Strawberry Processing Costs

cost-reducing adjustments in processing methods, plant size, and hours of operation may yield substantial savings

Carleton C. Dennis

The following article is the fifth in a series of progress reports on efficiency in the processing and marketing of frozen fruits and vegetables. The studies are being conducted cooperatively with the Agricultural Experiment Stations in Washington, Oregon, and Hawaii and the Agricultural Marketing Service, United States Department of Agriculture.

A recent study of the costs of processing strawberries for freezing showed that different plants employ fairly uniform procedures for much of the processing operation but several techniques are in use in other parts of the process. The plants studied varied in size from a strawberry input capacity of approximately 7,500 pounds to 25,000 pounds per hour. Annual strawberry processing hours varied from about 500 to a maximum of 2,000.

The study concentrated primarily on calculation of costs with each available technique for the various operations and determination of the least-cost combination of techniques for plants of various sizes and lengths of operating season. The least-cost method of performing a given operation may differ for plants of differing capacity or annual hours of operation, a fact that must be considered when determining the most efficient method for a given plant.

With labor, equipment, and other costs computed at the 1958 price level, it was found that adoption of a mechanical crate dumping mechanism in place of hand dumping methods would result in savings in plants of over 10,000-pounds-per-hour input capacity operating over 500 hours per year. If the plant had a capacity of 15,000 pounds per hour and operated 1,000 hours per year, adoption of a mechanical crate dumping mechanism would reduce total annual dumping costs—annual equipment fixed charges, plus labor and other variable costs—by $2,700. Greater plant capacity or a longer season would increase the saving.

Methods Studied

Even greater savings are possible in the casing stage where consumer-size cartons are placed in fiberboard cases. For example, when casing 10-ounce cartons, 24 per case, three methods are available. Method *A* uses a stapled case, manually places the cartons into the case, and manually seals the case. Method *B* uses top and bottom glued case, manually places the cartons into the case, and mechanically seals the case. Method *C* uses a top and bottom glued case, mechanically places the cartons into the case, and mechanically seals the case. If a plant has a capacity of 1,000 cases per hour and operates 1,000 hours per year, the total annual cost of this operation for Method *A* would be an estimated $33,504; for Method *B*, $30,146; and, Method *C*, $21,586. Thus, in a plant using Method *A*, total annual costs exceed those of Method *B* by $3,358 and Method *C* by $11,918. Other important savings could be obtained in many plants through changes in the sugar system and container filling phases of plant operation.

Total season costs for each plant operating stage at selected rates of output and hours of operation per season were calculated for each of the available techniques. The low-cost method in relation to hourly output rate and hours operated per season was determined from the calculated costs. The sum of stage costs with techniques selected in this way gives—for efficiently organized plants—an estimate of total season costs with different capacity output rates and hours of operation per season. Total season cost estimates for efficiently organized plants are shown in the graph at the left for several of the more common types of frozen strawberry products in relation to rate of output for a 1,000-hour operating season. The calculations on which the graphs are based assume that the plant packs only one product and do not include the costs of packing materials, sugar, freezing, or selling. These relationships, expressed on a unit cost basis, are shown in the graph at the right. With a given rate of plant output and length of oper-

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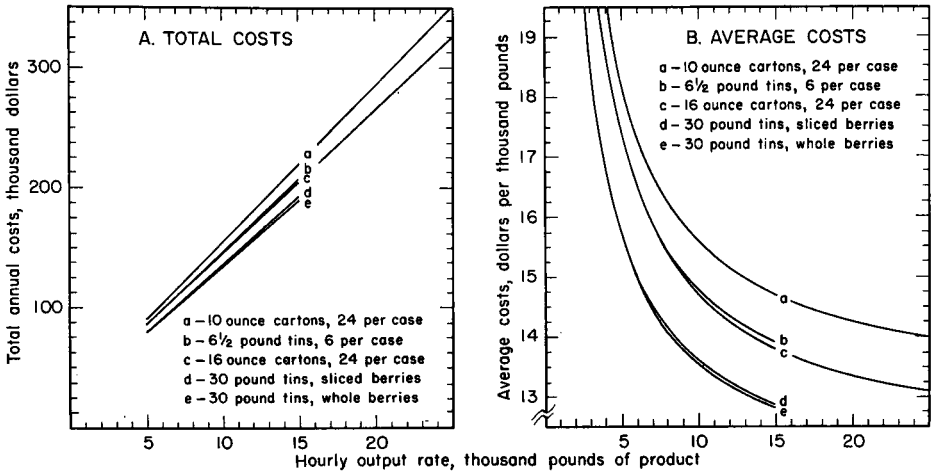
Total and average costs of packing various products in single-product plants processing strawberries for freezing—costs based on output poundage, a 1,000-hour operating season, 10% of the berry input removed from the inspection belt, and a 4:1 berry-sugar ratio, California, 1958. The cost calculations do not include the cost of packaging materials, sugar, or freezing.



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when the wet plots *B*, *D*, and *F*, and the intermediate plots *C* and *E* were pooled and the treatment value was calculated, the difference was highly significant.

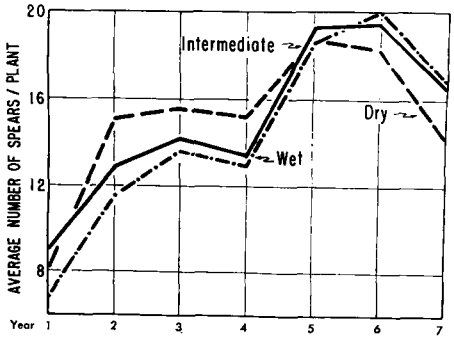
The mean number of spears per crown over the 7-year period—as given in the graph—indicated no significant difference occurred for the irrigation treatment. However, in the first four years, more spears were produced on the dry plots than on the irrigated treatments. Likewise, more spears were produced on the intermediate than on the wet treatment. In the fifth and sixth years the reverse became apparent. In contrast, the size of spear was definitely related to irrigation.

In this experiment, only the spears above 3/16" in diameter were measured. Due to the gradual decline in spear size with the advance in age of the plants, a larger proportion of spears were below the minimum size from the dry plots.

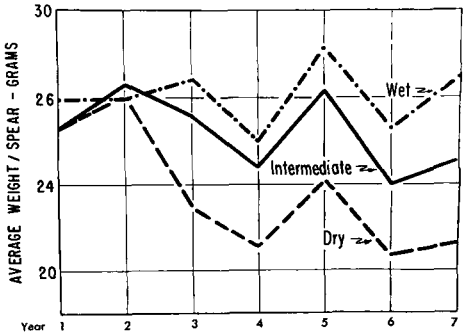
Just why more spears are produced on the dryer plots is not known.

On the basis of the results obtained in this long-term experiment it appears that asparagus can utilize about 20" of irrigation during the growing season in addition to the normal 16" rainfall.

Effect of irrigation treatments on average number of spears per plant.



Effect of irrigation treatments on the average weight per spear.



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The above progress report is based on Research Project No. 1175-E.

DEFOLIATION

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have been applied earlier for practical results. The trees in the block receiving the double application of dust did not drop their leaves more quickly or thoroughly than those receiving only a single one.

The dust was also applied relatively late—November 6—in the Sacramento County orchard. Most of the leaves were down in 15 days following dusting, and this allowed the pruning operation to start nine days earlier than in the control plots. A killing frost occurred the morning of November 25 which speeded up leaf drop in the control plots. Leaf fall sufficient to allow pruning often occurs as late as mid-December in that particular orchard.

There was no stimulation of fall bloom in any of the four orchards where the dust was applied, indicating that the dust could have been applied at least a few days earlier without harmful effects.

The dust applications had no effect on the blooming dates in 1958. However, there was some variation in the fruit set and crop in the different plots. The differences seemed to be associated with the presence of pollinizing varieties rather than to dusting treatment.

The defoliating dust should be applied only to that portion of an orchard to be pruned before the time of normal leaf fall. Application of 40–50 pounds of the dust to the acre should be made when the leaves are wet with dew, rain, or water spray. Most of the leaves should be down in approximately two weeks.

In the major pear districts of California it is probably safe to apply the dust between October 15 and October 25. To minimize any possible harmful effects of early defoliation, the dust treatments should be rotated to different blocks each year. Part of the cost of the dust—a lime nitrogen fertilizer—can be subtracted because of its fertilizing value.

W. H. Griggs is Associate Professor of Pomology, University of California, Davis.

E. J. Layman, Di Giorgio Fruit Corporation, and R. V. Newcomb, Orchard Consultant, assisted in conducting the defoliation tests.

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PROCESSING

Continued from page 2

ating season, packing in larger containers tends to result in lower processing cost per pound.

The effect of plant size on costs is illustrated in the graph at the right. A 5,000-pound-per-hour capacity plant packing 10-ounce cartons, for example, would have average costs of $18.29 per 1,000 pounds of product while a 10,000-pound plant would have average costs of only $15.59 per 1,000 pounds, a difference of $2.70 per 1,000 pounds of product. Successive 5,000-pound increments in plant capacity decrease average costs by $0.90, $0.44, and $0.27 per 1,000 pounds with average processing cost becoming $13.98 at an hourly capacity of 25,000 pounds. Most of the economies of scale are realized by plants of 10,000-pounds-per-hour capacity and very little additional economies are obtained by plants of capacity of over 15,000 pounds per hour. The decrease of average cost as plant size increases is due to a combination of the ability of a large plant to make more efficient use of its building, equipment, supervisory personnel, and so forth, and the use of various cost-reducing techniques which are economical only in large plants.

Increasing the number of hours a plant of given capacity rate operates per year, serves to spread many fixed and partially fixed costs over a greater quantity of product, thereby reducing the average processing cost. Cost calculations made for various lengths of operating season indicate that substantial savings can be obtained through increasing operating hours. This effect is most obvious in the shortest seasons and becomes smaller as hours operated become greater.

Berry quality—as measured by the quantity of berries that must be removed from the inspection belt by quality-sort labor—affects total and unit processing costs in two ways. Poor berry quality, for example, increases the costs of sorting a given quantity of raw product. Furthermore, to obtain a given quantity of output a larger quantity of raw product must be handled.

In a plant of 10,000-pounds-per-hour input capacity operating 1,000 hours per season, for example, a sortout of 5% of the berry input volume would cost about $10,500 less per season than with a sortout of 20%. If figured on the basis of 10,000 pounds of product output per hour, rather than on a berry input basis, total costs per season would be approximately $33,000 less per season with 5% as compared with 20% culls. These calculations assume that the raw product is purchased on a quality-grade basis such

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PROCESSING

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that berry cost in terms of packed output remains constant.

Plant designs corresponding to any of the capacity output rates considered, would permit operation at lower output rates. Much of the labor and other variable inputs could be adjusted downward with such reduction in volume, but other costs—such as equipment and building—are fixed. If a plant operates at less than its designed capacity, fixed costs must be borne by a decreased quantity of product and average cost will be higher.

The costs given in this report are based on an assumption that a plant packs only one strawberry product, that is, one size of container and either sliced or whole berries. However, most plants are multiple-product operations. In such plants, much of the process is identical for all products packed so the same equipment and labor can—for certain operations—be used for more than one product. Product differentiation occurs primarily in the container filling and casing stages with a single, nondifferentiated, product flow in other stages such as the receiving, dumping, and sorting operations. The capacity rate at such stages is greater than for any of the individual products. Economies of large scale operation are realized with respect to such common operations which would not be obtained by any one of the products if packed at the same rate in a single-product plant. Unit costs for given output rates of particular products would be less when the product is one of several produced simultaneously in a plant packing many different forms or types of containers.

Carleton C. Dennis is Cooperative Agent of the University of California Agricultural Experiment Station and the AMS, USDA.

This brief report is based on a detailed report, "An Analysis of Costs of Processing Strawberries for Freezing," which is available without cost from the Giannini Foundation of Agricultural Economics, 207 Giannini Hall, University of California, Berkeley 4.

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