

GROWING BERRIES on the OREGON COAST: Kiwifruit and Table Grapes

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The kiwifruit is a vigorous climbing vine. There are several species of kiwifruit available from nurseries. Some have been developed to produce fruit; others are ornamental. The “fuzzy” kiwifruit (*Actinidia deliciosa*), particularly ‘Hayward’, and the hardy or “baby” kiwifruit or “kiwiberries” (*A. arguta*), particularly ‘Ananasnaya’, are the most common fruit-producing, nonornamental cultivars available in stores or farmers markets. Both can be grown on the coast but are limited to warmer, protected sites. Hardy kiwifruit are smaller than fuzzy kiwifruit and have smooth edible skin and green, yellow, or red flesh, depending on the cultivar.

Kiwifruit plants are dioecious, meaning there are separate male and female plants. While male plants do not produce fruit, they are essential for pollination and fruit production on female plants. Usually, one male is needed for every 6 to 10 females; it is best to plant male and female vines of the same species. There are some self-fruitful kiwifruit cultivars that don’t need male-pollinizing vines, but even in these cultivars cross-pollination can increase fruit size. The fruit of kiwifruit plants is a berry, with some species having edible skin. Kiwifruit have one of the highest concentrations of vitamin C among fruit; they have at least twice that of an orange.

If you are reading this publication for the first time, we recommend you first read *Growing Berries on the Oregon Coast: An Overview* (EM 9177). It includes general information on site selection, soils, irrigation, mulching, nutrient management, and considerations specific to the coastal environment.

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Table grapes have a similar growth habit and management practices to kiwifruit. However, unlike kiwifruit, table grapes are produced in clusters that are picked when the latest maturing fruit (those at the tip of the cluster or those at the shoulders of the cluster) are ripe.

Site selection

Site selection is important with any berry crop, and kiwifruit and table grapes are no exceptions. A warm, protected microclimate will be important; direct, full sun is best for good fruit production on the coast. Avoid planting sites in depressions or low-lying basins because these areas usually have poor air drainage and turn into frost pockets. Kiwifruit are especially susceptible to frost damage in late winter and early spring because there are no “back-up” shoots within a bud. In contrast, table grapes have three growing points or possible shoots within each bud.

Wine grape cultivars will not receive enough heat units on the Oregon Coast to ripen; some may be grown successfully on more inland sites. Earlier-maturing table grapes can be grown successfully at most coastal sites, and mid-season cultivars should ripen in warmer microclimates on the southern coast.

Kiwifruit vines are particularly susceptible to wind damage. They have very long shoots that can be damaged by wind in the spring and summer. Wind can also cause rubbing, which becomes a callused or scabbed area on the fruit (Figure 1). Windbreaks (such as a row of trees or shrubs) can provide protection, but be careful where you establish them to avoid competition with the berry crop. See *Windbreaks for Fruit and Vegetable Crops*, listed in “For more information,” (page 9).

Kiwifruit vines are sensitive to wet or heavy soils and may be susceptible to root rot, depending on the cultivar. In addition, kiwifruit are also susceptible to

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Figure 1. Wind damage on hardy kiwifruit

Table 1. Recommended soil nutrient ranges for kiwifruit and table grapes

Soil nutrient	Deficient at less than (ppm)
Phosphorus (P) (Bray)	20–40
Potassium (K)	150–350
Calcium (Ca)	1000
Magnesium (Mg)	120
Manganese (Mn)	20–60
Boron (B)	0.5–1.0

verticillium wilt, a soil-dwelling fungal disease. Avoid planting kiwifruit vines in sites where other verticillium-susceptible crops (such as strawberries, raspberries, potatoes, tomatoes, peppers, or eggplant) have been planted in the past five years.

Soil

Soil pH

Kiwifruit and table grapes require a soil pH between 5.6 and 6.5. Test the soil 6 months to a year before you plant to give yourself enough time to modify the soil pH, if necessary. For instructions on lowering or raising the soil pH, refer to *Growing Berries on the Oregon Coast: An Overview* (EM 9177).

As with soil pH, test the soil for nutrient content and then amend it, if necessary, 6 months to a year prior to planting. Recommended soil nutrient levels are provided in Table 1.

Drainage

Kiwifruit vines prefer well-drained soil and benefit from the improved drainage provided by raised beds. Poor drainage can lead to root death and root diseases. Because of their large root system, kiwifruit benefit when planted in well-drained soil that is at least 2 (and ideally 3) feet above the water table. Kiwifruit roots will suffocate in soils that are water-logged for more than a few days in a row during the growing season, and the likelihood of root rot will increase. Table grapes are more tolerant of heavier soil.

Kiwifruit and grape cultivars for the coast

The kiwifruit most widely recognized by consumers is the large, fuzzy ‘Hayward’ cultivar (*Actinidia deliciosa*). ‘Hayward’ requires more frost-free days and heat units than are typically found in most parts of the Oregon Coast, but in warmer areas (e.g., Brookings and other warm microclimates on the southern coast) it is possible



Figure 2. 'Ananasnaya' hardy kiwifruit

to grow this type of kiwifruit successfully. 'Hayward' vines, if harvested at the proper time, produce large fruit that store and further ripen well; fruit do not ripen on the vine. Pick fruit as late as possible in the season, typically before the first hard frost is forecast.

The hardy kiwifruit species most recommended for fruit production on the Oregon Coast is *Actinidia arguta*. Hardy kiwifruit have a shorter storage and shelf life than fuzzy kiwifruit. They taste best when vine-ripened, but shelf life is shortened because vine-ripe fruit are very soft and the skin of the berry can tear at the stem end when picked. When kiwifruit are picked ripe or when they are just starting to soften, fruit quality is good and highly aromatic with excellent flavor that varies by cultivar. Recommended cultivars include 'Ananasnaya' (Figure 2), 'Issai', and 'Kens Red.' See *Growing Kiwifruit* (PNW 507) for detailed cultivar information.

There are many table grape cultivars available. Recommended cultivars for the coast include: 'Interlaken' (white), 'Reliance' (Figure 3), 'Canadice', 'Vanessa' (red), 'Price', 'Jupiter', and 'NY Muscat' (blue). See *Growing Table Grapes* (EC 1639) for more information.

Planting systems

Kiwifruit and table grapes are established similarly. As close to planting time as possible, purchase 2-year-old self-rooted (nongrafted) vines that are either bare-root or container stock. While grafted grapevines may be available (to provide resistance to the root-feeding insect phylloxera), this is not necessary for table grapes or for soil generally found on the coast.

Plant early in the spring to get plants as well established as possible in the first year. Plant on raised beds (see "Drainage," page 2). As with other berries, make the planting hole large enough so that the roots of



Figure 3. 'Reliance' table grape cultivar

bare-root nursery material fit without bending, although you may trim the roots a little to make them fit. The hole should not be deeper than necessary and no fertilizers or manures should be added to the planting hole because they will burn the roots. Instead, incorporate any required soil amendments the fall prior to planting (see "Soil," page 2). Vines should be planted so that soil just covers the top roots; do not mound soil around the base of the vine at any time. Tamp the soil down and water well. Keep the soil moist to promote root growth but don't overwater. Overwatering can promote root rot (see "Pests and Problems," page 8). To help prevent sunburn, paint the trunks with a mixture of 1:1 water and interior white latex paint. Milk cartons or grow tubes placed around the trunks can protect against sunburn and rodent feeding.

The most important goal in the planting year is to develop a single, straight trunk. Prune plants back to one or two buds at planting. Select a single vigorous shoot to train upward as the trunk. Place a stake beside the shoot and tie your chosen leader shoot to it (Figure 4, page 4). Don't tie it too tightly or you could girdle the shoot; flexible tie tape is a good choice. Connecting a string from the trellis wire to the stake can help support the stake and vine as it grows. The shoot should not wrap around the stake. Remove any new shoots that emerge at the base of the plant and any lateral branches to direct the plant's energy and growth into the trunk. If the trained shoot loses vigor and begins to twist early in the season or if it breaks, prune off the top of the shoot and train up a new leader from the uppermost branch; remove any other branches. The trunk should terminate 2 to 3 inches above the trellis wire (at about 6.5 feet). In kiwifruit, if the growing shoot (trunk) reaches the top wire early enough, you can try to form cordons (more permanent lateral branches on the trellis) the first year by topping the shoot 4 inches below the wire to encourage

lateral growth. Train two lateral branch shoots in opposite directions along the center wire. These will be the cordons or lateral canes of the vine (see “Pruning and training,” page 6). For more detailed information, see *Growing Kiwifruit* (PNW 507) and *Growing Table Grapes* (EC 1639).

Kiwifruit

The easiest kiwifruit training system to manage is a T-bar trellis (see “Trellising”). Space vines 15 feet apart in rows that are 15 feet apart, using a ratio of 1 male to 8 female vines. In the home garden, plant one male and one female vine to maximize fruit production. Vines are vigorous, and individual shoots grow 6 to 20 feet per year. Male vines should be dispersed evenly within a commercial planting block and must flower at the same time as female vines. Plant the outside rows with only female vines. Plant the next row with a male vine between every two female vines. Plant the following two rows with only female vines. Repeat this pattern throughout the interior planting rows. In this design, male plants run at right angles to the rows. However, there is some evidence that bees prefer to work down rows rather than across rows, so it may be desirable to place males in every row. Make sure you label the male and female vines in a permanent way because you will be pruning these differently throughout the life of the planting and you should only take leaves for tissue nutrient analysis from the female vines.

Table grapes

Plant table grapes 4 to 6 feet apart in the row with 10 to 12 feet between rows. Plants may also be grown as single vines. Table grapes are self-fruitful so only one cultivar is needed.

Trellising

Kiwifruit

Use the T-bar trellis (Figure 5) to more easily manage kiwifruit vines in the home garden. Commercial producers sometimes use a pergola (solid overhead canopy). T-bar construction is described here. To learn how to construct and train to a Pergola trellis, refer to *Growing Kiwifruit* (PNW 507).

For a T-bar trellis, use 8- to 9-foot-long pressure-treated (if you are not growing organically) or metal posts (if you have an organic certification) that are 4 to 6 inches in diameter. Drive the posts 2 to 3 feet into the ground (depending on soil type) and space them 15 to 20 feet in the row. Make sure end posts are 6 inches in diameter and drive them in at an angle so that the top of



Photo: Bernadine Strik, © Oregon State University

Figure 4. Kiwifruit vine in the planting year being trained to a bamboo stake to develop the trunk



Photo: Bernadine Strik, © Oregon State University

Figure 5. Kiwifruit vines trained to a T-bar

the post is leaning 1 foot from perpendicular, away from the row. Anchor the end posts well (Figure 6, page 5). Use cross arms that are 5- or 6-foot-long 2x6s bolted into cut notches at the top of the posts or attached to metal posts. The cross arms can be braced to the post using wood for additional strength. Run high-tensile wire down each side and the top middle of the cross arms. You can also add two intermediary wires to support the vines and fruit. Strong tension is needed, so use galvanized, 12-gauge wire and install sturdy wire tighteners. Kiwifruit vines are then tied to the wires on top of the cross arms.

Table grapes

Table grapes can be grown on many types of trellises. Refer to *Growing Table Grapes*, (EC 1639) for more detailed information.

Irrigation

Kiwifruit, like all berry crops, need adequate water to thrive. You can irrigate your crop by hand, or with sprinklers or drip systems—whatever works best for you. The important thing is to make sure that adequate moisture is getting to the root zone. For more information on irrigation, see *Growing Berries on the Oregon Coast: An Overview* (EM 9177).

As in all berry cropping systems, drip irrigation is ideal. Kiwifruit vines can be irrigated with a single line of drip irrigation per row with ½ gallon emitters placed every 18 inches.

Established kiwifruit typically need from 1 to 1.5 inches of water per week during the growing season. Despite the mild summer climate on the coast, it is unlikely that there will be enough precipitation to meet these water needs, and irrigation will be necessary. Wet the soil 0.5 to 1 foot deep with each irrigation. You may need extra water if your soil is sandy or windy.

Table grapes can be grown without water or irrigation in all but the establishment year. However, if you see any signs of plant stress, including small or shriveling fruit, it is best to water vines once per week to prevent this from happening in the future.

Fertilization

Urea or organic fertilizer products work well for providing nutrients to kiwifruit and grape vines as long as the soil pH is between 5.6 and 6.5. Kiwifruit plant roots are sensitive to fertilizer burn, especially near the trunk, so broadcast fertilizer over the entire root zone. Fertilizer burn symptoms include leaf necrosis or a blackening of the leaf edges.

New and young plantings

The roots of kiwifruit vines are sensitive to fertilizer burn. In the planting year, fertilize each plant with 0.4 ounce nitrogen (N) per plant per month in May, June, and July. Spread the fertilizer around the base of the trunk in a 12-inch diameter circle but avoid getting any on the trunk. The year after planting, apply 0.8 ounce N per plant per month in April, May, June, and July; spread the fertilizer evenly within a 2- to 3-foot diameter circle around each plant or broadcast it down the row (use 50 pounds N per acre). Third- and fourth-year plants should be fertilized with 2 to 3 ounces N every other month



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Figure 6. Example of an end anchor to support a trellis row. Note the screw anchor in the ground and the wire tightener close to the top of the post.

from March through July (60 to 90 pounds N per acre total). It should be broadcast in a band under the vine canopy. Do not fertilize young plants after July; this will force late growth and increase the potential for frost injury. Fertigation can be used in young plants. Kiwifruit vines are also very sensitive to chloride, so do not apply chloride-containing fertilizers. If soil tests indicate other nutrient needs, they should be applied in spring using foliar (for micronutrients) or broadcast band applications. Kiwifruit vines tend to take up significant amounts of phosphorous and potassium, so they may need to be applied. For more information, see *Growing Kiwifruit* (PNW 507).

Established plants

For vines over 6 years old (mature) use 0.5 to 1 pound N per vine (100 to 190 pounds N per acre) per year, depending on the cultivar or vine vigor. Apply two thirds of the total N in March; apply the last third in May or June. Irrigate a day or two before applying fertilizer, unless there has been a good rainfall, and then irrigate again after fertilizing. Fertigation can be used in mature kiwifruit vines, but you need to be careful not to apply too much N in one application because high N levels in irrigation water can injure roots.

Avoid fertilizers that contain high amounts of potassium chloride (muriate of potash) as high levels of chloride are toxic to kiwifruit vines.

Monitor soil pH every few years and add lime in autumn to maintain the soil pH within the desired range for kiwifruit.

Other than fertilization in the establishment year (similar to what is described for kiwifruits), grape plants do not require much fertilizer. Refer to *Growing Table Grapes* (EC 1639) for more detailed information.

Harvesting

Pick regularly. This helps ensure you collect fruit at its optimal ripeness, and reduces insect pests and diseases that are more prevalent on overripe fruit. During periods of hot or rainy weather, you may need to pick more frequently. Try to avoid picking when fruit are wet from dew, fog, or rain and don't wash it before storage. Wet fruit will decay faster. Refrigerate fruit immediately for optimal length of storage and quality.

Kiwifruit and table grapes do not change much in size or appearance during the latter stages of fruit maturity, so visual assessment is not a good guide for when to harvest. In both crops, commercial growers will use refractometer to determine sugar content and optimal harvest time (°Brix or percent soluble solids). Refractometers can be purchased online; however, it is also easy to taste hardy kiwifruits and grapes to assess when they are ready for harvest.

Fuzzy kiwifruit (e.g., the more common 'Hayward') are harvested at 6.5°Brix, when the seeds are black and the berry is very hard. In cooler regions of the coast, the fruit may not reach this stage of maturity and will not ripen after harvest. In this case, the site is not well suited for this crop. In warmer regions of the coast, pick this type of kiwifruit as late as possible (e.g., early November) or monitor fruit sugar levels using a refractometer. Store fruit in well-vented plastic bags or flats in the refrigerator or a cooler. Ripen at room temperature after about a month of storage.

Commercially, hardy kiwifruit are harvested at 8 to 14°Brix, usually in September, while fruit are still firm (seeds will be fully black). This fruit will store for up to 3 weeks under ideal conditions: near 32°F, high humidity, and scrubbing (removal) of ethylene (a ripening gas released by fruit). If you choose to let the fruit vine ripen, which happens over a couple of months, pick the fruit when it gently yields to the touch. If the skin tears when picking, you will need to eat or use the fruit very quickly. You can ripen hard fruit (picked at 8 to 14°Brix off the vine) by placing them with fresh apples or bananas (which give off ethylene gas) in a slightly vented plastic bag. Ripening takes 4 to 5 days at 77°F.

Grape clusters can be stored in vented plastic bags in the refrigerator or cold storage for 2 to 4 weeks, depending on the cultivar.



Photo: Bernadine Strik, © Oregon State University

Figure 7. A mature kiwifruit vine pruned to a bi-lateral cordon (looking down the center of the row)

Pruning and training

Kiwifruit vines are vigorous and must be grown in a site protected from wind. Properly pruning and training the young vines will ensure a good permanent framework, and facilitate pruning and training of mature vines in the future. Develop your vines into a bilateral cordon in the establishment years (Figure 7). A cordon is a more permanent part of the vine with one cordon running in each direction down the row. Fruiting canes (long spurs) are retained on each side of the cordon after pruning in winter. Female kiwifruit vines need to be pruned during the dormant season from late December to mid-January; pruning later can lead to excessive sap flow from the pruning cuts. Prune male vines right after bloom. It is only possible to tell male and female vines apart during flowering (Figure 8, page 7) and not during dormancy, so label vines clearly.

The productive wood in kiwifruit vines is 1-year-old (grew last season). Many of the buds on this wood will break and produce flowering shoots that can grow from several inches long (more like spurs) to fruit-bearing shoots as long as 8 feet (Figure 9, page 7). Buds may also produce shoots on older wood, but they are almost always vegetative; these shoots are often useful to replace spurs or cordons at pruning time, if needed.

Light exposure is important for good fruit production; shoots that are heavily shaded will not produce as many flower buds for next year's crop as those that are well exposed to light. For this reason, proper pruning and selection of wood is important.

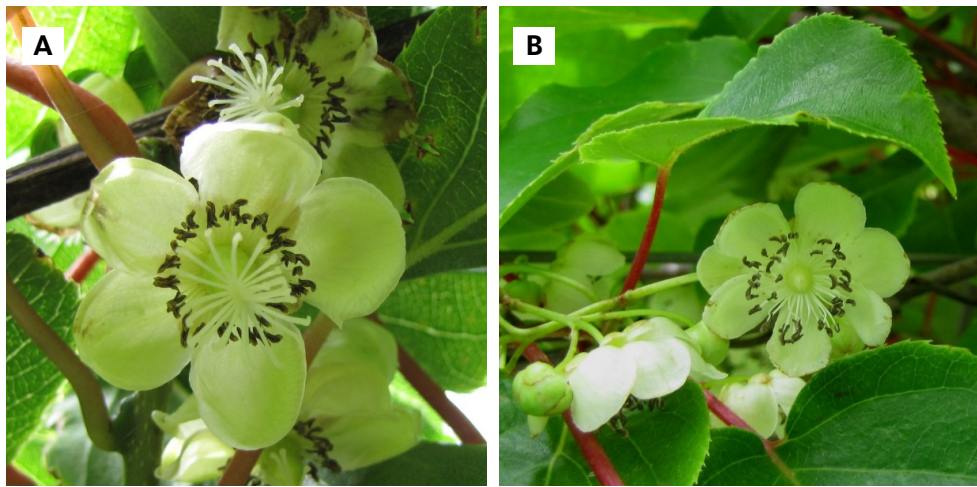


Photo: Bernadine Strik, © Oregon State University

Figure 8. Hardy kiwifruit flowers. A female (A) has a multi-branched style, or female part, in the center of the flower. A male flower, that lacks the multi-branched style (B).

Grapevines only produce fruit on last-year's growth (canes) and should be pruned in winter (December through February). Vines can be cane- or spur-pruned. Please refer to *Growing Table Grapes* (EC 1639) for more detailed information on pruning and training in grapevines, as it varies depending on the cultivar and the training system.

First growing season

Good pruning of healthy, mature kiwifruit and table grape vines typically involves removing about 70 to 90 percent of the wood that grew the prior season.

It is important to establish a good “framework” for each vine—a straight trunk with two cordons, one per side running down the row. See *Growing Kiwifruit* (PNW 507) for more detailed information on establishing the vine framework. By the third or fourth year, the permanent vine structure should be established. The vine framework is established faster in table grapes.

In the winter, each mature kiwifruit vine should be pruned or thinned to leave about 20 well-spaced canes (e.g., 10 per cordon with 5 on each side). Shorten each cane by cutting it just beyond the outer trellis wire (generally just over 2 feet long) and tie it securely; these are then called long spurs. If vines are not vigorous, limit the future crop by reducing the number of buds (length) of each spur. Remove suckers that grow from the base of the vine or from the top of the trunk.

New fruiting canes usually develop at the base of last year's canes, so most of the wood removed has already fruited. Cut back to this vigorous vegetative cane—selecting it as a replacement spur—shorten it to the outer wire, and tie it securely (Figure 10, page 8).

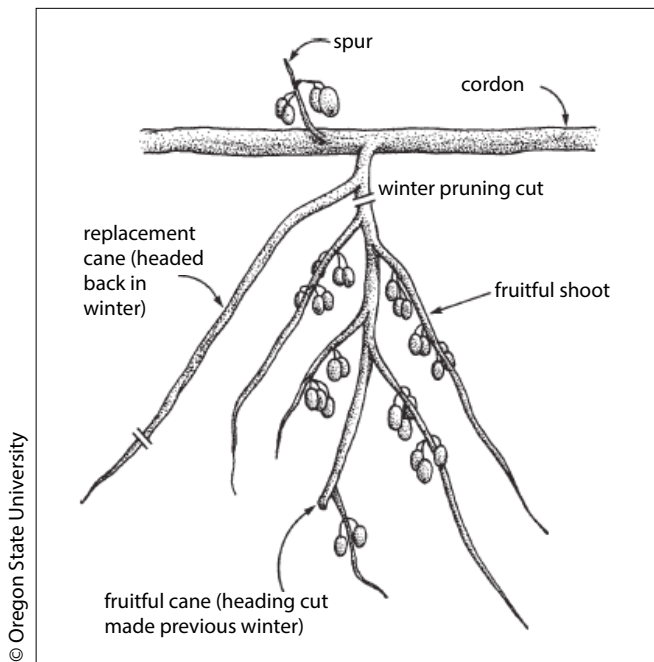
Fruiting canes that originate from the cordon may be left as replacement fruiting canes (new spurs). These canes should be pruned back to force new growth next season. Tie them to the wires for support. The fruiting canes that are left should be separated by 8 to 12 inches on the cordon. Shorter spurs may also grow from the cordon; if you see these, leave them, as they are quite fruitful. For more details on growing and pruning kiwifruit vines, refer to *Growing Kiwifruit* (PNW 507).

Hardy kiwifruit require replacement cordons every 3 or 4 years. To replace the cordon of either female or male vines, lay a vigorous vegetative shoot along the center training wire in each direction the year before you plan to remove the old cordon. The next year, when new lateral shoots have formed along the new cordon, you can cut off the old unproductive cordon.



Photo: Bernadine Strik, © Oregon State University

Figure 9. A hardy kiwifruit vine showing early shoot growth in spring



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Figure 10. Mature portion of a kiwifruit cordon in production. (Leaves are not drawn to simplify the figure.) Fruit are produced on shoots growing from last year's growth. Winter pruning cuts are shown by a double black line.

Summer pruning

Remove suckers from the base of the vine throughout the growing season. In a T-bar trellis system, hedging the growing shoots lightly helps to keep the aisles open. Hedge with a sickle bar and cut shoots to 2 feet from the edge of the trellis. You can also remove excessive vegetative shoots that you will not need the next year, although you should be careful not to prune too hard, as fruit and canes can be susceptible to sunburn.

It is natural for hardy kiwifruit shoots to stop growing during the growing season. After bloom, the tips of some shoots will die, resulting in a 6-inch black tip. This does not indicate the presence of disease.

Pests and problems

Weed management

Weeds compete with berry plants for water, nutrients, and light, so it is important to keep weeds out of the row. Hoe or hand-pull weeds before they become well established and to keep the soil loose, which will promote root and plant growth. A mulch layer of sawdust or bark may help control weeds, particularly annual ones. Do not mulch with straw as this can encourage voles, which feed on the bark of kiwifruit and grape plants, and damage the vines.

For chemical weed control, check with your county office of the OSU Extension Service or a garden or farm supply store for herbicides registered for use in kiwifruit and table grape plantings. Not all herbicides are registered for all crops.

You will also want to manage weeds between the rows (the aisles) so that they do not spread into the rows with your berry plants. The aisles can be cultivated and kept as bare soil or seeded with grass or another cover crop. If you are growing relatively few berry plants in your home garden, you may find it more practical to use other materials between your rows, such as bark mulch, wood chips, or straw. See *Commercial Red Raspberry Production in the Pacific Northwest* (PNW 598) for more detailed information on using cover crops in berry production systems.

Refer to the *PNW Weed Management Handbook* for more detailed information on weed control and specific weeds.

Insect Pests

Check with your local office of the OSU Extension Service for control recommendations if insects become a problem. Control methods are also outlined in the *PNW Insect Management Handbook*. Control options vary for commercial small-acreage farmers (with commercial pesticide applicator's license) and home gardeners.

- Kiwifruit—The only insects observed to cause problems in hardy kiwifruit in Oregon are thrips. High populations at bloom may cause scarring injury (ladderlike appearance) to fruit.
- Table grapes—Phylloxera, grape erineum mite, wasps, hornets, and birds can all be pest problems for table grapes. See *Growing Table Grapes* (EC 1639) for more information.

Diseases

Control methods are outlined in the *PNW Plant Disease Management Handbook*. Control options vary for commercial small-acreage farmers (with commercial pesticide applicator's license) and home gardeners. Check with your local office of the OSU Extension Service for control recommendations if diseases become a problem.

- Kiwifruit—Kiwifruit vines are sensitive to wet, heavy soil and standing water. Kiwifruit plants should be planted on raised beds to aid drainage and reduce the risk of phytophthora root rot. The most important disease problem in Oregon has been root rot, although botrytis fruit rot occasionally appears after long fruit storage. Kiwifruit vines are sensitive to root knot nematodes,

verticillium, and Armillaria oak root fungus, which may be found where oak trees have been present.

- Table grapes—Diseases that affect grape vines include crown gall, botrytis, powdery mildew, and Armillaria oak root fungus. See *Growing Table Grapes* (EC 1639) for more information.

For more information

To learn more about growing individual berry crops on the Oregon Coast, see these other publications in the series:

- *Growing Berries on the Coast: An Overview* (9177) <https://catalog.extension.oregonstate.edu/em9177>
- *Growing Berries on the Coast: Strawberries* (EM 9178) <https://catalog.extension.oregonstate.edu/em9178>
- *Growing Berries on the Coast: Blueberries* (EM 9179) <https://catalog.extension.oregonstate.edu/em9179>
- *Growing Berries on the Coast: Raspberries and Blackberries* (EM 9180) <https://catalog.extension.oregonstate.edu/em9180>
- *Growing Berries on the Coast: Gooseberries, Currants, and Other Minor Berry Crops* (EM 9182) <https://catalog.extension.oregonstate.edu/em9182>

Other OSU Extension publications

- *Commercial Red Raspberry Production in the Pacific Northwest* (PNW 598) <https://catalog.extension.oregonstate.edu/pnw598>
- *Growing Kiwifruit* (PNW 507) <https://catalog.extension.oregonstate.edu/pnw507>
- *Growing Table Grapes* (EC 1639) <https://catalog.extension.oregonstate.edu/ec1639>
- *Pacific Northwest (PNW) Insect Management Handbook, Pacific Northwest (PNW) Plant Disease Management Handbook, and Pacific Northwest (PNW) Weed Management Handbook* (revised and reissued annually) <http://pnwhandbooks.org>

Additional resources

- Windbreaks, Umatilla County Extension <http://extension.oregonstate.edu/umatilla/mf/windbreaks>
- Windbreaks for Fruit and Vegetable Crops (EC 06-1779), University of Nebraska Extension <http://extensionpublications.unl.edu/assets/pdf/ec1779.pdf>

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