

Vineyard Mechanization- A System Approach

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RECENT increases in the cost of hand labor have prompted grape producers to implement mechanized vineyard operations. Mechanized grape harvesting systems have gone through several changes since the 1960s. Pivotal strikers and bow rod units have reduced the amount of material other than grapes and increased the harvesting speed. Uniformly straight rows, cordons, and trunks are necessary to facilitate mechanical harvesting and other mechanized operations.

The cost of mechanical harvesting equipment is justified in larger vineyards or when growers custom harvest as a sideline. Harvest temperature and time from picking to processing are two factors that are very important to grape quality. At high temperatures negative flavor changes can occur within a very short period of time, and the temperature of the grapes at harvest governs the temperature until processing. Grapes produced in warm regions can be harvested mechanically at night and in the early morning before heat builds in the fruit. Growers with mechanical harvesters have maximum control over harvest timing considerations. Furthermore, sulfur dioxide can be added during the mechanical harvesting process to act as an antioxidant and reduce spoilage.

Along with mechanical harvesting, other mechanical operations can improve the efficiency and economics of grape production. Mechanical pruning, shoot thinning, canopy management, fruit thinning, leaf removal, and summer pruning further reduce dependency on expensive hand labor. The effects of mechanical pruning were studied on shoot-positioned grapevines in Arkansas trained to Geneva double curtain (GDC) and high wire, bilateral cordon systems. The results showed that continual pruning is most effective in shoot-positioned vineyards and reduced follow-up hand pruning by 50%. Recent studies have shown that hand labor can be completely eliminated if mechanical pruning is followed by adequate and timely mechanical thinning.

The overriding attraction of mechanized pruning and thinning operations is timing and control. Vines must be pruned to achieve the desired balance of fruit yield and quality. But bud damage due to winter injury and spring frost can reduce the fruit load to far below the level intended when the vines were pruned prior to these events. The speed of mechanized operations gives growers the flexibility to leave more buds and prune again later.

After the danger of killing frost has passed, if the fruit load is too high, the crop can be mechanically thinned approximately 30 days post-bloom, depending on variety.

TWELVE MECHANIZED SYSTEMS OF THE MORRIS-OLDRIDGE PLAN

1. *Vitis labruscana* (and other grapes with drooping growth habits) on GDC trellis and GDC-like canopy systems
2. *Vitis labruscana* (and other grapes with drooping growth habits) on single curtain trellis systems
3. Minimal-pruned *Vitis labruscana* (and other grapes with drooping growth habits) on GDC trellis and GDC-like canopy systems.
4. Minimal-pruned *Vitis labruscana* (and other grapes with drooping growth habits) on single-curtain trellis systems.
5. *Vitis vinifera* and French-American hybrids produced on GDC trellis and GDC-like canopy systems
6. *Vitis vinifera* and French-American hybrids produced on high wire and single curtain trellis.
7. Minimal-pruned *Vitis vinifera* and French-American hybrids produced on GDC trellis and GDC-like canopy systems
8. Minimal-pruned *Vitis vinifera* and French-American hybrids produced on a high-wire curtain trellis
9. *Vitis vinifera* and French-American hybrids produced on standard California T-trellis
10. *Vitis vinifera* and French-American hybrids produced on standard vertical moveable catch wires
11. *Vitis vinifera* and French-American hybrids produced on Lyre or "U" and other divided canopy trellis systems



This mechanical pruner is part of the Morris-Oldridge Plan and is used to establish test plots in a bilateral cordon vineyard at the University of Arkansas vineyards.

12. *Vitis vinifera* and French-American hybrids produced on Smart-Dyson ballerina (and similar) trellis systems

Thin To Win

French-American hybrids tend to be extremely fruitful and fruit and/or shoot thinning is almost always required to produce premium wines from French-American hybrids. Mechanical thinning is both economical and successful on these hybrids. Leaf removal operations are also practiced to produce a specific quality, and in some regions the leaf crop must be limited to ensure maturity due to a shortened growing season. Mechanized leaf removal is part of the Morris-Oldridge Plan for total vineyard mechanization.

New equipment has been developed, modified, and evaluated for the mechanization of each viticulture operation. Research has been conducted at the University of Arkansas since 1966 that has resulted in mechanized concepts and systems that will allow for almost complete mechanization of mature grape vineyards. Vineyard operations that have been mechanized include dormant pruning, fruit thinning, leaf removal, summer pruning, and harvesting for established vineyards. The Morris-Oldridge Plan for mechanizing vineyards was developed and includes 12 trellising and production systems (see page 1*). The system requires 40 different machines and/or apparatuses to accomplish the mechanization of all 12 of these systems. Each piece except the harvester bolts to a tractor-mounted frame with hydraulic controls. Twenty of these machines or attachments are already used in the industry. The Morris-Oldridge Plan is part of a pending international patent application that is the property of the University of Arkansas.



This Lyre or "U" harvester was developed for the Morris-Oldridge Plan and will also harvest the conventional vertical shoot position trellis system. Preliminary results indicate that this unit will harvest a high percentage of whole berries.

Timing Is Everything

Mechanical harvesters, shoot positioners, and pruning devices have been used for some time, but until now, there have been no integrated commercial systems that detailed the appropriate machine to use at the proper time for all 12 of the major trellising and production systems. Of equal importance is that these systems maintain fruit quality and are typically cost effective.

System 1 deals with grapes with drooping growth habits trained on GDC or similar trellis systems. A mechanical pruner (see photo on page 1yt) has been patented that can be used to prune after leaf fall and through the vines' dormant period. Two of these pruning units can be mounted to an over-the-row harvester to prune both sides of the GDC in one pass. A tractor-mounted model is also available that prunes one side of the GDC. At 10% bloom the shoots need to be positioned, and a mechanical shoot positioner for this system has been patented. Mechanical units have been developed which will remove excess fruit after berry set and

shatter.

Approximately 25 to 30 days post bloom, final adjustment of the fruit load is performed. These steps can help assure a balanced crop year after year and remove the problem of cyclic yields.

Before the grapes are ripe, the centers of double curtain trellises need to be separated or broken; mechanical units adequately perform this operation. At full maturity the grapes are harvested with a number of existing harvesters that can be equipped with quad rods or bow rods to assist in removal of difficult-to-harvest fruit and allow for excellent fruit removal with minimal damage to foliage. Maximum foliage allows for photosynthesis and storage of carbohydrates in the vines until frost and/or leaf drop.

Morris and Oldridge have developed similar descriptive instructions for the 11 other systems listed in their plan. These systems use various machines for each operation and give a description of the proper usage of each attachment plus the critical time for carrying out each operation. More recently, a mechanical harvester has been developed by Morris and Oldridge that will harvest the Lyre or "U" trellis, a major trellising system in the coastal regions of California and in France (see photo on this page). Due to the unique configuration of this trellising system, it has not previously been possible to mechanically harvest fruit trellised on it.

Additional research in the area of total vineyard mechanization and its impact on quality is needed on all species of grapes with emphasis on the development of totally integrated systems. The timely performance of most of the mechanization operations will be critical to the success of the total systems approach. By effectively mechanizing cultural and harvesting operations, the production of grapes for premium wine will become more competitive with regions that have available and inexpensive hand labor.

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