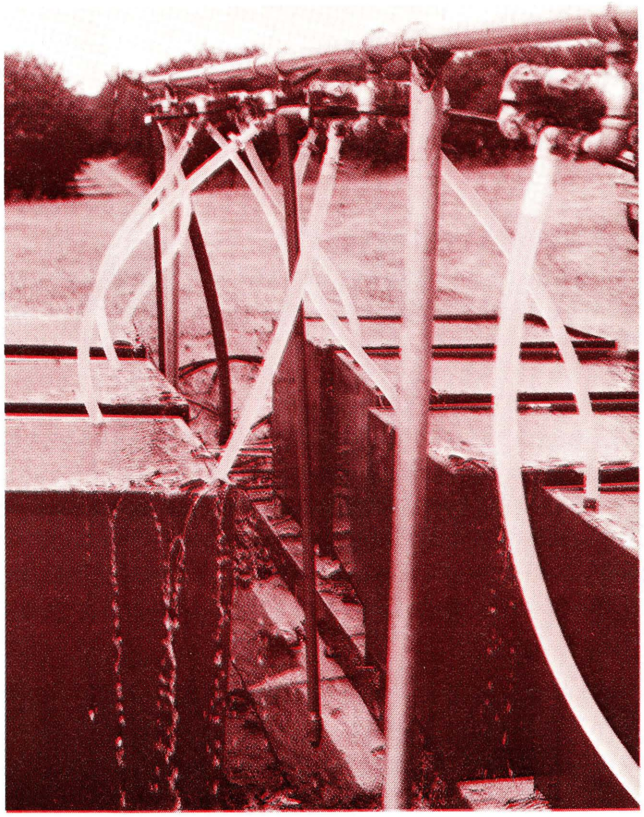
Cooling Stations and Handling Practices for Quality Production of Red Tart Cherries
Michigan State University
Cooperative Extension Service
Farm Science Series
B.F. Cargill, Associate Professor Research and Extension Specialist; George McManus, Jr., Grand Traverse County Agricultural Extension Agent; J. Stevens Bolen, Extension Specialist, Agricultural Engineering Department and Rural Manpower Center; and R. T. Whittenberger , Research Biochemist, Eastern Utilization Development Division, U.S.D.A.
May 1970
8 pages

Discontinued

Extension Bulletin 659 • Farm Science Series • Replaces EB 615

Cherry Harvest Mechanization (1)



Cooling Stations

and handling practices for quality production of red tart cherries

By B. F. Cargill, George McManus, Jr., J. Stevens Bolen and R. T. Whittenberger*

Michigan has far-outdistanced all other states in the production of red tart cherries. Fifty to eighty-five percent of the nation's production has come from Michigan for the past five years (1964-1968). During this period, the value of production to Michigan's growers has ranged from 12 to 30 million dollars per year.

This bulletin is one of a series of publications designed to assemble available information on mechanical harvesting and handling of cherries into a compact and useable form for both growers and processors.

More than 600 Michigan cherry growers will use harvesting machines on the 1969 crop. If the harvest is of normal size, these machines will probably harvest more than 80 percent of the state's red tart cherries (Only 3 percent were harvested mechanically in 1964.) Quality of the finished canned or frozen product will largely depend on how quickly the cherries are cooled and how they are handled during the "holding period"—the time between harvest and processing.

The most practical method to properly handle machine-harvested cherries during the critical holding period is to use cold water-filled standard measurement tanks having a capacity of about 25 cubic feet (1188 lbs.) of fruit. Cooling the cherries quickly and holding them in water at temperatures of 60° F or below helps prevent scald, facilitates pitting, and increases finished product yield. Quick cooling also reduces loss of weight which would otherwise penalize the grower. The economic advantages of proper handling are so great that processors should insist that the best methods be used.

The conditions under which tank-handled cherries should be held can best be maintained at orchard cooling stations—places at which cherries are quickly cooled and held in running water for periods up to eight hours. Such facilities usually consist of a concrete slab, an abundant supply of water and a means of disposing of the overflow water.

This publication provides basic information which will help growers plan, construct, and operate orchard

*Associate Professor Research and Extension Specialist; Grand Traverse County Agr. Extension Agent; Extension Specialist, Agr. Engineering Department and Rural Manpower Center; Research Biochemist, Eastern Utilization Development Division, U.S.D.A.

cooling stations to maintain product yield and quality and benefit the industry by providing quality fruit for processors.

Although cooling stations have been constructed by growers who machine-harvest, all water-handled cherries benefit by quick cooling and should, therefore, be held at a cooling station regardless of how harvested.

ESTIMATING NEEDED CAPACITY

The capacity of a particular unit should be based on the number of tanks that are to be handled in a 24-hour period and the delivery schedule that is to be maintained. A "rule of thumb" that many growers use suggests that space should be available for about 70 percent of the day's harvest. Growers who operate one mechanical harvester, work only during the day, and expect to harvest 30 tanks of cherries (approximately 750 cubic feet or 18 tons) should provide space for about 20 tanks. When the station begins to fill up, the tanks which were filled first can be scheduled and dispatched to the processor. This will leave room for the balance of the harvest, which could be scheduled into the processing plant during the late afternoon or evening. The space required for larger or smaller operations can be calculated in the same way—at 70 percent of the estimated total day's harvest. Cherry processing research shows that for best results this fruit should not be "soaked" for less than 4 hours or more than 8 hours. Delivery schedules and cooling station capacity should be planned accordingly.

Some growers prefer to provide space for enough tanks to hold all of the cherries that are to be harvested in one day. Doing so allows the grower some cushion to rely on, should an emergency arise which might disrupt the scheduling arrangement between the grower and processor. In case of a temporary breakdown at the processing plant, an entire day's harvest could be held through the night and delivered the next morning. Growers should realize, however, that while a long soak may provide the solution to a temporary emergency, the practice is *not* recommended. Soaking cherries more than 8 hours tends to bleach-out color and cause the fruit to develop scald and lose weight. This means lower grades and diminished returns.

Growers who operate their harvesting equipment at night as well as during the day normally make more deliveries, and might, therefore, be able to handle their tonnage with a station having a capacity of 50 percent of the 24-hour harvest. However, some space in addition to average needs, for use in emergencies, is well worth the added cost.

CHOOSING THE SITE

The cooling station should be located close to the orchard where the cherries are produced. If several orchards are involved, a central location should be selected.

The cooling station must be readily accessible by an all-weather road which will carry heavy duty trucks used for moving the tanks.

A double-row station which will accommodate 20 tanks should be located on a relatively level area approximately 50 feet by 50 feet, with enough slope to quickly drain off surface water. An area of this size provides room to load and unload transport trucks, and to maneuver the lift equipment used in handling tanks. Since lift-trucks are used a great deal directly in front of the cooling pad, serious consideration should be given to an all-weather surface for this area—either washed-rock, asphalt, or concrete. If production is likely to increase, ample space for expansion should be provided.

MAKING THE PLAN

The effectiveness of the cooling station is largely dependent upon its design and volume handled. There are several possible designs that should be considered before a specific plan is selected.

The *single row station* provides space for only one row of tanks. This is probably the simplest layout, and since all of the tanks can be moved in and out of position from one side, the other side can be used for water disposal.

The *double row station* provides space for two rows of tanks and should be accessible from both sides. Growers who have a suitable site and a considerable volume of fruit may prefer this design.

The *dual purpose cooling station* and storage shed serves as a cherry cooling area during the harvest season, after which the space can be used for a workshop or storage. In this case, the station is usually drained down the middle and covered by a clear span building. Growers who need both a cooling station and a storage building may wish to consider this type of unit. In some cases, existing storage buildings can be converted to cooling stations.

Existing concrete slabs can sometimes be used to advantage. Some growers have hard surfaced areas in the farmyard which can be used as cooling stations during the cherry harvesting season. Using an existing facility saves the cost of constructing a new one, and in some instances the results are quite satisfactory.

CONSTRUCTION

The construction details which follow are based on the assumption that Standard Measurement Tanks will be used (Fig. 1). The Standard Measurement Tank was developed by a committee of growers, processors, manufacturers, and researchers. It is recommended that the cooling water be introduced by means of an L-shaped piece of conduit into which slots have been cut. This introduces cold water at the bottom of the tank, allows it to circulate through the fruit and overflow at the top, carrying with it dirt, stems, leaves, and heat. Such a pipe (Fig. 1) can be kept at the cooling station and placed in the tanks prior to filling with cherries.

As already stated, growers who operate one mechanical harvester and harvest only during the day should provide space for about 20 tanks. Since a 20-tank station will provide sufficient space for the majority of growers, the construction of this size unit will be discussed.

For an operation of this size, the double-row cooling station is most practical. Concrete pad dimensions should be 11 feet, 4 inches by 40 feet (Fig. 2). This provides 60 inches of front-to-back space, plus a 16-inch gutter for waste water, with 48-inches of width for each Standard Measurement Tank.

A 4-inch concrete slab is adequate if fork lift equipment is not operated on the pad. Since the stations will be exposed to low winter temperatures, 6-inch by 6-inch #10 wire mesh reinforcing should be used to prevent separation at construction joints.

When ready-mixed concrete is used, growers should specify six bags of cement per cubic yard of concrete, 1-inch maximum, coarse aggregate, 6 gallons of water per bag of cement, and a stiff consistency with a maximum 3-inch slump test. When site-mixed concrete is used, coarse and fine graded aggregate should be blended with water and cement in the following proportions: mix 2¼ cu. ft. of fine aggregate, 3 cu. ft. of coarse aggregate, and 6 gallons of water for each bag of cement.

Figure 2 shows dimensions and details of the cooling station. Adequate drainage is essential, and proper sloping is important.

WATER SUPPLY

Processors usually insist that growers cool their water-handled cherries to 60° F or less before they are delivered to the plant. Time required to cool the fruit depends upon initial fruit temperature and temperature of the water used. The temperature of the water in most Michigan wells ranges from 48° to 54° F. If cold water is pumped through warm cherries, the temperature of the fruit is reduced. For example, 50° F water, which flows at the rate of 10 gallons per minute (g.p.m.) for approximately 25 minutes, will cool a tank containing 25 cubic feet of cherries from 80° to 60° F.

But, if the temperature of the water is significantly higher than that provided by most Michigan wells, a greater volume of water will be needed, or a means of cooling the water with ice or mechanical refrigeration.

When calculating the water supply needed at a given station, it should be remembered that while initial cooling requires approximately 10 g.p.m., 2 g.p.m. will maintain the temperature during the "holding period." The total amount of water necessary can be calculated by multiplying the number of tanks to be *cooled* at one time by 10 (g.p.m.) and adding 2 (g.p.m.) for each of the tanks to be *held* at any one time. This would mean that a 20-tank station, at which three tanks were being cooled and 17 tanks were being held, would require a maximum of 64 g.p.m. (3 × 10 plus 17 × 2 or a total of 64). In calculating total needs, a reasonable allowance should be added for water that is to be used in filling the empty tanks before they are sent to the orchard.

Growers who plan to use water from existing wells should make sure that the supply is adequate. A quick check can be made by measuring the amount of water produced during a 10-minute trial run, during which the pump is operated at its full capacity. If the check shows that the supply is inadequate, an experienced well-driller should be consulted. Wells and pumps vary considerably in their water yielding capacity—a 2-inch well may yield from 3 to 15 g.p.m.; a 3-inch well from 3 to 30 g.p.m.; a 4-inch well, 3 to 75 g.p.m.; and a 6-inch well from 3 to 120 g.p.m. When a new well is anticipated, contact the well company 6 months to a year in advance to insure an adequate water supply during the harvest season. The well-driller should be able to suggest a pump-well combination which will fulfill your requirements.

WATER DISTRIBUTION

The cooling station should be equipped with a system of pipes and hoses by which the necessary amount of water can be conveyed to each of the tanks. An overhead "main" running the length of the station, with outlets for each tank, is simple and effective. When the water is pumped directly from the well into the main, it should be provided with a pressure shut-off or relief valve, which will prevent excessive pressure build-up. Each tank outlet should be

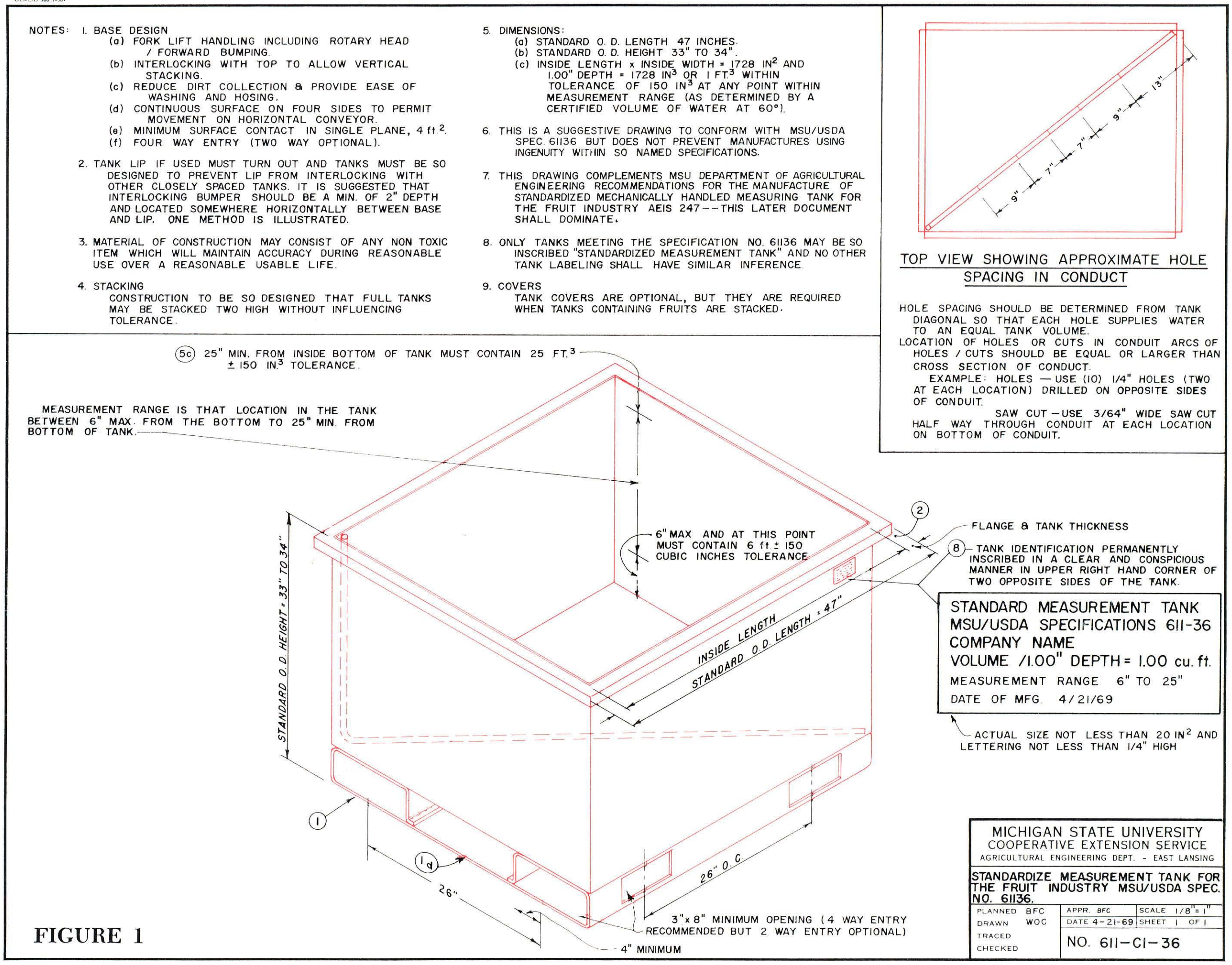


FIGURE 1

equipped with auto-flow valves which will provide 10 g.p.m. and 2 g.p.m. regardless of fluctuating water main pressure. A rubber or plastic hose long enough to reach the tank is attached to each of the outlets. These hoses should be equipped with "quick couplings" or a slip-over fit approximately 12 inches in length to prevent accidental water pressure removal. They can be attached to the "L" shaped pieces of slotted conduit through which the water flows into the tanks (Fig. 1). Plastic hose may prove unsatisfactory if it tends to stiffen at temperatures of 50°.

The driver who brings filled tanks from the orchard to the cooling station takes back tanks that are filled with cold water. The water distribution system should include an outlet which will enable the operator to quickly fill outgoing tanks.

A 3-inch pipe running down the center of the cooling pad at a height of about seven feet will provide an adequate "main" for the station shown in Fig. 2. The well and pump combination should be such that a water pressure of about 20 pounds per square inch (p.s.i.) can be maintained in the main. When this is done, ⅜-inch outlets and auto-flow valves at each lateral will supply 10 g.p.m. to each of the tanks being cooled, and 2 g.p.m. to the ones being held. Cooling stations of larger capacity usually require larger mains.

Growers who are interested in obtaining detailed information about the auto-flow valve system should contact their County Extension Staff or write to the Agricultural Engineering Department, Michigan State University, East Lansing, Michigan.

WATER DISPOSAL

Large amounts of water are involved, and the disposal problem should be given consideration before the site is chosen. In addition to the purely physical problems, there are health regulations which should

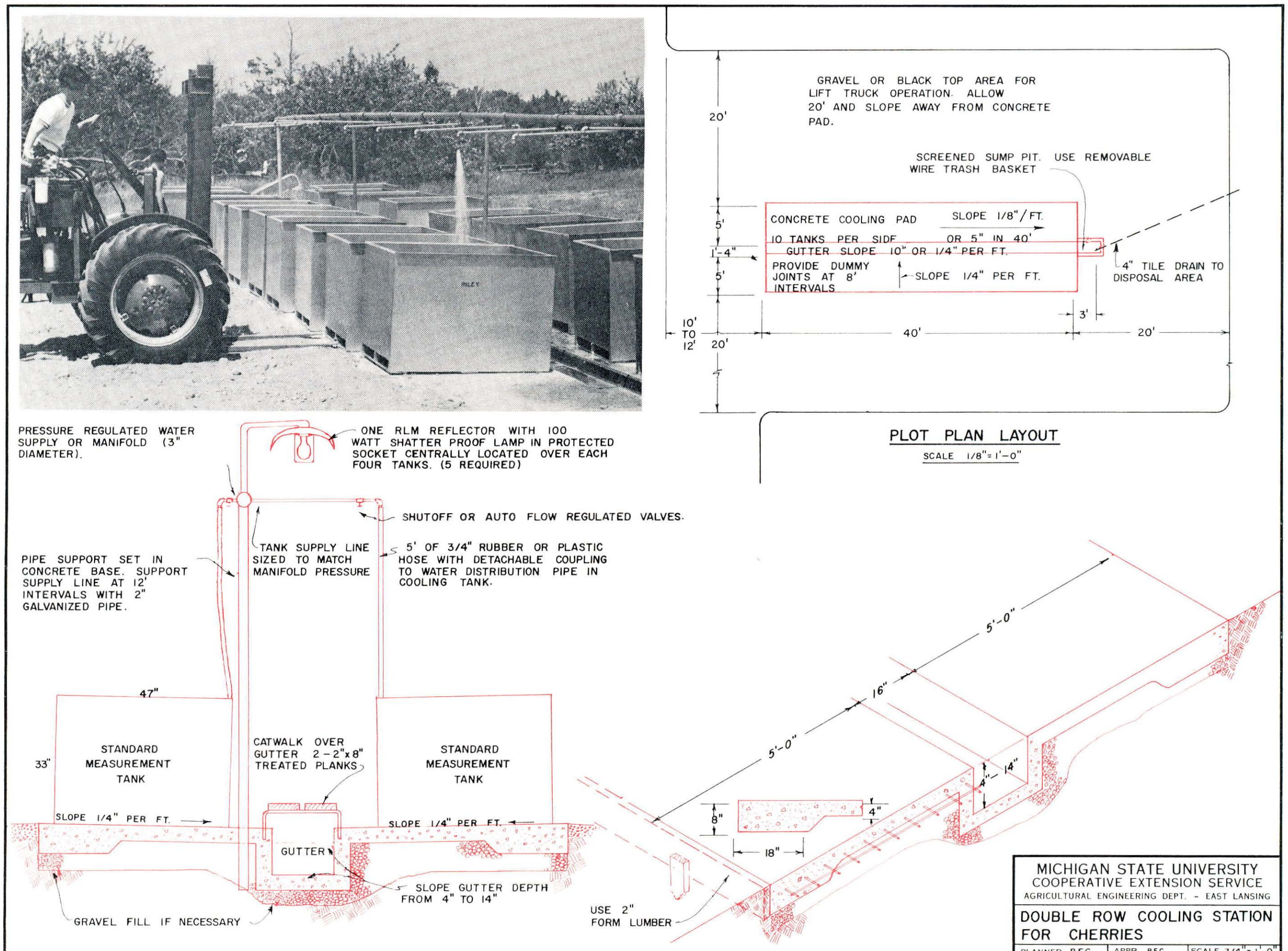


FIGURE 2

be taken into account. Growers should check the regulations with local health authorities.

The grower whose maximum needs are about 65 g.p.m. should provide disposal facilities which will carry water away at this rate, even though the system would not be called upon to operate continuously at maximum capacity. Total needs should be figured at one-half the maximum rate, or about 35 g.p.m. In this case, the amount of water would be 21 thousand gallons in a 10-hour day.

LIGHTING

If the cooling station is to be used at night, adequate lighting should be provided. Flood lights with non-breakable, shatter-proof bulbs in reflectors which illuminate the entire area are adequate for loading and unloading. If sorting is to be done at the station, additional light will be needed. In the double-row design, a 100-watt light should be centrally located over each group of four tanks (Fig. 2). In the single row design, a light should be located over each two-tank group.

OPERATING A COOLING STATION

The first tank of cherries to arrive at the cooling station on any given day, should be placed so that later-arriving tanks can be arranged for easy servicing and record-keeping. Arrange them so that the first tank in is the first one out.

As the tanks arrive, the 10 g.p.m. auto-flow valve should be turned on. When the tanks have been allowed to overflow for a while, the leaves and trash that float to the top should be skimmed-off and placed in containers for subsequent disposal.

Record the time that the cooling operation starts. Any simple, convenient system will do. Time can be "chalked" on the tank itself, or recorded on a card which stays with the tank until it reaches the processing plant. Another method is to use the individual tank numbers and keep the record on a conveniently located clip board. The information regarding each tank should accompany the containers when they are dispatched to the processing plant. Growers using a record-keeping system and maintaining close communication with the processing plant have been quite successful in moving fruit from their cooling station directly into the processing line.

When the temperature of the tanks has been lowered to 60° F or less (as determined by a good immersion thermometer), the flow of water should be directed through the 2 g.p.m. auto-flow valve. Water should not be shut off until the tanks are ready to be moved to the plant.

Before the tanks are removed from the pad for transport, water should be lowered in the tank to a point 2 inches above the cherries. A tank cover should be applied to prevent sloshing and loss of product during transport.

Cherry growers who provide themselves with good cooling facilities, and operate them properly, will help maintain the fruit quality which increases both demand and profits.

PRESERVING FRUIT QUALITY

Research and observations over the past few years point to three basic factors affecting the preservation of fruit quality. These are:

1. Design characteristics of the mechanical harvester.
2. Ability and attitude of the operator(s).
3. Post-harvest handling, cooling and processing techniques.

This data has served as a basis for developing guidelines for a harvesting, handling and cooling system that will preserve on-the-tree quality of the fruit. It is clear that mechanical harvesters and water-handling systems complement each other. Furthermore, reduced post-harvest bruise, and reduced scald development with consequent improvement in quality levels are only possible if proper handling and cooling techniques are used. These techniques include:

1. Harvesting fruit in pallet tanks containing 48 to 54° F water.
2. Minimizing or eliminating time periods when fruit is in water above 60° F.
3. Cooling fruit to below 60° F as quickly as possible after harvest.

TABLE 1—Effect of Temperature and Delay on Scald of Tart Cherries*

Holding Treatment of Cherries (water temp.)	Percent of Total with Scald	
	After 6 hrs.	After 24 hrs.
40°F	—	4
50°F	3	14
60°F	5.5	23
77°F	18	39
90°F	—	50

*Canner/Packer July, 1967.

4. Soaking properly harvested fruit from 6 to 8 hours before processing. (Excessive bruise levels may require undesirable soak-periods of 12 hours or more.)
5. Reducing amount of rehandling after harvest.

Handling tart cherries in cold water is a method for minimizing rebruising and the appearance of scald resulting from bruising and rebruising. Table 1 shows the effect of water temperature and soaking time on scalding. Note the increase in scald as soak time increases from 6 to 24 hours and, also, as water temperature increases from 40° F to 90° F.

Immediately after the orchard tank has been filled, the tank should be moved to the cooling pad. Water placed in an orchard tank at 50° F will be warmed up by the surrounding air and by the warmer fruit being conveyed into the tank. The use of ice to cool the water in the tank is only justified if there is a good chance that the water will reach 60° F, which might occur with a long hauling distance or machine breakdown. Adding ice, which is allowed to float in the tank, will only cause more bruising. Ice should be held in the tank corners with protective screening material.

The importance of moving harvested fruit to the cooling pad quickly is illustrated by the data in Table 2. As the cooling delay increases from zero to four hours, the presence of scald at processing time becomes more pronounced. An adequate handling system, a centrally-located cooling station and a conscientious harvesting crew are the best assurance that fruit is cooled quickly. When harvesting is delayed or interrupted for one-half hour, or operations are slow, partially filled tanks should be moved directly to the cooling station.

When fruit is delivered to the cooling station, immediate circulation of 10 g.p.m. of 50° F water is recommended to flush warm water and trash from the tank. Although most trash should be skimmed out of the orchard tank during filling in the orchard, additional trash can be removed from the tank if care is used to minimize the agitation of fruit. After the tank

TABLE 2—Quality—Post-harvest Cooling Effect*

TEST	Cooling Delay After Harvest (Hours) 0	2	4
	Scald Apparent in Fruit (Percent)		
A	0	1	9
B	0	7	32
C	3	29	46
D	0	—	34
E	0	8	36
F	0	10	18
Average	0.5	11.0	29.2

*Unpublished U.S.D.A. Research Data.

TABLE 3—Quality—Post-harvest Handling Effect*

Bruise at	Rebruise at	Scald at Processing	Yield Loss	Pitted Yield	Approximate Grade
		— — — — — Percent	— — — — —		
0 hr.	None	0	−0.5	85.6	A
0 hr.	3 hr.	34	−5.3	80.2	C
0 hr.	3 & 6 hr.	76	−7.9	77.2	Substandard
0 hr.	3, 6, & 24 hr.	74	−8.6	74.0	Substandard

*Michigan State Horticultural Society Annual Report, 94:83-87 May,65.

TABLE 4—Quality—Effect of Post-harvest Bruise*

Plant	Percent Scald Before Unloading	After Unloading
A	13.7	34.6
B	13.8	22.4
C	16.0	34.3
D	16.5	33.8
Average	15.0	32.0

*Michigan State Horticultural Society Annual Report 94:83-84 May, 65.

water has cooled down to incoming water temperature, water flow can be reduced to a level sufficient to maintain this inlet temperature, usually 2 g.p.m.

Research has proven that the development and appearance of scald is more evident with fruit that is rebruised during the handling operation. Rebruising can occur from severe agitation within the tank, from severe handling and movement of the tank itself, or any time the contents of the tank are dumped from one container to another. Elimination of dumping is one of the advantages of volume buying and sale of cherries in Standardized Measurement Tanks.

Table 3 shows the effect of various levels of rebruising after an initial harvest bruise (at 0 hours). Note that there is no scald and virtually no change in weight with only an initial bruise at 0 hours. But, as successive steps of rebruising occur, scald and weight losses increase quickly while pitted yield and grade decrease quite rapidly.

This same effect of rebruising is noted in Table 4, which shows the effect of an unloading operation at

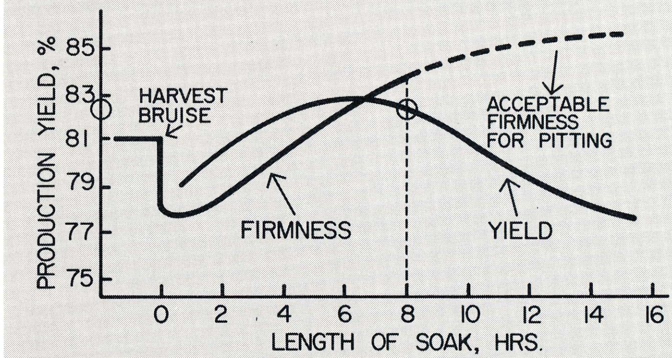


Figure 3—The effect of careful handling procedures on fruit firmness and yield during soaking. (Note that when firmness is sufficient for pitting, product yield is near the maximum of 83 percent.)

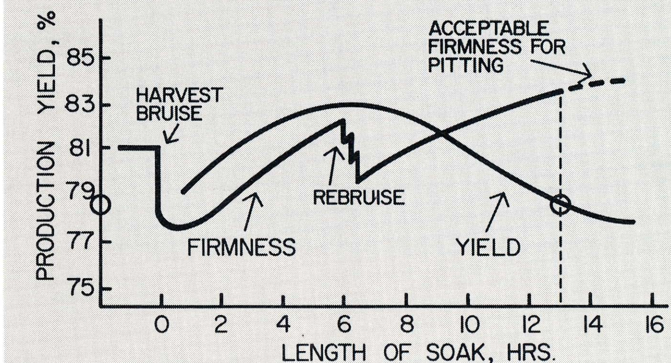


Figure 4—The effect of careless and severe handling procedures on fruit firmness and yield during soaking. (Note that when firmness is sufficient for pitting, product yield has been reduced to about 78 percent.)

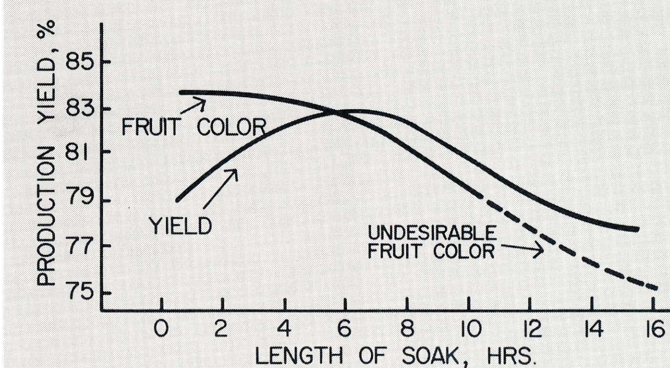


Figure 5—The effect of length of soak on product yield and fruit color. As soak periods are lengthened, yield and color losses result for both growers and processors.

processing time, performed prior to a soak-period. An extended soaking period is often necessary to regain firmness for pitting following excessive rehandling. The extended soaking can cause increases in scald, undesirable appearance and product weight and volume losses.

Figures 3 and 4 illustrate this effect by examining fruit firmness as affected by gentle and severe handling operations. As severity of the handling operation increases (in the orchard, at the cooling station, or at the processing plant), length of soak required to achieve desired fruit firmness for effective mechanical pit removal also increases. This additional length of soak results in yield and color losses through leaching, Fig. 5.

As mentioned earlier, one of the reasons for interest in volume measurement is to minimize rehandling. Present purchase agreements by weight require several rehandling operations between the time of exchange and processing time. Volume purchase, using a standardized measurement tank, eliminates several rehandling operations, reduces soak periods, and improves fruit quality by shortening product flow from the tree to the processing line.

SUMMARY AND CONCLUSIONS

There must be a thorough understanding that tart cherries harvested into water are a virtual "time-bomb." Once into the water, there is only a certain period of time available to process the product without undesirable physiological activity occurring. Growers and equipment operators must be as aware of this as processors in order to keep a smooth, even flow of fruit passing from the orchard through the processing plant. Practices and procedures, followed by growers and processors, that tend to shorten the time period from harvest to processing, are desirable.

The development of a proper and adequate harvesting system and ability to use it properly will allow all persons within the industry to maximize profits and produce highly respectable products.

The information in this Extension Bulletin is based on work conducted jointly by the Agricultural Engineering Research Division and Eastern Utilization Development Division, U.S.D.A., and Departments of Horticulture and Agricultural Engineering, Michigan State University, East Lansing, Michigan.

Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8 and June 30, 1914, in cooperation with the U. S. Department of Agriculture. George S. McIntyre, Director, Cooperative Extension Service, Michigan State University, East Lansing, Michigan. 2P-5:70-3M-ST