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Chemical manipulations in the fruit yield and quality of Shan-e-Punjab peach

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ABSTRACT

Shan-e-Punjab peach despite of being an old variety still is the choicest variety for the commercial cultivation in subtropical plains of northern India. The present investigation was carried out on 10 years old Shan-e-Punjab trees grafted on Sharbati seedling rootstock of peach. The trees were sprayed twice with calcium nitrate (1.0, 1.5 and 2.0 %), silver nitrate (0.005, 0.010 and 0.015 %) and zinc sulphate (0.25, 0.50 and 0.75 %). Results revealed that the foliar sprays of nutrients significantly influenced the yield and quality of peach fruit. The foliar sprays of calcium nitrate (2.0%) significantly increased the fruit yield (65.21 kg/plant), fruit weight (71.65 g), fruit length and breadth (5.62 and 5.02 cm), pulp weight (67.65 g), fruit firmness (14.73 lb/inch^2), TSS (12.36^{o}B), total sugars (8.01%) and juice content (37.32%), while it decreased the titratable acidity (0.74%) and polyphenol content (341.00 unit/ml/min) in peach fruits over the other treatments. The sprays of zinc sulphate (0.50%) also proved effective in respect of TSS improvement with lowest content of acid. The highest level of polyphenol oxidase activity (360.11 unit/ml/min) in pulp was registered in the fruits, harvested from untreated control peach trees.

Key words: *Prunus persica*, foliar nutrition, calcium nitrate, silver nitrate, zinc sulphate.

INTRODUCTION

Despite of being a deciduous and temperate fruit, peach has also shown great success in the subtropical areas of northern India. The low-chill peach cultivar like Shan-e-Punjab is being extensively grown in the subtropical areas of Jammu region for fresh fruit consumption. The trees are vigorous, and fruit development takes place during the summer months (March-May), and ready to harvest in last week of May. The fruits are highly perishable, and have very short shelf-life (2-3, days at ambient temperature), hence can not be transported over long distance. The fruit yield and quality depends upon various pre-harvest factors, of these foliar nutrition is one of the factors determining the quality and profitability of peach crop. Mineral nutrition is reported to influence the storage quality of fruits in many ways (Fallahi *et al*., 5).

Deficiency of calcium induces a range of postharvest disorders in several fruits and vegetables. Cell wall is being maintained by the uses of calcium as its interaction with pectin results in calcium pectate which assists molecular bonding between constituent of the cell wall (Dong *et al.,* 4). Pre-harvest calcium chloride sprays are known to extend the storage life by maintaining the fruit quality. Similarly, zinc and silver also influence the fruit quality in various ways. Zinc is a component of approximately 60 enzymes, playing a vital role in producing the growth hormone indole-acetic-acid, and also has a key role in N metabolism in plant, while silver ions act as anti-ethylene agent, and are effective in increasing shelf-life of fruits (Mahajan and Chopra, 10). So the present study was attempted to elucidate the influence of foliar applications of calcium, silver and zinc on yield and quality attributes of fresh peaches .

MATERIALS AND METHODS

The present investigation was carried out on ten years old Shan-e-Punjab peach trees planted at spacing of 7m × 7 m on Sharbati rootstock at Jakh, Samba, and the fruit quality was analysed in the lab of Division of Fruit Science, SKUAST, Jammu. The trees were sprayed twice with calcium nitrate (1.0, 1.5 and 2.0 %), silver nitrate (0.005, 0.010 and 0.015 %) and zinc sulphate (0.25, 0.50 and 0.75 %). The first spray of calcium nitrate and zinc sulphate (neutralized with lime) was given after petal fall stage, and second spray at 2 weeks before harvest, while silver nitrate was sprayed at five and two weeks before harvest. The experiment was laid out in randomized block design with 10 treatments, and replicated thrice.The observations for various physico-chemical characteristics were recorded at the commercial maturity (in the first week of June). The data on fruit yield were recorded and expressed

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as Kg/ tree. The average weight of 10 fruits per replication for each treatment was measured using electronic balance. The average fruit size was worked out with the help of vernier caliper. The pulp weight of was calculated by subtracting the stone weight from the total fruit weight. The fruit firmness was measured with the 'Magness Taylor Pressure Tester' (Plunger dia 8mm). The plunger was held against the fruit surface and forced into the fruit flesh with steady pressure. TSS of fresh fruit was determined by using a hand refractometer (Erma, Japan). Titratable acidity in terms of citric acid was determined by titrating 10 ml juice against standard solution of 0.1 N sodium hydroxide to a light pink colour adding phenolphthalein as an indicator (Ranganna, 14). Sugars were estimated as per the method of Lane and Eynon (9). Juice was extracted from the fruits with the help of juice extractor, strained through a muslin cloth and weighed in gram, and the percentage of the juice was calculated. Polyphenol oxidase (PPO) was assayed according to the method of Sadasivm and Manickam (15). The statistical analysis was performed by R-studio Version 2.0 3.1.3 (2018) using Library Tidy verse metrics.

RESULTS AND DISCUSSION

Application of various foliar nutrients significantly affected the yield and quality parameters of Shan-e-Punjab peach (Table 1).The highest fruit yield (65.21kg/plant) was recorded in 2.0% calcium nitrate treated trees, which was followed by 0.50% zinc sulphate,1.5% calcium nitrate and 1.0% calcium nitrate with the yield of 64.14, 63.07 and 61.24 kg/ plant, respectively. However, it was lowest (48.50 kg/ plant) under control plants. These results are in line with the findings of Raina *et al*. (12) who reported maximum yield in Sharbati peach with the foliar application of 2.0% calcium nitrate. The application of 2.0% calcium nitrate also exhibited highest fruit weight (71.65g) which was followed by 0.5% zinc sulphate (70.32g) and 1.5% calcium nitrate (69.45g) spray treatments. The lowest fruit weight (63.19g) was recorded in untreated plants. Application of calcium increased the assimilatory power of leaves to accumulate higher metabolites. These results are in close conformity with the finding of Gautam *et al.* (6) in peach. Zinc sulphate applications improved fruit weight through increased rate of cell division and cell enlargement leading to more accumulation of metabolites (Babu and Singh, 2).

The fruit firmness increased with the increase in concentration of calcium nitrate, zinc sulphate and silver nitrate (Table 1). Maximum fruit firmness (14.73 lb/inch^2) was obtained with 2.0% calcium nitrate, whereas least firmness (12.56 lb/inch^2) was recorded in control. The higher fruit firmness may be attributed to formation and deposition of calcium pectate responsible for thickening of middle lamella (Gupta *et al*., 7). Also according to Mastrangelo *et al*. (11) calcium forms the cross link with carboxylic group of polygalacturonase polymerase present in middle lamella of cell, and also reduce the activity of polygalacturonase thus stabilizing and strengthening the cell wall which is an accepted reason for firmness. Calcium nitrate 2.0% resulted in higher pulp weight and Sarrwy *et al.* (16) also reported that similar results in date palm cv. Amhat. Juice percentage was significantly affected with foliar application of nutrients and maximum juice content was recorded with calcium nitrate 2.0%. The

Table 1. Effect of foliar nutrition on yield and fruit quality of Shan-e-Punjab peach.

Treatments	Yield (kg/plant)	Fruit weight (g)	Fruit size (cm)		Fruit Volume (cc)	Fruit Firmness (lb/inch^2)	Pulp weight (g)	Juice (%)
			Length	Breadth				
Calcium nitrate (1.0%)	61.24	67.22	5.35	4.75	70.36	14.15	62.81	36.38
Calcium nitrate (1.5%)	63.07	69.45	5.44	4.84	72.24	14.42	65.30	36.16
Calcium nitrate (2.0%)	65.21	71.65	5.62	5.02	74.28	14.73	67.65	37.32
Silver nitrate (0.005%)	51.45	66.85	4.89	4.39	66.76	12.96	61.62	35.15
Silver nitrate (0.010%)	54.59	65.49	4.99	4.48	67.24	13.13	60.37	35.51
Silver nitrate (0.015%)	56.10	66.96	5.08	4.62	68.74	13.42	62.04	35.98
Zinc sulphate (0.25%)	58.93	67.30	5.17	4.57	66.26	13.74	62.57	36.24
Zinc sulphate (0.50%)	64.14	70.32	5.53	4.93	71.24	14.68	66.16	36.94
Zinc sulphate (0.75%)	60.71	68.29	5.26	4.66	69.36	14.34	63.77	36.76
Control	48.50	63.19	5.06	4.27	64.28	12.56	57.68	34.98
C.D. ($p \leq 0.05$)	0.53	0.78	0.09	0.07	1.24	0.17	0.12	0.78

Table 2. Effect of foliar nutrition on biochemical parameters of Shan-e-Punjab peach.

Treatments	TSS (°B)	Acidity (%)	Total sugars (%)	Polyphenol oxidase (unit/ml/min)
Calcium nitrate (1.0%)	11.20	0.81	7.25	348.00
Calcium nitrate (1.5%)	11.84	0.76	7.78	346.51
Calcium nitrate (2.0%)	12.36	0.74	8.01	341.00
Silver nitrate (0.005%)	10.16	0.78	6.94	358.61
Silver nitrate (0.010%)	10.42	0.82	7.06	356.70
Silver nitrate (0.015%)	10.84	0.88	7.26	354.23
Zinc sulphate (0.25%)	11.32	0.80	7.32	352.91
Zinc sulphate (0.50%)	12.16	0.72	7.91	344.22
Zinc sulphate (0.75%)	11.75	0.74	7.72	350.10
Control	10.00	0.92	6.78	360.11
C.D. ($p \leq 0.05$)	0.05	0.001	0.21	1.48

possible reason for maximum juice percentage was might be due to an enhanced deposition of solids in increased cell size and intercellular space which coupled with accumulation of water as reported by (Coombe, 3).

Various foliar sprays significantly influenced the fruit quality attributes of Shan-e-Punjab peach (Table 2). The highest total soluble solids (12.36°B) was observed in the fruits harvested from the trees sprayed with 2.0% calcium nitrate, while it was minimum in control. The increase in TSS content during the development processes is the effect of starch degradation and metabolic transformation in soluble sugars in the fruits as polysaccharides during later stages of harvesting. Similar results were documented by Rajkumar *et al.* (13) who observed that 2.0% calcium nitrate increased the TSS content in papaya. The fruits from control trees were highest in acid content, while the lowest acid content (0.72%) was found with 0.50% zinc sulphate application. The fruits of plants treated with 0.50% zinc also showed highest total sugar contents (8.01 per cent), while it was lowest in control (6.78 %). Increase in the level of total sugars in treatments containing Zn may be attributed to its effects on the activities of aldolase enzyme which is involved in the formation of sugars in fruits (Alloway, 1). The minimum polyphenol oxidase activity was observed in 2.0% calcium nitrate treatment (341.00 unit/ml/min). Calcium decreases the concentration of organic solutes in the fruit. These results are also in close conformity with the findings of Wang *et al*. (17) who reported that pre-harvest treatment of calcium decreased the activity of polyphenol oxidase in peach.

The Fig. 1 plot showed correlation among the fruit yield, fruit weight, fruit size (length and breadth) of peach cv. Shan-e-Punjab and depicted an association between the fruit parameters through line plot. The more linear the line, the strong is the correlation. Also, the fonts of the numerical figures in the graph depicts the degree and intensity of correlation between the variables under study. The larger is the font, the stronger is the correlation. Similar results were reported by Lal *et al*. (8). The Fig. 2 showed correlation among the fruit firmness, pulp weight, total soluble solids (TSS) and polyphenol oxidase (PPO) of peach cv. Shan-e-Punjab and depicted an association between the fruit parameters with line plot. Also, the fonts of the numerical figures in the graph depicts the degree and intensity of correlation between the fruit firmness, pulp weight, TSS and PPO. The Fig. 3 showed

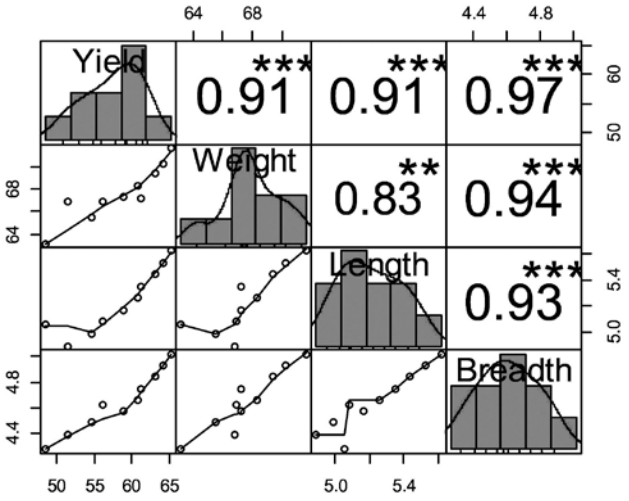

Fig. 1. Correlation plot of fruit characteristics of Shan-e-Punjab peach.

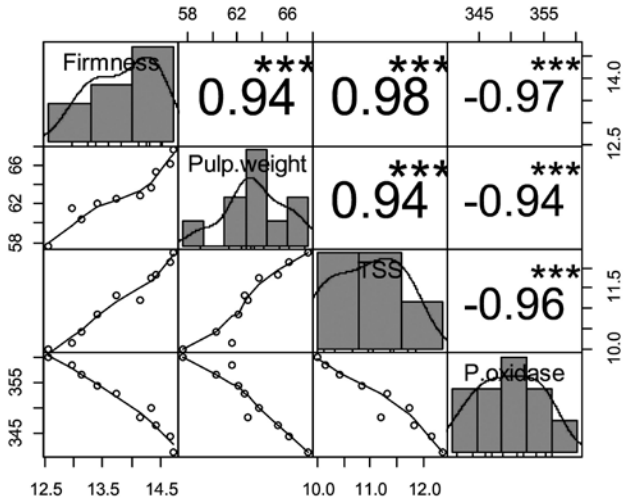

Fig. 2. Correlation plot of fruit characteristics of Shan-e-Punjab peach.

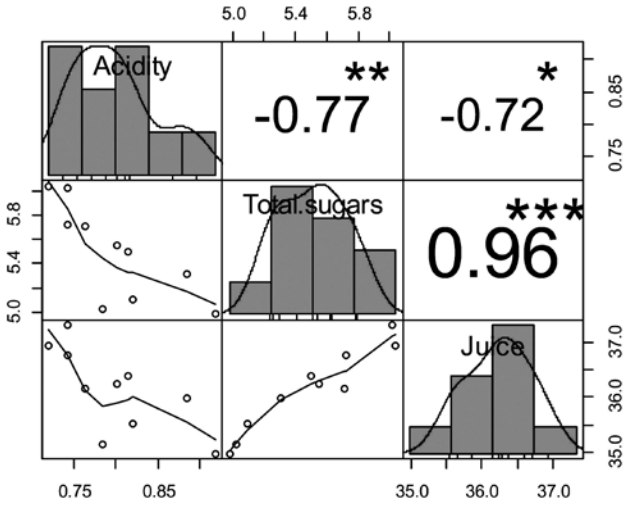

Fig. 3. Correlation plot of fruit characteristics of cv. Shan-e-Punjab peach.

correlation among the titratable acidity total sugars and juice content of peach cv. Shan-e-Punjab and depicted an association between the biochemical characteristics with line. The juice content showed a stronger correlation with TSS content of peach as depicted by the font size.

It is concluded that foliar application of calcium nitrate 2.0% was most effective for better fruit yield and quality in Shan-e-Punjab peach.

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