Acid:} \quad \frac{T \times E \times N}{100 \times W} \times 100$$

Where,

T= Titrate value, E= Equivalent weight of the acid (g), N= Normality of NaOH, W= Equivalent weight sample used in the aliqot for titration

Estimation of Soluble Proteins by Lowry's method

The aromatic amino acids existing in the protein *viz.*, tyrosine, tryptophan react with phosphomolybdo-phosphotungstate (FCR) reagent to develop a blue coloured complex at 660 nm in the spectrophotometer. The total soluble proteins were isolated from 0.5 g leaf sample using distilled water. One ml extracted filtrate was taken in test tube and five ml of alkaline copper reagent was added and incubate for 10 minutes. Followed by 0.5 ml of 1N FCR reagent was added and incubate in dark chamber for 30 minutes. The per cent absorbance was read at 660 nm. Total soluble proteins were calculated using Bovine Serum Albumin (BSA) standards (20-100 µg).

Colorimetric estimation of total free amino acids

The building blocks of all proteins are amino acids. Those free form amino acids exist in the tissues and not bound to proteins are referred as free amino acids. Estimation of total free amino acids postulates an indication about the physiological condition and health status of the plants. The total free amino acids in the samples extracts were analysed calorimetrically by following ninhydrin method. The best protocol called Ninhydrin method for estimation of the total free amino acids documented by Moor and Stein (1948).

RESULTS AND DISCUSSIONS

By following the standard protocol the different biochemical compounds were estimated from the mango inflorescence.

Total phenol

During first season of 2015-16, the total quantity of phenol was significantly highest in Mallika (76.27 mg/g), it was followed by Totapari (68.53 mg/g), Mulgoa consist of 61.50 mg/g, Kesar was having 48.02 mg/g, Langra was having 46.61 mg/g, Dasheri consist of 39.26 mg/g, Neelum, having 32.74 mg/g and Alphanso (31.27 mg/g of total phenols was recorded. The least quantity of phenol was recorded in Rasapuri variety of 18.19 mg/g followed by Baneshan, 29.31 mg/g (Fig. 1; Table 1).

In second season of 2016-17, the total phenol was maximum in Mallika variety (75.55 mg/g), followed by Totapari (68.86 mg/g), Mulgoa (63.00 mg/g), Langra (44.92 mg/g), Dasheri (40.62 mg/g), Kesar (39.07 mg/g), Alphanso (39.05 mg/g) and Neelum (32.53 mg/g). The least quantity of total phenol was observed in the varieties like Baneshan (29.68 mg/g) and Rasapuri (18.67 mg/g) (Fig. 2; Table 2). Least amount of total phenols were recorded in susceptible varieties *viz.*, Padiri, Neelum and Sindura than the high amount present in the resistant varieties *viz.*, Bangalora, Baneshan, Khader and Chinnarasam (Nachiappa & Baskaran, 1983; & Ram Singh & Agarwal, 1988). Similalry, maximum quantity of phenols were documented in Mallika and Totapuri followed by Baneshan (Girish et al., 2019).

Total sugars

The total sugar was estimated in the ten varieties of mango during 2015-16, where highest was recorded in the variety like Dasheri (56.65 mg/g tissue) followed by Baneshan (34.02 mg/g tissue), Mulgoa (33.06 mg/g tissue), Totapari (33.16 mg/g tissue), Alphanso (28.22 mg/g tissue), Kesar (27.56 mg/g tissue) and Langra (21.41 mg/g tissue). Comparitively low level of total sugar was observed in case of Rasapuri (15.61 mg/g tissue), Mallika (15.30 mg/g tissue) and Neelum (18.74 mg/g tissue) varieties (Fig. 1; Table 1).

Similarly, the total sugar content was analysed during 2016-17 in mango inflorescence displayed that the more quantity was recorded in Dasheri (55.82 mg/g tissue), followed by Baneshan (33.55 mg/g tissue), Mulgoa (32.95 mg/g tissue), Totapari (32.43 mg/g tissue), Alphanso (29.17 mg/g tissue), Kesar (28.28 mg/g tissue) and Langra (22.73 mg/g tissue). The lowest quantity of total sugar was observed in Rasapuri (16.52 mg/g tissue), Neelum (19.33 mg/g tissue) and Mallika (16.75 mg/g tissue) varieties (Fig. 2; Table 2). A comparatively more amount of reducing sugars was observed in susceptible variety compared to the lower content witnessed in resistant to moderately resistant varieties (Nachiappa & Baskaran, 1983; & Ram Singh & Agarwal, 1988). In contrary to this more amount of reduing sugar influence the check of leafhopper in mango (Girish et al., 2019).

Total Organic acid

The total quantity of organic acid present in the different varieties of mango during 2015-16 revealed that the lowest quantity was observed in Totapari (0.82), followed by Baneshan (0.82), Mallika (0.88), Rasapuri (1.28), Kesar (2.98) and Langra (3.00). The highest quantity of total organic acid was observed in Alphanso (5.85 Units/mg protein),

followed by Neelum (4.81), Mulgoa (4.93) and Dasheri (4.54) (Fig. 1; Table 1).

During the year 2016-17, the less quantity of total organic acid was observed in the varieties like Rasapuri (0.85) followed by Mallika (0.87), Totapari (0.88), Baneshan (1.26), Langra (3.19) and Kesar (3.02). In contrary the highest quantity of total organic carbon was recorded in Mulgoa (4.77) Dasheri (4.62), Neelum (4.55) and Alphanso (5.78) (Fig. 2; Table 2).

Total Soluble protein (Units/mg protein)

Presence of the total protein in the inflorescence was calculated during 2015-16 on ten mango varities indicated that the highest was recorded in Alphanso (941.92), followed by Mulgoa (860.88), Neelum (917.16), Dasheri (692.52), Kesar (521) and Langra (582.55). The lowest quantity of total soluble protein was recorded in the varieties like Baneshan (194.48), Mallika (181.42), Totapari (215.73) and Rasapuri (339.4) (Fig. 1; Table 1).

Similarly in the year 2016-17, the highest quantity of total soluble protein was recorded in Alphanso (943.74), followed by Neelum (913.27), Mulgoa (863.17), Dasheri (691.84), Langra (590.88) and Kesar (520.25). The least amount of protein was recorded in the varieties Mallika (181.94), Baneshan (194.82), Totapari (216.07) and Rasapuri (338.98) (Fig. 2; Table 2).

Total Amino acid

The estimation of total amino acid was studied during 2015-16 and the result displayed that the lowest quantity was recorded in Totapari (0.15) and Mallika (0.15) variety followed by Rasapuri (0.18) and Baneshan (0.23). Considerably more amount of total amino acid was recorded in the Kesar (0.31) Langra (0.36), Mulgoa (0.37), Alphanso (0.4), Dasheri (0.44) and Neelum (0.48) (Fig. 1; Table 1).

Similarly, quantity of the total amino acid during the year 2016-17 displayed that the less quantity of the amino acid was recorded in Rasapuri (0.16) and Mallika (0.16) followed by Totapari (0.17) and Baneshan (0.25). The more quantity of total amino acid was recorded in Kesar (0.33) Langra (0.36), Mulgoa (0.38), Neelum (0.45), Alphanso (0.4), Dasseri (0.45) (Fig. 2; Table 2).

In the present study, there was considerable less quantity of the organic acid, protein and amino acids were detected in the resistant individuals compared to susceptible variety (Table 3). The study follow the okra poor growth of *A. devastans* was observed in the varieties having insufficient concentrations of amino acids, organic acids and minerals and to the rich concentrations of toxic phenols present in these plants (Uthamasamy, 1986). Similarly, the more quantity of sugars, silica, potassium, tannins and phenols in the leaves of resistant varieties were related with resistance to leafhopper in okra (Hooda et al., 1997). The rich quantity of sugars and amino acids delivered good nutritional environment to the leafhoppers for their growth and development (Wilkinson et al., 1997; & Anusha, 2015). Increased quantity of proteins, amino acids and total phenol and reduced carbohydrate composition in sweet potato plants prevented the infestation of tobacco cutworm (*Spodoptera litura*) compared to normal plants (Sandyarani et al., 2013). The aphids infested shoot of mango were shown least quantity of sugars and amino acid content compared to healthy one (Lokeshwari et al., 2013) and the total soluble sugars, reducing sugars, non-reducing sugars and leaf nitrogen in case of sunflower showed positive correlation with leafhopper population and damage (Ghante et al., 2019). It displayed that this Sugar, phenol, protein, organic acid and amino acid play a significant role in the pest infestation and host preference.

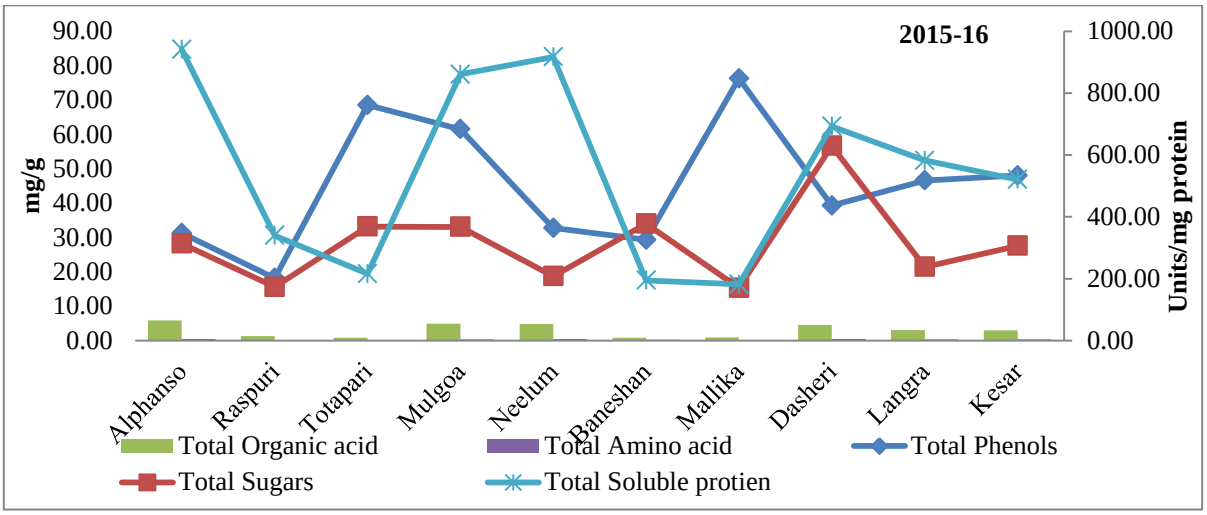

Figure 1. The total quantty of the different biochemical compounds present in the inflorescence of the mango during 2015-16

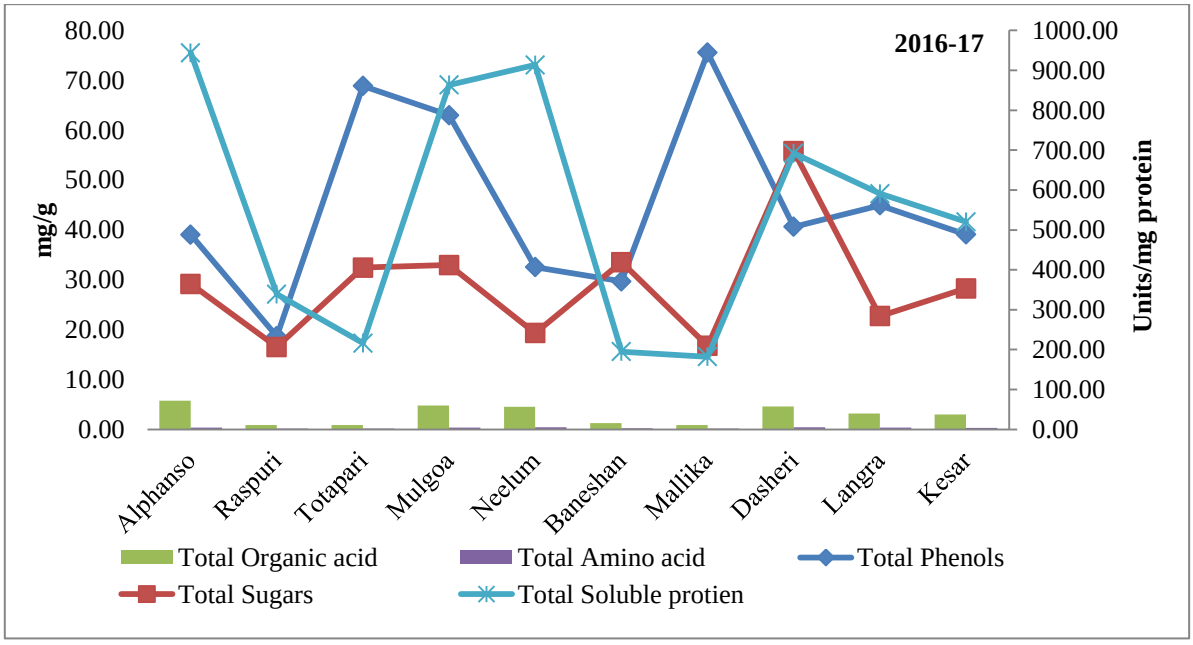

Figure 1. The total quantty of the different biochemical compounds present in the inflorescence of the mango during 2016-17

Table 1: Biochemical constituents of different mango cultivars studied during 2015-16

Varieties	Total Phenols (mg/g)	Total Sugars (mg/g)	Total Organic acid (Units/mg protein)	Total Amino acid (Units/mg protein)	Total Soluble protein (Units/mg protein)
Alphanso	31.27	28.22	5.85	0.40	941.92
Rasapuri	18.19	15.61	1.28	0.18	339.40
Totapari	68.53	33.16	0.82	0.15	215.73
Mulgoa	61.50	33.06	4.93	0.37	860.88
Neelum	32.74	18.74	4.81	0.48	917.16
Baneshan	29.31	34.02	0.82	0.23	194.48
Mallika	76.27	15.30	0.88	0.15	181.42
Dasberi	39.26	56.65	4.54	0.44	692.52
Langra	46.61	21.41	3.00	0.36	582.55
Kesar	48.02	27.56	2.98	0.31	521.00
Mean	45.17	28.38	2.99	0.31	544.71
S.EM=	0.39	0.24	0.08	0.01	1.42
SE.d=	0.55	0.33	0.11	0.01	2.01
CD (P=0.01)	1.58	0.96	0.31	0.03	5.80

Table 2: Biochemical constituents of different mango cultivars studied during 2016-17

Varieties	Total Phenols (mg/g)	Total Sugars(mg/g)	Total Organic acid (Units/mg protein)	Total Amino acid (Units/mg protein)	Total Soluble protein (Units/mg protein)
Alphanso	39.05	29.17	5.78	0.40	943.74
Rasapuri	18.67	16.52	0.85	0.16	338.98
Totapari	68.86	32.43	0.88	0.17	216.07
Mulgoa	63.00	32.95	4.77	0.38	863.17
Neelum	32.53	19.33	4.55	0.45	913.27
Baneshan	29.68	33.55	1.26	0.25	194.82
Mallika	75.55	16.75	0.87	0.16	181.94
Dasberi	40.62	55.82	4.62	0.45	691.84
Langra	44.92	22.73	3.19	0.36	590.88
Kesar	39.07	28.28	3.02	0.33	520.25
Mean	45.20	28.75	2.98	0.31	545.50
S.EM=	0.87	0.96	0.12	0.02	2.34
SE.d=	1.24	1.36	0.17	0.03	3.30
CD(P=0.01)	3.56	3.90	0.49	0.07	9.51

Table 3: Relationship of biochemical constituents on incidence of leafhoppers

Varieties	Rank*	Leafhoppers incidence	Total Phenols (mg/g)	Total Sugars(mg/g)	Total Organic acid (Units/mg protein)	Total Amino acid (Units/mg protein)	Total Soluble protein (Units/mg protein)
Mallika	I	3.34	75.91	16.03	0.88	0.16	181.68
Totapari		7.43	68.69	32.80	0.85	0.16	215.90
Baneshan		7.39	29.50	33.79	1.04	0.24	194.65
Raspuri	II	9.25	18.43	16.06	1.07	0.17	339.19
Langra		9.56	45.77	22.07	3.09	0.36	586.72
Kesar		10.64	38.55	27.92	3.00	0.32	520.62
Dasheri	III	11.27	39.94	56.23	4.58	0.45	692.18
Mulgoa		11.89	62.25	33.01	4.85	0.38	862.02
Neelum		12.85	32.64	19.04	4.68	0.47	915.21
Alphanso		16.32	35.16	28.70	5.82	0.40	942.83

* The ranking of the variety based on mean incidence of leafhopper

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