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Nutritional Assessment of Kinnow Mandarin Fruit (*Citrus reticulata* Blanco), Infected by Few Sucking Insect-Pests of Citrus

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Abstract: Present study was planned to investigate the detrimental effects of sucking insect-pests of citrus i.e., aphid, citrus psylla, white fly and thrips on various fruit related attributes and selected nutritional profile in Kinnow mandarin (*Citrus reticulate* Blanco). A marked enhancement from 15 to 416 in sucking insect-pest population was observed throughout the entire duration of study. A significant decline in fruit weight, total soluble solids, juice percentage and acidity while an augmentation in pulp weight and juice pH was recorded in response to elevation in infestation by target sucking insect-pests. However, quality characteristics like pulp/peel ratio, and peel weight had non-significant effect of insect-pest attack. A strong correlation was also established between infestation strengthen (insect-pest population) and fruit weight, total soluble solids and juice percentage.

Key words: Citrus, kinnow, sucking insect-pests, population, juice, quality

INTRODUCTION

Among the imperative and acceptable fruits in the world, citrus have distinguished position. Brazil and Florida are the leading regions in production and processing of citrus (Al-Farsi, *et al*., 2005; Niaz, *et al*., 2004; Yadav, 2007).

This fruit was initially grown by the inhabitants of Southeast Asia (Indonesia and China) but now broadly grown almost everywhere in the world under tropical and sub-tropical climate where the soil is quite favorable for its growth (Shah, 2004). Approximately 85% of the total soluble solids of citrus fruit are sugars. Citrus is a source of vitamin C and also contains an inspiring list of other essential nutrients (Whitney and Rolfes, 1999).

Production of citrus is being affected by different issues of abiotic and biotic stresses. Among all biotic factors, insect pests and diseases are major factors which not only reduce the growth of plant but also decrease the quality and quantity of the fruit (Abbott, 1999). Plant physiology (like quality of fruit, nitrogen in leaves) is negatively affected by insect pests (Ladanyia and Ladaniya, 2010; Malik and Bashir, 1994)

Different scientists have observed the damage insect pests on various crop. Mraicha *et al*. (2010) studies the quality of olive oil effected by olive fruit fly and resulted that the free acidity positively correlated with degree of attack of olive fruit fly and phenolic contents are negatively related. There was no significant change in fatty acid composition by infestation. Insect- pest infestation causes damage to the olive fruit and decrease the phenolic concentration and antioxidant quality of olive Sunpest damage increased up to 9%, protein content and sedimentation values decreased in grains in 100 Kernel weight (Kinaci and Kinaci, 2004).

Whitefly is a big feeder of phloem sap and hence reduces transportable carbohydrate and other nutrients carried in vascular bundles and reduces overall productivity of host plants by competing for available nutrients (Byrne and Bellows, 1991).

Six macro nutrients and seven micro nutrients were analyzed in six popular indigenous mulberry varieties by insect pest infestation. Due to aphid, citrus psylla, white fly and thrips infestation all the nutrients were decreased in leaves of mulberry in almost all the varieties. Feeding on such leaves will affect the growth and development of silkworms which affect the silk production (Mahadeva and Nagaveni, 2012).

Effect of feeding of the rosy apple aphid, on apple fruit and leaf growth was studied on the branches of two-year-old Golden Delicious trees grafted on M26 rootstock. There was a little influence on leaf growth. At high fruit densities the contribution was relatively higher at high than at low aphid densities. (De Berardinis *et al*., 1994).

The present study was planned to measure the fruit contents in mandarin after the infestation of sucking insect-pest and correlate the population of sucking insect-pest with fruit contents.

MATERIALS AND METHODS

The present study was conducted in the citrus progeny block at University College of Agriculture, University of

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Sargodha. To observed diversity in the number of infecting insect-pests on kinnow plants. Three plants of were tagged as insecticides treated and three plants were insecticide non treated. Each plant was divided in three portions, upper, middle and lower. From each portion, three leaves were tagged and data was recorded from these tagged leaves after three days interval. Data was collect at morning time from Feb to end of March. Number of insects from each portion was counted. Number of sucking insect pests from each plant was correlated with the nutritional value of fruit by linear regression. Following parameters were used:

Fruit weight (g): Fruit size is an important parameter both for scientific understanding and for commercial purposes. Measured by electric balance (Rosati, *et al*., 2009) in grams.

Peel weight (g): Peel weight in grams was measured by using digital electric balance (KERN and Sohn GmbH, Germany. WC0757708 (Shokrollah *et al*., 2011).

Pulp weight (g): Pulp weight in grams was measured by using digital electric balance (KERN &Sohn GmbH, Germany. WC0757708 (Shokrollah *et al*., 2011).

Juice percentage: The juice content was calculated in following way (Pozo *et al*., 2007).

$$\text{Juice\%age} = \frac{\text{Total wt. of juice (g)} - \text{Beaker wt. (g)}}{\text{Total wt. of fruit (g)}} \times 100$$

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).

TA (%) = 0.1 N NaOH used x 0.0064 x 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 (Table 1). The scatter plot (Fig. 1) spectacles the interaction between fruit weight and insect pest population of Kinnow plant. It also indicated that fruit weight and insect-pests population have a negative association.

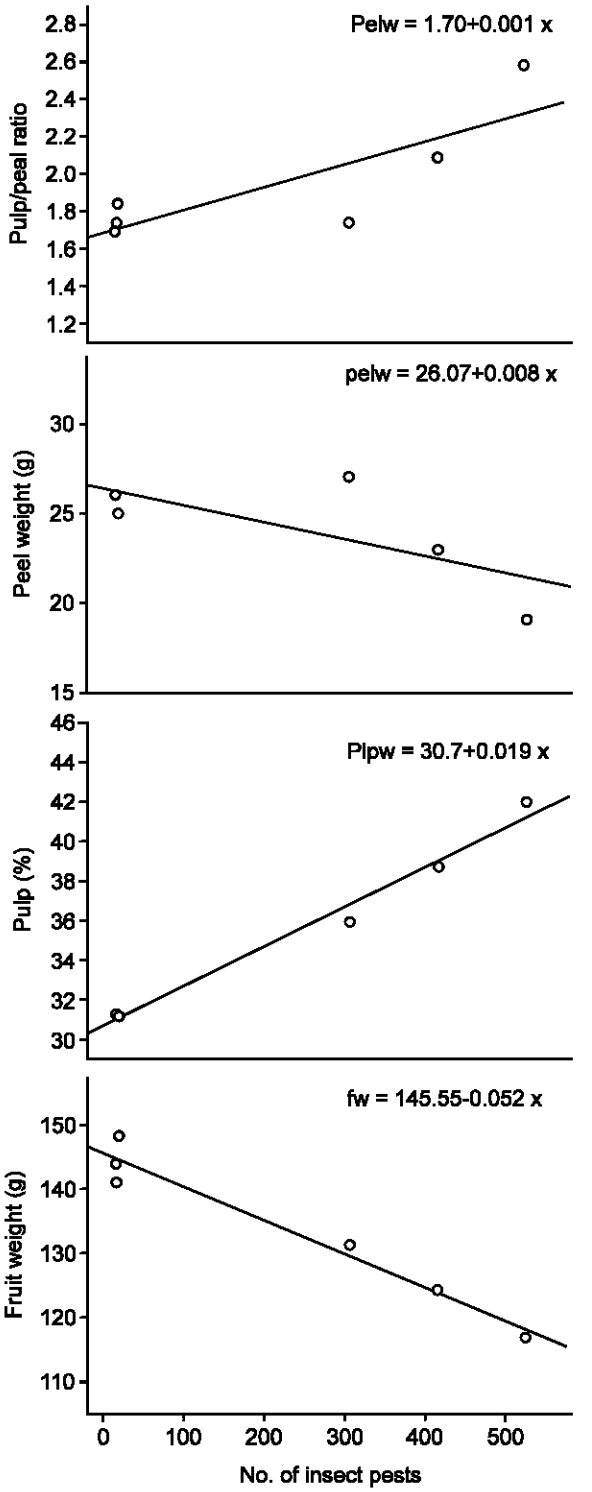

Fig. 1: Effect of number of insect pest on fruit weight, peel weight, pulp% and pulp peel ratio of kinnow fruit

Peel weight (g): There was minor and none significant decrease in peel weight due to insects infestation,

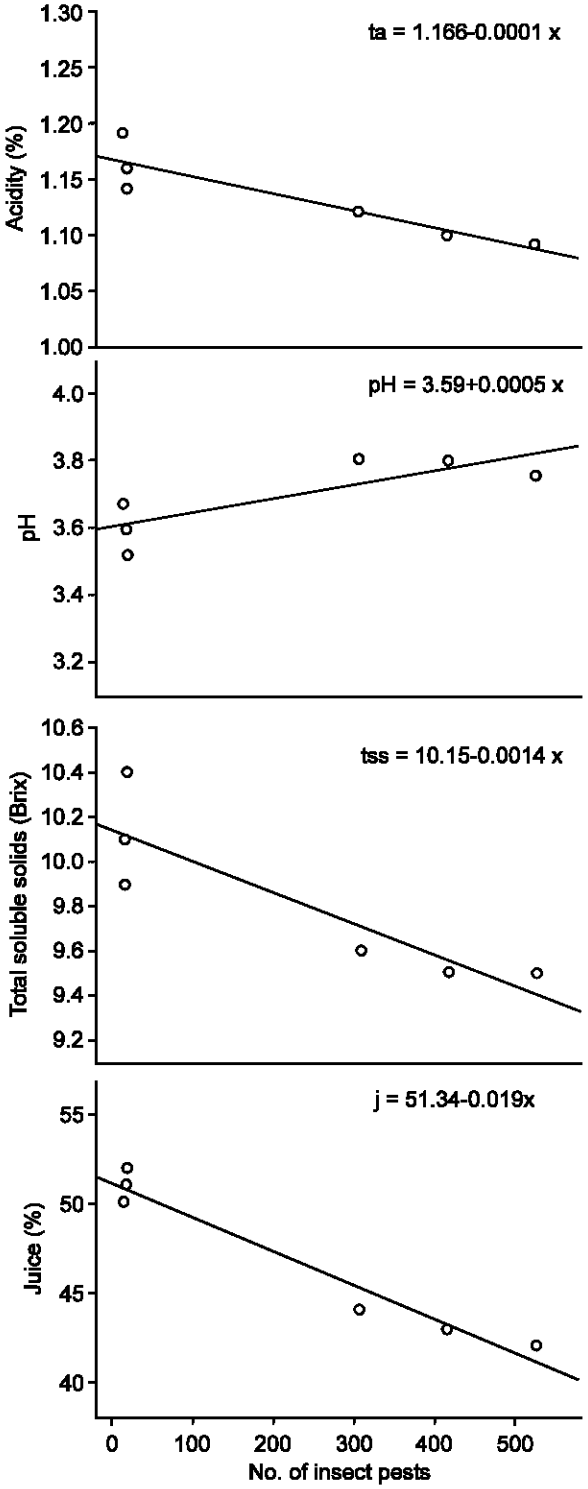

Fig. 2: Effect of number of insect pest on juice%, Total soluble solids (Brix), pH and Titratable acidity of kinnow fruit

scatter plot (Fig. 1) also displays the association between peel weight of Kinnow (in gram) and insect pest population (in number). It indicates that there is no significantly association between peel weight and population of insect pests.

Pulp percentage (g): The data in Table 1 showed a significant increase in pulp percentage of kinnow due to increase in insect infestation and reduction in juice percentage. The scatter plot (Fig 1) also depicted the association between pulp percentage of Kinnow and insect pest population. It clearly indicated that there is a positive association between pulp weight and population of insect pest. As the population of insect pest increases, the pulp percentage also increases.

Pulp / peel ratio: According to the results presented in Table 1 non significant positive association was observed between the Pulp/peel ratio and population of insect pest. As the population of insect pest increases, the Pulp/peel ratio also increased. While there will be minor increases (0.001) in the Pulp / peel ratio for a unit increase in insect pest population

Total soluble solids (Brix): The scatter plot (Fig. 2) 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.

Juice percentage: There was a negative association between the juice percentage and population of insect pest. As the population of insect pests increases, the juice percentage decreases.

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.

Titratable acidity: Data presented in Fig. 2 displayed a negative association between the titratable acidity and population of insect pest. As the population of insect pest was increases, which decreased the titratable acidity.

DISCUSSION

Sucking insects uses specialized mouth part (stylet) for chronic shortages of photosynthesis by heavy infestation of sap sucking insects and severely reduces the growth potential of the plant (Mahadeva, 2011). The increased population of insects on plant resulted in depletion of transportable carbohydrate which leads to reduction in fruit weight (Byrne and Bellows Jr., 1991). When insect feed on plants, carbohydrates and total soluble solids are decreased due to stress caused by insect attack, which leads to the reduction of growth potential and ultimate juice percentage in fruit (Bardner and Fletcher, 1974). Plant responses to fluctuation in carbohydrate

Table 1: Effect of number of insect pest on fruit weight, peel weight, pulp%, pulp peel ratio, juice%, Total soluble solids (Brix), pH and Titratable acidity of Kinnow fruit

Number of Insect	Fruit weight	Peel weight	Pulp %	pulp peel ratio	Juice %	pH	Titrable acidity	TSS
15	141	26	31.2	1.69	50	3.67	1.19	9.9
19	148	25	31.1	1.84	52	3.52	1.14	10.4
17	144	26	31.3	1.73	51	3.6	1.16	10.1
306	131	27	35.9	1.74	44	3.81	1.12	9.6
525	117	19	41.9	2.58	42	3.76	1.09	9.5
416	124	23	38.7	2.09	43	3.8	1.1	9.5

status vary noticeably. Carbohydrate depletion in multi cellular plants regulates genes for photosynthesis, remobilization and export, while decreasing mRNAs for storage and utilization (Koch, 1996). Results suggest that carbohydrate play an important role, not only in metabolic processes associated with fruit development, but also in respiratory processes (Liu *et al*., 1999). So, above reference confirm present results that insect pest infestation decreases the fruit weight. Because due to insect attack depletion of carbohydrate occurred which reduced the growth potential of plant and carbohydrate played an important role in development of fruit.

Fruit peel is very imperative factor to determine the shelf life of fruit. Postharvest life of citrus fruit is strongly influenced by the nature of the peel. Usually, citrus fruits with thin peel and easily separated from segments present a shorter postharvest life than those which, like oranges, lemons and grapefruits, have a thick and compact layer of albedo strongly linked to the segments (D'Aquino *et al*., 1999). According to our result minor decrease in peel weight and fruit weight was observed by insect pest infestation on citrus. This minor decrease was also due to reduction in transportable carbohydrate (Byrne and Bellows, 1991) and during the period of rapid fruit size expansion, soluble sugars accounted for most of the increase in fruit tissue biomass (peel: 17% to 22%, flesh: 40% to 44%, of weight) (Liu *et al*., 1999).

The physical analysis profile of fruit is incomplete without determination of pulp weight. When citrus is processed for juice or sections, 45 to 60 percent of their weight remains in the form of peel, pulp and seeds (Hendrix and Redd, 1995). The extracts of the citrus pulps usually contain beta-cryptoxanthin, in considerable amounts in all species except lime and the red apocarotenoid beta-citraurin as well. In case of mandarin and lime the carotenoid compositions of peel and pulp show a good coincidence (Agócs *et al*., 2007). In present results there was minor increase in pulp weight which was significant in Kinnow.

Conclusion: It was concluded that sucking insect-pest at their initial stage of attack and growth are less deleterious to Kinnow fruit quality and production but with the passage of time they become very drastic for both quality and productivity. Therefore, their management should be made at their early stages of growth to increase the quality and production of Kinnow in Pakistan.

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