Lightweight Catching Frames

effect on fruit quality and harvesting costs studied in successful field trials with Imperial and French prunes

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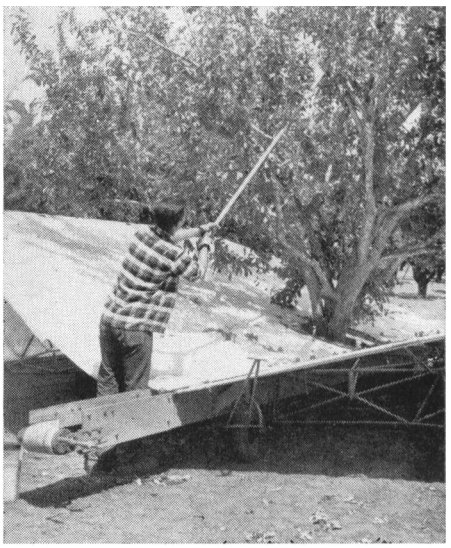
A lightweight catching frame helps protect fruit quality from harvest damage because—by keeping the fruit off the ground—it minimizes skin damage and imbedded dirt.

In addition to studies at Davis and field tests at Hollister—as part of a project on the improvement of processing methods for Imperial prunes—the frames were successfully tried on French prunes, apricots, and walnuts.

All fruit handled during the three-year study was graded commercially because one main interest of the experiment was to note any significant differences in the quality of the dried fruit.

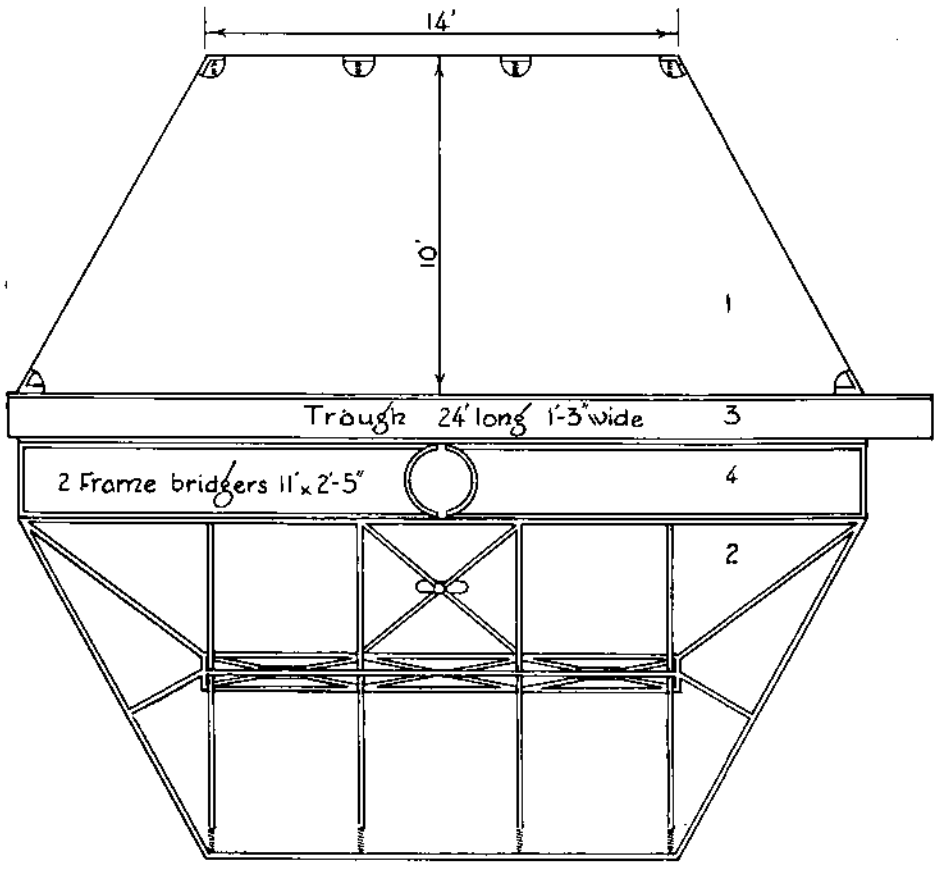
Furthermore, the tests dispelled the fear that harvesting with frames might bring down green immature fruit at the start of the season. Such prunes would show puffy and inferior meats and low sugar content, but practically no defects of this sort were encountered in frame-harvested fruit.

The basic structure of the catching frame—developed for the studies—is in two sections made of thin-wall steel tubing. Canvas—tomato sheeting—is stretched over the framework of each section and attached to coil spring extenders at the outer edge to maintain proper canvas tension. Each canvas-covered section slopes toward a central trough. Trials showed that the best slope is approximately 25° with sufficient curvature at the bottom to enable prunes rolling with high velocities to jump the trough and roll part way up the other side. In some cases this action may be repeated before the fruit drops gently into the trough.



A catching frame in operation.

Plan view of frame. 1, Frame unit showing stretched canvas with coil spring extenders. 2, Schematic view of a frame showing basic construction with thin wall tubing. 3, Hand cranked conveyor trough integrally mounted with unit 1. 4, Frame bridger providing an unbroken surface for the flow of fruit between frame 2 and conveyor.



The trough, made of plywood and attached to one frame only, has a hand-cranked conveyor belt, which delivers the fruit at one end. An unbroken surface for the flow of fruit is achieved by the addition of small rectangular canvas frames to bridge the opening between the two large sections, which are separated by the tree trunk. This frame bridger can be slid in or out to fit any size of tree trunk.

The frames were designed to operate in rows where the trees are spaced 22' apart and—for ease in moving—each frame section is mounted on three pneumatic-tired wheels.

The frame sections are moved along a tree row—one on each side of the row—and aligned on opposite sides of the trunk of the tree selected for picking. The frame bridgers are set in place and adjusted to the trunk diameter.

When the tree is shaken, the fruit falls onto the canvas and rolls to the trough, which is just off-center, next to the tree trunk. The fruit is moved along the trough into boxes by the hand-cranked conveyor belt—when some hand removal of leaves and twigs can be made. On light picks, the trough need not be emptied at each tree. When the shaking is finished, the frame bridgers are emptied

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into the trough and placed on one of the frames. The frames are then advanced to the next tree.

When the trough delivers fruit to the rear, filled boxes do not have to be moved in order to transfer the frame to the next tree. Box handling is reduced to a minimum. Another advantage of the frames is that ground preparation is not critical for this operation; a level surface will assist the work but a clodless surface is not needed.

Effectiveness

Of the total fruit harvested, 80% was delivered to the trough, 12.5% missed the frame and fell to the ground, and 7.5% fell to the ground during periods between pickings. Although the frame failed to intercept one eighth of the fruit, increasing the frame size would probably not increase its effectiveness. Some prunes, by their trajectory, would still fall outside the frame area; other fruit, hitting the canvas, would bounce off; and still others would fall in the unprotected space around the tree trunk.

The frames have not yet been used to capacity through an entire harvest season, but trials on Imperial and French prunes indicate that four workers—three handling the frames and one picking fruit from the ground—would pick at a rate equivalent to five men shaking and hand picking from the ground. This would reduce labor requirement by 20%.

All crew men may not finish their normal duties at the same time. One or more may be momentarily idle or assist other crew members in parts of their operation which are unusually long. Idle time does not occur simultaneously for all members of the crew except in rest periods, but each member may have some delay at one tree or another. An alert crew learns to reduce avoidable delays.

A reasonable season's average, with from two to four pickings, would be one half ton per hour. Depending on yield and number of pickings, a seasonal total for one set of frames would be 10 to 15 acres and up to 90 tons.

A comparison of the cost of harvesting—with frames and with conventional methods—showed that frame-collected fruit could be harvested for $8.60 a ton as against an average of $10 to $12 a ton for hand-picked fruit. Costs are based on the average rates of yield and pay for the 1954 season—$1 an hour for labor, an investment overhead of 60¢ a ton and a yield of 5.78 tons per acre.

The frames have been used during the last three years in tests to determine whether a better-quality Imperial prune could be obtained by direct dehydration rather than by the sun-drying methods that are now employed.

The picking results were very favorable. Skin breakage incurred in harvesting was very markedly reduced in 1952 and 1953. It was less serious with windfalls in 1954 than in the previous years, but use of frames still reduced breakage. Fruit damage which occurs in harvesting is aggravated by direct dehydration but apparently it is diminished by sun-drying.

When frames are used, imbedded dirt is not a problem as far as harvesting is concerned. An analysis of the frame-picked fruit did show that some dirt was picked up in subsequent operations. This is a point that might be investigated to improve the quality of fruit going to market.

Bleeding is a serious loss to the grower; it shows up as lost weight in the dried product and causes the fruit to stick to the tray, resulting in defective dried fruit known as slabs. There appears to be a stage of maturity when bleeding occurs with commercial direct dehydration, regardless of how the prune is harvested or handled.

Bleeding reduction with the use of frames showed up decisively on the runs of the first two years.

Bleeding appears to be related directly to sugar content and maturity. With the high sugar content characteristic of the prunes harvested in this experiment in the first two years, the frames were the major contributing factor to the success with direct dehydration. With the low sugar content of 1954, neither frame-gathered nor windfall fruit bled badly, with the exception of the last run. Unfortunately, not enough work has been done to reach a definite conclusion. At present it is doubtful that frames will reduce bleeding to the point where growers would find it profitable to dehydrate directly. Perhaps other factors—such as tunnel temperature variations—might be investigated to see if a combination drying procedure might be the answer to reduced bleeding.

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Time for Sequence of Operation of Frames
(Yield/cycle is 36.7 pounds)

Operation	Men A & B time (secs.)	A & B per cent	C & D time (secs.)	C & D Per cent
1. Move frame	14.2	10.9	18.2	14.0
2. Set canvas	10.1	7.8	The rest of C's time was spent cranking conveyor, separating trash and moving boxes. D's time was spent picking up fruit on ground.	
3. Get pole hook	6.0	4.6		
4. Shake	49.0*	37.7		
5. Advance pole	10.0	7.7		
6. Unload bridger**	32.0	24.6		
7. Delay	8.7	6.7		
Total cycle	130.0	100.0		

* This analysis was made of a clean-up operation of fourth picking of Imperial Prunes. Thus it may not be indicative of the time required for shaking.

** This operation included unloading bridger into trough, placing bridger on frame, picking off large obstructions in the conveyor, and possible delay in waiting for C to finish his work.

Results on Imperial Prunes

Run	Sugar content, fresh fruit Per cent 1952 Frames*	1952 Windfall	1953 Frames*	1953 Windfall	1954 Frames*	1954 Windfall
1	27.1	27.0	22.5	25.0	21.5	21.0
2	...	...	...	...	22.0	24.9
3	...	...	26.0	24.2	21.2	21.0
4	...	...	27.2	26.6	21.2	19.1
5	...	...	25.4	26.8		
	Skin breakage, in harvesting, as observed before dehydrating Per cent					
1	3.4	62.8	14.2	47.0	18.5	19.0
2	11.0	70.6	17.3	71.5	22.6	40.5
3	11.3	63.8	23.6	75.2	18.4	27.6
4	...	...	31.2	71.2	20.0	26.0
5	...	...	42.0	66.3	...	...
	Bleeding†, from direct dehydration Per cent					
1	32.6	75.5	19.2	66.7	19.6	20.0
2	19.2	82.2	13.1	51.7	14.7	13.4
3	66.1	97.8	9.3	47.0	17.8	30.8
4	...	...	19.1	52.0	52.8	80.8
5	...	...	23.1	76.3	...	...

* It is estimated that one half of skin damage occurred as a result of harvesting.

† All bleeding was recorded, regardless of its severity.