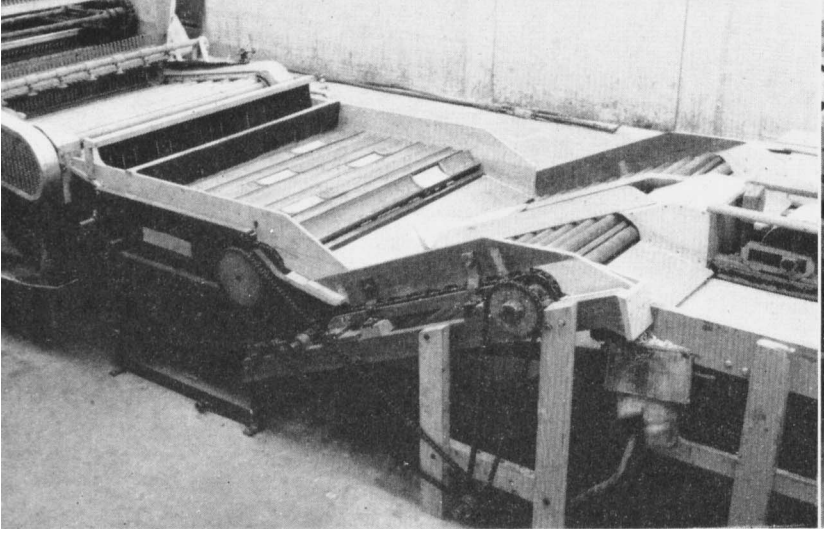
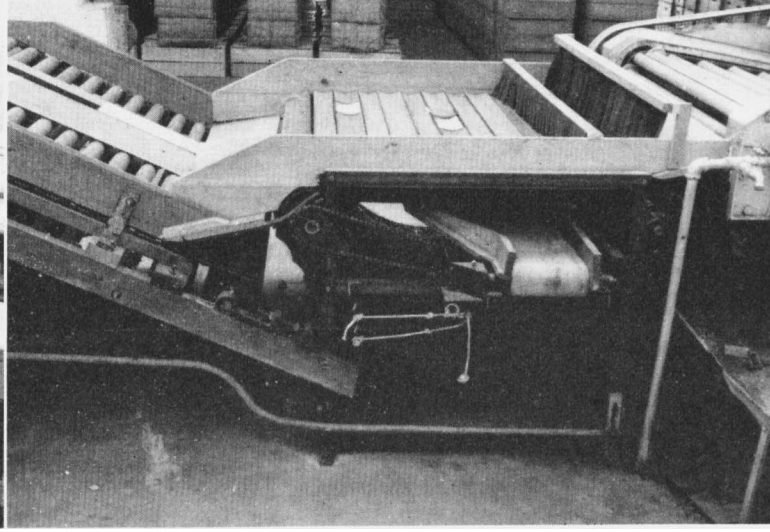


Sampling machine installation in washer line.' White rectangles in slatted conveyor are drops.



Side view showing arrangement of conveyors. Note belt conveyor which delivers the dropped fruit.

Mechanized Sampling

accurate description of growers' products by marketing and processing organizations possible

A. M. Thym and Roy J. Smith

Accurate description of each lot of fruit and vegetables sent to marketing and processing organizations is necessary if each grower is to be paid what his product is worth.

The price received by a grower should reflect the relative market value of the grade he delivers.

Efficiency demands large-scale handling methods which mean working with lots larger than are delivered by most growers. Best market returns demand selling without close reference to individual lots. Consequently the maintenance of the identity of each grower's lot, if not impossible, at least is difficult and expensive.

One method sometimes used for describing grower's lots is by sample. A small portion is separated from the main lot and carefully graded. The main lot thus can be handled with the sole purpose of maximizing returns to the whole organization.

Obviously a sample must be representative of the main lot. Recent studies in the lemon industry have found that it has not been easy to attain representativeness. The methods used have either depended on personal judgment or were cumbersome and expensive.

Sampling Objectives

To be impersonal, economical and yet accurate, it appears that a sample must be taken by a machine. People are too liable to err in such work, no matter how careful they may try to be.

A machine, while apparently a necessity, must be properly designed.

Some of the factors which require attention are as follows:

1. The sample segment must be as small as possible. This sample segment is the the amount taken from a grower's lot each time. The sum of the sample segments makes up the total sample for a grower's lot. These sample segments should be as small as possible and they should be spread as widely as possible throughout the grower's lot so that each portion can be properly represented.

2. The sample segment, as it is taken, should not be influenced by the character of the individual fruit. Size, shape, color or other characteristics of fruits or vegetables should not affect its being chosen.

3. For efficiency reasons, the total sample should be as small as possible. At the same time it should be large enough to insure adequate accuracy. As it happens, this latter requirement may be satisfied on large lots by a small percentage of fruit, perhaps 1/10 of 1%. On small lots, however, a much larger percentage may be required, perhaps as much as 5%. This last percentage, or any percentage approaching it, might be inefficient on large lots. Consequently, these two requirements of efficiency and of accuracy often require that different sample percentages be taken for different grower's lots, depending on their size. This difference in percentage of sample taken for different growers does not mean that growers would be treated differently. Rather, it does mean that comparable accuracy would be attained for all regardless of size of lot.

Mechanization

To separate out a sample in this fashion requires a methodical impersonal method, in short, a machine. A number of machines are now in the lemon industry but most fall somewhat short in one respect or another of satisfying the principles outlined above. Recently a machine has been built and demonstrated which seems to attain the goal desired.

Basically the machine consists of a slat conveyor over which all the fruit passes. Drops are inserted into the slats at certain positions through which the sample drops onto a roll board and belt. The belt carries the fruit to one side for color segregation and whatever else the management wishes to do with it.

The machine achieves the objectives outlined by the two new devices.

First, the drop allows only part of one row of fruit to be dropped at a time. One row can be dropped because each slat is concave in shape and hence carries only one row of fruit instead of helping to carry two rows as does the conventional slat conveyor. Thus, the sample segment is kept as small as possible. The hole that

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SAMPLING

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is formed by the drop must be large enough to allow the fruit always to fall through and not bridge over—but no larger. Thus, the size or shape of a fruit has no influence on its being taken in the sample.

Second, the drops—apparently scattered over the conveyor—are in lines. By means of controls under the conveyor any one line or any combination of lines can be opened. Thus anywhere from one to 15 drops can be operated. In percentage terms, anywhere from 0.5% of the lot to 8% can be obtained in steps of approximately ½%. Any combination of percentages that might be wanted by an organization can be built into the machines. A remarkably high and uniform degree of accuracy can thus be obtained in the sample.

Research Method

The development of the machine represents an example of coöperation in research. The Division of Agricultural Economics, in coöperation with Ventura County packing houses, worked out the requirements for such a machine. The initial design, construction, and tests were carried out by the Division of Agricultural Engineering in its shops at Davis.

Recently a Ventura County citrus growers committee contracted with a commercial machinery company to construct a pilot model under the supervision of the Division of Agricultural Engineering.

It is believed that an important step has been made in sampling and immediate installation is being planned by a number of lemon packing houses.

The investigation thus far has been limited to lemons but the ideas suggested appear to be equally applicable to many other products such as oranges, apples and tomatoes. In consequence it is hoped that marketing and processing companies will be able to offer their growers a more exact equity than in the past and yet achieve large-scale efficiency in their operations.

A. M. Thym is Associate in Agricultural Engineering, Davis.

Roy J. Smith is Associate Professor of Agricultural Economics and Assistant Agricultural Economist in the Experiment Station and on the Giannini Foundation, Berkeley.

SEEDLINGS

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method saves the labor of transplanting from a seed flat, eliminates the hazard of spreading virus diseases by handling during transplanting, and the seedlings do not sustain the usual 10- to 14-day setback from root injury.

Growing and Hardening of Plants

Because of freedom from disease, the seedlings may be grown safely in greenhouses at high humidity and temperatures of 80° F, and with high levels of soil moisture and fertility. Probably constant-level watering or subirrigation could be used with still greater reduction of labor. About 50 days are required from seeding to hardening off, compared to about 80 days for the usual method.

The flats are moved outdoors for two to three weeks to harden the plants, during which time most of the leaves are shed and the stems become tough and wiry.

The plants are pulled from the flats by hand and, after the soil is shaken from the roots, placed in celery crates for delivery to the field. Experience indicates that such plants are suitable for machine planting, that they start rapidly, and that the root systems are at least as good as those of seedlings pricked out of seed flats.

Healthy Plants Produced

The total effect is to produce healthier plants more dependably and quickly, with less labor and expense. Because the plants are free of virus diseases and such organisms as root-knot nematode and the Rhizoctonia, Pythium, Phytophthora, or Sclerotinia fungi which cause root, stem, and fruit decay, and of Verticillium which causes wilt, the hazard of introducing them to uninfested fields is eliminated. Because of the savings effected by these improved methods, it is probable that the plants can now dependably be grown in greenhouses as cheaply as they can with uncertainty in outdoor seedbeds.

It cannot be too strongly emphasized that the success of this method depends on using soil and seed freed of pathogens, and on rigorous sanitation, and that without these conditions losses actually may be increased.

Kenneth F. Baker is Professor of Plant Pathology and Plant Pathologist in the Experiment Station, Los Angeles.

ORCHARDS

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ing as many of the old scaffold branches as possible to reëstablish a satisfactory framework branch system. Because of the vigorous growth of its new shoots a skeletonized lemon tree soon becomes top-heavy.

The deheaded lemon trees studied were the most desirable from a commercial standpoint because of their structure and because they produced almost as much fruit as the skeletonized trees. More extensive studies of the response of lemon trees to severe pruning are now in progress.

Recommendations Premature

This report is not intended to advocate severe pruning of crowded trees, since it is unlikely that trees which are unproductive because of other limiting conditions would respond in the same manner as would trees which are limited merely by crowding.

While field experiments now underway with crowded old trees already have given promising results, much more work will be necessary before definite recommendations can be made regarding a rehabilitation program.

Pruning experiments are also in progress to determine whether trees can be prevented from getting too large and at the same time continue to produce profitable crops of high-quality fruit.

S. H. Cameron is Professor of Subtropical Horticulture and Plant Physiologist in the Experiment Station, Riverside.

R. W. Hodgson is Assistant Dean of the College of Agriculture, Los Angeles, Professor of Subtropical Horticulture and Subtropical Horticulturist in the Experiment Station, Los Angeles.

Right. **Skeletonized lemon, photographed two years after pruning. Note the undesirable two-stage effect.** ***Left.*** **A deheaded lemon tree two years after pruning.**