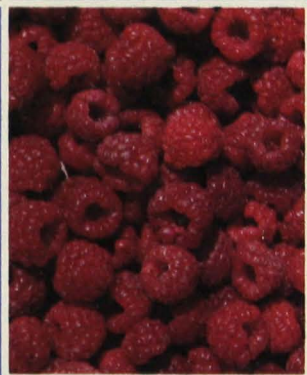
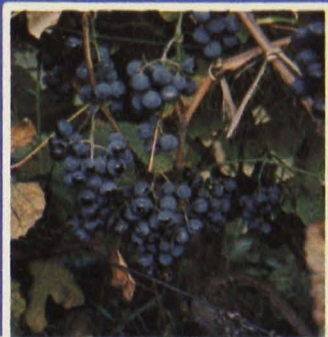
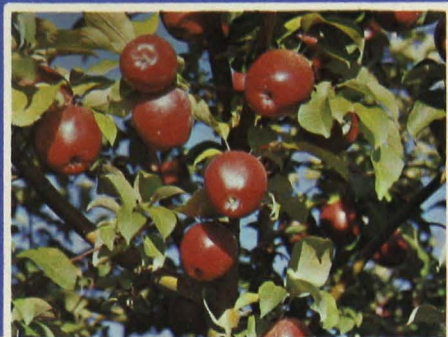


MN 2000 EB/255 rev. '81



Fruit for the Home

This archival publication may not reflect current scientific knowledge or recommendations.
Current information available from University of Minnesota Extension: <http://www.extension.umn.edu>

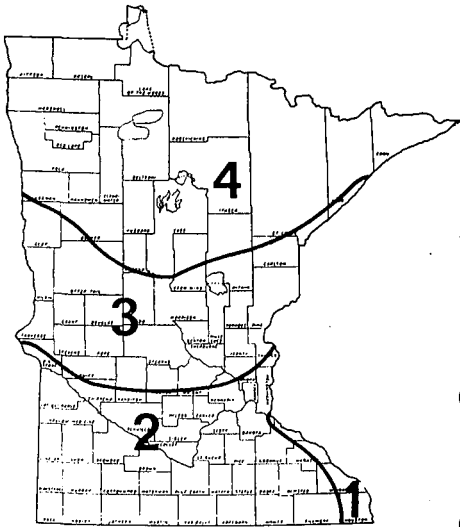
L.B. Hertz

Extension Bulletin 255 — Revised 1981
Agricultura Extension Service
University of Minnesota

UNIVERSITY OF MINNESOTA
DOCUMENTS

MAY 9 1985

ST. PAUL CAMPUS
LIBRARIES



Minnesota Fruit Zones

Contents

General Planning	
Selecting the Site	3
The Planting Plan	4
Care Before Planting	4
Why Trees Fail to Bear	6
Culture of Tree Fruits	
Apples and Pears	6
Dwarf Apples	15
Stone Fruits	15
Culture of Small Fruits	
Strawberries	19
Raspberries	25
Currants and Gooseberries .	30
Grapes	31
Blueberries	35
Wild Fruits	35

L. B. Hertz*

*L. B. Hertz is an extension horticulturist and professor, Department of Horticultural Science. The author gratefully acknowledges the contributions of J. A. Lofgren, extension entomologist and professor, Department of Entomology, Fisheries, and Wildlife, and H. G. Johnson, extension plant pathologist and professor, Department of Plant Pathology.

INFORMATION ON FRUIT SPRAYS

For information on home spraying, see Extension Folder 375, *Home Fruit Spray Guide*. For information on commercial spraying, see Extension Folder 583, *Commercial Apple Pest Control Guide*, Horticulture Fact Sheet 51, *Commercial Strawberry Pest Control Guide*, and Horticulture Fact Sheet 52, *Commercial Raspberry Pest Control Guide*. Copies are available from your county extension agent or from the Bulletin Room, Agricultural Extension Service, University of Minnesota, St. Paul, Minnesota 55108.

Mention of commercial names does not imply endorsement nor does failure to mention a name imply criticism.

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. Norman A. Brown, Director of Agricultural Extension Service, University of Minnesota, St. Paul, Minnesota 55108. 60¢

Fruit for the Home

Growing fruit in your garden or home orchard can be interesting as well as profitable. With proper planning, you can enjoy luscious vine- and tree-ripened fruit throughout the year. In addition to being good to eat, fruit furnishes bulk and many body-building minerals and vitamins essential to good health.

Your success in growing fruit will depend on:

- planting site selection
- choice of varieties adapted to your locality
- pest control
- cultural care

Since good fruit can be grown in every county in Minnesota, you should be able to grow your own supplies for fresh use, freezing, and canning.

Information on the cultural requirements of each commonly grown fruit follows.

GENERAL PLANNING

Selecting the Site

In many parts of Minnesota, selecting the proper planting site for fruit is of utmost importance. The soil should be fertile and well-drained for most fruits. Avoid soils of sandy texture for growing apples in northern Minnesota. Air drainage also is necessary since protection against late spring frosts may mean the difference between a good crop and no crop.

Select a comparatively level site for small fruits and tree fruits such as apricots, plums, and cherry plums, which require cultivation. However, for air drainage, there should be some slope over the area leading to a lower level; then, cold air can drain during frosty periods. If your site is on a slope, plant rows on the contour to prevent erosion. Grapes demand a southern exposure to aid ripening.

If a natural windbreak is not present, provide one on the north, south, and west sides of the orchard. You can provide one by locating your orchard within the farm shelterbelt. For small fruits such as strawberries and raspberries, protection from hot south and west winds probably is

most important. To avoid root competition and shading, don't plant fruit too close to windbreak trees. Allow 50 feet from the inner row of the shelterbelt trees to the fruit trees.

Also consider the proximity of the site to your house. You can plant small fruits, such as strawberries and raspberries, at one end of your vegetable garden.

The Planting Plan

Since fruit planting represents considerable expenditure in time and money, follow a carefully considered plan. Give thought to spacing, number of plants, selection of varieties, and arrangement.

Using the information in the following table and in Horticulture Fact Sheet 3, *Fruits for Minnesota*, draw up a plan that meets your own requirements. Remember that a small, well-cared-for planting yields more fruit than a large, neglected one. Allow ample space for tree fruits to develop without crowding. Then you will have low spreading trees that are easy to spray and harvest.

Care Before Planting

Fall or early winter is the best time to plan your fruit planting and place your order for nursery stock. Order only those varieties that are adapted to your area, and order early so you will get the varieties you want.

It is best to purchase plants from a local reputable nurseryman. This reduces shipping costs and assures delivery of the stock in the best possible condition. Generally, order from a northern nursery rather than one too far south or east; a northern nursery is apt to have adapted varieties grafted upon hardy rootstocks. This is vital—a tree can be no hardier than its root system.

The size of nursery stock is less important than its condition. Plants should be vigorous and healthy with well-developed root systems. A 2- or 3-year-old tree that is well-branched usually bears fruit earlier than a 1-year-old whip. In northern and western Minnesota, where a lowheaded, bushy tree may be desired, a small tree that can be cut back severely when planted gives the best results.

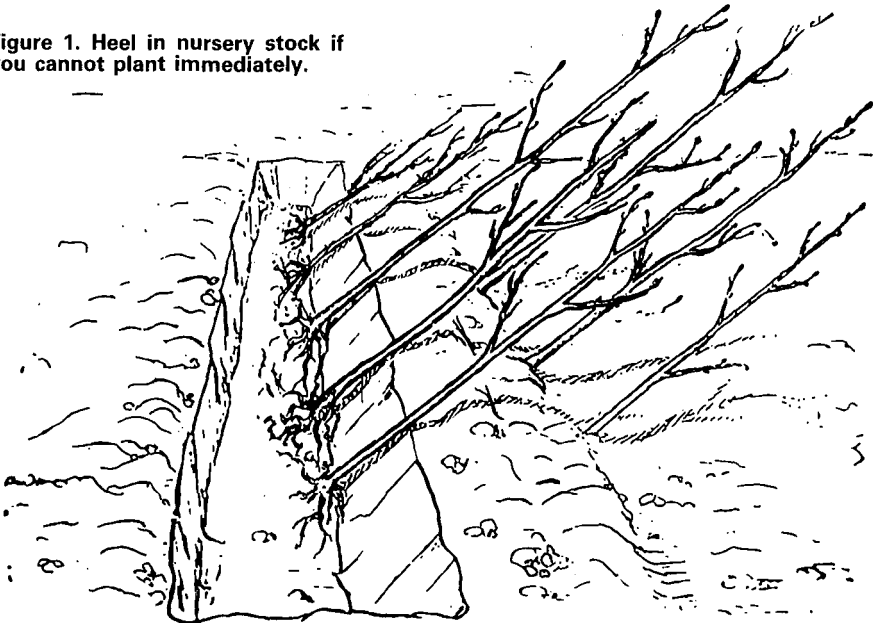
Early spring is a good time to plant most fruit. When the nursery stock arrives, examine it carefully. If roots are dry, place them in water for several hours. Plant immediately if the weather is satisfactory. If not, heel the plants into moist soil on the north side of a building or in some other cool, shady spot (figure 1). You can hold carefully heeled-in nursery stock for a week or longer if necessary. Be sure to keep roots moist and covered at all times.

Planting distances, time intervals from planting to fruiting, approximate yields, and ripening dates

Fruit	Distance between rows	Distance between plants in row	Time from planting to fruiting	Approximate yield per plant	Ripening period
	feet	feet	years		
Small fruits					
Currants	8	5	3	2-3 qts.	July
Gooseberries ...	8	5	3	2-3 qts.	July
Grapes	8	8	3	4-6 qts.	Sept.-Oct.
Raspberries ...	6-8	2½-4	2	1 qt.	July-Oct.
Strawberries ...	4	2	1	½ qt.	June-Oct.
Blueberries	6	4	1	1-2 qts.	July-Aug.
Tree Fruits					
Apples					
(nondwarf type)	25	25	4-10	5-10 bu.	Aug.-Oct.
Apples (dwarf type)*	20	15	2-4	2-4 bu.	Aug.-Oct.
Crabapples	25	25	3-7	5-10 bu.	Aug.-Oct.
Apricots	20	20	2-4	1-2 bu.	July-Aug.
Cherries					
(sour)	15	15	3-5	¾ bu.	July-Aug.
Cherries (Nanking)					
	8	6	2-3	2-4 qts.	July
Cherry plums ..	15	15	2-4	1 bu.	Aug.-Sept.
Plums	20	20	3-5	1-2 bu.	Aug.-Sept.
Pears	30	30	5-10	4-6 bu.	Sept.-Oct.

*See section on dwarf apples, page 15.

Figure 1. Heel in nursery stock if you cannot plant immediately.



Why Trees Fail to Bear

Failure of a fruit tree to produce fruit is a common and often perplexing problem. Of course, a tree must attain some size and age before it flowers and fruits. And the time required varies with the kind of fruit, the variety, and the growing conditions.

Generally, pears take longer than apples, apples take longer than crabapples, and crabapples take longer than plums—although some plums may be much slower than crabapples. The time interval between planting and fruiting may range from 10 years for some pear and apple trees to 1 or 2 years for some crabapples and plums.

If you induce rapid vegetative growth by applying excessive nitrogen fertilizers, overwatering, or pruning heavily, flowering will be delayed. Trees growing in the shade also may be greatly delayed.

One common reason for failure to bear is lack of proper pollination. Some fruit trees are self-sterile and produce defective pollen, whereas many others are incompatible. Pollination may be insufficient if there is a lack of bees at time of bloom.

To guard against a lack of good pollen, plant more than one variety of apples, pears, and apricots. Hybrid plums produce defective pollen, so always include a pollinator variety in the planting. (See the discussion on pollination under stone fruits.)

CULTURE OF TREE FRUITS

Apples and Pears

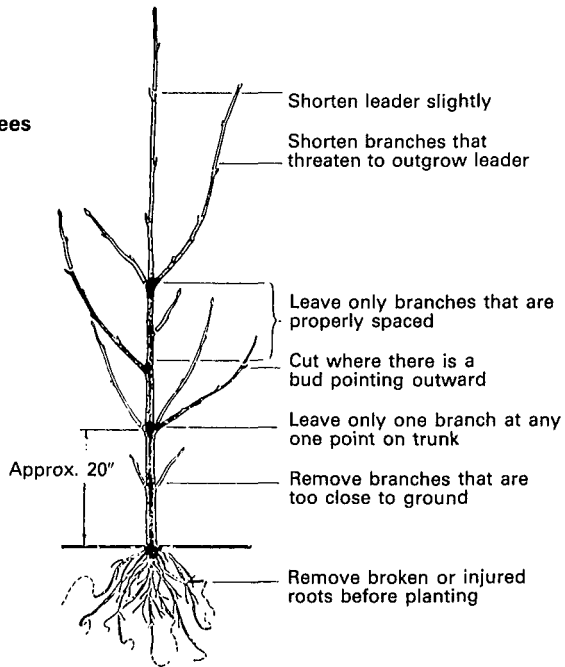
PLANTING. If the area is sufficiently level to prevent erosion, thoroughly prepare the soil for your apple and pear orchard during the season before planting. On a steep slope, start the trees in an established sod. During the previous summer, spade and work the soil in a 3-foot circle where each tree is to be planted.

Plant trees in the early spring as soon as the soil can be worked. Make the hole large enough to accommodate the root system without bending the roots and deep enough so the newly planted tree is about 1 inch deeper than it was in the nursery.

When making the hole, place the topsoil in a separate pile from the subsoil. Prune any broken or long, straggly roots. Then place the tree in position with the first strong, wide-angled branch toward the southwest. Work the topsoil around the roots and tramp it to compact the soil and remove air pockets. Add a pail of water if the soil is dry. Finish filling the hole, using the subsoil on top.

Leave the surface 2 to 3 inches loose with a shallow depression around the tree to catch and hold water. Prune the young tree carefully, selecting strong, wide-angled branches to form the framework (figure 2). These

Figure 2. Prune young fruit trees when you plant them.



“scaffold” branches should be at least 6 inches apart, up and down the trunk.

When planting apples and pears, allow ample room for the trees to develop without crowding. (See the table on page 5 for approximate planting distances.) Close planting results in upright trees that are difficult to spray and harvest.

SOIL MANAGEMENT. Young trees have difficulty competing with weeds for water and nutrients. On level or nearly level ground, an area extending 3 feet in all directions from the trunk of the tree should be cultivated or mulched in order to eliminate grass and weeds. As trees approach bearing age, a grass sod should be established. Bluegrass makes a good ground cover for mature trees.

In dry parts of the state, it may be advisable to continue cultivation in the mature orchard if new growth at branch tips is less than 8 inches. Where it is moist, however, it may be advisable to establish the sod earlier if terminal growth is extensive. Rapid, succulent growth is more subject to winter injury and fire blight.

On steep slopes, you can successfully plant apples and pears in sod. Keep an area around the base of the tree worked, and add fertilizers as needed. Mow the grass two or three times each season; allow clippings to remain on the ground.

A straw mulch, if used, should be about 6 inches deep or deep enough to smother weeds. Replenish this mulch each fall. If the grass is tall when cut, you can rake it up and use it for mulching under trees. This mulch aids in moisture penetration and weed control.

Since the mulch may increase the fire hazard in dry periods, take special care to prevent fires.

Use commercial fertilizers as needed. If growth is satisfactory and leaves appear vigorous and dark green, it is not advantageous to fertilize. But if growth is slow and leaves are small and light green, fertilizers are beneficial. A complete fertilizer such as 10-10-10 is probably the best choice for the home gardener. However, some successful orchardists use only ammonium sulfate or ammonium nitrate.

Some orchardists apply fertilizer in a broad ring starting about 2 feet from the trunk and extending beyond the branch tips. Others use a fertilizer spreader and cover the ground uniformly between trees. In the latter case, a heavy grass growth is encouraged over the entire area; sufficient mulching material then can be grown in the orchard.

The application rate varies with the size of the trees and the application method. Apply ammonium sulfate or ammonium nitrate at the rate of about $\frac{1}{2}$ pound for each inch of trunk diameter. A young tree, 2 to 3 years old, requires about $\frac{1}{2}$ pound, while a mature tree might take 4 to 6 pounds. Double the rate for a complete fertilizer such as 10-10-10.

If you fertilize the entire area between trees, apply about 300 pounds of ammonium sulfate or ammonium nitrate per acre or about 600 pounds of a complete 10-10-10 fertilizer per acre.

The best time to apply fertilizers is early spring before growth starts. Late spring or summer applications may encourage late growth with resulting winter injury.

PREVENTING WINTER INJURY. Cold temperatures may have harmful effects on apple and pear trees throughout Minnesota. By planting hardy varieties, you will reduce losses from winter injury.

Cold injury due to immaturity of wood (cold occurring before the tree has developed cold hardiness in the fall) usually results from conditions causing trees to continue vigorous growth into the fall. Too much water, abnormally warm fall temperatures, and excessive amounts of nitrogen may cause excessive fall growth and predispose the tissues to cold injury. To reduce winter injury, keep trees moderately vigorous before winter arrives. Avoid practices such as late cultivation, excessive irrigation, and heavy or late applications of nitrogen fertilizers that tend to stimulate fall growth.

Sunscald, another type of injury, normally occurs in late winter on the southwest side of the main trunk and large branches. Bark, being brown or gray, absorbs the sun's rays in midafternoon and often warms up to 20° F. above the surrounding air temperature. Bright sunny days in late winter may activate the cambium and bark tissues on southwest stem exposures. This reduces their cold resistance and may result in injury due to cold night temperatures. The bark then dries and splits; wood-rotting fungi enter and may seriously weaken or even kill the tree.

To protect a tree from sunscald, shade the southwest sides of the main trunk and large branches. Simply tie narrow boards to the branches and

main trunk, wrap the stem with strips of burlap, or hang evergreen branches on the southwest side of the main branches and trunk. Painting the trunk with a white latex paint may help reduce sunscald, since white paint lowers the temperature by reflecting light.

A tree that is headed low and has a heavy growth of branches on the southwest side has some natural protection against the sun's energy. Usually such a tree is damaged less by sunscald.

MICE AND RABBITS. Many young fruit trees are lost each year because of girdling by rabbits and mice. To prevent girdling, enclose the trunk's base with a cylinder of $\frac{3}{4}$ -inch mesh hardware cloth (figure 3). Make this cylinder at least 6 to 8 inches in diameter, and extend it from about an inch below the soil level to the first branch. A less permanent protection is to wrap the base of the trunk with heavy burlap.

These safeguards should successfully prevent mouse damage and reduce rabbit damage. But when the snow is deep rabbits may eat branch tips, so try to reduce the rabbit population—trap and shoot them where permitted. Leaving pruned branches on the ground also reduces damage to living trees; rabbits chew the bark from the branches and leave trees alone.

Many chemical sprays and paints are recommended as rodent repellants. Among these Arasan 75, Thiram 42-S, and Ringwood Chemical Corporation's Ringwood Repellant usually are effective. You can make a similar preparation by dissolving $1\frac{1}{2}$ pounds of crushed rosin in 1 quart of ethyl (grain) alcohol. Use a paint brush to apply these preparations to the trunk and lower branches.

Some orchardists greatly reduce losses from mouse injury by putting cinders around the base of the trunk to a depth of about 6 inches. Remove all leaves and trash from around the base or stem in the fall for added effectiveness. Baiting with poison grain also effectively reduces the mouse population.



Figure 3. Protect fruit trees with a cylinder of hardware cloth to prevent mouse and rabbit damage.

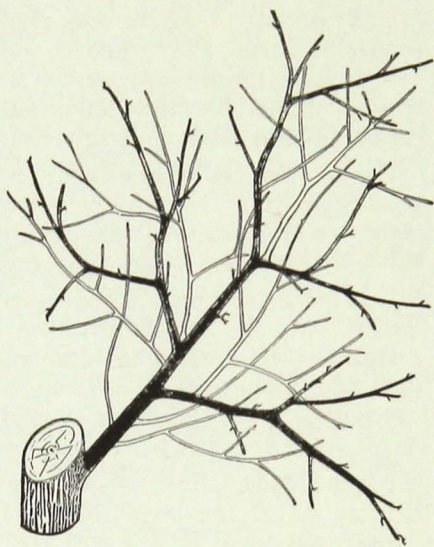


Figure 4 (left). When pruning young trees, leave strong, wide crotches (1 in photo) and eliminate narrow-angled crotches (2 in photo).

Figure 5 (right). When pruning a bearing fruit tree, remove branches that are too close to the trunk, weak shoots that crowd bearing branches, and branches in crotches of other branches (white branches in drawing).

LIVESTOCK INJURY. Too often the farm orchard is used as a pasture for livestock. There is no surer way of ruining your orchard. Besides damaging the trees by browsing and rubbing, livestock pack the soil. Even chickens can do a great deal of damage by scratching up the grass and exposing the soil to the sun.

PRUNING. Your pruning job helps to shape the young apple or pear tree and to give it a strong framework. Pruning at planting time consists simply of removing all side branches except those selected for the permanent framework and heading back the selected branches. You also have to prune during the second and third years to remove narrow crotches and select additional scaffold branches (figure 4).

The ideal tree has a central leader and six to eight well-spaced scaffold branches. These scaffold branches should come from the main trunk at a wide angle and be uniformly spaced around the trunk. If any side branches grow upward and overtake the leader, head them back.

Make all cuts as close to the main stem as possible to insure rapid healing; use a sharp knife or pruning shears. When it becomes necessary to cut a branch back from the tip, always make a smooth cut just beyond a side branch or lateral bud. Remember, pruning is a dwarfing process. Continued heavy pruning of a young tree lengthens the time before the tree bears.

As the tree approaches maturity, a light pruning each year is beneficial. Remove any dead or diseased branches such as those showing fire blight cankers. Make the cuts as close to the main stem as possible. If the branch is large, first undercut to prevent tearing the bark when the branch falls. Paint large scars, 2 or more inches in diameter, with asphalt tree paint. Remove all water sprouts (fast growing, upright branches) and branches that cross and rub (figure 5).

Remove small branches near the center of the tree that have ceased to grow more than a few inches in length each year; they produce only small, poorly colored fruits. Little pruning should be necessary at the top and sides of the tree.

It is better to prune a little each year than to prune heavily at infrequent intervals. Severe pruning upsets a tree's balance. It also often results in production of an abnormal number of water sprouts which may increase the danger of fire blight.

Early spring, before growth starts, is the best time to prune your fruit trees. Complete heavy pruning by mid-April. You can remove water sprouts and weak branches during summer months. For additional information, see Extension Folder 161, *Pruning Fruit Trees*.

THINNING. Many varieties tend to be "alternate bearing"—they may set a heavy crop one year and produce very little or no crop the next.

Formation of fruit buds for the following year's crop begins a few weeks after flowering. A heavy crop of developing fruits at this time frequently prevents such bud formation. Consequently, early removal or thinning of the fruits during the "on" year may reduce the tendency toward alternate bearing. Thinning also results in larger and better colored fruits.

Hand thin after the June drop or about July 1. Where fruits are clustered, remove all but two fruits in each cluster. Space the fruits from 5 to 8 inches apart, removing the small insect- and disease-injured fruits first. Fruits can be spaced closer together on the outside and top of the tree

Figure 6. The Regent apple is becoming a popular variety in Minnesota.



than in the center, because such branches receive full sunlight. *Thinning actually takes little time—the improved yields and quality more than repay the expense.*

HARVESTING AND STORING. Apples and pears are very perishable, so handle them with extreme care. If you plan to use summer apples for pies and sauce, you can harvest them before they reach full maturity. Generally, pick them when they are needed.

Harvest apples and pears when they reach the proper stage of maturity—when they separate readily from the fruit spurs and before they drop. You may want to pick the tree several times in order to get all fruit at the right stage of maturity.

Grasp the fruit and lift it up to “unhinge” the stem from the spur. Handle fruits carefully to avoid bruises and stem punctures.

To prevent shriveling, store apples at a constant low temperature and in a room with a high moisture content. Storing fruit in crocks, barrels, or plastic-film lined containers helps reduce shriveling. The best storage temperature is near 32° F. The fruit does keep at higher temperatures, but for a shorter time.

Pick pears a little on the green side and allow them to ripen in a cool basement. Such pears are juicier and have fewer gritty stone cells than tree-ripened fruits. Pears do not keep for long periods, so eat or can them when they are ready.

INSECTS AND DISEASES. Apples and pears suffer from about the same insect and disease pests. Growing clean fruit requires a careful program of sanitation and spraying. Since many insects and diseases overwinter on dead twigs and fallen leaves and fruits, a thorough fall cleanup greatly reduces infection the next year. Follow the spray schedule given in Extension Folder 375, *Home Fruit Spray Guide*.

Listed below are the important insects and diseases:

Codling moth is the familiar apple worm. You can recognize it by the brown excrement forced out of the tunnels. Affected fruits generally break down in storage and should be used at once. A thorough spray program controls this pest.

Apple maggot, also known as the “railroad worm,” is a troublesome and destructive apple pest. The maggots tunnel through the flesh and finally destroy the fruit entirely (figure 7).

In the early stages of injury, it is necessary to cut the apple open to see the tunnels. But in later stages you can see brown tunnels through the skin. The maggots continue their destruction after the apples have been harvested and stored. What appears to be a normal fruit when picked may break down completely in a few weeks.

The maggot flies lay their eggs mainly during July and August, so keep fruit covered with spray during this period. Destruction of infested fruit helps control the apple maggot. See Entomology Fact Sheet 20, *The Apple Maggot*.

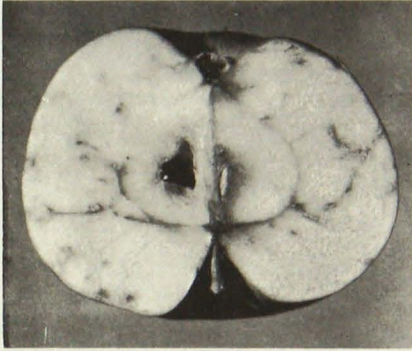
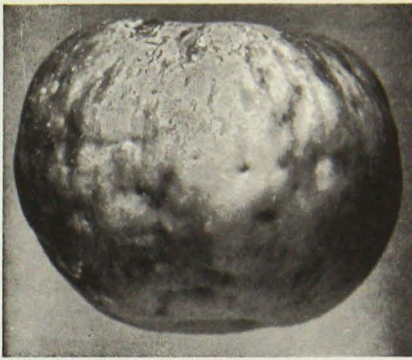


Figure 7 (above). Fruits showing apple maggot injury.

Figure 8 (right). Curculio injury on a plum.

Plum and apple curculio cause considerable damage to apple and plum fruits (figure 8). The apple curculio—a dark-brown snout beetle—feeds and lays eggs on young fruit. The resulting pits are shallow, funnel-shaped depressions, quite unlike the damage caused by the plum curculio. Most infested fruits drop during June. Destroy fallen apples.

The plum curculio, a snout beetle, is about $\frac{1}{8}$ of an inch in length. Adult beetles feed on expanding leaves and flowers but turn to the young fruit when it forms. Soon after the petals fall (when the shucks shed on stone fruits), you can see round feeding punctures on the newly formed fruit.

Egg laying starts when fruits are about $\frac{1}{4}$ inch in diameter and is almost completed by the time they are $\frac{1}{2}$ inch in diameter. You can distinguish the egg laying injury from feeding injury by the crescent-shaped cuts made by the females around the area where they lay eggs. Affected fruits either drop prematurely or remain on the tree and become distorted and covered with scars.

Although a thorough sanitation program aids in the control of plum and apple curculio, spraying with a recommended insecticide is most effective.

Scale insects, small sucking insects, develop under a hard protective scale that clings tightly to the twig. When these insects are numerous, they may completely coat the surface of twigs on old, neglected apple trees. By sucking the juice from twigs and branches, they weaken growth and affected branches usually die.

To control scale insects, follow the recommendations given in Entomology Fact Sheet 34, *Control of Scale Insects on Trees and Shrubs*.

Cankerworms often feed on unsprayed trees, eating leaves, blossoms, and young fruit. Tent caterpillars and webworms cause similar injury during the summer months. Following a regular spray program usually will prevent infestations by these pests. See Entomology Fact Sheet 21, *Cankerworms*.

Mites may become a serious apple pest. These tiny pests are hard to see. They suck the juice from the apple leaves, thus weakening growth. When mites are abundant, the apple leaves usually become "bronzed" and appear "leathery."

Mite control is best accomplished by spraying with dicofol (Kelthane) before mites have had a chance to build up. Where mites have increased to large numbers, eradication is extremely difficult and may require more than one spray.

Aphids are small sucking insects, often found during the summer on the underside of young leaves. These insects are likely to appear in dry weather and may disappear almost completely after a heavy rain. When aphids are very abundant, they may cause "leaf curling" and also reduce tree growth and vigor. A thorough spray program is necessary for control.

Apple scab is a very serious disease of apples in Minnesota, particularly during a wet season. Scab is caused by a fungus which produces dark-green or gray velvety spots on leaves and fruits. These spots usually are first seen soon after petals fall. At picking time, scabby apples are deformed and cracked. A thorough spray program is necessary for control. See Plant Pathology Fact Sheet 33, *Apple Scab*.

Fire blight, a bacterial disease, appears during the spring and early summer months. Affected flower clusters and blighted twigs turn black. Affected leaves wilt, turn brown, and remain attached to the twigs all summer. The bacteria overwinter in cankers which develop on infected branches.

Fire blight is most serious on vigorous, succulent growth; so for control, adapt a cultural system that reduces such growth. Sod culture reduces fire blight, since trees are less succulent and harden off better for winter. Prune out all diseased branches and cankers. Disinfect cut surfaces and pruning tools between cuts with formaldehyde, denatured alcohol, or liquid household chlorine bleach mixed half and half with water. See Plant Pathology Fact Sheet 17, *Fire Blight*.

Cedar-apple rust is one of the most common and destructive apple diseases, although it is one of the easiest to control. Rust occurs on apple leaves and fruits and occasionally infects twigs. Leaf infections usually show up during May, appearing as small, pale-yellow spots on the upper surface. Fruit lesions appear near the calyx end and are similar to the leaf lesions.

For control, use either ferbam or zineb or plant resistant varieties. See Plant Pathology Fact Sheet 4, *Cedar-Apple Rust*.

Dwarf Apples

Dwarf apple trees are standard apple varieties grafted onto dwarfing roots or grafted so that a dwarfing stem section (interstem) is inserted into the normal tree stem. In either case, small-statured trees that produce fine quality fruit can be grown.

Standard varieties which are grafted on M.7 rootstock are popular dwarf trees for the small home garden. Mature trees on M.7 are usually no more than 10 to 12 feet high. They start fruiting 4 years after planting, and fruits are usually of fine color and quality. Because of the small size, you can thoroughly control insects and diseases with a small inexpensive knapsack sprayer.

Trials with trees of M.7 showed the trees to be moderately cold-hardy, at least in southern Minnesota. However, in extremely dry, snowless winters, this rootstock has been killed or severely injured when growing under clean cultivation. Trees that were in sod mulch or had other organic mulches over the roots survived without injury.

Because of their advantages in the home garden, these dwarf trees seem worthy of trial. But always mulch them, at least for the winter. When spacing trees, take into account the size of tree that can be expected from the rootstock involved. In general, follow the same cultural practices as described for standard apples and pears.

Stone Fruits

Minnesota conditions are suitable for several types of stone fruits; plums, cherry plums, bush cherries, sour cherries, and certain hybrid apricots. Although peaches have fruited, they have not proved hardy; the trees often are killed either to the ground line or entirely.

Apricots resulting from crosses with the hardy Manchurian apricots appear hardy and fruit quite regularly. Two varieties, Moongold and Sungold, developed at the University Horticultural Research Center near Excelsior are recommended (figure 9). The apricot and also some plums and cherries bloom so early that late spring frosts are a hazard.

Plums are of three general groups: the so-called hybrid plums, selected wild plums, and European-type plums. Hybrid plums generally are

hardy, having been derived by crossing native plums with high quality, tender varieties.

European plums of the species *Prunus domestica* formerly were considered too tender for Minnesota winters. But recent tests revealed that a variety such as Mount Royal may be hardy in southern Minnesota and also in favored sites farther north.

Cherry plums owe their hardiness to the native sand cherry, which was crossed with several plum varieties to produce the cherry plum group. Generally, these cherry plums develop into large bushes with fruits intermediate in size between the sand cherry and plum. The Nanking bush cherry can be grown in the form of a very small tree or, more commonly, as a shrub about 6 to 8 feet tall. Leaves are hairy, and fruits are rather small but densely clustered along stems. The fruits are good to eat fresh or for jelly. They also make good sauce and pies.

Two varieties of pie cherries, North Star and Meteor, from the University Horticultural Research Center, are hardy in southern Minnesota. They also have been satisfactory in favored areas in central and more northerly sections. These two varieties produce fruits of good sour cherry size and quality. They produce attractive small trees and deserve extensive use.

Sweet cherries are not hardy in Minnesota.

PLANTING AND SOIL MANAGEMENT. The method for planting stone fruits is the same as that described for apples and pears. Plant stone

Figure 9. Sungold apricot should be planted along with Moongold for cross pollination, to obtain good fruit set.



fruits in a block separate from apples and pears, preferably on nearly level ground, as you should keep them under cultivation.

Stone fruits grown in sod are more subject to leaf diseases and early defoliation than those grown under clean cultivation. For this reason, cultivation generally is practiced in the plum and cherry orchard. If you place stone fruits next to small fruits, you can cultivate them along with raspberries and strawberries.

If it is necessary to plant stone fruits on the steep slope where cultivation is not practical, heavily mulch the soil underneath the spread of the branches with straw or marsh hay. Sod may cover the remaining space. Use fertilizers as needed; follow the same recommendations as for apples.

PRUNING. Prune plums and pie cherries in a manner similar to that recommended for apples and pears. Since the trees are smaller, the scaffold branches selected may be closer together. Eliminate all narrow crotches and remove all dead and diseased branches.

Cherry plums normally grow in the form of a tree or large bush with numerous stems from the ground. Stems that are 2 to 4 years old are the most productive. To have a new supply of these young stems each spring, you must cut out the old, unproductive stems. Cut them back as near to the ground as possible.

Bush cherries need pruning to cut out any dead, old, or diseased wood. If you want to grow the Nanking cherry as a tree, you must train it for the first few years. If you desire a bush form, merely cut the tree back severely when you plant it.

POLLINATION. Plum plantings often require two varieties to insure cross-pollination, since most hybrids are self-sterile. Certain varieties are better pollinators than others, so include them in the planting. For hybrid plums, Toka and South Dakota are recommended. For cherry plums, plant Compass. The European plums generally are self-fertile and do not require a pollinator.

For Nanking cherries, plant several selections to insure cross-pollination. North Star and Meteor are self-fertile pie cherries. Moongold and Sungold apricots are self-sterile and should be planted as a pair.

PREVENTING WINTER INJURY. Stone fruits are less subject to sunscald than apples and generally are not protected. To reduce winter damage, plant only varieties recommended for your area. Also, adopt cultural practices that harden-off the trees in the fall. With some soils and in a wet fall, a cover crop of oats planted early in September hardens the trees for winter and furnishes needed organic matter.

MICE AND RABBITS. These pests often cause heavy losses to plum and cherry trees. Protect them in the same manner as described for apples.

INSECTS AND DISEASES. Stone fruits are affected by several serious insect and disease troubles. Follow the spray schedule given in Extension Folder 375, *Home Fruit Spray Guide*.

The following insects and diseases are the most important:



Figure 10. Brown rot attacks plums as shown by the plum in the foreground of the photo. The disease organism overwinters on mummies like the plum in the lower background.

Plum curculio (see description on page 13).

Plum gouger is a smooth snout beetle, slightly larger than the plum curculio. Eggs are laid in tiny punctures in the skin of young fruit. When grubs hatch, they bore directly to the pit where development and pupation take place.

The adults cause the principal damage when they bore their way to the outside. Their exit is marked by round holes, about $\frac{1}{8}$ inch in diameter. The holes first appear when the fruit ripens. For control, see information on plum curculio, page 13.

Aphids (see description on page 14).

Peach tree borer kills many stone fruits, cherries, plums and apricots and destroys the vigor of others. It passes the winter in the larval form. If small, it is usually on the bark in silken protective coverings; if large, it is in burrows under the bark. In the spring, the boring is continued and a cavity is formed in the sapwood just beneath the bark. Gum and sawdust collect at the openings of the burrows and around the base of the tree.

Leaf spot diseases are quite common on stone fruits. They result in a spotting of leaves and premature defoliation. Burying some of the infected leaves and increasing the vigor of trees may reduce the severity of these diseases. A thorough spray program with a recommended fungicide will control leaf spot diseases.

Brown rot is common on cherries, plums, and apricots. It attacks flowers and fruit. The disease may become evident at blossoming time. Infected blossoms give the appearance of having been frosted. Warm, damp weather favors this phase of the disease; dry weather checks it.

This disease is best known as a disease of the fruit (figure 10). A brown spot forms where the organism enters the fruit. These spots enlarge until the whole fruit is discolored. Such fruits are soft and watery and later become covered with brown tufts of fungus growth.

Fruits are most susceptible when they start to ripen. Fruits affected by plum curculio or gouger are most apt to be infected. The disease may spread after fruits have been harvested. Losses in transit and storage may be heavy.

The disease organism overwinters on mummies (diseased fruits that dry and either fall to the ground or cling to the tree) and in cankers formed on diseased twigs and branches, so destruction of mummies and removal of infected branches help control brown rot. A regular spray program with a fungicide usually is effective.

Black knot is a serious fungus disease of stone fruit which results in disfiguring. The most characteristic disease symptom is a black, rough, spindle-shaped enlargement on the twigs.

The control program is based on removal of the knots from the tree plus application of ferbam or captan to prevent new infections. Start a spray program as soon as tree growth begins and continue it until May or early June.

CULTURE OF SMALL FRUITS

Strawberries

To grow fine strawberries, you must carefully attend to every detail of their culture. Perhaps the most common mistake is failure to properly space the runner plants that develop during the growing season. Consequently, a strawberry "patch" with closely crowded plants develops. These plants compete for moisture and mineral and produce small, misshapen berries.

PREPARING THE SOIL. You can grow strawberries on almost any soil if you properly prepare it. A rich, sandy loam is best, but even a clay or sandy soil produces good strawberries if sufficient organic matter is worked into it before planting.

Although strawberries require an abundance of moisture at fruiting time, never plant them in poorly drained soil. If at all possible, locate the plantings where they can be watered any time moisture is insufficient.

The strawberry bed generally is at one edge of the vegetable garden or may be planted between young fruit trees. It is always advisable to plant strawberries in soil that has been under clean cultivation for at least one summer previous to planting time. Planting them in such soil prevents severe infestations of white grubs, and also reduces the common and serious problem of controlling perennial weeds.

Plow or spade under a liberal application of well-rotted manure, about 20 tons to the acre, and work the ground thoroughly before planting. On a small area, use about 4 bushels of manure for 100 square feet. Manure not only improves the physical texture of the soil, it also increases its water-holding capacity and improves fertility. If rotted manure is not available, incorporate a balanced commercial fertilizer such as 10-10-10 at the rate of 1 pound per 100 square feet.

PLANTING STOCK. Obtain plants from a local nursery if possible. Plants that are shipped in from a long distance seldom arrive in the best condition for planting.

Plants of most of the important strawberry varieties that have been certified as substantially free of virus diseases now are available. All reliable nurseries sell such plants or plants grown from such stocks if these lines are available.

Virus diseases can be an important factor in rendering strawberry plants unthrifty and unproductive. So it is always advisable to obtain plants that are certified free or essentially free of virus diseases. However, young, vigorous plants taken from a planting that appears strong and healthy usually are satisfactory.

PLANTING. Plant strawberries early in the spring as soon as the soil is dry enough to cultivate effectively.

Before planting, keep roots covered with moist burlap or another covering at all times—never allow them to dry out. If the roots are too long and straggly, you may trim them with a sharp knife or shears. The plants also may benefit from removing some outer leaves.

Be careful when deciding on the depth to set the plants. If you set them too deep, the crown will rot or fail to send out runner plants. If you plant them too shallow, the exposed crown will dry out. Set plants so the exposed crown is just level with the soil line (figure 12).

Open a slit in the ground with a spade and spread the roots out in this opening. Remove the spade and compress the soil firmly about the roots. A little practice will enable you to do a good job with plants set at the proper depth.

If possible, plant in the evening or on a cloudy day. If the soil is dry, scrape away the surface layer before making the opening. This procedure prevents dry powdery soil from falling in around the roots.

SPACING, RUNNER DEVELOPMENT, FLOWER DEVELOPMENT. June-bearing varieties are most often grown in a **matted row system**. If you use this type of planting, set mother plants 2 feet apart in rows at least 4 feet apart to allow for cultivation. The runner plants that develop can then root freely and form a matted row about 2 feet wide (figure 11).

June-bearing varieties also can be grown in the **spaced row system**. Place mother plants as in the matted row system, but space the runners so they will root no closer than 4 inches apart. Once a 2-foot row has developed, remove all other runner plants. This system requires more work but usually will result in higher yields and increased fruit quality than the matted row system (figure 11).

With either type of spacing, remove all flowers from newly planted June-bearing strawberries during the first year. These flowers produce only small fruit. Allowing these fruits to develop reduces growth and strong runner development, which subsequently results in lower yields and poorer quality fruit the following year. The main function of plant

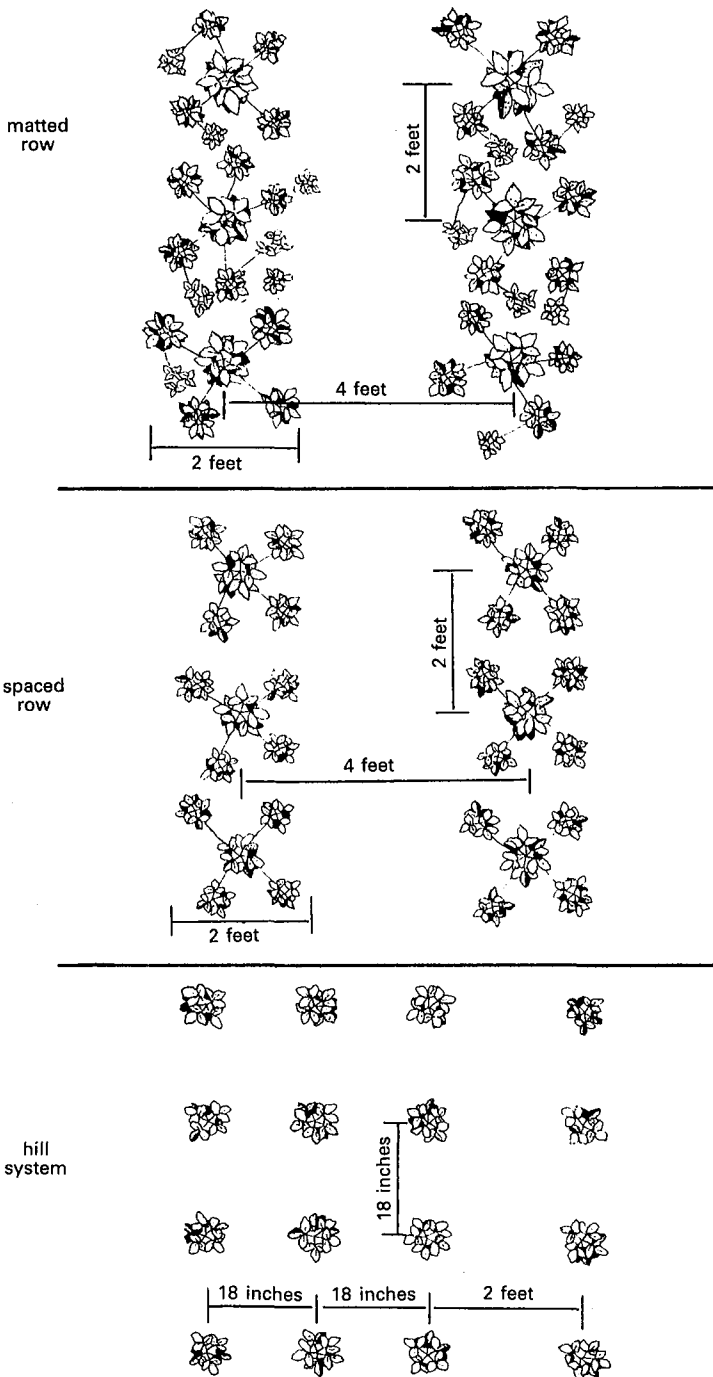
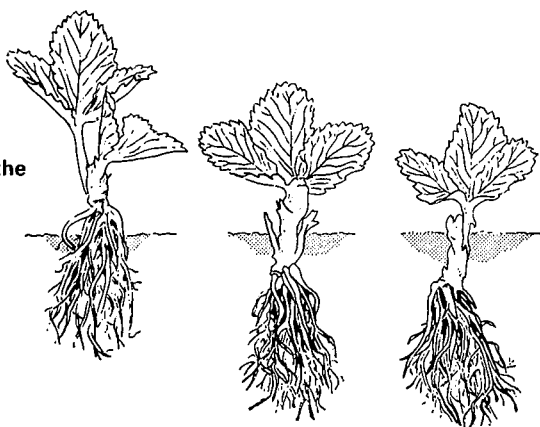


Figure 11. June-bearing strawberry varieties can be grown in a matted row system (top) or in a spaced row system (middle). The triple row hill system (bottom) is recommended for everbearing varieties.

Figure 12. Plant strawberries at the proper depth.



growth the first season is to develop strong runner plants that will fruit well the following year.

Everbearing varieties are best grown in the **hill system**. Set mother plants 18 inches apart in rows spaced 18 inches apart. Separate each group of three rows by a 2-foot walkway (figure 11).

If you use the hill system, remove all runners so that each plant develops many crowns. Work the soil around each plant until the fruit begins to ripen. Then apply a mulch of chopped straw, ground corn cobs, or other suitable material. The mulch keeps the fruit clean and also preserves moisture. You also may use black plastic as a mulch with the hill system. Use it at planting time.

Remove all flowers on everbearing strawberry plants up to July 1 of the first year. Flowers that develop after that date generally produce a small crop.

WINTER PROTECTION. Blossom buds for the summer crop of June-bearing strawberries are formed in the fall. Exposure of these buds to temperatures as low as 20° F. seriously reduces the yield of good quality berries, so you must mulch plants before severe winter weather. But don't apply the mulch until plants have been subjected to a few good frosts to harden them off. The time to apply the mulch varies with the season and location. Normally, early November is right in the Twin Cities area.

For mulching, use straw or marsh hay that is free from weed seed. Apply it to a 2- or 3-inch depth over the entire planting. If the area is not protected from wind, you might have to place boards or branches on the mulch to hold it down.

Leave the mulch on as late in the spring as possible to hold back bloom until after frost. Check frequently. If leaves start to turn yellow, remove the mulch at once.

When removing the mulch, lift the straw from over the rows and place it in the picking aisles. Leave some of the finer mulch materials in the row. The plants can then push up through a light covering and the berries will be kept clean during the picking season. If a late spring frost threatens plants in bloom, use the mulch in the picking aisles to cover them (figure 13).

Since the mulch covers the space between the rows, no cultivation is needed during the second season until after harvest. If weeds come up through the mulch, pull them at once.

HARVESTING. To prevent soft and spoiled berries, pick them as soon as they are ripe. In the home garden, allow berries to become an overall red color. The sugar content is higher and the flavor is better in garden-ripened fruit. You must pick every other day during the peak of the season for maximum production.

Pick the berries carefully and handle them with care to prevent bruising. Always pick all of the ripe berries, since they will not keep until the next time. Eat fresh strawberries as soon after picking as possible, and can and freeze the surplus. Ripe strawberries may be held for several days in a good refrigerator.

You may pick the fall crop of everbearing strawberries less frequently than the summer crop, because the crop is lighter and the weather usually cooler. Nevertheless, it is advisable to pick twice a week if the crop warrants it.

Birds often damage many berries during the ripening period. Locating the patch away from trees where birds nest reduces this problem. You may have to cover the rows with coarse netting or chicken wire to keep birds out.

WATERING. Strawberries demand a continuous moisture supply throughout their development. A dry period following planting seriously reduces plant production and development; a dry spell during harvest greatly reduces the crop. If at all possible, locate the bed where it can be watered as needed.

RENOVATING. Some growers prefer to abandon the patch after harvesting the first crop; others like to carry it over for a second and even a third year. If the planting is continued for more than the 1 year, thoroughly renovate it after harvest.

Remove the coarse mulch material and cultivate or plow between the rows, leaving a narrow band of plants about 12 inches wide. Remove the



Figure 13. Work the winter mulch into the picking aisles.

old plants with a hoe, leaving only strong young plants. A sidedressing of a complete fertilizer applied at the rate of 1 pound for 25 feet of row generally proves beneficial.

If the weather is dry, a thorough watering at this time speeds new growth. Continue to cultivate throughout the season; space runner plants as recommended for the first summer.

INSECTS AND DISEASES. You can reduce most insect and disease troubles in strawberries by following the practices recommended in this bulletin. Sprays or dusts are helpful in most cases. A thorough spraying with a fungicide such as captan combined with methoxychlor and malathion usually controls insects and diseases. See Extension Folder 375, *Home Fruit Spray Guide*.

Strawberry leaf diseases are common in Minnesota. There are at least three: leaf spot, leaf scorch, and leaf blight. You can distinguish leaf spot by the definite spots that are purplish at first. As the spots become older, the centers turn tan to white with purplish borders.

Leaf scorch produces small, dark-purplish spots that lack white centers. Leaf blight produces large red to brown spots bordered by purple; the spots range from $\frac{1}{4}$ inch to over 1 inch in diameter. Leaf blight also affects the fruit, especially on everbearing varieties. All three of these leaf diseases may appear on the same plant or leaf, thus making disease identification rather difficult.

Sanitation and good culture combined with captan sprays are recommended. Start new plantings with healthy plants. If old plantings are left, renovate them thoroughly after harvest. Burn old leaves and straw.

Botrytis fruit rot may cause heavy losses to ripening and harvested fruit. The fungicide captan effectively controls this disease. Apply the first spray before plants flower. Applications may be repeated at weekly intervals until a few days before harvest.

White grub (larva of the June beetle) is a serious insect pest on strawberries since it feeds on plant roots. Do not plant strawberries on land that was in weeds or grass the previous year—the June beetle lays its eggs in such places. Also avoid planting strawberries near shade trees or thickets, as adult June beetles feed on tree leaves at night. For grub control see Extension Folder 375, *Home Fruit Spray Guide*.

Spider mites and cyclamen mites also may become serious pests. Cyclamen mites are particularly prevalent on everbearing varieties but also may be serious on June-bearers. These tiny mites feed on the young developing leaves and flowerbuds in the crown of the plant, causing stunting and distortion of the plant.

You can control both spider mites and cyclamen mites by spraying thoroughly with Kelthane during the prebloom period. For cyclamen mite control, you must apply the spray forcefully into the crowns of the plants.

The strawberry weevil girdles stems of flowerbuds and clusters.

The tarnished plant bug causes many berries to be small and causes much of the distortion known as "nubbins" in fruits.

The strawberry sawfly feeds on leaves.

A thorough prebloom application of an all-purpose fruit spray greatly reduces damage from these insects.

WEED CONTROL. Successful strawberry culture requires that the bed be free of weeds. A bed kept free of weeds the first season will have fewer weeds developing prior to harvest time the next season. Frequent, shallow cultivation (including hoeing and weeding) is effective but must be started early and repeated several times during the season. In addition to weed control, cultivation helps keep runner plants within the allotted row area and permits easier rooting of runner plants. Do not allow the rows to get wider than 2 feet.

CHEMICAL WEED CONTROL. Weed-killing chemicals (herbicides) control weeds effectively and economically. Their use in small plantings, however, does have certain limitations and generally is not justified.

For large plantings, Dacthal and Tenoran are effective in both new and fruiting plantings. Dacthal is effective only on germinating weeds, whereas Tenoran is effective against small (1 to 2 inches), newly germinated weeds and germinating weeds. (Neither of the above herbicides is effective against perennial weeds such as quackgrass or Canadian thistle.) For control of weeds during the fruiting year, use diphenamid or Devrinol. Apply just prior to mulching the strawberry bed.

Raspberries

Four kinds of raspberries—red, purple, black, and yellow—are grown in Minnesota. Red raspberries are the most popular, and available varieties are sufficiently cold-hardy anywhere in Minnesota. Black and purple raspberries are less cold-hardy; for optimum fruit production, they often require cane protection. Yellow raspberries, except for fruit color, have all the characteristics of red raspberries. Blackberries (which can be distinguished from raspberries because the cores of blackberries come with the picked fruit) lack the cold-hardiness necessary for Minnesota.

PLANTING. Grow raspberries on a well-drained soil that is high in organic matter. Almost any soil type will do if the planting can be watered during dry periods. Avoid light, sandy soils unless irrigation is available.

For best results, plant on soil that was cultivated the previous season. Apply about 20 tons of well-rotted manure per acre before plowing (4 bushels for 100 square feet). Work the soil thoroughly just before planting. Since weeds (especially quackgrass) are difficult to remove from an established planting, the area should be free from perennial weeds.

Plant in the early spring as soon as the soil can be worked properly. Purchase certified plants from a reliable nursery to be certain of obtain-

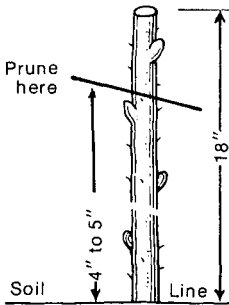


Figure 14. Prune off all but a few inches of the raspberry cane at planting time.

ing high quality stock. Since virus diseases are serious in raspberries, use only healthy, disease-free plants.

Obtaining plants from an old, abandoned patch or from a neighbor is very costly. It takes just as much time and work to care for an infected planting as it does to care for one that is free from disease.

Plant as soon as possible after the nursery stock arrives, and never allow the roots to dry from exposure to air. Pack the soil firmly around the roots after planting. Cut back the tops to within 12 inches of the ground to encourage the production of vigorous new canes (figure 14).

Correct spacing depends on the training system you follow. If the plants are to be grown in hills, a 6- by 4-foot spacing is about right. If the plants are to be grown in a hedgerow, you may set the plants 2½ feet apart in rows 6 to 9 feet apart.

SUMMER CARE. Raspberries should have clean cultivation throughout planting life. Failure to cultivate allows canes to develop all over the patch. This results in competition for moisture, minerals, and sunlight, and berries will be small and inferior. Such a condition also favors insects and diseases.

If you grow plants in hedgerows, limit the spread of rows to about 18 inches in width. When you grow plants in hills, cultivate in both directions. Keep the cultivation shallow to avoid injury to raspberry roots.

Stop cultivation after August, as late cultivation may encourage late growth.

Since raspberry canes must be vigorous to produce large, high quality berries, you must try to maintain soil fertility. Use a balanced fertilizer such as 10-10-10, at the rate of about 1 pound per 25 feet of row or about ½ cup around each hill. Broadcast the fertilizer between rows, and work it into the soil about May 1.

PRUNING AND TRAINING. Raspberries must be properly pruned and trained if they are to produce the desired crop. The two systems of training commonly followed in Minnesota are:

Hedgerow. In the hedgerow system, plants may be supported or unsupported. If supported (wire-trellis-hedgerow), set posts about a rod (16½ feet) apart in the rows. Stretch two wires on opposite sides of the posts at about 3½ feet from the ground. Place the canes between the posts, and tie the wires at intervals to prevent their spread. In the spring before growth starts, cut the tips of the canes to a height of about 4½ feet (figure 15).

If unsupported, cut canes back in early spring to about 4 feet so the fruiting canes will not bend over and interfere with cultivation (figure 16).

Hill. In the hill system, plants are usually tied together (teepee-hill) or to a stake (staked-hill). In the spring, tie and cut back the canes. For the staked-hill system, tie the canes securely to a stake driven into the center of the hill. You may use binder twine or strips of cloth for tying. Then cut back the tips of the canes to about 5 feet (figure 17). For the teepee-hill system, tie the canes together about 3 feet from the ground; make a second tie about 6 inches higher. Make these ties tight so canes are held firmly in place. Cut the tops back to about 4 feet from the ground (figure 18).

Purple or black raspberries need not be tied. When new canes that emerge in early summer are 20 to 30 inches high, top them back to 18 to 24 inches. This will induce development of strong lateral branches near the top of the cane. The following spring, cut back these laterals within about 8 inches of the main cane. They then will produce fruiting branches.

THINNING. Raspberry canes grow the first year, fruit the second, then die. To thin red and yellow raspberries, remove the old canes as soon as the fruit is harvested. The new canes and suckers also should be thinned, leaving four to six strong canes per foot of hedgerow and about seven strong canes per hill.

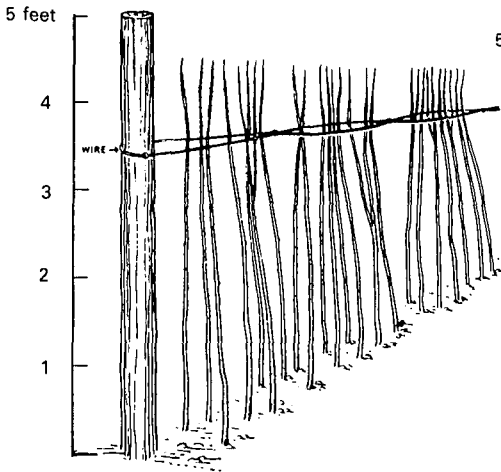


Figure 15 (above). Wire trellis-hedgerow system.

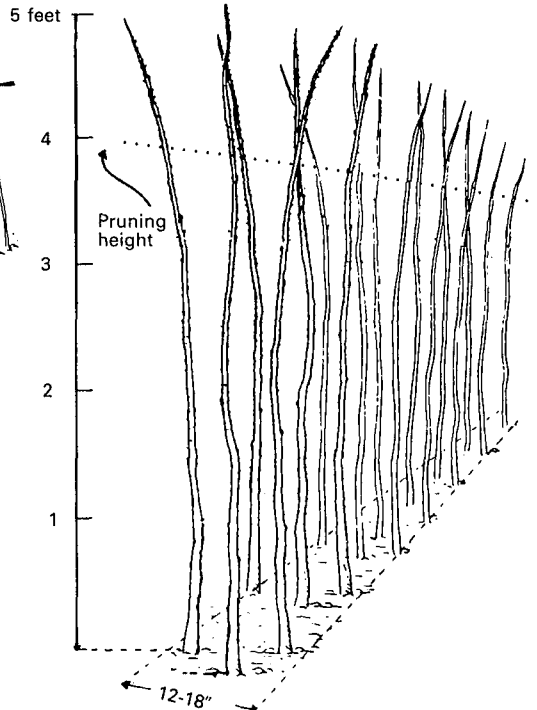


Figure 16 (right). Unsupported-hedgerow system.

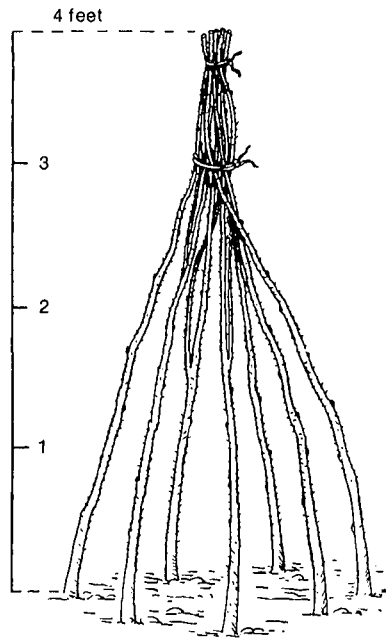
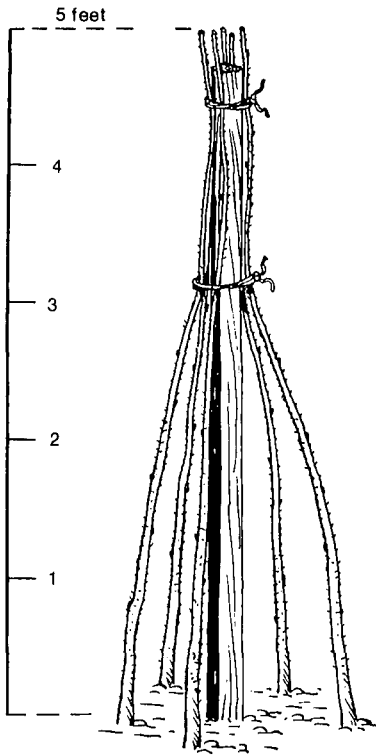


Figure 17 (left). Staked-hill system.
Figure 18 (above). Teepee-hill system.

To thin black or purple raspberries after harvest, remove all canes that have borne fruit. Select four or five new canes per plant and remove all others.

Fall-bearing varieties do not conform entirely to the usual red raspberry pattern. The fall crop is produced on canes that developed the same season; the following summer, another crop is produced on the same canes. Healthy, vigorous plants can produce heavy crops both times. If only a fall crop is desired, cut the canes to the ground in the early spring; this eliminates the summer crop completely.

If both summer and fall crops are desired, thin the canes the same way as ordinary red raspberry varieties, following the summer harvest. The shoots that bear the fall crop should not be removed, as they will bear again the following summer.

WINTER PROTECTION. Raspberry plantings frequently suffer from winter injury. This loss seems to result from alternate warm and cold periods in late winter. Warm days in February or March cause buds to swell and lose their cold resistance. When these warm days are followed by cold nights or prolonged cold spells, buds are either killed or seriously weakened. The result is either dead cane tips or new growth that is weak and unproductive.

If winter conditions are extremely dry and without appreciable snow cover, much injury also may result from cane drying. Such winter damage may seriously reduce the crop.

The only practical means of protecting canes from winter damage is to bend the canes down in the fall and cover them with soil. If the planting is located where snow covers the area all winter, you may bend the canes over and hold them in place with a wire loop resembling a croquet wicket, or place a few shovels-full of soil on cane tips. Do this in late October or early November before the ground freezes. In the spring, uncover the canes and tie them to their supports.

INSECTS AND DISEASES. Raspberries have few insect pests, but diseases are quite numerous and troublesome. See Extension Folder 375, *Home Fruit Spray Guide*, and Plant Pathology Fact Sheet 8, *Raspberry Diseases*.

Mosaic is the most serious disease of the raspberry. Since this virus disease is within the plant, there is no cure. The disease fruits in reduced plant vigor and crumbly berries. The leaves are smaller than normal and crinkled, with a yellow and green mottling. Remove or "rouge" the diseased plants.

It is difficult to recognize this disease in its early stages, so start a new planting with disease-free plants purchased from a reliable nursery. If possible, don't start a new planting near an old planting that is infected with mosaic. If you must, remove the old plants and keep the ground cultivated to destroy any sprouts that emerge from old crowns or roots.

Black raspberries are particularly susceptible to mosaic, so plant them away from red raspberries if possible.

Crown gall is a bacterial disease that produces swellings on the roots or crowns at or near the soil line. These swellings reduce plant vigor and cut down yields. Avoid trouble by planting only disease-free stock.

Anthracnose is a fungus disease that produces lesions on young canes, leaves, and fruiting stems. By harvest the disease may have spread to the leaves. The spots appear as small, purplish, raised areas that enlarge and become sunken and grayish in the center. This disease increases the loss due to winter injury and reduces the size and quality of berries.

Start with disease-free plants, and keep the planting thoroughly thinned-out and weeded. This procedure results in good air circulation and makes conditions less favorable for infection. If the disease becomes serious, you can control it with a thorough spray program. Black raspberries are likely to be more seriously affected by this disease than are red and purple raspberries.

Spur blight is less common than anthracnose. The disease shows first on young canes, where a purplish-brown discoloration may extend completely or partially around the stems at the point of leaf attachment. Fruiting branches that develop from such areas are weak, generally die, and produce little fruit.

Generally, you can control spur blight by following cultural practices that provide good air circulation around plants. If serious, spur blight can be controlled by spraying.

Spider mites suck the juice from the underside of leaves. Affected leaves show rusty-brown blotches and fine silken webs. In severe infestations, a thorough spray application of an effective miticide such as Kelthane is recommended.

Cane borers of two types infest raspberries. The adult of one type deposits its eggs near the cane tip, causing it to wilt. The other type attacks the base of the cane, causing a swelling. For control, remove and burn affected canes as soon as you notice them. Make the cut well below the point of injury.

Raspberry sawfly often causes severe damage. This small, green, many-legged worm eats the soft leaf tissue, leaving only a skeleton of veins. An all-purpose fruit spray applied after leafing out but before blossoming is effective.

Sap beetle. Adult sap beetles, black and yellow spots on the back, can be attracted to juice from overripe fruit at or near harvesttime. To prevent attracting these beetles, do not allow overripe fruit to accumulate. Also, spray the foliage with carbaryl (Sevin).

Currants and Gooseberries

Currants and gooseberries are hardy and easy to grow in all parts of Minnesota. They grow best in areas where summer temperatures are relatively low and moisture plentiful.

PLANTING. Currants and gooseberries grow on almost any soil type but do best on heavy soils that are high in organic matter. Plant in the early spring in soil that has been thoroughly prepared. Space the plants about 5 feet apart in rows 8 feet apart. Usually, 2-year-old nursery-grown plants are used.

Set the plants about an inch deeper than they were in the nursery and firm the soil around the roots. Remove all but four or five canes; cut these back to about $\frac{1}{3}$ of their original length.

SUMMER CARE. Keep the ground thoroughly cultivated throughout the life of the planting. Avoid deep cultivation that might injure roots. Fertilize the plants each spring using 1 cup per plant of a complete 10-10-10 fertilizer.

PRUNING. Pruning currants and gooseberries is not difficult. After the 4th year, remove all 4-year-old stems. Three-year-old or younger stems produce the best fruit. Removal of these old stems stimulates vigorous young shoots at the base. If too many young shoots develop, thin them out. About 12 stems from the base is about right for a mature bush. Prune early in the spring before growth starts (figure 19).

INSECTS AND DISEASES. Comparatively few insects and diseases affect currants and gooseberries. They can be readily controlled by clean

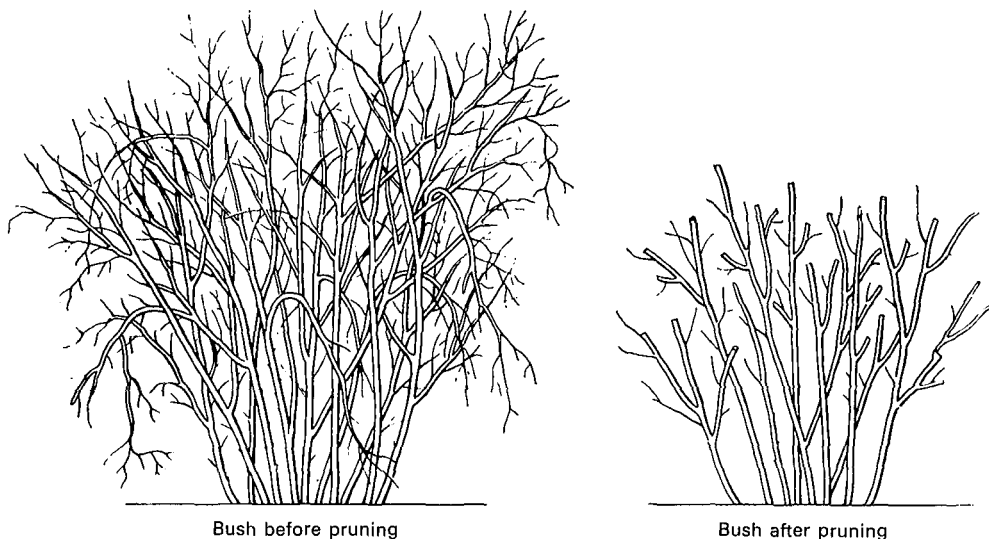


Figure 19. The "before" and "after" of pruning curren and gooseberry bushes.

cultivation, pruning, and if necessary, spraying. See Extension Folder 375, *Home Fruit Spray Guide*.

Leaf spot diseases are quite common. The spots are small and circular with gray centers. If these spots become numerous, the result is premature defoliation of bushes. Strict sanitation to destroy infected leaves usually checks this disease.

Powdery mildew is common and covers the leaves with a white moldy growth that results in distortions of leaves and stem tips. You can best control this disease by following the recommended spray schedule.

White pine blister rust shows up on curren and gooseberries as rust patches on the undersides of leaves. Spots are covered with hairlike projections that hang down. The Viking variety of red curren is quite resistant to this disease and should be grown in white pine areas.

Curren worm feeds on the leaves and often strips all of the leaves from the plant before the damage is noticed. You can control this worm by spraying with an all-purpose fruit spray.

Curren aphid sucks juice from the undersurface of leaves, causing reddish discoloration and crinkling. An application of malathion when the leaves are $\frac{1}{2}$ inch long controls this insect.

Grapes

Grapes can be grown in almost any part of the state for home use. But success depends on the selection of a suitable site and planting of adapted varieties.

SELECTING THE SITE. Since grapes require full sunlight and high temperatures to ripen, exposure is important. Select a site on a southern slope or plant the grapes on the south side of a windbreak. In northern Minnesota, grapes have been grown successfully on the south side of a building. The soil should preferably be a sandy loam with a high humus content.

PLANTING. Prepare the soil thoroughly before planting. Well-rotted manure applied at the rate of 1 bushel per 50 square feet should be thoroughly mixed into the soil prior to planting. Plant in the spring as early as possible using vigorous 2-year-old plants with well-developed root systems. Set the plant a little deeper than it was in the nursery and firm the soil around the roots. Space the plants about 8 × 8 feet and run rows across the slope.

SOIL MANAGEMENT. Grapes require clean cultivation for best results. Keep weeds removed from the rows by hoeing. Do not cultivate after August 1, since late cultivation encourages late growth with consequent winter-killing.

Grapes usually respond favorably to fertilizer applications. Apply a high nitrogen complete fertilizer in a broad circle about 2 feet out from the stem. Use 1 cup per plant; apply it early in the spring.

TRAINING SYSTEMS AND PRUNING. Grapes usually are trained to a wire trellis. Drive posts at 16-foot intervals along the rows. Then stretch two or three wires about 18 to 24 inches apart along the posts.

Figure 20. Grapes can be successfully grown in almost any part of Minnesota.



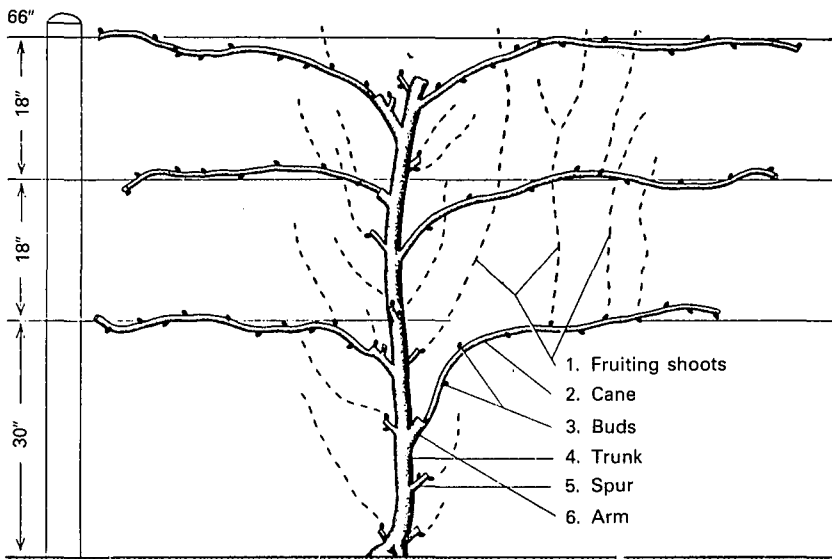


Figure 21. Training system for hardy grapevine.

Hardy grapes normally are trained with an upright stem and branches that go out in both directions along the wires. Since grapes are produced on 1-year-old wood, select vigorous young canes with well developed buds to produce the crop. Each dormant bud should produce between one and three clusters of grapes. Prune a mature grapevine so it retains about 40 dormant buds (figure 21).

If you use a two-wire trellis, cut back the four young branches that you select for the framework so that each bears about 10 buds. If you use three wires, cut back the selected branches to about seven buds. Cut back any short branches near the main trunk to one or two buds. These buds will develop strong shoots from which the fruiting canes can be selected the next year.

When you grow tender grapes such as Van Buren and Fredonia, the training system must allow the canes to be laid down and covered each fall, particularly in fruit zones 3 and 4 (page 2). Select and tie a strong cane to the lower wire of the trellis. Later, tie the branches that develop from this cane to the upper wires for support. In the fall, cut back these upright branches to two or three buds. Lay the canes down and cover them with straw mulch or 6 to 8 inches of soil (figure 22).

If it seems advisable to lengthen the central cane, merely select a strong branch near the tip and cut it back to four or five buds. After several years, this old cane may become overgrown and so covered with spurs that winter protection becomes difficult. To replace the old trunk, select a vigorous young cane from near the stem base. When it has reached a satisfactory size, cut off the old trunk.

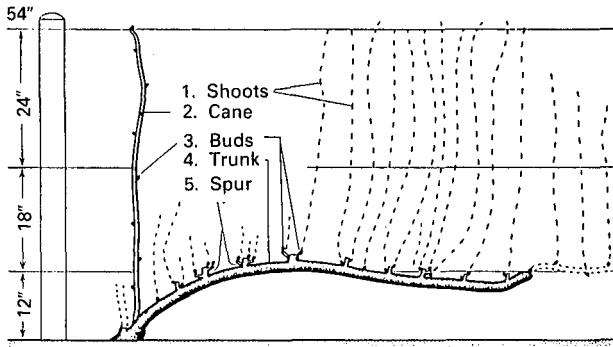


Figure 22. Training system for tender grapevine.

Prune grapes during their dormant season. Prune tender grapes in the fall just before covering them for winter; prune hardy varieties in late winter. Profuse bleeding may follow spring pruning, but is not particularly harmful.

Grapevines that have been neglected for a number of years are difficult to prune to the desired form. Cut back severely, leaving only four or six fruiting canes, depending on the number of wires. If there are no fruiting canes near the plant base, you may have to cut back the old canes to within 3 to 4 feet of the ground. This forces vigorous new growth from near the base that can be selected for the next year's crop. Such pruning sacrifices 1 year's crop but is worthwhile. Neglected vines produce few usable fruits.

INSECTS AND DISEASES. A few insect and disease pests may become serious on grapes. See Extension Folder 375, *Home Fruit Spray Guide*.

Black rot is a fungus disease that affects both leaves and fruits. Dark-brown spots appear on the leaves and leaf stalks. The affected fruits turn from green to red or brownish-black and shrivel. These mummied fruits may drop off or remain attached to the clusters.

Downy mildew appears as yellowish-green spots on the upper side of leaves. A downy growth appears on the underside of these spots. If infected, berries turn brown, shrivel, and drop off. Follow the recommended spray program.

Leafhoppers may become quite numerous and do considerable damage to grapes. The hoppers are small, about $\frac{1}{8}$ inch long, and winged. They fly about in swarms like gnats. By sucking the juice from leaves, they cause them to appear whitish, then brown and dry. Injury to leaves reduces the size and quality of fruits. An all-purpose fruit spray gives effective control.

Grapes are extremely sensitive to 2,4-D, so take great care if you use this herbicide anywhere in the area. The use of relatively nonvolatile forms of 2,4-D such as amines is advisable.

Blueberries

In recent years, interest in growing cultivated blueberries has increased considerably. With Minnesota's severe winters, blueberry growing cannot be recommended unless you are willing to give plants the necessary winter protection. Even our native blueberries often kill back to the snowline.

Blueberries must be grown on acid soil. If the soil is neutral or just slightly acid, you must prepare a special soil mixture of equal parts of acid peat and garden soil. Adding sulfur or aluminum sulfate helps maintain an acid soil. Have a soil test made before planting blueberries. If the pH is above 5.5, add more acid peat or aluminum sulfate.

Cultivation of blueberry plantings should be limited to shallow hoeing because of the shallow root systems. Use a mulch consisting of sawdust, shavings, oak leaves, or straw to keep weeds down. A sawdust mulch 6 to 8 inches deep has helped blueberries at the Horticultural Research Center.

If you use a mulch, also apply a high nitrogen fertilizer, since the decomposing mulch materials remove nitrogen from the soil. Use about 2 ounces of a high nitrogen complete fertilizer for each young plant. Increase this to about $\frac{1}{2}$ pound per plant when plants are mature.

Do not use fertilizers containing nitrate nitrogen, such as ammonium nitrate. Ammonium sulphate has been used with great success along with sawdust mulches at the Horticultural Research Center.

Because blueberries grow best where the water table is 14 to 22 inches from the surface, they will need irrigation during dry periods. If the water is hard, use rain water. Hard water makes the soil more alkaline.

Locate your blueberry planting where snow is apt to drift in and stay all winter. If this is impossible, you may have to enclose the plants in boxlike structures filled with leaves, straw, or other mulch materials.

Several standard high bush blueberry varieties are being grown at the Horticultural Research Center. Rancocas, Bluetta, and Bluecrop have been among the best. Plant at least two different varieties to provide cross-pollination.

Wild Fruits

Minnesota has many wild fruits other than blueberries, strawberries, and raspberries. Some of them are the highbush cranberry, serviceberry, elderberry, and chokecherry. These fruits might well be planted in a windbreak. In addition to adding beauty and giving wind protection, they furnish good fruit for jelly and preserves. Wild fruits attract birds and help keep them out of strawberries and raspberries.

