Buy California
Narrative - Final Status Report

Grant Recipient/Program Name: Dr. Carlos H. Crisosto, University of California, Davis

Contract number/Function Code: 02-0732

Project Name: Characterizing New California Stone Fruit Cultivars According to Fruit Quality (Flavor) and Market Life

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A. Introduction

1. *Describe the project benefits and results.*

In the last decade, total stone fruit (peach, plum and nectarine) production has increased, the cost of production has increased, but the rate of consumption (demand) and return to the grower has remained the same or decreased. Consumer surveys have associated low tree fruit consumption mainly to 1) consumption of unripe fruit, 2) presence of internal breakdown (IB) symptoms, and 3) lack of flavor. Our research program has resulted in published ripening protocols for stone fruit packers/shippers, receivers and consumers. Ongoing education of these groups by the University and the California Tree Fruit Agreement (CTFA) shows promise in resolving the first complaint.

Internal breakdown is a very important problem in all stone fruits with the exception of cherries. The symptoms of internal breakdown (chilling injury) in stone fruits include flesh browning, dry and mealy texture, reddening of the flesh, translucency of the flesh, development of “off flavor”, and failure to ripen. There are several factors affecting the expression of internal breakdown. Among them are cultivar, climate, maturity, postharvest temperature management, and marketing time period. It is very important to understand the IB susceptibility of each stone fruit cultivar so that it can be marketed and consumed before symptoms are expressed. One of the main objectives of this research was to evaluate the market life of new stone fruit cultivars. This information will be used in the short term to plan new plantings and develop shipping and retail postharvest handling strategies. In the long term, geneticists and breeders will use this information to understand the genetic inheritance of IB, locate the genes related to this disorder, and develop stone fruit cultivars free of IB. In addition, this new information is important for plant physiologists in order to design fundamental studies to improve the basic understanding of the IB problem.

In order to increase demand, breeders have developed many new cultivars with

markedly different flavor attributes. More and more often the marketplace wants to define quality fruit as those with high soluble solids concentration (SSC). Also, there has been increasing demand for fruit with low titratable acidity (TA)-- white flesh or sub-acid stone fruit. A second goal of our research was to characterize the new stone fruit cultivars and segregate them into groups according to the consumer's perception of their flavor and relate this to the fruit's SSC, TA and aroma. This information will help our industry better target product to demand and increase overall consumption (domestic and export markets).

2. *Describe collaborative partnerships.*

   This research project developed information that complements other projects supported by the California Tree Fruit Agreement (CTFA), the California Cling Peach Board (CCPB), the University of California Discovery Grant Program (BioSTAR) the California State University Agricultural Research Initiative (CSU-ARI), and private companies. In this *Buy California* project, we evaluated quality and market life of new nectarine, peach and plum cultivars during the 2002 and 2003 seasons. This information is fundamental to developing shipping and retail postharvest handling protocols to avoid internal breakdown of stone fruit as a short-term solution to the problem. Our CTFA/CCPB/BioSTAR project seeks a long-term solution by trying to understand the genetic basis for IB and eliminate it through genetic manipulation. In our CSU-ARI project, we are studying the relationship between fruit soluble solids concentration (SSC), titratable acidity (TA) and consumer acceptance. This information combined with the organoleptic survey of new cultivars has allowed us to create stone fruit flavor groups that can be used for focused promotion and marketing activities

   In addition, we are able to continue to collect data on new cultivars thanks to a new grant from the California State University Agricultural Research Initiative (CSU-ARI).

3. *Describe the interest and support received from farmers, commodity groups and broader sectors of the agricultural community.*

   As the stone fruit postharvest Specialist for the University of California, I am frequently asked about the market life and sensory qualities of our newer varieties. Does a particular peach variety have sufficient market life to ship it to Asia? Will its sugar and acid profile meet the expectations of the buyers? Stone fruit shippers and growers have been asking for this type of data in order to make intelligent marketing decisions (in the short term) and planting decisions (in the long term). Thanks to this research, I will be able to better answer some of these quesitons. I have attached three letters of appreciation from members of the industry.

B. Evaluation

1. *Describe the goals and objectives achieved in narrative and quantitative terms.*

The specific objectives for this project were to:

1. Measure the organoleptic quality (SSC, TA and aroma) of 10 new nectarine, 10 new peach and 5 new plum cultivars.

2. Measure market life for 10 new nectarine, 10 new peach and 5 new plum cultivars.

3. Summarize historical quality and market life data for nectarines, peaches and plums.

Organoleptic quality (Flavor). The new stone fruit cultivars being planted have markedly different flavor qualities (low acid, high acid, high soluble solids concentration, highly aromatic, non-melting, etc.), and we are also reaching new markets with different consumers. For this reason, we believe that it is important to understand the role of soluble solids concentration (SSC), titratable acidity (TA) and other flavor components in consumer acceptance in order to develop a quality index. Early studies have associated high consumer acceptance with high SSC in peaches. In France, with a large diversity of flavors available in the peach genotype (white/yellow flesh and low/high acidity) a minimum of 10% SSC for peaches with a low TA, and 11% SSC for peaches with a high TA is being evaluated as part of a quality standard. In Italy, with an industry that has a high proportion of yellow flesh cultivars, a minimum SSC of 10% for early season, 11% for mid season and 12% for late season cultivars was previously proposed.

In our previous work, we found three types of relationships between consumer acceptance and tree fruit cultivars. In one group of cultivars, the degree of liking and percentage consumer acceptance rapidly increased as ripe soluble solids concentration (RSSC) increased, reaching 70-75% consumer acceptance. After that point, consumer acceptance reached a plateau and became insensitive to additional increases in RSSC. The saturation points ranged from 10-12% RSSC according to cultivar. In another group of cultivars, the degree of liking and percentage consumer acceptance increased as RSSC increased, reaching very high levels (90-100% consumer acceptance). In a third group of cultivars, consumer acceptance was low (70%) and related to ripe titratable acidity (RTA) within a given RSSC range.

In this study we used a panel of 10 sensory judges to describe fruit organoleptic characteristics (flavor) such as sweetness, sourness, flavor intensity and aroma. We evaluated 25 cultivars originating from different breeding programs.

Yellow and white flesh, low and high acidity, high SSC and highly aromatic cultivars were selected to be tested because their potential differences on flavor perception. Cultivars were then segregated into clusters according their organoleptic characteristics using principal component analysis (SIMCA, P7.01, UMETRI).

Among fruit characteristics the relationship between sweetness and sourness accounted for almost 88% of the variation between judge's perception and the fruit's physical properties. Using these two principal components, cultivars were segregated into five groups named "balanced", "sour", "aromatic", "sweet", and "flavorful". In general, traditional yellow flesh high acidity cultivars such as 'Elegant Lady' and 'O'Henry' peaches, and 'Spring Bright' nectarine and 'Fortune' plum were segregated into the "balanced" organoleptic group. Japanese plums such as 'Blackamber', 'Purple Majesty', 'Earliqueen', etc. were classified into the "sour" group. White flesh and low acidity yellow flesh nectarines and peaches were classified into the "sweet" or "aromatic" groups. Within the group of cultivars evaluated, none was classified into the "flavorful" group. Our recent "in store consumer tests" carried out using low acidity yellow flesh 'Honey Kist' nectarine ("sweet" group) and the low acidity yellow flesh peach 'Ivory Princess' (aromatic group) indicated that these new cultivars have a higher consumer acceptance (90%) than members of the 'balanced' group.

Market life. Each of the 25 new stone fruit cultivars were screened for susceptibility to internal breakdown (IB) at two storage temperatures—32ºF (0ºC) and 41ºF (5ºC). Each week, fruit were ripened and evaluated for SSC, TA symptoms of internal breakdown (IB). Market life or postharvest life potential was defined as the number of weeks each cultivar can be stored at 32º or 41ºF with less than 20% incidence of internal breakdown symptoms. According to their market life potential at each storage temperature, the cultivars were classified into three categories:

A. IB non-susceptible and temperature insensitive (fruit with at least 4 weeks of market life at both temperatures).
B. IB non-susceptible (at least 4 weeks of market life) at 32ºF but susceptible (less than 4 weeks of market life) at 41ºF (temperature sensitive).
C. IB susceptible (less than 4 weeks of market life) at both storage temperatures.

Of the 25 stone fruit cultivars evaluated for this study, 13 (7 nectarine, 3 peach and 3 plum) were Category A—not susceptible to IB at either temperature. With their long postharvest life potential and high tolerance of poor temperature management, these cultivars are good candidates for shipment to distant markets (export). Four of the new cultivars evaluated (1 nectarine, 2 peach and 1 plum) were Category B—not susceptible to IB at 32ºF, but susceptible at 41ºF. For these cultivars it is important for shippers to enforce good

temperature management practices to avoid poor arrivals. In addition, shippers may test the benefits of preconditioning treatments or other techniques on these cultivars in order to prolong their postharvest life. The remaining eight new cultivars evaluated were Category C—IB susceptible at both temperatures. It is recommended that shippers investigate preconditioning these cultivars or other techniques and/or only market them locally and rapidly.

Of the 32 cultivars evaluated historically, we found only 1 that was in Category A. Twenty-three were in Category B and 8 were in Category C. For the older cultivars grown in California, good temperature management and/or preconditioning are important to prolong their postharvest life.

The main goal of this project was to increase demand for California stone fruit by improving quality. Our data can be used toward this end in the following ways:

1. Encourage the industry to deliver stone fruit to the consumer within its effective market life so as to provide a consistently satisfying product. In addition, a ripening technique should be applied at some point prior to consumption.

2. Encourage innovation within the industry with respect to fruit flavor and quality. We would like to see companies market their fruit's unique organoleptic characteristics and target specific groups of consumers based upon their preferences.

3. Encourage growers to investigate a fruit's flavor quality and market life (storage and shipping potential) before planting.

2. *Provide an in-depth explanation of the grant program benefits.*

California stone fruit growers are struggling financially due to high fixed costs and low prices for fruit. We believe that only by improving product quality can they increase demand. Unable to do this, supply will have to decrease—an undesirable outcome for all. It is an unfortunate reality that at a time when the industry most needs fruit quality research they are financially least able to afford it. This has been the greatest benefit of the *Buy California* grant program. It brought significant resources to the table to jump-start an important research area. In our case, we were also able to use it to generate matching funds in order to generate even more data.

3. *Did you meet the project completion time frames? If no, identify the issues or problems that impacted the grant project.*

   All of the data was collected, analyzed and summarized as proposed. We are currently preparing publications and scheduling presentations with companies for distribution to our industry. We are also preparing the information for posting on our website.

4. *Describe how you were able to overcome these issues, problems, or concerns.*

   Not applicable.

C. Budget

1. *Provide total in-kind and matching contributions.*

   Our *Buy California* project complemented projects supported by the California Tree Fruit Agreement (CTFA) and the California State University Agricultural Research Initiative (CSU-ARI). In FY 2002-2003 the California Tree Agreement provided $17,717 in support of work on sensory evaluation of stone fruit, and $54,912 to understand the genetic basis for internal breakdown. In FY 2001 to 2003 CSU-ARI provided $155,012 to study the relationship between fruit harvest maturity and eating/storage quality; and the measurement of quality non-destructively

2. *Did the total in-kind and matching contributions change from the revised grant agreement? Provide details.*

   Our original project proposal was to evaluate fifty stone fruit cultivars. The *Buy California* program was only able to provide funding for the evaluation of twenty-five stone fruit cultivars. To fulfill the intent of the original proposal, we applied to the California State University Agricultural Research Initiative (CSU-ARI) for matching funds. In FY 2003-2004 they awarded us $60,000 in matching funds to continue our research for an additional year with the potential to complete a one-to-one match in FY 2004-2005. The award for the final year is still pending. We are currently seeking funds to continue this type of research beyond 2005.

3. *Provide a description of any unspent grant funds including earned income.*

   No unspent funds remain.

4. *Describe the post-funding strategy and action plan to continue the project.*

   This line of research will continue for an additional year thanks to the matching funds provided by the CSU-ARI grant program. We are now focusing on extension of the information we have developed to interested members of our industry. We will do this through direct consultation and workshops with individual companies, presentation at our annual "Stone Fruit Quality Meeting", articles in our newsletters (the *Central Valley Postharvest Newsletter* and the *Perishibles Handling Quarterly*), and development of a stone fruit quality resource area on my website (http://www.uckac.edu/postharvest.html). This web site already includes all of the *Central Valley Postharvest Newsletter* issues and other articles relevant to our fresh fruit growers, packers, shippers and handlers.

D. Attachments

See attached letters of appreciation from Fruit Patch Sales, Mountain View Fruit Sales and Trinity Fruit Sales.