Indian J. Hort. 71(1), March 2014: 92-98

Effect of salicylic acid and calcium on the shelf-life of peach cultivars

B.L. Attri*, Hare Krishna*, B. Das, J.K. Ranjan*, Pragya**** and N. Ahmed*****

Central Institute of Temperate Horticulture, Regional Station, Mukteshwar 263 138, Uttarakhand

ABSTRACT

For extending the marketability, a study was carried out on the effect of bio-regulators, *viz*., salicylic acid and Ca-EDTA on different peach cultivars like FLA-16-33, Flordaking, Canter and Flordasun. The selected fruits were dipped for 10 min. in salicylic acid @ 400 ppm, Ca-EDTA @ 500 ppm and control (distilled water dip). The treated fruits were stored in CFB boxes at ambient temperature (20-22°C having RH 85-90%) for two weeks. During storage, physico-chemical characteristics such as TSS, acidity, ascorbic acid and sugars of different treatments were studied at 3 day intervals. The results revealed that the fruits treated with bio-regulators and calcium had significantly better firmness and low PLW (16.83-25.08%) during storage for 12 days as compared to control (21.28-27.10%) after 9 days. The TSS, acidity, ascorbic acid and sugars in treated peaches remained intact, whereas in untreated fruits, the conversion rate was faster. The treated fruits irrespective of cultivars had a shelf-life of 14 days as compared to 9 days in control. Thus, the shelf-life of the peaches could be increased with better physico-chemical characteristics using bio-regulators like salicylic acid and Ca-EDTA.

Key words: Peach, salicylic acid, calcium, physico-chemical characteristics, ascorbic acid.

INTRODUCTION

Peach (*Prunus persica* L. Batsch.) is one of the most important stone fruits gaining popularity in mid to high hill temperate zones owing to global climate change as it requires low chilling than other major temperate fruit crops. The fruits of peach arrive in the market before the onset of monsoon but have a limited shelf-life because of high respiration rate and fast ripening. It renders a glut in the market in the season and the growers do not get remunerative returns for their produce. Loss of pulp firmness and rot development are the main factors that lower the quality of harvested fruits. Therefore, these fruits are generally marketed shortly after harvesting (Kluge and Jacomino, 11). Peaches are climacteric fruits and the ethylene action regulates their ripening process. At a certain stage of the ripening process, the ethylene links itself to its action site in the cell, promoting a succession of events that result in ripening and senescence (Moore, 18). The plant bio-regulators play a vital role to increase the shelf life of fruits. Of several growth regulators, salicylic acid, also known as 2-hydroxybenzenecarboxcylic acid, is an organic acid (Raskin, 22), which functions as plant hormone by checking the effect of ethylene production as well as biosynthesis thereby restricting the ripening in many fruits like apple (Yan *et al*., 24), peach (Han *et al*., 8) etc. Similarly, calcium is thought to be the most important mineral element determining the fruit quality. It helps in maintaining fruit firmness and decreases the incidence of physiological disorders (Conway *et al*., 6). Calcium is one of the most significant fruit tree nutrients but it is very difficult to accumulate enough in the fruit because of its less mobility in the plant. Its accumulation is more during the fruit development but tends to decrease in the latter phase (Cline and Hanson, 4). Conway and Sams (5) suggested that calcium treatment significantly reduced the rate of ripening as a result of enhanced endogenous levels of auxin and cytokinin. As the post harvest shelf-life of peach is very limited there is an need to ascertain post harvest management to improve the storage life in order to regulate the supply of quality fruits for longer period in domestic and distant markets. Hence, the present investigations were undertaken to study the effect of salicylic acid and calcium on the post harvest shelf-life of some peach cultivars.

MATERIALS AND METHODS

The present investigations were carried out at CITH Regional Station, Mukteshwar, Nainital (Uttarakhand) during 2009-10. Fully matured fruits of different cultivars of peach, *viz*., FLA-16-33, Flordaking, Canter and Flordasun were procured from the State Horticulture Farm, Chaubattia (Ranikhet) in plastic crates. In the laboratory, the bruised, insect-pests damaged and diseased fruits were sorted out and uniform size fruits sere selected for the

*Corresponding author's E-mail: attribl_cith@rediffmail.com
**CIAH, Bikaner, Rajasthan
***IIVR, PO Jakhani, Varanasi, U.P.
****NBPGR, New Delhi
*****CITH, K.D. Farm, Old Air Field, P.O. Rangreth, Srinagar 190 007 (J&K)

experiment. The selected fruits were subjected to proper washing in running water. After washing the fruits were given different post-harvest treatments in aqueous solutions of bio-regulators, *viz*., salicylic acid (SA) @ 400 ppm, Ca-EDTA (Ca) @ 500 ppm and control (distilled water dip) for 10 min. at ambient temperature (22-24°C). The concentration of the bio-regulators was selected on the basis of earlier work carried out on other temperate fruits as the higher concentration spoiled the fruits, whereas lower had insignificant effect. The dipping duration was also selected based on the earlier work. The treated fruits (50 in each treatment) were subjected to air-drying in shade at room temperature followed by storage in the card board boxes (CFB) at a temperature of 20-22°C having RH 85-90% for 2 weeks. The fruits as well as extracted juice was subjected to physical characters analysis, *viz*., weight (g), length (mm), breadth (mm), juice (%), and stone (%) by following standard methods (Ranganna, 21). Similarly, the total soluble solids (TSS °Brix) of the juice were recorded with hand refractometer (Erma, Japan) corrected at 20°C, acidity (%) and ascorbic acid contents as described by Ranganna (21). The reducing and total sugars (%) of the juice were estimated as per the methods of AOAC (1). The physiological loss in weight (% PLW) of the fruit was calculated on initial weight basis and expressed in per cent. The data following analysed completely randomized block design (CRD) with 12 treatments replicated thrice as per the methods given by Panse and Sukhatme (20).

RESULTS AND DISCUSSION

The maximum fruit weight was recorded in Flordasun (128.47 g) followed by Flordaking (118.80 g) and minimum in FLA-16-33 (109.42 g) (Table 1). The ascorbic acid content was the highest in Canter (21.40 mg/100 g) and the lowest in Flordaking (8.00 mg/ 100 g). The different cultivars of peach were found to have significant variations in various physico-chemical characteristics, which are attributed to the variation in the varietal characters of the fruits (Farooqui *et al*., 7). The highest PLW was recorded in the untreated fruits (water dip) of Flordaking (27.10%) followed by Flordasun (25.78%) as depicted in Fig. 1. The untreated fruits lost their firmness and marketability after 9 days of storage, whereas, the treated fruits particularly with SA had the lowest PLW in Flordasun (16.83%) followed by Canter (17.00%) having firm fruits compared to Ca-EDTA after 12 days of storage. The lowest PLW in the treated fruits may be attributed to the reduced respiration rate thereby maintaining the turgidity of the cells and increasing the shelf-life significantly. Exogenous application of SA decreases the respiration rate, leakage of cell membrane electrolyte, delay of the peak of ethylene production as well as an increase in polyphenol oxidase and peroxidase activities. Further, higher concentration (>500 ppm) have been found harmful in post harvest shelf-life of peaches (Li and Han, 14). The peach treated with $CaCl_2$ (4 & 6%) and stored in cold store proved effective in reducing spoilage, PLW and maintaining fruit firmness, palatability rating, acidity, vitamin A content and pectin methylesterase (PME) activity throughout the storage period as compared to ambient conditions (Navjot *et al*., 19). The exogenous application of salicylic acid inhibited the respiration rate and delayed the ethylene production peak of ripening peaches at ambient storage conditions (Han *et al*., 9). The plum fruits treated with $Ca(NO_3)_2$ (0.5, 1.0 and 2.0%) and stored at low temperature

Table 1. Physico-chemical characteristics of different peach cultivars.

Characteristics	Cultivar			
	FLA-16-33	Flordaking	Canter	Flordasun
Weight (g)	109.42 ± 0.442	118.80 ± 2.75	104.60 ± 2.29	128.47 ± 2.05
Length (cm)	5.48 ± 0.018	5.78 ± 0.006	5.55 ± 0.015	5.90 ± 0.015
Breadth (cm)	5.87 ± 0.009	6.20 ± 0.015	5.82 ± 0.006	6.42 ± 0.012
Stone wt. (g)	4.95 ± 0.015	4.75 ± 0.015	5.21 ± 0.012	5.98 ± 0.018
Pulp wt. (g)	87.60 ± 0.798	95.57 ± 0.646	85.17 ± 0.597	105.43 ± 0.384
TSS (°B)	8.6 ± 0.069	7.8 ± 0.069	7.8 ± 0.069	8.8 ± 0.069
Acidity (%)	0.59 ± 0.006	0.65 ± 0.006	0.66 ± 0.006	0.62 ± 0.006
Ascorbic acid (mg/100 g)	15.52 ± 0.029	8.00 ± 0.032	21.40 ± 0.034	8.20 ± 0.032
Reducing sugars (%)	1.40 ± 0.009	1.70 ± 0.018	1.74 ± 0.029	1.78 ± 0.069
Total sugars (%)	2.2 ± 0.069	2.4 ± 0.006	2.2 ± 0.015	2.0 ± 0.012

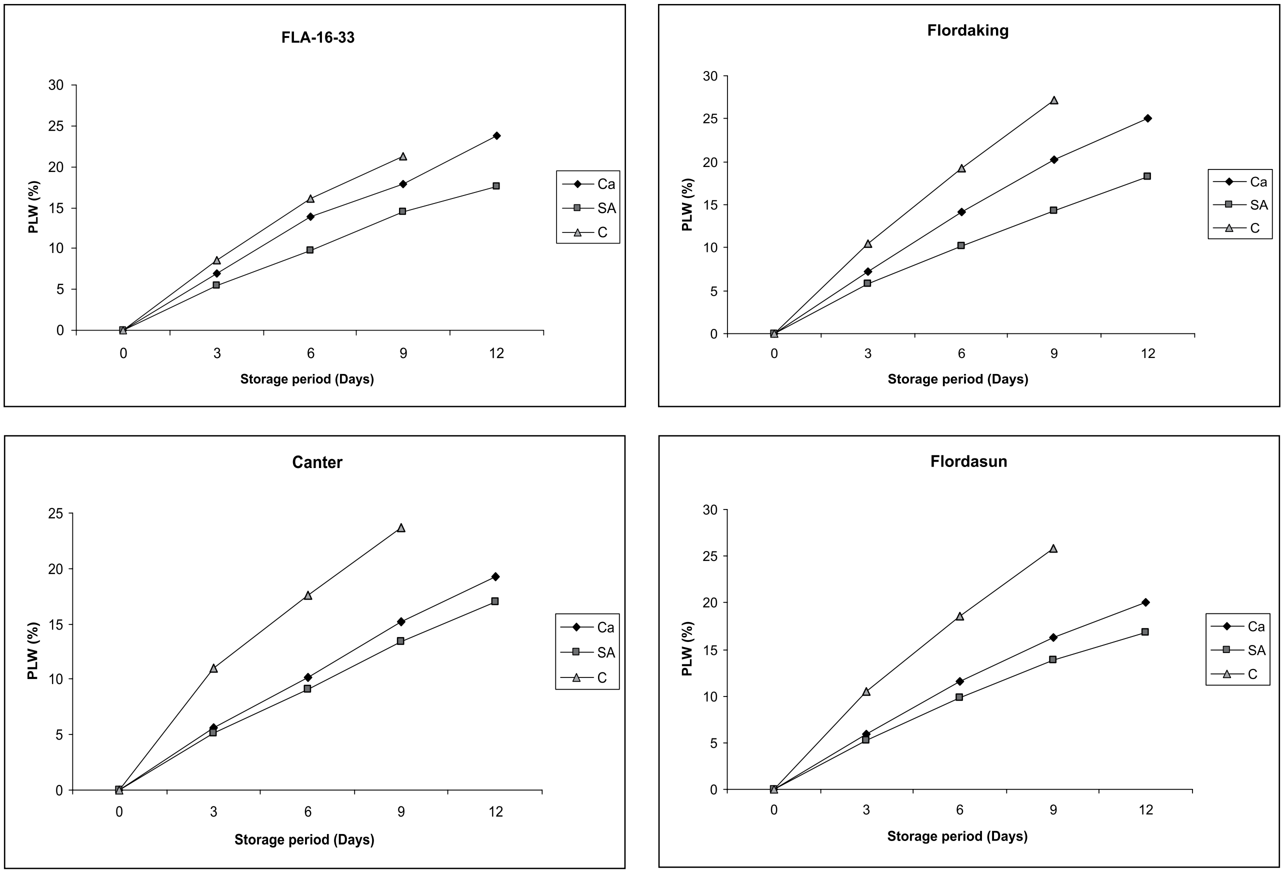

Fig. 1. Effect of various treatments on PLW (%) in different peach cultivars.

revealed that the fruits treated with 2% $Ca(NO_3)_2$ recorded the highest firmness throughout the storage as compared to control signifying the utility of calcium nitrate during transit and marketing (Mahajan *et al.*, 15). Similarly, the PLW (%) was also less in fruits treated with calcium nitrate revealing that calcium is helpful in maintaining fruit firmness and tissue rigidity thereby checking the moisture loss from the fruit surface. The retention of higher firmness with post harvest application of calcium nitrate may probably be due to the role of calcium in maintaining the cellular organization and regulating the enzyme activities (Jones and Lent, 10).

The total soluble solids (TSS) of the fruits were found to increase significantly. The TSS of the untreated fruits increased faster as compared to those treated with SA and Ca (Fig. 2). As the respiration rate in the untreated fruits was high, the conversion of the un-dissolved compounds to dissolved particles may be high resulting in higher TSS. On the other hand, in the treated fruits, as the respiration rate was checked, the conversion was also delayed with better firmness of the fruits. The results of the present study are in line with those reported by Balakrishnan (2) who has reported that the maintenance of TSS in stored fruits may be due to the decline in hydrolytic enzymes that are associated with fruit ripening. Unlike the total soluble solids, the acidity (%) of the fruits was found to decrease significantly during storage. The acidity in the fruits under control irrespective of the cultivars was found to decrease faster as compared to the fruits treated with SA and Ca-EDTA (Fig. 3). As the respiration was checked due to exogenous application of bio-regulators, the acidity was found to remain under control. These results are in line with those reported by Banik *et al.* (3), where it has been mentioned that retention of high acidity means slow ripening.

SA treated fruits retained significantly higher ascorbic acid for a longer period as compared to the fruits dipped in water (control) irrespective of the cultivars (Fig. 4). The ascorbic acid content of the fruits increased with the ripening followed by decrease during senescence. As SA and Ca had restricted the process of ripening the retention of the ascorbic acid was attributed due to slow rate of

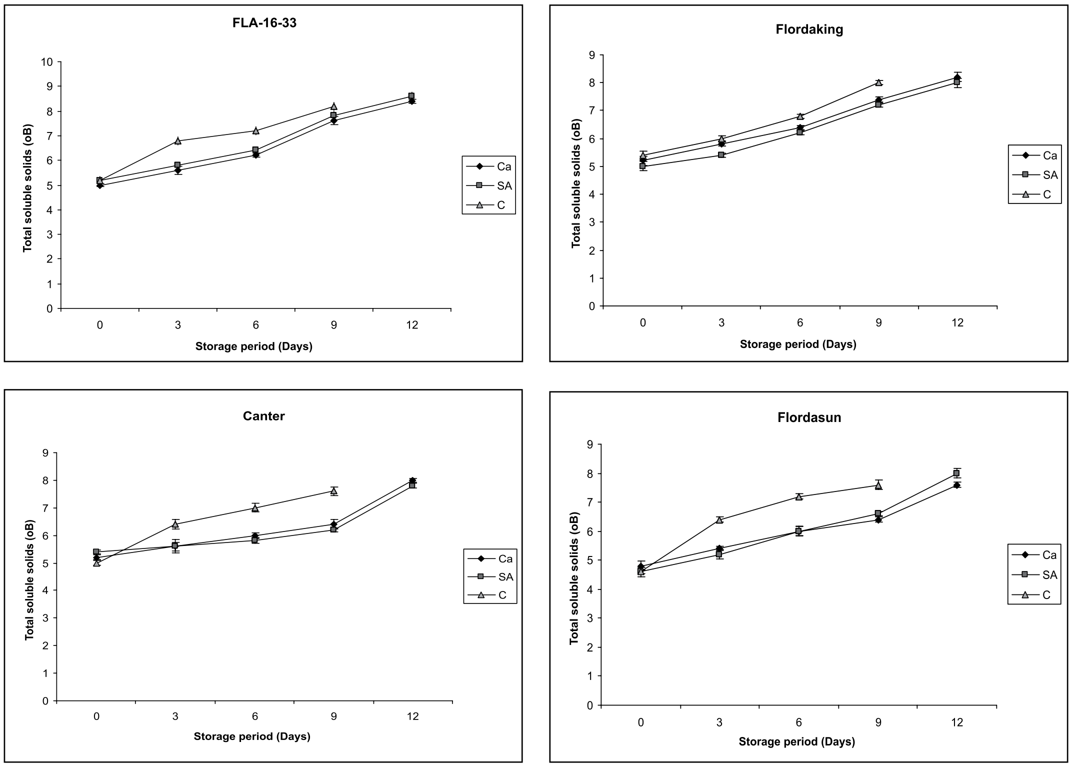

Fig. 2. Effect of various pre-storage treatments on TSS (°B) on different peach cultivars.

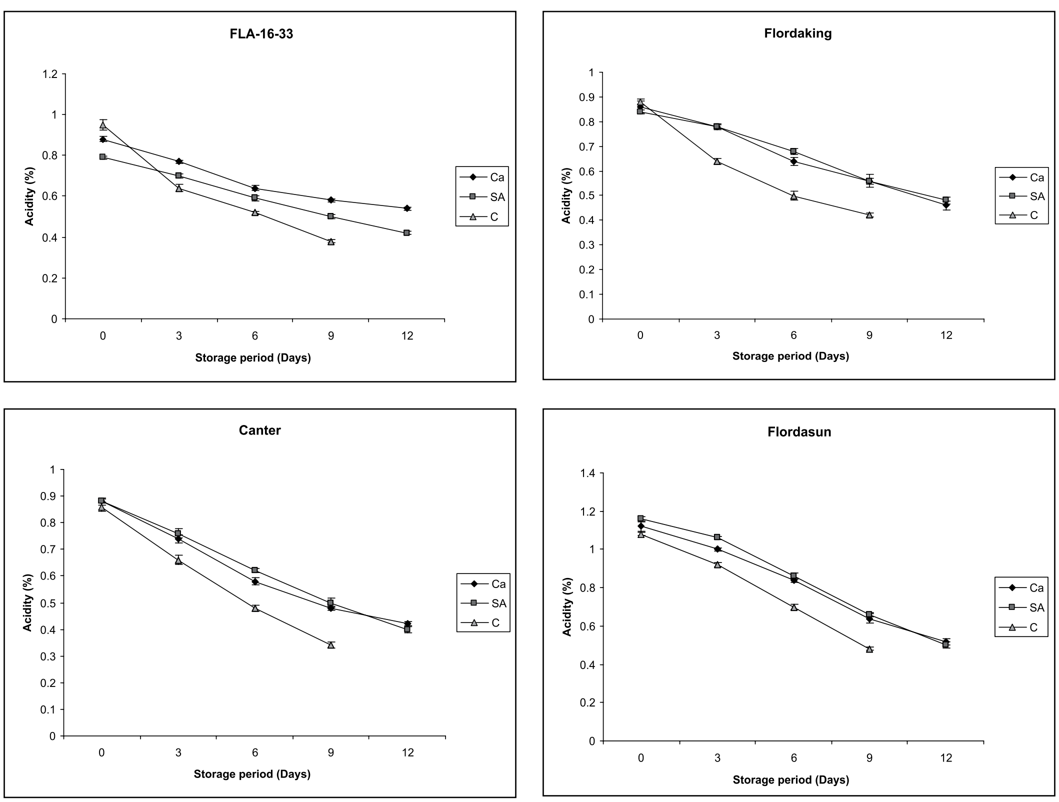

Fig. 3. Acidity (%) as influenced by various pre-storage treatments on different peach cultivars.

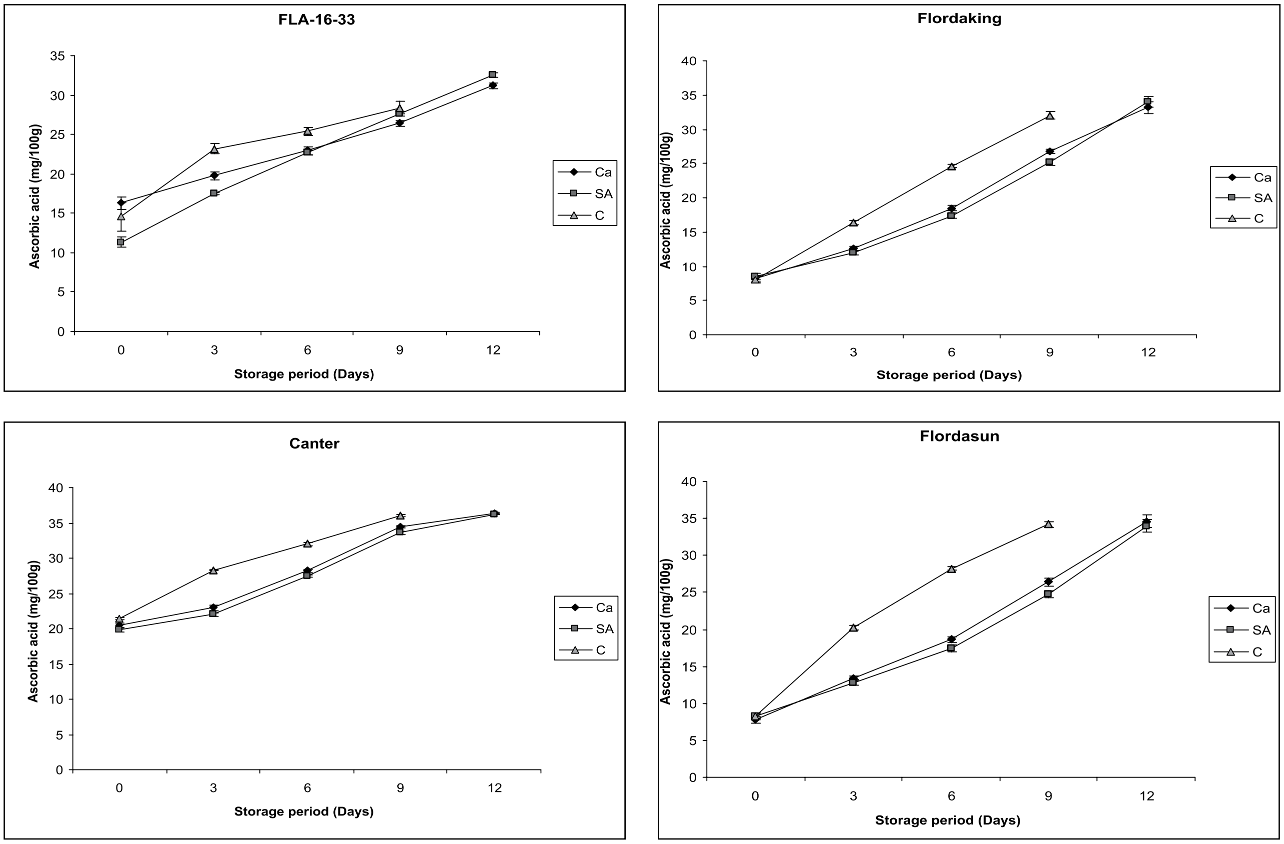

Fig. 4. Effect of various treatments on ascorbic acid (mg/100 g) on different peach cultivars.

ripening. The post harvest dip of calcium chloride, calcium lactate and calcium propionate helped to increase significantly the shelf life with reduced ethylene production of peach stored in cold storage for 4 weeks (Manganarisa *et al.*, 16).

The reducing sugars (%) in the different cultivars were found to decline significantly with faster rate in the water dipped fruits compared to the fruits treated with SA and calcium (Fig. 5). The faster reduction in the water dipped fruits may be attributed due to catabolism of sugars by respiration which has also been reported by Knee and Smith (12) in apple fruits during storage. Contrary to the reducing sugars, the total sugars in the fruits increased significantly with a faster rate in the water dipped fruits compared to fruits treated with bio-regulators (Fig. 6). The increase in the total sugars during storage may be attributed due to the hydrolysis of starch which was highest in the non-treated fruits compared with treated ones. The results are in conformity with those in apple and sugar apple (Knee and Smith, 12; Mo *et al.*, 17). Among the various concentrations of calcium chloride and calcium nitrate, 1% calcium nitrate had increased the post-harvest shelf-life of *aonla* significantly even after 21 days of harvest with better quality (Kumar *et al.*, 13). Calcium is known to play an important role in decreasing the fruit rots by manipulating respiration and ethylene evolution of fruits in apple (Conway and Sams, 5). Pre-storage or pre-harvest application of SA may provide a useful means of controlling post-harvest decays and extending post-harvest life of fruit during storage in peach (Wang and Li, 23).

From the present investigations, it was concluded that the peach fruits which had a very short post-harvest shelf life can be manipulated to be stored for longer duration through proper chemical intervention, which involves use of bio-regulators like salicylic acid and Ca-EDTA which will help the growers to fetch remunerative returns for their produce and increase the availability of the fruit in the market for a longer duration especially cultivar Flordasun followed by Canter by using SA @ 400 ppm.

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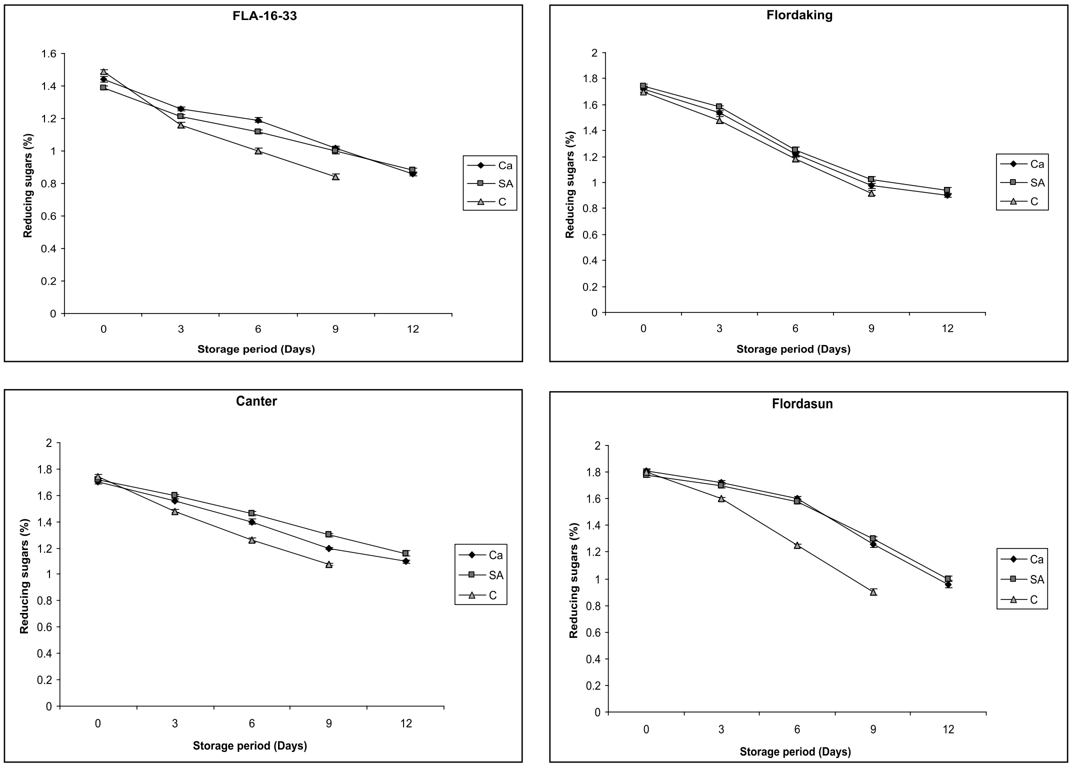

Fig. 5. Variations in reducing sugars (%) of different peach cultivars as affected by pre-storage treatments.

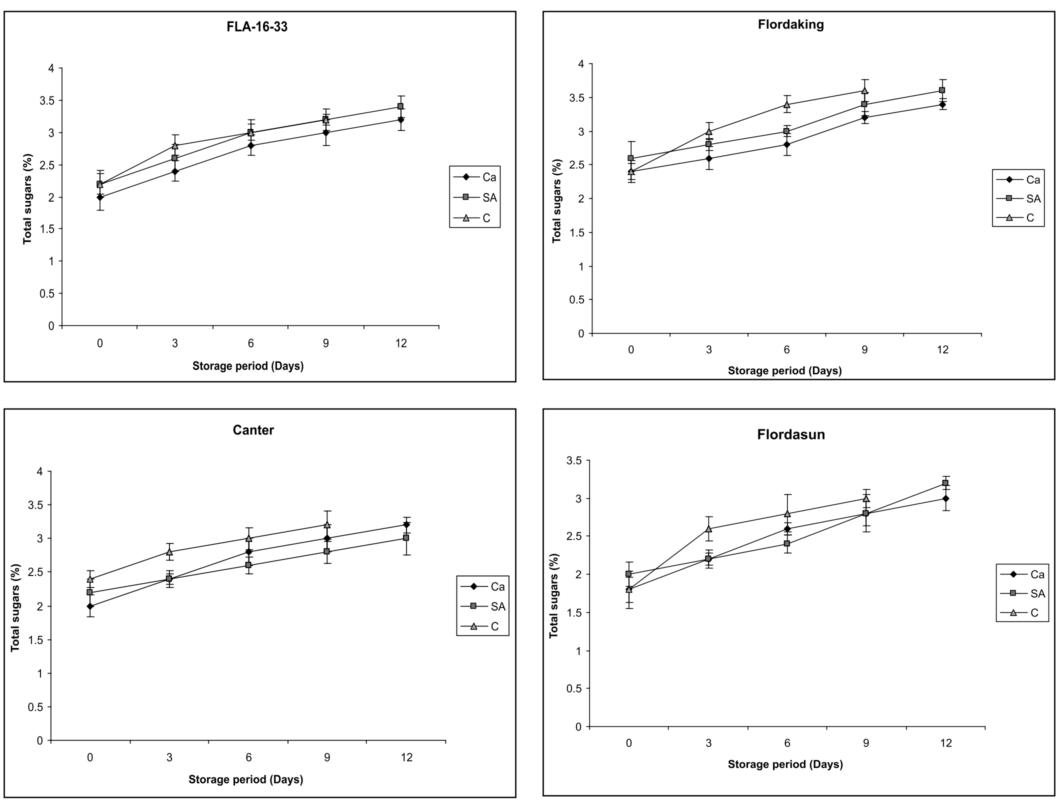

Fig. 6. Influence of various post-harvest treatments on total sugars (%) in different peach cultivars.

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Received: July, 2012; Revised: January, 2014;
Accepted: February, 2014