



the vertical saws was 15° off vertical, slanted in toward the vine trunk.

The vines in this trial were nearly ideal for mechanical pre-pruning. The cordons were straight and uniform. The arms, on which the spurs were located, had developed very little length, because the vines were young. The saws, set about 5 inches from the cordon wire, cut only an occasional arm.

Varying amounts of hand pruning followed machine pruning. The four comparison studies were: normal hand pruning, 32 buds per vine; machine pre-pruning plus maximum hand pruning, 32 buds per vine; machine pre-pruning plus moderate hand pruning, 49 buds per vine; and machine pre-pruning plus minimum hand pruning, 75 buds per vine.

The bud numbers per vine are the averages for all varieties and differed considerably among varieties. Chenin blanc, for example, had 102 buds per vine with minimum pruning, and French Colom-

## Effects of mechanical pruning on grapes

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**G**rape growers have long used hedging or mowing to remove part of the wood on vines trained to cordons. This pre-pruning of superfluous one-year-old wood facilitates the work of the pruners, who then remove all but 10 to 20 spurs per vine selected for fruiting.

Recently, more sophisticated pre-pruning machines have been developed by commercial firms. Their guiding systems permit removal of greater amounts of the prunings, although follow-up by hand pruners is always required. In 1979 we began to study the effects of such machines on wine grape productivity and fruit quality. Small numbers of seven wine grape varieties were pre-pruned.

The machine used was a mechanical grape harvester with the picking head replaced with a pruning head consisting of six circular saws arranged in an inverted "U" configuration. The two upper horizontal saws could pivot around the stake. Their height above the cordon could be constantly adjusted by an operator whose only function was to position these two saws. The positions of the vertical double saws, one set on each side of the vine, were adjusted before pre-pruning began but not while in operation. The lower of



Older vines fared poorest in mechanical pre-pruning tests.

bard had only 54. The variation was due to differing bud numbers at the base of the canes.

In all varieties, the normal hand-pruned vines and the machine pre-pruned vines followed by maximum hand pruning gave similar fruit quality (soluble solids and total acidity) and yields. With minimal follow-up, only French Colombard and Barbera produced normal yields of quality fruit. Chenin blanc, Petite Sirah, and Ruby Cabernet were the most severely over-cropped with low fruit maturity. Grenache and Carignane showed intermediate results. Even with moderate amounts of hand pruning following machine pre-pruning, Ruby Cabernet, Petite Sirah, and Chenin blanc still over-produced with fruit of lower maturity. Thus, most but not all varieties required follow-up hand pruning after machine pre-pruning to reduce the number of retained buds to near that on the normally hand-pruned vines.

Smaller simulated machine pre-pruning trials were also established in varieties 10 to 16 years old to observe the effects of rather severe cuts made on arms 4 to 12 inches long. Normal hand pruning was compared with simulated machine pruning by using a chain saw to make horizontal and vertical cuts in an inverted "U" configuration some 4 to 6 inches away from the cordon.

The response depended on variety and age of the vine. The machine-pruned 16-year-old Grenache, with well-developed arms, produced only 14 percent of a normal crop. Ten-year-old vines of the same variety produced about half a normal crop. In contrast, 16-year-old Rubired produced a normal crop when machine pre-pruned. The latter had less elongated arms than Grenache and



Pre-pruning vines with a modified mechanical grape harvester reduced yields of most varieties in U. C. tests. More sophisticated commercial machines facilitate pruning, but require follow-up by hand pruners.



pushed latent buds from the cordon and the bases of the arms, many of which were fruitful.

Thirteen-year-old Ruby Cabernet gave an equivalent crop whether hand pruned or machine pre-pruned. However, French Colombard of similar age suffered about a 20 percent yield reduction when machine pre-pruned.

Thus, machine pre-pruning of older vines gave variable results. Substantial cuts on well-developed arms reduced yield of most varieties. These results are the first season's response from machine or simulated machine pre-pruning. We plan to follow repeated treatments on the same vines for at least two more years.

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## Improved harvesting and handling benefit table grape markets

Klayton E. Nelson



Quality of table grapes is maintained when they are harvested in cool morning temperatures, kept shaded after harvest, and cooled as soon as possible.

**T**able grapes (*Vitis vinifera* L.) are physiologically a relatively durable fruit. They have a low respiration rate and can therefore live a long time after harvest. However, they are extremely susceptible to decay, can be injured easily, and lose water readily. Modern technology has alleviated these problems so that table grapes can be sold most of the year and in most of the major world markets.

In the United States the production of vinifera table grapes is essentially limited to California and Arizona, in areas with long, relatively dry summers. Until the end of the 19th century, California table grapes were produced almost exclusively for local markets. The large markets of eastern United States became accessible after completion of the transcontinental railroad and, later, development of the ice-refrigerated railroad car. Growth was slow at first, but by 1924 annual shipments had increased to 55,000 cars (1,000 lugs per car) because of more efficient and complete re-icing services across the United States, faster railroad schedules, Prohibition causing growers to switch from wine grapes to table grapes, and enactment of standardization laws prescribing minimum quality standards for the fruit.

Still, delayed and inadequate cooling often resulted in soft, unattractive berries and dry stems that broke readily during handling. Decay was an ever-present hazard, especially when wet weather occurred before harvest. Further, the grapes had to be marketed immediately after harvest, because they could not be held in cold storage for more than a few days without drastically losing quality; the result was market gluts and low prices.

In studying chemical composition of table grapes as the fruit matured, F. T. Bioletti was primarily concerned with the soluble solids content influenced chiefly by the sugars (glucose and fructose). Taste tests were included to relate palatability to sweetness (soluble solids), sourness (total titratable acidity), and a balance of these two constituents (sugar/acid ratio). Bioletti concluded that the soluble solids content was the simplest and most reliable indication of when the grapes were acceptable. He recommended minimum solids contents high enough so that the fruit would be palatable even if the grapes had an unusually high acid content in a cool season.

Many of these recommendations were incorporated into the State Standardization Act of 1921. Unfortunately, the industry was reluctant to accept these standards, because they were considered