CENTRAL VALLEY POSTHARVEST NEWSLETTER

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Editor

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A world-class plant pathologist and a friend of agricultural industries of California.

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Dr. Joseph M. Ogawa, known simply as "Joe Ogawa" to the fruit and nut tree industries and fresh market tomato growers of California, died 20 January 1996 following a stroke and a bout with cancer. He was 70 years old. He was an emeritus professor of Plant Pathology at the University of California, Davis. He was a faculty member for 37 years from 1954 until 1991 when he officially returned. In his retirement, however, Joe continued to be active in research and teaching up until his illness.

Dr. Ogawa's strong interests and keen insights in California agriculture evolved from his childhood days growing up on a fruit farm in Sanger, CA. After war-time relocation, a short enrollment at the University of Nebraska, and military service, Joe entered the University of California, Davis where he obtained a B.S. in Plant Sciences (1950) and a Ph.D. in Plant Pathology (1954). After graduating, Dr. Ogawa joined the faculty at UC Davis and through a productive research and teaching career, he became an internationally recognized authority on pre- and postharvest diseases of stone fruit trees, nut crops, and tomatoes. He published more than 300 technical papers and popular articles, and co-authored two books on diseases of tree fruit and nut crops and was the senior editor of the Compendium of Stone Fruit Diseases for the American Phytopathological Society. Professor Ogawa guided 31 students to advanced degrees, all of whom have gone on to distinguished careers at various universities, government institutions, and agricultural industries throughout the United States and the world.

Joe Ogawa loved his profession because he could help people. Through his dedication, hard-work ethic, and brilliant insightfulness, he became known for his ability to solve difficult production problems. To the stone fruit growers, packers and handlers of California, Joe was a close friend who they could always depend on for help in managing pre- and postharvest diseases. Joe was an excellent communicator who spoke "the grower's language." We will truly miss his great sense of humor, his honesty, his leadership through example, and most of all, his friendship.

RIPENING PROTOCOL FOR STONE FRUIT

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Because stone fruit are a climacteric fruit, they are harvested when they reach a minimum or higher maturity, but are not completely ripe. Initiation of the ripening process must occur before consumption to satisfy consumers. Most consumers will be satisfied after eating ripe peaches and nectarines and they will return to buy again, thus, increasing your sales. However, when consumers eat even high quality but unripe peaches and nectarines, they will not be satisfied and the consumers will wait a long time before buying again, therefore, your sales will not increase.

In response to this important industry concern, the California Tree Fruit Agreement (CTFA) in cooperation with the Pomology Department (UC-Davis) have prepared this protocol designed to properly ripen peaches and nectarines for warehouse and produce managers.

1. Checking the Initial Fruit Ripeness

Flesh firmness is the best indicator of stone fruit ripening and one predictor of their potential shelf life. A penetrometer is a quick and simple device to determine fruit firmness. Either a hand-held or drill press-mounted instrument can be used. The drill press-mounted instrument is recommended for accuracy and consistency. Fruit which reach 6-8 lbs are considered "Ready-to-Buy." Fruit which reach 2-3 pounds flesh firmness are considered ripe, therefore, "ready-to-eat." Fruit which arrives in your warehouse or retail store should be tested for flesh firmness using a standard fruit penetrometer with an 8.0 millimeter (5/16 inch) tip. This initial firmness value and your fruit rotation will determine your ripening management.

A) Upon arrival to the warehouse, select twenty fruits and place them to warm up at 68 ^{o}F (room temperature) before taking flesh firmness readings.

B) Remove a nickel-sized slice of skin on each side-cheek of the fruit with a knife or potato peeler. Hold the fruit against a hard, stationary surface such as a table top or, if you are using the drill press-mounted system, the base.

C) Slowly and constantly force the pressure tester tip into the fruit to the depth of the inscribed line on the end of the tip. Measurements are more consistent when the same person always performs the firmness tests. Reset the tester gauge and record each reading to the nearest half pound.

2. Communicating with Your Merchandisers

Find out the anticipated consumption schedule (fruit turning schedule) for these arriving fruit before starting your fruit ripening and/or establishing your temperature conditions. Establish your ripening protocol according to this anticipated consumption schedule.

3. Determining the Rate of Softening

The rate of fruit softening (lbs firmness lost/day) varies among peach and nectarine cultivars and is controlled by temperature. A high rate of softening is achieved at 68 to 77^{o}F and a low rate of softening is accomplished by using lower temperatures (Table 1). Temperatures higher than 77^{o}F will reduce the rate of softening, induce off flavors and irregular ripening. This general guideline information (Table 1) was developed under our experimental conditions, therefore, these softening rates may vary according to physiological maturity and environmental conditions during ripening.

4. Fruit Ripening Conditions

Peaches and nectarines harvested at or higher than the "California Well Mature Stage" do not need ethylene exposure to ripen properly because fruit softening is temperature dependent. In fact, exogenous ethylene application will not accelerate California well mature peach and nectarine fruit ripening.

Adequate air circulation within the room to assure uniform fruit temperature is desired. Pallets should be placed at least 18 inches from the room walls and six inches from each other to provide good air circulation. High humidity around the fruit during the ripening process, preferably 90%, to prevent fruit shrivel is necessary. It is also important to assure that carbon dioxide produced by the fruits does not accumulate in the room by using continuous air exchange or by opening the room for an air change.

5. Calculating the Number of Days to the Transfer And/or "Ready to Eat" Points

$$\text{Number of Days at } (^{o}\text{F}) \text{ to Reach the Transfer Point} = \frac{\text{Initial firmness (lbs) - Transfer point (lbs)}}{\text{Rate of softening at } (^{o}\text{F}) \text{ (lbs/day)}}$$

As the relationship between fruit firmness and bruising indicate that soft fruit are more susceptible to bruising than hard fruit, to reduce physical damage occurring during the transportation and handling at the retail point, we recommend moving fruit to the retail store before fruit reaches 6-8 pounds (transfer/shipping point). The establishment of 6-8 pounds as the Transfer Point is based only on our previous experience with fruit damage during harvesting, hauling, and packaging and in our laboratory tests. As bruising incidence varies among different retailer operations and among cultivars, you should develop your own Transfer Points for your conditions.

6. Controlling the Rate of Softening

Careful temperature and flesh firmness control are the key to success in this ripening program. If you want to slow down your ripening because of changes in your rotation time, place your fruit at a lower temperature.

7. Keeping Record

Start to develop your own information for your specific cultivars, ripening conditions and stores. Write down your rates of softening, transfer points, fruit arrival to your different stores, decay incidence, physical damage, consumer reaction to "Ready to Buy" or "Ready to Eat" fruit, etc. This information will be extremely valuable to improve your ripening program in the future.

Table 1. Rate of fruit softening for different peach and nectarine cultivars grown in California.

	Rate of Softening (lbs/day)		
Cultivar	59°F	68°F	77°F
NECTARINE			
Armking	2.2	>3.3	4.4
Armqueen	2.2	>3.3	4.4
August Red	0.9	1.3	1.7
Aurelio Grand	2.2	>3.3	4.4
Autumn Grand	1.0	1.5	2.0
Early Sungrand	2.2	3.3	4.4
Fairlane	1.5	2.2	2.9
Fantasia	1.5	2.2	2.9
Firebrite	1.5	2.2	2.9
Flamekist	1.3	2.0	2.7
Flaming Red	1.1	1.7	2.3
Flavortop	1.5	2.2	2.9
Gold King	0.9	1.4	1.9
Granderli	1.5	2.2	2.9
Independence	1.5	2.2	2.9
July Red	1.3	2.0	2.7
June Glo	1.7	2.5	3.3
Late Le Grand	0.9	1.4	1.9
Le Grand	1.5	2.2	2.9
May Diamond	1.7	2.5	3.3
Mayglo	2.2	3.3	4.4
May Fair	1.5	2.2	2.9
May Grand	1.7	2.5	3.3
Moon Grand	1.5	2.2	2.9
Red Diamond	0.5	0.8	1.1
Red Free	1.5	2.2	2.9
Red Grand	1.5	2.2	2.9
Red June	1.5	2.2	2.9
Regal Grand	0.5	0.7	0.9
Royal Giant	1.5	2.2	2.9
September Grand	2.2	>3.3	4.4
September Red	0.6	0.9	1.2
Sparkling Red	1.7	2.5	3.3
Spring Grand	1.5	2.2	2.9
Spring Red	1.7	2.5	3.3
Summer Diamond	2.2	3.3	2.9
Summer Grand	0.5	0.7	0.9
Summer Red	0.9	1.4	1.9
Sun Grand	2.2	>3.3	4.4
PEACH			
Angelus	1.5	2.2	2.9
Autumn Gem	0.5	0.7	0.9
Belmont	1.3	2.0	2.7
Cal Red	1.5	2.2	2.9
Carnival	1.5	2.2	2.9
Cassie	3.4	5.0	6.6
Coronet	2.2	>3.3	4.4
Early Coronet	1.5	2.2	2.9
Early Fairtime	2.2	>3.3	4.4
Early O'Henry	1.5	2.2	2.9
Elegant Lady	1.7	2.5	3.3
Fairtime	2.2	>3.3	4.4
Fay Elberta	1.5	2.2	2.9
Fayette	1.5	2.2	2.9
Fire Red	0.5	0.7	0.9
Flamecrest	0.5	0.7	0.9
Flavorcrest	1.5	2.2	2.9
Fortyniner	2.2	>3.3	4.4
June Lady	1.5	2.2	2.9
Kings Lady	2.2	3.3	4.4
Lacey	1.1	1.7	2.3
May Crest	1.5	2.2	2.9
Merricle	1.5	2.2	2.9
Merrill Gemfree	1.3	2.0	2.7
O'Henry	1.5	2.2	2.9
Pacifica	1.5	2.2	2.9
Pageant	1.5	2.2	2.9
Parade	1.5	2.2	2.9
Redcal	1.5	2.2	2.9
Redtop	1.9	2.9	3.8
Regina	1.5	2.2	2.9
Royal Gold	2.2	>3.3	4.4
Ryan Sun	1.7	2.5	3.3
Sparkle	1.7	2.5	3.3

Springcrest	1.3	2.0	2.7
Springold	2.2	>3.3	4.4
Spring Lady	1.3	2.0	2.7
Summer Lady	1.1	1.7	2.3
Summerset	0.5	0.7	0.9
Suncrest	2.2	>3.3	4.4
Windsor	0.5	0.7	0.9

MARKET LIFE POTENTIAL FOR NEW STONE FRUIT CULTIVARS

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Internal breakdown represents the main limitation to shipping plum and late season peach and nectarine cultivars. Because stone fruit cultivars vary greatly in their susceptibility to internal breakdown, it is essential to determine their individual potential shipping life. To identify the potential shipping life for new stone fruit cultivars, fruit from new cultivars were evaluated for internal breakdown incidence after storage at 32 and 41°F. Fruit samples were collected at commercial harvest according to the CTFA color chips for low crop load commercial orchards. Fruit samples were removed weekly for up to 5 weeks from storage and allowed to ripen at 68°F before evaluation. Maximum and minimum market life are defined as the number of weeks for each cultivar under continuous storage at 32 and 41°F, respectively.

A large variability in the minimum and maximum market life was observed among these cultivars during this "rare" California season. There was greater variability in minimum market life which varied from less than 1 week to 5 weeks while maximum market life varied from 3 to 5 weeks. Among the yellow flesh peaches, early cultivars were the least susceptible to internal breakdown, mid season cultivars were intermediate and late season cultivars were the most susceptible (Table 1). Among white flesh peaches, the harvest season did not make any difference in internal breakdown susceptibility (Table 1). In white flesh peaches, the maximum and minimum market life varied from more than 3 to 5 weeks, and 1.5 to 5 weeks, respectively. The end of the market life for white flesh peaches was mainly due to decay incidence rather than internal breakdown. Fruit storage temperature was not as important in the market life of the white flesh cultivars as in the yellow flesh ones, except for 'White Lady' and 'Snow Giant' cultivars.

Table 1. Maximum and minimum market life of stone fruit when stored at 32 or 41 °F.

	Market Life[z] (Weeks)		Type	
Cultivar	Maximum 32°F	Minimum 41°F	Fruit	Flesh
Peaches (yellow flesh)				
Kern Sun	5[d]	4	cling	nonmelting
June Sun	4[d+]	4		
Crown Princess	4[+]	4	cling	nonmelting
Fancy Lady	3[d+]	1-2	free	melting
Summer Lady	4-5	1-2	free	melting
August Sun	2-3	2-3		
Ryan Sun	3-4	1-2		
September Sun	3[d]	>1		
Autumn Rose	1-2	<1		
Peaches (white flesh)				
Snow Flame	5	5	cling	nonmelting
Snow Brite	3[+]	3		

White Lady	4[d]	1-2		
Sugar Lady	4[d]	4		
Summer Sweet	3[d+]	3-4		
Snow Giant	4	2-3		
Nectarines				
Early Diamond	5	5	semi-free	melting
Royal Glo	4[d]	4	semi-free	melting
Mayglo	5	5	semi-free	melting
Sparkling May	5	5	semi-free	melting
Zee Grand	5	5	semi-free	melting
May Diamond	5	5	free	
Sun Diamond	5	5	free	
Spring Brite	5[d]	5	cling	melting
Red Diamond	5	5	free	
Ruby Diamond	4-5[d]	3-4	free	
Summer Fire	5	3	cling	
August Red	5	4	cling	melting
September Red	4	1	cling	melting
Plums				
Showtime	3-4	2	free	N/A
Angeleno	4-5	2-3	free	N/A

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[z] The end of market life was determined when more than 25% of the fruit were mealy or 15% of the fruit had a score of 3 (25% flesh browning) or higher for flesh browning.

[+] End of market life due to decay.

[d] High decay incidence.

The variability in market life of nectarines was very low, varying from 3 to 5 weeks (Table 1) excluding 'September Red.' Even storage at 41°F did not reduce the market life for many of these cultivars. The exceptions were 'Ruby Diamond,' 'Summer Fire,' 'August Red,' and 'September Red.'

The maximum market life for 'Showtime' (early season) and 'Angeleno' (late season) plums was 3.5 and 4.5 weeks, respectively. For both cultivars, storage at 41°F reduced their market life by almost one half (Table 1). In general, longer market life was achieved in peaches and plums stored at 32°F than at 36-41°F (Table 1).

PEACH AND NECTARINE SKIN DISCOLORATION, INKING, STAINING, BLACK STAINING

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Skin discoloration in peach and nectarine fruits has become a frequent problem in the last decade in California, Washington, Georgia, South Carolina, New Jersey, and Colorado, as well as in other production areas in the world such as Italy, New Zealand, Australia, Argentina, and Chile.

Inking symptoms appear as discolored brown and black spots or stripes but are restricted to the skin. Abrasion damage in combination with heavy metal contamination are requirements for inking development. The damaged skin cells, where the anthocyanin/phenolic pigments are located, collapse and their contents reacts with heavy metals turning their color dark brown/black. Iron, copper and aluminum (heavy metals) are the most deleterious contaminants. Only 5-10 ppm iron is enough to induce inking at the physiological fruit pH. This contamination can occur within 15-20 days before harvest, during harvesting or packing operations. Foliar nutrient, fungicide and insecticide preharvest sprays which contain heavy metals in combination with abrasion damage have the capacity to induce inking on peach and nectarine fruit when sprayed close to harvest. Some tips for controlling this condition are:

1. Reduce fruit abrasion damage.

    A. Treat fruit gently.
    B. Avoid long hauling.
    C. Keep picking containers dirt free.
    D. Supervise harvest.

2. Reduce contamination of fruit.

    A. Keep harvesting equipment clean.
    B. Avoid dust contamination on your fruits.
    C. Check your water quality for heavy metal (Fe, Cu & Al) contamination.
    D. Do not spray foliar nutrients containing heavy metals during fruit maturation.
    E. Tentative preharvest application intervals for the following fungicides and foliar nutrients were developed (DBH-days before harvest):

    Z.I.P.7 = 20 DBH
    Benlate7 = 12 DBH
    Rovral7 = 7 DBH
    Funginex7 = 3 DBH
    Ronilan7 = 1 DBH

3. In case of a possible inking situation with peach and/or nectarine, delay your packaging for 48 hours to detect fruit inking damage during your grading operation.

4. As a long term solution, it is suggested that chemical manufacturers attempt to identify and remove the possible sources of contamination from their products that may cause inking before distributing them.

FRUIT FREEZING INJURY

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Freezing injury can be encountered in fruit that are purposely stored at very near their freezing point or that encountered some accidental exposure to subfreezing temperatures because of some malfunction in the refrigeration system. Injury can occur whenever fruit are exposed to too low a temperature, whether in cooling, storage, transport or distribution centers.

Occasionally, freezing can occur in any type of fruit. Decay development can occur faster on freeze injured fruit. Fruit which have been frozen have greater susceptibility to mechanical injuries, especially surface discoloration from transit vibration/abrasion.

Freezing injury will appear as glassy, "water soaked" or translucent areas in the flesh. With time these injured areas will dry, leaving open "gas pockets" in the flesh. The freeze injured tissue of most fruits will begin to brown as a result of enzymatic oxidation of phenols released by the injured tissue. Where freezing occurs at the fruit surface, the glassy or browning symptoms may be visible without cutting.

Often when injury is seen it is necessary to determine whether it is indeed from freezing, or whether it is from some other cause.

Similar symptoms can be associated with injury from other causes. Water core in apples and some senescent breakdown problems can cause flesh translucency. Many disorders can cause internal browning or even the development of gas pockets in the flesh. Surface browning may be confused with scald disorders in apples, Asian and European pears, or even chemical or mechanical injuries on many fruits.

Freezing injury resulting from short-term accidental exposure to sub-freezing temperatures will occur on the most exposed fruit - near box openings on outside and corner boxes of the pallet, for example. Damage may be worse on the exposed surface of the fruit, with little or no relationship between freezing injury and the SSC patterns within or among fruits.

Freezing injury symptoms on fruit after long term storage at near-freezing storage temperatures should be seen first in the lowest soluble solids concentration (SSC) portions of the fruit and in the lowest SSC fruit within a lot. Each fruit has a typical SSC pattern. For pears and apples that we have evaluated, the lowest SSC is in the core area, the highest SSC in the outer flesh near the blossom end of the fruit. For Asian pears, the lowest SSC is in the shoulders (stem end) and the core and highest in the flesh near the blossom end. For kiwifruit, the lowest SSC is in the flesh nearest the stem end, the highest SSC is in the core and flesh tissue near the blossom end. For grapes, the lowest SSC occurs at the basal tip of the cluster, the highest SSC near the shoulders. While we would expect to see freezing appear first in the core area of a pear, for example, we should verify the relationship between SSC and injury by refractometer measurements.

A fruit freezes because of: a) accidental short-term exposure to temperatures considerably below its freezing point; or b) prolonged exposure to a temperature just below its freezing point. In the latter case, the injury pattern should relate to the SSC pattern of the fruit. This is because low SSC fruit will freeze at a higher temperature than high SSC fruit.

Maintain temperatures just above freezing. It requires good equipment and careful management. Of equal importance is accurate monitoring of SSC of fruit as a basis for estimating the freezing point of tissue. The relationship between SSC and freezing point for stone fruits is presented in Table 1.

Table 1. Relationship between stone fruit SSC (%) and freezing point.

SSC	Safe Freezing Points	
(%)	(°F)	(°C)
8.0	30.7	-0.7
10.0	30.3	-0.9
12.0	29.7	-1.3
14.0	29.4	-1.4
16.0	28.8	-1.8
18.0	28.5	-1.9

'FORTUNE' PLUM RIPENING

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Our ripening test results on 'Fortune' plums indicated that red color development was directly related to fruit temperature (Table 1). After a 48-hour exposure at 68°F, plums were full red. Red color development covered the yellow ground color completely and any blemish present on the stem end or other fruit parts was masked. Red color did not develop in ethylene treated or untreated fruit stored at 41 and 32°F.

Table 1. 'Fortune' plum fruit characteristics after ethylene treatment (100 ppm).

Temperature (°F)	Trtmt	Red surface color (%)	Surface blemishes	Firmness (lbs)
	Initial	76	Visible	7.8
32	5HR-C2H4	80	Visible	6.9
32	24HR-C2H4	78	Visible	7.4
32	48HR-C2H4	77	Visible	6.2
32	Air	81	Visible	6.2
41	5HR-C2H4	76	Visible	7.4
41	24HR-C2H4	78	Visible	7.0
41	48HR-C2H4	78	Visible	6.9
41	Air	71	Visible	7.2
68	5HR-C2H4	80	Masked	4.1
68	24HR-C2H4	82	Masked	2.1
68	48HR-C2H4	96	Masked	1.8
68	Air	95	Masked	4.0

Ethylene treatment (100 ppm) did not increase red color development but reduced fruit firmness. Fruit firmness was not affected by ethylene treatment when fruit were stored below 41°F. When fruit were ethylene treated at 68°F, ethylene treated plums had darker red color and lower fruit firmness than untreated plums. Even in plums treated with ethylene for 5 hours (68^{o}F) and then kept at 68^{o}F in ethylene-free air, blemishes were completely masked by the new red color development but firmness went down to 4 lbs. Ethylene treatments in addition to warming (68^{o}F) could be beneficial in speeding ripening of less mature plums and thereby making the ripening of the entire lot more uniform.

Cosmetic 'Fortune' plum blemishes will be masked during ripening but fruit softening will also occur. Plum ripening can be used to reduce cosmetic blemishes in 'Fortune' plum but to avoid physical damage during transportation and warehouse handling, it may be done at the warehouse or retailer end.

EVALUATION OF SKIN COLOR AS A MATURITY INDEX FOR NEW CHERRY CULTIVARS GROWING IN THE SAN JOAQUIN VALLEY

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During the relatively cool 1995 cherry season which was characterized by low crop loads, the fruit maturity stage, determined by skin color, correlated well with initial cherry quality attributes and storage potential. Soluble solids concentration (SSC) and fruit weight, increased as the cherries changed skin color from pink to mahogany. Titratable acidity (TA) and SSC/TA ratio increased as 'Brooks' and 'Tulare' cherries changed color from pink to mahogany. An increase in SSC and TA occurred in 'Brooks' and 'Tulare' when skin color changed from the bright red to mahogany. This increase in TA and SSC during cherry maturation was previously observed in these early cultivars growing in the San Joaquin Valley. The SSC/TA ratio increased when fruit skin color changed from pink to bright red on 'Brooks,' from pink to red on 'Tulare,' and from pink to mahogany on 'King'. The lack of differences in the SSC/TA ratio for 'Brooks' and 'Tulare' between the bright red and mahogany skin color is explained by the increase of acidity paralleling the increase in SSC of the mahogany color cherries.

Our preliminary storage test showed that cherries picked at the bright red skin color were firmer and had less water loss, pitting, and decay problems than cherries picked at the dark or light red skin color stages.

In this preliminary study 'Brooks' and 'Tulare' fruit harvested at the bright red skin color assured the greatest initial quality based on the SSC/TA ratio. 'King' fruit picked at the mahogany color had the highest initial quality.

CANCELLATION OF POSTHARVEST USE OF ROVRAL 50WP ON STONE FRUIT CROPS AND OTHER LABEL CHANGES OF THE FUNGICIDE

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Pre- and Postharvest usage of Rovral 50WP on Stone Fruit Crops

Iprodione, the active ingredient of the agricultural chemical Rovral manufactured by Rhône-Poulenc Ag Company, is a broad spectrum fungicide registered in most countries throughout the world where stone fruit crops are grown. This fungicide was developed in 1974 and was shown to be active against brown rot (*Monilinia* spp.), gray mold (*Botrytis cinerea*), shot hole (*Wilsonomyces carpophilus*), Sclerotinia decay (*Sclerotinia* spp.), black rot (*Alternaria* spp.), and other fungal decays affecting stone fruit crops. Iprodione is also effective against Rhizopus rot (*Rhizopus stolonifer*) and Gilbertella decay (*Gilbertella persica*) when the compound is mixed with oil emulsions.

Rovral fungicides (Rovral 50WP an 4F) are used preharvest during bloom and as fruit cover sprays to protect blossoms and fruit, respectively from plant pathogenic fungi. In 1989, the fungicide formulation Rovral 50WP was also registered in the United States for use as a postharvest treatment of fresh market stone fruit crops (cherry, peach, plum and nectarine). In the late 1980's and early

1990's other postharvest fungicides such as benomyl (Benlate 50WP), thiophanate-methyl (Topsin M), and triforine (Funginex) were canceled from postharvest usage. Thus, in recent years, iprodione was the only postharvest fungicide labeled for postharvest used for the control of brown rot and other decays (gray mold, black rot, etc.) of stone fruit crops.

Latest Label Changes Effecting Stone Fruit and Table Grape Crops

On 18 March 1996, Rhône-Poulenc Ag Company notified EPA that the company has taken voluntary actions to reduce the dietary exposure of iprodione, the active ingredient of Rovral 50WP, on stone fruit crops and table grapes in the United States. Effective immediately, the company has made the following changes to the Rovral 50WP label for stone fruit crops: 1) Postharvest use has been removed from the label; 2) Number of preharvest applications per season has been reduced from 5 to 4 application; and 3) The preharvest application interval (PHI) has been increased from 0 to 7 days. On grapes, the PHI has also been increased from 0 to 7 days. These changes were in compliance with guidelines established by the Dietary Risk Exposure System (DRES) of the United States Environmental Protection Agency (EPA). All label changes of Rovral 50WP were voluntary by the registrant and were not an EPA revocation.

In a recent meeting with representatives of the stone fruit and table grape industries of California and the University of California at the Kearney Agricultural Research Station, Rhône-Poulenc Ag Company managers explained that postharvest usage and 0 day PHI account for the highest residues of iprodione on fresh market stone fruit crops. Thus, other changes in preharvest usage of the stone fruit label or dropping other crop usage's from the Rovral 50WP label would not dramatically reduce the dietary exposure of the fungicide as much as the current label changes. The company also explained that other new crop labels for Rovral, namely, the new cotton label, were coincidental and did not increase dietary exposure of iprodione. Currently, Rhône-Poulenc is awaiting instructions from EPA and the Department of Pesticide Regulation (DPR) of California for re-labeling inventory of Rovral 50WP. Re-labeling will include Rhône-Poulenc inventory and may include supplies of wholesale distributors of the fungicide. Retail distributors could have up to 2 years to sell Rovral inventory with the old label but this depends on EPA and California DPR regulators. "End-users" of the fungicide including packers and service companies would not be effected by re-labeling efforts and they could use the fungicide until their supplies are exhausted.

Future Plans for Postharvest Management of Stone Fruit Decays with Fungicides

Currently, the only fungicide registered for postharvest use on stone fruit crops is dicloran (e.g., Allisan). This fungicide is mainly for control of Rhizopus rot. Thus, no other fungicide is registered for postharvest control of brown rot and other decays of stone fruit crops. Due to the serious nature of the recent changes to the Rovral label, the California Grape and Tree Fruit League has also been notified and will be in communication with the fresh market stone fruit industries of California

Rhône-Poulenc Ag Company will continue to conduct toxicology studies and meet with EPA regarding the safety of iprodione in efforts to reinstate Rovral 50WP as a postharvest fungicide of stone fruit crops. The voluntary cancellation of iprodione by Rhône-Poulenc, however, prohibits any request for an emergency registration (Section 18) of iprodione for postharvest usage on stone fruit crops. Because adequate supplies of iprodione are available for the 1996 growing season, no immediate request for an emergency registration of a postharvest fungicide will be made to EPA by the fresh market stone fruit commodity groups. Researchers at the University of California have planned studies to evaluate other fungicides for postharvest use including several sterol biosynthesis inhibiting (SBI) fungicides such as imazalil (Fungaflor), tebuconazole (Elite), and myclobutanil (Rally). These initial studies will be completed in 1996 and the stone fruit industries will be poised for emergency registration and development of additional fungicides for postharvest use for the 1997 growing season.

DEVELOPING CRITICAL BRUISING THRESHOLD FOR STONE FRUIT

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One approach to produce high quality fruit is to delay fruit harvesting. However, over-mature fruits are soft, more susceptibility to impact damage and disease infection. To avoid fruit bruising, harvesting time has to be determined very carefully. Impact bruising is caused either by dropping the fruit onto a surface or by dropping an object onto the fruit. The intensity of the bruise will depend on the height of the drop and the type of impact surface material. Impact bruising can be caused by dropping fruit in a picking bucket, by dumping into the field bin, by various drops in the packing operation, or even during filling of containers in the packing line. An impact bruise may or may not be visible on the surface of the fruit, and normally will not cause a surface indentation. However, this type of bruise often causes brown flesh discoloration extending well below the surface. Impact damage causes surface fruit wounding which facilitates entrance and development of rot organisms.

Bruising reduction during harvesting: Effects of picking containers and bin trailer types on bruise development were evaluated on 'Flavorcrest', 'Red Top', and 'O'Henry' peach and 'September Red' nectarine cultivars. Fruit used in these experiments were collected from the KAC and other orchards at the commercial harvest time. Dirty nylon bags and dirty canvas bags induced higher bruising and decay development than the clean canvas bags and picking buckets on 'September Red' nectarine. In 'Flavorcrest', 'Red Top', and 'Rich Lady', bruising incidence was lower on fruit harvested with the picking buckets than on fruit harvested with picking bags. 'O'Henry' peaches picked with clean pick-pack tote containers (plastic) had nearly half the bruising and decay damage as peaches picked with picking buckets. Individual pickers affected fruit impact bruising incidence, but not decay or abrasion damage. On 'September Red' nectarine, the percentage of fruit with bruises varied from 17-31% and the number of bruises per fruit from 0.4-0.7 depending upon the individual picker. Fruit picked early in the day (7:00 A.M.) had more impact bruising than fruit picked late (9:00 A.M.). In general, decay incidence was higher on fruit harvested during the late pick, except when dirty containers were used in which case decay was high at both picking times.

Impact bruising reduction during hauling: Comparisons between standard solid axle trailers and rubber axle trailers were made on fruit picked into plastic and wooden bins. Fruit hauled within the orchard on the rubber axle trailers in painted wooden bins had less bruising than fruit hauled on the standard trailers. Abrasion damage was not affected by trailer type. Similar results were obtained during the long haul test (5 mile ride). It is important to point out that physical damage levels after the picking, dumping and hauling operations were not much higher than physical damage levels just after picking and dumping operations. Our data indicated that hauling less than 5 miles did not contribute too much to fruit physical damage. Most of the damage occurred during picking, dumping and hauling within the orchard. This points out the importance of careful supervision during harvesting.

Impact bruising reduction during the packinghouse operation: A survey of the bruising potential for different packing line operations was conducted using an accelerometer (IS-100). The IS-100 sphere measures the levels of bruising potential that fruit are exposed to when run on these packinglines. The sphere records this information as velocity changes and as energy (G). Average bruising potentials (G=s) varied from 24 to 143 G within/between packinglines. In general, the bin dumping and transfer points at the beginning (transfer to the pony sizer) and at the end of the packing line (packaging filling) had the highest G values.

To evaluate the potential impact damage of the levels measured in the packingline, we determined the bruising susceptibility among different cultivars. As soft fruit bruise more than hard fruit, we calculated the energy level (G) to induce bruising at different fruit firmnesses. To determine the level of energy to induce a bruise in a given cultivar, we dropped fruit from different heights on different positions on the fruit (cheek, shoulder, suture and tip) on a known surface. Bruising incidence of several peach, nectarine and plum cultivars was determined for drop heights of 0 cm, 1 cm, 5 cm, and 10 cm x position (tip, suture, cheek and shoulder) combinations.

By using statistical data analysis manipulations, we calculated minimum fruit firmness (lbs) values in relation to three bruising potentials (66, 185, 246 G) for each cultivar (Table 1). Among the cultivars evaluated, plums tolerated impact damage much better than nectarines and peaches. In some peach cultivars, we found a "safe window" of fruit firmness for impact damage.

To use this approach to preduct bruising, we need to measure fruit firmness in the weakest spot on the fruit. The weakest spot on the fruit varies according to cultivar. In general, early cultivars soften faster at the tips and late cultivars at the shoulders/sutures. The tip was the softest position for 'Rich May,' 'Rich Lady,' 'Queencrest,' and 'Mayglo.' The shoulder was the softest position for 'Kern Sun,' 'Spring Bright,' 'Summer Bright,' 'Ruby Diamond,' 'August Red,' 'Fancy Lady,' 'Summer Fire,' 'Elegant Lady,' 'Summer Lady,' 'Diamond Princess,' 'O'Henry,' 'Ryan Sun,' 'August Sun,' 'September Sun,' 'Snow Giant,' and 'Red Diamond.' The suture was the softest spot for 'Arctic Rose,' 'Summer Grand,' 'White Lady,' 'Sugar Lady,' 'Snow Brite,' and 'September Red.' On the commercial harvest date, there were up to 7 pounds difference in fruit firmness between the strongest and the weakest spots on the fruit, with the exception of the plums which ripened uniformly at all positions. In all cultivars, firmness measured on the cheek was the highest. Thus, it is not well related to fruit bruising susceptibility.

Table 1. Minimum flesh firmness measured at the weakest point necessary to avoid bruising at three levels of physical damage.

Cultivar	Drop Height 1 cm (~66 G)	 5 cm (~185 G)	 10 cm (~246 G)
Plums			
Blackamber	0	0	4[z]
Royal Diamond	0	0	7
Angeleno	0	0	0
Peaches (yellow flesh)			
Queencrest	0	4	9
Rich May	0	9	9
Kern Sun	4	6	9
Diamond Princess	0	12	12
Flavorcrest	0	0	>3-<10
Elegant Lady	0	0	>6-<13
O=Henry	0	0	6
Fancy Lady	3	11	11
Summer Lady	0	0	14
August Sun	5	9	15
September Sun	0	0	10
Ryan Sun	0	0	10
Peaches (white flesh)			
Snow Brite	13	14	17
Snow Flame	13	13	13
Snow Giant	0	12	14
Sugar Lady	0	15	15
White Lady	5	14	15
Nectarines			
Royal Glo	10	10	11
Mayglo	7	7	7
Red Diamond	7	13	13
Ruby Diamond	9	9	12
Rose Diamond	7	9	9
Spring Bright	11	13	13
Summer Fire	3	9	13
Summer Bright	8	8	9
Summer Grand	2	5	10
Arctic Rose	0	6	11
August Red	6	13	13
September Red	0	10	10

[z] Fruit firmness measured with an 8 mm tip dropped on 1/8" PVC belt.

Unfortunately, we also determined that bruising damage is cumulative. For example, if a 10 cm drop will induce bruising in a cultivar with 8 lbs firmness, then ten drops of 1 cm each on the same spot on the fruit will induce similar damage. Although, the probability of a fruit dropping on the same spot 10 times during packing is low, we recommend reducing potential impact damage in your packing line as much as possible. The use of padding materials, baffles, and deceleration curtains to reduce G-forces, thus, impact damage at the transfer points in the packing line is encouraged. The 3/4" PVC/Neoprene (Cal Industrial Rubber) and the *No Bruze*[7] padding materials induced approximately 85% reduction in G in relation to naked metal. These two materials survived the physical abuse of one packing season.

Temperature also has an important effect on the level of susceptibility of fruit to impact bruising. Bruising incidence is higher at low temperatures 32 and 41°F than at temperatures between 50-68°F. Bruising incidence from impact damage decreased rapidly when fruit flesh temperature changed from 32 to 50°F.

EVALUATION OF POSTHARVEST FUNGICIDES FOR CONTROL OF BROWN AND RHIZOPUS ROTS. 1995

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Fungicides were applied to freshly-harvested fruit to assess their efficacy with natural and artificial inoculum. Rovral in oil (iprodione; 1200 ppm in 100% oil; PNPL 251) alone or with Allisan (dicloran; 2400 ppm) was applied through an *air-atomized nozzle over horse-hair brushes*. The volume applied was 0.25 ml per fruit. Fruit were not inoculated, or simultaneously wounded, with a needle (1 mm by 2 mm puncture) and inoculated with 10Φl of *Rhizopus stolonifer* (4,000 or 20,000 spores/ml) or *Monilinia fructicola* (20,000 spores/ml) spores 15 min. after treatment. Fungicide residues from ten fruit from each treatment were determined by gas chromatography. The incidence of decay was determined after 5 days storage at 20C.

Residues of iprodione and dichloran were 0.7-1.1 and 0.7-1.4 ppm, respectively. The volume applied to each fruit and iprodione residues were below that recommended for

Rovral in oil alone to control rhizopus rot. In 5 or 6 tests to control brown rot, the Allisan+Rovral combination was not superior to Rovral in oil alone. In 3 of 4 tests to control rhizopus rot, the combination was significantly superior to Rovral in oil alone where rhizopus rot incidence was high.

FRUIT INSPECTION LIGHTING

Nancy Esch and Agustin Lacayo
Paramount Citrus

Peaches, plums, apples and oranges all have one thing in common. They require manual visual inspection for external blemishes and defects that affect the final grade of the fruit. Depending on the layout of the packing line, this may entail inspection of the fruit at 3 to 4 different areas. Regardless of the handling system, fruit moves past the inspector at a rapid rate and it can vary significantly in color, size, shape and type and severity of defects. Each inspector typically looks at one hundred items each minute, and must accurately sort the fruit into different grades, based on these parameters.

Recent studies have concluded that the intensity and quality of the light at the inspection area is very important to improve the accuracy of the sorting done by the inspectors. Most down grading of fruit is the result of defects and blemishes on the fruit surface. Defects caused by insects, rots, diseases, cuts, punctures, bruises, wind scar and limb rubs are often brown or gray tones. The best light source must be able to enhance the appearance of these types of defects so that they are very apparent to the inspector, regardless of the fruit color.

The cost of illumination is low compared to the cost of labor, but more light will not change a difficult task into an easy one. That being said, there are 4 key issues to keep in mind when trying to improve the lighting environment of an inspection area.

1) The SP-30 (3000^{o}K) lamp is the best choice of light to enhance the appearance of brown defects.

2) There should be at least 250 foot-candles (fc.) of light falling on the sorting surface for light colored fruit (dark purple plums may require up to 500 fc).

3) The sorting surface should have a non-glossy finish and be darker in color than the fruit. This can be accomplished with black or dark gray belting or gray PVC for the roller beds.

4) Surfaces near the sorting area and the clothing of the inspectors should not be bright or highly reflective. Painted areas should have a matte finish.

In the past couple of years, surveys have been taken of the light intensity (foot-candles) currently in use for fruit inspection. In almost all cases, light intensity was too low (generally less than 100 fc). Therefore, improvement of inspection lighting may not be as simple as installing SP-30 lamps into existing fixtures. A four lamp fluorescent fixture located above the inspectors= head (36 to 40 in. from the inspection surface) is necessary to obtain at least 250 foot-candles of light on the sorting surface. A 2 lamp unit will be too close to the sorting surface (24 in. above the inspection surface) and may be an accident waiting to happen. An inspector leaning over the sorting surface to reach fruit on the far side stands a good chance of hitting his head on the light fixture.

New federal regulations aimed at improving the energy efficiency of lighting have encouraged the development of energy saving lamps, ballasts and fixtures. The following table provides several examples of changes that can be made to inspection lighting and the approximate costs. Sources :

1) Guyer, Daniel, Roger Brook and Edward Timm. 1994. Lighting systems for fruit and vegetable sorting. Agricultural Engineering Information Series # 618. Michigan State University - Cooperative Extension Service.

2) Pat Becker. All-Phase Electric Supply Company. 1-800-537-6300.

Current fixture type:	Suggested changes or replace with:	Cost per item:	Notes :
High output 8 ft.(4 lamp) fixture	a) Electronic ballast (retrofit, need 2)	$32.35	34% reduction in wattage compared to standard magnetic ballast.
	b) SP 30 lamp (T-12 style, need 4)	$6.86	
High output 8 ft. (2 lamp) fixture	a) Industrial 4 ft. (4 lamp) fixture with one electronic ballast (need 2)	$80.00	Allows placement of fixture above the inspector=s head.
	b) SP 30 lamp (T-8* style, need 8)	$2.00	
Standard 4 ft. (4 lamp) fixture	a) Electronic ballast (retrofit, need 1)	$23.00	40% reduction in wattage compared to standard magnetic ballast.
	b) SP 30 lamp (T-8 style, need 4)	$2.00	
Standard 4 ft. (2 lamp) fixture	a) Industrial 4 ft. (4 lamp) fixture with one electronic ballast	$80.00	Allows placement of fixture above the inspector=s head.
	b) SP 30 lamp (T-8 style, need 4)	$ 2.00	

* T8 style lamp is the new generation, energy efficient fluorescent lamp; it is 1 inch in diameter.

HYDROCOOLER WATER SANITATION IN THE SAN JOAQUIN VALLEY STONE FRUIT INDUSTRY

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Most packing house operators in the San Joaquin Valley use chlorine in their hydrocoolers to kill pathogens in the water and on fruit surfaces. Such practices prevent the buildup of pathogens in the water and can greatly reduce fruit infections during subsequent storage and transportation. Chlorination is also advantageous because it leaves no residue on the fruit for human health concerns. Further, in our research we have not seen any damage of fruit treated with up to approximately 500 ppm sodium hypochlorite. However, because chlorination leaves no residue on the fruit, pathogens which land on the fruit surface after treatment will not be killed.

The main forms of chlorine used include sodium hypochlorite (NaOCl), calcium hypochlorite ($Ca(OCl)_2$) and chlorine gas (Cl_2). Sodium hypochlorite comes in a 5.25% solution (household bleach) and 12.75 or 15% solutions available through laundry and swimming pool chemical suppliers. Calcium hypochlorite usually comes as a powder or tablets in formulations of 65%. However, it does not dissolve readily (especially in cold water) and undissolved particles can cause phytotoxic chlorine burns on the fruit. To prevent this, one should first dissolve the powder or granules in a small amount of warm water before adding to the hydrocooler water. If using tablets for continuous, slow-release of chlorine, ensure that the tablets are placed so that water circulates well around them. Chlorine gas comes in pressurized gas cylinders and should be handled cautiously according to label instructions.

Factors Controlling Sanitation Activity
There are several factors that influence available chlorine levels and how effectively pathogens are killed:

pH: When sodium hypochlorite is added to water, it forms sodium hydroxide (NaOH) and hypochlorous acid (HOCl) (Reaction #1).

Reactions:
1) NaOCl + H_2O <-> NaOH + HOCl (active form)
2) HOCl <-> H^+ + OCl^-
3) HOCl + HCL <-> H_2O + Cl_2 (gas)

All three forms of chlorine produce hypochlorous acid (also called available chlorine, free chlorine or active chlorine) which is what kills the pathogens. In solution, the hypochlorous acid can disassociate to form hypochlorite ion (OCl^-) (Reaction #2). Hypochlorite ions are relatively ineffective against pathogens. At low pHs, most of the chlorine is in the hypochlorous acid form while at high pHs, most of the chlorine will be in the ion form (Fig. 1). However, at pHs below 6 available chlorine activity is lost rapidly because another reaction is favored which produces toxic chlorine gas (Reaction #3). Therefore, maintaining a pH of around 7 will maintain about 80% of the chlorine in the hypochlorous acid (active) form with very little in the gaseous form.

Adding either sodium hypochlorite and calcium hypochlorite will increase pH, while adding chlorine gas will decreases pH. After adding commercial chlorine, adjust the pH of the water to 7 by adding either acid or base. One can determine the pH of water by using an electronic pH meter or color-changing paper indicator. Muriatic (HCl) or citric acid are commonly used to lower pH while sodium hydroxide (lye) will raise pH. Typically, in this area we may need to decrease pH of our hydrocooler water. To lower pH, one can determine the amount of acid to add by taking a sample of the water, adding acid to the sample until the pH drops to 7, and then multiplying the amount of acid added per gal. of sample by the total number of gallons in the tank. For example, if 1 fl oz of acid added to a 5 gal. water sample reduces the pH to 7 and the tank holds a total of 300 gal., then (1 fl oz/5 gal. sample) x (300 gal. tank) = 60 fl oz or about 1.9 quarts of acid to lower the tank to pH 7. After adding acid to the hydrocooler tank and allowing about 10 minutes for thorough mixing, verify its pH and Afine tune@ it if necessary.

Chlorine concentration: Although low concentrations of hypochlorous acid (<40 ppm) have been reported to kill most pathogens within 1 minute, higher concentrations (75 -100 ppm) are commonly used to compensate for various losses of available chlorine in the tank.

Exposure time: High available chlorine concentrations kill pathogens after short exposure times (< 1 min.). At lower concentration, more contact time is required to kill the pathogens.

Amount of organic matter in the water (e.g. fruit, leaves & soil): Organic matter in the water will inactivate hypochlorous acid and can quickly reduce the amount of available chlorine. Chlorine which combines with organic matter no longer is active against pathogens but will still be measured by total chlorine testing kits.

Water temperature: At higher temperatures, hypochlorous acid kills pathogens more quickly but is also lost more rapidly due to chlorine gas formation and reactions with organic matter.

Type and growth stage of the pathogens: Although germinating spores and mycelium are relatively easy to kill, spores are much more resistant to chlorine and pathogens growing inside the fruit (inside wounds or as quiescent infections) are shielded from the chlorine and not killed.

San Joaquin Valley Hydrocooler Water Survey

During the 1995 stone fruit season, we surveyed both total and available chlorine levels in several commercial hydrocoolers. We found that available and total chlorine levels started out high in the morning, but then quickly declined by about 50% during the first 48 bins. Under these conditions, pH was not an important factor because both total and available chlorine levels dropped so quickly. Therefore, frequent monitoring (~ every 30 bins) of available chlorine levels is essential to control pathogens in hydrocooler water.

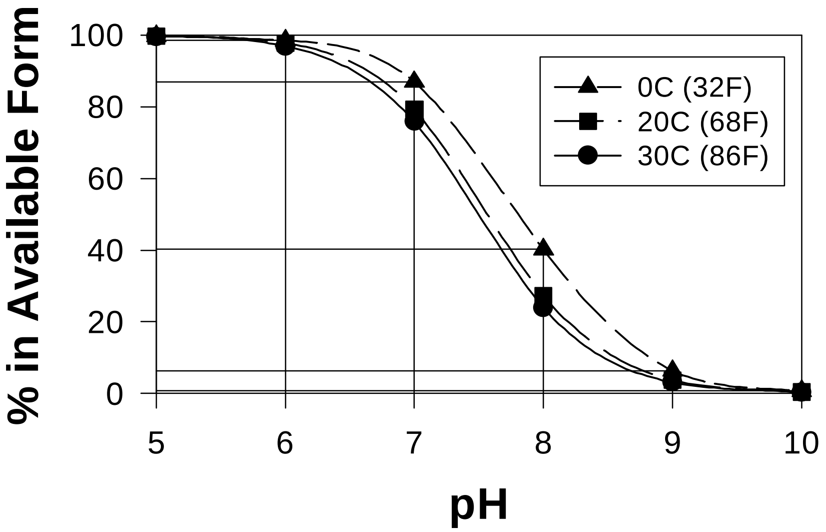

Fig. 1. Percent of chlorine in the available (HOCl) form at different pHs and temperatures.

Kits for measuring total and available chlorine can be easily purchased. Those that measure available chlorine are preferred because chlorine ions or Acombined chlorine@ may give high readings in total chlorine kits.

When using sodium hypochlorite, sodium ions are released (Reaction #1) and can accumulate to levels which may damage the fruit (Table 1). Sodium levels are cumulative and rise each time more sodium hypochlorite is added. Because of this and accumulating dirt, it is important to drain the tank daily and add fresh, clean, potable water. Drained water can usually be applied to nearby farmland. However, check pollution control regulations and local restrictions before disposing of the water.

Recommendations:

X Check available chlorine levels often (~every 30 bins). Total chlorine measurements may be adequate when water is clean and pH is near 7. Installation of automated systems to monitor and adjust available chlorine and pH levels may be worth consideration.
X Maintain available chlorine levels between 75 and 100 ppm.
X Maintain pH around 6.5 - 7.5.
X Drain the tank at the end of each day and refill with clean water.
X Use all chemicals according to their labels (e.g. chlorine, muriatic acid, lye, etc.).
X Use self cleaning screens in hydrocoolers to remove large debris.

Table 1.

pH	Ounces of 65% $Ca(OCl)_2$ per 100 gal. of water	Resulting ppm $Ca(OCl)_2$	Pints of 5.25% NaOCl solution per 100 gal. of Water	Pints of 12.75% NaOCl solution per 100 gal. of Water	Resulting ppm NaOCl	ppm Na	Estimated ppm of available chlorine (HOCl) at specified pH
6	2.1	104	1.6	0.7	108	33	**75**
	2.8	139	2.2	0.9	144	45	**100**
7	2.5	120	1.9	0.8	125	39	**75**
	3.3	160	2.5	1.0	167	51	**100**
8	5.8	282	4.5	1.8	294	91	**75**
	7.7	376	6.0	2.5	392	121	**100**
9	38.9	1892	30.0	12.4	1970	608	**75**
	51.8	2523	40.0	16.5	2627	811	**100**

POSTHARVEST RESEARCH UPDATES

Project Title:

Determination of Maximum Maturity for Stone Fruit

Carlos H. Crisosto

There is a large variability among different stone fruit cultivars in the ability to accumulate SSC and the rate of softening during maturation. Bruising critical values also varied among stone fruit cultivars. Fruit position is an important factor in the calculation of these bruising critical values. In general, plums tolerate more physical abuse than yellow and white flesh peach and nectarine cultivars.

Development of maximum maturity indices for yellow and white flesh peach and nectarine cultivars, and plum, nectarine and peach cultivars with darker skin color development before maturation based on critical bruising values and eating quality is being carried out.

In store peach consumer testing was conducted for >Elegant lady= (July) and >O=Henry= (August) peaches in Northern California. Approximately one thousand consumers indicated that SSC and SSC/TA ratio levels were positively correlated with consumers= preferences, although, consumers use fruit red color and hardness as judging criteria when purchasing peaches.

Project Title:

Studies on Stone Fruit Internal Breakdown

Carlos H. Crisosto

Studies focusing on the role of orchard factors and controlled atmosphere storage conditions on the incidence of internal breakdown (IB) in nectarines, plums and peaches were carried out at the F. Gordon Mitchell Postharvest Laboratory. Our work investigated the influence of "orchard factors" such as fruit size, fruit canopy position, nitrogen and maturity stage on internal breakdown. Delaying harvesting reduced flesh browning incidence but not mealiness. Onset of mealiness and flesh browning symptoms were related to fruit size and canopy position. In general, fruit canopy position corresponded with the onset of the internal breakdown symptoms while fruit size corresponded with the intensity of these symptoms. Soil nitrogen levels influenced flesh browning only on fruit from very deficient trees. In all cases, mealiness developed earlier than flesh browning. Internal breakdown varied among cultivars, with new cultivars generally being less susceptible than those currently used. Fruit performed better in the 17%CO_2 + 6%O_2 CA storage conditions than the 5%CO_2 + 3%O_2 conditions. CA conditions extended market life mainly by reducing flesh browning rather than mealiness in fruit stored at 38^{o}F. A relationship between fruit size, canopy position and CA conditions was established. Large fruit sizes developed mealiness and flesh browning earlier than medium and small size fruit. CA performance will depend on cultivar, fruit size, canopy position, potential market life and shipping time to market.

Project Title:

Cultural and Chemical Controls of Preharvest and Postharvest Brown Rot of Peaches, Nectarines, and Plums, and Mucor Rot of Late Varieties of Nectarines and Plums

Themis Michailides

The results of the 1995 study with peach and nectarine fruits and of similar studies with prunes suggest that the role and importance of mummified fruit may have changed over the last 10-15 years because of major changes in practices in stone fruit orchards. We found that most of the apothecia were produced in areas covered with weeds in the lower areas under the tree canopies where water accumulated. But a more extensive survey needs to be done before any definite conclusions are made. Apothecia developed from "conditioned" (stromatized) mummified fruit in late February to early March, each produced millions of ascospores, a major source of primary spore inoculum. Therefore, major efforts should be taken for the development of effective methods to destroy mummified fruit. In conclusion, the 1994 and 1995 studies showed that 1) Fresh mummies do not produce apothecia, thus, knocking the infected fruit onto the ground at the end of harvest should reduce the chances for the fruit to "be conditioned" for apothecia production, and 2) Destruction or removal of mummies from the orchard should help reduce the incidence of brown rot. A second major source of spore inoculum later in the season is thinned fruit (especially those thinned after pit-hardening) on the ground which can provide conidial spore inoculum that infects green fruit causing latent infections and ascospore inoculum in the following spring. Therefore, if possible, thinning fruit before pit hardening should reduce the chances for their contributing to the secondary spore inoculum of brown rot.

Preliminary experiments suggest that we may be able, using a simple freezing technique, to predict brown rot in stone fruit (peaches, nectarines, plums, and prunes) by determining the levels of latent infections on green fruit earlier in the season. However, these tests need to be expanded by including fruit samplings from at least 10 orchards to obtain meaningful relationships. Prediction of incidence of brown rot at harvest time and postharvest would help growers making decisions on preharvest sprays and packers and shippers in selling fruit in an orderly fashion. Bloom sprays with Kelpack or the yeast Aureobasidium pullulans reduced blossom blight equal to Benlate sprays, and Seacret provided an intermediate control level. Therefore, for the least blossom blight, it is possible to develop alternatives to conventional fungicides in orchards where a reduced pesticide application program is desired. Unfortunately, because of a severe hailstorm, we could not obtain any information on the efficacy of these materials on fruit rot.

Late varieties of nectarines (such as >September Red= or >August Red= and some varieties of plums) can be infected by Mucor piriformis. This fungus develops during cold storage and can destroy entire lots of fruit marketed domestically or abroad. Research performed in the 1995 season clearly indicated the source and the way these fruits can become contaminated. Soils of late variety nectarine orchards harbor propagules of the pathogen, which are attached to the bottom of harvest bins, and contaminate the hydrocooling water. In addition, debris remaining in the hydrocooling line can carry the pathogen from one season to the next.

Project Title

California Utility Grade Collection and Analysis Project

Dennis L. Nef

On February 6, 1995 the California Tree Fruit Agreement Inspection Uniformity Subcommittee directed CTFA staff to prepare a proposal to provide hard data on the impact of a utility grade for peaches and nectarines. Final approval of the research project was given at a joint meeting of the Peach Commodity Committee and Nectarine Administrative Committee on May 4, 1995. During the 1995 season CTFA staff, under the direction of Dr. Dennis Nef, California State University, Fresno, sampled early, mid and late season fruit from cull belts of small, medium and large sized peaches from Kern and Fresno/Tulare districts. The fruit was inspected and categorized as being undersized, meeting marketing order requirements, meeting or failing Ag Code standards and in the case of nectarines failing marketing order but meeting U.S. No. 1 grading standards. Fruit meeting the Ag Code was further analyzed to identify the major types of defects. These data were statistically analyzed and results offer some insights into the amount of fruit available to be packed under a utility grade.