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An antibiotic mechanism in the ridge gourd (*Luffa acutangula* (Roxb.) L. genotypes against Leaf miner, *Liriomyza trifolii* (Burgess) and fruit fly, *Zeugodacus cucurbitae* (Coquillett)

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Abstract
An inquiry on screening of ridge gourd genotypes against leaf miner, *Liriomyza trifolii* (Burgess) and fruit fly, *Zeugodacus cucurbitae* was undertaken by analyzing the leaf miner and fruit fly infestations. correlation analysis showed that the total sugars, reducing sugar and non reducing sugar exhibited a significant positive correlation. where as, phenols and tannins showed a significant negative correlation. This suggested that both miners and fruit flies would prefer plants with more sugars. Genotypes, NS-3 and ERG-4 registered the highest total sugars (2.13% and0.89%) and reducing sugars respectively. Similarly, overall phenol content (60.49mg 100 g^{-1}) was highest in surekha and tannin content (24.63mg 100 g^{-1}) was highest in amoha genotype. The genotypes with large concentrations of phenols, tannins and less amount of sugars were found to be major biochemical features showing reduced leaf miner and fruit fly infestation. These traits have proven to be significant requirements for breeding of potential genotypes.

Keywords: *Luffa acutangula*, *Liriomyza trifolii*, *Zeugodacus Cucurbitae* infestation, genotypes, screening

1. Introduction
Ridge gourd, *Luffa acutangula* (L.) Roxb. is an important cucurbitaceous vegetable crop grown in different parts of India and in other tropical countries of Asia and Africa. Plants are generally exposed to a variety of biotic and abiotic factors that may alter their genotypic and/or phenotypic properties resulting in expression of different mechanisms of resistance, to pest attack according to Gogi *et al*., 2010 [5]. Mechanisms of resistance in plants are either constitutive or induced and are grouped into three main categories: antixenosis, antibiosis and tolerance. Plants which are responsible for antibiotic resistance reduces the insect survival, fitness of new generation adults and increasing developmental time of insects. Painter, (1951) [8].

The ridge gourd growers solely rely on synthetic chemical weapons for the management of fruit fly. In some areas, farmers spend about 25 per cent of the cost of cultivation only to buy synthetic insecticides (Anon, 2004) [1]. The residues of pesticide affected the export potential of gourd because of serious concern of the importing countries (Quasem, 2003) [10]. Moreover, repeated use of toxic insecticides is not only hazardous to the environment but also directly affects the health of the farmers and consumers. The extent of losses varies between 30 and 100%, depending on the cucurbit species and the season. (Panda and Khush, 1995) [9]. Therefore, it is desirable to explore alternative methods of management of leaf miner and fruit fly, which are economically sustainable and environmentally friendly.

The genotypes of ridge gourds also vary in defense strategy against leaf miner and fruit fly infestation. To overcome the detrimental consequences of chemicals, use of resistant cultivars can prove one of the effective and reliable alternative approaches for the management of these pests. In this regard, the present investigation was undertaken to screen and evaluate the genotypes of ridge gourd against leaf miner and fruit fly.

2. Materials and Methods
The experiment was carried at Bediganahally village, Channarayapatna taluk, Hassan district during *rabi* season in 2017-18. All the recommended agronomic practices were carried out as

per package of practices except pest management. Seventeen genotypes were procured from various sources. (Horticultural college, Bagalkote and seed shops) and the genotypes used for the study were, Amoha, Arbhavi local, Arka sumeet, CO-1, DMRG-1, DMRG-25, ERG-4, Jaipur long, Mandira, Naga, Naagin, Nandini, NS-3, Pusa nasdar, Sureka, Torilong krishna and VDG-1.

Biochemical parameters such as total sugars, reducing sugar, non-reducing sugar, tannins and phenols of all the genotypes were analyzed from leaf samples selected randomly at 60 DAS from each replication and analyzed as per the standard procedures for each parameters. Total soluble sugar was estimated by using anthrone reagent (Dubios *et al.*, 1956) [4]. Reducing sugar was determined by following Nelson's modification of Nelson-Somogyi's method (Somogyi, 1952) [13]. The non-reducing sugar was calculated by substracting the quantity of reducing sugar from total sugar and was multiplied to get non-reducing sugar. Total phenols was analysed by following Singleton and Rossi (1965) [12] and the tannin was estimated by Folin-Denis method.

The data collected were statistically analysed by using SPSS software version 16.0. For the accuracy of the results ArcSin-1√x transformation was done whenever needed and subjected to analysis of variance after transformation of data through SPSS. The biochemical parameters of tested genotypes of ridge gourd were analysed through one way ANOVA by using SPSS to determine either the differences in above mentioned parameters are significant or non significant. Means were separated by Duncan's Multiple Range Test. Correlation of leaf miner infestation with phenols, tannins, total sugars, reducing and non-reducing sugar were computed.

3. Results and Discussion

Seventeen genotypes of ridge gourd entries were screened for leaf miner and fruit fly infestationand analyzed biochemically

Leaves from the 17 entries were analyzed separately at 60 DAS and estimated different biochemical constituents such as total sugars, reducing sugars, non-reducing sugars, phenols and tannins by following standard procedures to know the variation of biochemical traits across the screened genotypes.

In the seventeen ridge gourd genotypes total sugar ranged between 1.25 to 2.11%. Total sugar content was higher in the genotypes *viz.*, NS-3, Torilong Krishna, Vdg-1 and Erg- 4 with a sugar content of 2.13, 2.11, 2.01 and 1.96%, respectively. There was no significant difference among the genotypes with their sugar levels. The total sugar content was highest in the genotypes *viz.*, Erg-4, Vdg-1, Torilong Krishna and NS-3 which were above the average of leaf miner and fruit fly infestation.

In similar investigations, Susceptible cotton genotypes had higher levels of sugars, whereas the resistant genotypes had comparatively lower levels of sugars (Thimmaiah, 1992; Chandrashekara, 1994) [14, 2]. The total sugars (r = 0.527*) was significantly and positively correlated with fruit infestation in the ridge gourd genotypes.Similarly, mustard aphid population showed significant positive correlation with sugar content, indicating that higher amounts of sugar was needed for survival of the mustard aphids, providing better nutritional conditions for the growth and development and thus sugar content in plants was generally associated with susceptibility. These observations of earlier workers are in line with the present findings.

The Reducing and non-reducing sugars in the ridge gourd genotypes were in the range of 0.409 to 0.896% and 0.619 to 1.556 %, respectively. High content of non-reducing sugar was observed in genotypes *viz.*, Ns-3 with a non-reducing sugar content of 1.55% followed by Torilong Krishna with 1.23% which were not statistically on par with each other.

These genotypes with higher reducing and non-reducing sugar content caused higher damage by attracting more number of insect herbivores. Mohan Kumar and Venugopal, (1999) [7] reported lower content of reducing sugars in leafhopper resistant cotton cultivars as compared to the susceptible strains.

The total phenols in different ridge gourd genotypes were in the range of 26.63 to 60.49 mg/100 g^{-1}.The genotypes with lower phenol content caused higher damage to plants in terms of both leaf miner and fruit fly infestation. It seemed that total phenol content had visible effect on level of infestations inflicted by both leaf miner and fruit fly. Higher phenolic content is associated with lower degree damage by *Scirtothrips dorsalis* in chilli (Manoj, 1994) [6] reported high content of phenols in BPH resistant rice varieties comparison to the susceptible ones. Higher content of total phenols in blackgram genotypes, showing resistance to whitefly and leaf hoppers (Chhabra *et al*. 1993) [3].

Tannins content in different ridge gourd genotypes were in the range of 10.83 to 24.63 mg $100g^{-1}$. The highest total tannins content was observed in genotypes *viz.*, Amoha, Naga, C0-1 and Ns-3 with the tannin content of 24.63, 23.60, 22.59 and 22.94 mg 100 g^{-1},respectively. There was no significant difference among the genotypes. They were statistically on par with each other. Similarly lower content of phenols was observed in genotypes *viz.*, Vdg-1, Erg-4 and Torilong Krishna with the phenol content of 13.32, 12.4 and 10.83 mg 100 g^{-1}, respectively. There was no significant difference among them with respect to their tannin content.

The genotypes with lower tannin content caused higher damage to plants in terms of both leaf miner and fruit fly infestation. It seemed that total tannin content had visible effect on level of infestations caused by both leaf miner and fruit fly.

The present findings are in line with the study of Robbins *et al.*, 1987 [11]. reported an increase in the amount of total tannins after feeding by aphids which indicated that tannins might play an important role as feeding deterrents suggesting that tannins help in inactivating insect enzymes as well as dietary proteins. Thimmaiah, (1992) [14]; Chandrashekara, (1994) [2] reported higher level of tannins in young leaves, stem tip and squares of resistant cotton genotypes than the susceptible genotypes.

The change in the concentration of biochemical compounds exert marked influence on the physiology of the plant, which in turn influence further leaf miner and fruit fly infestation. Taking clue from the earlier works, it is possible that ridge gourd genotypes have differed substantially in chemical constituents or morphological characteristics or both.

Table 1: Variations in biochemical parameters among different genotypes of ridge gourd

Genotypes	Total sugars Per cent (%)	Reducing sugars Per cent (%)	Non reducing sugars Per cent (%)	Total Phenol content ($mg100g^{-1}$)	Total Tannin content ($mg100g^{-1}$)
DMRG-1	$1.33±0.47^{c}$	$0.46±0.01^{e}$	$0.86±0.48^{efgh}$	$53.32±0.19^{cd}$	$21.28±0.70^{abcd}$
DMRG-25	$1.25±0.08^{c}$	$0.49±0.03^{de}$	$0.76±0.09^{fgh}$	$52.32±1.23^{cd}$	$21.49±1.71^{abc}$
JAIPUR LONG	$1.36±0.01^{c}$	$0.69±0.01^{b}$	$0.67±0.04^{gh}$	$40.36±1.37^{f}$	$16.95±0.19^{e}$
PUSA NASDHAR	$1.27±0.07^{c}$	$0.65±0.03^{b}$	$0.61±0.07^{h}$	$45.2±0.28^{e}$	$17.86±0.05^{de}$
SUREKHA	$1.29±0.11^{c}$	$0.68±0.04^{b}$	$0.61±0.06^{h}$	$60.49±0.52^{a}$	$18.05±2.14^{cde}$
ERG 4	$1.96±0.06^{a}$	$0.89±0.01^{a}$	$1.06±0.07^{bcde}$	$26.63±0.14^{g}$	$12.4±2.12^{f}$
VDG 1	$2.0±0.05^{a}$	$0.86±0.02^{a}$	$1.15±0.03^{bcd}$	$29.39±0.94^{g}$	$13.35±1.94^{f}$
AMOHA	$1.65±0.01^{b}$	$0.52±0.01^{cd}$	$1.16±0.21^{bc}$	$39.73±0.47^{f}$	$24.63±2.92^{a}$
CO 1	$1.26±0.04^{c}$	$0.48±0.07^{de}$	$0.77±0.05^{fgh}$	$50.96±1.65^{d}$	$22.59±2.65^{ab}$
NAGA	$1.41±0.08^{c}$	$0.48±0.08^{de}$	$0.93±0.02^{cdef}$	$55.43±0.99^{bc}$	$23.60±1.33^{a}$
TORILONG K.	$2.11±0.02^{a}$	$0.87±0.04^{a}$	$1.23±0.04^{b}$	$30.1±1.67^{g}$	$10.83±0.22^{f}$
NS-3	$2.13±0.05^{a}$	$0.58±0.03^{c}$	$1.55±0.08^{a}$	$59.76±1.76^{a}$	$22.94±0.10^{ab}$
ARABHAVI	$1.39±0.05^{c}$	$0.58±0.02^{c}$	$0.81±0.01^{fgh}$	$40.26±0.09^{f}$	$18.65±0.66^{cde}$
ARKA SUMEET	$1.35±0.08^{c}$	$0.51±0.04^{de}$	$0.84±0.04^{efgh}$	$51.76±0.52^{cd}$	$18.78±1.26^{cde}$
MANDIRA	$1.31±0.01^{c}$	$0.40±0.03^{f}$	$0.90±0.03^{defg}$	$54.66±0.09^{c}$	$19.59±2.21^{bcde}$
NANDINI	$1.35±0.08^{c}$	$0.46±0.05^{ef}$	$0.89±013^{efg}$	$58.53±0.52^{ab}$	$18.65±0.71^{cde}$
NAAGIN	$1.34±0.04^{c}$	$0.46±0.01^{e}$	$0.87±0.04^{efg}$	$58.49±0.47^{ab}$	$18.33±0.61^{cde}$
S.Em±	0.09	0.01	0.09	1.16	1.20
CV	7.28	4.47	12.88	3.47	9.02
CD at 0.05	0.27	0.05	0.27	3.50	3.60

Mean values in each column followed by a common letter are not significantly different by DMRT (P= 0.05)

Table 2: The correlation analysis of biochemical parameters with leaf infestation by leaf miner and fruit infestation by fruit flies in various genotypes of ridge gourd

Category	Leaf infestation %	Fruit infestation %	Total sugars	Reducing sugars	Non reducing sugars	Phenols	Tannins
Leaf infestation %	1	0.625^{**}	0.702^{**}	0.016	0.015	-0.405	-0.233
Fruit infestation %	0.625^{**}	1	0.527^{*}	-0.141	0.121	-0.510^{*}	-0.452

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

4. Conclusion

Analysis of biochemical parameters like total sugars, reducing sugars, non-reducing sugars, total phenols and tannins showed significant variation among the genotypes evaluated. Significant and positive correlation of total sugars, reducing and non-reducing sugar was recorded with fruit fly and leaf miner infestation. Whereas, phenols and tannins were negatively correlated with both leaf miner and fruit fly infestation. These factors can be exploited efficiently for the breeding of potential genotypes in ridge gourd.

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