

Prune Harvest Methods, Costs

comparative study made on efficiency of various types of labor-saving equipment used in 1954 prune harvest season

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Harvesting 400,000 tons of California's fresh prunes—to make about 160,000 tons of dried prunes—requires an estimated total of 195,000 man-weeks of labor. Peak labor requirement in early September is over 30,000 seasonal workers in addition to family and regular labor.

There is growing interest in newer methods to reduce the number and cost of seasonal workers. Picking and hauling alone are estimated to cost \$33.20 a dry ton or \$13.30 a fresh ton—about 20% of the total cost of production.

Prune harvesting is not a single process similar in all prune districts. In Santa Clara and San Benito and, to some extent, in Napa and Sonoma counties, prunes ripen unevenly and must be gathered in two or three pickings. In the Sacramento Valley, prunes largely hang on the tree until shaken or picked off, so are gathered in a single picking. With dehydrator capacity limited by overhead costs, it is necessary—in all areas—to spread the harvesting over a three-to-four week period, which means starting earlier and working later than the best time from the quality standpoint. More rapid mechanical methods to shorten the harvest period meet the serious difficulties of dehydrator capacity, as even the conventional hand methods did in the 1954 season.

Harvesting prunes is composed of three operations: getting the fruit off the tree, usually by natural drop and shaking; picking the fruit from the ground, usually by hand, and into boxes; and hauling the fruit to the dehydrator, usually in lug boxes on trucks.

In the coast counties, the earlier picks are commonly made after some fruit has fallen and lain on the ground a few days. A light shake by hand, using poles with hooks, brings down fruit that is almost ready to drop. In the last pick, more shaking may be needed to clean the trees. In such cases, shaking is not difficult or costly. Sometimes it is done by the pickers and paid for at about 5¢ more per 50-pound box, so costs the grower about \$2 a ton for the season. To have better control of the operation, many growers hire men to shake the trees for the pickers, paying perhaps \$1 per hour, and hire pickers at, say, 20¢ a box instead of 25¢ when they do the shaking. The

cost of this method—on the hourly basis for the season—would probably be a little more—perhaps \$3 per ton.

In the Sacramento Valley, where vigorous shaking is required—and largely done by hand—costs are higher. Cable shaking—in combination with cleaning up by pole knocking—is rather widely used in Tehama County. Pneumatic shaking is also used in several orchards.

In 1953 and 1954, some shaking costs were obtained in Tehama, Colusa, and

Sutter counties for shaking by hand, by cable, and by pneumatic gun.

Shaking by hand was done by the pickers in one orchard and included in the box rate of 30¢ a box, compared to 20¢–22¢ when all prunes were on the ground, and to 25¢ when pickers did a little knocking to clean the trees after cable or pneumatic shaking. At 10¢ a box, this would cost about \$4 a ton for the hand shaking.

Cable shaking, with overhead and re-

Probable Cost of Prune Harvesting Methods*
Based on an Assumed Capacity over 24 Days

	1 Hand	2 Hendry frame	3 DeTar trough	4 UC frame	5 Curtis frame	6 Goodwin picker
Number of picks assumed . . .	2	2	1	2-4	1	2
Assumed maximum acres . . .	8	9	15	17	43	67
Assumed maximum tons . . .	48	54	90	100	250	400
Original cost of equipment . .	\$5	\$55	\$510	\$310	\$5,000	\$4,640
Original investment per acre	.60	6	34	18	167	70
Equipment overhead						
per year . . . . .	.80	17	104	54	683	600
Equipment overhead per ton	.02	.31	1.15	.54	2.73	1.50
No. men in crew,						
incl. shaking	2	2	3	4	4	7-9**
Est. av. output per hour, tons	.20	.25	.46	.52	1.20	3.00
Tons per man hour . . . . .	.10	.12	.15	.13	.30	.33
Man hours per ton						
Shaking	3.0	8.0	6.7	7.7	3.3	2.9
Picking	8.0					.7
Hauling . . . . .	.5	.5	.5	.5	.5	.3
Total	11.5	8.5	7.2	8.2	3.8	3.9
Costs per ton						
Extra ground preparation						.50
Shaking labor if						
separate (hand)	3.00					3.00
Man labor picking crew . .	8.00	8.00	7.06	7.69	3.54	1.17
Tractor, etc. at cost rates .	—	—	.77	—	1.46	.67
Equipment overhead . . . .	.02	.31	1.15	.54	2.73	1.50
Hauling—man and truck . .	2.00	2.00	2.00	2.00	2.00	—
Total harvesting cost . .	13.02	10.31	10.98	10.23	9.73	6.84

* Costs shown are largely estimated on the basis of observations over a short period but calculated as though for an entire harvest. Overhead costs on equipment were spread over a reasonable maximum tonnage for the season to show the probable minimum overhead costs per ton for the shakers, catching frames, picking machines, etc.

1. Hand method shows a 2-man crew unit, but paid \$11 a ton for shaking and picking with an arbitrary division between \$3 for shaking and \$8 for picking up from the ground.

2. The Hendry frame output covers shaking, boxing fruit from the frame, and picking from the ground, going over the orchard twice.

3. The DeTar trough and canvas example is based on a single pick with about 1/2 of the crew time spent in picking up about 10-25% of the fruit from the ground and then placing canvases and pneumatic shaking and boxing the fruit from canvases and trough in 2/3 of their time.

4. The UC frame figures are based on a 4-man crew with ground fruit picking time included, and 2 to 4 times over the orchard. Shaking is by hand.

5. The Curtis frame is a once-over operation with no ground fruit picked by hand.

**6. The Goodwin machine crew would include 4 shakers, 1 raker, 1 machine operator, and 1 forklift operator, but shakers would work full time and machine crew not so much so output per hour of crew operation is based on 6 rather than 4 shakers.

pairs on the cable and shaker, and a tractor at \$1 an hour—with hand shaking to clean up the trees—was reported to cost \$4.04 per ton in one orchard. The hand-picking rate on this farm was 20¢ a box of 50-55 pounds and 22¢ later in the season—as boxes got heavier—with total average cost for the season of \$8.34 per ton. Hauling was computed to cost \$1.87 per ton for a total harvesting cost of \$14.25. Other costs of cable shaking varied from \$3 to \$5 a ton.

Pneumatic shaking was observed in a number of orchards. One grower—in 1953—had two tractors with mounted compressors on power take-offs, which, with guns and mounting, came to between \$1,200 and \$1,300 per unit with two guns. With reported overhead and repair costs, and two tractors and six men at \$1 per hour, calculated costs came to \$3.24 per ton, based on observed rate in fairly young orchard with good crop. Other observations gave costs up to \$5.40 per ton. Usually it was cheaper to pay the pickers two or three cents a box more to clean the trees than it was to have the men with the long heavy guns get all the fruit off. Work rates averaged six minutes per tree with one gun.

Pneumatic shaking did not show as much fruit or tree damage as cable shaking or hand knocking. Both pneumatic and cable shakers have a place in combination with catching frames.

Of the four methods of picking—from the tree by hand, with ladders; from the ground by hand after shaking; shaking the fruit on to canvases or catching frames; and lifting the fruit from the ground by machine—picking from the tree by hand would probably result in the best fruit quality if it could all be done when the fruit is at the right maturity for highest quality. Tree picking takes a little more time and costs a little more than shaking and picking up by hand from the ground, but ground damage to shaken prunes is avoided.

Canvases are rarely used for catching prunes. Picker resistance has been cited as the reason for nonuse regularly. The pickers, paid by the box, pick the ground fruit and put it in one set of boxes. They then spread the sheets and shake the tree, rolling the fruit into a pile from where they move it by hand—with some sorting out of defective fruit, leaves and twigs to a different set of boxes. One grower in Tehama County reported cable shaking and boxing from the sheets cost \$9 a ton.

Catching frames show promise of improving fruit quality and reducing costs and can be used in combination with hand, cable, or pneumatic shaking. In most areas, there is still some ground fruit to be picked before or after each use of the frame—perhaps 10% to 25%.

A light, portable catching frame—the

Hendry—developed in Napa County has proved well suited to small acreage orchards. The catcher is in two sections, each 9' x 20' of muslin stretched over steel frames, and with flaps at the tree row. The frames are 42" high at the tree and slope downward to box height at the outer edges. This permits pole shaking from outside the catcher. Construction cost was about \$50.

The Hendry frame was used in 1954 to harvest a three-acre orchard. Two boys picked about a ton in half a day. Each section of the frame was moved into position separately. The tree was then hand shaken with long hooked poles. After the shake, the fruit was boxed from the frames and from the ground.

The UC catching frame—developed at Davis—has two sides of canvas stretched on a steel tubing frame, with each side mounted on three rubber-tired wheels. One frame has a hand-cranked conveyor belt and bridge-panels to fill the tree row gap after frames are in position. The catcher can be built for around \$300. Each side of the frame is light enough for two men to move and maneuver. In its experimental use on Imperials near Hollister in 1954, shaking was by hand with hooked poles, and four different picks—totaling six tons—were made in one acre at a labor cost of \$9.70 per ton, including the ground fruit before and after the frames were moved. The rate for ground picking in the same orchard was \$9 a ton. With full season's use, the overhead on the frame would be \$4 an acre with a 17-acre season's use, or less than 60¢ a ton of fruit. Tried on French prunes, four men, with hand shaking, got 36 boxes, while two additional men picked six boxes from the ground in 72 minutes. This is 42 boxes, or 1.05 tons, for 7.2 man hours, or .146 ton per man hour. Damage to falling fruit was negligible, as compared to some damage in the fruit shaken to the ground.

A successful but complicated prune harvester—the Curtis—was built at Gerber. It is a large U-shaped catching frame—tractor mounted—with movable slot panels and wings operated by the driver. The harvester contains a built-in cable shaker, two conveyor belts for boxing prunes, and a blower for removing leaves. It was used successfully in 1954 to pick 206.5 green tons from 35 acres in 150 hours, 30 of which were at night. Average performance rate—with a four-man crew—was 1.37 tons per hour from 14 trees. One man operated the tractor and the controls for the frame and cable shaker. A man in the frame hooked the cable for shaking and hand-cleaned the small limbs. Two men boxed the fruit as it came off the belts. There was no ground fruit to be picked up because the entire crop was shaken into the frame. Damage to falling fruit was much less

than when fruit is shaken to the ground. The cost of the harvester would be about \$5,000 on a commercial basis. Reported operating cost per hour was: \$2 for the frame, \$2 for the tractor, and \$4.25 for labor, for a total of \$8.25, and a picking cost of \$6.05 per ton. Costs shown in the accompanying table were figured on a different basis and came to \$7.73 per ton for the picking.

Another type of prune harvester—the DeTar—used in Suisun Valley, is a wheel-mounted trough with canvas sheets. The sheets are extended in pairs on both sides of the trough, so two trees are picked at one set. It is pulled by a steel-squirrel, which also powers the single pneumatic shaker. The 1954 season average—with ground fruit picked up ahead not included—was 22.6 boxes per crew hour, at a cost of \$6 per ton, plus 70¢ overhead on equipment, or \$6.70 for the fruit from the canvas. Ground fruit varied from 10% to 25%.

Hauling in these cases was in lug boxes with trucks, or tractors and trailers, or wagons. Costs, including a nominal overhead on trucks, ranged from \$1.50 to \$3 a ton from orchard to dehydrators.

The Goodwin picker observed in several cases—two in 1952, one in 1953, and three in 1954—will pick up the prunes adequately if ground preparation is good. An extra ground smoothing with a suitable drag at a cost of about \$3 per acre should be considered part of the cost of machine picking. The machine can be used for more than one pick, but in the cases observed, the entire crop was taken at once by shaking, raking out of tree row, and then picking up by machine. It takes about four men hand shaking, or two men with pneumatic shakers, to shake ahead of a machine—perhaps more when shaking is difficult. One man can rake the fruit out of the tree row. Rate of machine picking is up to an acre an hour and varies with yield from one to six tons, depending on transportation limitations.

The total investment for machine-picking is between \$4,000 and \$5,000 for the picking machine, the small tractor side-rake, half of the cost of the fork lift and dumping attachment, trailer, tubs, a receiving tank and washer at the dehydrator. The probable operating costs shown in the table are based on a rate of three tons per hour as an average of two pickings in about 133 hours of operation, out of a maximum harvest period of 216 hours.

Where soil and fruit conditions are such that a picking machine can be used successfully, it offers the greatest reduction in cost and labor requirement of any method.

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