FRUIT UTILIZATION AND MECHANIZATION

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Mechanization of harvesting and pruning m many fruit crops has occurred in response to the scarcity and expense of hand labor in many fruit-producing regions. Arkansas Agricultural Experiment Station scientists have been leaders in development of mechanization technology in cane fruits, strawberries and grapes. This interdisciplinary effort included food science research to develop new cultural and fruit handling systems and to determine the effects of these systems on fruit yield and quality; engineering and food science research to develop prototype machines; and fruit breeding and genetics research to provide high-quality, high-yielding varieties that are well-adapted to mechanical harvesting.

Blackberries: Research on harvest mechanization of blackberries was initiated at the Arkansas Agricultural Experiment Station in 1961 and a tractor-drawn cane fruit prototype harvester was developed in 1964. The harvester exploits the plant's natural shedding of ripe fruit (fruit abscission) to allow repeated selective harvesting as the fruit matures. The machine shakes the plants and ripe fruit falls into a collecting mechanism. Research has shown that mechanically harvested blackberries are of better quality than hand-picked fruit because it is impossible for hand pickers to identify ripe berries by color alone. Since the prototype harvester was developed, commercial harvesters have been constantly improved by the company awarded manufacturing rights.

Cultural systems for growing cane fruits for processing had to be changed drastically with the development of the mechanical harvester. An important principle necessary to obtain maximum efficiency of the harvester on erect blackberries was making available a continuous hedgerow of plants to enter the machine. A mechanized pruner was designed that not only results in improved harvesting efficiency, but also reduces the labor required for pruning.

While new cultural systems were being developed, parallel research programs were conducted with in-plant cleaning equipment, postharvest handling systems and product utilization. Also, an extensive breeding program on blackberries developed several erect cultivars suited for mechanization. It is hoped that these developments will allow Arkansas, once a major blackberry producing state, to reestablish this industry.

The University of Arkansas cane fruit harvester, with minor modifications, has been used successfully to harvest raspberries, blueberries, currants and gooseberries as well as blackberries.

Strawberries: Strawberries have been considered among the least adaptable crops to mechanical harvesting. Research on harvest mechanization of strawberries was initiated at the Arkansas Agricultural Experiment Station in 1964 and a prototype harvester was developed in 1967. In the process of developing a mechanical harvester for strawberries, several harvesting principles were studied. One approach included clipping the fruit from the plant, but a majority of the large fruit was not harvested since it was on the ground. Therefore, it was considered necessary to use a mechanism that would lift the large fruit from the ground. The University of Arkansas harvester utilizes a pneumatic-stripping system. The strawberries are harvested once-over when a majority of the crop has developed acceptable maturity.

In-plant equipment was developed to clean the mechanically harvested fruit and separate the strawberries into distinct maturity classes. Research indicated that the percentage of immature fruit present on an optimum once-over harvest date of suitable cultivars did not detract from the product quality of puree or the processed products manufactured from this puree.

A totally new integrated system for production, harvesting, raw product handling and utilization of machine harvested strawberries was developed, with emphasis on quality maintenance of the final product.

A strawberry breeding program produced strawberry lines that had 90 to 95% of their fruit reaching maturity for a once over harvest.

Grapes: Major developments in juice and wine grape harvest mechanization occurred in the early and mid-1960s and mechanization was practiced commercially by the late 1960s in Arkansas vineyards. Research in the Department of Food Science has shown that mechanically harvested grapes can have better quality than hand-harvested grapes when delivered promptly and properly to the processing unit. The following factors were found to influence quality of machine-harvested grapes: (a) machine operation; (b) cultivar and production system; (c) harvest temperature and interval between harvesting and processing; and (d) postharvest handling.

Perhaps the major quality problem with mechanically harvested grapes is fruit damage from the beater rods or slappers and from the handling after harvest. Fruit of most cultivars are removed primarily as single berries. This is particularly true of berries with fairly loose attachment. The difficulty of mechanical harvest also depends upon training system, type and condition of the trellising system and vine vigor.

Research showed that a considerable time delay between mechanical harvesting and delivery to the processing plant can 'result in increased enzymatic activity and browning, oxidation, and development of off-flavors. Research indicates that temperature from the time of harvest to the time of processing influences the quality of machine-harvested grapes more than any other factor. Addition of sulfur dioxide (SO_2) to machine-harvested grapes was found to decrease quality loss during holding. Also, SO_2 discouraged bacterial spoilage in grapes held at high temperatures over an extended period; it also served as an antioxidant to prevent juice browning.

Guidelines were developed in cooperation with the commercial grape-processing industry which included the use of SO_2 and night harvesting during periods of high daytime temperatures. These guidelines allow the grape industry to maintain the quality of machine-harvested grapes.

Now that the majority of all juice and wine grapes produced in Arkansas are mechanically harvested, a major research effort has been initiated to investigate ways of totally mechanizing vineyard operations without sacrificing final product quality. This effort involves canopy management, mechanical shoot positioning and mechanical pruning. An experimental winery and juice pilot plant have been equipped that will allow a complete evaluation of these new cultural management systems on juice and wine quality.