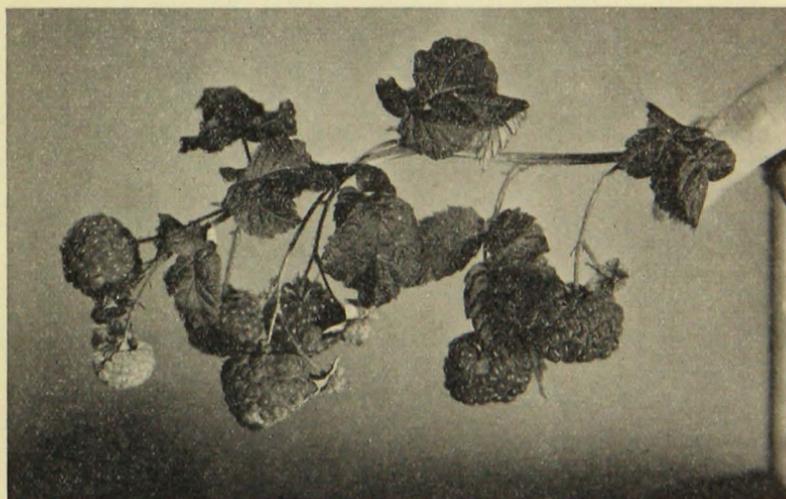


Picking, Handling, and Packing Fruits for Market

J. D. WINTER AND W. H. ALDERMAN
DIVISION OF HORTICULTURE

W. C. WAITE
DIVISION OF AGRICULTURAL ECONOMICS



UNIVERSITY OF MINNESOTA
AGRICULTURAL EXTENSION DIVISION

Published in furtherance of Agricultural Extension, Acts of May 8 and June 30, 1914.
W. C. Coffey, Acting Director, Agricultural Extension Division, Department of Agriculture,
University of Minnesota, Co-operating with United States Department of Agriculture.

7-35-10M

THE problem of picking, handling, and packing Minnesota fruits, so that they may reach the market in the best possible condition, will become increasingly important as it becomes necessary to find new outlets and a wider market for the steadily increasing production. This applies particularly to strawberries and raspberries which are among the most perishable of horticultural crops.

APPLES

Picking and Handling

Apples must be picked carefully to avoid bruising. Some form of picking-bag should be used in commercial orchards. Several types of picking-bags, designed to permit the handling of apples with a minimum of bruising, are available. Pickers must be instructed carefully and supervised closely to prevent bruising during picking operations.

If apples are to be held in storage, they should be picked at just the right stage of maturity. If they are too immature, they will be likely to wilt in storage, and the quality will be inferior when the apples are ready for market. The ease with which the fruit separates from the tree and the ground color of the fruit are better indications of picking maturity than the browning of the seeds. Fruit intended for storage should be well ripened, but not overripe.

It is important to place apples in the storage room as soon as possible after they are picked. Even one day's delay may make a decided difference in their keeping-quality. Fruit, to be placed in common storage, should stand outside only long enough to cool off, so that the field heat will not affect the storage-room temperature.

Containers

The basket makes a desirable package for Minnesota apple-growers, and no change appears to be justified under present market conditions. Poorly constructed, two-hoop baskets may bulge when filled with fruit and require as much as three pounds of additional fruit to fill them. The three-hoop basket is superior to the two-hoop, round-bottomed basket. The tub basket protects the fruit from bruising better than the round-bottomed type, and it stacks easier in storage and for shipment. In many apple-growing sections the tub basket has become the popular type, but in Minnesota the round-bottomed basket is more commonly used.

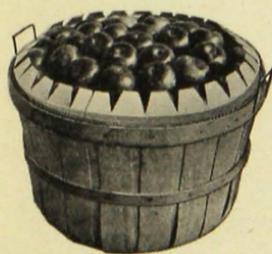
A new type of apple box was introduced about five years ago in the Hudson Valley of New York, and is now widely used in New York

and New England states. It is known as the Eastern apple crate. It is made in two sizes, one containing 2,618 cubic inches and the other containing 2,645.5 cubic inches. This allows a minimum volume of $1\frac{1}{5}$ bushels according to legal measure for apples in Minnesota. The Minnesota law defining a bushel of apples was amended by Chapter 270 Session Laws 1935, to conform to the United States Standard Container Act which defines a bushel as 2,150.42 cubic inches. Fruit marketed in the Eastern apple crate is less subject to bruising than fruit packed in baskets, and it takes up very much less space, an important item in warehousing and transportation.

The barrel also is used extensively for apples in the Eastern United States. The Northwest type of wooden box, with contents of 2,173.5 cubic inches, is used almost exclusively in most apple districts of the west. A cell-type paperboard carton is being used in some eastern districts for fancy apples, and a standard paperboard carton holding 20 pounds of apples has been used to a limited extent by western shippers.

Packing

The introduction of ring packing forms (Fig. 1) has increased the popularity of the basket pack, because it enables growers to put up attractively-faced baskets of apples with a minimum amount of labor and expense. An 11-man crew can sort, grade, face, and pack 70 to 80 bushels per hour. Oiled shredded paper is being used extensively with the faced-basket pack, and paper fringes are used sometimes around the top of the basket on the inside of the rim to protect the fruit from injury.



Basket of Apples Packed
with Ring Form

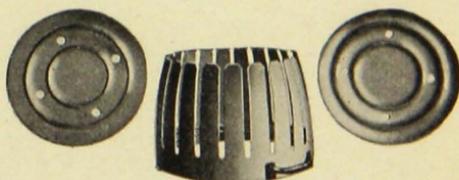


Figure 1
A typical Ring Packing Form with Facing
Discs for Medium and Large Fruit

A good basket must be strong enough to hold the face intact when filled. Baskets sometimes are damaged by improper handling. Nests of baskets never should be tossed, thrown, or dropped on end to the floor. Unused baskets that are held over to the next crop season should be stored in tiers on their sides.

PLUMS

The marketing of Minnesota-grown plums has not yet developed to a point at which there is any standardization in marketing methods or in type of pack. Many plums are sold in half-bushel baskets, which are far from ideal for the larger plums reaching the local markets.

For smaller quantities, the three-quart basket is an economical size. The oblong till basket and the square basket of the California type are too deep to be entirely satisfactory for locally-grown plums.

The fact that plums in several localities are being sold in used peach crates indicates that a comparatively shallow container of about one-third bushel capacity may be a very desirable size for Minnesota plums.

RASPBERRIES

Method of Picking

The least possible amount of pressure should be used in picking raspberries. Experienced pickers use three fingers. This method distributes the pressure in picking more evenly than when only two fingers are used.

Experiments have shown that there may be a wide difference in the keeping-quality of berries picked by different people. Therefore, it is highly important that the grower require his pickers to use the greatest care in all picking operations. The berries should be sorted as they are picked, and the overripe berries and culls should be placed in separate containers. Berries frequently are crushed by holding too many in the hand before they are placed in the box. The practice of piling up berries on a carrier of full boxes, to be taken off later and placed in other boxes, should not be permitted. About seven to eight pickers are required per acre.

Effect of Rainfall and Dew

As shown by common experience, berries picked while wet after a rain do not keep well. The duration and amount of the rainfall undoubtedly has an effect on the keeping-quality, which is entirely distinct from that of moisture on the berries. Berries picked following a prolonged period of rain are not properly matured and lack firmness. It is generally considered undesirable to pick raspberries while they are wet with dew.

Time and Frequency of Picking

Freshly picked raspberries normally have a temperature above that of the surrounding air, except in the early morning. Berries picked

early in the day remain cooler during the day than those picked later, a difference of as much as 17 degrees Fahrenheit having been noted between early morning and noontime pickings. Experiments have shown that berries picked early in the day and berries picked in the late afternoon keep better than those picked during the middle of the day.

Most plantings are picked every other day, or one half of a planting is picked one day and the other half the following day. In hot weather, in the height of the season, it is often desirable to pick the entire planting daily to obtain berries of uniformly good, marketable condition.

Reducing Berry Temperatures by Air-Cooling

Experiments in Minnesota have shown that berries coming directly from the field during the heat of the day and held in a *well-ventilated* berry shed will cool to a temperature *below* that of the air. Most of this cooling takes place in the first two hours after picking. Under the conditions of the experiments mentioned, the rate of cooling averaged 5 to 8 degrees Fahrenheit per hour, *which is a more rapid rate of cooling than could be obtained in a well-constructed ice refrigerator* not equipped with a fan.

In order to get a maximum rate of cooling, berries should be placed in a well-ventilated berry shed, consisting only of a roof and a few boards on the south side to protect the fruit from the sun. Cooling is decidedly less rapid in an enclosed shed, even with windows and door open. Berries cool very slowly when placed in a pint box on the ground under the shade of a berry bush where they are sheltered from the wind.

Cellar Storage for Berries

The average cellar cannot be considered a cool storage place for berries, and it will not provide the temperatures obtained from ice refrigeration. The air-temperature of an ordinary cellar during the raspberry season is about 70 to 75 degrees Fahrenheit. *After the fruit* in such a cellar has cooled to about 80 degrees, the rate of cooling becomes extremely slow, and is not likely to go much below 75 degrees. A properly constructed ice refrigerator will reduce the berry temperature to about 48 degrees—or lower, if a fan is used.

Ice Refrigeration

The temperature at which berries are held after picking is one of the principal factors that determine their market condition. Within normal storage temperatures it has been shown that for each rise in temperature of about 15 degrees Fahrenheit, the keeping-quality of

berries is reduced one-half. Promptness and rapidity of cooling become increasingly important as the time required for marketing increases.

In 1934 tests were made to determine the effect of different periods of ice refrigeration on the keeping-quality of red raspberries. The weather during the period was dry and the berries were firm. Under such conditions, raspberries were found to keep in marketable condition for from five to seven days. Berries that were under refrigeration for two or three days remained in marketable condition, after their removal from the refrigerator, as long or even longer than freshly picked berries. It was found that berries cooled for 10 to 15 hours kept in much better condition than uncooled berries, when hauled to distant towns.

A few hours delay in placing raspberries in the refrigerator had no appreciable effect on the length of time the berries remained in marketable condition, but berries picked in the early morning and not cooled until the afternoon or evening of the same day showed a decided loss in keeping-quality.

Containers

Raspberries are commonly packed in pint boxes made of wood veneer. The deep-style Hallock type of box is used in Minnesota. An extensive test of paperboard boxes was made in 1934. Several types of these boxes were used but none appeared to have any advantage over the wood-veneer boxes, and in many instances they were much less satisfactory. It was found, also, that raspberries in paperboard boxes cooled more slowly than similar berries in the wood-veneer boxes. The cost of paperboard boxes is about the same as of those made of wood-veneer.

The 24-pint ventilated crate, using the deep-style Hallock containers, undoubtedly is the most desirable crate for general use by Minnesota raspberry growers. It is used exclusively by the principal berry-shipping associations in the state as well as by some of the largest individual growers. This ventilated crate has a divider between the top and the bottom deck, which rests on grooves cut into the headers and the middle partition. In this way the berries on the top of the bottom deck are protected and are not crushed by the boxes in the top deck. Another advantage of the ventilated crate is that it permits berries to cool much more rapidly than old-style crates.

The old-style, non-ventilated crate has no divider between the top and the bottom deck of boxes. The ventilated crate reduces loss from spoilage and is replacing the old-style crate to a large extent.

STRAWBERRIES

Picking

Strawberries should be picked by pinching off the stem between the thumb and forefinger, leaving a part of the stem attached to the berry. The suggestions as to care in the picking of raspberries apply equally to strawberries. Berries injured by insects¹ and by birds decay very rapidly and should be culled out in picking. Such damage is most prevalent in the fall. The number of pickers required varies according to the crop, but normally is about five to six per acre. Most June-bearing strawberries grown in Minnesota are picked every other day. It is generally considered that strawberries picked while wet with dew will keep satisfactorily if given an opportunity to dry-off before the crates are filled and the covers are nailed on.

Cooling and Refrigeration

Strawberries grown in Minnesota are about as perishable as red raspberries and they require careful handling in order that they may reach market in first-class condition. Much of the information on cooling and refrigeration given under the heading of raspberries will apply also to strawberries. A limited test of strawberries in the fall of 1934 showed that they could be kept in marketable condition in a properly constructed farm refrigerator for from 8 to 12 days.

Containers

The spring crop of strawberries is sold in Minnesota mostly in quart boxes. The fall crop is sold in both quart and pint boxes, with a decided trend toward a more general use of the pint box. The Hallock type of box is used by nearly all Minnesota growers. A recent survey made among 230 retail merchants in Minneapolis showed that the Hallock type of box had come to be so uniformly identified with home-grown strawberries as to approach "trade mark" recognition. The same survey showed, among merchants, a practically unanimous opinion that home-grown berries are much superior in quality

¹ Much insect damage to berries is caused by crickets. These insects can be controlled by using a poison bran mash made of the following ingredients:

	Small quantities	Large quantities
Bran	1 quart	100 lb.
Molasses	¼ cup	2 gal.
White arsenic or paris green....	1 teaspoonful	5 lb.
Water	Enough to moisten	10 gal.

This should be scattered in the evening as thinly as possible around the plants but not directly on the foliage. An application or two is usually sufficient.

and flavor to shipped-in berries. Because of this, there appears to be no reason to consider any change in the type of berry box used in this state.

In Minnesota the June crop of strawberries is sold in 16-quart and in 24-quart Hallock crates. The 24-quart is used mostly in the vicinity of Saint Paul and Minneapolis, but in other parts of the state the 16-quart crate is used extensively. Shipping associations use a crate having a divider between the top and bottom decks, but most of the crates used elsewhere in Minnesota are without this and the top boxes are placed directly on the bottom boxes.

Considerable quantities of fall-bearing strawberries have been sold locally in 12-pint "flats," which are crates holding a single layer of pint boxes. It is likely that these "flats" will come into more general use during the fall season, because the small units appear to meet the market demand at that season of the year better than the larger crates, and the single layer gives better protection to the berries.

Farm Refrigerator for Cooling Berries

Figure 2 shows details for the construction of a farm refrigerator, having a capacity of thirty-eight 24-pint, Hallock-type, raspberry crates, or twenty-two 24-quart, Hallock-type, strawberry crates. The materials used in construction cost about \$35, and a complete plan and list of materials may be obtained for 15 cents by writing to the Office of Publications, at University Farm, St. Paul.

Two used, 50-gallon steel drums, originally containing lime-sulphur solution, are used for the ice chamber. These two drums easily hold 400 pounds of ice. The drain pipes should not allow water to stand in the drums, but should be so arranged as to seal the drains from the entrance of air. A shallow drip-pan, not over one inch deep, of galvanized steel, must be provided to catch any condensation from the drums; and the bottom of the drip-pan should be insulated with standard insulation board and waterproof paper, to prevent condensation on the bottom of the drip-pan.

The rate of cooling is determined largely by the quantity and the temperature of the fruit. Under average conditions, a refrigerator of this type will cool berries at the rate of about four to six degrees Fahrenheit per hour, and will require about 150 pounds of ice daily for the cooling of 15 or 20 crates of raspberries each day. No salt is needed.

An ice chamber of the bunker type may be used. This increases the cost of materials to some extent, especially if used steel drums are available at little or no expense. If a bunker type of construction is

used, there should be an opening for air circulation, at both top and bottom of ice bunker. The size of each opening should be 90 square inches per 100 pounds of ice capacity. The ice chamber should take about 30 per cent of the total available space. For ordinary loading, each cubic foot of ice chamber will hold about 50 pounds of ice.

A fan may be installed in a bunker-type refrigerator, to increase the rate of cooling. With a fan in operation, the berries will cool as much as 15 or 20 degrees Fahrenheit in the first hour, when a relatively small quantity of fruit is being cooled. For large quantities of fruit, a fan is necessary to obtain adequate cooling. The fan should be arranged to draw air up through the bunker and force it over the top of the load. The size of the ice chamber may be reduced if a fan is installed.

In building a refrigerator, it is particularly important to avoid materials that will produce an odor. Spruce is generally used in household refrigerators. Douglas fir is satisfactory for the purpose, and is less expensive and more easily obtainable than spruce. Cedar must not be used on account of the objectionable odor it imparts to the berries. Pitch pockets should be carefully avoided.

Different materials may be used for insulation. In an experimental farm refrigerator, constructed in 1934, the insulation consisted of about two inches of rock-wool bat placed between the studding and joists, which were made of 2"x2" lumber. It is very important to prevent, so far as possible, the absorption of moisture by the material used for insulation. A slight increase in moisture adds very materially to conductivity. The more air-proof the construction, the more effective the insulation will remain. The use of waterproof paper on both sides of the studding and joists is recommended. This should be standard insulating paper, which is odorless. An odorless asphalt applied hot to both sides of any of the standard insulating boards will provide better moisture resistance but adds to the expense.

The inside of the refrigerator should be finished by applying varnish over two coats of shellac. The shellac prevents excessive penetration of varnish and adds to the moisture resistance. In place of shellac and varnish, a good enamel paint may be used over two coats of aluminum paint applied as priming.

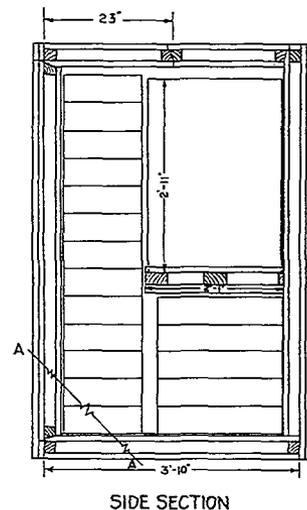
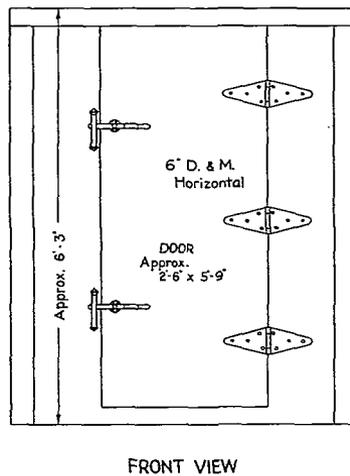
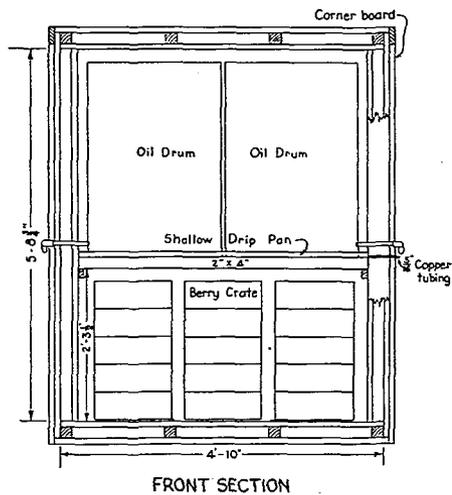
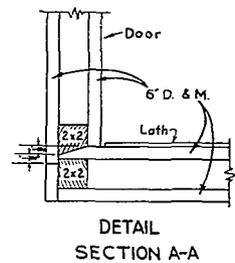
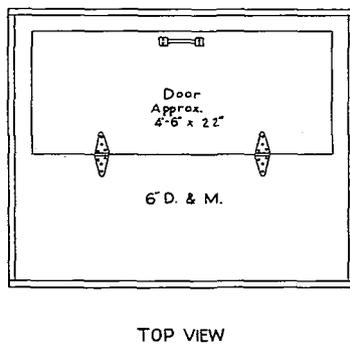
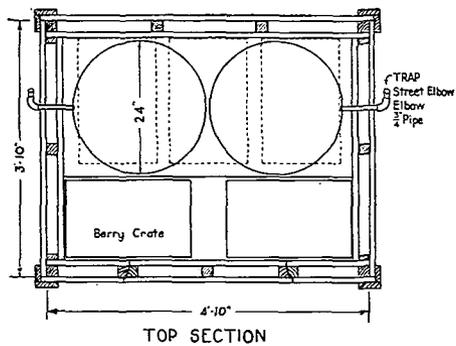


Fig. 2. Plan for a Simple Farm Refrigerator for Cooling Berries

RECOMMENDATIONS

1. Growers should supervise their pickers closely to see that the fruit is picked and handled very carefully at all times.

2. The basket is a desirable container for Minnesota apples, and a more general use of ring packing forms should be encouraged in connection with the basket pack.

3. Apples intended for storage should be well ripened when picked and should be placed in the storage room as promptly as possible.

4. Picking berries during the middle of the day in hot weather should be avoided if possible. Experiments indicate that berries picked during the early morning or late afternoon keep better than those picked at midday.

5. Berries, when picked, should be placed in a well-ventilated berry shed, or other place that is open on all sides, to permit a maximum of air movement. Berries that are overripe or injured should be placed in separate containers at the time of picking.

6. The cooling of berries by ice refrigeration on the farm prolongs the marketable condition of the fruit for several days. A suitable refrigerator can be built at low cost. The construction and use of such a refrigerator is recommended for growers who normally lose some berries from spoilage or who are forced at times to sell their fruit at a low price to escape loss from spoilage.

7. Berries to be cooled by ice refrigeration may be placed first in a well-ventilated shed for about two hours, without any apparent loss of keeping-quality. When the berries are warm, this practice will result in a saving of ice and it is possible that the evaporation which takes place in the berry shed may improve the keeping-quality when the moisture content of the berry is high.

8. A ventilated type of crate with wood-veneer boxes is the most satisfactory for raspberries.