Effects of prolonged drying and harvest delay following ethephon on walnut kernel quality

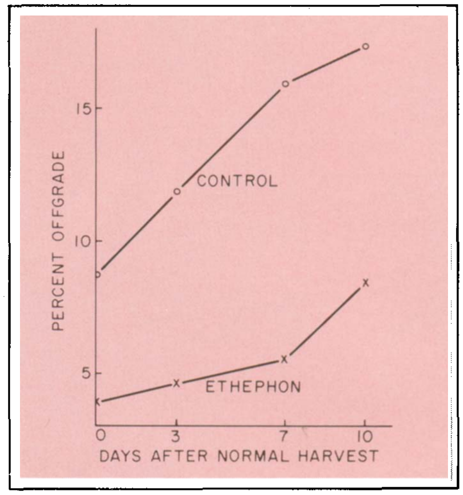

Fig. 1. Percent offgrade 'Payne' nuts from four harvest timings.

George S. Sibbett ■ George C. Martin ■ T. Mark Draper

Following walnut maturity, kernel quality declines until dehydration is complete. Previous research has shown that prolonged intervals between maturity and practical harvest, delays in harvest, and delays in processing after harvest all have adverse effects on kernel quality (poor color, insect infestation, and mold) and subsequent value. These effects are further aggravated by high temperatures.

Foliar applications of ethephon at kernel maturity have been shown to promote an earlier, more complete harvest of walnuts without increasing drying time. Because physiological processes are hastened by ethephon, researchers have suspected that delays in harvest following ethephon application will result in more rapid quality loss than normal. However, data exist to clarify this possibility. It is also not known whether non-treated nuts of different maturities harvested on the same day result in different levels of quality.

At harvest, heavy demands are made on equipment and management time. Occasionally, nuts remain in the dryer longer than is necessary to reduce moisture to the required 8 percent. It is known that this management oversight wastes costly fuel; however, we do not know if walnut quality is affected by prolonged drying.

The three objectives of this study were: (1) to determine if ethephon treatment affects the rate of loss in quality and value which results from delays in harvest; (2) to compare quality and value of nuts at different stages of maturity harvested on the same day; and (3) to compare quality and value of walnuts dried for the normal time with those subjected to prolonged drying.

Materials and methods

Ten mature Payne walnut trees were sprayed at nut maturity, when packing tissue turned brown, with a handgun using 500 ppm solution of ethephon. Ten adjoining trees were used as untreated controls. Sampling commenced when 80 percent of the nuts from treated and untreated trees were hullable, ethephon-treated nuts being hullable ten days before controls. Additional samples were taken three, seven, and ten days later. Limbs were shaken in each quadrant of each of ten trees on all sampling dates with two nuts taken from each quadrant. The eight nuts from each tree were hulled, numbered for each repetition, placed in mesh bags, weighed individually, and dried at 107° F. Weights were taken after 4, 8, 12, 24, 32, 48, and 54 hours to establish the rate of drying. Final moisture percent of kernel and shell was determined with a Cenco Moisture Meter. All samples were submitted to Diamond Sunsweet, Inc., for quality analysis using standard USDA procedures.

Non-treated Trinta walnuts were taken on the same day with hulls intact but loose, as representative of the earliest feasible harvest, and without hulls, as representative of a delayed harvest. Following hull removal both samples were dried at 107° F and evaluated for kernel quality.

Non-treated Serr walnuts were harvested with intact hulls, hulled, and placed in the dryer at 107° F. After 36, 60, 84, and 108 hours, samples were taken for kernel quality evaluation. At this stage of the season normal drying time for Serr was 36 hours.

Results

Ethephon-treated nuts had less quality loss after harvest delay than non-treated controls (table 1). The percent total edible kernel of ethephon nuts was greater than controls by an average of 3.5 percent at normal harvest, and 9.2 percent when harvest was delayed for 10 days. The loss of edible kernel is illustrated by the increasing percent offgrade as harvest is delayed (fig. 1). Based on approximate 1976 walnut prices, effects of delay in harvest on kernel quality were less and returns higher from ethephon-treated nuts than from controls (fig. 2).

Walnuts taken at the earliest practical time contain the greatest percent moisture and require the longest time to dry (fig. 3A). As harvest is delayed, hull dehiscence occurs on the tree and some drying takes place; thus, these walnuts contain less moisture as they enter the dryer (compare figs. 3A, B, C and D). The rate of drying is relatively fast at first, slowing down as the last portion of water evaporates (figs. 3A, B, C, D). Drying rate depends upon moisture content of the nuts as they enter the dryer, but not on ethephon treatment (figs. 3A, B, C, D).

When harvested at the same time, Trinta walnuts with intact hulls had superior quality to walnuts with hulls dehisced (table 2). Observations of packing tissue suggest variable hull dehiscence

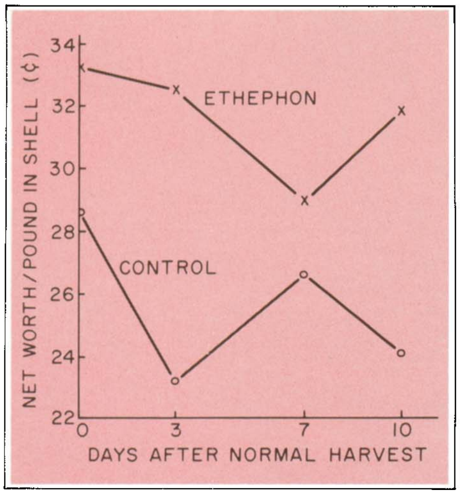

Fig. 2. Value of 'Payne' kernels from four harvest timings.

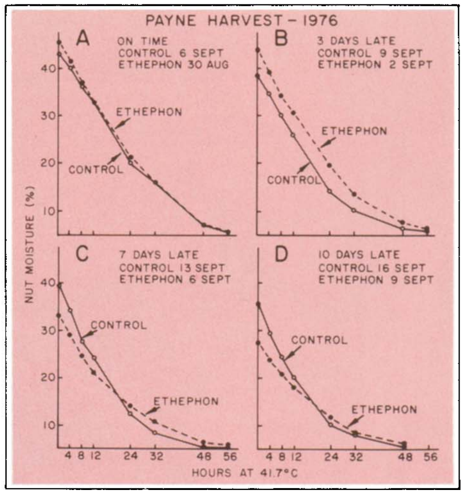

Fig. 3. Drying rate of 'Payne' walnuts at 107° F (41.7°C). (A) Harvest on time; (B) harvest 3 days late; (C) harvest 7 days late; and (D) harvest 10 days late.

to be due in part to erratic maturation of nuts throughout the tree.

When harvest crews fall behind work schedules, nuts may be left in the dryer beyond the time required for moisture removal. Though considerable fuel is wasted with this practice, there does not appear to be a material loss in quality and subsequent value with Serr nuts (table 3).

Discussion

Walnuts are mature and at their highest quality as soon as packing tissue turns brown. This usually occurs one to three weeks before sufficient hull dehiscence for normal harvest. Treatment with ethephon at nut maturity results in earlier hull dehiscence and harvest, and superior kernel quality. Nut samples from ethephon treatment were taken on 30 August, 2 September, and 6 September, whereas, the first control sample was taken on 6 September. Ambient high temperatures from 30 August through 6 September were over 93°F each day. Thus, at a time when nut quality was high, ethephon-treated nuts with dehiscing hulls were without vascular connections to the tree and were not subjected to whole tree stress that could only have decreased quality by removing water from the nuts. We are not implying that ethephon improves nut quality; but by advancing hull dehiscence, it arrests kernel development at the point of high quality evident at maturity. Nevertheless, delays in harvest are deleterious to both control and ethephon-treated nuts. For best quality and value per pound, walnuts must be harvested as early as possible after maturity. Any harvest delay results in increased offgrade kernels. Most insect damage or mold can be prevented by timely harvest. Because growers delivering offgrade kernels are currently penalized at the rate of 14¢ per pound, the issue becomes financially perilous.

Control and ethephon-treated nuts with similar initial moisture had similar drying rates. It is evident from this and previous work that rate of drying is a function of initial moisture and not of ethephon treatment.

A facet of this investigation that warrants additional attention is the rate of water loss in the dryer: walnuts lose water more rapidly in the first stage of the drying process than in the later stages. Therefore, energy for drying is less costly initially per unit of water removed than for the final period of drying to achieve 8 percent moisture.

Nuts left in the dryer beyond the time necessary to reduce moisture to 8 percent did not lose appreciable quality. Apparently, the evaporative cooling effect of drying in a forced-air draft oven precludes the high kernel temperatures that decrease quality in direct sunlight. From a practical standpoint, cost of fuel will discourage excessive time in the dryer.

George S. Sibbett is Farm Advisor, Tulare County; George C. Martin is Pomologist, UC, Davis; and T. Mark Draper is Laboratory Helper, Tulare County.

TABLE 1. Quality of 'Payne' Kernels from 4 Harvest Timings*

Days after normal harvest	Control					Ethephon				
		Harvest grades (percent)†					Harvest grades (percent)†			
	Date	Light	Light amber	Amber	Total‡ edible	Date	Light	Light amber	Amber	Total edible
0	6 Sept	26.8	9.7	4.0	40.5	30 Aug	37.1	5.1	1.8	44.0
3	9 Sept	14.3	14.1	9.0	37.4	2 Sept	33.8	6.3	2.9	43.8
7	13 Sept	24.0	8.5	2.6	35.1	6 Sept	17.2	16.5	9.5	43.2
10	16 Sept	29.4	3.9	0.8	34.1	9 Sept	32.1	6.0	2.7	43.3

*Average values of 10 samples per harvest time for each treatment.
†Color of kernels as judged by USDA standards.
‡Total of light, light amber, and amber grades.

TABLE 2. Effect of Hull Condition on 'Trinta' Kernel Quality and Value*

Hull condition	Harvest grades (percent)					Net worth ¢/lb
	Light	Light amber	Amber	Total edible	Offgrade†	
Intact	34.8	3.9	2.7	41.5	2.5	31.5
Dehisced	16.4	5.0	2.4	23.8	12.4	15.9

*Data from single 500 g sample per hull condition.
†Defects due to insects, mold, shrivel, black color, or rancidity.

TABLE 3. Effect of Prolonged Drying on 'Serr' Kernel Quality and Value*

Drying time (hr)	Harvest grades (percent)†					Net worth ¢/lb
	Light	Light amber	Amber	Total edible‡	Offgrade**	
36	49.0	7.6	1.6	58.2	0.8	46.0
60	49.6	4.4	3.0	57.0	2.2	43.8
84	50.4	7.0	1.8	59.2	2.2	45.6
108	44.2	11.0	2.2	57.4	1.8	43.6

*Data from single 500 g sample for each drying time.
†Color of kernels as judged by USDA standards.
‡Total of light, light amber, and amber grades.
**Defects due to insects, mold, shrivel, black color, or rancidity.