Improving Prune Harvesting

efficiency and cost compared for various hand and mechanical tree shaking and picking methods

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This is the first of two articles reporting the results of a work simplification study and methods analysis undertaken for California prune growers and dehydrater operators.

Mechanization of prune harvesting could reduce costs—in some cases—by more than 60%.

Mechanized harvesting makes available to the industry the advantages of increased yield, lower labor requirements, and a more uniform condition of the fruit at the dehydrater.

Improvements Recommended

Where much shaking is required pneumatic shakers appear to be the most satisfactory application of available equipment. If workers are properly trained, pneumatic shakers will not damage the bark of the tree and small branches as much as the pole-beating method currently used. Two pneumatic shakers should be used at the same time, preferably shaking different trees. They can be operated by a motor-driven compressor transported on a small handcart. When used for pruning, the compressor can be attached to a tree pruning rig. This would free the tractor, usually used for this purpose, for other orchard operations or for fork lift handling of prune containers at the dehydrater.

Harvesting prunes from the ground by hand should be reduced to a minimum although it may be some time before this can be accomplished. Productivity can be increased however, by putting the following recommendations into practice.

Orchard land should be prepared before harvesting begins so it is as flat and as free from clods, rubble, and growth as possible.

Proper instruction should be given the pickers on how to grasp as many prunes as possible with both hands simultaneously, and deposit them without looking up. Experienced and new pickers will be inefficient unless properly instructed.

Where feasible, a man should be assigned specifically to haul lugs.

As mechanical harvesting methods can not be applied to all orchards, raking and scooping equipment was designed to increase production in manual harvesting. The equipment was experimental and further improvements are in progress. The scoop tested was used to fill a lug box with prunes previously raked into a windrow.

The rake and scoop were tested on pulverized loam soil, cloddy ground and on smooth late irrigated land. They were used with exceptionally good results on the very hard surface of late irrigated land, but the cost of sprinkler irrigating would probably prohibit this method.

The equipment proved to be very satisfactory on pulverized loam soil. However, the rake was unsatisfactory on cloddy ground. A new rake is being designed to pass over low lying clods while raking up small prunes. During the last pick or clean-up, foliage on the ground must be removed for effective use of the rake and scoop.

With the rake and scoop method of hand harvesting or with hand picking, low bed trailers are recommended for increased productivity.

A nut pickup machine adapted for harvesting French prunes was successfully tested at Windsor in 1951. Prior to harvesting, the loam soil had been floated to remove waviness and rolled to pulverize the clods. After shaking and some between-tree and center-of-aisle raking, pick-up began. All but a small portion of the fruit, which remained in the troughs, was successfully picked off the ground and mechanically deposited into bins drawn behind the harvester on a trailer. Additional floating would have permitted the pick-up of all the fruit on the ground. Fruit damage was small and the fruit was delivered to the bins relatively free of trash or clods. The rate of pick-up was three lugs per minute or

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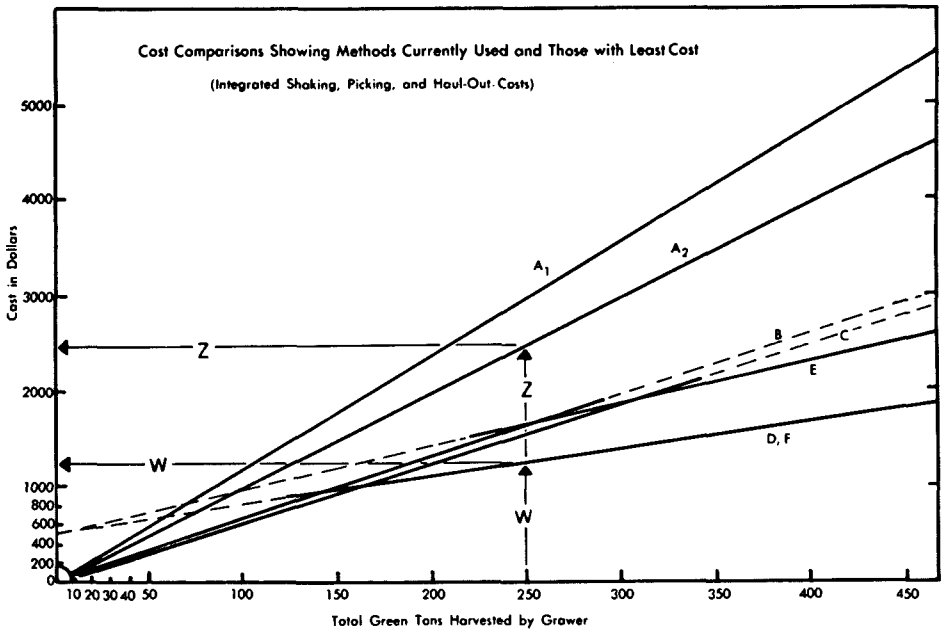
***Left*, an adapted nut harvester picking French prunes on pulverized loam soil on a ranch at Windsor. *Right*, loading lugs picked up by harvester. Productivity—3 lugs per minute.**



A_1 hand picking 30¢ per lug, including pole shaking, plus truck haul out;

A_2 hand picking 25¢ per lug, including pole shaking, plus truck haul out;

B raking and scooping on pulverized loam soil plus pneumatic shaking plus truck haul out;

C contracted mechanical pickup plus pneumatic shaking;

D owned mechanical pickup plus pneumatic shaking;

E mechanized catcher frame, including spraying trees with hormones;

F mechanized catcher frame.

E, F, includes pneumatic shaking;

C, D, E, F, includes trailer haul out.

Least cost methods consider harvest cost only. Different varieties of fruit, soil, and maturing conditions may necessitate other than least cost methods in order to maintain quality of fruit, reduce clod pickup, and utilize nature's fruit dropping operation.

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the equivalent of approximately 40 hand pickers. The harvester has not been tested on Imperial prunes.

Pulverizing the land is a necessity when using a mechanical pickup and will reduce fruit damage due to falling fruit. Pomologists indicate the pulverizing may be detrimental to the soil. Methods of soil conditioning that will overcome this deficiency should be studied.

There are two possible methods for harvesting fruit which remains on the tree until it is shaken off. A mechanized catcher frame to be tested this season may provide the answer as to the relative efficiency of pickup versus catching methods, particularly in the case of such soft and easily damaged fruit as Imperials.

Where catcher frames are being used, fruit handling, lug filling and orchard loading should be mechanized as an integral part of the frames. Catcher frames should have no slats which may cause fruit damage and should be mechanically transported. They should be constructed of canvas suspended on springs attached to a lightweight metal frame.

Prunes stay in a firmer condition and lose less solids through sun dehydration if they remain on the tree instead of lying on the ground. For this reason, growers interested in high quality fruit and sanitation could use catcher frames so the fruit does not touch the ground. Areas, where the prunes drop to the ground on reaching maturity, could also use catcher frames if fruit drop can be controlled.

The use of rapid harvesting equipment such as a mechanical pickup or catcher frame will make bulk handling of prunes in the field and in the dehydrater a necessity. Different methods of bulk handling are to be tested this year.

Cost Comparisons

The cost comparisons presented in the two graphs on pages 13 and 14 are based on specific tree yields and soil conditions. To make them generally applicable, trends and not exact calculated costs should be taken from the curves.

The comparison of shaking costs where shaking is needed, shows that for crops over 40 tons, two pneumatic shakers are the most efficient. The cost of the two shakers, and of the motor-driven compressor, was depreciated over five years. Also it was assumed that—with attachments—the shakers could be used for tree pruning.

For crops of less than 40 tons, and for large crops that require relatively little shaking, hand pole shaking is still the most economical. Arrow X in the graph on page 14 shows the approximate cost of shaking a crop of 250 tons using two pneumatic shakers, while arrow Y shows the approximate cost using hand pole shaking.

Total harvest cost comparison, showing curves for different methods of harvesting are compared in the graph on page 13. Each curve includes the cost of shaking, picking—or catching—orchard loading and haul out.

For crops over 170 tons, mechanized harvesting by a mechanical pickup or by a mechanized catcher frame—is recommended. Although the pickup is much faster than the catcher frame, such factors as increased land preparation costs should make the total cost per ton approximately the same. Pickup cost is calculated from observed data while catcher frame cost has been estimated.

All equipment except tractors has been depreciated over five years. Six dollars per acre has been allowed for the additional land preparation required when using mechanical picking. Arrow W

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***Left,* experimental prune scoop developed for use in harvesting studies. *Right,* scoop, used on pulverized loam soil. Productivity was over 14 lugs per man-hour.**

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shows the approximate cost of mechanically harvesting 250 tons of green prunes, and arrow Z shows the approximate harvesting cost when prunes are picked at 25¢ per 50-pound lug.

For crops under 140 tons two curves, B and C, should be considered. Curve C shows the cost of contracting mechanized harvesting equipment at $15 per hour. This method of harvesting is becoming more widely used. Curve B showing the cost of using the rake and scoop, includes a charge for additional preparation of the land.

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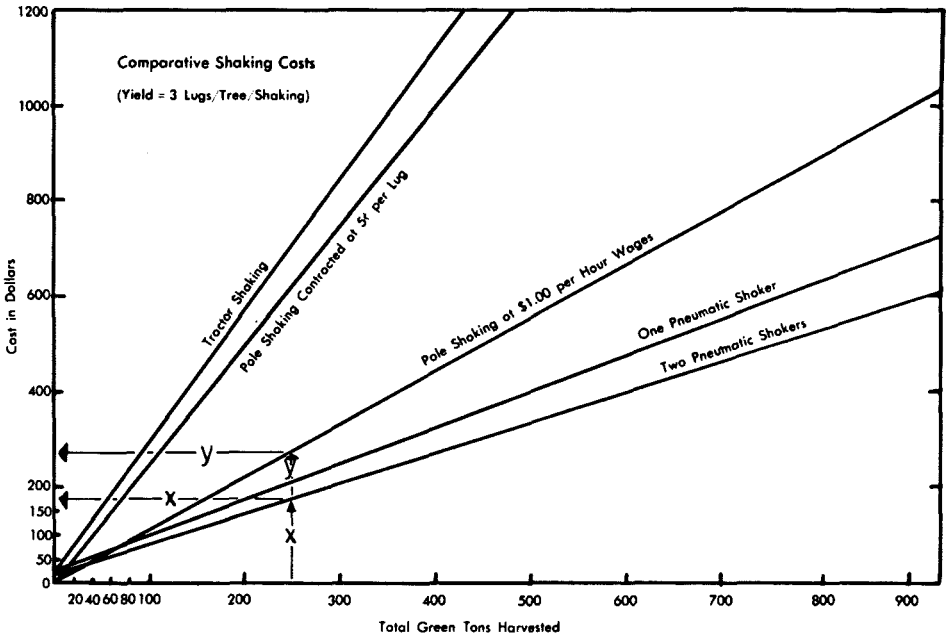

Labor Productivity and Tonnage Capacity Comparison Using Different Shaking Equipment

Shaking Methods	Labor Productivity	Tonnage Capacity Per Unit of Equipment		
	%	Unit of Equipment	Tons	%
Pole Shaking	100	One Pole Shaker	268	100
One Pneumatic Shaker	224	One Pneumatic Shaker	600	224
Two Pneumatic Shakers	224	Two Pneumatic Shakers	1200	448
Tractor Shaker (10 hrs./day)	70	One Tractor Shaker	375	140
Tractor Shaker (20 hrs./day) (with headlights)	70	One Tractor Shaker	750	280

Labor Productivity and Tonnage Capacity Comparison Using Different Integrated Harvesting Methods

Harvesting Method	% Labor Productivity*		Tonnage Capacity	
	(P)	(N)	Equipment/unit/season Tons	%
Hand Picking	100	105	31.2	100
Raking and Scooping— Late Sprinkle Irrigation	365	435	187	600
Raking and Scooping— Pulverized Loom Soil	242	270	83	266
Simple Catcher Frame	197	—	197	630
Improved Catcher Frame.	—	734	506	1620
Mechanical Pickup	—	900	955	3060

* P and N are % labor productivity for pole shaking and pneumatic shaking respectively.

LIMA

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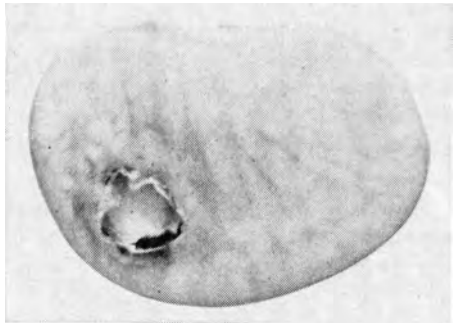
The first treatment—September 7—was made under favorable conditions but the lygus kill was not all that could be desired. The kill resulted in a 73% reduction under the check. This failure to obtain a better kill undoubtedly explains in part why some lygus and worm-injured beans appeared in the treatment.

Lygus counts in the untreated plot rose to a high of 7.4 per sweep on September 19—the heaviest population of lygus bugs encountered in baby limas. At the same time the count in the treated portion of the field had risen to an average of 2.4 lygus per sweep—a 68% reduction under the untreated check. The field was retreated the following morning with a better kill resulting than that obtained by the first application.

On September 26, the treated fields showed an 89% reduction under the check and there was a marked difference in the appearance between the treated and untreated portion of the field. In the check there was no bloom, few if any young pods, and the older pods showed much evidence of insect damage. In the treated portion of the field there was a scattering of bloom, small pods were present in good numbers and no evidence of lygus damage could be found. There was also a noticeable difference in worm damaged pods between the treated and untreated plots.



Necrotic lesion on green baby lima bean caused by the feeding of lygus bugs. Patterson 1951.

At harvest time the total damage of the pods—buckskin, severe and superficial worm damage—was 3.2% in the treated areas, compared with 15.8% in the check plot. The total damage of the beans—necrotic and worm-damaged beans—was 0.5% in the treated field, and 12% in the check plot.

These data do not show the loss due to blossom and pod drop as a result of lygus feeding. An indication of this is given, however, since the green pods from 50 plants from the treated plot weighed 3½ pounds more than did the pods from the untreated plot. In addition, there were 642 more pods from the treated than from the untreated sample of 50 plants.

These data further show that 12% of the beans from the check plot showed some type of insect injury while less than one per cent were similarly injured in the treated plot.

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