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ETHYLENE PRODUCTION AND FIRMNESS OF PEACH AND NECTARINE FRUITS AS RELATED TO STORAGE[1]

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Abstract. **Firm ripe fruit of 'Flordagold' peach and a numbered selection of nectarines (Fla 3-4) were stored at 2°, 6°, 10°, 15° and 18°C for 4 weeks. Ethylene production, firmness, total soluble solids and acidity were studied as related to storage treatments. Minimal ethylene production was observed at 2°C with slightly higher levels produce at 6°C. Storage at 2°C and 6° kept fruits at a good quality for marketing for at least 4 weeks.**

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Ethylene production in fruits during maturation is important to shelf-life (1, 2). Fruits develop the capacity for enhanced ethylene production during cold storage. Cold stress induces metabolic changes that lead to accelerated ethylene production that influences ripening of pears (4). Ethylene evolution by both peaches and nectarines increased as storage period was prolonged (6). Higher rate of ethylene production was found in peaches and nectarines with higher storage temperatures (6).

Fruit firmness is known to be associated with ethylene production (3). The rate of softening of 'Flordagold' peach fruit was found to be slower than other peaches (3). Little changes in total soluble solids (TSS) and a considerable decreases in acidity of peach and nectarine fruit were found with increased cold storage (6).

The purpose of this investigation was to study the effect of low temperature storage on the post-harvest physiology of two new selections 'Flordagold' peach and nectarine 'Fla 3-4'.

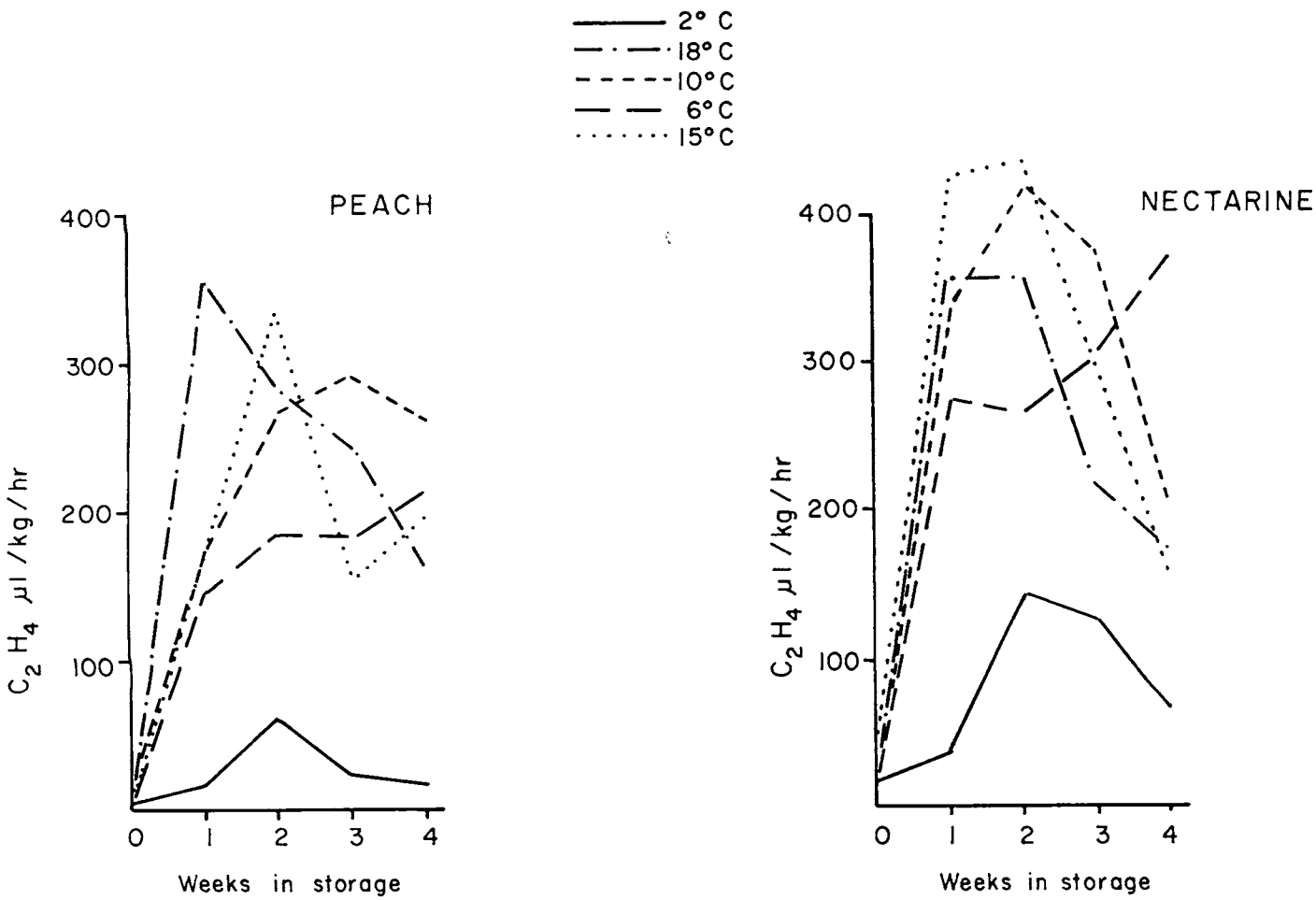

Fig. 1. Effect of 2°, 6°, 10°, 15° and 18°C storage temperatures on ethylene production in peach and nectarine.

Materials and Methods

Fruits of 'Flordagold' peach and a numbered selection of nectarine (Fla 3-4) were harvested at the firm-ripe stage from experimental plots at the University of Florida, Gainesville, Florida. The harvested fruits were quickly transported to the laboratory and placed carefully in foamy paper containers. Fruit containers were randomized and transferred to 2°, 6°, 10°, 15° and 18°C storage rooms within 3 hours after picking. Samples were taken every week and each sample consisted of three replicates. Sampled fruits were removed from the storage chambers to an 18°C room for 24 hours before chemical analysis.

Ethylene measurements were done after enclosing fruits in gas-tight glass jars for one hour prior to ethylene sampling. Ethylene in the samples were determined using a Varian Aerograph Series 200 (with sampling valve) gas chromatography equipped with a flame detector and an activated alimina (F-20), 6', 60/80 mesh and 1/8" column. The temperature of the column was maintained at 95°C (injector at 150°C). The N_2 and H_2 gas flow rate was 25 ml/minute (air was 300-350 ml/min). Areas under peaks on chromatograms were used as indexes of quantities based on standard curves.

Fruit firmness was determined after the peel was removed with a Magness-Taylor pressure tester equipped with 5/16" plunger. Total soluble solids (TSS) was determined using T/C hand refractometer. Juice acidity was determined using NaOH titration. The acidity is expressed as g citric acid in 100 ml juice (F = .0064).

Differences among treatments and cultivars were tested for significance by an analysis of variance (5).

Results

Ethylene Production

Ethylene evolution by both peaches and nectarines increased with storage time and temperature. 'Fla 3-4' fruits generally produced more ethylene in all treatments than did 'Flordagold' peach (av 268.3 vs. 187.3 μl/kg/hr). The rate of ethylene production from fruit increased as the period of storage increased reaching a maximum in 1 to 2 weeks then declined (Fig. 1).

The largest difference among storage periods was found one week after storage. Ethylene evolution increased from 6.2 to 171.4 μl/kg/hr in nectarines. Storage of fruits at 2°C depressed ethylene production in both cultivars. Changing storage temperature from 2° to 6°C stimulated ethylene by 3- to 6-folds in nectarine and peach, respectively. The highest rate of ethylene production was at 18°C storage in peach and at 10°-15°C with nectarine.

Statistical analysis showed significant differences between peach and nectarine with storage temperatures and ethylene production.

Firmness

Fruit firmness is one of the more important criteria in storage evaluation because it is directly related to shelf-life. Softening processes should be at the minimum level at cold

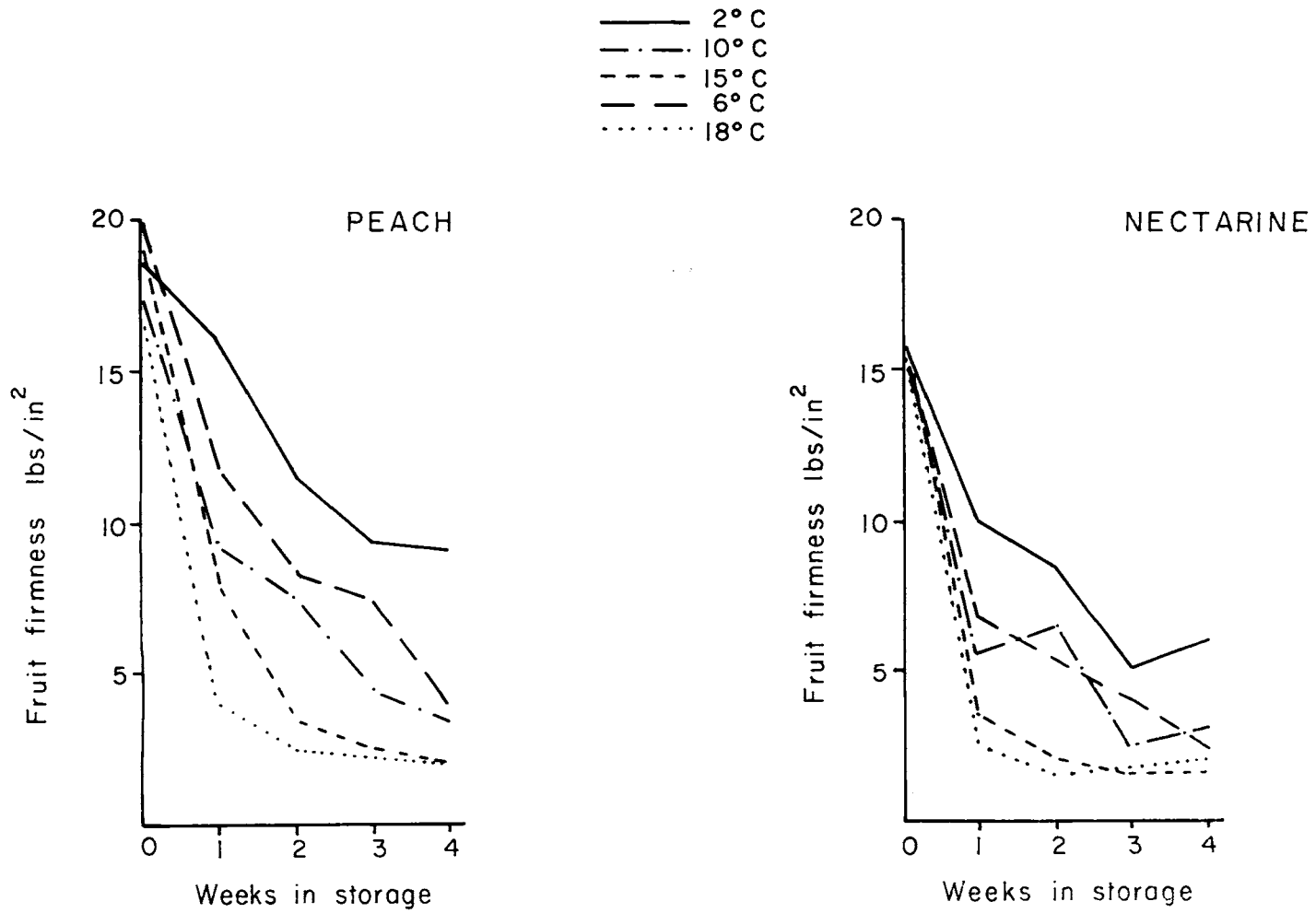

Fig. 2. Effect of 2°, 6°, 10°, 15° and 18°C storage temperatures on fruit firmness of peach and nectarine.

storage. Fruit stored at 2°C retained good firmness during the whole course of experiment. Storage at 6°C and 10°C kept fruit from softening but less than those stored at 2°C. However, fruits stored at 15° and 18°C started to loose firmness during the second week of storage (Fig. 2).

Firmness was generally found to decrease as the storage prolonged. 'Flordagold' peach, a firm fruit at maturity responded slower in loss of firmness in the higher storage temperatures than did 'Fla 3-4' nectarine.

Statistical analysis demonstrated significant differences between peach and nectarine with storage treatments and along with length of storage.

Total Soluble Solids (TSS)

'Flordagold' peach was slightly higher in TSS content than 'Fla 3-4' nectarine in all storage treatments. Percentage of total soluble solids ranged from 10.3 to 11.8 for peaches and from 11.4 to 12.1 for nectarines. TSS of both cultivars was found to significantly increase as storage prolonged (Fig. 3). Fruits stored at low temperatures (2° and 6°C) had lower TSS. However, storage at 10° and 15° produced the highest TSS values over the period of storage.

Although analysis of variance did not show differences in TSS between peach and nectarine, there were significant differences among storage temperatures and among periods.

TSS to Acid ratios increased in peaches and nectarines stored at 2°C; however, changes during storage at 6°, 10°, 15° and 18°C were small (Fig. 4).

Acidity

No marked differences in acidity were observed between peach and nectarine under the different storage temperatures. However, there was an increase in acidity by storage with both cultivars (Fig. 5). Analysis of variance showed significant effects of storage temperatures and length of storage on juice acidity. A relatively lower juice acidity was found in fruits stored at 2°C and is probably due to lower rate of metabolism.

Discussion

'Flordagold' produced much less ethylene compared to 'Fla 3-4' nectarine. Consequently, 'Flordagold' has a slower rate of softening than does 'Fla 3-4' nectarine. Thus, the reduction of ethylene production during fruit storage could increase shelf-life of 'Flordagold' peach (3). The biological basis for firmness in 'Flordagold' peach could be due to impairment of ethylene biosynthesis as well as a decreased capacity of the softening mechanism to respond to ethylene (3). Evidently, ethylene induces the synthesis of cellulases (1) and may also stimulate pectinases in some fruits (1).

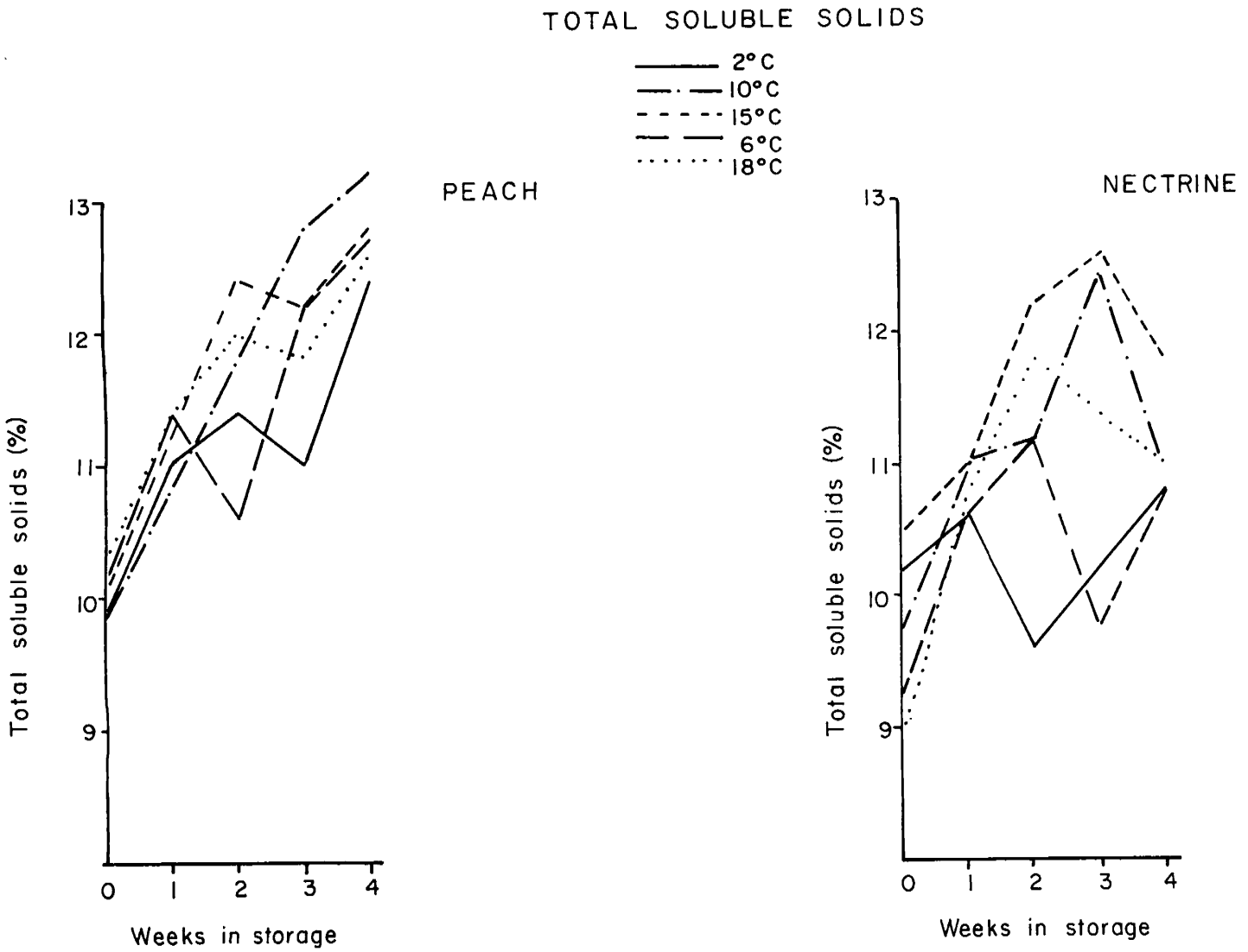

Fig. 3. Effect of 2°, 6°, 10°, 15° and 18°C storage temperatures on fruit total soluble solids (TSS) in peach and nectarine.

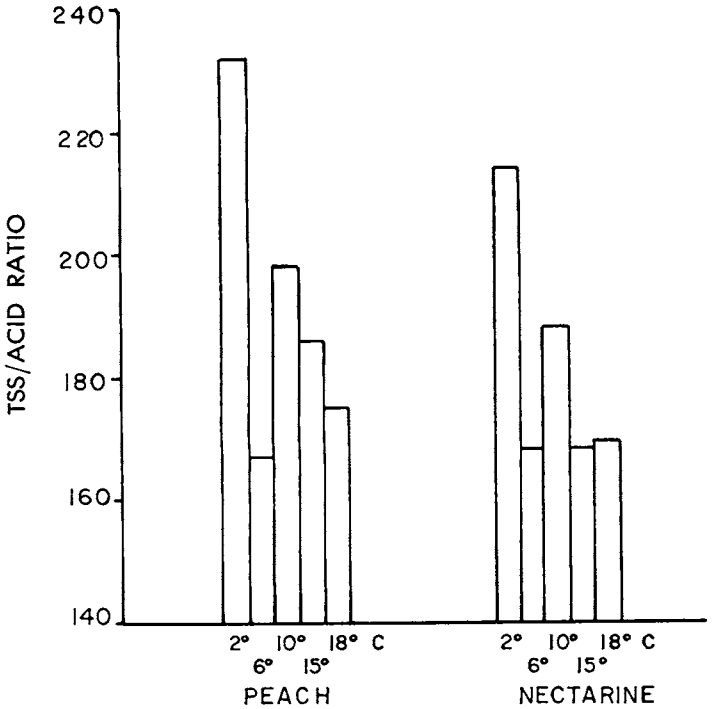

Fig. 4. Effect of 2°, 6°, 10°, 15° and 18°C storage temperatures on TSS/acid ratio in peach and nectarine.

There is a point of maximum ethylene production above which fruit quality seems to be adversely affected. This value was between 60 and 180 μl/kg/hr for peach and between 100 and 300 μl/kg/hr for nectarine. These rates are slightly higher than those found by Vakis (6).

Ethylene production in fruits stored at 2°C, for both cultivars was within these limits. Moreover, fruit qualities, firmness and TSS to acid ratios were considered best when compared to other treatments. Therefore, storage at 2°C kept fruits at the least internal changes and hence prolonged shelf-life of the fruits.

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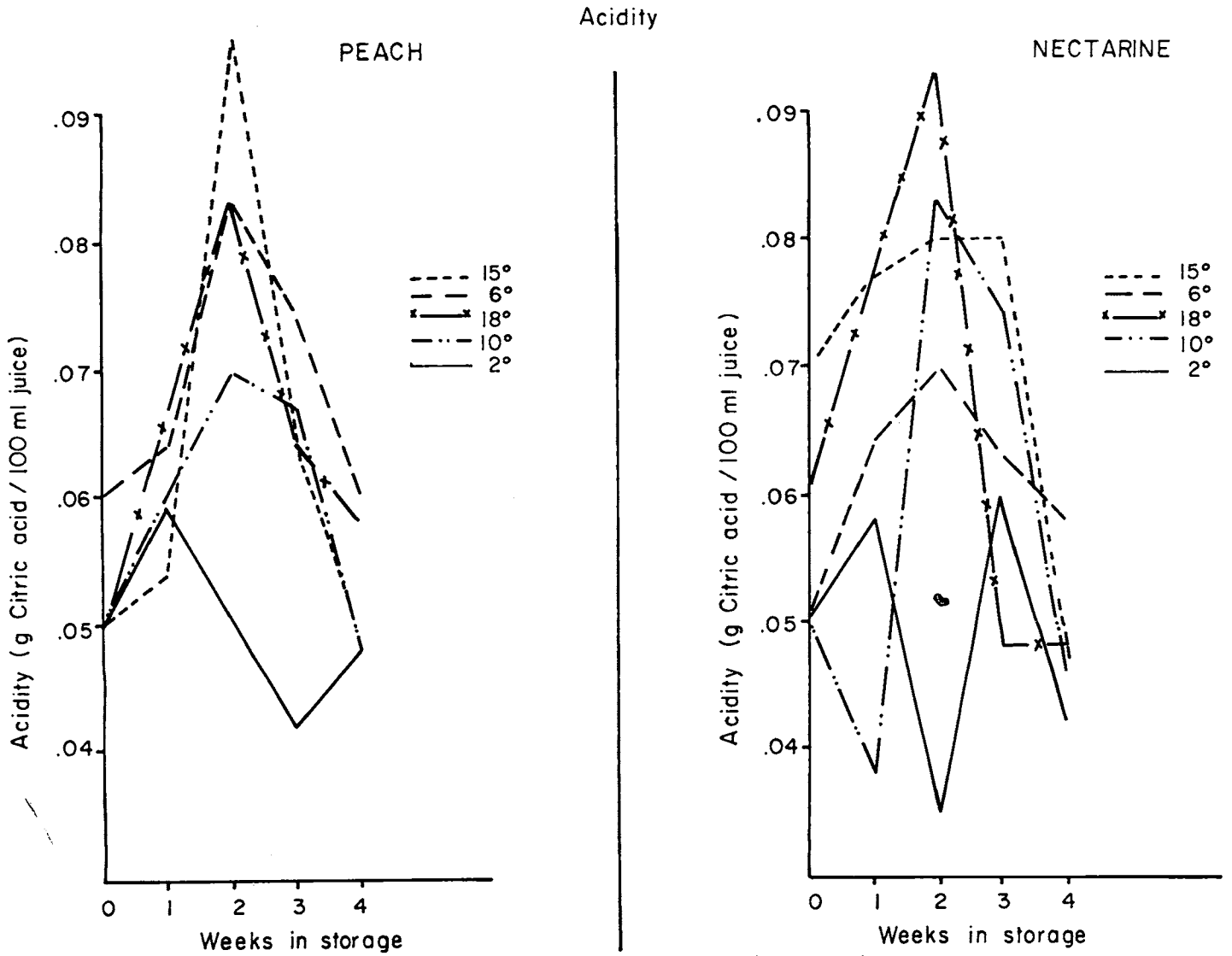

Fig. 5. Effect of 2°, 6°, 10°, 15° and 18°C storage temperatures on fruit acidity of peach and nectarine.