

CENTRAL VALLEY POSTHARVEST NEWSLETTER

COOPERATIVE EXTENSION

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Editor

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OPTIMUM PROCEDURES FOR RIPENING STONE FRUIT

Carlos H. Crisosto

This article deals with the ripening of peaches, nectarines, and plums at destination points (distribution centers, retail stores, foodservice operations, etc.). We also covered pre-conditioning/pre-ripening at the shipping point.

In California, peaches, nectarines, and plums are normally picked when ripening has been initiated (high maturity stage),

thus producing sufficient ethylene to carry on ripening upon arrival to the warehouse. In fruit picked at low maturity, ethylene application during ripening at 20°C only reduces firmness variability within the sample without speeding up ripening. Therefore, most stone fruits harvested at

the “high maturity stage” do not need ethylene exposure to ripen properly. Exceptions may be the “very slow” ripening plum cultivars, without the ability to produce their own ethylene.

The rate of fruit ripening varies among peach, nectarine, and plum cultivars and it is controlled by temperature. A fast rate of ripening is achieved at 20 to 25°C and a low rate of ripening is accomplished by using lower temperatures (Table 1). Temperatures higher than 25°C will reduce the rate of ripening, inducing off flavors, irregular texture, and promoting irregular ripening. White flesh nectarines and peaches have a high rate of softening (Table 2).

Flesh firmness is the best indicator of ripening and one predictor of the potential shelf life. Fruit that reach 6-8 pounds are considered “ready-to-buy.” Fruit that reach 2-3 pounds flesh firmness are considered ripe, (“ready-to-eat”). Thus, the end of ripening is determined by the firmness.

Ripening at Shipping Point: Partial ripening after harvest to a specific firmness is starting to be used commercially. Controlled-ripening at 20°C immediately (conditioning) after harvest for 48 hours limits development of mealiness and flesh browning on chilling injury susceptible peach and nectarine cultivars. Longer ripening can be done based on firmness and buyers’ requirements. After this partial ripening treatment fruit must be cooled below 2.2°C as quickly as possible. This protocol allows delivery of fruit across the country that is “ready to buy” and free of chilling injury symptoms.

Ripening at Retailer Point: Fruit that arrives in your warehouse or retail store should be tested for flesh firmness using a standard fruit penetrometer. A ripening

protocol based on warming should be established according to the anticipated consumption schedule (fruit turning schedule). Soft fruit are more susceptible to bruising than hard fruit. To reduce potential physical damage occurring during transportation from the warehouse to retail stores and handling at the retail stores, we suggest transferring fruit to the retail store before fruit reach 6-8 pounds for peaches and nectarines, and 4-6 pounds for plums (transfer/shipping point). The establishment of these transfer/shipping points is based only on our previous experience with fruit damage during retail handling. As bruising incidence varies among different retailer operations and among cultivars, you should fine-tune your own transfer points for your conditions.

Temperature conditions for stone fruits during and after ripening should be adjusted according to the desired rate of ripening. The rate of fruit softening (number of days to reach 2-3 pounds-force) varies among peach, nectarine and plum cultivars and can be controlled by the storage temperature used (Table 1). For example, mature ‘O’Henry’ peaches are usually harvested and shipped with a flesh firmness between 10 and 14lbs-force. If these California ‘O’Henry’ peaches arrived at the distribution center with an average firmness of 12lbs-force and were placed in the 20°C room, they will reach 2-3lbs-force (“ready-to-eat”) after ≈6 days. To reduce bruises, we recommend that stone fruits be delivered to the retail store before they soften below 5-6lbs-force. Thus, the ‘O’Henry’ peach should be delivered to the retail store by day 3 after arrival. These peaches will be ready-to-eat (2lbs-force) by 48 hours after delivery to the retail store. As stone fruits will continue to ripen in the display case, they should be checked often and the softest fruit be placed at the front of the display. Checking fruit firmness daily is

highly recommended to control the ripening rate. To slow down the ripening rate, stone fruits should be kept at low temperatures.

Peaches, plums, and nectarines harvested at a lower maturity stage than the “well mature stage” may need added ethylene (100 ppm for 24 hours or longer) to ripen evenly. For the “very slow” ripening plum cultivars (such as Angeleno, Black Beaut, Casselman, Kelsey, Late Santa Rosa, Nubiana, Queen Ann, Red Rosa and Roysum) ethylene exposure may be required to induce and accelerate the ripening process. Furthermore, ‘Roysum’ must be continuously exposed to ethylene (100 ppm) for several days (normally 3 to 4) at warm temperatures to ripen properly. Without giving special attention to ripening, these “very slow” ripening plum cultivars vary in performance, depending upon chance exposure to ethylene during handling.

Table 1. Ripening rates of peaches, plums and nectarines at 10°, 20° and 25°C measured with a UC Firmness tester (7.9 mm tip).

Cultivar	Rate of Softening (lbs per day)		
	10°C	20°C	25°C
PEACHES			
Spring Lady	0.5	2.1	2.5
Flavorcrest	1.0	2.3	3.4
Rich Lady	1.0	2.2	2.9
Elegant Lady	1.3	2.6	3.3
Zee Lady	1.3	2.5	3.1
Summer Lady	1.1	2.5	2.9
O’Henry	1.0	2.2	2.9
Ryan Sun	1.7	2.5	3.3
Average	1.1	2.4	3.0
NECTARINES			
Mayglo	0.7	2.3	3.0
Rose Diamond	0.8	1.7	2.8
Red Diamond	0.6	1.6	1.9
Spring Bright	1.2	2.4	2.8
Summer Bright	0.7	2.2	2.8
Summer Grand	1.3	2.0	3.2
Summer Fire	0.7	1.8	2.1
August Red	0.3	2.1	2.3
September Red	0.6	1.8	1.9

Cultivar	Rate of Softening (lbs per day)		
	10°C	20°C	25°C
PLUMS			
Black Beaut	0.6	0.6	0.9
Santa Rosa	0.3	0.6	0.8
Blackamber	<0.2	0.6	0.7
Fortune	0.4	0.9	1.3
Friar	0.3	0.6	1.3
Simka	0.8	1.2	1.7
Royal Diamond	0.3	0.5	1.1
Casselman	0.2	0.5	0.6
Angeleno	0.2	0.4	0.5
Average	0.4	0.7	1.0
APRICOTS			
Patterson	0.2	1.5	1.6

Table 2. Ripening rates of some white flesh peaches and nectarines at 20°C measured on the cheek and suture with a UC Firmness tester (7.9 mm tip).

Cultivar	Rate of Softening (lbs per day)	
	Cheek	Suture
PEACHES		
September Snow	3.2	3.3
Snow King	4.2	3.7
Average	3.7	3.5
NECTARINES		
Arctic Pride	4.0	4.1
Arctic Snow	4.1	4.6
Average	3.8	4.0

REDUCING CHERRY PITTING INCIDENCE

Carlos H. Crisosto

A survey carried out in 1993 showed that pitting and bruising incidence reached up to 38% for ‘Brooks’ cherry upon arrival to the packinghouse. This pitting level increased up to nearly 70% during the packinghouse operations. Since then, growers and packinghouse managers have been making changes to reduce pitting damage during their operations. This article has the goal to review pitting reduction recommendations in preparation for this new season.

The following recommendations for reduction of pitting during packinghouse operations were prepared by Joe Grant and Jim Thompson as a result of their work done on 'Bing' cherries:

- 1) Cluster cutter damage can be reduced by slowing the belt speed or adjusting the tines so they touch the rough top belt. An even better option would be to develop a belt that allowed the tip of the tines to be below the surface that supports the cherries. Saw type cluster cutters should be operated at high capacities as often as possible.
- 2) Shower type hydrocoolers should be designed to minimize the distance between shower pan and the fruit. An 8" distance between the conveyor and the shower pan eliminated pitting damage in one hydrocooler.
- 3) Use water transfer between a horizontal conveyor and a flighted inclined conveyor. Use smooth conveyor belts whenever possible.
- 4) Do not hand sort boxes after they have been filled, except perhaps to remove poor quality fruit on the surface of the pack.

More detailed information on this subject can be found in the 1997 California Agriculture (March-April issue). Domestic subscriptions are free upon request and may be requested from their web site <http://danr.ucop.edu/calag/>. You may also write to *California Agriculture*, 1111 Franklin St., 6th floor, Oakland, CA 94607-5200, or call (510) 987-0044, FAX (510) 465-2659 or e-mail calag@ucop.edu.

CTFA ABSTRACTS

FUNDAMENTAL STUDIES ON STONE FRUIT INTERNAL BREAKDOWN – DEVELOPING A PRACTICAL PROTOCOL TO REDUCE PEACH INTERNAL BREAKDOWN

Carlos H. Crisosto, David Garner and Joan Boyd.

Summary

- Temperature management is the most important commercial tool for reducing symptoms of internal breakdown (IB). Immediate and prolonged storage at 5°C induced incidence of internal breakdown. Immediate storage at 0°C decreased symptoms of IB.
- Controlled delayed cooling treatments at 20°C for 48 hours reduced mealiness and flesh browning development in all three peach cultivars during storage/postharvest handling. However, decay development may be a problem in infested fruit without good fungicide treatment.
- During the 48 hour delay at 20°C the fruit lost approximately 4 lbf. firmness. If the fruit are stored at 0°C after the delayed cooling treatments the firmness quality of the fruit is maintained. If fruit are stored at 5°C following 48-hour delay at 20°C then fruit softening may be a problem after ten days.
- All cultivars in this experiment showed that maximum storage quality of the fruit is maintained with a delayed cooling treatment of 48 hours at 20°C. Fruit quality of delayed treatments at 20°C for 48hrs was better than that of treatments immediately cooled at either 0°C or 5°C. Fruit that was delayed cooling for 48 hrs

at 20°C and stored for ten and twenty days at 5°C maintained better texture quality than fruit stored under the same conditions with different delayed cooling conditions.

ASSESSMENT OF POSTHARVEST AND RETAIL HANDLING PRACTICES ON MICROBIAL FOOD SAFETY RISK REDUCTION

Trevor V. Suslow, Ana Maria Hernandez, Xunli Nie, Marcella Zuniga, and Alex Puerta, University of California, Davis.

Objective 1:

Standardization and reproducibility of artificial inoculation and recovery of food-borne pathogens on mature peach, plum, and nectarine.

The first step in any new project concerned with risk assessment of food-borne pathogens on any complex media, such as fruits and vegetables, is to determine the recovery efficiency for microbial enumeration in an artificially inoculated sample. In replicated studies we determined that the recovery efficiency of *Salmonella typhimurium* and *Pseudomonas fluorescens* A506 (see below for strain description) on mature plum and nectarine was high, reproducible, and within acceptable limits for detecting survival over time. For both plum and nectarine, the presence of the epidermal peel in macerated extraction buffer solutions resulted in consistently lower survival/recovery of inoculated bacteria from samples. Recovery from peach was more variable, especially for *Salmonella*. In repeated tests, the presence of the peel in the macerated sample was inconsistently associated with a rapid initial decline in bacterial counts over a one-hour period. Peach flesh separated from the peel did not have this affect. With some peach varieties, for example Crimson Lady, the

effect was not as pronounced or not observed for *Salmonella* but did impact survival of P.f. A506.

Objective 2:

Persistence of non-pathogenic *Salmonella* strain (LT2rifnal) and non-pathogenic surrogate indicator strain (*P. fluorescens* A506rif) on peach, plum, and nectarine (PPN) at three holding temperatures and two relative humidity conditions.

In replicated comparison tests, *Pseudomonas fluorescens* A506rif was determined not to be a good indicator of survival potential of *Salmonella* on PPN at any storage condition. In general, survival of A506 on the surface of fruit was much higher, especially at low humidity conditions (or perhaps more appropriately rapid drying rates). This “food-safe” bacterium would not be an appropriate choice for environmental or model testing of persistence. Another surrogate strain must be identified.

Salmonella LT2rifnal, artificially inoculated onto the surface of PPN persisted for at least 5 days and greater than 15 days, depending on the storage conditions and fruit. In general, bacterial populations followed a progressive decline over time under most conditions. The exception was a relatively persistent population on plum at 2.5°C (36.5°F) and high relative humidity.

Low temperature favored *Salmonella* persistence on all fruit types. “Ripening” temperatures and low, initial relative humidity accelerated die-off to non-detectable levels. The effect was more rapid on nectarine and plum as compared to peach.

Objective 3:

Determine the in vitro sensitivity of *Salmonella* and *E. coli* pathogens to selected postharvest fungicides.

Three pathogenic strains of *E. coli* O157:H7, four serovars of *Salmonella*, and *Salmonella typhimurium* LT2rif^{nal} were evaluated for sensitivity to selected fungicides and a bactericidal antibiotic, streptomycin, as a positive control for inhibition under the test conditions. Two proprietary antimicrobial formulations composed of FDA GRAS (Generally Recognized As Safe) botanical extracts were also included as an additional non-antibiotic control.

Tests were conducted at 0, 1, 4, 10, 40, and 400 µg/ml with Rovral, Medallion, Orbit, Rally, Indar, and Topsin.

Tests were conducted at 0, 10, 25, and 50 µg/ml with streptomycin and 0, 2.5, 12.5, and 25 µl/ml with compound 694D-2 and B156.

All test strains grew in all concentration exposures at levels indistinguishable from 0µg/ml for the fungicides. All test strains were completely inhibited by all concentrations of streptomycin and B156. We are interested to pursue the efficacy of the B156 material, which also has activity against *Monolinia* and *Botrytis*.

We are completing an evaluation of the effects of postharvest fungicides on bacterial survival following spray application and drying on fruit surfaces.

IMPROVING THE RIPENING PROTOCOL FOR WAREHOUSES AND PRODUCE STORES

Carlos H. Crisosto, David Garner, Monica Schnitzler, and David Parker.

Summary

The rate of fruit softening (pounds of firmness lost per day) varied according to fruit temperature, species, cultivar, and

growing season. The rate of softening for peaches and nectarines was high at 68°F (20°C) and 77°F (25°C), and low at 50°F (10°C). Some cultivars had a higher rate of softening than others. The rate of softening was lower for plums than for peaches and nectarines. White flesh nectarines and peaches had high rates of softening at 68°F. In addition to measurement with the UC firmness tester (destructive), ripening rates were also measured using a non-destructive firmness sensor (Durofel). It consistently and reliably described changes in fruit firmness during ripening and looks very promising for monitoring ripening nondestructively at retailer warehouses. Impact values measured during retail handling with the IS-100 were low. These levels of impact should not cause any damage to peaches, nectarines or plums with more than 6 lbf firmness.

MANAGEMENT AND EPIDEMIOLOGY OF PRE- AND POSTHARVEST BROWN ROT AND OTHER DISEASES OF FRESH MARKET STONE FRUIT CROPS. I. PREDICTION OF PREHARVEST BROWN ROT OF FRUIT AND II. EVALUATION OF FUNGICIDES FOR PRE-AND POSTHARVEST MANAGEMENT OF BROWN ROT BLOSSOM AND FRUIT ROT

James E. Adaskaveg, Department of Plant Pathology, University of California, Riverside; B. Teviotdale, Department of Plant Pathology, UC Davis-KAC; H. Förster, D. Thompson, Department of Plant Pathology, UC Riverside; and S. Johnson, Department of Pomology, UC Davis-KAC.

Postharvest fungicide treatments

New fungicides for postharvest management of fresh market stone fruit were evaluated in 1999. Another Section 18 registration for postharvest use of the "reduced-risk" (EPA-classification) fungicide fludioxonil was obtained on apricots,

peaches, plums, and nectarines in California in 1999 and full registration is expected in 2000. In laboratory and experimental packingline studies, fludioxonil, tebuconazole, and fenhexamid were very effective treatments for control of brown rot, when either applied before or after inoculation. Fludioxonil and fenhexamid were very good wound-protection treatments for gray mold. Still, only fludioxonil was effective for *Rhizopus* rot control. Additionally, fludioxonil provided effective management of *Gilbertella* and *Mucor* decays. No other fungicide has ever been developed for management of multiple decays caused by Zygomycete fungi. Thus, fludioxonil represents a broad-spectrum, reduced risk pesticide and sets a new standard for postharvest decay control. Fenhexamid is a very effective treatment against gray mold and is also effective against brown rot. Residue trials for this fungicide were postponed in 1999 but they have been re-scheduled as part of the IR-4 program in 2000. Fenhexamid will be very complementary to tebuconazole's spectrum of activity. Additionally, we screened new fungicides and identified TM-417 and TM-415 as additional materials for brown rot (TM-415 and TM-417) and gray mold (TM-417) control on stone fruit crops. The biological control compound AQ-S1 was very effective for brown rot control. Additional studies with biological controls are planned in 2000.

FUTURE EVENTS

April 29 – May 4, 2000

IARW & WFLO Annual Conference and Trade Show, Phoenix, AZ.

May 1-3, 2000

Int. Conference on Integrated View of Fruit & Veg. Quality, Griffin, GA.

May 2-4, 2000

Aspetic Processing and Packaging, UC Davis.

Contact Diane M. Barrett at (530) 752-4800 or dmbarrett@ucdavis.edu

May 23, 2000

Pomology KAC Field Day, Parlier, CA.

Contact Scott Johnson, (559) 646-6547

June 10-13, 2000

CLFP World Congress on the Processing Tomato, Sacramento, CA.

June 20, 2000

Pomology KAC Field Day, Parlier, CA.

Contact Scott Johnson, (559) 646-6547

July 25, 2000

Pomology KAC Field Day, Parlier, CA.

Contact Scott Johnson, (559) 646-6547

August 22, 2000

Pomology KAC Field Day, Parlier, CA.

Contact Scott Johnson, (559) 646-6547

September 2000

AgTech 2000, Food Quality and Safety, UC Davis.

September 12-15, 2000

6th Annual Fresh-Cut Workshop, UC Davis.

Contact Marita Cantwell or Sharon Munowitch, University Extension, (800) 752-0881, Fax (530) 757-3558, e-mail smunowit@unexmail.ucdavis.edu

October 19-21, 2000

Intl. Conf. on Improving Postharvest Technologies of Fruits, Vegetables, and Ornamentals, Murcia, Spain.

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October 27-31, 2000

PMA Convention & Expo, Anaheim, CA.

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