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PECAN HARVESTING

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The Use of Ethylene to Improve Pecan Harvesting¹

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FAILURE of pecan nuts to mature satisfactorily has been a serious problem in certain of the fertile valleys of the irrigated Southwest which are characterized by favorable growing conditions and high fall temperatures. Imperfect maturity is manifested by a faulty or delayed separation of the shuck from the shell and subsequent dehiscence of the shuck. This delays harvest, increases the cost of gathering and preparing the nuts for market, and contributes to the pre-harvest germination of the nut through providing a continuous supply of moisture in close contact with the shell over an extended period. A further commercial defect and manifestation of immaturity is the light color of the shells of some nuts. Shells of well matured nuts are a typical brown.

These imperfections have been more completely described in a recent publication (2) in which a relation of maturity and filling of the nut to tree vegetativeness was reported. By controlling vegetativeness a considerable control over nut filling and maturity may be had. There are, however, certain climatic difficulties which prevent the complete and satisfactory elimination of the maturity problems by cultural methods alone. Filling of the nuts appears to respond quite satisfactorily to cultural manipulations.

Preliminary studies of the effect of ethylene upon pecan maturity were made during the 1935 harvest and have been conducted more extensively in the 1936 season. It has been found that ethylene is effective in causing the shucks of pecan nuts to loosen from the shells, and the shucks when so loosened dehisce normally. Ethylene gas applied for a 48 hour period during the middle of September to a tree enclosed under a fumigating tent caused normal shuck dehiscence and ripening of the nuts. (Fig. 1, A.) This was more than 30 days prior to the usual harvest date. Before treatment the nuts gave no evidence of approaching maturity. They were, of course, incompletely filled.

At intervals from the middle of September throughout the period of harvest, nuts of many varieties were picked, placed in reasonably air tight containers and surrounded with an atmosphere containing ethylene of an approximate concentration of 1-1,000. Without exception the shucks were loosened by the ethylene and could readily be removed from the nuts after 24 to 48 hours. It was not possible to maintain constant temperatures in the treatment chambers but by applying artificial heat the temperature in some chambers was maintained as high as 45 degrees C for a period of 12 hours without apparent injurious effect upon the quality of the nut or kernel. Four charges of ethylene were made each 24 hours and complete ventilation provided between successive charges.

The effectiveness of ethylene in pecan harvesting appears to be limited to improving the separation of the shuck from the shell for it has had no effect upon the coloring of the shell. Coloring of the shell

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seems to develop from contact with the shuck tissues during the process of drying. By adapting the harvesting practices to permit of drying the nut in the shuck after treatment with ethylene, normal shell coloring is produced.

In Arizona, as elsewhere, the custom has been to wait for the opening of the shucks to begin pecan harvest. Under the high temperature conditions of this district a completely satisfactory condition of shuck opening is seldom attained in commercial orchards of some varieties. As soon as the shucks have opened sufficiently to make it at all possible, the nuts are thrashed from the trees. The shucks which in a considerable proportion of the nuts still adhere are immediately removed, usually with considerable labor and expense. The shell on the nuts to which the shucks have adhered very tightly is poorly colored. After removing the shucks the nuts are allowed to dry until ready for market.

By the use of ethylene certain improvements in the method of harvesting seem possible. Instead of waiting for the shucks to open before beginning harvest, the nuts may be gathered as soon as maximum quality of the kernel is attained. This will necessitate picking rather than thrashing the nuts from the tree, allowing them to drop onto sheets spread beneath the trees. By this method of harvesting the nuts as soon as picked would be treated with ethylene for a period of 24 to 48 hours, after which they would be dried with the shucks still on. Drying in contact with the shucks provides for normal coloration of the shell (Fig. 1, D). In the 1936 experimental work, the nuts were dried by placing them in the sun. It is presumed that artificial drying would be as effective. In drying, the shell becomes normally colored,

TABLE I—PRELIMINARY DATA ON MATURITY OF HALBERT NUTS FROM TREES OF INTERMEDIATE TO HIGH VEGETATIVENESS, YUMA, ARIZONA

Date	Shuck Separation	Pre-harvest Germination (Per Cent)	Shell Color	Specific Gravity of Nuts	Kernel*
1936					
Oct. 9.	30 per cent opening along sutures. Basal portion of shuck still adhering.	3.4	Normal to Light	.75	Slightly lacking in oil but good flavor and quality.
Oct. 15.	50 per cent opening along sutures. Shucks loosening at base.	15.9	Normal	.78	Kernels seem to have full quality and flavor.
Oct. 21.	Slow advancement in shuck separation and opening	29.6	Normal	.79	Kernels seem to have full quality and flavor.
Nov. 2.	Continued slow advancement.	35.7	Normal	.79	Kernels seem to have full quality and flavor.

*These data are based upon examination of the kernels after all nuts had been cracked. Chemical analyses are now in progress.

the shucks open well (Fig. 1, C) and can be readily removed. The nuts are at once ready for grading and marketing. With ordinary sun drying the entire process of picking, gasing, drying and grading appears to require not more than 10 to 12 days and this because of the earlier possible picking date should provide for considerably earlier marketing than has been the rule.

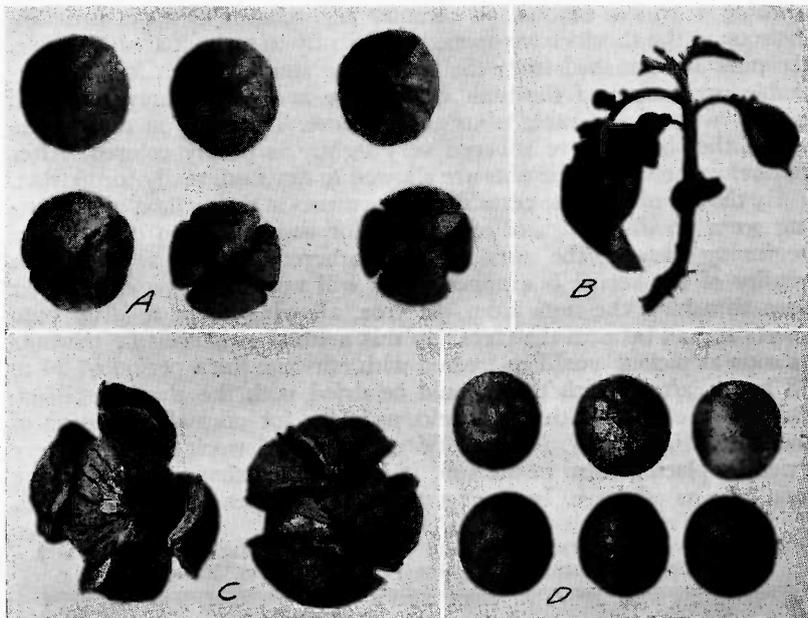


FIG. 1. A, Bottom row, showing normal opening of shucks following exposure to ethylene during mid-September. Photo taken eight days after treatment. Top row, nuts from an adjacent untreated tree. B, Epinasty of a young potato plant after being confined with pecan shuck tissue for 36 hours. C, Showing condition of shuck opening in Burkett following treatment with ethylene gas and subsequent drying. D, Coloring of shell following: (top) drying after shuck removal, and (bottom) drying in the shuck. Ethylene treatment improves the color of the shell chiefly in that drying the nut with the shuck on becomes practical.

The present indications are that in this region of high fall temperatures, optimum quality of the kernel may be attained before the shucks open well. It is during this period that much of the pre-harvest germination of nuts occurs. By picking the nuts as soon as optimum kernel quality is attained it is believed that pre-harvest germination can be largely prevented. The preliminary data of Table I suggests how this may be accomplished on Halbert nuts from a commercial orchard in the Yuma Valley. Pre-harvest germination is frequently extensive in this variety.

Apparently by the middle of October or shortly thereafter, the kernels had attained their full commercial quality and very little was

gained either in quality of nut or in ease of harvest by allowing them to remain upon the tree. By so doing a substantial loss was incurred through an increase in pre-harvest germination. On October 15 germinated nuts had no growth of the hypocotyl outside of the shell and were marketable as a lower grade. With the growth of the hypocotyl as the season advanced the germinated nuts lost any value they may have had.

With the use of ethylene to loosen pecan shucks, the shuck opening itself is no longer a satisfactory index of when harvesting should begin. With the picking date dependent upon the attainment of optimum kernel quality, it is necessary to know when this quality is attained and to have an index of it which can be used by the grower. Thor and Smith (3), found that if harvest occurs too early the quality of pecans is sacrificed. Similarly, in Arizona, if harvest of some varieties is delayed losses through pre-harvest germination are incurred. It is planned that further studies will be centered upon gaining an accurate index of kernel quality.

The effectiveness of ethylene in causing pecan shucks to loosen from the shells at once raises the question of possible ethylene-like emanations from pecan tissues. One test for emanations causing leaf epinasty was made. For this, a method described by Denny (1) was used. This consisted of confining a young potato plant under a bell jar with pecan shucks. In this one case a typical epinasty of the plant (Fig. 1, B) followed after about 36 hours.

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