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Developing Canning Peach Critical Bruising Thresholds

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Abstract

The position of the softest spot on the fruit was the shoulder for 'Andross', 'Carson', 'Starn' and 'Ross' canning peach cultivars. Critical bruising thresholds were similar among canning peach cultivars evaluated, ranging from 6.0-7.0 lbf at a bruising potential of 240 G. Potential sources of bruising damage using two different mechanized harvesters were located using an instrumental sphere (IS-100). Bruising potential values of each harvester were small and similar, except at the bin dump portions of each machine.

Introduction

In recent years, farm labor shortages in California are shifting the harvesting of canning peaches from hand harvests to mechanized harvests. Severe bruising occurring at harvest can limit cannery performance for cling peach cultivars and reduce grower monetary return. Prior studies using fresh-market stone fruit cultivars developed critical bruising thresholds (CBT) to create maximum maturity indices that allow growers to decide how soft fruit may be picked to reduce postharvest damage (3).

We developed maximum maturity indices for canning peach cultivars using bruising susceptibility measurements

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based on fruit firmness at the softest point on the fruit. These CBT were calculated for different levels of fruit firmness and bruising potential (G). The CBT predict how much physical abuse fruit will tolerate at different firmness levels during harvest and processing. The use of CBT will allow us to decide how soft we can pick without inducing bruising, thereby maximizing the quality potential of fruit from different orchards.

Materials and Methods

During two seasons, 1999 and 2000, an evaluation of impact bruising susceptibility of 'Andross', 'Carson', 'Starn' and 'Ross' canning peach cultivars was carried out at the F. Gordon Mitchell Postharvest Laboratory (University of California, Kearney Agricultural Center, Parlier, CA).

Bruising Potential Survey

A survey of the bruising potential (G levels) for different mechanized harvesting operations was conducted using an instrumental sphere (IS-100) (TECHMARK, E. Lansing, MI) device according to Brown's recommendation (1, 2). Harvester "A" was evaluated while static at the F. Gordon Mitchell Postharvest Laboratory. Harvester "B" was evaluated while harvesting peaches in Yuba County, California. The IS-100 uses a triaxial accelerometer to measure acceleration, but includes an analog-to-digital (A/D) converter and a programmable microcontroller imbedded into beeswax and covered with urethane. The microcontroller stores accelerometer data in memory. The number of impacts stored is determined by the A/D sample rate. The IS-100 has computer interface capability for downloading collected data to a personal computer. Impact surfaces and each transfer point within each mechanical harvester were repeated 5 times.

Table 1. Impacts (G) recorded at transfer points of canning peach harvesters.

Transfer points	Mean[z](G	S[y]	Range (min-max)
Harvester A			
Tree to Harvester Catch Frame	49.7	47.4	11.0-213.4
Catch Frame Conveyor to Bin Fill	30.8	48.2	10.7-177.4
Bin Fill to Empty Bin	208.2	163.3	25.2-424.2
Harvester B			
Tree to Harvester Catch Frame	29.9	25.7	10.7-164.3
Catch Frame Conveyor to Bin Fill	34.5	28.0	10.7-160.2
Bin Fill into Empty Bin	37.5	48.2	10.1-290.0

[z]Means were calculated using the peak impact measured during each of the 5 trips of the instrumented sphere across each transfer point.
[y]Indicates standard deviation.

Fruit Bruising Susceptibility

Bruising susceptibility was determined by subjecting fruit with different firmnesses to three bruising energy levels (G). Impact bruising potential was created by dropping fruit from different heights onto a surface of known characteristics. The impact bruising energy was measured with an IS-100 device (1, 2, 3). The three impact bruising levels were selected based on bruising potential surveys of two commercial mechanical peach harvesters and previous work of packinghouse bruising potential surveys (3).

The softest firmness at which a given cultivar did not develop a bruise when exposed to three different bruising potential levels (240, 320, 360 G) was defined as CBT. The CBT were determined using percentile ranking of bruises greater than 100 mm^2 such that only the 1st percentile of bruises greater than 100 mm^2 occur when flesh firmness was greater than the CBT.

Results and Discussion

Bruising Potential Survey

Bruising potentials of 213 and 164 G were recorded as the IS-100 device impacted the padded catch frames of each harvester from a height of 3.3 meters (Table 1). During fruit conveyance on each harvester, a high value of 177 G was recorded on harvester "A" and a high value of 160 G was recorded on harvester "B" (Table 1). Maximum bruising potentials of 424 G (harvester "A") and 290 G (har-

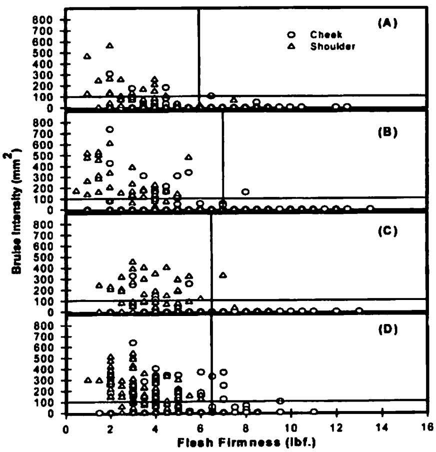

Figure 1. Bruise intensity of (A) 'Androse' (B) 'Carson' (C) 'Starn' and (D) 'Ross' canning peaches at different levels of fruit frimness at 240 G impact bruising intenstity. Vertical lines are drawn such that bruises greater that 100 mm^2 to the right of the line represent only the 1st percentile of all bruises greater that 100 mm^2.

vester "B") occurred when fruit dropped into bins (Table 1). Fruit falling from the conveyor of harvester "A" fell 1.1 m before striking the bottom of an empty bin. The manufacturer of harvester "B" had devised a hopper that could be raised from the bottom of the bin as it filled. This hopper included three internal transitions reducing the maximum fall to 0.5 m as fruit dropped from the conveyor into an empty bin.

Fruit damage susceptibility (G) during mechanized harvests can be reduced by several methods. Padding materials offering adequate impact protection should cover all potential impact areas on harvesters. The bin fill portion of the mechanical harvest operation can be improved by reducing transfer height from conveyors to either empty or partially filled bins. Harvester operators should reduce speed enough to ensure that fruit from one shake do not lie on the catch frame, thereby damaging fruit from subsequent shakes. Harvester crews need to remove tree branches and other foreign debris as soon as possible from harvester catch frames.

Bruising Susceptibility

CBT were developed for different canning peach cultivars. The minimum fruit firmness (CBT) able to tolerate impact bruising (Table 2) was similar among canning peach cultivars within each bruising potential level. In general, the CBT for canning peaches were lower than those determined for fresh market peaches and nectarines at a bruising potential of 240 G (3). The position of the softest spot on the fruit was the shoulder for 'Andross', 'Carson', 'Starn' and 'Ross' canning peach cultivars (Table 2). Fruit do not ripen uniformly and differences in firmness between softest and firmest positions on fruit can differ by 3-4 lbf.

The relationship between bruising and firmness was similar for the canning peach cultivars investigated at each bruising potential level. When fruit were exposed to 240 G, 'Andross' and 'Carson' canning peaches bruised when they softened below 6.0 pounds and 7.0 pounds, respectively (Fig. 1). 'Starn' and 'Ross' cultivars start-

Table 2. Minimum flesh firmness of four clingstone peach cultivars necessary to avoid commercial bruising at three levels of physical handling (Critical Bruising Thresholds). Only the 1st percentile of bruises greater that 100mm^2 occurred when flesh firmness was greater than CBT.

Cultivar	Drop Height[z] (10 cm) ~240 G[y]	(20 cm) ~320 G	(30 cm) ~350 G	Softest position
	Minimum Firmness (Lbs)[x]			
Andross	6.0	6.0	8.0	Shoulder
Carson	7.0	7.0	7.0	Shoulder
Starn	6.5	7.5	7.5	Shoulder
Ross	6.5	6.5	7.0	Shoulder

[z]One hundred and forty fruit were dropped on a 1/8" PVC belt overlaying steel for each drop treatment. Damaged areas with a diameter equal to or greater than 2.5 mm were measured as bruises.

[y]Impact bruising forces measured with the instrumental sphere (IS-100) and expressed as acceleration (G).

[x]Fruit firmness measured at the softest point on the fruit using a penetrometer with an 8 mm tip and expressed as lbs-force.

Table 3. Bruise intensity and bruise incidence of four canning peaches measured on fruit with firmness below critical bruising threshold (CBT) at 240 G.

Cultivar	CBT at 240 G (lbf)	Mean Bruise Intensity (mm²)	Bruise Incidence (%)
Andross	6.0	40.0	14.0
Carson	7.0	91.9	32.0
Starn	6.5	66.2	21.0
Ross	6.5	44.6	13.6
P value	z	0.49	0.35

[z]CBT determined using percentile ranking of firmness where burising was greater than 100 mm².

ed to bruise when firmnesses went below 6.5 pounds (Fig. 1).

The location of the impact on the fruit was an important factor in the calculation of these critical bruising thresholds. All of the canning peach cultivars evaluated sustained similar bruising injuries when exposed to approximately 240 G (Fig. 1). In general, soft fruit were more susceptible to impact bruising than hard fruit.

Bruise size (intensity) and the percentage of fruit with bruises larger than 100 mm² (incidence) were used to compare four canning peach cultivars by choosing only fruit with firmness below the critical bruising thresholds (Table 3). Neither bruise intensity nor bruise incidence were significantly different between cultivars. 'Andross' fruit below 6.0 lbf subjected to impact forces of 240 G had a mean bruise intensity of 40.0 mm² and a bruise incidence of 14.0% (Table 3). This was comparable to 'Ross' fruit below 6.5 lbf with a mean bruise intensity measuring 44.6 mm² and a bruise incidence of 13.6% (Table 3). 'Starn' fruit below 6.5 lbf were more susceptible to bruising with a mean bruise intensity of 66.2 mm² and a bruise incidence of 21.0% (Table 3). Of the canning peach cultivars examined, 'Carson' fruit below 7.0 lbf were most susceptible to bruising with a mean bruise intensity measuring 91.9 mm² and a bruise incidence of 32.0% (Table 3).

Additional factors to consider when comparing bruising susceptibility of canning peach cultivars is the firmness distribution of the fruit at harvest and how quickly fruit soften during ripening on the tree. Surveys of 'Andross' and 'Ross' firmness within the canopy indicated that softer fruit were located in the upper, south facing portion of the canopy and firmer fruit were located in the lower, north facing portion of the canopy.

The use of CBT will allow us to improve the quality of mechanically harvested canning peaches. Under specific conditions, orchard monitoring of fruit firmness will help decide how late fruit can be harvested while reducing bruising potential of mechanically harvested fruit. If most of the fruit firmness is above the CBT, bruising should be minimal.

Further investigations of orchard design, such as exploring planting density and tree training systems, are necessary as they relate to mechanical harvesting. Pruning strategies within existing orchards are needed that reduce both tree heights and potential fruit impact points within the canopy, such as horizontal scaffold branches. Future breeding strategies should incorporate bruising susceptibility and include a survey of fruit firmness within the canopy at harvest. This would select for varieties that ripen uniformly. Finally, a time course analysis of firmness near harvest could help eliminate selections that ripen over a very short period.

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