OREGON STATE UNIVERSITY EXTENSION SERVICE

GROWING BERRIES on the OREGON COAST:

An Overview

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Contents

This publication includes general information on site selection, soils, irrigation, mulching, nutrient management, and other considerations specific to the Oregon Coast. See the OSU Extension catalog for additional publications in this series with information on growing specific types and varieties of berries.

Growing berries can be a rewarding experience, however, growing them on the Oregon Coast presents some unique challenges. You can grow delicious blueberries, strawberries, blackberries, raspberries, kiwifruit, table grapes, gooseberries, currants, and other berries provided you select cultivars (varieties) that are adapted to the coast region, and you establish and manage your plants to grow well and stay healthy.

In this publication, we outline the general issues related to growing berries on the coast. To maximize your success in growing specific berries, see the following five publications:

- *Growing Berries on the Oregon Coast: Strawberries* (EM 9178)
- *Growing Berries on the Oregon Coast: Blueberries* (EM 9179)
- *Growing Berries on the Oregon Coast: Raspberries and Blackberries* (EM 9180)
- *Growing Berries on the Oregon Coast: Kiwifruit and Table Grapes* (EM 9181)
- *Growing Berries on the Oregon Coast: Gooseberries, Currants, and Other Minor Berry Crops* (EM 9182)

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Table 1. Climate characteristics of some Oregon coastal and inland sites[1]

	Frost free days	Growing degree days	Mean max. temperature	Mean min. temperature	Mean temperature	Mean precipitation
	90% chance	base 50 °F	°F	°F	°F	Inches
Coastal sites:						
Seaside	168	1458	57	44	51	75
Tillamook	128	1256	60	42	51	88
Otis	179	1403	59	43	51	95
Florence	202	1433	57	44	51	71
Bandon	167	1355	61	44	53	59
Brookings	238	1697	62	47	54	77
Inland sites:						
Aurora[2]	170	2211	63	44	54	42
Grants Pass	124	2736	67	43	55	31

[1]Western Regional Climate Center. 2016. Cooperative Climatological Data Summaries. Retrieved from https://wrcc.dri.edu/coopmap/. For climate information specific to where you live, follow the link to find a station near you.

[2]Location of Oregon State University's North Willamette Research and Extension Center

This overview and the publications listed above are based on the experience of Oregon Coast Extension specialists, farmers, and gardeners. This series is intended to help owners of small farms and home gardeners. We encourage you to read through this publication first and then go to the crop-specific publications for more detail.

Site selection

Coastal Oregon has extreme variation in microclimates. How far a site is from the ocean, local topography, exposure to wind and salt, and the difference in latitude from the northern to the southern ends of the state can create very different growing conditions. Some sites are virtually on the beach and are exposed to salt spray, high winds, and sandy soils. Others are located in small valleys or behind ridges, where they are protected from more extreme environmental elements. These protected sites can provide excellent microclimates for berry production. See Table 1 for the climate characteristics of some Oregon coastal and inland sites.

Berries are perennial crops that can produce fruit from 3 to 50 or more years, depending on the crop, site, and management practices. Because of their longevity, you should carefully consider the ideal location for planting. Even strawberries, which are only productive for 3 to 4 years, and black raspberries ("blackcaps"), which tend to succumb to disease after 4 to 8 years, benefit from good site selection.

Basic sunlight, frost, and soil considerations

Direct, full sun is best for good fruit production. Raspberry and blackberry plants can tolerate partial shade, but yield and fruit quality may be lower. Winter cold or frost damage can be an issue with all berry types, although strawberries and kiwifruit are especially susceptible to frost in late winter and early spring. Blackberry plants are the most tolerant of heavy soils, while strawberry, raspberry, kiwifruit, and blueberry plants are sensitive to wet or heavy soils and may be susceptible to root rot, depending on the cultivar. To minimize risk of frost damage and disease, sites should have good air drainage without frost pockets.

Crop rotation

It is important to practice crop rotation with berries, when possible. Strawberries, raspberries, and kiwifruit are susceptible to verticillium, so you should avoid sites where these berries or other susceptible crops (such as potatoes, tomatoes, peppers, or eggplant) have been grown within the past three years. Crop rotation will also disrupt other pest and disease cycles in the field.

Trees and animal pests

Birds are a major pest of blueberries and can be damaging to other berry crops as well. If possible, it is best to avoid planting berries in sites surrounded by trees, which provide habitat for birds, or plan to use bird depredation techniques (see *Bird Management in Blueberries* in "For more information," page 9). Another reason to avoid treed areas is that trees can shade plants and compete with them for water and nutrients. Trees also interfere with cold air drainage and air circulation, which can increase frost damage and disease.

Photo: Sally Reill, © Oregon State University

Figure 1. Strawberry plants in a raised bed with netting to protect from birds and deer

In some environments, deer and elk can be very destructive. Often, a well-designed deer fence is the only way to protect your garden or small farm from damage by deer. A greenhouse, row covers, and netting (Figure 1) can provide more localized protection.

Salt and wind exposure

When selecting a site for planting, consider the potential for salt and wind damage, especially if the site is located within view of the ocean. Symptoms of salt stress (from splash, salt intrusion in irrigation water, or wind-blown spray) generally include burned leaf edges and reduced plant vigor (Figure 2). Windbreaks (such as a fence or a row of trees or shrubs) can alleviate wind damage. On the Oregon Coast, summer winds typically blow out of the north, so providing protection on the north side of your farm or garden will help minimize damage and should increase air temperature. Windbreaks can help protect plants, but you need to establish them so that they don't compete with your berry crop for water and nutrients. See *Windbreaks for Fruit and Vegetable Crops* listed in "For more information," page 9.

Soil type

All berry crops grow best in a well-drained, fertile, sandy loam or clay loam soil that has moderate water-holding capacity. Coastal soils range from almost pure sand in some places to high clay content in others. Soil that is very coarse, sandy, or gravelly needs to be monitored closely for watering and fertilizing needs because it will not hold water or nutrients as well as a clay or sandy loam soil. Soils on the other end of the spectrum, with high clay content, can hold too much water during the months with high rainfall and increase the chances for root problems. Many soils that are unsuitable for berry production can be improved by tiling, increasing organic matter content, building raised beds, modifying soil pH to the ideal range for the crop through amendment with lime or sulfur (S), and modifying soil nutrient levels, if needed.

Nutrient testing and modification

It is important to test your soil prior to planting berry crops to ensure it is suitable, especially if you are growing berries commercially. It can be very difficult or even impossible to "fix" your soil after planting. Ideally, collect soil samples for testing a year or more before planting. This will provide adequate time to amend the soil, if necessary. However, if it is not possible to do this so far in advance, then be sure to collect soil samples at least the summer or fall before planting. Typical soil analyses will include phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sodium (Na), and pH. We recommend also testing your soil for micronutrients, particularly boron (B) and organic matter.

A Shoemaker-McLean-Pratt (SMP) buffer test is helpful for determining how much lime to apply if the soil pH is below the ideal range for a specific berry crop. If the soil pH is too high, elemental S is needed to acidify the soil, with the rate depending on soil type (see Soil pH, page 4). For more information, see *A Guide to Collecting Soil Samples for Farms and Gardens* (EC 628). You will probably also want to consider incorporating organic matter.

Photo: Cassie Bouska, © Oregon State University

Figure 2. Wind and salt damage to raspberry plants growing within 100 feet of the ocean in Brookings, Oregon

Drainage

All berry crops prefer well-drained soil and can benefit from the improved drainage of raised beds. Poor drainage can lead to root death and root diseases. The soil water table should be at least 14 inches below the soil surface. Raised beds should be about 1 to 1.5 feet high, although raspberries and kiwifruit vines will benefit from beds that are 2 to 3 feet high because they are more sensitive to poor drainage and have large root systems. Blackberry plants do not typically require a raised bed and are the most tolerant to heavier soils. All berry 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. Almost any soil type is suitable or can be amended to make it suitable, although plants will be more vigorous and produce more fruit when grown in a well-drained, fertile, loam soil with some water-holding capacity.

Raised beds should be constructed by hilling soil and organic matter (piling it into a mound into which a single plant can be planted, or piling up an entire row of built up material if planting multiple plants). Filling wood walls (constructed raised bed) with soil (and any needed amendments) is another option (Figure 1, page 3). Drainage tiles can also be beneficial, if your soil is slow to drain or if you have a high-water table. Install the drain tile near the berry row or section of ground with poor drainage (at least 25 inches deep). Organic matter aids in soil aeration, drainage, and water- and nutrient-holding capacity. The ideal organic matter to use varies with the berry crop (see "Organic matter," page 5). Incorporate organic matter into the soil before planting.

Soil pH

Strawberries, raspberries, blackberries, and kiwifruit have similar soil pH requirements (Table 2). Blueberries, however, require relatively acidic soil. Ideally, you would test the soil a year before you plant to give yourself enough time to modify the soil pH, if required. For more information about soil testing, see *Laboratories Serving Oregon: Soil, Water, Plant Tissue, and Feed Analysis* (EM 8677), *Soil Sampling for Home Gardens and Small Acreages* (EC 628), and *Soil Test Interpretation Guide* (EC 1478). If the soil test indicates the pH is above that recommended for blueberry, add enough elemental sulfur (S) to lower the pH to 5.5; see *Acidifying Soil for Blueberries and Ornamental Plants in the Yard and Garden* (EC 1560). If the soil is too acidic (the pH is too low) for any berry crop, add lime to the soil as recommended by the soil analysis to raise the soil pH to the upper end of the ideal range for the berry crop. See *Applying Lime to Raise Soil pH for Crop Production (Western Oregon)* (EM 9057) for more information.

Table 2. Recommended soil pH for berry crops

Berry type	pH
Strawberry	5.6–6.5
Blueberry	4.5–5.5
Raspberry	5.6–6.5
Blackberry	5.6–6.5
Kiwifruit	5.6–6.5

Drainage tiles

Plant roots need air to survive. When soil is saturated with water, roots can suffocate and die in a matter of days when plants are not dormant. Tiling helps to lower the water table and can move subsurface water away from plant roots. Drainage tiles are perforated plastic pipes that are installed 24 to 30 inches below the soil surface. Soil water enters the pipe through the perforations and it flows through the pipe until it is emptied into a drainage ditch. The drainage tiles must be installed along a gradient with enough slope so that the water velocity is high enough that soil particles do not silt (settle) out of the water but low enough to not cause erosion around the pipe. Drainage tiles are usually installed as part of a network in a field or garden so that multiple lines empty into a main line, which then moves the water out of the area and empties into a ditch. Drainage tile supplies can be purchased from home improvement stores or online. See *Planning a Subsurface Drainage System*, listed in "For more information," page 9.

In general, if your soil pH is too low for berry production, incorporate finely ground dolomitic limestone at a rate of approximately 5 to 10 pounds per 100 ft^2 (1.1 to 2.1 tons per acre). You can also use high pH composts to add organic matter and increase soil pH. However, avoid composts with a high salt content (electrical conductivity or EC), such as fresh animal manures. Amendments should be incorporated into the soil about a year prior to planting as it takes time for the soil pH to adjust after the addition of lime or S. Many coastal sites, especially those that were originally forested areas, have relatively acidic soil. These sites may already be suitable for blueberries; however, the soil pH may need to be raised for other berry crops.

Organic matter

You can increase soil organic matter content by incorporating (amending with) fine wood chips or sawdust (common in blueberry), bark, well-composted manures, or plant-based composts. Composted manure and plant-based composts can be used as a pre-plant amendment in all berry crops except for blueberry. It is important that whatever material you apply is free of pest insects and weed seeds. Apply organic matter at a rate of 1 to 2 inches per area being planted. All of these organic materials differ in nutrient content, pH, salt content (EC), and carbon to nitrogen ratio (C:N), which affects the rate of decomposition. For more information on the use of organic matter in crop production refer to *Improving Garden Soils with Organic Matter*, EC 1561.

Incorporate the organic material into the soil by digging, plowing, or tilling. Mixing the amendment(s) in well ensures uniformity of soil properties. If you apply large amounts of fresh organic material with a high C:N, such as sawdust, you can aid decomposition by applying approximately 3 ounces of N per 100 ft^2 (80 pounds per acre). When adding N, choose an appropriate fertilizer for the berry crop.

It is important to eliminate perennial weeds before planting because they are very hard to control in berry crops after planting, with either conventional or organic means. Don't let annual or perennial weeds go to seed and ensure that any amendments applied, such as composted yard debris or manures, are free of weed seeds.

Selecting a cultivar

It's important to select a cultivar that is adapted to your growing region. Our recommendations here are based on cultivar traits (e.g., fruiting season and disease susceptibility) and the shared experiences of local farmers, gardeners, and Extension agents. If you are planning a small farm, it is important to test new cultivars to assess their suitability to your specific microclimate and production goals. Cultivars differ in fruiting season, cultural requirements, fruit quality, flavor, appearance, tolerance to pests, cold hardiness, plant longevity, and fresh and processed fruit characteristics.

You can vegetatively propagate many berry crops (e.g., strawberries from daughter plants and raspberries from primocanes or "suckers"). Unfortunately, this practice can introduce pests, diseases, and viruses into a new planting. It is important to buy certified, disease-free plants from a reputable nursery rather than propagating plants from a well-established planting. Some cultivars are patented, making propagation illegal without an agreement and nursery license.

Focus on cultivars recommended for small farms or home gardens as these tend to have a combination of good flavor, relative disease tolerance, and are suited to hand-harvesting. It is also best to avoid late-season cultivars or those that need a long growing season because many sites on the coast don't get enough heat units to ripen those cultivars.

For more information on specific cultivars, refer to the berry-specific publications in this series, listed on page 9.

Establishing your planting

Irrigation water quality

All berry crops require irrigation for good growth and fruit quality. On some small farm sites, overhead irrigation may be needed for frost protection in the late winter or spring, particularly for strawberries and kiwifruit. We recommend testing irrigation water to ensure it is of good quality for commercial berry crop production. High chloride (more than 70 ppm), bicarbonate (more than 200 ppm), and sodium (more than 50 ppm) are the most damaging impurities to berry crops. Check with an irrigation or Extension specialist to help interpret water analyses.

Irrigation

All berry crops need adequate water to thrive, whether that comes from irrigation or rainfall. Fruit is made up of mostly water, so sufficient irrigation during fruit production is essential for the best yields and fruit quality. Berry plants require from 1 to 3 inches of water per week, depending on the crop, plant vigor, stage of growth, soil type, and weather. Monitor your irrigation carefully, whether done by hand, sprinklers, or drip systems, to ensure the root zone of the plants is being adequately watered.

With each irrigation, wet the soil to a depth of 0.5 to 1 feet. The rooting area should be wet enough that the soil does not fully dry out between irrigation cycles. Sandy soils will require more frequent and lighter water applications than heavier soils. Extra water may also be necessary on windy sites. Newly set plants do not have well-developed root systems, so plants can be easily stressed. Irrigate several times a week or as needed so that the root zone and soil are thoroughly wetted, but standing water does not accumulate. One easy way to monitor soil moisture content is to use a soil probe. Insert the probe to a depth of 1 to 1.5 feet and check to see if the soil is wet—but not too wet—between irrigations and is wet to the bottom of the soil sample. Surface mulch can help conserve soil moisture (see "Mulching").

Berry crops' water demand is highest during fruit development, so it is especially critical to provide uniform and adequate water during that period. It is also important to provide adequate water during fruit bud formation, which occurs during the late summer to fall for most berries.

Under-canopy or drip irrigation is ideal for berry production because it can reduce disease and weed problems and conserve water. Most berries can be irrigated with a single line of drip irrigation per row with 1/2 gallon emitters spaced every 12 inches (strawberries) to 18 inches. For blueberries, two drip lines per row are recommended. Berries can also be irrigated using micro sprinklers (under the canopy) or overhead sprinklers, which can also be used for frost protection (generally only in commercial production). See *Drip Irrigation: An Introduction* (EM 8782) for more information.

If you are growing berries commercially, you can schedule irrigation to coincide with crop water needs. To do this, you need to be able to assess soil moisture and crop evapotranspiration (ET) data. AgriMet Pacific Northwest Cooperative Agricultural Weather Network (https://www.usbr.gov/pn/agrimet/) provides weekly estimates of crop ET based on weather conditions, a reference crop (usually grass or alfalfa), and the relationship between the reference crop and the crop of interest. These estimates give you an idea of the water lost by a mature and healthy plant. Crop water needs will be lower for stressed or young plants. Monitoring soil moisture in your planting will give you an idea of whether you are under- or over-irrigating. See *Western Oregon Irrigation Guides* (EM 8713) for more information.

Mulching

Mulch can help control annual weeds, conserve soil moisture, and, depending on the type of mulch, provide a source of nutrients. Organic mulch is most commonly used with blueberries as this crop prefers soil with a high organic matter. See *Growing Berries on the Oregon Coast: Blueberries* (EM 9179) for more information on mulching blueberries.

Organic mulch can also be used with other berry crops. Be careful to not bury strawberry, raspberry, or blackberry crowns because this can lead to crown rot. Deep straw, when used as a mulch, can lead to increased vole or rodent activity, which can damage the plants.

Fertilization

Berry crop fertilizer needs vary. By using plant tissue and soil analyses as well as your observations of plant growth, you can make efficient use of resources and not over- or under-apply fertilizer nutrients. Ideally, collect tissue samples annually and soil samples at least 6 months before planting (and every few years, subsequently). See the berry-specific publications in this series, listed on page 9, for details on nutrient management, soil and tissue sampling, soil and plant analysis laboratories in Oregon, and interpreting laboratory analysis results.

To calculate how much nitrogen (N) to apply during the year, divide the amount of N you need by the percentage of N in the fertilizer. For example, if the recommendation is to apply 2 ounces of N and you are using 16–16–16 fertilizer (16% each of N, phosphate, and potash), the calculation would be 2 ounces ÷ 0.16 (decimal equivalent of 16%), or 12.5 ounces of the fertilizer product. Use the same approach to calculate how much of other nutrients you need to apply.

Before applying N, observe whether plants are growing well with available N. Plant growth should be good, and leaves should be a healthy green, not pale green or yellow. See the berry-specific publications in this series for specific nutrient recommendations during crop establishment and planting year.

There are many types of solid (granular) and liquid inorganic and organic fertilizers available (Table 3, page 7). Depending on the type of fertilizer product, there are different application methods to ensure maximum availability of N to the plants.

Inorganic granular fertilizers are often applied in equal portions (splits) throughout the spring to ensure maximum efficiency of plant uptake and minimize risk of salt stress to the berry plants. Granular organic fertilizers such as feather, soybean, or cottonseed meals require longer periods of time for N to be available. Therefore, it's best to apply granular organic fertilizers about a month before inorganic fertilizers are applied.

Table 3. Percent of nitrogen, phosphate, and potash content typical of commonly used manures and organic and inorganic fertilizers

Fertilizer material	% N	% P_2O_5	% K_2O	% Water content
Manures[a]				
Dairy	0.5	0.16	0.44	87
Beef	0.65	0.43	0.53	82
Poultry	1.3	1.02	0.5	73
Hog	0.45	0.27	0.4	84
Sheep	1	0.36	1	73
Horse	0.7	0.25	0.6	60
Organic fertilizers—Nitrogen sources				
Alfalfa meal	2	0.5	2	–
Bat guano	10	3	1	–
Feather meal[b]	12–13	0	0	–
Blood meal[b]	12–15	1	1	–
Cottonseed	6–7	2	1	–
Fish emulsion[b,d]	3–5	1	1	–
Fish meal[b]	10	4	0	–
Organic fertilizers—Phosphate sources				
Bone meal	1–4	12–24	0	–
Rock phosphate[c]	0	25–30	0	–
Organic fertilizers—Potassium sources				
Greensand	0	0	3–7	–
Kelp meal	1	0.1	2–5	–
Fertilizer material	**% N**	**% P_2O_5**	**% K_2O**	**% Sulfur**
Inorganic fertilizers—Nitrogen sources				
Ammonium sulfate	21	0	0	–
Ammonium sulfate solution[d]	8	0	0	9
Ammonium thiosulfate[d]	12	0	0	26
Ammonium phosphate	11	5	20	–
Ammonium polyphosphate[d]	10 or 11	34 or 37	0	–
Ammonium phosphate-sulfate	16	20	0	15
Ammonium nitrate solution[d,e]	20	0	0	–
Calcium ammonium nitrate[d,e]	27	0	0	–
Calcium nitrate[e]	15.5	0	0	–
Urea	46	0	0	–
Urea solution[d]	20 or 23	0	0	–
Urea-sul	37–46	0	0	4–8
Urea ammonium nitrate solution[d]	28–32	0	0	–
Inorganic fertilizers—Phosphate sources				
Triple superphosphate	0	45	0	–
Inorganic fertilizers—Potassium sources				
Sulfate of potash-magnesia	0	0	21	11
Potassium chloride[f]	0	0	60	–
Potassium-magnesium sulfate	0	0	22	22
Potassium nitrate	14	0	45	–
Potassium sulfate	0	0	52	18

[a] About 25 percent of the N is available in the first year.

[b] These materials contain a substantial amount of quickly available nutrients that plants can use early in the season.

[c] Very low availability (only 2 to 3 percent of total P_2O_5). Useful only in acidic soils (pH 6.0 or below)

[d] Suitable for fertigation

[e] Not suitable as the main source of N for blueberry production

[f] Not suitable as the main source of K for kiwifruit production; should be avoided altogether in blueberry production

Adapted from the *Caneberry Nutrient Management Guide* (EM 8903), *Growing Kiwifruit* (PNW 507), *Nutrient Management for Blueberries in Oregon* (EM 8918), *Soil Fertility in Organic Systems: A Guide for Gardeners and Small Acreage Farmers* (PNW 646), and "Nutrient management for blueberry – Assessing plant nutrient needs and designing good fertilizer programs" (Strik, B. and D. Bryla) from the Oregon State University Blueberry School proceedings, 2015.

In general, liquid fertilizers are available relatively quickly to plants but may also move out of the root zone quickly. So, for liquid fertilizers, it is best to divide the total amount of N into small applications, either through fertigation (applying fertilizer through a drip irrigation system) or by hand. Fertigation can be used instead of granular fertilizers for any berry crop, provided you have an efficient drip irrigation system installed and have the appropriate filters and injector pumps for fertilization. Instead of making a few fertilizer applications per year, by using fertigation you can split your N application into weekly or biweekly applications. More frequent, smaller nutrient doses lead to more efficient plant use and less fertilizer loss from the system. There are various inorganic fertilizers and organic fertilizers (including fish emulsion and liquid formulations of corn- and soybean-based products) that are suited for fertigation (Table 3, page 7). See *Drip Irrigation: An Introduction* (EM 8782) for more information.

When we give fertilizer rates for perennial fruit crops, the rate given per acre should be applied to only the in-row area. Thus, the rates for granular or liquid products (fertigated) are the same—essentially, the fertilizer is concentrated into the row area where the plant roots are located. Established, matted row strawberries are an exception, as fertilizer is often applied to the entire field when the aisles are narrow. Rates are suggested starting points. It is important to monitor plant growth and nutrient status (especially in commercial small farms) to assess whether rates need to be adjusted.

For berry crops, we mainly discuss fertilization with N; however, other fertilizers may be needed, based on tissue and soil analyses. Soil and nutrient sufficiency levels, and proper sampling times are provided in the berry-specific publications in this series (listed on page 9). Tissue analysis is recommended for commercial small farms. Based on the results from a soil analysis, you may need to fertilize with 4.5 ounces of phosphorous (P) per plant (55 pounds P per acre) in February or March and 6.5 ounces of potassium (K) per plant (80 pounds K per acre) in late winter or early spring.

Environmental effects

Cold and frost

Growing parts of berry plants may be susceptible to frost damage when temperatures dip just below freezing in late autumn or late winter to early spring, or to cold damage during early, mid-, or late dormancy from late autumn through winter. Susceptibility to injury depends on the type of berry, the temperature at a particular stage of plant growth, and the cultivar. The cultivars listed in the berry-specific publications in this series are cold-hardy on the coast. Site location will have a large impact on the potential for damaging frost or winter temperatures (e.g., winter cold injury may only be possible at high-elevation, coastal sites). Mid-winter cold injury is likely not a problem for any berry crop at most sites along the coast.

Frost will injure the flowers of most berry crops at 28°F (blueberry) to 30°F (most other berry crops). The likelihood of frost damage to flowers depends on the berry plants' location and time of bloom. For example, strawberries bloom earlier than raspberries. Particularly cold temperatures in the autumn, when the plants are not fully dormant, and in late winter to early spring, when they are leaving dormancy, are the most likely to cause damage to susceptible tissues in sensitive cultivars. Once chilling requirements are met, an unseasonal warm spell can break dormancy early, making some berry crops more susceptible to cold temperatures after the warm spell (e.g., in 'Marion' blackberry).

There are several site selection factors that can help reduce frost and winter cold injury in berry plants. Low areas or locations that you know are particularly cool microclimates should be avoided. Work to increase air movement by removing barriers to cold air drainage, like trees, if possible. Clean, cultivated areas are warmer during periods of frost than areas with permanent cover crops. However, cultivation reduces heat transfer from soil to air at night, so do not cultivate immediately prior to a forecasted frost.

Management techniques can also reduce frost injury. Row cover (also called floating row cover) can be used to protect smaller areas (Figure 3, page 9). In the case of a forecasted frost event during bloom (in strawberry, for example), apply the row cover over the plants in the late afternoon or early evening (to trap the heat) and then remove it in the morning after frost danger has passed. Strawberry flowers with frost damage will have black centers and will either not produce fruit or will produce misshapen fruit. Blueberry plants will likely not need protection from cold or frost on the Oregon coast. Blueberry flowers tolerate 28°F at open flower and lower temperatures at earlier stages of development. Bloom date in blueberry cultivars varies little, despite a relatively wide range in harvest dates. Kiwifruit vines are quite sensitive to frost damage to early emerging shoots in late winter and early spring; temperatures below 30°F will kill young, growing shoots. Row covers may be used to protect these vines in the home garden.

In larger plantings, wind machines, smudge pots, or other heating devices can be used if there is a temperature inversion (warm air locked above cold air closer to

Photo: Bernadine Strik, © Oregon State University

Figure 3. Row cover being used to protect early blackberry shoots from frost damage in the Willamette Valley

the ground). In addition, sprinklers can provide approximately 6°F to 8°F of frost protection in some situations. Start the irrigation system before temperatures fall below freezing and continue until temperatures rise above freezing and the ice melts. Using sprinklers in this way is only practical for larger areas where good frost protection irrigation systems can be designed. Berries grown in containers can be left outside for the winter; however, they should be brought inside if there is a frost event that would cause management action for plants in the ground (e.g., frost at bloom).

Late-fruiting berry crops (e.g., 'Darrow' or rabbiteye blueberry; day-neutral strawberry; primocane-fruiting raspberry and blackberry; and semi-erect blackberry) benefit from being grown in a tunnel that is covered with plastic in the later months of the season (late August through October) so that more fruit can be harvested. The tunnel provides protection from rain and increases temperature, which increases late-season fruit quality. It is important to keep in mind that tunnels that are covered with plastic are very susceptible to wind damage. Since they are expensive, small-acreage farmers need to evaluate the economic benefit of using tunnels on the coast.

Wind

Wind damage is a very real concern in coastal environments. Physical damage from breaking branches and uprooted plants can occur in the high winds of the more exposed areas of the Oregon coast during the winter months and on some sites in the summer. Lighter, summer winds increase airflow over the leaf surface of your plants, resulting in increased water loss through evapotranspiration. Even when air temperatures seem cool, plants may need irrigation due to higher plant-water loss and loss of water in the soil profile. Wind may also reduce bee activity. When placing hives, take into consideration the effect that wind will have on bees or provide habitat that encourages the presence of native bees.

Salt

Sites that are within 100 feet of the ocean should be protected from salt damage. Symptoms of salt damage include brown or necrotic leaf edges, defoliation, and low plant vigor.

Homes and gardens that are directly exposed to the prevailing summer or winter winds or both and to possible salt spray will have the most challenges when it comes to berry production. Strategically designing wind and spray barriers on your property will allow you to create warmer, protected microclimates that will better favor berry production. See *Trees Against the Wind* (PNW 5) for more detailed information about planning, establishing, and caring for windbreaks.

Salt exposure can also occur through the use of brackish irrigation water. While many inland, protected coastal sites provide excellent microclimates for berry production, adjacent waterways may be under tidal influence. You must test sources of irrigation water for salt content.

Fog

The collision of warmer inland air and cooler oceanic air along the coast very often creates a swath of fog that encroaches on many coastal communities each summer afternoon. While this often leads to a reduction in wind speed, fog also reduces the sunlight reaching plants. The cool, moist air that accompanies fog also can increase the risk of fungal diseases. While there is nothing you can do about the presence of fog, you can select disease-resistant cultivars if your site is located in the fog belt. Working to create optimal microclimates also becomes more important when consistent fog is present. Selecting south-facing slopes, utilizing hedgerows and fences as windbreaks, and employing row covers are some options you can use to maximize the amount of heat and sunlight the berry plants in your garden or small farm receive each day.

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: 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: Kiwifruit and Grapes* (EM 9181) https://catalog.extension.oregonstate.edu/em9181
- *Growing Berries on the Coast: Gooseberries, Currants, and Other Minor Berry Crops* (EM 9182) https://catalog.extension.oregonstate.edu/em9182

Other OSU Extension publications

Production

- *Blackberry Cultivars for Oregon* (EC 1617) https://catalog.extension.oregonstate.edu/ec1617
- *Blueberry Cultivars for the Pacific Northwest* (PNW 656) https://catalog.extension.oregonstate.edu/pnw656
- *Caneberry Nutrient Management Guide* (EM 8903) https://catalog.extension.oregonstate.edu/em8903
- *Growing Kiwifruit* (PNW 507) https://catalog.extension.oregonstate.edu/pnw507
- *Nutrient Management for Blueberries in Oregon* (EM 8918) https://catalog.extension.oregonstate.edu/em8918
- *Raspberry Cultivars for the Pacific Northwest* (PNW 655) https://catalog.extension.oregonstate.edu/pnw655
- *Strawberry Cultivars for Western Oregon and Washington* (EC 1618) https://catalog.extension.oregonstate.edu/ec1618

Soils and Irrigation

- *A Guide to Collecting Soil Samples for Farms and Gardens* (EC 628) https://catalog.extension.oregonstate.edu/ec628
- *Acidifying Soil for Blueberries and Ornamental Plants in the Yard and Garden: West of the Cascades* (EC 1560) https://catalog.extension.oregonstate.edu/ec1560
- *Applying Lime to Raise Soil pH for Crop Production (Western Oregon)* (EM 9057) https://catalog.extension.oregonstate.edu/em9057
- *Drip Irrigation: An Introduction* (EM 8782) https://catalog.extension.oregonstate.edu/em8782
- *Improving Garden Soils with Organic Matter* (EC 1561) https://catalog.extension.oregonstate.edu/ec1561
- *Laboratories Serving Oregon: Soil, Water, Plant Tissue, and Feed Analysis* (EM 8677) https://catalog.extension.oregonstate.edu/em8677
- *Soil Fertility in Organic Systems: A Guide for Gardeners and Small Acreage Farmers* (PNW 646) https://catalog.extension.oregonstate.edu/pnw646
- *Soil Sampling for Home Gardens and Small Acreages* (EC 628) https://catalog.extension.oregonstate.edu/ec628
- *Soil Test Interpretation Guide* (EC 1478) https://catalog.extension.oregonstate.edu/ec1478
- *Western Oregon Irrigation Guides* (EM 8713) https://catalog.extension.oregonstate.edu/em8713

Problems

- *Trees Against the Wind* (PNW 5) https://catalog.extension.oregonstate.edu/pnw5

Additional resources

- AgriMet, Pacific Northwest Cooperative Agricultural Weather Network http://usbr.gov/pn/agrimet/
- Planning a Subsurface Drainage System, BE-07685 from the University of Minnesota Extension Service http://www.extension.umn.edu/agriculture/water/planning-a-subsurface-drainage-system/
- Bird Management in Blueberries http://www.nwberryfoundation.org/falconry.html
- 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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