Mechanical Harvesting of Prunes in Oregon

Prepared by Robert L. Stebbins
Extension Horticulture Specialist, Oregon State University, Corvallis

Almost all prunes grown in the interior valleys of California are mechanically harvested, using shakers to remove the fruit and catching frames or canvasses under the tree to catch it. Catching frames are not as practical in the coastal areas because much of the fruit often falls to the ground before harvest. Pick-up machines are used to mechanically harvest prunes in some of these orchards. University of California and USDA agricultural engineers produced the basic designs for much of the equipment that is used.

In cooperation with University and USDA workers, growers and equipment manufacturers developed the large array of prune harvesting equipment which is available for purchase today. Although the machinery operates well under California conditions, most of it is not designed to operate efficiently in the hillside orchards of Oregon.

Since 30 to 40% of the cost of producing prunes in Oregon is represented by harvest labor, mechanization could reduce production costs considerably. This cost reduction probably will be necessary for growers to realize a profit at prices similar to those paid to California growers. In Oregon, both adult and school-age prune pickers are employed. Harvest labor is a problem in cool summers when much of the prune crop matures after school has opened.

Hand picking costs per ton of fruit harvested remain fairly constant, while costs per acre harvested increases proportionally with increasing yield. With more mechanical harvesting, just the opposite is true. Pick-up harvesting costs per ton of fruit harvested decrease with increasing yield but are only rarely constant on a per-acre basis. Very mechanical harvesting brings greater savings with lower high yields and lower savings with lower irregular production. However, only the total cost of harvesting one tree or the number of trees that could be harvested should be considered the number of tons a machine could harvest in a given year.

The more economical machines are the ones that give the lowest total labor cost per ton in an average situation. More efficient machines harvest faster from one to two acres per hour with a crew of two to four men. Slower machines with greater crew requirements may cost less initially, but be more expensive in time.

Tree Shaking

For many years, prunes for processing have been shaken to the ground first and then picked up by hand. Before machine shakers became popular, a long pole with a metal clamp on the end was used. Because shaking trees by hand is very tiring, pickers prefer to have the grower shake the trees. Also, hand shaking often breaks and scars limbs of the tree.

Simple knockar-type shakers which do not clamp to the tree have been used successfully. These are more damaging to the trunk or limbs than shakers with clamps. When great force is required to remove all of the fruit. Boom shakers mounted rigidly to a tractor have been used successfully. The advent of catching frames has increased the need for the inertia shaker which does not transmit shaking force back to the catching frame. The inertia shaker can be mounted on a catching frame, tractor, or other conveyance. Its more flexible mounting generally permits more rapid placement on the trees with a limb shaker. A trunk shaker fits in between the belts and thrown into bins. The old boom shakers when were equipped with a pincer type clamp, which readily injured the lower limbs of the tree. The newer "C" clamp causes less damage on limbs. These rubber chocks have been found to permit more rapid placement on the trees.

The shaker should be designed so that either trunk shaking or limb shaking is possible. The early trunk shaking caused much damage to limbs. Later models have been equipped with air and sand pillows and rubber outer covers to prevent damage. When properly operated, the better models do little damage to the tree.

Hand shaking can be done at many different rates. For many years, prunes for processing have been shaken so that the whole tree can be shaken with one simple clamping, a grower can harvest more trees per hour with a trunk shaker than with a limb shaker. A trunk shaker fits in better with some one-man catching frame shaker systems than a limb shaker does. Unfortunately, many trees have too many low limbs for trunk shaking. Trunk shakers also require more power than limb shakers.

Pruning and Training

For trunk shaking, the lowest limb of the tree should be about 2½ to 3 feet from the ground. For limb shaking, a tree should have no more than three main scaffold branches. Secondary branches should not arise closer than 2½ feet from the trunk. The limbs should be spaced as far apart as possible. This allows the shaker operator to make only three attachments, to avoid "skimming" the branches (horizontal limbs are more easily skinned), and to simplify the place to clamp, thus increasing rate of speed. Prune the tree to stiffen to increase shaking efficiency.

Pick-Up Systems

Like the French prune tree grown in the coastal areas of California, the Italian prune trees frequently drop the prune fruit just before harvest. Still, some fruit falls to the ground between the first, second, and third harvests. Because of this habit of fruit dropping, pick-up machines for harvesting Italian prunes for processing seem more practical than catching frames. Pick-up machines, if properly designed, may be able to pick more fruit per hour, especially when only a small amount of fruit is gathered from each tree in a single picking.

The UC and USDA engineers devised a new pick-up principle for prunes, somewhat similar to that used in most filbert harvesters in Oregon. The system uses two parallel rubber belts. The front one is covered with rubber fingers and the rear belt is smooth. A resilient roller about one inch in diameter travels about ⅜ to ⅝ inch above the ground in front of the rear belt. It rotates in the opposite direction to the front belt and serves to push the fruit into the area between the two parallel belts. The fruit is elevated between the belts and thrown into bins.

A pick-up machine suitable for Oregon conditions should be capable of climbing a fairly steep hillside and operating in light mud. It should carry one or two bines and be capable of a rapid rate of harvest. The shaker should be mounted on a vehicle with wide, smooth tires that do not leave ruts.

One of the principal drawbacks to pick-up machine harvesting is the careful ground preparation required. Filberts growers who harvest with pick-up machines have encountered and solved most of the problems involved. Since prunes are several times larger than filberts, it might not be necessary to roll the ground quite as smooth for prunes as for filberts.

This is one of a series of Fact Sheets reporting Cooperative Extension work in agriculture and home economics, Gene M. Lear, director. Printed and distributed in furtherance of Acts of Congress of May 8 and June 30, 1914. Oregon State University, Oregon counties, and U. S. Department of Agriculture cooperating.
Aside from the problem of preharvest drop, one of the principal disadvantages of the shake-and-catch system is the difficulty encountered in operating some frames on steep slopes.

Basically there are two types of catching devices: stretched canvas or wooden "frames" and canvas "roll-outs." Some units have a stretched canvas on one side and a roll-out on the other.

Stretched canvas or wooden frames may consist of a single limb or two halves. They may be self-propelled or tractor-towed. Some frames have a self-propelled device for operation on hills. Generally the fruit is moved about the frame on a central conveyor. A fan located under the elevator part of the conveyor blows leaves out of the fruit as they fall into the bulk bin. Tractor-towed frames operate with the fruit falling from the tractor.

A trunk or limb shake (progressively) is mounted on the catching frame. Sometimes two limb shakers are mounted on a catching frame system. Motorized two shakers 110° apart in a circle around the tree increase the area of favorable attachments that can be made.

Catching frames should be padded well enough to prevent fruit damage. They should be capable of operating at speeds of at least one tree every two minutes with a crew of two or three.

Roll-out catching devices may be designed to harvest one or two rows at a time. Their main advantages are: (1) lower initial cost and (2) better adaptation to hillside operation. Major disadvantages are slower rate of pick and larger crew requirement. The canvas is rolled out and retrieved on a power-driven bar. Some canvas roll-out machines have a tray that drops to the ground at the side of the machine. The fruit is then rolled into the fold of the canvas until it reaches the tray, which lifts it up onto the conveyor. Elevating the fruit onto the conveyor can be a problem with machines that have no tray. Most roll-out machines are towed and powered by a tractor.

Bulk Handling

Handling large quantities of fruit rapidly requires the use of bulk bins. Mechanical harvesting cannot be successful unless bulk handling is also practiced. A fork lift attached to a tractor or other vehicle for use in the orchard is essential. The processor must have equipment to unload trucks carrying bins and to remove fruit from the bins. Special trailers that straddle a stack of bins are used in some fruit-growing regions. They have hydraulic lifts to eliminate the need for a fork lift in loading or unloading the trailer.

Changing from boxes to bins has the following advantages: Reduced container costs; reduced costs for field distribution, collection, and stacking of containers; reduced transportation costs due to less container weight per ton of fruit; reduced storage requirements; and reduced fruit damage in loading and unloading and in transit.

The usual procedure for ground preparation is as follows: (1) The cover crop (or winter weed control) is diced or plowed with a cover crop drill, disc, or harrow. A spring-tine harrow or peg harrow is used for summer weed control when a roller for making clods and a cutter or drag harrows are used. (2) Gent weeding or Kinble. (3) Tractor orchard floor harrow for the orchard floor or to the catching frame with little damage. Preliminary tests have shown the feasibility of mechanically harvesting Italian prunes for the fresh market. Stem pulls were found less frequently with mechanically harvested fruit than with hand-picked fruit. Italian prunes for canning also have been harvested using the shake-and-catch system. Harvesting must begin before too much fruit has fallen to the ground. The principal advantages of the shake-and-catch system are: (1) Careful ground preparation is not required, (2) the fruit is kept cleaner, and (3) the fruit suffers less damage.

Careful rolling and leveling of the soil surface is essential to a successful prune pick-up operation. Mole, gopher, and mice tunneling can present problems in pick-up operations. A control program is justified.

Variations in the combinations of equipment used and minor differences in equipment design are common.

The fruit should be picked when all of the flesh has reached an amber color but before it turns brown. Pick-up operations will severely damage prunes that have become extremely soft and are turning brown inside.

Shake-and-Catch Systems

Fruit from Italian prune trees is rather easily removed by shaking and falls to the ground or to the catching frame with little damage. Preliminary tests have shown the feasibility of mechanically harvesting Italian prunes for the fresh market. Stem pulls were found less frequently with mechanically harvested fruit than with hand-picked fruit. Italian prunes for canning also have been harvested using the shake-and-catch system. Harvesting must begin before too much fruit has fallen to the ground. The principal advantages of the shake-and-catch system are: (1) Careful ground preparation is not required, (2) the fruit is kept cleaner, and (3) the fruit suffers less damage.

The orchard floor is leveled, just as in the orchard. Careful rolling and leveling of the soil surface is essential to a successful prune pick-up operation. Mole, gopher, and mice tunneling can present problems in pick-up operations. A control program is justified.

Roll-out catching devices may be designed to harvest one or two rows at a time. Their main advantages are: (1) lower initial cost and (2) better adaptation to hillside operation. Major disadvantages are slower rate of pick and larger crew requirement. The canvas is rolled out and retrieved on a power-driven bar. Some canvas roll-out machines have a tray that drops to the ground at the side of the machine. The fruit is then rolled into the fold of the canvas until it reaches the tray, which lifts it up onto the conveyor. Elevating the fruit onto the conveyor can be a problem with machines that have no tray. Most roll-out machines are towed and powered by a tractor.

Bulk Handling

Handling large quantities of fruit rapidly requires the use of bulk bins. Mechanical harvesting cannot be successful unless bulk handling is also practiced. A fork lift attached to a tractor or other vehicle for use in the orchard is essential. The processor must have equipment to unload trucks carrying bins and to remove fruit from the bins. Special trailers that straddle a stack of bins are used in some fruit-growing regions. They have hydraulic lifts to eliminate the need for a fork lift in loading or unloading the trailer.

Changing from boxes to bins has the following advantages: Reduced container costs; reduced costs for field distribution, collection, and stacking of containers; reduced transportation costs due to less container weight per ton of fruit; reduced storage requirements; and reduced fruit damage in loading and unloading and in transit.