Quality of Dried French Prunes

studies on fruit maturity for influence on yield, quality, time-range for most profitable harvest of interior valley prunes

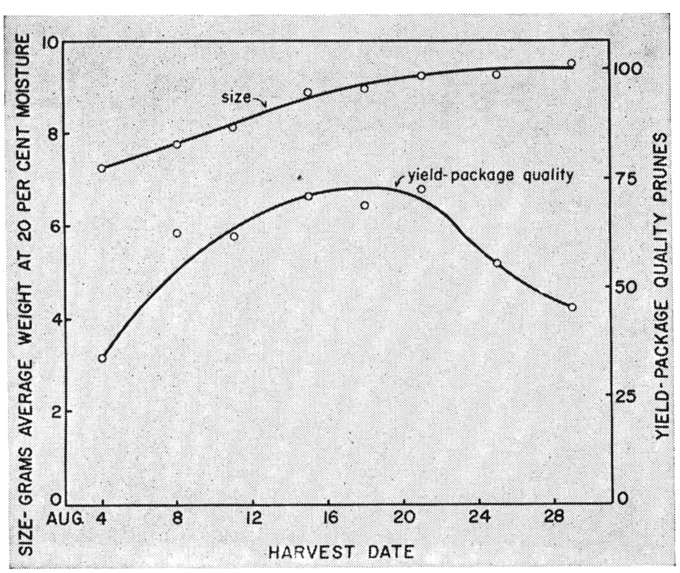
L. L. Claypool and John Kilbuck

Color—of the flesh and of the skin—is perhaps the most reliable single index of maturity in French prunes grown in the interior valleys of California.

To be of good quality, French prunes after processing should have light amber flesh, free of air pockets, with glossy dark, reddish-black skins free from blemishes, and the sugar content should be high.

Fruit maturity at harvest time is considered to be one of the important factors in dried fruit quality, but dehydrator requirements make it uneconomical to harvest all prunes at peak maturity. Therefore, studies were undertaken—at the request of growers—to find the compromise point of maturity for beginning harvest in the interior valleys of California that would least affect peak yield and dried fruit quality.

To develop sufficiently accurate information relative to certain physical and chemical changes occurring during maturation, approximately 1,200 prunes were tagged in 1951. The fruits were measured in cheek diameter and divided into eight lots of 150 prunes. The lots were set up in such a way that the fruits were randomized as to position on the tree and the average size of prunes in each lot was essentially the same. In 1952, lots of about 240 fruits each were set up in a similar manner, two lots being harvested each week during a four-week period. Physical and chemical measurements were made at time of harvest. Harvest of experimental lots extended from August 16 through September 11 in 1951, and began 12 days earlier in 1952.



Changes in size of French prunes and yield of package quality fruit in relation to harvest date, 1952.

Fruit Drop

In 1951 almost no prunes dropped from the test trees until after the third harvest on August 23. By the final harvest on September 11, only 70% of the fruit initially tagged was retained. Variability in drop between harvest dates is related to climatic conditions.

In 1952 there was a small drop between the first and second harvest dates, and then no important drop until after the sixth harvest on August 21—about the time fruit drop began in 1951. By the seventh and eighth harvest dates, losses increased perceptibly so that on August 29 only 77% of the fruit was retained.

Fruit Size

The prunes had attained approximately full physical size—in 1951—as measured by diameter and weight—by August 16, the first harvest date. Measurements on August 8 indicated that fruit grew further after that date, so that full size and first harvest date were very close. There was a gradual, though not entirely consistent, reduction in fruit size as measured by fruit diameters in lots harvested subsequently.

In 1952, when harvesting of experimental lots was begun earlier, maximum physical size—as measured by diameter, weight, and volume—was reached about August 11, the third harvest date, after which fruit size diminished.

As prunes approached maturity, the green color—chlorophyll—faded from both the flesh and the skin. The flesh became a very light amber color which gradually darkened—with greater intensity developing in both the yellow and red—as maturity advanced. Fruits that were overripe at harvest or had been injured by excessive temperatures in the orchard were so dark as to be reduced in quality.

During the period of maturation, prune flesh softened rapidly. At the same stage of physical size or soluble solids development, the fruit harvested in 1951 was softer than that in 1952. Much of the difference was due to the later harvest in 1951, but there also seems to have been a seasonal difference. In other tests, similar differences have been noted between years and between orchards in the same year.

Soluble solids and total solids increased in percentage with delay of harvest. Such a percentage increase in solids during the period of increasing fruit size will be reflected in an even greater increase in dry matter per fruit. However, the percentage of increase in solids after the prunes had begun to diminish in size might seem to be attributable to a concentration of the solids already present. Calculations of total dry matter indicated that carbohydrates continued to move into the fruit in important amounts well after water supply was restricted to the point that fruit weight diminished.

Changes in acidity followed a pattern similar to that reported for many fruits. With advancing maturity, pH—relative acidity-alkalinity—increased and titratable acidity diminished.

Maturity at Harvest

The prune grower's interest in harvest maturity is based primarily on how it affects yield and quality.

Most of the French prunes in California are dehydrated in commercial dehydrators to about 20% moisture. Therefore, a delay in harvest is an advantage—in this respect—because it allows some of the drying to occur while the fruit is still on the tree or in the orchard. Greatest yields and lowest dehydration re-

Concluded on next page

PRUNES

Continued from preceding page

quirements in these studies resulted from delayed harvest.

An evaluation of quality suitable for packaging indicates that the quality was essentially the same for all 1952 lots except the first lot and the last two. The first lot was slightly immature, with poor skin color, whereas the last two lots were overmature and dark-fleshed. It was assumed that prunes that dropped before harvest would suffer heat damage sufficient to render them below package quality.

The highest yield-quality factors were obtained for the harvest dates from August 15 to August 21, but acceptable factors were also recorded for the August 8 and 11 harvest dates. The graph on page 13 illustrates the yield of package quality fruit in relation to total yield at different harvest dates.

Maximum orchard temperatures in 1952—during the entire month of August and early September—were below those known to cause heat injury to fruits on the tree. Had injurious temperatures occurred during the harvest season, as is not uncommon, prune quality would have been influenced considerably. Such damage becomes progressively more severe as the prunes advance in ripeness.

Range of Harvest Period

On the basis of these investigations, French prunes harvested after chlorophyll has disappeared from the flesh and skin will result in a dried fruit with desirable dark skin color and light amber flesh—when properly dehydrated. The skin color of fruit harvested at dates progressively later will continue to be of good quality, but flesh color will become an undesirable dark brown late in the harvest season or following exposure to temperatures above 100F.

If harvest in the interior valleys is begun as soon as chlorophyll has disappeared from the skin and flesh, the loss of potential tonnage may be great and premiums for large sizes reduced because the prunes are still growing rapidly. However, if harvest is delayed until full size is attained, quality in the latter part of the harvest season—as measured by air pockets and dark flesh color—may be greatly impaired.

Where several weeks are required for harvest, best results for the entire crop may be expected if harvest begins about a week after sampling shows that chlorophyll has disappeared from the flesh and the skin. Such a practice should eliminate much of the tonnage loss that results when harvest begins immediately after chlorophyll disappearance, and under most conditions should permit completion of harvest before the flesh color has darkened seriously—exclusive of periods of excessive heat.

Flesh firmness measurements may be used as an aid to the color index as to when harvest should start—usually at from three to five pounds—but the soluble solids measurement is a more important index. When the crop is normal or less, harvest might well start when soluble solids attain 24%. If the crop is very heavy, soluble solids may not reach as high as 20% while the fruit is turgid. In that case, the soluble solids index of maturity is of little value.

L. L. Claypool is Professor of Pomology, University of California, Davis.

John Kilbuck was Assistant Specialist in Food Technology, University of California, Davis, at the time the above study was made.

The above progress report is based on Research Project No. 1457.

This study was stimulated by a more extensive investigation conducted under contract with the United States Department of Agriculture as authorized by the Research and Marketing Act of 1946.

FROST

Continued from page 5

amount of protection necessary may have been greater; and *3*, the inversion may have been weaker. To have protected the crop during this frost, the wind machines would have had to have a large amount of heater support.

The section east of wind machine No. *1*, which had little cover crop and firm ground and with a bare field to the east, shows to have been a warm spot. Here is a case that shows the value of solar heat absorbed during the day to aid in combating frost conditions. The soil, being bare and packed, was in perfect condition to conduct heat readily, making the soil surface warmer at night than otherwise. The condition of the soil surface may not be such an important factor in other years because usually there are rainy spells during the spring with the frost nights following. But for years like this and to aid in protecting against late frosts, it is a good idea to have no cover crop or only a sparse one.

Portable Wind Machine Tests

On three nights a mobile heated wind machine, which blows a warm air jet to each side of its path, was tested.

The upper diagram in column 3 on page 5 shows the response pattern for this machine operated to protect 15 acres. The machine took 6⅔ minutes at 3.2 mph to make one round trip. The poor temperature response was obtained because over the 15 acres only 4 Btu/hr ft^2—British thermal unit per hour per square foot—was added, while with smudge pots in the same orchard on a frosty night about 32 Btu/hr ft^2, not counting the extra heat from the border pots, would be released. It was also found that the portable heater could not raise the temperature of a very sensitive, quick-responding thermometer 100′ from the track. At 75′ distance, the thermometer would give a small response about every third trip of the heater, but after each rise the temperature would fall completely back to the starting temperature.

Since the throw of the warm air jet from the portable heater was only one third the distance necessary to cover the space inside of the path, a test was made with the heater traveling a back and forth route, as shown in the lower diagram in column 3 on page 5. The towing speed was increased to nearly 10 mph so that a round trip was made in three minutes. The resulting 1F response covers 4.1 acres with an average heat input of 15 Btu/hr ft^2 showing that it is necessary to add heat in sizable amounts when responses over 1F are needed.

Protection by Other Means

Many almond growers in the Chico area rely entirely on orchard heaters for frost protection. It was observed that 20 or more heaters or pots per acre—properly operated and with extra units around the borders—did provide complete protection during last spring's frosts.

One orchard in which sprinkling was used was observed. Evidence of some small amount of protection to the crop and no damage to the trees was shown. From this one observation, however, it was not possible to make a reasonably good appraisal of the value of sprinkling for frost protection.

D. G. Rhoades was Assistant Specialist in Agricultural Engineering, University of California, Davis, when these studies were made.

F. A. Brooks is Professor of Agricultural Engineering, University of California, Davis.

A. S. Leonard is Specialist and Lecturer in Agricultural Engineering, University of California, Davis.

H. B. Schultz is Associate Specialist in Agricultural Engineering, University of California, Davis.

Data, from which the effectiveness of the large, dual gasoline engine wind machines—Goodspeed orchard near Durham—was determined, were obtained by D. E. Kester, D. S. Brown, and W. P. Pierce, University of California, Davis.

Walter Stile, almond grower; the Frost Master Co.; Harry Hanson, U. S. Weather Bureau; and Ralph Parks, Extension Agricultural Engineer; Henry Everett, Farm Advisor, Butte County; C. E. Barbee and E. L. Tippie, of the University of California, co-operated in the studies reported here.

The above article is the seventh annual report of progress in the study of wind machines in orchards published in California Agriculture.