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Full Length Research Article

Nutritional Profile of Fairchild Fruit Infected by Sucking Insect-Pests of Citrus

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Abstract

Present experiment was scheduled to examine the harmful effects of sucking insect-pests i.e., citrus aphid (*Toxoptera citridus*), citrus psylla (*Diaphorina citri*) and thrips (*Scirtothrips citri*) on different fruit related attributes of Fairchild. A significant decline in total soluble solids, fruit weight and acidity was observed while an increase in juice pH was recorded in response to elevation in infestation by target sucking insect-pests. A strong correlation was also established between pest infestation (insect-pest population) and fruit weight, total soluble solids and titratable acidity. Over all it was concluded that insect-pest infestation may deteriorate fruit quality of Fairchild and is therefore it is important to control insect pest infestation to increase fruit quality especially fruit weigh and juice contents of Fairchild which may be helpful to increase the orchard production and net return from the crop.

Key Words: Citrus, Fairchild, insect-pests, infestation, quality

Introduction

As compare to all fruits in the world, citrus have striking position in production (Yadav, 2007). The top countries in production and processing of citrus fruit are Brazil and Florida (Al-Farsi *et al.*, 2005). Firstly, this fruit was cultivated by the natives of South-East Asia (Indonesia and China) but now it is almost grown everywhere in the world under tropical and sub-tropical climate (Ladanyia and Ladaniya, 2010). The total soluble solids of citrus fruit contain approximately 85% sugars. Citrus fruit is not only a rich source of vitamin C but also contains other essential nutrients (Shokrollah *et al.*, 2011).

Citrus production is being affected by different abiotic and biotic stresses issues. Among all the biotic factors, the major factors are insect pests and diseases which reduce the growth of plants as well as also cause quantitative and qualitative losses of fruits (Miguel and Clara, 2003; Cameron and Soost, 1977). In addition, physiology of plants is also negatively affected by insect pests (De Berardinis, *et al.*, 1994) which is reported in different studies. According to Mraicha, *et al.* (2010) the olive oil quality affected by olive fruit fly and find the free acidity significant correlation with degree of attack of olive fruit fly but the phenolic contents were negatively correlated. Whereas, the fatty acid composition was not significantly changed by insect-pests infestation. This infestation seriously damages the olive fruit and cause reduction the phenolic concentration and antioxidant quality of olive.

Whitefly mostly feed on phloem sap and hence block the transportable carbohydrate and other nutrients which are carried in vascular bundles and reduces overall production of host plants by challenging for available nutrients (Byrne and Bellows, 1991). There were six macro nutrients and seven micro nutrients observed in six popular native mulberry varieties by the infestation of insect pests.

Due to white fly, aphid, citrus psylla and thrips infestation, nutrients were reduced in mulberry leaves of almost all the varieties. Growth and development of silkworms which feed on such leaves affect the silk production (Mahadeva and Nagaveni, 2012). Similarly sucking insect pest significantly reduce the fruit weight, juice percentage, and acidity in kinnow fruit under their greater infestation (Zubair *et al.*, 2015). The percent crop damage through insect pest depends upon the type of insect pest moth parts, as some insects are sucking (aphids), some are chewing (grasshoper) and some have rasping (thrips) mouth parts (Pedigo and Rice, 2006). The percent damage by insect pest is about 9-21 percent depending upon the best practices adopted to control their damage (Borror and White, 1998).

There is no or less work done to measure the damage in Fairchild fruits quality through infestation of insect-pests. Therefore, the present study was aimed to figure out the losses in fruit quality under infestation of sucking insect-pest.

Materials and methods

The present study was carried out in the citrus progeny block at University College of Agriculture, University of Sargodha. To observe the deleterious effect of number of insect-pests on Fairchild plants, three plants were treated with insecticide and were considered as control whereas, three plants were non-treated and were considered as insect-pest infested plants. Each plant was divided in three segments; upper, middle and lower. From each segment, three leaves were tagged and data was recorded from those tagged leaves with three days interval. The data was collected in the morning from February to end of March during the year of 2015 and the total number of insect pests observed on chemical treated and no treated plants is shown in fig. 1. Number of insects from each portion was counted. Number of sucking insect pests from each plant were counted and the collected data was correlated with nutritional value of fruit by linear regression. Following parameters were taken under consideration during the period of study:

Fruit weight (g)

Fruit weight is an important parameter both for scientific understanding and for commercial purposes. Measured by electric balance (Barranco *et al.,* 2004) in grams.

Juice percentage

The juice % was calculated in following way (Pozo *et al.,* 2007).

$$\text{Juice \%} = \frac{Total\ weight\ of\ juice\ (g) - beaker\ weight\ (g)}{Total\ weight\ of\ fruit\ (g)} \times 100$$

pH of juice

For pH measurement, about 20 ml of juice was taken in a beaker and pH was determined using digital pH meter (Hanna Instruments, Mauritius; Cairns *et al.,* 2002).

Total soluble solids (°brix) in juice

A refractometer ATAGO, RS-5000 (Atago, Japan), was used to measure total soluble solids (TSS) of juice. The reading of TSS (%) was recorded with the refractometer that was pointed directly at a light source (Saleem *et al.,* 2007).

Acidity of juice (%)

Titratable acidity (TA) of fruit juice was determined by method given by Ranganna (1986).

$$\text{TA \%} = \frac{0.1\ N\ NaOH\ used \times 0.0064 \times 100}{ml\ of\ juice\ used}$$

Results

Fruit weight (g)

With the increase of insect pest population the fruit weight affected and lost their fruit weight upto10.61% as compared to control. The scatter plot (Fig. 2) spectacles the interaction between fruit weight and insect pest population of Fairchild plant. It was also indicated that fruit weight and insect-pests population had negative association.

Total soluble solids (°brix)

The scatter plot (Fig. 3) indicates that there is a negative association between the total soluble solids and population of insect pest. As the population of insect pests increases, the total soluble solids decrease to 4.31% compared to control.

Juice percentage

There was a non-significantly negative association between the juice percentage and population of insect pest. As the population of insect pests increases, the juice percentage decreased to 25.07 % as compared to control (Fig. 4).

pH

Positive association was observed between the pH and population of insect pests. Population of insect pest was increased along with the pH value of juice upto 2.59 % compared with control (Fig. 5).

Titratable acidity

Data presented in Fig. 6 display a negative association between the titratable acidity and population of insect pest. As the population of insect pest was increased titratable acidity of fair-child fruit was decreased 7.89 % as compared with control.

Discussion

Different biotic and abiotic stresses are threatening the agricultural productivity (Aslam *et al.,* 2013; Aslam *et al.,* 2015; Maqbool *et al.,* 2016) Insect-pest damage the quality and quantity of all agricultural crops including fruit crops (Miguel and Clara, 2003). In our study fruit quality of fair-child fruit was observed under the infestation of different insect pests. The insect-pests infestation significantly reduced the fruit fresh weight, total soluble solids, juice percentage, which was may be due to sucking of plant sap and damaging the plant photosynthetic factory leaf through damaging and reducing the leaf surface area exposed to light with increase in insect-pest population (Zubair *et al.,* 2015). Similarly, with the increasing population of insect pest on plants lead to depletion of transportable carbohydrate which cause reduction in fruit weight as reported by Byrne and Bellows, (1991).

By the feeding of insects on plants, carbohydrates and total soluble solids also decreased due to stress created by insect attack, which leads to the reduction of growth prospective and ultimate juice percentage in fruit in our study carbohydrate contents were no studied but our results are in confirmation of the study of Bardner and Fletcher, (1974) which reported that increase in incest-pest attach reduce carbohydrate and total soluble solids in plants.

An increase in pH and decrease in titratable acidity was observed under increasing insect-pest infestation due to fluctuation in total soluble salts and carbohydrate status of fair-child fruit. These results are supported by the previous study of (Lu *et al.*, 2007; Koch, 1996) which stated that the carbohydrate depletion and total soluble salts changes can affect the status of pH and acidity in plants. So that the carbohydrate play an important role, not only in metabolic processes associated with fruit development, but also in respiratory processes (Liu *et al.*, 1999; Zubair *et al.*, 2015). The above reference confirm our results and show that insect pest infestation decreases the fruit weight. Because due to insect attack depletion of carbohydrate occurred which reduced the growth potential of plant as carbohydrate play an important role in development of fruit (Zubair *et al.*, 2015).

Conclusion

It was concluded that sucking citrus aphid, citrus psylla and thrips are deleterious for fair-child fruit quality and production with the passage of time and they become very drastic for both quality and productivity of crop and their early control is essential to prevent the crop damage and losses from these sucking insect-pests.

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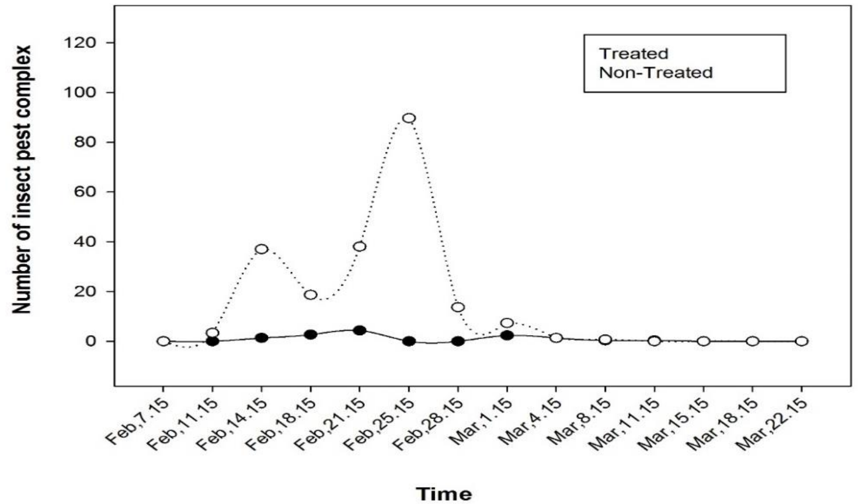

Figure 1: Number of insect pest observed through Feb – Mar 2015 on Fairchild fruit plant

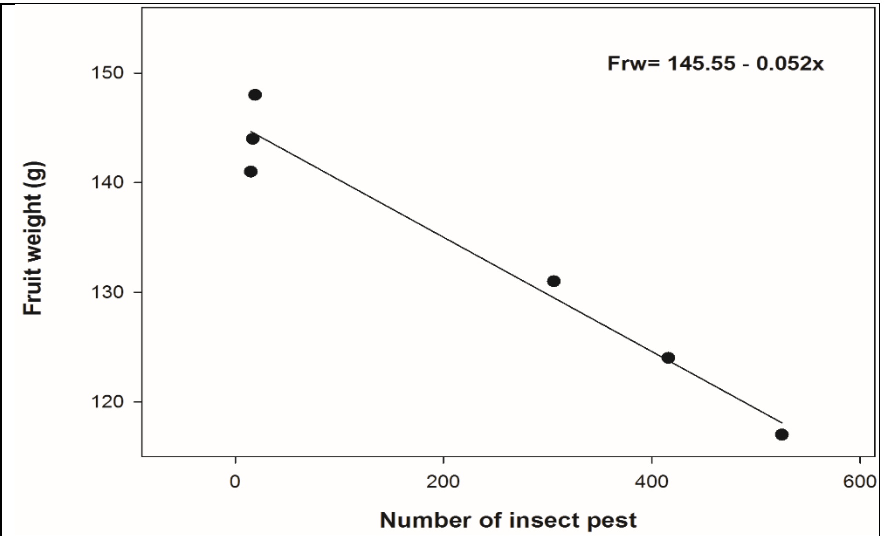

Figure 2: Effect of number of insect pest on fruit weight of Fairchild fruit

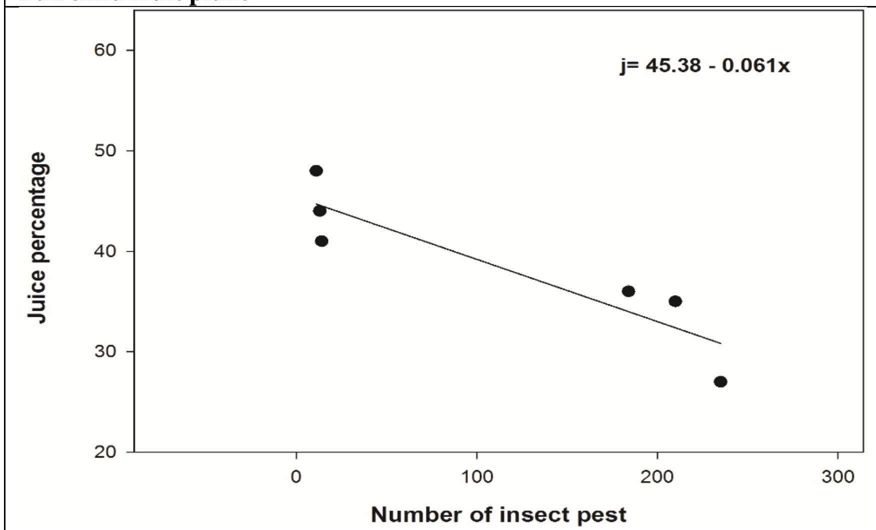

Figure 3: Effect of number of insect pest on juice of Fairchild fruit

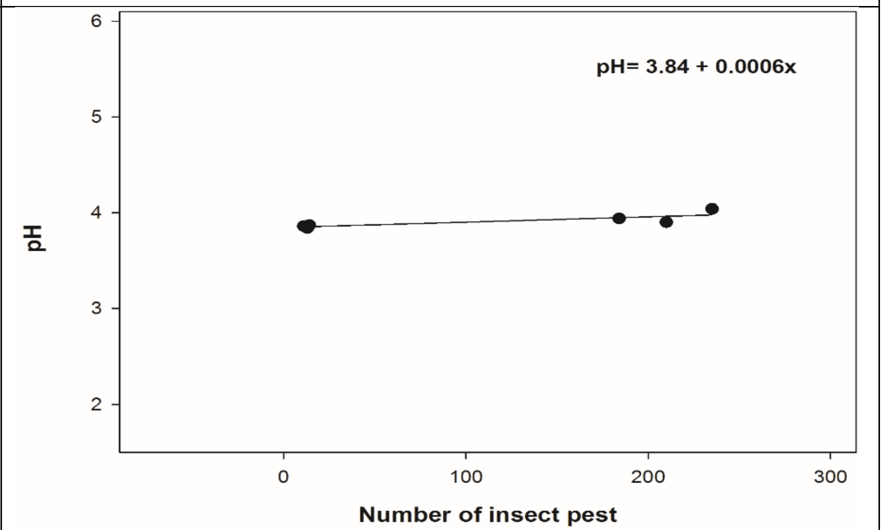

Figure 4: Effect of number of insect pest on pH of Fairchild fruit

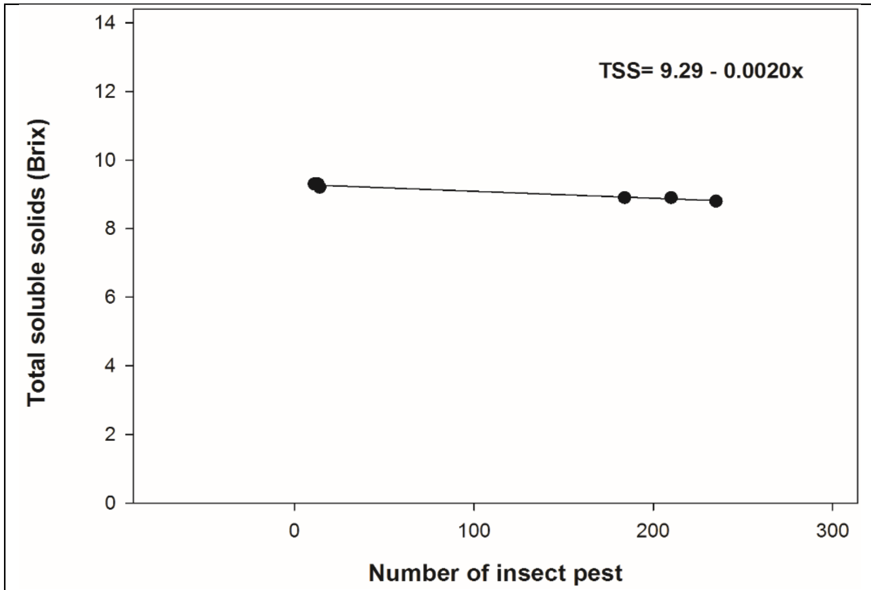

Figure 5: Effect of number of insect pest on total soluble solids (Brix) of Fairchild fruit

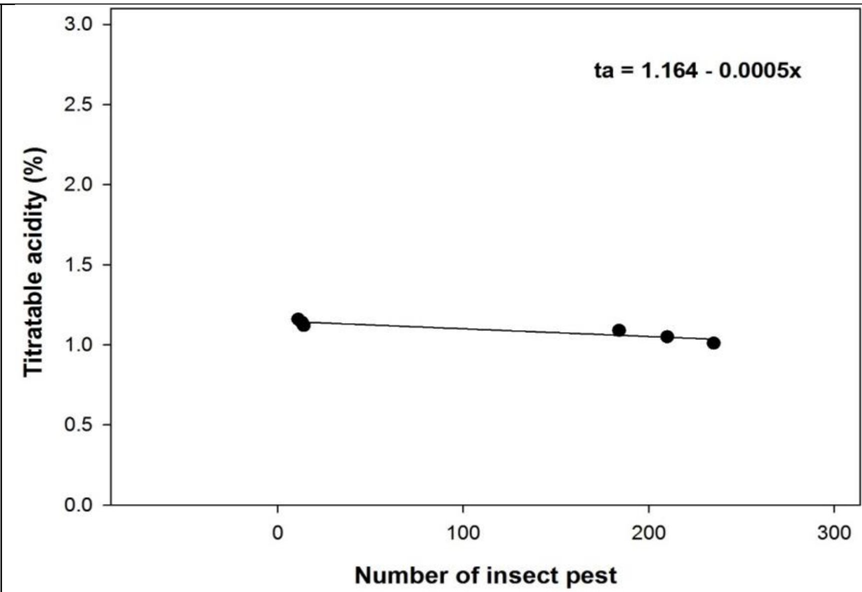

Figure 6: Effect of number of insect pest on titratable acidity of Fairchild fruit