WALNUT QUALITY AND VALUE MAXIMIZED BY HARVEST MANAGEMENT

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These studies show that early walnut harvest minimizes insect-damaged kernels and maximizes quality and resulting kernel value. Direct relationships exist between harvest date and nut quality. Differential in value within walnut growing districts is directly dependent on time elapsed between date of maturity and harvest. Temperatures during harvest may account for differences in value between districts.

Once nuts are removed from the tree, picking should proceed as rapidly as possible to maintain optimum kernel color and value. Rate of loss in kernel quality is directly proportional to increasing air temperature. Kernel temperature of about 140°F appears to be the threshold for onset of kernel darkening, and is reached in the sun at air temperature above 90°F and in the shade at air temperatures of 104°F or greater. Once threshold kernel temperatures are attained, substantial loss in value can occur within nine hours. Threshold kernel temperatures are reached fastest when nuts are harvested during midday. Rapid pickup is essential at that time to maintain quality. Shaken nuts with hulls still intact, typical in harvest of early varieties, reach threshold kernel temperatures faster and remain at those temperatures longer than nuts without hulls. Sun-exposed nuts on the tree remain cooler than those exposed to similar condition on the ground. This suggests that growers should store nuts on the tree for short periods of time if delays in picking are anticipated.

IMPROVED WALNUT VARIETIES and orchard management techniques have significantly increased walnut production in California. Since the mid 1950s, average per acre production rose from six-tenths of a ton, to more than one ton in 1972. Conversely, walnut kernel quality has declined during the same period. Percentage of light colored kernels (most valuable) has dropped between 4 and 6%. Insect damaged kernels (primarily navel orangeworm) have become an increasing problem in delivered lots.

Walnut quality determines nut value. Value decreases as kernels darken, while those infested with insects or mold are almost worthless. Quality is influenced by climate, irrigation practice, variety, pest and disease control measures and harvest procedures. In these studies, two segments (shaking & picking) of the harvest operation were examined as they relate to walnut kernel quality. The accompanying two reports of experiments are designed to show: (1) influence of harvest timing, and (2) effect of delays in picking and dehydration following shaking on walnut kernel quality.

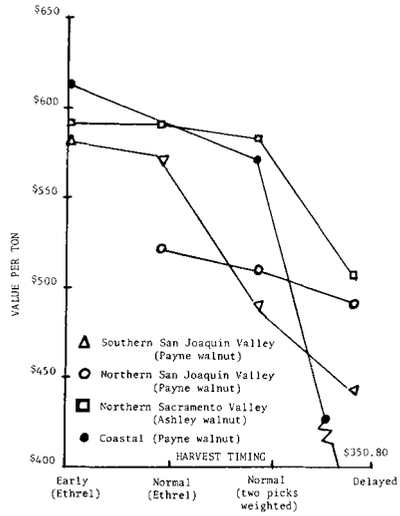
HARVEST TIMING AND KERNEL QUALITY

Walnut kernels are mature, lightest in color, and of highest value when packing tissue between kernel halves has just turned brown (see photo). The time interval between packing tissue brown (PTB) and harvest varies with climate. They often coincide in cool, coastal areas, but in hot interior valleys as much as three weeks difference can occur.

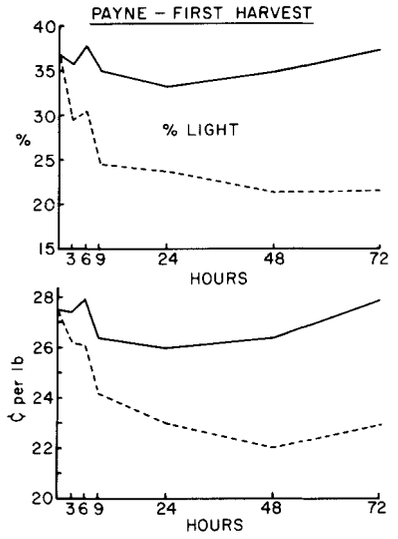
Practical harvest can only begin when hulls dehisce and approximately 80% of the nuts can be removed from the trees. During the interval between PTB and harvest, kernels become darker. Thus, highest quality is obtained by harvesting nuts as soon after maturation as possible. Insect damage may also increase if harvest is delayed, as husks begin to dehisce. This experiment shows effects of harvest timing on color and insect infestation of walnut kernels.

Mature Payne or Ashley walnut orchards representing the four climatic walnut districts of California (southern San Joaquin Valley, central San Joaquin Valley, northern Sacramento Valley, and Coastal) were selected for the experiment. Fifteen single tree replicates of the following treatments were used: 1) *early harvest timing—100% removal:* 500 ppm Ethrel applied at packing tissue brown, harvest commencing approximately seven days later; 2) *normal harvest timing—100% removal:* 500 ppm Ethrel applied seven days prior to anticipated normal harvest, harvest at normal time; 3) *normal harvest timing—two picks:* grower practice, 80% removal first shake, 20% second shake; and 4) *delayed harvest timing—100% removal:* harvest commencing at time of normal second shake of treatment three, to determine kernel quality at harvest. Samples of 100 nuts were taken from each replication and submitted to Diamond Walnut Growers, Inc., for evaluation and insect determination.

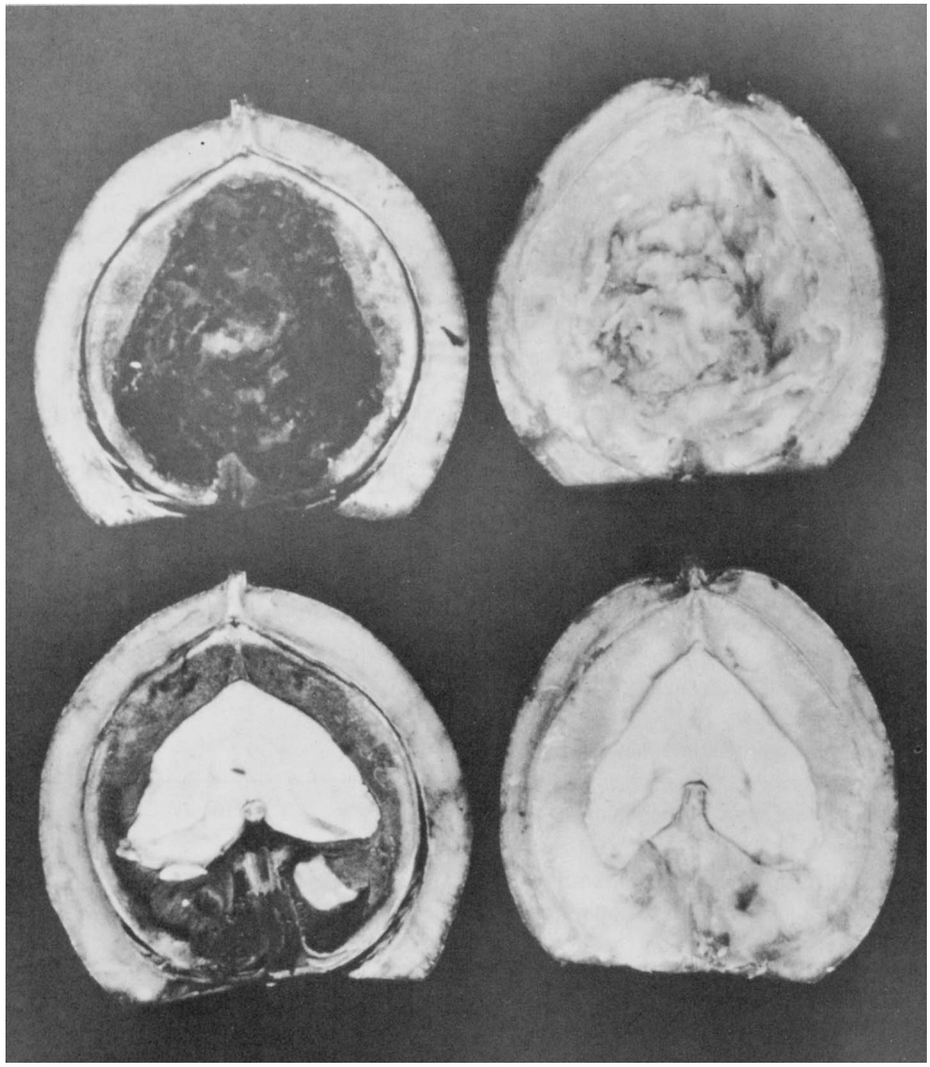
Harvest date, percentage of light-colored kernels, percentage of total edible



INFLUENCE OF HARVEST TIMING ON VALUE PER TON OF PAYNE OR ASHLEY WALNUTS



COLOR AND VALUE OF PAYNE KERNELS FROM THE FIRST HARVEST AS AFFECTED BY EXPOSURE TO THE SUN OR SHADE, 1972



Packing tissue has completed browning (PTB) in nuts to left. Nuts to right are immature.

kernels (all kernel grades), percentage of offgrade kernels, and value per in-shell pound are shown in the table. Harvest treatments spanned approximately three weeks. In all districts best quality and highest value occurred with earliest harvest and declined as harvest date was delayed.

The extent to which kernel quality and value was reduced by harvest delay varied between districts. In the coastal district harvest timing treatments spanned the greatest period of time (24 days). Between the early timing and the growers' normal timing, nuts lost almost 2¢ per in-shell pound within seven days. As harvest was delayed past the normal timing, value loss was significantly different from earlier harvest treatments, amounting to approximately 13¢ per in-shell pound from the earliest date. In the interior valley districts, harvest timing treatments covered 20 days, and value losses, though substantial, were not as great as on the coast. In the graph, value per ton as related to harvest timing in each district is presented to show the marked reduction as harvest is delayed.

Insect infestation

Although 1973 was a year of minor worm damage (primarily navel orangeworms), significant increases in worm infestation occurred as harvest was delayed in the southern San Joaquin (from .26% damaged kernels for the early harvest, to 4.24% for delayed harvest) and northern Sacramento Valleys (from .52% in the early harvest to 1.92% in the delayed harvest). In the coastal and northern San Joaquin districts, there was no significant difference in worms. In all districts, however, the earliest harvest treatments had fewest insect-damaged kernels, showing that if harvest is delayed and husks remain split on trees, damage from navel orangeworm increases.

Effect of Ethrel

In walnut districts where the interval between maturity PTB and practical harvest is substantial, the harvest date can be advanced 7 to 10 days before normal by foliar applications of the growth regulator Ethrel at PTB. In all test locations except the northern San Joaquin Valley, almost 100% removal was attained with one shake when Ethrel was applied at either PTB or just prior to normal harvest. Once Ethrel is applied, harvest must commence as soon as feasible to avoid accelerated loss in kernel quality.

Advancing harvest of early varieties with Ethrel did not prolong drying time. In the southern San Joaquin Valley test, drying time of the treatment harvested 8/28/73 was shortened approximately 30% over the normal 40 to 48 hours.

PICKING DELAY AND KERNEL COLOR

Following shaking, walnuts are windrowed, picked up, hulled and dehydrated. Between shaking and picking nuts may be left on the ground for extended periods of time, if they exceed the capacity of harvest and dehydration equipment. When this interval is lengthy hull darkening and softening have been observed where nuts were exposed to sun or high air temperatures. A series of experiments were conducted in 1972 and 1973 to relate kernel quality to the following exposure conditions: (1) sun versus shade exposure of walnuts left on ground for varying lengths of time; (2) time of day nuts are placed on the ground; and (3) presence or absence of hulls on the nuts. Kernel temperatures were recorded for nuts on the tree as well as on the ground.

Mature Payne and Hartley trees, common walnut cultivars in the southern San Joaquin Valley, were selected for these tests. For each cultivar, eight pairs of trees (replicates) were harvested. For each treatment in each experiment, 80 nuts from each pair of trees were placed in nylon net bags and subjected to treatments dictated by the particular experiment. Samples from all tests were subjected to the various treatments, then submitted to Diamond Walnut Growers for kernel quality evaluation.

Kernel quality

Nut samples were harvested from the eight pairs of trees, and were placed on

the ground in direct sun or shade at 10:00 am and picked up and hulled at intervals of 3, 6, 9, 24, 48, or 72 hours. Control nuts were hulled and dehydrated immediately following shaking for comparison with the sun and shade treatments.

In 1972, substantial loss in Payne kernel color occurred within three hours for nuts placed in sun from the first harvest. (see graph). Air temperatures reached 97°F, the highest recorded during the test. This resulted in kernel temperatures of about 113°F in nuts exposed to the sun and 81.5°F in shade. The percentage of light-meat kernels dropped from 35% to 25% after nine hours, and to about 20% after 72 hours. Nuts in the shade from this harvest showed no substantial kernel color change. For nuts exposed to the sun, value per in-shell lb dropped from 28¢/lb at harvest to 24¢ after nine hours and to 22¢ after 48 hours. Nuts in the shade suffered no substantial loss in value.

During the second Payne harvest, air temperatures did not exceed 86°F. Kernel temperature in the sun peaked at 98.6°F, with shade kernels at 76.6°F. At air temperatures lower than those sustained in the first harvest, little difference in kernel value occurred between sun- and shade-exposed nuts, both kinds selling for about 24¢/lb.

For both Hartley harvests, air temperatures did not exceed 85.1°F, and loss in kernel value between either sun- or shade-exposed walnuts was slight. For sun-shaded walnuts, kernel value was about 25¢/lb after 72 hours; for sun-exposed nuts, kernel value was about 24¢/lb in both harvests.

In 1973, also a relatively cool year, air temperatures during the first harvest of Payne and Hartley exceeded 86°F for only short periods. As a result, kernel color and value of nuts exposed to the sun did not decline to the same extent as in 1972. In the first harvest, about 37% of the sun-shaded Payne walnuts were light in color 72 hours after picking. This figure dropped to about 27% for sun-exposed nuts. Exposure to sun affected the color of Hartley walnuts less, with light meats constituting about 35% of the first harvest, whether the nuts were exposed or shaded. Price per lb dropped from about 26¢ for the shaded kernels to 24¢ for the exposed ones in the first Payne harvest. For the first harvest Hartley walnuts, prices were 25¢/lb for shaded nuts and 24¢/lb for sun-exposed nuts. Mold or insect damage was not affected by these treatments either year of the test.

These studies suggest that nuts on the ground exposed to sun will lose substantial quality and value when air temperatures reach approximately 90°F. Placing nuts in the shade minimizes color change. If air temperatures exceed 100°F, kernel temperatures of nuts in shade will exceed the threshold level, resulting in rapid darkening of kernel color.

Time of day

In 1973, first-pick Payne walnuts were harvested and placed in full sun each hour from 8:00 a.m. to 4:00 p.m. The samples remained in the sun for three hours, after which they were hulled, dehydrated, and submitted to Diamond Walnut Growers for crackout analysis. Conditions on that day were moderate, with a maximum air temperature of 91.4°F at about 4:00 p.m. Although there was no kernel value loss early, nuts sampled at 2:00 p.m. had dropped suddenly in value to 15% of control. This rapid loss occurred as kernel temperatures reached critical levels in those nuts placed in sun at midday.

Obviously, as harvest continues through the hot portion of the day, nuts should be processed rapidly to avoid value loss. Early or late in the day, nuts can sustain several hours on the ground in sun, provided air temperatures are not excessive. But if air temperature is quite hot, processing should proceed rapidly.

Influence of hulls

To determine influence of hulls on kernel quality when processing is delayed, Hartley walnuts with and without hulls were placed in either midday sun or shade and sampled at 3, 6, 9, and 24-hour intervals. Kernel temperatures for sun-exposed nuts with hulls reached 113°F, but only 104°F for sun-exposed nuts without hulls. Value per lb was about 26¢ for sun-exposed nuts without hulls, and about 25¢ for sun-exposed nuts with hulls. Thus critical kernel temperatures are reached more quickly and sustained for longer periods of time when nuts are harvested with hulls, typical of early harvested varieties.

Effects of sun

Delays in walnut drying following shaking result in substantial quality and value loss. The question then arises of whether to leave nuts on the tree or on the ground if delays are anticipated. To get an answer, thermocouples were used to monitor kernel temperatures of sun-exposed and shaded Payne walnuts in the tree and on the ground.

Once the connection between nut and tree is broken and the transpiration stream ceases, the temperature of sun-exposed walnut kernels increases rapidly, while sun-exposed nuts on the tree remained cooler. Shaded nuts, either on the tree or on the ground, did not differ appreciably in temperature. If picking is to be delayed, it is better not to shake unless cool air temperatures are forecast. Nuts should not, however, be left on trees for prolonged periods of time because of possible navel orangeworm infestation.

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KERNEL QUALITY AND IN-SHELL VALUE OF WALNUTS AT VARIED HARVEST DATES*

Treatment	Harvest date	Light kernels	Total edible kernels	Off-grade kernels	Value in-shell
		%	%	%	¢/lb
SOUTHERN SAN JOAQUIN VALLEY — Payne walnut					
Early timing (Ethrel)	8/28	34.8	42.7	3.7	26.60¢
Normal timing (Ethrel)	9/10	35.5	43.4	5.3	26.33¢
Normal timing†	9/10	33.4	40.3	6.8	24.83¢
Delayed timing	9/19	28.9	38.5	9.5	22.51¢
NORTHERN SAN JOAQUIN VALLEY — Payne walnut					
Early timing (Ethrel)	‡				
Normal timing (Ethrel)	9/13	31.0	43.4	4.0	26.30¢
Normal timing†	9/13	29.6	43.4	4.0	25.70¢
Delayed timing	9/24	25.1	42.2	5.8	24.90¢
NORTHERN SACRAMENTO VALLEY (BUTTE CO.) — Ashley walnut					
Early timing (Ethrel)	9/5	44.8	46.5	2.1	29.64¢
Normal timing (Ethrel)	9/10	41.3	47.3	1.9	29.60¢
Normal timing†	9/10	43.1	46.5	2.4	29.21¢
Delayed timing	9/24	35.1	40.5	9.4	25.69¢
COASTAL — Payne walnut					
		%	%	%	¢/lb
Early timing (Ethrel)	9/13	43.1	48.7	1.7	30.59¢
Normal timing (Ethrel)	‡				
Normal timing†	9/20	41.1	45.4	2.0	28.64¢
Delayed timing	10/6	18.9	30.3	17.2	17.69¢

* Values connected by a common line are not significantly different from each other.
† Weighted average of two picks.
‡ Not included in test.