1909

# PROCESSING MECHANICALLY HARVESTED CHERRIES IN 1962

## QUALITY AND COST COMPARISONS

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An Excerpt From
Great Lakes Cherry Producers
Marketing Cooperative, Inc.
Annual Report for 1962

# COMMENTS ON MECHANICAL HARVESTING OF CHERRIES IN 1962

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Machine harvesting of red Cherries is a new concept. Five years ago it was inconceivable that Cherries could ever be shaken from trees in total quantity without prohibitive damage to tree and fruit. Yet today the vision of a new and more efficient way of harvest is a reality.

The story of the rise of mechanical harvesting is a story of concerted action by a handful of growers, equipment manufacturers, processors, and research scientists. Problems transecting the entire Cherry industry were met. The first and key problem concerned the development of shaking equipment. Unless equipment could be designed that would remove all or nearly all Cherries from a tree, there was little use of carrying the experiments further. After it was demonstrated that Cherries could indeed be separated by shaking (3, 11), subsequent problems were tackled in the order of their importance.

As might be expected, early failures were commonplace. Recoveries were low (3), bark damage was excessive, and Cherries were overbruised. Equipment did not operate efficiently, if it operated at all. Proper ways of decelerating, collecting, and handling Cherries were unknown. Meanwhile, growers became aware of the harvesting research and adopted an attitude of "wait and see". Above all, they demanded equipment that would not damage trees and would operate reliably at all times. Yet they never questioned the prediction that tremendous savings in harvesting costs could be effected.

## EXPERIENCES IN 1962

The citation of an example will indicate the degree of advancement of the mechanical harvesting movement in 1962. Herbert Teichman, a grower near Eau Claire, Michigan, machine-harvested his entire crop (110 tons) without the aid of a single hand-picker. He initiated night harvesting and kept his equipment in operation for 18 to 24 hours a day. Trees on hillsides as well as on level ground were harvested. Bark damage was nominal and Cherry bruising was no worse than for hand-picked fruit. The first 90 tons of the unsorted crop received an average grade of 91% of U. S. No. 1 at a processing plant. The last 20 tons were of inferior quality. After completion of his harvest, Teichman made the equipment available to other growers for the harvesting of an additional 90 tons.

The significance of this performance is far-reaching. It proves that a complete and satisfactory job of machine-harvesting can be done with present techniques and equipment. It proves further that quality can be maintained and bruising can be minimized. A grower not only can be freed of his dependence on hand-pickers, but he can slash harvesting costs at the same time. The performance shows also that night harvesting and custom harvesting can be practical.

In citing Teichman's results we must not overlook or fail to give credit to several other growers who practiced mechanical harvesting with equal success. Acknowledgment also is due equipment manufacturers who worked closely with growers and gave assistance in many ways.

Figure 1. Equipment used by Teichman in day and night harvesting of 110 tons of Cherries.

## CHERRY BRUISING

A realistic and over-all appraisal of mechanical harvesting in Michigan in 1962 shows a dark side as well as a bright side. Perfection has not yet and never will be reached. Perhaps the most common and grievous fault was overbruising. For instance, in 3 of the 7 mechanical harvesting systems that we studied, overbruising occurred (see orchards 5, 6, and 7 of Table 1).

If Cherries are being harvested for the juice plant, bruising is of little consequence and harvesting can proceed at a rapid and carefree rate. If, however, processing quality is desired, the question becomes not "How many pounds per hour can be harvested?" but "How great is the bruising?"

Both grower and processor suffer losses when overbruising occurs. Badly bruised Cherries, whether handled in lugs or water, lose 1 to 3% in weight before delivery

to a processing plant (7, 10). The grower accordingly is short-weighted while the processor can complain about poor quality and low processed yield.

A Cherry is most tender and most susceptible to bruise damage at the time of harvest (6, 9). This places a critical requirement on the harvesting equipment and is the basis for our endless campaign against overbruising in the orchard. During the first six to eight hours after harvest, however, the living tissues of the Cherry, regardless of their environment, undergo changes which result in a toughening of the flesh (1, 9). For this reason Cherries can be handled somewhat more roughly in a processing plant than in an orchard.

Sources of harvest bruising have been pointed out previously (4, 5, 8). Pocketing, piling up at tree trunk, unprotected hard surfaces, lack of decelerator strips, faulty conveyors, faulty elevators, excessive speed, excessive handling, high temperatures, improper pruning (2), hand raking, pole thrashing, and careless personnel are common sources of bruising. A careless crew can obtain poor results with excellent equipment, just as capable workers can often do an acceptable job with inferior equipment.

Table 1. Range in bruise damage of mechanically harvested Cherries

| Orchard No. | Harvest Method | Bruised Cherries - % |
|---|---|---|
| 1 | machine | 4.4 |
| 2 | machine | 4.6 |
| 3 | machine | 4.6 |
| - | hand (ave.) | 4.8 |
| 4 | machine | 4.9 |
| 5 | machine | 9.2 |
| 6 | machine | 9.8 |
| 7 | machine | 11.6 |

## PROCESSING STUDIES

During 1961 and early 1962 it became apparent that information was needed on the commercial processing of pure machine-picked Cherries. Previously, such Cherries either had been blended with hand-picked lots for processing, or had been diverted directly to the juice plant. Questions concerning the removal of stems, removal of debris, sorting, processed yield and processed quality of mechanically harvested Cherries were unanswered.

In 1962, therefore, we enlisted the cooperation of several growers and processors who were willing to participate in the study. Detailed data were taken during all

harvesting, handling, and processing steps, and the behavior of Cherries was followed from the tree to the table. In all, 55 tons of straight machine-picked Cherries from six different harvesting systems in the three major Cherry producing areas of Michigan were processed in four different plants. An additional 33 tons of hand-picked fruit from the same orchards were processed also. Twenty test runs were made with samples which ranged in weight from two to six tons. Before the tests, which usually were made following a scheduled break in plant production, the processing lines were cleaned thoroughly in order to accurately separate the experimental lots. Cherries of poor quality as well as good quality were accepted in the order of their occurrence. Thus, a true cross-section of machine-picked Cherries in Michigan was obtained.

Cherries were handled and processed under normal conditions. This made possible (1) a direct comparison with hand-picked fruit, and (2) a determination of the nature and magnitude of new problems. The processing data are summarized in Table 2.

The advantages of the hand-picked Cherries over their machine-picked counterparts were as follows: raw product grade, 2.5%; attached stems, 2.4%; defective Cherries (excluding stems), 0.1%; soft, bruised Cherries, 3.5%; rate of sorting, 17.3%; cost of sorting, 23.9%; pick-outs, 1.2%; and pitted yield, 0.6%. Although the hand-picked lots had the lower grade point score, a higher proportion of them produced an A grade pack (70% vs. 57%).

Table 2 shows also the range in values of the quality and yield factors. Considerable overlapping of values occurred. This means in other words, that some machine-picked lots were superior to some hand-picked lots, and vice versa.

Table 2. Processing characteristics of machine-harvested and hand-harvested Cherries

| Factor | MACHINE-HARVESTED | | | HAND-HARVESTED | | |
|---|---|---|---|---|---|---|
| | No. of tests | Average | Range | No. of tests | Average | Range |
| Cherries processed, sample weight | 12 | 4.6 tons | 2.1- 6.3 Tons | 8 | 4.1 tons | 1.7- 6.0 tons |
| Raw product grade, U.S. No. 1 | 38 | 89.3% | 85.0-93.5% | 20 | 91.8% | 88.0-95.5% |
| Cherries with stems attached | 38 | 2.9% | 1.0- 4.5% | 20 | 0.5% | 0.0- 1.5% |
| Defective Cherries (excluding stems) | 38 | 7.8% | 3.5-14.0% | 20 | 7.7% | 4.5-11.5% |
| Soft, bruised Cherries (a) | 20 | 8.3% | 4.0-14.1% | 4 | 4.8% | 2.5- 7.4% |
| Pounds of Cherries per minute per sorter | 12 | 7.9# | 3.4-21.6# | 12 | 9.8# | 6.8-16.9# |
| Slow-down of sorting line | 12 | 17.3% | 0.0-52.0% | - | - | - |
| Cost of sorting one ton of Cherries (b) | 12 | $9.48 | $7.65-22.08 | 8 | $7.65 | $4.41-11.01 |
| Pick-outs | 10 | 4.8% | 2.4- 7.5% | 7 | 3.6% | 1.4- 5.8% |
| Yield of pitted Cherries | 12 | 82.3% | 76.8-86.2% | 8 | 82.9% | 78.4-86.2% |
| Grade score, frozen and canned | 35 | 90.9 | 85.3-97.0 | 18 | 90.6 | 86.0-95.5 |
| Grade, frozen and canned | 35 | 57% A | C-A | 18 | 70% A | C-A |

(a) Not scored as a defect in grade determination.
(b) Based on a cost of $2.25 per hour per sorter (wages plus supervision).

## STEMS, DEFECTS, AND COSTS

The most significant change required for the processing of machine-picked Cherries comprised a slowing-down of the sorting belts. About 17% more time than normal was required to pick out defective fruit. Especially time consuming was the method of handling the 3% of Cherries with attached stems. The sorting women would pick out a Cherry with a stem, remove the stem, and return the Cherry to the belt. Meanwhile, other seriously blemished Cherries would be missed, and the grade score would suffer accordingly. Alternative answers to the stem problem should be sought. The presence of attached stems was the major cause for the increased ($1.83 per ton) sorting costs.

Except for attached stems, defective Cherries (wind-whip, limb-rub, decay, etc.) were equally concentrated in the hand-picked and machine-picked lots. This finding, obtained from 58 determinations by four federal inspectors, was contrary to expectations. Experience has shown that harvesting machines bring down all Cherries on a tree, defective as well as sound. Our tests show that hand-pickers also collected essentially all of the Cherries. Whatever sorting was done was ineffective.

If a high proportion of Cherries on a tree are defective, an increase in processing difficulties will follow, regardless of the method of harvest. Thus, several lots of both hand-picked and machine-picked Cherries received a processed grade of C. Indeed, during the season many loads of hand-picked fruit were relegated to juice plants. The relatively high proportion of defective fruit in 1962 was traceable to frequent wind storms. In seasons of fewer storms, sorting operations would be easier and sorting costs lower.

Willard Burnette, of the Burnette Farms Packing Company at Keeler, Michigan, observed that many of the defective Cherries in machine-picked lots were relatively small, partially dried, and conspicuously blemished. Consequently, each defective Cherry had a relatively small effect on raw product grade, since grade is determined by weight rather than by number of defective fruit. Moreover, such fruit was comparatively easy to detect and remove on the sorting belt.

The average grower was paid 2.5% less for machine-harvested Cherries than for hand-picked fruit (2.4% more attached stems plus 0.1% more blemished fruit). With Cherries worth $100 per ton, the 2.5% was equivalent to $2.50 per ton. On the other hand, sorting and stemming costs were $1.83 per ton more, and pitted yield was 0.6% less, equivalent to a loss of $.60 per ton. Therefore, the additional cost of processing mechanically harvested Cherries was $2.43 per ton, a value which balanced well with the $2.50 per ton decrease paid the grower.

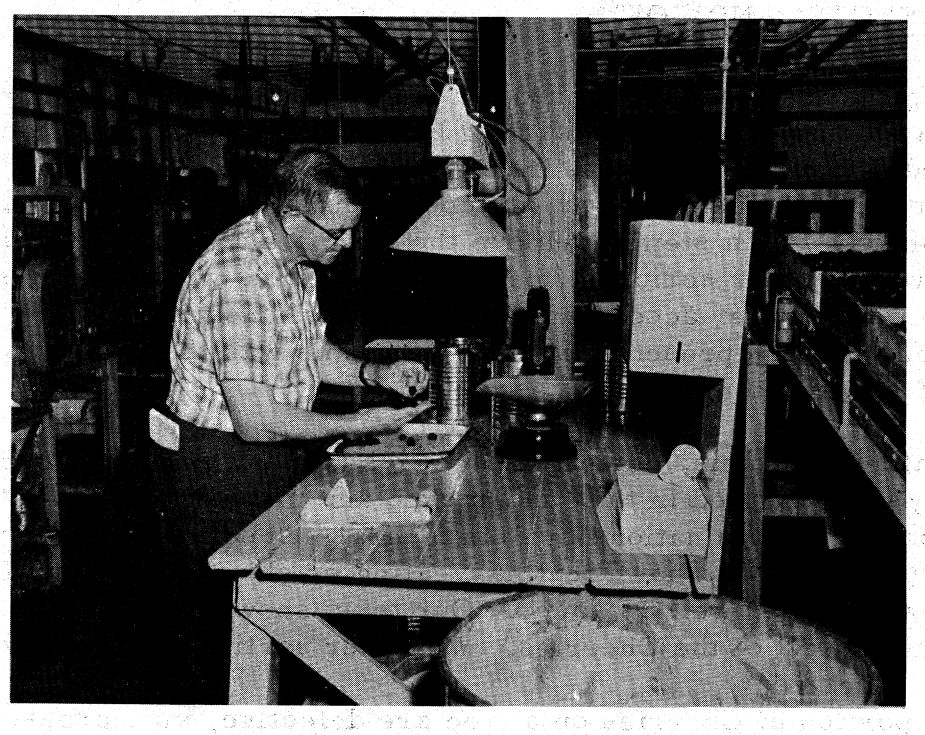

Figure 5. Federal inspector determining the raw product grade of machine-harvested Cherries.

## QUALITY PACK

If we select from the study only those samples which received grade A after processing, a new set of sorting and cost values is obtained (see Table 3.)

Table 3. Quality pack of machine-harvested and hand-harvested Cherries

| Factor | Machine harvested | Hand harvested |
|---|---|---|
| Raw product grade, U.S. No. 1 | 90.4% | 94.2% |
| Cherries with stems attached | 3.3% | 0.5% |
| Defective Cherries (excluding stems) | 6.3% | 5.4% |
| Slow-down of sorting line | 22.0% | - |
| Cost of sorting 1 ton of Cherries | $13.16 | $10.28 |
| Pick-outs | 5.1% | 4.1% |
| Yield of pitted Cherries | 82.5% | 84.9% |
| Processed grade score | 93.2 | 92.0 |

With grade A pack, sorting and stemming costs of machine-picked Cherries were $2.88 per ton more than for hand-picked fruit. Processed yield was 2.4% lower, equivalent to a loss of $2.40 per ton. Therefore, packing costs, as far as sorting, stemming, and yield are concerned, were increased by $5.28 per ton. At the same time, the grower was paid $3.40 per ton less for the machine-harvested fruit. This left a balance of $1.88 per ton in favor of the grower.

Similar findings on quality and processed yield of machine-harvested Cherries were obtained by C. L. Bedford of the Department of Food Science, Michigan State University, East Lansing, Michigan.

The leaves, twigs, and other debris present in mechanically harvested Cherries have been of minor concern to processors. Such debris is less than 1% of sample weight (5) and is easily floated off in water.

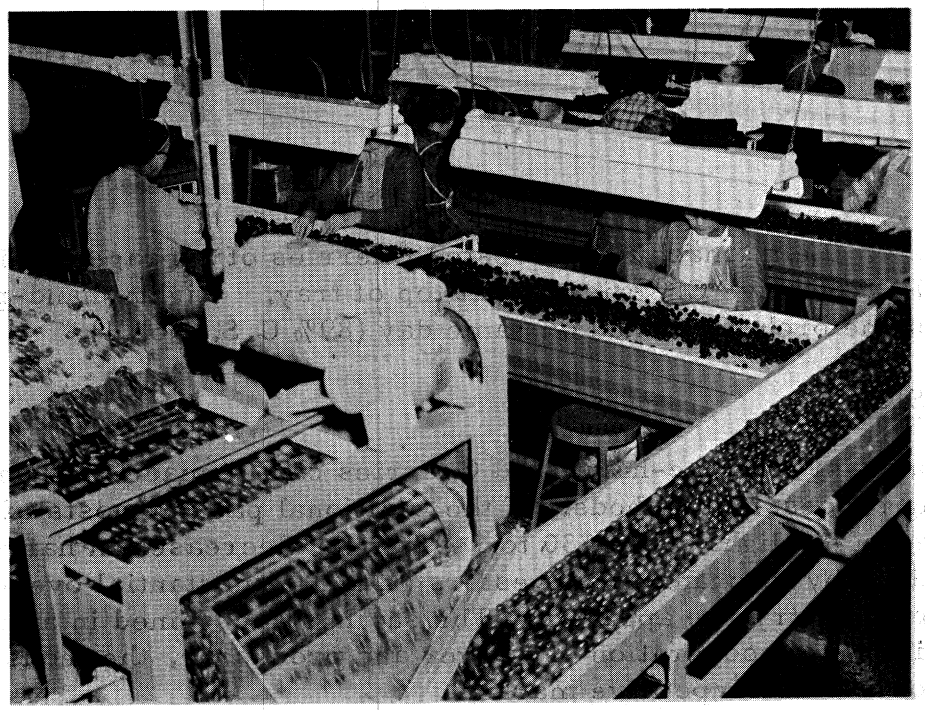

Figure 2. Sizing and sorting of machine-harvested Cherries in a processing plant.

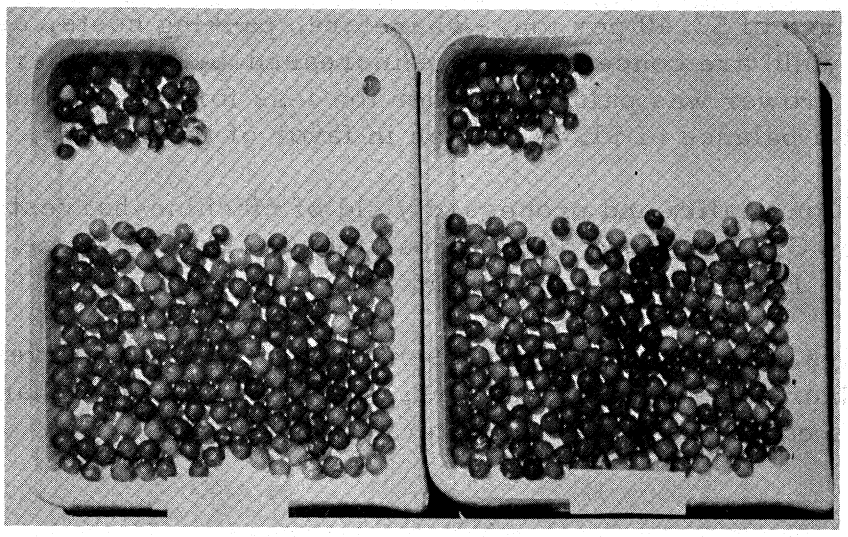

Figure 4. Left: machine-harvested Cherries of average quality (89% U.S. No. 1). Defective Cherries are at top of tray. Right: hand-picked Cherries from same orchard picked on same day (89% U.S. No. 1).

## CONCLUSION

Quality packs of machine-harvested Cherries can be made with only minor changes in existing processing methods. If the additional packing costs of $3 to $6 per ton are viewed in the light of the $30 to $40 per ton decreases in harvesting costs brought about by mechanical harvesters (4, 5, 8), substantial over-all savings to the Cherry industry are apparent. The savings are gained in an area of great need. With close cooperation of grower and processor, the industry can strengthen its position in the competitive market.

Problems associated with the processing of mechanically harvested Cherries are not new. Attached stems, blemished fruit, and overbruising have caused trouble with hand-harvested fruit throughout the years. Mechanical harvesters in most cases merely aggravate these faults.

Improvements can be expected in the packing of all Cherries, regardless of the method of harvest. Leonard Sobkowski, of Cherry Growers, Inc. at Traverse City, Michigan, has recently pointed out the potential significance of new electronic Cherry sorting machines. The machines discard defective Cherries and deliver a constant pre-set quality of fruit to the pitters. Trials with the machines are planned in 1963.

## LITERATURE CITED


1. Buch, Margaret L., Kathryn G. Satori, and Claude H. Hills (1961). Effect of bruising and aging on the texture and pectic constituents of canned red tart Cherries. Food Technol. 15: 526-31.

2. Cain, John C. (1961). Mechanical harvesting of sour Cherries: effects of pruning, fertilizer, and maturity. Proc. 1961 Annual Meeting, N. Y. State Hort. Soc. pp. 198-203.

3. Gaston, Harold P., J. H. Levin, and S. L. Hedden (1959). Experiments in harvesting Cherries mechanically. Mich. State Agr. Expt. Sta. Quart. Bul. 41: 805-11.

4. _____, J. H. Levin, and S. L. Hedden, and R. T. Whittenberger (1961). Experiences in mechanical harvesting of Cherries. Mich. State Hort. Soc. Annual Report 90: 14-25.

5. Guest, R., E. D. Markwardt, R. L. LaBelle, and O. C. French (1960). Mechanical harvesting of red tart Cherries. N. Y. State Agr. Expt. Sta. Progress Report, Feb. 1960, pp. 1-28.

6. LaBelle, Robert L. and J. C. Moyer (1960). Factors affecting the drained weight and firmness of red tart Cherries. Food Technol. 14: 347-52.

7. _____(1961). Improvements in harvesting, handling, and processing the red tart Cherry. Great Lakes Cherry Prod. Mktg. Coop, Inc. 1960 Progress Report, pp. 36-44.

8. Levin, Jordan H., H. P. Gaston, S. L. Hedden, and R. T. Whittenberger (1960). Mechanizing the harvest of red tart Cherries. Mich. State Agr. Expt. Sta. Quart. Bul. 42: 656-85.

9. Whittenberger, Robert T. (1952). Factors which affect the drained weight and other characteristics of heat-processed red Cherries. Food Research 17: 299-306.

10. _____and C. L. Hills (1953). Studies on the processing of red Cherries. I. Changes in fresh Cherries caused by bruising, cooling, and soaking. Food Technol. 7: 29-31.

11. _____and_____(1960). Bruising of red Cherries in relation to the method of harvest. U. S. Dept. Agr., Agr. Research Service Circ. ARS 73-27; 14 pp.