

CENTRAL VALLEY POSTHARVEST NEWSLETTER

COOPERATIVE EXTENSION

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Carlos H. Crisosto

Editor

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PEACH AND NECTARINE SMALL SIZE STUDY RESULTS

(Extracted from CTFA Newsletter,
December 1992)

Dr. Christine Bruhn, University of California Center for Consumer Research, reported the results of her summer-long study on consumer perception and demand for small size peaches and nectarines to the Peach and Nectarine Committees in Fresno on December 2, 1992. Dr. Bruhn's study which surveyed over 200 consumers nationwide in five major markets, attempted to discern consumer preferences for peach and nectarine sizes including those currently available and those below minimum size.

Dr. Bruhn reported that the major concern for consumers continues to be quality issues. Seventy percent of consumers were satisfied with the sizes presently being offered, but only 30 to 40 percent were satisfied with the quality of the offerings. Retailers were nearly

unanimous in that they would not market sizes smaller than the existing minimums and that small sizes were detrimental in the marketplace.

Bruce Knobloch, Director of Produce for Schnuck Markets in St. Louis, commented that the results of Dr. Bruhn's study were consistent with focus group studies conducted previously by their own company. As a result of their studies, Schnuck Markets offers medium and large sizes as consumers have limited demand for small fruit.

Dr. Bruhn recommended that the Committees address the problem of "mealy" peaches, improved maturity, and adherence to high standards of quality and maturity. She stated her opinion that the industry would be best served by donating undersize fruit to charities and the Committees should more aggressively promote this outlet.

PEACH, NECTARINE AND PLUM INTERNAL BREAKDOWN

Carlos H. Crisosto and Beth Mitcham
Pomology Department, UC Davis

Many peach, nectarine, and plum cultivars have a limited storage and market life because of susceptibility to internal breakdown also called chilling injury, dry fruit, mealiness, or woolliness.

What are the symptoms? The main symptoms of this disorder include flesh browning, flesh mealiness, black pit cavity, flesh translucency (plums), red pigment accumulation (bleeding), and loss of flavor. Internal breakdown can also reduce the fruit's resistance to invasion by disease organisms.

When are the symptoms visible? These symptoms normally appear after holding fruit at room temperature for a few days following cold storage. For this reason, this problem is usually experienced by the consumers, and not by growers and/or packers. Among stone fruits the greatest symptom development occurs at temperatures between about 36°F and 46°F (2.2° and 7.8°C). While symptoms will still develop at 32°F (0°C) or below, they develop more slowly and normally become less severe than at higher temperatures.

Are there cultivar susceptibility differences? Stone fruit cultivars vary greatly in susceptibility to internal breakdown injury. Some of them show no apparent susceptibility when grown under California climatic conditions. Among peaches and nectarines; early season cultivars are least susceptible, late-season cultivars most susceptible. Among plums, there is no seasonal pattern of susceptibility.

What can we do? A long term solution to eliminate this problem could be pursued

through a plant breeding program by removing the genes causing this problem in new varieties produced. In the meantime, temperature management is the only tool commercially available to delay the onset of internal breakdown. Storage below 0°C (32°F) but above the freezing point is beneficial to delay chilling injury symptoms and extend market life.

Are there possible new techniques to reduce the problem? A high temperature conditioning treatment which involves holding fruit at a specific temperature before storage has delayed development of symptoms. However, this treatment induced mold fruit and flesh softening. Under laboratory conditions, a combination of high temperature plus modified atmosphere treatment has been proposed to delay internal breakdown symptoms without inducing flesh softening. Further research should be done before commercial applications can be made. A different attempt to reduce internal breakdown and reduce fruit decay by using hot water dipping treatments is being tried by a UC-Pomology team led by Dr. Beth Mitcham.

PHYSIOLOGICAL AND PATHOLOGICAL POSTHARVEST PROBLEMS OF CHERRIES

Carlos H. Crisosto
Pomology Department, UC Davis
and Themis J. Michailides
Plant Pathology Department, UC Davis

Cherry Surface Pitting

Surface pitting on sweet cherries has long been an important physiological problem in the fresh market cherry industry. Pitting was initially attributed to orchard factors such as water stress, viruses, and insect damage, but now it has been well established that the majority of pitting is the result of physical damage.

Surface pitting on sweet cherries is the development of small to large sunken depressions on the surface of the cherry that occur after the fruit has been mechanically damaged. This damage can occur during any number of operations in the picking, packing, and shipping procedures common in handling fresh market sweet cherries.

Reduction of pitting can be achieved by identifying and avoiding physical damage during harvesting and postharvest operations. Growing a large firm sweet cherry, high in soluble solids, harvesting at the dark red to light mahogany stage, also helps to reduce pitting. These high quality cherries are more resistant to the physical damage occurring during cherry harvesting and handling.

Pathological Problems

Alternaria Rot (*Alternaria alternata* (Fr.) Keissl). Alternaria rot is dark brown to black, firm, and slightly moist. The affected area appears as a spot on the surface of the fruit and may be covered with olive-green spores and white to gray strands of mold. The rotted tissue can be readily separated from the surrounding flesh. The fungus is widespread in nature, entering the fruit through cracks or wounds. There are no effective chemical controls but suppression has been reported with Rovral 50W. Alternaria rot has been reduced by storage in modified atmospheres at 10% CO₂ or cold storage at 32°F.

Blue Mold (*Penicillium expansum* Lk ex Thom). Blue mold rot first appears as a circular, flat, light-brown area. The affected tissue is soft and watery. As the rot develops, the skin cracks to reveal small, white tufts of mold. Under humid conditions the mold grows, producing a crop of bluish-green spores. It is particularly common in fruit that has been exposed to rainfall or high moisture conditions. Susceptibility increases as the fruit matures.

Brown Rot (mainly *Monilinia fructicola* (Wint.) Honey). Brown rot is a firm rot similar to that caused by Botrytis (gray mold). Initial lesions are light brown to beige and sometimes darker in color, with well defined margins, but decayed tissue cannot be easily separated from the surrounding healthy tissue. Lesions are quickly covered with the beige to tan tufts of sporulation on the surface of the fruit. It is common in fruit with cracks exposed to rain or damaged fruit as latent infections that can develop during or after fruit ripening. The fungus grows slowly at 32°F. With proper handling, avoiding mechanical wounds and bruising, and cooling, brown rot decay can be reduced.

Cladosporium Rot (*Cladosporium herbarum*). This fungus is widespread in orchards but enters the fruit only through breaks in the skin. The decayed tissue is hard, dry, gray to black and the rotted area is easily separated from the flesh. Careful handling, removal of damaged fruit and rapid cooling are the only effective management tools for this decay.

Gray Mold (*Botrytis cinerea* Pers.: Fr.): Gray mold rot first appears as a light-brown spot on the skin. As the fungus grows, the underlying flesh becomes watery and dark brown. Under dry conditions, beige to gray spores are produced abundantly; under moist conditions, such as those created in a cherry box, an abundant white growth of fungus may cover affected fruits.

Rhizopus Rot (*Rhizopus stolonifer* and other *Rhizopus* spp.): This is one of the most serious postharvest diseases of cherries. Decay lesions are soft water-soaked areas that can lead to liquification of the fruit. Infection usually occurs after harvest and enters the fruit through cuts, cracks, or bruises. The fungus produces excessive white strands on the fruit surface interwoven with black sporulation structures of the pathogen. The

fungus will not develop below 45°F and can be controlled with effective temperature management, by holding cherries as close to 32°F as possible.

MANAGEMENT AND CONTROL OF BITTER PIT IN APPLES

Kevin Day

Farm Advisor, UCCE Tulare County, Visalia
and Carlos H. Crisosto
Pomology Department, UC Davis

Bitter pit is characterized by internal lesions just below the skin of fruits. Externally these lesions show up as small, dry, dark-colored areas about 1/8" to 1/4" in diameter. Rarely is this condition present at harvest, more often it appears while fruits are in storage. While sometimes thought to be a pest or disease problem, bitter pit is actually a physiological disorder related to low concentrations of calcium within fruits.

There are a number of factors which predispose apples to bitter pit problems. Usually these are factors which dilute the amount of calcium available to growing fruits.

Excessive tree vigor can have such an effect since growing shoots compete with fruits for available calcium. Consequently, lightly cropped trees, and overfertilized trees often have greater problems with bitter pit. So do young trees which often are growing quite vigorously. Very large fruit and immature fruit often have low calcium concentrations, and are usually more affected by bitter pit. Bitter pit is also more of a problem in areas with hot, dry climates. There are also differences in varietal susceptibility to bitter pit.

Preharvest control strategies should center around two basic activities: cultural manipulations, and calcium sprays. Heavy applications of fertilizers, especially nitrogen and potassium should be avoided. Summer sprays of magnesium containing compounds

can also cause bitter pit problems. If soils are overly acidic, applications of lime may be beneficial. Water stress during fruit development should be avoided. Excessive fluctuations in soil moisture during the summer have been implicated in causing bitter pit. Less well understood is the role of summer pruning. It appears that summer pruning may help decrease bitter pit because it reduces fruit to shoot competition for calcium. Exactly how much benefit this provides is currently unknown.

Calcium sprays are the most effective method for reducing bitter pit. In Washington State, it is common to apply calcium with every in-season spray. A general spray program may include 4 to 6 calcium sprays at 2 week intervals beginning in June. Calcium nitrate (20 lbs/acre) or calcium chloride (12 lbs/acre) are the most commonly used materials and rates. Limited experience in the southern San Joaquin Valley indicates that these rates should be suitable for our area, but small scale testing under your own conditions can help give you a better idea of responses. Postharvest calcium drenches can be effective in reducing bitter pit, but are generally regarded as less helpful than preharvest sprays.

Prompt cooling, low temperatures and high humidity storage conditions can be effective in reducing the problem.

In summary, bitter pit is best controlled by a combination of the above strategies. If bitter pit has been a problem in your orchard keep in mind the concept of fruit to shoot competition for calcium. Bitter pit can result unless calcium is adequately available to support both shoot and fruit growth. Also, anything which increases the ability (or need) for shoots to draw in or use calcium (such as excessive shoot growth) can increase the potential for bitter pit.

PREHARVEST FACTORS AFFECTING STONE FRUIT QUALITY

R. Scott Johnson
Pomology Department, UC Davis

Fruit quality is a very broad term which can be defined in many different ways. Just a few of the characteristics that come under the category of fruit quality include firmness, ground color, amount of red coloration, brightness of red coloration, size, sugar level, acid content, texture, freedom from defects, fruit shape, and general appearance. Almost every cultural practice performed by a grower will influence one or more of these quality parameters. Therefore, the grower can have significant impact on the final quality of his fruit. This report will briefly discuss several cultural practices including tree nutrition, irrigation, thinning, girdling, pruning and harvesting practices.

Tree Nutrition. Peach and nectarine trees respond dramatically to nitrogen fertilization. Heavy applications stimulate vigorous vegetative growth and generally cause detrimental effects on fruit quality. Fruit maturity is delayed, percent red coloration is decreased, and fruit size is not increased compared to more optimum levels. Our research has indicated a leaf nitrogen level between 2.6% and 3.0% produces the best fruit quality without decreasing fruit size or productivity. There is also some evidence to suggest that heavily fertilized trees are more susceptible to brown rot and certain insect pests.

Irrigation. Maximum fruit size is obtained by supplying trees with optimum amounts of water during the season. However, higher levels of soluble solids can be obtained by imposing moderate water stress during fruit growth. This will also reduce fruit size but in some cases only slightly. Imposing severe water stress late in the summer on an early maturing

variety will decrease fruit quality the following year by increasing doubled and deep-sutured fruits.

Thinning. Fruitlet thinning produces the well-known response of increasing fruit size. It also reduces total yield so a balance between yield and fruit size must be achieved. Generally, maximum profit does not occur at maximum marketable yield since larger fruit bring a higher price in the market. A grower must rely on his own experience to determine the optimum thinning level for any given orchard and variety. Leaving too many fruit on a tree not only reduces fruit size but also decreases the soluble solid content of each individual fruit. Therefore, fruit quality can be sacrificed in several ways if thinning is not performed correctly.

Girdling. Girdling early season peaches and nectarines advances maturity by several days and also increases fruit size. However, the practice should be approached with caution since fruit quality can be compromised in the process. Split pits can be increased, some nectarines can become russeted and fruit flavor can also be detrimentally affected. These responses vary considerably among varieties so it is important to experiment with each individual variety before deciding to girdle the whole orchard.

Pruning. The greater the light interception by an individual fruit and surrounding leaves the better the quality of that fruit. This includes fruit color, fruit size, and soluble solids content or flavor. For instance, fruit in the top of the tree are always better quality than those in the lower, shaded canopy. In some cases the differences can be very substantial, even if the lower fruit are left on the tree for a longer period to reach advanced maturity. Summer pruning practices which increase light penetration into the canopy will generally improve fruit quality. For instance, the practice of removing interior water sprout can

significantly increase light penetration and improve fruit size, color and soluble solids content of lower fruit in the canopy. However, extensive summer pruning which removes many leaves surrounding the fruit can have a the opposite effect. These leaves are important for supplying carbohydrates to the fruit may increase fruit color but decrease fruit size and soluble solids content.

Harvesting practices. Harvesting practices have probably the most dramatic effects on fruit quality. As a fruit approaches maturity, many quality parameters are changing rapidly. Fruit size soluble solids content, and percent red color are all increasing. However, fruit firmness is also decreasing at the same time. With many newer varieties, fruit softening occurs at a relative slow rate. Therefore, it is possible to leave these fruit on the tree for 3-5 days beyond minimum maturity in order to improve fruit quality and total yield. In some cases, the fruit must be handled a little more carefully but it is still possible to get it to market in good shape. This practice has the potential of substantially increasing grower's profits while improving fruit quality at the same time.

INTRODUCING

DR. ELIZABETH J. MITCHAM

Adel A. Kader
Pomology Department, UC Davis

I am pleased to introduce Dr. Elizabeth J. Mitcham, Postharvest Pomologist in the Department of Pomology at UC Davis. She joined the UC Postharvest Group as of July 15, 1992, and her responsibilities in research and extension will focus on postharvest biology and technology of fruit crops.

Dr. Mitcham received a B.S. degree in horticulture from the University of Maryland (1984), a M.S. degree in horticulture from North Carolina State University (1986), and a

Ph.D. degree in horticulture from the University of Maryland (1990). Her M.S. thesis was on "Soluble carbohydrates and postharvest needle retention in fraser fir as affected by harvest data and postharvest storage conditions." The publication based on her M.S. thesis was selected for the 1988 Ornamentals Publication Award of the American Society for Horticultural Science. Her Ph.D. thesis was on "Cell wall synthesis during tomato fruit softening." In 1989, she received the Scott Award for Excellence in graduate study from the University of Maryland.

During the past two years Dr. Mitcham worked as a Research Associate in the USDA, ARS Horticultural Research Laboratory in Orlando, Florida. She explored the effects of high temperature quarantine treatments on mango fruit physiology, ripening, and quality; also, she characterized the ripening of carambola fruit.

Dr. Mitcham will participate in teaching postharvest courses beginning in September 1992, and will develop a program of research and educational activities on postharvest biology and technology of fruits. Her focus area during the next few years will be nonchemical alternatives for controlling postharvest pathogens and prevention of physiological disorders. Her primary extension responsibilities include apples, pears, cherry, cling peach, apricot, prune, berries, walnut and almond.

Please join me in welcoming Dr. Mitcham to California and to UC Davis.

REDUCING CHERRY DAMAGE IN PACKINGHOUSE OPERATIONS

Joe Grant,
Farm Advisor, San Joaquin County, Stockton
Jerry Knutson,
Assoc. Dev. Engineer, Ag. Eng., UC Davis

Jim Thompson,
Ext. Ag. Engineer, Ag. Engineering, UC Davis

Laboratory tests and a field survey were conducted to determine amount of Bing cherry pitting and bruising caused by harvest and packinghouse operations located in San Joaquin Co., California.

Laboratory tests indicated that most cherry damage was caused by dropping fruit on to rough surfaces such as traction belting or the woody end of cherry stems. Drops of three inches on these surfaces cause damage to most cherries. Twelve inch drops cause little damage if cherries land on smooth conveyor belting, foam padding, or another cherry. Fruit temperature from 38°F to 75°F and soluble solids from 16.2% to 20.5% soluble solids had no detectable effect on damage susceptibility.

The packinghouse survey showed that about 30% of the fruit was damaged before it arrived at the packinghouse. Most of the damage was probably caused by the picker since a study done the previous year, indicated that little of the fruit is damaged before harvest or in transportation to the packinghouse. We did not attempt to determine how pickers damage fruit or what could be done differently to minimize this damage.

The survey revealed that packinghouses caused virtually none to almost 50% of the fruit to be damaged. Both very old and new packinghouses could cause low fruit damage if operated and maintained properly. Sorting fruit after box filling and bin or box filling caused damage to at least 40% of the fruit. This may have been caused by fruit being pushed against woody cherry stem ends as the fruit was moved within the container. Sorting should be done on conveyor belts and mechanical fruit decelerators should be used in bin and box filling operations. Damage caused by stem cutters was variable, indicating that they can be operated to cause

little bruising or pitting. Sizers and eliminators caused minor amounts of damage. Both the survey and laboratory tests confirm that most fruit drops in packinghouses can cause little damage.

Future testing should focus on determining how cherries are damaged in harvest. This year's tests suggest that cherry stem ends are a source of the problem. Factors such as rate of fruit throughput and type of equipment for box and bin filling should be evaluated as causes of the high damage rates in some packinghouses. Lab tests should be repeated to confirm that fruit temperature and soluble solids content do not affect cherry damage susceptibility.

PRECOOLING BEFORE LOADING

(Extracted from Loading
Makes the Difference, Jim Thompson)

Most temperature management problems during transport could be reduced with the use of improved design refrigerated trailers that have deep floors, recessed-groove sidewalls, high capacity fans, pressure bulkheads, and solid state temperature controllers. These features are used in modern marine container vans in which fresh produce is transported for transit times much longer than those occurring in domestic shipments in the United States. A few U.S. truckers now have trailers with these advanced design features. However, problems related to the extra weight of deep floors, the reduced inside width of recessed-groove walls, and their extra susceptibility to damage during loading and unloading have prevented most truckers from purchasing these improved-design trailers. Hopefully, these design and handling problems can be solved. Meanwhile, truckers can contribute to better product transit temperatures and fewer losses by following these recommendations:

Trailers should be precooled to remove the heat contained in the walls, ceiling, floor, and

doors before loading with already cooled products. If not removed, this heat would be rapidly conducted to the load. The disadvantage of precooling a trailer before loading is that during loading some warmer air may enter the trailer, resulting in condensation on the trailer's inner surfaces. A useful trailer precooling guide is as follows:

1. Precool trailers, especially during warm weather.
 - a) Trailers to be loaded at refrigerated docks should be precooled to their desired thermostat set point.
 - b) Trailers to be rapidly loaded (15 to 20 minutes) at non-refrigerated docks should be cooled to about 5°F above their desired thermostat set point.
 - c) Trailers that will be loaded slowly (30 minutes or more) at non-refrigerated docks should be precooled to about 5°F lower than a temperature half way between the ambient air temperature and the desired thermostat set point. For example, if the ambient air temperature is 75°F and the desired set point is 35°F, the trailer should be precooled to 50°F.

$$\frac{75^{\circ}\text{F} - 35^{\circ}\text{F}}{2} = 20^{\circ}\text{F}$$

$$\text{and } 75^{\circ}\text{F} - 20^{\circ}\text{F} = 55^{\circ}\text{F}$$

$$\text{and } 55^{\circ}\text{F} - 5^{\circ}\text{F} = 50^{\circ}\text{F}$$

This will prevent accumulation of excess moisture on the trailer's inner surfaces and subsequent extensive cycling of the refrigeration unit.

2. Determine and record product temperatures during loading.

3. Load the product away from sidewalls and on pallets or racks, especially during very hot or very cold weather exposure during the trip.
4. Do not load so high that the air delivery chute is collapsed or blocked.
5. Do not load all the way to the rear doors, leave at least 4 inches between the rear of the load and the rear doors.
6. Secure loads properly by bracing or with load-locks.
7. Make sure lengthwise air channels are not blocked in mixed loads.
8. Keep the trailer in optimum conditions with regular checks and maintenance.
 - Refrigeration unit operative
 - Walls, doors, and air delivery chute in good repair
 - Floor grooves cleaned out.
9. Keep transit times to an absolute minimum by avoiding unnecessary delays en route.
10. When mixed loads of fresh fruits and vegetables are shipped, it is important that the various commodities are compatible with one another with respect to their requirements for temperature, modified atmospheres, relative humidity, and protection from odors or physiologically active gases (ethylene).
11. Load extra packages at the rear end of a palletized or racked load on short pallets or racks to provide air circulation under the load.

POSTHARVEST RESEARCH UPDATE

Project Title:

Pre- and Postharvest Diseases of Fresh Market Peaches and Nectarines with Emphasis on Postharvest Fungicides Effecting Decay Control and Epidermal Staining

Dr. James E. Adaskaveg and Dr. Joe Ogawa

Summary:

- 1) In extensive laboratory tests using inoculated fruit, the efficacy of Rovral 50WP and other products containing iprodione were improved with the addition of wax/oil emulsions (i.e., Decco 251, 281, and other similar commercial and laboratory preparations) to effectively control *R. stolonifer*, as well as *M. fructicola*, and *B. cinerea*. The control was similar or equivalent to control obtained using Botran 75W or mixtures of Botran 75WP and Rovral 50WP.
- 2) Experiments varying the concentrations of iprodione or the wax/oil mixture (Decco 251, 281) were done to determine the most effective concentrations of each material for control of *Rhizopus stolonifer*.
- 3) Quantitative analytical chemistry indicated that the solubility of iprodione was increased in specific wax/oil formulations (including Decco 251) while residues on fruit did not exceed established tolerance.
- 4) Phytotoxicity was observed when excessive application of Rovral-Wax/Oil mixtures were made with prolonged drying times.

Project Title:

Studies on Skin Discoloration Disorder (Inking, Staining) in Peaches and Nectarines.

Carlos H. Crisosto, Guiwen Cheng, Kevin Day and R. Scott Johnson

Summary:

Our second-year study confirmed our previous information pointing out that development of inking in peaches and nectarines occurred mainly during the harvesting and transport operations. Inking development is related to physical abuse to the fruit occurring during fruit handling (harvest and transport operations) within the orchard and during transport to the packinghouse. Anatomical studies comparing healthy, naturally and/or induced inking tissues using the Scanning Electron Microscope (SEM) and Light Microscope (LM) showed that only exocarp cell disruption is associated with its occurrence. This indicates that abrasion damage is involved with inking development.

Genetic makeup: Inking susceptibility varied among the 13 commercial cultivars surveyed during the 1991 season and 15 cultivars during the 1992 season. In general, mid- and late season cultivars were susceptible to inking. 'Flavorcrest', 'O'Henry', 'Elegant Lady', 'Royal Giant', 'Fantasia', 'Red Top', and 'Flaming Red' were the most susceptible to inking among the different cultivars. Inking evaluation tests carried out under controlled laboratory conditions (same imposed abrasion level) indicated little differences in susceptibility to inking among early, mid and late season cultivars. 'May Glo' and 'Flavorcrest' showed more inking than the other cultivars.

Fruit pigment composition: A detailed study of phenolics, PPO activity and anthocyanin composition of the different cultivars will be carried out during the winter season. This analysis will help us to understand the effects of the amount and type of pigment among different cultivars on inking development.

Inking mechanism: A detailed study of the mechanisms of skin discoloration in peaches and nectarines was carried out using an apparatus for inducing abrasion damage in the

lab and a colorimeter for recording color change. The results provided new insights into the effects of pH and metallic ions and implied some potential blue/black color removal approaches. Data supported our previous year's conclusion that abrasion-type damage is the initial and main factor leading to the development of discoloration. The intact fruit skin did not discolor under the same pH and ion conditions that caused discoloration on abraded skin. Results also pointed out that the level of Fe required to cause severe discoloration can be very low.

Orchard Influence: Orchard environment is a very important factor in the incidence of inking, and a better understanding of these differences between orchards will help to solve the inking problem. During this season, a series of laboratory and field experiments were carried out to study these differences.

Calcium foliar sprays: Studies on the effect of calcium sprays on inking susceptibility, fruit quality and postharvest performance were carried out on one nectarine and three peach cultivars. Foliar calcium sprays applied every 14 days, starting 2 weeks after full bloom and continuing until 1 week before harvest, did not reduce inking incidence on the nectarine and peach cultivars. We feel that further research on foliar Ca applications, including applications earlier than two weeks after full bloom, is necessary before commercial recommendations to improve fruit quality can be confidently made.

Fruit maturity: During the 1992 season, we initiated a preliminary study on the relationship between inking and fruit maturity. Harvest date was found to significantly affect inking incidence on 'Elegant Lady', but not on 'Cal Red' or 'Flaming Red'. Results of the preliminary study done on 'Fantasia' nectarine suggested no direct correlation between fruit firmness and inking susceptibility. Thus, more evidence is needed to prove the idea that

there is a relationship between harvest time (fruit maturity) and inking incidence due to changes in fruit firmness during fruit maturation. Our studies suggested that the difference in inking susceptibility within an orchard or tree is a more complex subject.

Project Title:
Stone Fruit Waxing

Carlos H. Crisosto, David Garner and Themis Michailides

Summary:
A detailed study of the effect of the postharvest brushing and waxing operations was carried out during the 1992 season. Six nectarine and eight peach cultivars were evaluated for rate of water loss as well as the incidence of mold, bruising damage, and skin discoloration (inking). The two vegetable origin waxes and one edible coating tested were not as effective in protecting fruit from water loss as the mineral oil/animal fat waxes. Preliminary results suggest that vegetable waxes are not able to compensate for the damage done by the brushing operation in peaches and nectarines, which leads to a high rate of water loss. In nectarines, waxing without brushing was the best treatment. In some instances, the waxing operation did increase the incidence of inking.

A comparison of fruit water loss, permeability to CO₂ and C₂H₄, and cosmetic appearance properties indicated significant differences among the four commercial waxes and one edible coating tested.

Project Title:
Review of Stone Fruit Maturity

Carlos H. Crisosto

Summary:

A review summarizing all of the information published on nectarine, plum, and peach fruit maturity from 1980 to 1992 was carried out. Advantages and disadvantages of different maturity indexes were discussed. The use of ground color, although an imperfect index, is actually the most practical and reliable method for determining minimum maturity. Color chip sequences should be corrected to smooth out some of the limitations of this maturity index. Fruit firmness is an excellent indicator of maximum maturity. A combination of ground color and fruit firmness may be better than a single index to assay stone fruit maturity. Fruit soluble solid content (SSC) varies significantly among orchards as well as from tree to tree and, therefore, is not a reliable indicator of fruit maturity. However, SSC is a good indicator of fruit quality.

We hope that development of new technologies in the near future such as near infrared (NIR), magnetic resonance (MR), and light transmittance (LT) will lead to an ideal, non-destructive, and reliable maturity index for the nectarine, plum, and peach fruit industry.

Project Title:

Automatic Inspection and Grading of Stone Fruit

Michael Delwiche, R. Scott Johnson and N. Singh

Summary:

The ultimate goal of this research is develop realistic methods for color and defect grading of stonefruits, which could then be integrated with commercial sorting machinery. A computer vision inspection system consisting of an illumination chamber, color camera, and

image processing hardware was developed for maturity grading peaches. The CTFA color chart was used for maturity grading. Preliminary measurements were made on the CTFA color standards. When plotted in red-green (RG) color space, it was found that the spacing between colors was not uniform and they did not lie in alphabetical order. Therefore, the maturity chart was revised by grouping the original 13 colors (A-M) into 6 groups (A, C, E, G, I, and K), resulting in a more evenly spaced color sequence. Experiments were run to compare the performance of the machine inspection system at estimating peach maturity with manual grading and colorimeter measurements. Tests were conducted on three cultivars: CalRed, Summerset, and Fairtime. Three images of each peach were taken to view the entire fruit surface. Each point (i.e., pixel) in the images was assigned a class (one of the six ground colors, blush, defect, or background) using a simple look-up table. The class totals for all three images were summed to give the number of pixels in that class. The percentage of pixels assigned to each class was calculated and the peach was graded the maturity color for which not less than 20% of the surface area was equal or greener than the corresponding color standard. The machine grading results are now being summarized and compared with manual grading results.

Project Title:

Effects of Nitrogen Fertilization in Susceptibility of Stone Fruits (Nectarine and Peach) to Brown Rot (*Monilinia fructicola*)

Themis J. Michailides, David Morgan, Hugo Ramirez, Carlos H. Crisosto and Scott Johnson

Summary:

Nitrogen fertilization long has been recognized

as being associated with changes in the levels of disease and yields of plants. The effects of nitrogen fertilization on the susceptibility of stone fruit to brown rot fungus, *Monilinia fructicola*, are not known. We initiated a study to determine if and how nitrogen fertilization applied at different rates affects susceptibility of nectarines to brown rot. In the summer of 1990, preliminary experiments indicated that 12.5% of Flavortop nectarines from trees fertilized with 325 lbs/acre ammonium nitrate had natural infections by *M. fructicola*, as compared to 4.2% and 0% of fruit from trees fertilized with 225 and 100-175 lbs nitrogen per acre, respectively. Similarly, 76-90% of Fantasia nectarines collected from trees that had been fertilized with 225-300 lbs ammonium nitrate per acre and spray-inoculated (without wounding) with a conidial suspension of *M. fructicola* were infected and developed 10 lesions per fruit, whereas 62-67% of fruit from trees fertilized with 100 to 175 lbs ammonium nitrate per acre were infected with only 2 to 3 lesions per fruit. Similar results were obtained with inoculated Flavortop nectarines, although incidence and severity of disease were lower than on Fantasia. After wound inoculation, however, Fantasia fruit from trees fertilized with different levels of ammonium nitrate were equally susceptible to the fungus. In addition, blossoms of Fantasia nectarines from trees fertilized with the higher levels of nitrogen, after spray-inoculating with a spore suspension of *M. fructicola*, had a greater incidence of infected stamens than similarly inoculated blossoms from trees fertilized with the low nitrogen levels. Blossoms of unfertilized trees were the most resistant to infection. Although we do not have any explanation about the mechanism of this blossom resistance, differences observed in cuticle thickness of fruits from trees fertilized with different levels of nitrogen partially explain the differences in fruit susceptibility to the disease. We also studied differences in incubation (time required for the first

symptoms of disease to appear) and latent times (time required for sporulation) of the pathogen.

Studies to determine the effect of nitrogen fertilization on the overwintering phase (brown rot mummies hanging on the trees) of the pathogen are in progress. We believe this information will be very useful to the stone fruit growers because, once the effects of the various treatments of nitrogen fertilization are determined and the mechanisms of resistance to brown rot defined, proper recommendation could follow. Perhaps management of the disease could be possible by a careful use of nitrogen fertilization. This could lead to less use of pesticides for control of brown rot and less contamination of underground water with nitrates.

Project Title:

Evaluation of Stone Fruit Advanced Selections and New Cultivars

David Ramming

Summary:

A total of 62 advanced stone fruit selections and 22 standard commercial stone fruit cultivars were planted at Kearney Agricultural Center. The advanced selections were comprised of 8 apricots, 20 nectarines, 19 peaches, and 15 plums. Both nectarines and peaches were evaluated during the 1992 season to examine differences in fruit size, TSS, and flesh pressure between advanced selections and standard commercial cultivars.

Seven peach selections were compared with 'Fairtime', 'Flamecrest', 'Flavorcrest', 'Gemfree', and 'O'Henry'. Similarly, ten advanced nectarine selections were compared with 'Fairlane', 'Fantasia', 'Firebrite', 'Flamekist', 'Maygrand', and 'Summercrest'.

Project Title:

Non-Destructive Sensing of Quality Attributes in Peaches and Nectarines

David C. Slaughter and Carlos H. Crisosto

Summary:

A non-destructive technique for sensing the quality of peaches and nectarines was investigated during the 1992 harvest. After evaluating ninety fruit (consisting of Fantasia nectarines and Summerset and O'Henry peaches), we determined that non-visible near infrared (NIR) light could be used to determine the soluble solids, sucrose, and fructose content of intact peaches and nectarines without damaging the fruit. Correlation values between the NIR technique and the standard analytical technique ranged from $r = 0.8$ for fructose to $r = 0.9$ for soluble solids. However, we were unable to develop a relationship between the NIR technique and glucose content. Work continues to determine if a relationship can be developed for sensing the chlorophyll content of the flesh non-destructively.