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Essentials of BLUEBERRY CULTURE

By Stanley Johnston

MICHIGAN STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
SECTION OF HORTICULTURE
EAST LANSING



Illustrations on this page, courtesy Blueberry Co-operative Association.
Cover illustration, courtesy A. B. Morse Company, St. Joseph, Mich.

The improved blueberry is a very popular fruit and may be used in many ways — both fresh and cooked.





ESSENTIALS OF BLUEBERRY CULTURE

BY STANLEY JOHNSTON



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Essentials of Blueberry Culture

By STANLEY JOHNSTON

THE BLUEBERRY IS EVEN MORE AMERICAN THAN TURKEY FOR THANKSGIVING, for it was in this country in great abundance and was highly prized by the Indians before the white settlers arrived.

Because of the abundant supply of wild blueberries, little was done to cultivate or improve this fruit for nearly 300 years after the Pilgrims landed. In 1906 investigations were started by the United States Department of Agriculture, under the direction of the late Dr. F. V. Coville, whose work in determining the soil requirements of the blueberry and in breeding and selecting varieties of unusually large size was of first importance in developing the cultivated blueberry industry.

Much credit for improving the highbush blueberry must also be given to Miss Elizabeth White of Whitesbog, New Jersey, who made selections of outstanding wild bushes and who, in cooperation with Dr. Coville, established the first commercial plantings of hybrid blueberries. A few of Miss White's selections served as parent stock in blueberry breeding work, and one, Rubel, has been an outstanding commercial variety.

DISTRIBUTION OF THE BLUEBERRY

Many species of the blueberry are native to different parts of the United States. These can be divided into two general groups or types, highbush and lowbush.

The lowbush species are generally found in the more northern states or highlands farther south. Large quantities of wild lowbush blueberries are harvested for market in many places. However, the supply is decreasing each year.

Most of the experimental and improvement work with the blueberry has been done with the highbush type, especially the northern species, *Vaccinium australe*. This species is found growing native in Michigan about as far north as the lower end of Saginaw Bay, although apparently it can be grown in suitable soil as far north as Ludington or Traverse City on the western side of the state adjacent to

Lake Michigan. It is also established in central and southern New York; in the New England states, particularly in southern New Hampshire, Vermont and Maine; in the vicinity of Puget Sound in Washington; extensively in New Jersey, and as far south as North Carolina.

The cultivated blueberry industry has been founded on improved varieties of the northern highbush blueberry and is largely confined to New Jersey, North Carolina and Michigan, with small plantings in Massachusetts, New York and Washington. There are probably 3,500 ^{2,500} acres of cultivated blueberries in the states mentioned, with an annual production ranging between seven and eight million pints. ⁴⁻⁵

There is no cultivated industry with the lowbush species of the blueberry, although areas of wild plants, such as in parts of Maine, have been improved in production to some degree by systematic burning to remove competing vegetation and by dusting with insecticides for insect control.

While the blueberry is found in many different parts of the country, it is very exacting in its soil and climatic requirements, and the prospective grower should be certain that these conditions are suitable before engaging in blueberry culture.

CHOOSING THE LOCATION FOR BLUEBERRY GROWING

In selecting a location, careful consideration should be given to:

1. **Climate**—The northern highbush blueberry forms the basis for the cultivated blueberry industry. This species does not succeed in many northern regions, such as northern Michigan, probably because of too short a growing season and too low winter temperatures. Neither does it do well in the far South.

2. **Markets**—Nearness to markets, both for fresh use and commercial processing, is a distinct advantage in growing a perishable fruit.

3. **Availability of Pickers**—A mature blueberry plantation requires a large number of pickers. Their availability should always be kept in mind when choosing a location.

SELECTING THE PLANTATION SITE

A good site for a blueberry plantation should have (1) a suitable soil, and (2) be as free from frost as possible.

Soil Requirements

Reaction—The blueberry plant requires a soil that is very acid, preferably one within the pH range of 4.0 to 5.1. The prospective grower should have his soil tested by his county agricultural agent or the Michigan Agricultural Experiment Station (Fig. 1).

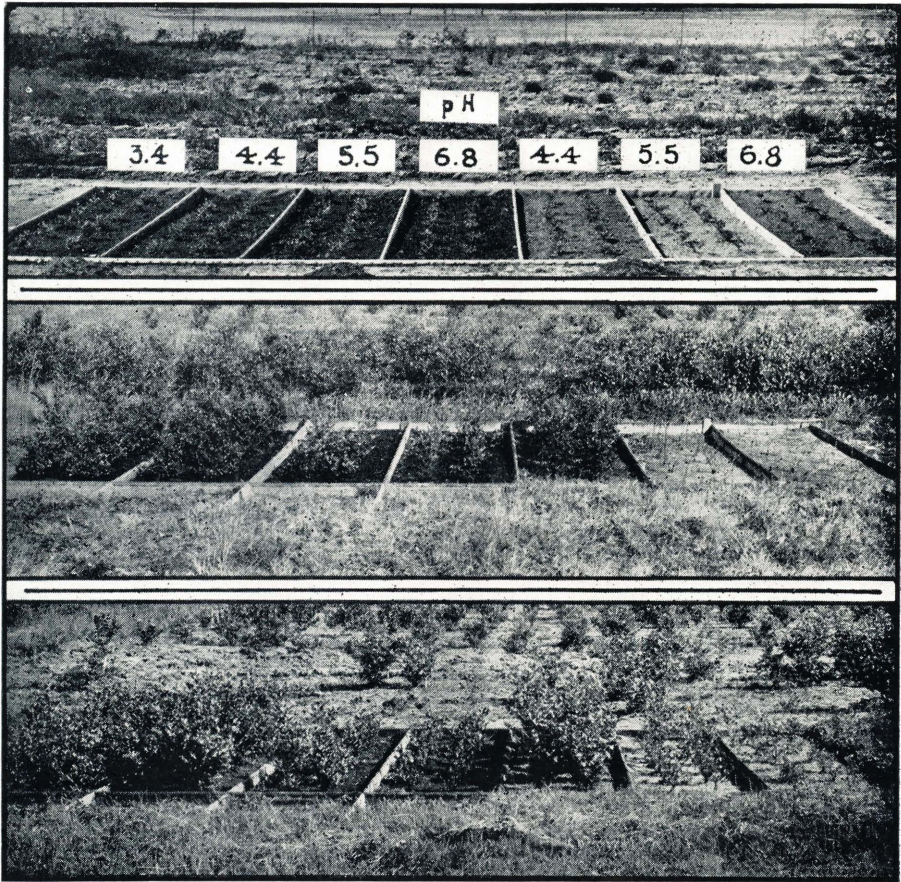


Fig. 1. Rubel plants set in muck and sand soils of various degrees of acidity. Above: Plants soon after setting. Center: Same plants after 2 years' growth. Below: Same plants after 3 years' growth. From left to right: Extremely acid, very acid, moderately acid, and slightly acid muck soils. (pH 3.4, 4.4, 5.5, and 6.8 respectively); and very acid, moderately acid, and slightly acid sand soils (pH 4.4, 5.5, and 6.8 respectively). The plants in the slightly and moderately acid sand and muck soils are making poor growth, the leaves are abnormally colored, and they drop prematurely. The plants in the extremely acid muck (pH 3.4) are growing fairly well but not as well as those where the pH is 4.4. Soils testing below pH 4.0 should receive sufficient lime to raise the pH to about 4.4 for best results.



Fig. 2. Left: A blueberry plant after growing for 6 years where the soil was too acid (pH 3.2). Right: A 2-year-old plant growing in the same area after the soil had been treated with limestone at the rate of two tons per acre, raising the pH from 3.2 to 3.8.

Merrill (1) has shown that it is practicable to make soils testing below pH 4.0 suitable for blueberry production by applying limestone at the rate of one to four tons per acre, depending upon the degree of soil acidity to be corrected (Fig. 2). If possible, the limestone should be worked into the soil before planting.

Several materials may be used to increase soil acidity, including sulfur, sulfate of aluminum, crude tannic acid, and acid peat. Of these, sulfur is most commonly used. Acidifying soil for commercial blueberry culture is not recommended, unless the necessary change in soil reaction is slight. Prospective growers confronted with this problem are advised to write to their experiment station for assistance.

*not bank
line sufficient
see*

Moisture Content—The highbush blueberry grows best where the water table can be maintained from 14 to 22 inches below the surface. It is not always possible to provide this ideal condition, but for practical purposes the water level in the soil at least should not be lower than 10 to 12 inches from the surface during the spring months. Insufficient soil moisture results in lack of fruit bud formation, and,

if the deficiency is great, in the injury or death of the plants. Too much water, especially during the growing season, can be as injurious or even more so than insufficient (Fig. 3).

Organic Matter—Other factors being equal, blueberry plants increase in growth and productiveness in direct proportion to the increase in amount of organic matter contained in the soil (Fig. 4).

Texture—Blueberry plants are usually found growing in the wild state on soils ranging from sand to peat. For some time it was thought

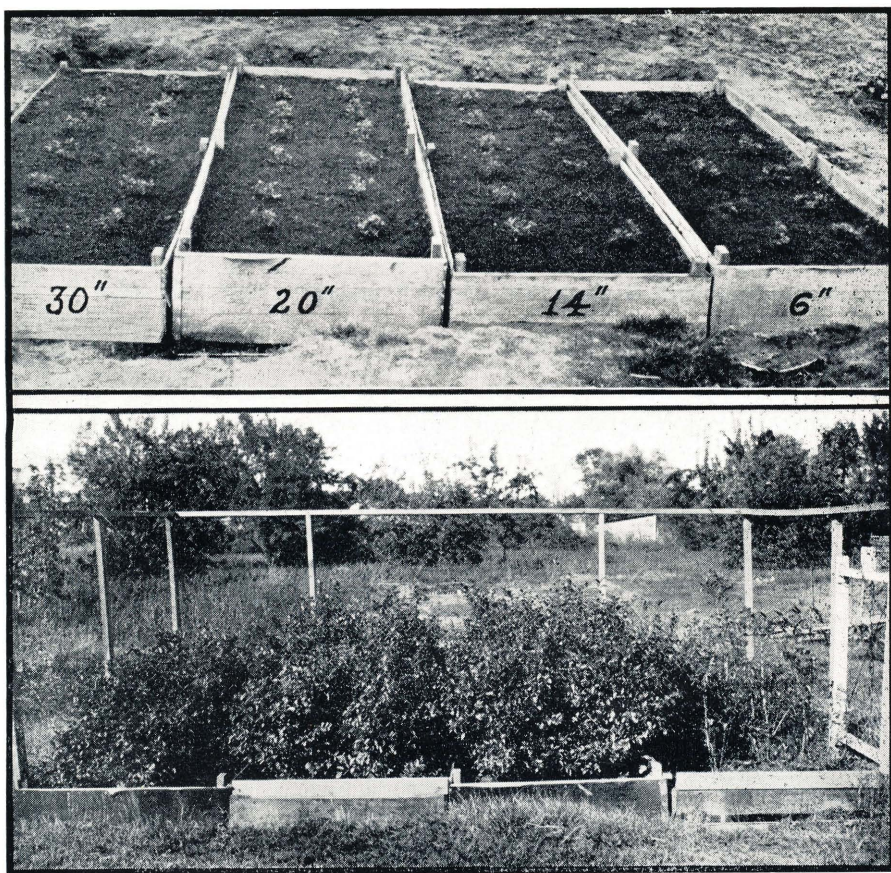


Fig. 3. Rubel plants with water table constantly maintained at different depths. Above: Plants soon after setting. Below: The same plants after 4 years' growth. From left to right: Water table maintained at 30, 22, 14, and 6 inches. The 30-inch water table did not furnish sufficient moisture, while the 6-inch water table was too near the surface.



Fig. 4. Blueberry plants in their fourth growing season, growing in (left) a white sandy soil having very little organic matter, and (right) in a soil well supplied with organic matter. The pH of both soils is about the same.

that they would not grow on a clay soil. However, recent experiments have shown that blueberry plants will grow well on such a soil provided it is sufficiently acid. Apparently, though, most areas of naturally suitable blueberry soils are of a sandy or peaty nature (Fig. 5).

Avoid Frost Injury

To obtain proper soil moisture requirements, it is usually necessary to establish the plantation on comparatively low land that is more subject to frost than higher land. Wide, open areas permitting as much movement of air as possible should be chosen. Avoid valleys or depressions with hills close by. Nearness to large bodies of water is added insurance against frost.

VARIETIES

Several varieties of improved blueberries are now available. They ripen in succession, beginning early in July in Michigan, providing fruit over a period of nearly 8 weeks.

Weymouth—The earliest named variety. Berries are large, dark blue, and of fair quality. Has not done well in Michigan. *see*

June—A few days earlier than Cabot. Ripens its berries in a short season. Berries of good size and quality. Difficult to propagate. Somewhat lacking in vigor and susceptible to leaf spot. Not recommended for commercial use in Michigan.

Cabot—Early. Bush low and spreading. Fruit medium-large and of fair quality. This variety is susceptible to injury from winter cold and frost. Frequently damaged by the cranberry fruit worm. Not recommended for planting in Michigan. *see*

Adams—Ripens about with Cabot. Bush large, upright, and productive. Heavy pruning required to produce berries of reasonably large size. Quality only moderately good. Planted very little in recent years. *see*

Stanley—Ripens in early-midseason. Upright, open bush that requires little pruning. Berries are large and of exceptionally good flavor. The berry has a large picking scar that may be objectionable in wet seasons. The most promising variety of its season. *see*



Fig. 5. Blueberry plants (left) growing vigorously in a soil having a high clay content (31.8 percent) and with a pH of 4.87; and failing (right) in a soil having a slightly smaller clay content (28.8 percent) but with a considerably higher pH reading of 6.08. This indicates that the proper degree of soil acidity is more important in the successful growth of the highbush blueberry than the clay content of the soil.

Rancocas—Ripens about with Stanley and just before Pioneer. Bush vigorous, upright, and productive. Requires heavy pruning as bushes grow older. Fruit medium-large, light blue, and of good quality. Of doubtful value for commercial planting in Michigan because of its susceptibility to leaf spot, and the cranberry fruit worm.

Pioneer—Ripens 10 days or 2 weeks after Cabot. The bush is spreading, fairly vigorous, and variable in productiveness. Apparently very susceptible to crop loss from unfavorable weather at blossoming time. Quality excellent.

Concord—Ripens about with Pioneer and resembles that variety somewhat. The fruit is large and of good quality. The skin tears easily in picking which is objectionable. However, the good type of bush, productiveness, and excellent flavor of this variety justify its fairly extensive commercial trial.

Dixi—Ripens in midseason. Berries large, dark blue, and of good flavor. It probably cannot compete with Jersey, which ripens at about the same season.

Rubel—Ripens about 14 to 18 days later than Cabot. Vigorous, upright bush that is productive. Berries are moderately large, light blue, attractive, and of good quality if allowed to ripen thoroughly but sour if picked too soon. The berry is very firm and, therefore,

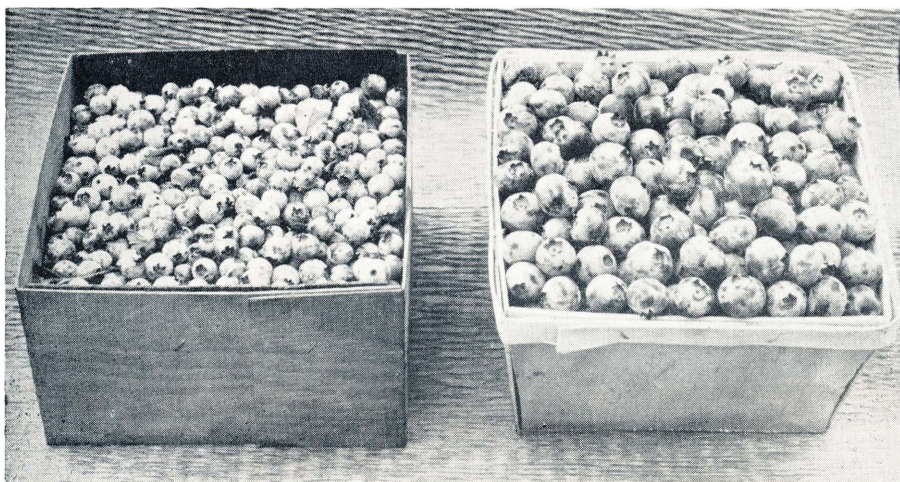


Fig. 6. Left: Wild blueberries. Right: A box of the Jersey variety of improved blueberries. This variety is becoming increasingly popular in Michigan.

an excellent shipper. Most widely grown commercial variety but at present is second in demand to Jersey.

Jersey—Ripens about with Rubel, possibly extending the season a little later. Bush semi-upright and very vigorous. Fruit large and firm, making it an excellent shipper. A very promising new variety of about the same season as Rubel that is rapidly increasing in popularity in Michigan (Fig. 6).

Atlantic—Ripens about with Rubel. Plants fairly vigorous and semi-spreading. Productive. The berries are large, rather flat in shape, light blue in color and of excellent flavor. The picking scar is very small. Only a few plants are in bearing in Michigan but it seems to be worthy of trial.

Pemberton—Ripens with Jersey. Very vigorous and productive. Berries large, round, medium-blue, and with a large picking scar that may be objectionable. Flavor fairly good. The great vigor and productiveness of this variety make it worthy of commercial trial.

Burlington—Ripens about a week or 10 days after Rubel. The plants grow slowly but eventually attain large size. Berries are medium in size, of good color, and excellent flavor. It is hoped that this variety will be of value in lengthening the harvesting season. It has not been grown long enough to determine its true value, which at present is questionable.

PROPAGATION

The blueberry is not easy to propagate by ordinary methods and requires special treatment as well as careful attention. Until recent years plants were so high in price that there was considerable incentive for users of even comparatively small numbers of plants to attempt to propagate their own. Now, unless one intends to grow large acreages, it will no doubt be found cheaper and more convenient, as well as time-saving, to purchase plants from growers or nurserymen.

The following outline of propagation methods is given for those who like to propagate their own plants:

Building the Propagating Frame

A so-called box propagating frame is used, measuring 6 feet long, 27 inches wide and 16 inches high. Dimensions for length and width may be changed to accommodate glass sash of various sizes that may be on hand. The cutting tray is made of 4-inch lumber with $\frac{1}{8}$ - or

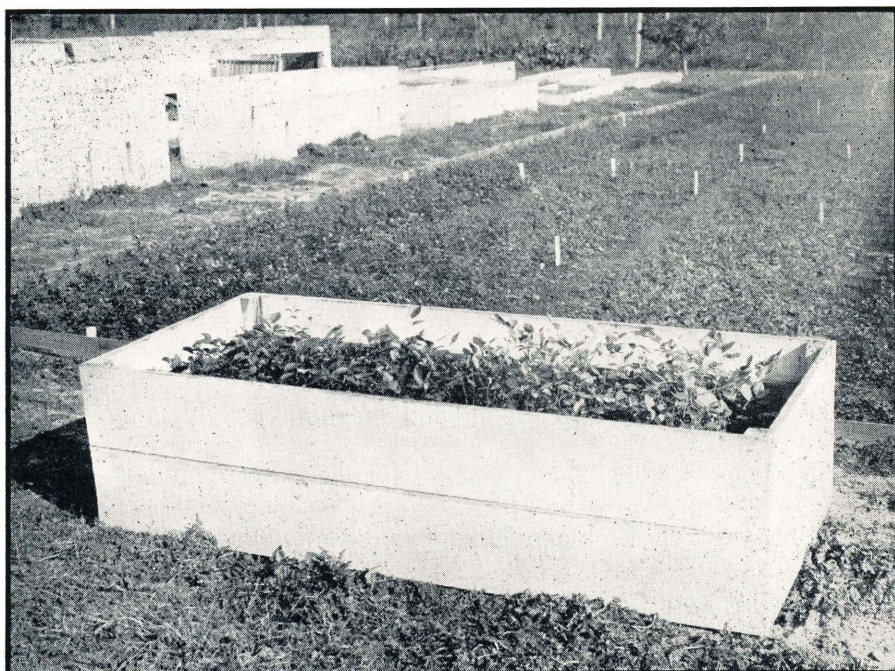


Fig. 7. A low box propagating frame, 16 inches high. See Fig. 8 for more details of construction.

$\frac{1}{4}$ -inch mesh hardware cloth stapled on the underside. This tray rests on braces nailed on the inside of the frame 8 inches from the top. It can be removed without disturbing the cuttings, which facilitates handling. After the cuttings are planted the glass sash and shade are placed on top of the frame. (See Figs. 7 and 8 for construction details.) Burlap similar to that used for bran sacks makes the best shading material as it provides just about the right amount of light. Closer or looser woven materials should not be used.

Location of Propagating Frames

It is important that the propagating frames be located in the open sunlight, well removed from buildings and trees.

Making and Storing the Cuttings

1. Blueberries are commonly propagated by means of cuttings made in late winter or early spring from shoots produced the previous season.

2. Use sound shoots of medium to medium-large size for cuttings. Avoid winter-injured wood or wood with fruit buds (Fig. 9).
3. Make the cuttings about 4 inches in length, the lower cut being made at a slant just behind the lowest bud, and the upper cut just above the top bud on the cutting.
4. Cuttings are best made with a sharp knife.
5. To make planting easier, cuttings should be bunched in groups of 50 with all the butts pointing the same way.
6. If stored before planting, the bundles of cuttings should be placed in shallow flats or propagating trays in clean peat moss which has been soaked in water and then pressed until just damp, but not too wet. Keep in this condition and store in a cool place until ready to plant. Many cuttings have been ruined by storing in too wet peat moss. (Usually better results will be obtained if the storage period can be eliminated or reduced to a very short time.) *extra*

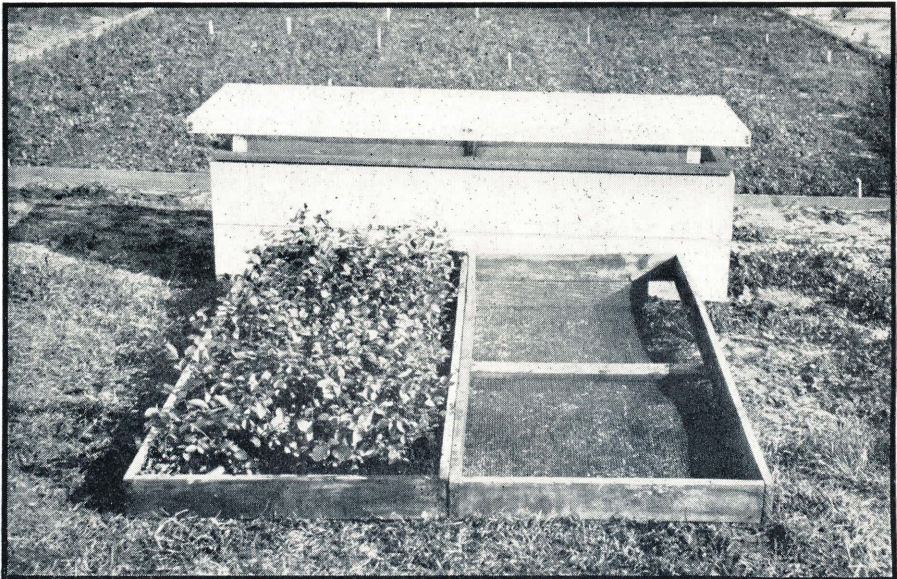


Fig. 8. Low propagating frame with glass sash and burlap shade in place. In front is an empty cutting tray and one filled with rooted cuttings. These trays set in the top of the propagating frame (see Fig. 7), and, being movable, provide a very convenient way of handling cuttings prior to planting in the nursery.



Fig. 9. Shoot at left shows winter injury; beside it is another shoot showing the extent of the injury. Shoot in center undesirable for cuttings because of the prevalence of fruit buds. Shoot at right illustrates best type of wood for hardwood cuttings. At the extreme right is a hardwood cutting ready for planting.

Material in Which to Root Cuttings

Ground sphagnum peat moss has given the best results as a material in which to root cuttings. The best peat of this kind came from northern Europe before the war. Since the war it has been coming largely from Maine and Canada, but is not so satisfactory. Do not use peat from local peat beds unless it has been carefully tested and found to be satisfactory.

Do not add soil, fertilizers or other materials to the ground peat moss (Fig. 10).

Planting Cuttings

1. Cuttings are usually planted about the middle of April in Michigan, or as soon as danger from severe freezing has passed.

2. The peat should be soaked before placing in the propagating frames by being submerged in water. The soaking period will range from two or three to several hours. Some peats become saturated

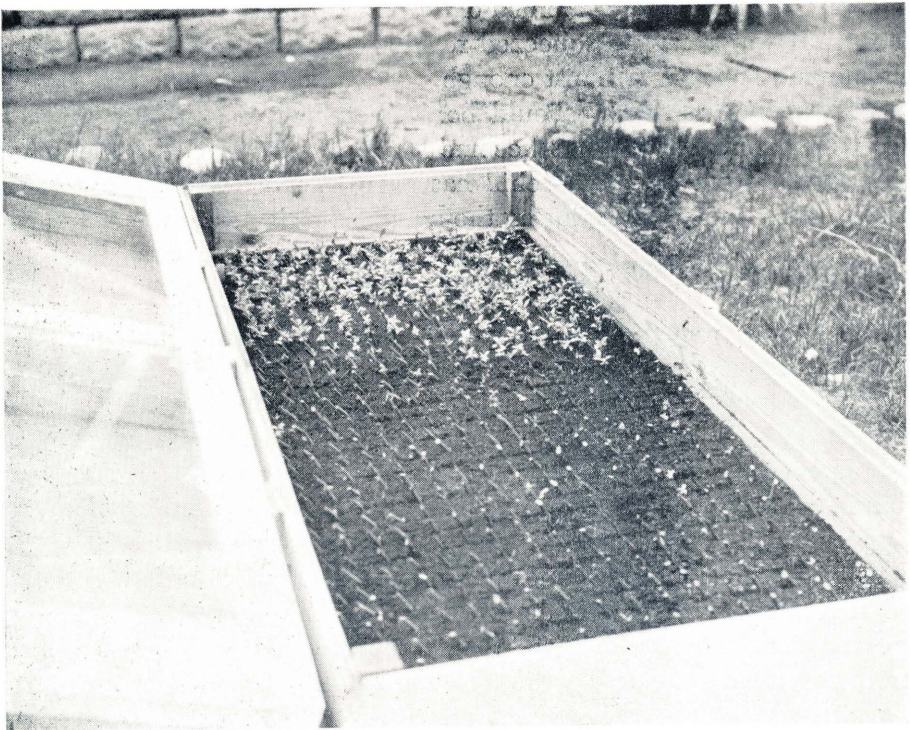


Fig. 10. Cuttings in the foreground of the propagating frame that have failed to start new growth were killed by fertilizer having been mixed with the peat. Those in the background are alive and growing where no fertilizer was added.

with water quickly. Too long a soaking period for such peats gives poorer results. A long soaking period does not seem to injure the peat from northern Europe. After soaking, fill the trays to the top to allow for settling.

3. To plant, push the cutting into the peat at a slant about two-thirds of its length. Plant in rows 2 inches apart and space the cuttings slightly more than an inch apart in the row.

4. Sprinkle thoroughly after the cuttings are in place.

5. The glass sash and burlap shade should be placed over the cuttings and kept there, except for watering periods, until the cuttings are well rooted, which is usually about the middle of July in Michigan. Sufficient ventilation may be obtained by permanently blocking up the sash about $\frac{3}{16}$ of an inch on one side.

Watering

The peat should be examined daily to determine if it is sufficiently moist. If water can be squeezed readily from the peat between the thumb and finger, it is moist enough.

If water is needed it should be applied with a sprinkler in the morning before the cuttings become warmed very much by the sun. Only water from which the chill has been removed should be used. Never water the cuttings during the heat of the day or in the evening.

Sanitation

Loss from fungous infection after planting is sometimes serious if the cuttings are not properly handled.

The cuttings should be examined every morning preferably, or at least every other morning, and all those showing signs of dying should be removed at once. Weak cuttings will not form roots and are a source of infection.

Foreign matter of all kinds and also leaves showing signs of fungous infection should be removed as soon as observed.

If fungous infection becomes established in the cutting bed, increased ventilation will assist in checking it. Care will have to be used not to increase ventilation to the point where severe wilting takes place.

Never spray cuttings in propagating frames to control fungous infection. To do so will almost certainly result in severe spray injury to the cuttings.

Ventilation

When one is certain that virtually all cuttings are rooted, the sash should be gradually blocked up a little higher each day for about a week or 10 days until the cuttings are fully ventilated. Then remove the glass sash but leave the burlap shade over the cuttings until about the middle of September when it can be removed to permit the cuttings to harden properly for winter. Water the cuttings when necessary, which may be frequently after the glass sash has been removed.

Storing Cuttings Over Winter

In October or early November, a trench 4 inches deep and wide enough to accommodate the trays of cuttings should be prepared. After the trays are placed in the trench, all open spaces should be filled in around them with soil. A closely woven wire fence is an added protection to keep dogs, cats and rabbits out of the trays during the winter.

Planting and Caring for the Nursery

The following spring the rooted cuttings should be removed from the trays and planted in the best available piece of suitable soil in rows 18 inches or more apart, depending on the method of cultivation, and about 6-10 inches apart in the row (Fig. 11).



Fig. 11. An excellent blueberry nursery. The best available piece of suitable land should be used for the nursery.

*after
up
hoe*
Cultivate and hoe the soil in the nursery thoroughly, until September, and then sow a cover crop if weed growth is not dense.

Better plants will be grown if the nursery is fertilized about a month after planting, or early in June in Michigan. (See discussion on the use of fertilizers.)

FIELD PLANTING

1. Plants two or three years old are considered best for field planting. Large plants do well but require more labor in digging, handling and planting. Small plants can be used but generally do not result in as good a stand, especially if a poor growing season is encountered after planting.

2. A planting distance of 10 feet by 4 feet is recommended. A narrower distance between rows does not permit tractor cultivation after the plants have reached maturity, and a wider distance too greatly reduces the number of plants per acre.

3. Wet spots in the field should be ridged before planting and the plants set on the ridges. Tile draining may be needed to remove excess water from some exceptionally wet places.

4. Leave as many roots and as much earth on the plants as possible in transplanting from the nursery row to the field.

5. Set plants an inch or two deeper than they grew in the nursery.

6. Do not put fertilizer or other chemicals in the plant holes. If the soil lacks organic matter, mixing a shovel full of peat with the soil in each planting hole will be helpful.

7. Either before or soon after planting, prune off all fruit buds on the plants. This will probably be sufficient pruning at this time unless the tops are very large in proportion to the roots left after digging.

PROVISIONS FOR POLLINATION

Recent experiments in Michigan by Merrill (2) indicate that the standard blueberry varieties now being grown commercially are self-fertile although experiments in New Jersey and Massachusetts have given opposite results. It is possible, therefore, at least in Michigan, to plant varieties in larger blocks than formerly was done. Larger blocks of a single variety simplify cultural operations somewhat,

especially harvesting. However, more than one variety—probably three or four—should be planted to extend the harvesting season and distribute any risks that might be involved in planting only one variety.

CULTIVATION

The blueberry plant is very shallow-rooted and accordingly, cultivation should be shallow. It should be frequent enough to keep down weeds. Light cultivation should be continued through the harvesting season, if possible. Heavily loaded bushes bending into the row-middles sometimes make cultivation difficult or impossible temporarily.

As soon as the harvest is over, a cover crop of some annual such as oats, Sudan grass, or mixtures of these or other suitable crops should be sown, unless an adequate weed cover crop can be obtained.

Hoeing is an expensive and time-consuming operation, but it is necessary for best growth, especially while the plants are young. It is also important in helping to control the mummy berry disease. (See discussion on mummy berry disease control.) The time and expense involved in hoeing can be reduced greatly by the use of a grape-hoe attachment on the tractor.

MULCHING

Blueberry plants grow well if mulched heavily with straw or sawdust. Mulching is recommended for small home plantings. Heavy straw mulches are not advised for commercial plantations because of the great fire hazard. Sawdust mulches are satisfactory commercially providing sufficient sawdust can be obtained. The mulch must be heavy, preferably 6 to 8 inches thick, which means that an enormous amount of mulching material is needed per acre. It will probably be necessary to add some mulch material each year. (Larger amounts of fertilizer will be needed if a sawdust mulch is used.)

USE OF FERTILIZERS

1. Excellent results have been obtained from the use of a complete fertilizer. (An 8-8-8 formula is recommended for sand soils, and a 3-9-18 formula for muck soils.)

whole article different

2. The potash in the above mixtures should be derived from sulfate of potash. Instances are known of injury to young blueberry plants from the use of muriate of potash, but no cases of injury on older plants have been reported.

3. It is recommended that 2 ounces of the approved mixed fertilizer be applied around each plant early in the spring of the second year in the field, and that this amount be increased one ounce each year until a total of 8 ounces per plant is being used. Moderate variations can be made in the amount of fertilizer used depending upon the fertility of the soil. The area fertilized should be widened each year about a foot beyond the spread of the bushes until the fertilizer is being distributed over the entire space between the rows.

4. Few growers fertilize the plants the first year in the field, but one ounce per plant may be applied about a month after planting if the soil is rather infertile. Care should be used not to allow the fertilizer to touch the leaves if late applications are made.

5. Never use fertilizer in the planting holes or in propagating frames. Instances of severe injury from these practices have occurred (Fig. 10).

6. Nursery beds may be fertilized about a month after the rooted cuttings have been planted, using the recommended complete fertilizer (8-8-8) at the rate of $\frac{1}{2}$ pound per 100 square feet and exercising care not to get any of the fertilizer on the plants. Mixing the fertilizer with an equal amount of sand makes it easier to apply in small amounts and prevents the fine fertilizer dust from blowing on the plants.

PRUNING

1. Blueberry plants need not be pruned until the end of the third year in the field. Then only the small bushy growth near the base of the plant should be removed.

2. Recent experiments at the South Haven Experiment Station conducted by Brightwell (3) showed that the heavier the pruning given mature blueberry plants the (1) smaller the crop; (2) larger the berries; and (3) higher the percentage of berries maturing early.

3. In Michigan late-maturing berries, even though medium-to-small in size, bring considerably better prices than larger, earlier maturing berries. This is because of less competition from wild blueberries, the bulk of which matures earlier than the cultivated, and from other fruits of the same season such as strawberries, raspberries and cherries. Therefore, some form of light pruning which will produce maximum yields of later maturing berries, even though somewhat small, seems best for Michigan growers. This situation might be entirely different in other areas where different marketing conditions prevail.

4. A light pruning each year is recommended for Michigan blueberry plantations for the following reasons:

- (a) To remove dead and broken branches and the large clusters of very thin, bushy wood that accumulate in mature bushes. These clusters of bushy wood can be removed with only a few pruning cuts. Do not remove small, thin shoots individually because of the high labor cost, and a certain proportion of this type of wood should be left in the bush to produce the later maturing berries.
- (b) To remove an occasional old stem (sometimes called cane) which has lost its vigor to the point where it no longer produces any moderately vigorous new shoots. Sometimes it is necessary to remove the entire stem to the ground, but more often it may be cut back to vigorous side shoots.
- (c) To remove bearing branches close to the ground. Berries on these branches usually get very dirty and pickers dislike to handle them.
- (d) To serve as insurance against extremely dry years when berries on unpruned bushes become very small (Fig. 12).

5. Plantations on light soils deficient in organic matter must be pruned more than those on better soils because of the inability of the lighter soils to furnish sufficient moisture to properly mature the large crops produced on unpruned or lightly pruned plants.

6. The type of pruning recommended can almost all be given mature bushes with lopping shears much faster and easier than with hand shears, thereby cutting the cost of pruning which is a time-consuming and expensive operation.

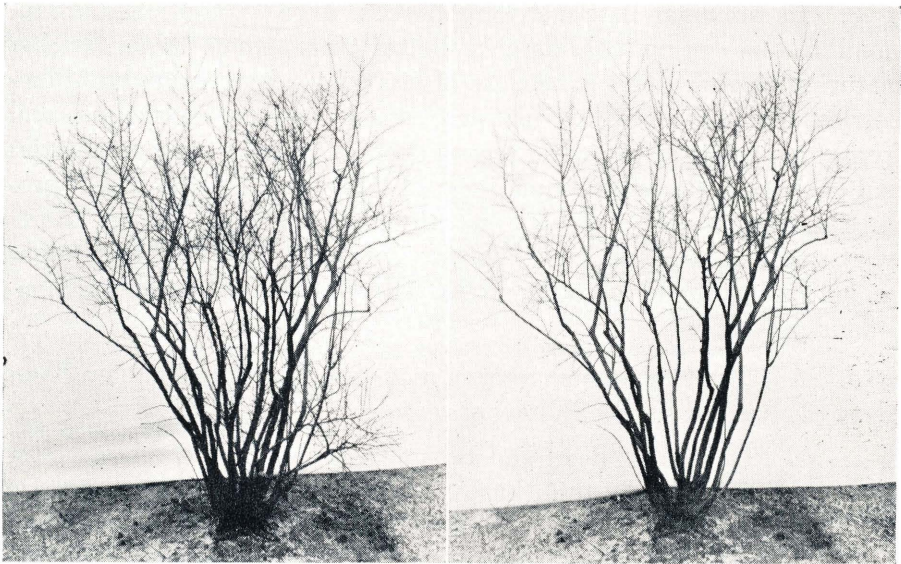


Fig. 12. Left: A mature Rubel bush before pruning. Right: The same bush after receiving the light type of pruning recommended for the average Michigan plantation. Low branches and one old stem have been removed together with a few of the largest clusters of fine, bushy wood. Plants growing on light soils poorly supplied with organic matter will probably have to be given somewhat heavier pruning than shown above.

7. Pruning may be started as soon as the leaves drop in the fall and be continued as late as through blossoming time or slightly after if necessary.

INSECTS

Several insects attack the blueberry plant. Most of them are of minor importance but a few are distinct threats to the blueberry industry, especially the cranberry fruit worm and the blueberry fruit fly.

Cranberry Fruit Worm

This insect works on the berries, beginning about a month before maturity. Clusters of berries are webbed together by the young worms, and these clusters are rendered worthless. This pest has been increasing in importance in Michigan for several years. The best control is obtained by dusting with a 1-percent rotenone dust, at the rate of 30 pounds per acre. The first application should be made just before the berries touch in the clusters, and the second 10 days later. A thorough job of dusting is necessary for control.)

different spraying method

Caterpillars

Several different kinds of caterpillars attack the leaves of blueberry plants, especially during July and August, and can quickly devour the leaves on a large plant. They have not been prevalent enough in Michigan to require spraying entire fields. Pickers should be asked to report them. The caterpillars can then be brushed off the plants and crushed, or heavily infested twigs can be removed and burned.

White Grubs

These grubs are the larvae of June beetles and, on a few occasions, have injured blueberry plants seriously by eating the fibrous roots. Plants set on newly turned sod are most subject to attack. It is better to plant on land which has been cultivated the previous year. Little if any trouble should be experienced if this precaution is followed.

Blueberry Fruit Fly or Blueberry Maggot

This has been the most troublesome blueberry insect in eastern United States for several years. A light infestation was found in a few Michigan cultivated blueberry fields for the first time in 1943. The adult is a fly, similar to that of the apple maggot, but smaller. It appears early in the blueberry season, usually in early July. The female must have soft, overripe berries in which to lay her eggs; hence, it is important to do a thorough job of harvesting all ripe berries at each picking. The eggs hatch into small, light-colored maggots, $\frac{1}{4}$ to $\frac{1}{2}$ inch long, which work inside the berries. Soft, overripe berries should not be sent to the fresh market or cannery. Michigan blueberry growers should contact the Entomology Section of the Michigan Agricultural Experiment Station, East Lansing, for information on control measures. Eastern growers can obtain directions for control from the New Jersey and Massachusetts Experiment Stations located at Pemberton and East Wareham, respectively.

DISEASES

Stunt

Plants with this disease become dwarfed in size, the foliage is smaller, somewhat mottled and cupped, and the berries are small, later in maturing and worthless (Fig. 13). This disease has been preva-



Fig. 13. Above: A healthy three-year-old Jersey plant (left) and a plant of the same variety and age (right) infected with the stunt disease. Below: A healthy shoot (upper left) and one (lower right) infected with the stunt disease. This disease is caused by a virus, and infected plants are stunted in growth, have smaller leaves that are curled, cupped, and mottled in color, and the berries are very small, late in maturing and worthless. Systematic removal and burning of the diseased plants is the recommended treatment.

lent in fields of cultivated blueberries for many years but has become serious only in a few instances. However, like all virus diseases, it is potentially very hazardous and growers should remove all infected plants as quickly as observed. Plantations should be examined systematically once or twice during the growing season to search for diseased plants. These should be removed and burned.

Annual inspection of blueberry fields for the stunt disease is now necessary in Michigan if plants are grown for sale. *added here Insp*

Mummy Berry

different
In some seasons, growers are greatly concerned to see many berries turn pale in color before ripening and finally turn gray and shrivel. Losses are occasionally severe, especially following wet springs and in plantations growing on peat soils or moist, sand soils containing large amounts of organic matter. The disease is caused by a fungus, *Sclerotinia vaccinii* Wor. It is not present in serious proportions every year, and is less serious if the weather is dry during the blossoming period when infection takes place.

Many experiments for the control of this disease have been tried at South Haven. Best results have been obtained from early and thorough cultivation. Suggested procedure is as follows:

1. Plow fields or parts of fields where infection has been severe, as early in the spring as possible. Complete at least 2 weeks before blossoming. Often there are several dry days in March or early April before spring rains begin. Take advantage of these days. If impossible to work the field in early spring, plow, cultivate, and hoe in early November. This is recommended **only** where mummy berry infection is severe and where the field cannot be cultivated in early spring. Plowing gives better coverage of mummied berries than disking. Plowing should be shallow. A three-bottom vineyard plow is an excellent implement for this purpose.

2. Hoe between the plants immediately after plowing. Hoe worst infected areas first. Hoeing is extremely important. Experimental plots not hoed had over 50 percent more infection than hoed plots. Before hoeing, remove mummied berries lodged in plant crowns with a sharp stick.

3. Cultivate the field in the spring once a week, beginning soon after plowing and continuing until after blossoming. This is to destroy spore-producing shoots that arise from the old mummied berries.

different control measures

Other Diseases

There are various twig blights and galls on blueberry plants caused by diseases that at present are not of sufficient importance in Michigan to require control measures.

PRODUCTION

Production begins in a small way the year after planting, although it is best to remove the blossoms to prevent bearing. The second-year crop is too small to be of importance and all of the strength of the bush might better go into growth.

Yields vary greatly with soil conditions and care, but on the average 200 to 400 quarts may be harvested the third summer in the field, and 700 to 1,000 quarts the fourth summer. Plants reach full bearing in about eight years. Average yields in full bearing, under good conditions, should range from 2,000 to 3,000 quarts per acre, although occasionally much higher yields are obtained.

Blueberry bushes are usually long-lived, some plants being known that are probably considerably over 100 years of age and in good condition.

HARVESTING

Harvesting begins in southern Michigan early in July, in a normal season, and extends until about September 1, with the peak production reached during the first week in August.

Blueberries hang on the bushes exceptionally well after maturity, better than most small fruits. Picking once a week is usually often enough.

Picking should be done carefully. Only fully ripe berries should be picked, as those having a reddish tinge are sour. Each bush should be picked cleanly so that no overripe berries are left for the next picking (Fig. 14).

In Michigan, the berries are picked into small pails fastened around the picker's waist, although in New Jersey picking directly into the pint cups or boxes is preferred. The former method has the advantage of inspecting the berries as they are poured from the pail into the pint cups and of removing cull berries, leaves, sticks and other foreign material. Picking directly into the pint cups or boxes which will be sent to market leaves more of the natural blue bloom



Photo: A. B. Morse Co., St. Joseph, Mich.

Fig. 14. A packed pint box of blueberries ready for market. Note the cellophane cover and grade designation. This pack has met with general approval on the markets.

on the berries. Each picker has a carrier, usually holding eight pint cups. When these are properly filled they are taken to the packing shed.

GRADING AND PACKING

A very large share of the cultivated blueberries produced in the United States is marketed through the Blueberry Cooperative Association, a cooperative organization embracing most of the blueberry growers in New Jersey, North Carolina and Michigan, the three principal producing states. Similar grades are packed in each state under slightly different names. The three top grades are sold under the master brand name of Tru-Blu-Berries.

Michigan grades are as follows:

- Superior—85 or fewer berries in a measuring cup. ⁹⁰
- Golden Moon—86 to 130 berries in a measuring cup. ⁹¹⁻¹⁴⁰
- Columbia—131 to 190 berries in a measuring cup. ¹⁴¹⁻¹⁹⁰
- Lake State—All marketable berries more than 190 to a measuring cup.

The berries are not actually run over a grading machine but are graded by means of occasional measuring cup counts. With a little practice, one can place berries in the proper grade at a glance.

The pint cups or boxes are filled rounding full and then covered with a sheet of cellophane on which has been printed the proper grade name. The cellophane sheet is fitted tightly around the pint box and held in place by means of a rubber band or piece of sticker tape.

Growers not belonging to the Blueberry Cooperative Association generally use cellophane covers with their own brand names and distinctive types of package.

MARKETING

The Blueberry Cooperative Association has established certain grades and standards which all members must meet. This has proved to be an orderly, efficient and satisfactory method of marketing.

The large cultivated blueberry has met with a favorable reception on the markets for fresh fruit, canning and quick-freezing. The fresh berries may be used in many ways including serving with sugar and cream, as an attractive addition to fruit salads, and on ice cream. The canned or quick-frozen berries are famous for pies and various kinds of muffins and puddings (Fig. 15).

CONCLUSION

There is always a fascination about growing something new, and no doubt many persons will be tempted to grow cultivated blueberries who do not have the proper conditions available. It is important to note that blueberry culture, owing to exacting soil and climatic requirements, is a highly specialized type of fruit growing. Prospective growers should consult their experiment stations or successful blueberry growers for advice before proceeding.

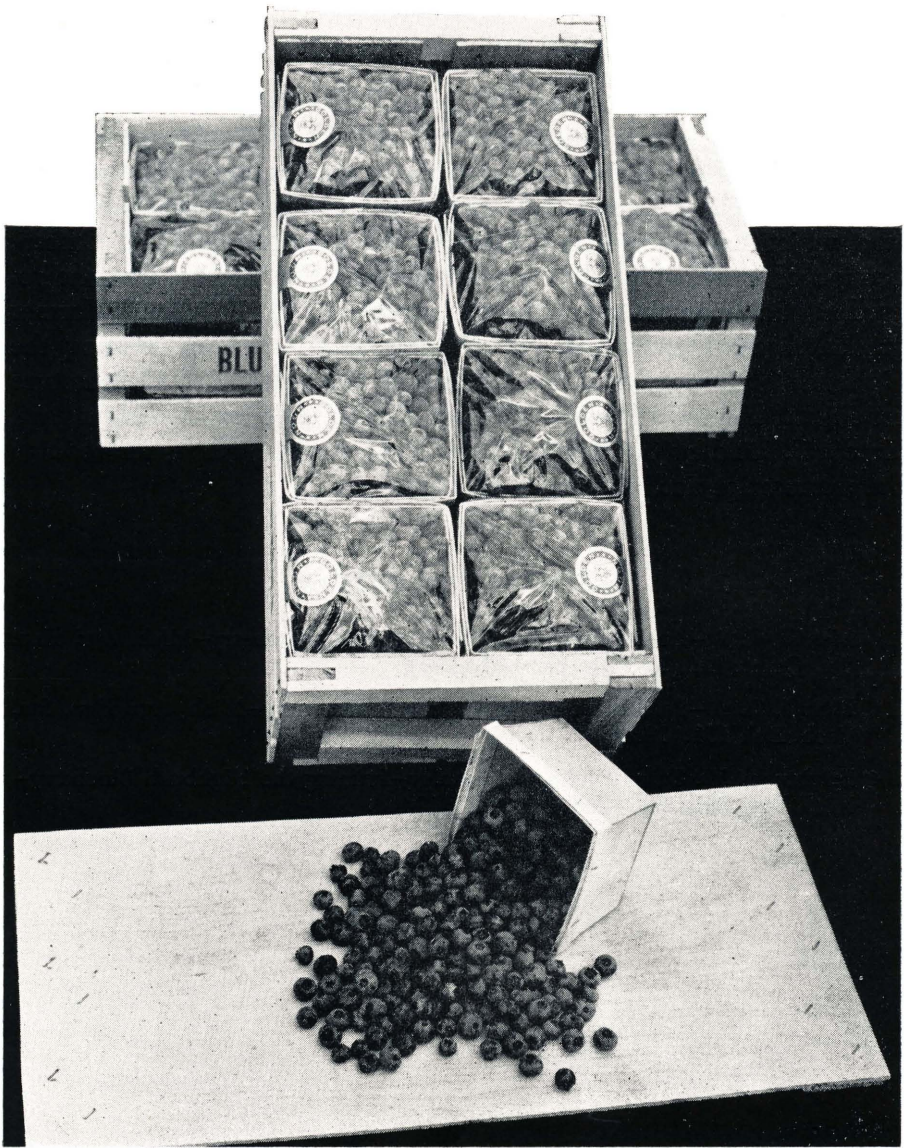


Photo: A. B. Morse Co., St. Joseph, Mich.

Fig. 15. Nearly all cultivated blueberries are marketed in 16-pint crates. Packed in this way, cultivated blueberries can be shipped satisfactorily very long distances, going from Michigan to New York and Los Angeles.

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