Growing Raspberries
In Washington

Extension Service
Institute of Agricultural Sciences
The State College of Washington
Pullman, Washington
The raspberry is a top-ranking small-fruit crop. It lengthens the fresh fruit season and can stand a wide range of soil and climatic conditions. It can be grown commercially, and, space for space in the home garden, few fruit crops give bigger returns.

The commercial planting may be as large or as small as you want to make it. Small plantings go hand in hand with other crops, and large plantings make good one-crop businesses. Most commercial plantings of Washington are in the coastal region, where the climate is mild, but there are also fairly large plantings in other parts of the state.

Like other fruits, they fit well into the average family diet. Whether you want fresh fruit, frozen fruit, canned fruit, or a delicious jam, you can have it in raspberries. And they not only taste good, but with their Vitamin C content they are especially good for you.

Choosing Your Site

High production is the key to growing raspberries successfully, and the land, more than any other single factor, influences production. Even though it may cost much more, good land is cheapest in the long run. It's easier and cheaper to produce a large crop on good land than an average crop on poor land. Good land pays for itself, but poor land may not. Once the planting is paid for, the net returns are much greater from good than from poor land.

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A loam or sandy loam soil ranging from 2 to 4 feet deep is ideal. The more nearly level your land is, the easier it is to care for the planting and to harvest your crop. Steep slopes need special soil management to prevent serious soil erosion, and it is difficult to use equipment on them.

FIGURE 1. Three-year-old raspberry plants.
The plants, on the left, in well-drained soil grew and produced fruit normally.
The canes, on the right, in poorly-drained soil leafed out, bloomed, and formed berries that developed to one-third the size of mature berries. The leaves then wilted, the berries dried up, and the plants died. Water soon drained into a hole dug 1 foot deep beside the dying plant.

Raspberries require good drainage. Allowing the water table to stay within 2 feet of the surface for more than a few days can be disastrous. This water kills the feeder roots, and the plants suffer during warm weather. In the case of serious injury, the plants may start growing almost normally but they soon wilt and die in early summer. Less injury stunts the new canes and causes the foliage to turn yellow. If in doubt as to the drainage of a piece of proposed raspberry land, drill a series of holes several feet deep in it, and see how much water there
is in these holes during the wet period. If water accumulates and remains in them for several days at a time, drainage cannot be good.

Having your commercial planting site near a city is a big advantage. Lots of labor at your door means fewer berries lost in the field and lower picking costs. Being near a market and needed supplies also cuts down the cost of transportation to and from market.

The blooming period of raspberries is late compared with that of other crops. For this reason, frost is not a serious factor in Washington, although heavy frosts before blossoming can cause serious damage.

Ten years is about as long as the average planting should be kept, although there are good plantings in the state more than 30 years old. As a rule, the better the soil and the better the care given the planting, the longer it can be kept in profitable production.

Preparation the Soil for Planting

Weeds in the planting reduce yields and increase the cost of production. The time to get rid of weeds, particularly quack grass, is before planting. There is no practical means of getting rid of them once they become established in the planting. Delay planting a year, if necessary, to get rid of them before setting your plants.

If the soil needs rebuilding, do it before setting the plants. Green manuring and fertilizing are easier when the land is open than after the plants are set. If your land is run-down, take a year to build it up. If it’s in fair shape, turning under one good green manure crop with lots of fertilizer may be enough. But regardless of how much time you need to condition the land, don’t overlook it. Rushing the planting without it is always a costly mistake.

Quite naturally the amount of soil building to be done depends upon the condition of the land to start with. Land which has been in sod or alfalfa for the previous 3 or more years probably contains enough organic matter. It may also contain the necessary nutrients, especially if the soil-building crops have been fertilized well.

It is impossible to prepare freshly broken sod for setting the plants immediately. It’s a good idea to grow a cultivated
crop following sod, and to set the plants the second year. The soil is then in good tilth and the lapse of time after breaking the sod lets the organic matter decompose.

Land that has been producing other crops is sometimes planted to raspberries. Usually this land requires some improvement before setting the plants. How much depends upon its fertility. With average fertility in western Washington it is well to apply as much as 15 to 20 tons of manure and 400 pounds of superphosphate; in eastern Washington the manure and 600 pounds of 16-20-0 are suggested. If manure is more or less rotted, it and the commercial fertilizer may be applied in the fall or winter up to 2 weeks before setting the plants. It is better to apply strictly fresh manure to the green manure or cultivated crop grown the year previous to setting, but you can apply it whenever it is available.

If manure is not available, you must condition the land by using green manure crops and commercial fertilizer. Although there appears to be no substitute for farmyard manure, green manure is fairly satisfactory when you use lots of commercial fertilizer with it.

You must start your conditioning program well ahead of planting and you can’t expect to do a satisfactory job in less than 18 months. Starting 18 months before you expect to set your plants gives time to produce two fall and one summer green manure crops.

Fast-growing crops are ideal for producing green manure. The more they grow, the better. Those that grow during the cool periods of late fall and early spring are better than those that grow only during warm weather, except for your summer crop. They produce more vegetation. There is also some advantage in using legume crops. Deep-rooted crops, such as sweet clover, serve to loosen tight soil besides fixing extra nitrogen.

Mainly through practice, growing a mixture of Rosen rye and hairy vetch has become more or less standard. Unfortunately, some of the vetch seeds germinate as much as 2 or 3 years after seeding. The resulting weed problem may be serious. If so, you can use Rosen rye alone. Abruzzi rye is promising in western Washington, although experimental work with it here is limited to 3 years. It doesn’t seem to be hardy enough, however, for central and eastern Washington.

Austrian winter peas alone or with rye or wheat is another good combination. These peas are not as hardy as vetch, but
they usually come through the winter in western and central Washington. Once in a while they freeze out in central Washington and in the northern part of the coastal region.

Among the deep-rooted crops are annual and biennial sweet clover. In addition to a heavy top growth, these produce large roots that loosen the soil upon decaying.

For summer green manure, there are such crops as oats and buckwheat. These can be sown after the fall green manure has been turned under. Buckwheat makes an excellent growth from late sowing. Although seldom seen in Washington, it has possibilities even though it is not a legume.

When planting the green manure, use plenty of seed. A poor stand cannot give you a full crop. Suggested rates of seeding are given in Table 1.

**WHEN TO SEED**

You can seed in the fall or early summer.

**Fall Seeding.** Crops such as vetch, rye, and winter wheat are hardy enough for fall seeding. How early to seed varies somewhat with the season and the soil, but you should seed early enough to establish the cover crop in the fall.

<table>
<thead>
<tr>
<th>Western Washington</th>
<th>Fall Seeding</th>
<th>Spring Seeding</th>
<th>Eastern Washington</th>
<th>Fall Seeding</th>
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<td>Lbs. per Acre</td>
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<td>Crop Combinations</td>
<td>Lbs. per Acre</td>
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<td>Rosen rye</td>
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<td>Austrian winter vetch</td>
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Table 1. Green Manure Crop Combinations with Seeding Rates
ever tonnage you get in the fall is that much gained. In western Washington, seeding in September has become fairly popular. Seeding at this time, just ahead of the fall rains, is easier than later.

Once the green manure crop is started in the fall, it stands considerable abuse. Taking out old canes can then go on regardless.

Crops seeded extra early in the fall may lodge. This extra growth, of course, is not objectionable if the crop doesn’t die or winter kill because of it. If you have an extremely dense growth, a light disking in the late fall seems to give some protection. The disked crop starts growth early in the spring and makes a fine early growth.

Spring Seeding. Winter-tender crops are usually seeded in the spring. Among these are Austrian winter peas, when seeded in central and eastern Washington. They sometimes come through the winter in south central Washington when seeded in the fall, but spring seeding is safer. Spring wheat and oats are sometimes used where, for one reason or another, winter hardy crops have not been seeded in the fall. You can also use buckwheat. And, of course, sweet clover as a green manure crop is usually seeded in the spring.

The earlier you seed, the better. Just as soon as the ground thaws out and can be worked is none too early for cool-weather crops like peas and oats. Sowing early lets them make their usual growth before hot weather. Sowing later may not.

Summer Seeding. You need not let your ground stand idle during the summer. If you are in an irrigated area or where you can irrigate, you can increase your green manure tonnage a great deal by a summer green manure program. Even without irrigation, you generally gain quite a bit. As soon as you turn under the fall green manure crop in the late spring, you can get the ground ready and seed a summer green manure crop.

Fertilizer applied immediately before or at the time of seeding to stimulate extra growth is good. How much to apply depends somewhat upon the condition of the land. There is no harm in applying more than the green manure crop needs. The surplus becomes available for the plants to be set later, and insures extra green manure tonnage. You probably know about what your soil needs. If not, about 300 pounds
of 16-20-0 is a good amount for most soils, and you may want to repeat the application when you turn the green manure under.

Once the necessary fertility and organic matter have been added, the soil need only be put into shape for setting the plants. Without waiting for the rye to reach the heading stage in the spring, disk down the green manure and plow it about 8 inches deep.

In western Washington wet weather sometimes keeps you from plowing when you want to, but usually there is at least a short time during which you can do it. Disk the plowed ground once or twice and then level it, if necessary. Finish off by going over it two or three times with a harrow. In western Washington, where the soil may become packed too much by later rains, it is not necessary to firm it as much as in central and eastern Washington, where packing rains are unlikely.

By the time you must get the land ready for planting in the spring, the green manure crop is still small. The rye is not yet in the heading stage. Don’t delay preparing for planting to let the green manure crop grow more. But you can get a 3- or 4-foot strip ready for setting the plants. Then let the rest of the green manure grow almost until the usual stage for working it down. In non-irrigated areas, however, you dare not let it use up too much moisture.

**Red Raspberries**

**Setting the Plants**

The success of the planting depends upon the planting stock. Make every possible effort to get healthy, disease- and insect-free plants. You can purchase them from growers and nurseries.

Select good mature plants. Those that start during the latter part of the last growing season are ideal. By the dormant period when they are 18 to 24 inches tall and 1/4 to 3/8 inches in diameter at the ground level, the root systems are well formed and able to get the plants off to a good start after transplanting.

The roots of the young plant are fine and tender. Be care-
ful when digging the plants to keep from tearing the roots. Don't pull the plants; always dig them.

The sooner the plants are set after digging, the better. Many plants have been ruined by mistreatment between digging and transplanting. Keep them fresh. If you can't transplant them immediately, select a well-drained spot and heel them in. Cut the bands and separate the plants of the bundle so that soil is around each root. You cannot cover the roots correctly without separating the plants from the bundle. As you cover the roots, pack the soil to keep air out.

You can set the plants either in the spring or fall. But spring setting is better, and the earlier in the spring, the better. In western Washington, any time in January or February is good. In eastern Washington, late March or early April is about as early as you can start. Planting early lets the plant get started before hot, dry weather. Plants established early usually produce canes for a good crop the second year. Plants set later sometimes don't.

The first crop can be up to 4 or 5 tons. Plants with as many as four 5-foot canes in each hill can produce 3 to 4 tons of berries the first cropping season. And there are records of 5 tons per acre. Such records don't just happen! They come from many good practices, such as getting the land ready and setting the plants early.

Many plants start slowly or completely fail to start for the simple reason that they have been set too deeply. Set them about 1 inch deeper than they grew as young plants. The roots are then about 4 inches deep. The buds from which the new canes come are near the base of the stalk of the newly set plant. If the plants are too deep, the new canes cannot push through the thick layer of soil.

Setting more than one plant in each hill increases the number of fruiting canes per hill for the first crop season. The extra crop which comes from this practice more than makes up for the extra cost of the plants. And there seem to be no ill effects from it.

There are several methods of making holes. One common method is as follows:

1. Insert a spade about 8 inches deep.
2. Push it forward and backward once or twice to make an opening big enough to place the roots.
3. Put the roots in full depth and pull them out to the desired depth, spreading them at the same time.

4. Remove the spade.

5. Step on the soil to press it next to the plant, and go on to the next space. This method is fast and quite satisfactory, especially during the early part of the season. You need a plant setter and a digger.

Another method is to dig a hole with a spade.
1. Dig the hole big enough; don’t cramp the roots.

2. Spread the roots so that soil surrounds each root. Extra large root systems need special care. Otherwise, you have an air pocket around the roots.

3. Once the plant is in place, fill the hole two-thirds full with fine moist soil, and pack firmly.

4. If the soil is so dry or planting is so late that watering seems advisable, apply water when the hole is about three-fourths filled with soil and finish filling the hole with soil after the water has soaked in. If watering is not necessary, fill the hole completely with loose soil, pack the lower part, but leave a mulch of loose soil on top.

A third method is to open up furrows with a plow. With the furrows laid out, you need only to keep the cross rows in mind as you plant. The cross rows, too, may be marked by pulling a marker across the field.

The stalk of the plant, when set, varies from 1 to 3 feet tall. Cut it to about 8 inches. For the most part, the stub serves as a marker, since new shoots come from below rather than above the surface of the soil.

**Systems of Planting**

The *linear system* is almost the only planting system used in Washington. The plants are set 30 to 36 inches apart in rows ranging from 7 to 9 feet apart. With vigorous varieties, such as the Washington, it is not advisable to set plants closer than 36 inches apart in the row, and in the Puyallup Valley 7 feet seems to be the standard distance between rows. Elsewhere 8 feet seems to be the most popular distance.
FIGURE 2. A newly set raspberry planting. The plants were set in early spring.

Trellising

The trellis consists of one or more No. 12 galvanized wires stretched and fastened to posts set 25 to 30 feet apart in the row. There are many trellising systems; some growers use one and some another. And in some areas where the canes remain short, no trellising system is used. A trellis need not be elaborate, but it must be fairly sturdy. There isn’t the strain against the wires that you have with grapes, but there is some strain when the crop is on it.

The various systems are the same as far as posts are concerned. Six and one-half to 7-foot posts are set 25 to 30 feet apart. You need posts at least $6\frac{1}{2}$ feet tall to make them solid with $4\frac{1}{2}$ feet extending above the ground. End posts must be even longer.

The number of wires varies from three to five, depending upon the system you use. As a rule, there is one top wire and one or more pairs of lower wires. The top or support wire, as it is called, supports the canes which are tied to it. The other wires, which are called guard wires, protect the canes from passing machinery.

It is customary to fasten the wires directly to the posts. Setting the posts so that the greatest diameter extends across rather than with the row gives a greater spread between the
guard wires. If you put hooks or nails into the posts, you can move the wires easily; or you can nail cross arms to the posts and fasten the wires to them. Making and keeping these up, however, is extra expense and may not be necessary. A more common practice is to use spreaders, as shown in Figure 2. The cross arms and spreaders are made of 2" x 2" material, and are about 16 inches long. Notches sawed near the ends hold the wires.

THE THREE-WIRE TRELLIS

The support wire is about 4½ feet from the ground. You can staple it to the top of the post at this height if you set the posts evenly. Make the support wire tight so that when the canes are tied to it, it holds them in place.
In this system there is one pair of guard wires. They are about 30 inches from the ground. Don't staple them to the posts, because you'll want to move them from time to time as you place the new canes inside the wires. Hooks for holding the wires are good here. You can drive heavy nails into the post and bend them up to form hooks.

As the new canes grow, they become too tall for the wire at 30 inches. By putting in two sets of hooks, one at 30 inches and the other about 10 inches above, you can move the wire up as the canes grow.

**THE FIVE-WIRE TRELLIS**

The five-wire trellis has two pairs of guard wires. The lower one is about 24 inches from the ground and the other about 18 inches higher. With two sets you don't need to raise the wires as the new canes grow. The extra wires also give more protection than you get from one set.

**THE FOUR-WIRE TRELLIS**

There is still another system in which there are simply two sets of guard wires. The canes may or may not be tied to the top wires. In any event, the top, as well as the bottom, wires protect the new canes. Staple the top set about 4 feet from the ground. And hook the lower set about 2 feet from the ground.

**Treating Posts**

The posts are a serious weakness in raspberry trellises; they soon rot off. You can make the average post last three times longer by treating it with a 5 per cent solution of pentachlorophenol for 12 to 48 hours. Mix the pentachlorophenol with any light oil, such as kerosene or diesel fuel oil No. 200.

There are several methods of treatment. Some treatments give more penetration than others. In general, those that penetrate most cost most. The *cold soak* method is most common. It is both simple and effective. The *hot and cold* method is more effective, but requires heating. *Treating under pressure* is even more effective, but more difficult and costly.

Treat the butt end of the post to 6 inches above the intended ground line. Species such as larch, Douglas fir, and western red cedar require 24 hours or more of treatment. Western yellow pine, lodgepole pine, alder, willow, and cottonwood, on
the other hand, can be treated in 12 hours. Generally speaking, soft woods absorb the material faster.

Training and Pruning

Suppose it is the fall of the year and you’ve already removed the old, fruited out canes and the surplus canes. In each hill you now have just the number you intend to keep for fruiting, with possibly one or two extra. You have done no heading. You can bunch the canes of each hill into one bunch and tie them firmly to the top wire to avoid wind injury during the winter, or you can clip off the ends at about 6 feet.

In late winter, or early spring, you must finish the pruning. If you bunched them in the fall, cut the band, remove extra canes, and head the remaining ones at 4½ feet.

Separate the canes of each hill into two equal parts. Spread them, leaving about 18 inches between the two bunches, and tie them to the top wire. With hills set 36 inches apart, this system also allows 18 inches between bunches of neighboring hills.

As the new shoots grow during the summer, keep them between the guard wires. Go over the patch frequently during the early part of the summer, to put the new shoots inside the wires. Allowing the new canes to grow beyond the wire before putting them in usually causes extra work and breakage.

REMOVE OLD CANES AND THIN WEAK ONES

The old canes are of little or no value after the fruit is picked. Take them out immediately following harvest and make room for the new canes. Cut them as near the surface of the ground as possible. Taking them out and burning them at this time helps to control some insects and diseases. If you have no pests that overwinter in the canes, leaving the canes in the field for humus has merit.

Immediately after harvest is also a good time to thin out surplus canes. You can get rid of all surplus canes at this time or you can take out only the smallest ones and the suckers around the hill; you have already taken out many of the suckers in early hoeings.

You may question thinning out surplus canes following harvest because summer pruning may dwarf the plants. In practice, however, the dwarfing does not appear to be serious.
Mature plantings sometimes injure themselves by overproduction. Don't leave too many canes. This doesn't necessarily mean that you should cut down the number of canes to what the soil can stand in its present condition; it may be better to fertilize more. Pruning to get big canes lowers production, but fertilizing increases it.

The number of canes one plant can support depends mostly upon the soil, the moisture, and pruning. Because the soil fertility and moisture vary so widely in different areas, it is impossible to say how many canes to leave in each hill under all conditions. The number varies from planting to planting and from plant

![FIGURE 4. Mature raspberry canes in a dormant condition.](image)

A—A hill with no canes removed. It's a good idea to remove weak and most of the surplus canes earlier.

B—A hill with weak and surplus canes removed.

C—A hill with canes tied to the top wire ready for the winter. Tying prevents wind whipping. Another way to prevent it is to cut them off about 1 foot above the top wire in the fall. You then must cut them again 6 inches above the wire in the spring.
Table 2. Approximate Number of Red Raspberry Canes per Acre for Various Planting Distances

<table>
<thead>
<tr>
<th>Distance Between Rows</th>
<th>Distance Between Plants</th>
<th>Hills per Acre</th>
<th>Canes per Hill</th>
<th>Canes per Acre</th>
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<tr>
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<td>2,904</td>
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<td>14,520</td>
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<tr>
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to plant. Pruning, therefore, is an individual plant problem and not a general treatment that can be used on raspberries generally or even on a single planting. You can prune to increase the size of fruiting canes, but do so only when the soil fertility is at a very high level. Otherwise, your production will be less than it should be.

If you are an experienced raspberry grower, you know about how many canes to leave. Otherwise, start with about six in each hill and adjust the number from year to year according to the size of the resulting canes. With the usual planting distance of 3 feet between plants, and 7 or 8 feet between rows, the customary number ranges from five to about ten.

The number of canes in each hill naturally must vary according to planting distances. With this in mind, the average number for each hill probably should be figured on an acre rather than on a hill basis. It is not known from experimental information how many there should be per acre in red raspberry plantings in Washington, but about 12,000 appears to be what is commonly used. Table 2 indicates the number of canes per acre for various planting distances.

DORMANT PRUNING

The dormant pruning, which is mostly heading the canes and spurring the branches with a pair of hand shears, is a simple job. The best time for it is in late winter. There is little to be gained from starting earlier than January, and you should be through before the buds start swelling. The amount and nature of the pruning varies with the age of the planting. Young plantings may need light pruning, but low vigor usually calls for heavy pruning as well as heavy fertilization.

First Year. Young plants seldom injure themselves by overproduction. For this reason, it is not necessary to prune
FIGURE 5. Mature raspberry canes after spring pruning and tying.
A—A hill after spring heading.
B and C—Hills showing canes spread and tied. The canes in each hill are divided into two equal groups. The ties on the wire are spaced 18 inches apart or half the distance between the hills.

to limit production. Plants which produce up to five or six canes that are long enough to reach the support wire can also support all the resulting fruit. Shorten the long canes to the regular height (4½ feet) and spur to 2 inches those branches that do not reach the support wire. No more pruning is needed. Don't head branches that are long enough to reach the top wire. Tie to the top wire those branches that are long enough.

Second Year. The plants are not yet in full production. The average number of suitable fruiting canes in each hill is still somewhat less than it will be a year or two later when the planting reaches full production. And ordinarily there is considerable branching at this time, especially with varieties such as Washington. Don't try to save all the canes for fruiting.

You may have taken out all the surplus canes following harvest. If so, no further thinning is necessary. Otherwise, thin them down now to the number you want to keep for fruiting. There is a limit to how small the canes may be, but a safe rule to follow this second year is to get rid of canes that do not reach the support wire. As soon as you have thinned, head the canes at 4½ feet. You still must take care
FIGURE 6. Mature raspberry canes before spring or dormant pruning. Weak and surplus canes removed.
A—A hill with canes tied in one bunch to the top wire for protection against wind whipping.
B—A hill with canes separated and retied.
Mature raspberry canes after spring or dormant pruning. Note that the branches have been cut back to 2-inch spurs.
C—A hill with canes all tied in one bunch to the top wire ready for the winter.
D—A hill with canes separated and retied ready for spring.
of the branches. Last year you brought the long branches up for fruiting. This year, spur all branches to two buds. The plants are now older and there are more good fruiting canes in each hill.

**Three-Year-Old and Full-Bearing Plants.** The nature and extent of the dormant pruning depends upon what you did following harvest. If you thinned the canes down to the number to be kept for production, you have only to head the remaining canes. Otherwise, you must first thin out the surplus canes.

The usual height for heading, as mentioned earlier, is about 4½ feet. This height has not been proved by experiments to be better than any other, but in practice it is quite satisfactory. It is about the upper limit, since boys and girls not able to reach laterals from high heading do much of the picking. Even lower heading is best when you expect your picking crews to be mostly smaller boys and girls.

Pruning usually serves to reduce the fruit load. In so doing, it increases fruit size and prevents overproduction. In raspberry pruning, load limiting comes mainly from cane thinning rather than from heading. Heading regulates the height of the fruiting laterals and may delay the first picking a day or two.

Canes headed heavily produce longer fruiting laterals, and in extreme cases they produce laterals lower on the cane. Canes headed high, on the other hand, produce slender laterals and may not produce low laterals. You therefore may vary your heading considerably without reducing the crop if you thin the canes to about the number the soil can stand.

**Fertilizing the Bearing Plants**

The plants must be kept in good vigor. Along with the crop of fruit, they must produce strong canes for next year's crop. It is only by keeping the vigor high that you can expect canes that can produce big crops.

Conclusive experimental information about fertilizing raspberry plantings in Washington is not available. These suggestions, therefore, are based upon experimental information that is available and upon good field practices.

There is no substitute for organic matter. You can supply it as farmyard or green manure. Use farmyard manure
when you can, but, unfortunately, there is not enough of it for all plantings; so you may have to use green manure crops instead. A green manure crop is valuable as a soil holder as well as a soil builder. So, even though you may not need organic matter, a green manure crop should be helpful. Green manure crops are discussed on pages 5 to 7.

The fertilizer elements in which our raspberry soils are deficient are not clear-cut. Some soils in fairly good fertility do not show response to fertilizers of any kind. But it's better to keep the fertility up than to let it run down to the stage where cane and fruit production is low. It is on this basis that regular fertilization is suggested.

Nitrogen is the fertilizer element most often needed in Washington. Some soils do not need more phosphorous or potash, but the soils in western Washington generally need some phosphorous, and some of them need potash. Start with 800 to 1,000 pounds of a mixture such as 5-10-5 for bearing plantings if you need potash. Otherwise use equivalent amounts of nitrogen and phosphorous or 400 to 500 pounds of 16-20-0.

In eastern and central Washington, use about 300 pounds per acre of a mixture such as 16-20-0.

Apply half the fertilizer right before seeding the green manure crop. This application helps the green manure in the fall and is available to the raspberry plant as the green manure decomposes. Apply the rest of the fertilizer as you work the green manure crop down when the rye starts heading or slightly earlier. Do not allow the green manure to grow too long. You may injure the crop by using up moisture the raspberry plants need.

Applying the fertilizer over the entire soil surface of the planting is the usual practice but you can put spring applications in furrows. In western Washington, where raspberry growers usually plow between the rows in the spring when the green manure crop is ready to be worked down, putting the fertilizers in the furrow closest to the row has some advantage. It seems to keep the phosphorous from being tied up.

Plowing to the row at this time and leaving the soil here for a month or 6 weeks destroys the weeds. You plow away from and hoe out the row later.
Cultivation

Raspberry plants are shallow rooted. The young plants grow rapidly and soon completely occupy all the soil. By the third year, even with the farthest planting distance, the soil is completely filled with feeder roots.

Being shallow-rooted, raspberries require shallow cultivation. Deep cultivation may not be harmful while the plants are small, but it injures roots in older plantings. Keep as near to 2 or 3 inches as possible.

In general, cultivate only to control weeds. Start in the spring when it is time to work the cover crop down. Turn the green manure under or work it down with a shallow running cultivator or disk. Be careful to keep the disk shallow.

You must cultivate during the summer to keep down weeds. But it is not advisable to cultivate during harvest, except as necessary to get the ground ready for seeding the cover crop following harvest.

Irrigation

Irrigation is needed in areas such as Spokane, Yakima, and Walla Walla. It is not a common practice in western Washington, but there it sometimes increases yields enough to make it worth-while; it need only add to the natural rainfall, and, during some seasons, two or three irrigations are enough.

Well-timed, sizable applications of water are better than frequent surface watering. Surface watering limits root growth to the surface soil. The spacing of the irrigations must be figured to fit each soil type. Irrigate as often and as thoroughly as necessary to keep the soil moist. In the gravelly soil of the Spokane Valley, particularly during the warm period of July and August, the time between applications should not be longer than about 10 days. In the heavier soils of western Washington, every 2 or even 3 weeks may be often enough.

Rill irrigation has been the standard method in Washington for years, but sprinkling is now fairly general. Both methods are good as long as they keep the root-feeding area of the soil moist and do not cause soil erosion or pack the soil. Sprinkling has some good advantages on rough land.
where rill irrigation causes soil erosion. It also has some disadvantages. Unless the soil is protected by vegetation, sprinkling causes some packing.

**Propagation**

New plants come from adventitious buds on roots. Plants form on normally growing roots, but mechanical injury to the roots makes them form faster. It is for this reason that many plants spring up in the cultivated area between rows in bearing fields. When plants are scarce, they may be produced from 3- to 4-inch pieces of root, cut in the early spring and planted in a propagating medium or directly in a nursery row.

**Harvesting**

Good care and good timing are doubly important in picking raspberries. Whether or not your harvest goes off smoothly depends upon how you prepare for it. You need a crew large enough to get over the patch as fast as the berries ripen. Plan to pick about every other day.

It's impossible to know the number of pickers you need for all conditions. The number varies with the weather and from planting to planting. And you don't need as many pickers at the beginning of the season as you do later. As a rule, five pickers per acre should be able to get over the planting every other day.

**PICK ONLY RIPE BERRIES**

Ripe berries separate from the core easily, and are fully red. Picking all of the ripe berries as you go over the patch makes a nice-looking pack. Picking green berries, on the other hand, makes an uneven pack. And missing ripe berries means overripe fruit in the next picking.

**BETTER AND FASTER PICKING**

As with most jobs, there are skills and techniques in picking raspberries. Learn these well in the beginning, and you'll become a fast and good picker.

Berries bruise easily. Using three instead of two fingers as you take hold of the berry tends to avoid bruising. Cup-
ping the hand upward rather than downward lessens the danger of dropping berries. Occasionally there is a temptation to hold too many berries in the hand at one time. It is difficult to hold more than three or four without bruising.

It is customary to pick into hallocks. These are set into trays holding from six to twelve hallocks. The tray, filled with empty hallocks, is set and locked into a four-legged rack which stands about 2 feet high. There is a handle on the rack so it can be carried easily as you go down the row. Keep it handy and ahead of you as you pick. When all hallocks are full, carry your rack, tray and all, to the berry shed and exchange the filled tray for an empty one. You have only to unsnap the tray, lift it out, and put in an empty one.
Once the berries are picked well, you are ready to take them to the processor. Remember that you are handling a highly perishable product; so keep the berries as cool as possible. Keep the trays in the shade, and deliver to the processing plant twice every day. Berries soften and become overripe rapidly in the berry shed. Holding them too long here may lose all you gained by picking carefully and on time.

**YOUNG PEOPLE MAKE EXPERT PICKERS**

Young folks make excellent pickers. Painstaking boys and girls, though inexperienced at first, with some good instruction from an experienced picker, can learn to pick well and fast in a short time. To beginners, picking may seem to be simply getting the berries off the plant, but it isn’t. You must consider both the plants and the ripe as well as green fruit. Fortunately, the way that protects the fruit and plants is faster in the long run.
Varieties

Many varieties of red raspberries grow well in Washington. Almost from the beginning of the industry in the state, Cuthbert has been among the favored varieties. At one time it was favored over all others. Its lack of hardiness and its high susceptibility to some virus diseases led to the development of Washington, which is resistant to these troubles. Washington has now all but replaced Cuthbert. In recent years, weaknesses in Washington have appeared which show beyond question that it is not the ideal variety for this state.

**Washington**: Berries of medium size, bright red, of excellent quality, sweet; suitable for preserving, freezing, and fresh use; midseason; will withstand wide range of soil, but will not stand poor drainage; resistant to mosaic.

**Cuthbert**: Berries of medium size, bright red, of excellent quality, sweet; suitable for preserving, freezing, canning, and fresh use; midseason to early; semi-hardy, large, will withstand wide range of soils; susceptible to mosaic.

**Willamette**: Berries large, bright color, of good quality but not as good as Washington and Cuthbert, semi-sweet; suitable for canning, preserving, freezing, and fresh use; midseason; hardy, suckers freely; will withstand a variety of soil conditions, not wet or too heavy.

FIGURE 9. Picker unsnapping carrier from the field-rack. The snap holds the carrier firmly, but is still easy to unsnap.
**Latham**: Berries of medium size, color good but not as attractive as Washington and Cuthbert, quality fair, somewhat seedy; suitable for fresh use and fair for canning, preserving, and freezing; midseason; hardy, not especially tall.

**Newburgh**: Berries large, light in color, of fair quality, sweet, seedy, lacks sprightliness of better varieties; fairly suitable for fresh use, lacks color necessary for other uses; midseason; hardy, not especially tall; will withstand a wide range of soil types; new growers should consult market references.

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**Black Raspberries**

You propagate black raspberry plants by what is called *tipping* or *tip-layering*. The long canes eventually droop until the tips touch the ground, and the tips soon take root. Plants rooted by midsummer are ready for setting the following spring, but those rooted later are small.

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**Planting Distances**

There is considerable variation in planting distances. The distance between rows varies from 7 to 9 feet. Seven feet is the more common spacing, but occasionally more space is needed to accommodate wide machinery.

Within the row there is even more variation than between the rows. Here the spacing varies from 3 feet, when the plants are grown with a trellis, to 4 or even 5 feet, when they are kept in cross-cultivated hills. In Washington, the closer spacing seems to be more productive.

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**Setting the Plants**

The plants may be set during the dormant period or during the late spring when in partial leaf. Both periods are satisfactory. Cover the dormant plants about an inch deep and remove the old canes at setting time to prevent the spread of anthracnose. When setting plants in leaf, avoid covering the leaves.
The plants must be kept in good vigor. Vigorous, healthy plants produce capacity crops of choice fruit, but weak plants produce inferior fruit and low yields.

Success with black raspberries depends to a great extent upon soil management. Plan it early and adjust your original plan as necessary to keep the plants healthy and in good vigor. The green manure, fertilizer, cultivation, and irrigation suggestions made for red raspberries apply to black raspberries also.

Training the Plants

The training of black raspberry canes differs from the training of red raspberry canes in that branching is desired. It is brought about by *pinching out* or heading the tips of the new canes during the summer. The height at which this heading is done determines the final height of the plants. Twenty-four to thirty inches is considered the right height. The branches then start 18 inches or more above the ground.

Head as soon as the new canes are tall enough. Don’t allow them to grow more than an inch or two beyond where you want to head them. To delay longer often causes *die back* in the main stalk.

There are two different methods of training the canes. One is with a trellis and the other is without a trellis. As practiced generally, both include tipping the young canes.

**TRELLIS SYSTEMS**

The *no-trellis system* is simply heading new canes and shortening the resulting branches. With this system, the plants are headed low, sometimes as low as 18 inches, to stiffen the canes as much as possible. Special attention is given to using only stiff canes for fruiting to keep them off the ground when loaded with fruit. When this system is used, the plants are often set so that they can be cross-cultivated.

The *trellis system* is similar. Here you can head a little higher because the canes receive some support from the trellis.

**THE TRELLIS**

The trellis is similar to the one used for red raspberries. The posts are set 25 to 30 feet apart and one pair of No. 12 galvanized wires is stretched on either side of the posts. The wires are stapled to the posts 6 to 8 inches above the height at
which the new canes are headed. Occasionally a second set of wires is used to support the fruiting laterals.

Rarely, the canes are allowed to go without tipping. They are then trained to the same kind of trellis used for red raspberries. This no-heading system is by no means a proved practice, but it gives you a chance to use more fruiting canes and get higher yields.

**Dormant Pruning**

You can prune between January 1 and April 1. In central and eastern Washington, however, late February is about as early as you should start because of the danger of winter injury from early pruning.

It is impossible to make a set rule about the number of canes to leave in each hill. But, in general, leave all the canes over 1/3 inch in diameter measured 1 foot above the ground.

If you thinned the canes down to the number considered suitable earlier, you only need to shorten the fruiting branches. Otherwise, remove the old canes and thin out the weaker ones. Thinning out weak canes and heading the rest prevents overproduction.

Fruiting wood must be limited to what the plant can carry. Obviously, the amount depends upon the fertility of the soil, and the soil moisture. With good soil and plenty of moisture,
the branches on canes less than 1/2 inch in diameter (1/3 to 1/2) should be cut to five buds and those on stronger canes over 1/2 inch should be cut to eight buds. Here again the length of these branches must depend upon the vigor of the plant and you must gauge your pruning according to the vigor of your particular planting.

**PRUNING AFTER HARVEST**

The plant produces many canes each season, some of which must be gotten rid of. After harvest, take out the weak canes as you remove the old canes. During the harvest season, which lasts from 3 to 6 weeks, many new canes appear. They, for the most part, are not as good as the earlier canes and, of course, are unheaded. You should be through heading the new canes by the beginning of harvest. Take these late canes out following harvest. Only rarely will you want to remove any headed canes at this time.

**Varieties**

Many varieties are being grown in Washington. Of these, some appear to be definitely better than others. For western Washington, Munger seems to top the list. For other parts of the state, Bristol and Cumberland are good.

**Bristol:** Berries large, high-flavored, hard to pick after rains; suitable for canning, freezing, and fresh use; midseason; hardy, vigorous growth; productive; grows on wide range of soils; extremely susceptible to anthracnose.

**Cumberland:** Berries extra large, of good quality; suitable for canning, freezing, and fresh use; midseason; usually hardy, usually productive; grown in wide range of soils; planted more widely than any other variety.

**Dundee:** Experimental; berries of good quality. Promising in western Oregon; grown to limited extent in Washington. Plants vigorous and productive.

**Evans:** New York origin. Experimental. Productive in western Oregon. Not as vigorous as Dundee.

**Logan:** Ohio origin. Experimental. Promising in western Oregon.

**Munger:** Berries attractive, of good quality; suitable for canning, freezing, and fresh use; earlier than Cumberland and Bristol; hardy; grown in central and western Wash-
Ingested; soil—grown in wide range of soils; insects and diseases—susceptible to mildew.

**Morrison:** Experimental; berries largest of black varieties, firm, glossy, of fair quality; apparently suitable for canning, freezing, and fresh use; late; plant—productive; apparently same requirements as for other varieties; insects and diseases—not especially susceptible to insects and diseases.

**Plum Farmer:** Berries large, firm; suitable for canning, freezing, fresh use; early, short seasoned, usually picked in two or three pickings; plant hardy; grown in wide range of soils; not especially susceptible to any insects or disease.

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**Diseases and Their Control**

Leave at least 300 feet between the red raspberry plants and the black raspberry plants because some black raspberry varieties are susceptible to red raspberry mosaic.

**BLUE STEM**

A fungus disease that is more severe on black than on red raspberries.

**Symptoms:** Infected new shoots become dwarfed and may wilt. The leaves turn yellow and wilt; they may look like those infected with streak or mosaic. Fruit dries up before ripening. Old canes become bluish in a streaked pattern. Reddish brown spots appear on infected roots.

**Control:** Fungus enters from soil through crown or root wounds. Plant healthy stock in clean land. Don’t plant raspberries following potatoes, tomatoes, or eggplant. Get rid of wilted plants.

**YELLOW RUST**

A fungus disease occurring particularly during wet seasons.

**Symptoms:** Yellow rust spots in lower and upper leaf surfaces and on young canes. Early infected old leaves may fall early. Yellow spots turn black in the fall. Infected canes
may break. Fruit of seriously infected plants fails to develop and ripen properly.

**Control:** Spray canes in delayed dormant condition (buds beginning to swell) with:
1. Bordeaux 4-6-50 and one pint Penetrol
or
2. Liquid lime-sulphur, 4 gallons to 100 gallons of spray
or
3. Two pounds of Fermate and 3 ounces of spreader in 100 gallons of spray.

The lime-sulphur spray aids in suppressing mites.

Covering fallen leaves in early winter with soil reduces the number of overwintering spores and, in turn, the source of new infection.

**ANTHRACNOSE**

A fungus disease affecting both red and black raspberries.

**Symptoms:** Circular and slightly sunken spots on young shoots; spots purple at first; margins remain purple with slightly raised edge but centers eventually turn light gray; more spots in lower part of plant; light spots sometimes appear on black raspberry fruit. Spots on infected leaves may drop out, causing a *shot hole* appearance.

**Control:** Plant clean stock. Remove old canes when setting black raspberry plants. When disease is present, remove and burn old canes following harvest. Avoid conditions that keep the air from circulating among the plants.

**Spray:** *First* when buds start opening, with 1 gallon of lime sulphur in 9 gallons of water or 4-4-50 Bordeaux and 1/2 pint of Penetrol. *Second* when first flower buds show white, with 4-4-50 Bordeaux and 1/2 pint of Penetrol. If the infection is in lower part of the canes only, spray just here, using 6-6-50 Bordeaux.

**CANE BLIGHT**

A fungus disease which affects both red and black raspberries. Sometimes it is serious following winter injury.

**Symptoms:** Infected areas are light in color; they are often flat and cracked; tiny black spots sometimes appear
on the infected surface. The wood of the infected area may turn dark. The infections weaken the cane and cause breakage. Infection sometimes occurs on the tipping wounds of black raspberry canes.

**Control:** Remove heavily infected and old canes following harvest. The delayed dormant lime sulphur spray suggested for anthracnose is somewhat effective.

**CROWN GALL**

A bacterial disease found on the roots.

**Symptoms:** Irregularly shaped galls appear on roots and crown. Infected plants become weak and gradually die.

**Control:** Do not plant infected canes and do not set plants on infected land. Remove diseased plants if there are only a few in a planting. Heavily infected fields should be destroyed as soon as production becomes unprofitable.

**RASPBERRY MOSAIC**

A virus disease affecting both red and black raspberries.

**Symptoms:** Leaves mottled with raised dark-green areas between veins; tissue along leaves usually yellowish green; entire leaf light in color; leaf symptoms more common on new shoots than on old canes. Plants stunted. Fruit insipid and small.

**Control:** Plant disease-free stock. Inspect planting and dig out infected plants.

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**Insects and Their Control**

**ORANGE TORTRIX**

A fawn- or gray-colored moth about 1/2 inch long. The greenish-white larva with a brown head is about 1/2 inch long when full grown. It drops into the fruit containers as the fruit is being picked and is hard to pick out. The larva feeds upon the foliage and occasionally upon the fruit.

**Control:** ABOUT MAY 15—plants in half leaf
Dust: Apply 25 pounds of prepared 5 per cent Rhothane (DDD) dust per acre.
   or
   Apply 50 to 70 per cent cryolite dust. (Add 25 pounds 50 per cent DN-4 per acre to the above dusts if mites are present.)

Spray: Apply 150 gallons Rhothane spray—2 pounds of 50 per cent wettable powder per 100 gallons per acre.
   or
   Apply 3 to 4 pounds of Cryolite per 100 gallons.
   (If Willamette mite is present, add 1/4 pound of DN-111 to either of the above sprays.)

About June 1—2 weeks after earlier treatment
Repeat earlier treatment. Do not apply during the blooming period.

About June 15—at least 2 weeks ahead of harvest
Repeat earlier treatment.
If mites are present, dust with 25 to 30 pounds of 1/2 to 1 per cent tetraethyl prophosphate (TEPP) per acre.
   or
   Spray with 1/4 to 1/2 pint of 25 per cent TEPP per 100 gallons plus 1/2 pint of rotenone-bearing concentrate.

Raspberry Fruitworm
A yellowish-brown beetle about 3/16 inch long. It feeds upon fruit buds, unfolding leaves, and blossoms. The feeding sometimes distorts the berries.

The female beetle fastens eggs to the blossoms just before they open. The full-grown larva is about 1/3 inch long. It has light brown spots on the back of each segment. It tunnels the core of the berry and sometimes eats into the berry itself.

The adult beetle overwinters in the soil and begins to come out in mid-April.

Control:
1. Seven days after first blossoms appear, or when adult beetles are found actively feeding upon the lower foliage, spray with 27 ounces of 5 per cent rotenone in 100 gallons of water.
   or
Dust with rotenone containing at least 1/2 to 1 per cent rotenone.

2. *Ten days later*—repeat the treatment 10 days after the first application.

3. *Ten days later*—repeat the treatment 10 days after the second treatment.

**RASPBERRY ROOT OR CROWN BORER**

A clear-winged moth with a wing expanse of about an inch. The moth lays eggs on leaves and stems. The larva or borer crawls down the cane and burrows into it at about the soil line. It feeds here and makes a case for overwintering. In the spring it keeps on tunneling into the canes and works into the crown. It feeds here for some time, weakening the plant. In the spring and summer of the second year, it changes to a pupa and comes out in August or September.

**Control:** Infested canes often wilt suddenly. Remove and burn them immediately. Make cuts to remove these and old canes close to the ground following harvest. It is important to remove canes after the season is over.

**RASPBERRY CANE MAGGOT**

A small brownish fly about half the size of a house fly. The fly deposits eggs near the tips of young shoots. The whitish larva is about 1/3 inch long. It first girdles the stalk and then burrows into it. The girdling causes the cane to wilt.

**Control:** Cut off and burn the girdled canes. Make the cut several inches below the girdle.

**RASPBERRY SAWFLY**

A fly-like insect. The females lay their eggs upon the leaves, where the larva starts feeding. Serious infestations may partly eat off most of the leaves. The injury is most noticeable in May and June.

**Control:** A few days after blossoming, spray with 3 pounds of cryolite per 100 gallons of water.

or

Dust with a mixture of 70 pounds of cryolite and 30 pounds of talc.

Control is not difficult but later treatment is necessary.
Spray or dust with rotenone at dilution suggested for raspberry fruitworm.

**WILLAMETTE MITE**

Almost microscopic mites which cause a yellowing or browning of the leaves.

**Control:** Several insecticides are effective. Apply treatments as often as necessary to keep infestation down, directing sprays and dusts to the lower leaf surfaces.

1. DN-111 spray, 1/4 pound per 100 gallons of water.  
   Caution: Do not use DN-111 with oil or on plants sprayed with oil after the dormant season.
2. Spray with 25 per cent tetraethyl-pyrophosphate, 1/4 to 1/2 pint per 100 gallons water.
3. Sulphur—Dust at the rate of 25 to 40 pounds per acre.  
   or  
   Spray with 4 to 6 pounds of wettable sulphur per 100 gallons of water.

**RASPBERRY APHID**

It spreads raspberry mosaic.

**Control:** Spray with:

1. Tetraethyl-pyrophosphate according to the manufacturer's directions. Make treatments at first signs of pest.  
   or  
2. One pint of nicotine sulfate in 100 gallons of water.  
   Must be applied on a warm day.