

2016 Pest Management Guide for Wine Grapes in Oregon

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Photo: P.A. Skinkis, © Oregon State University

The reddening visible in the upper canopy was due to Willamette mite infestation late season in a warm, dry year in the Willamette Valley.

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Introduction

This pest management guide is developed for use by vineyard managers in Oregon. It provides recommendations for chemicals, formulations, and usage rates of products that are intended to prevent, manage, and control vineyard diseases, insects, mites, weeds, and vertebrate pests. When selecting a pesticide, consider its efficacy and its impact on beneficial arthropods, honey bees, and the environment. Not all registered pesticides are listed in this guide. These recommendations are based on research, label directions, and vineyard-use experience for Oregon.

Thorough knowledge of the current seasonal climate in the region, cultivars, planting density, vine

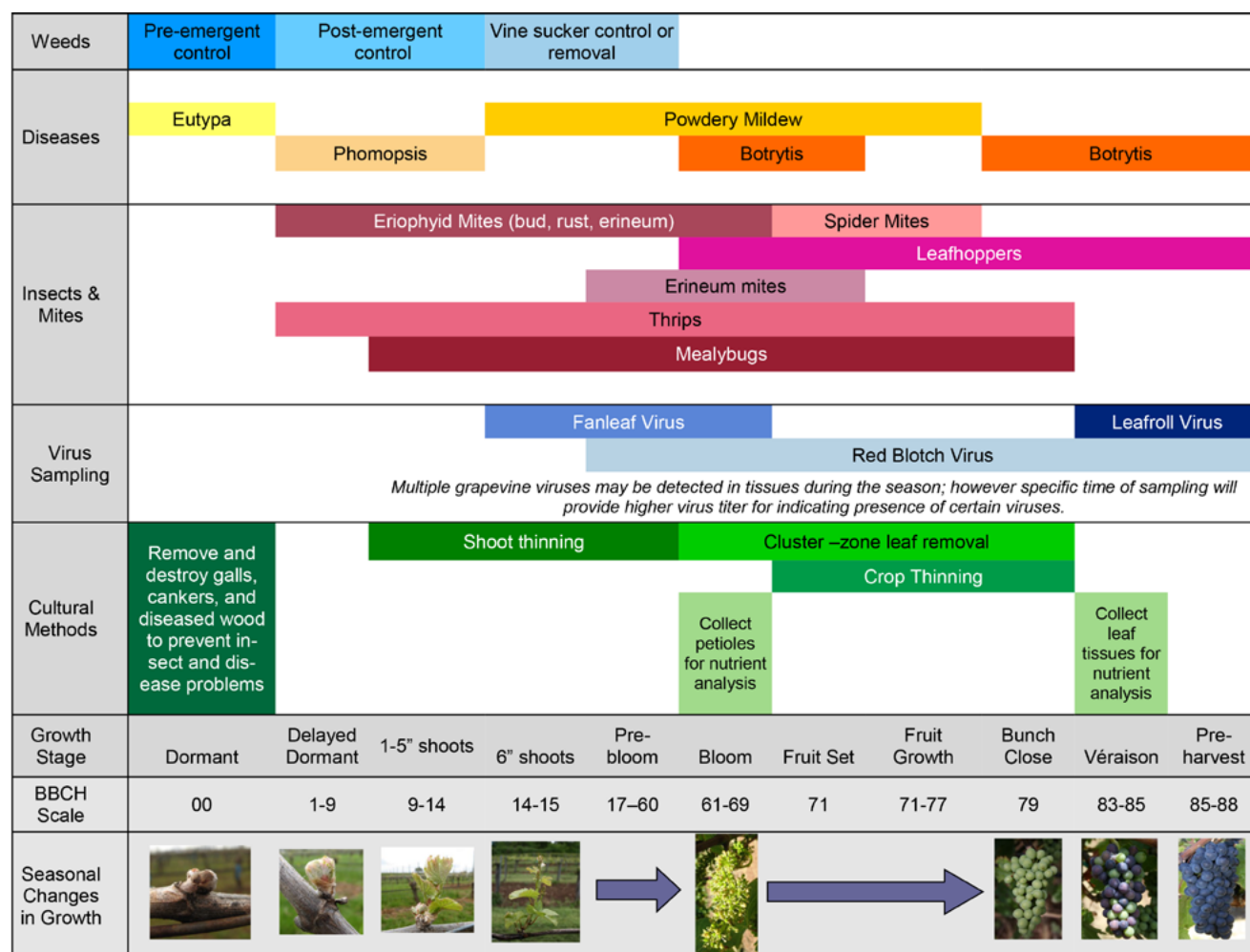


Figure 1. Seasonal timing for monitoring and management of weeds, insects, mites, and diseases in vineyards. Main pests of concern across Oregon's grape growing regions are included. Growth stages and BBCH-scale are based on the extended BBCH-scale (Figure 2, page 32). Figure by Patricia A. Skinkis, © Oregon State University.

vigor, canopy characteristics, pest complex, and past pest problems is important for optimizing pest control decisions such as timing and application rate, amount of water to use in application of products, and method of application. Correct pest identification is important in selecting the appropriate pesticide and management method. An understanding of a pest's biology, life cycle, and susceptible developmental stages further assists in selecting the optimal product and timing of application for successful prevention and management.

This guide does not intend to promote or discriminate between products. Occasionally, new formulations of a product (or similar formulations containing a different concentration of an active

ingredient) may be registered for use on grapes and the pests listed on the label but may not be listed in this guide. Consult the labels of alternative products to determine whether they offer advantages over the products listed in this guide. Formulations, application rates, and registration status may change. For this reason, the details given in this guide are accurate to the knowledge of the authors on the date of publication. Determine label rates of all products used on your farm and verify current registration status with the Oregon Department of Agriculture: http://oda.state.or.us/dbs/pest_productsL2K/search.lasso

Refer to the pesticide label for instructions on the use of a specific product. The product label is a legal document that explains effective rates and methods

Principal Growth Stages of Grapevines—Extended BBCH Scale

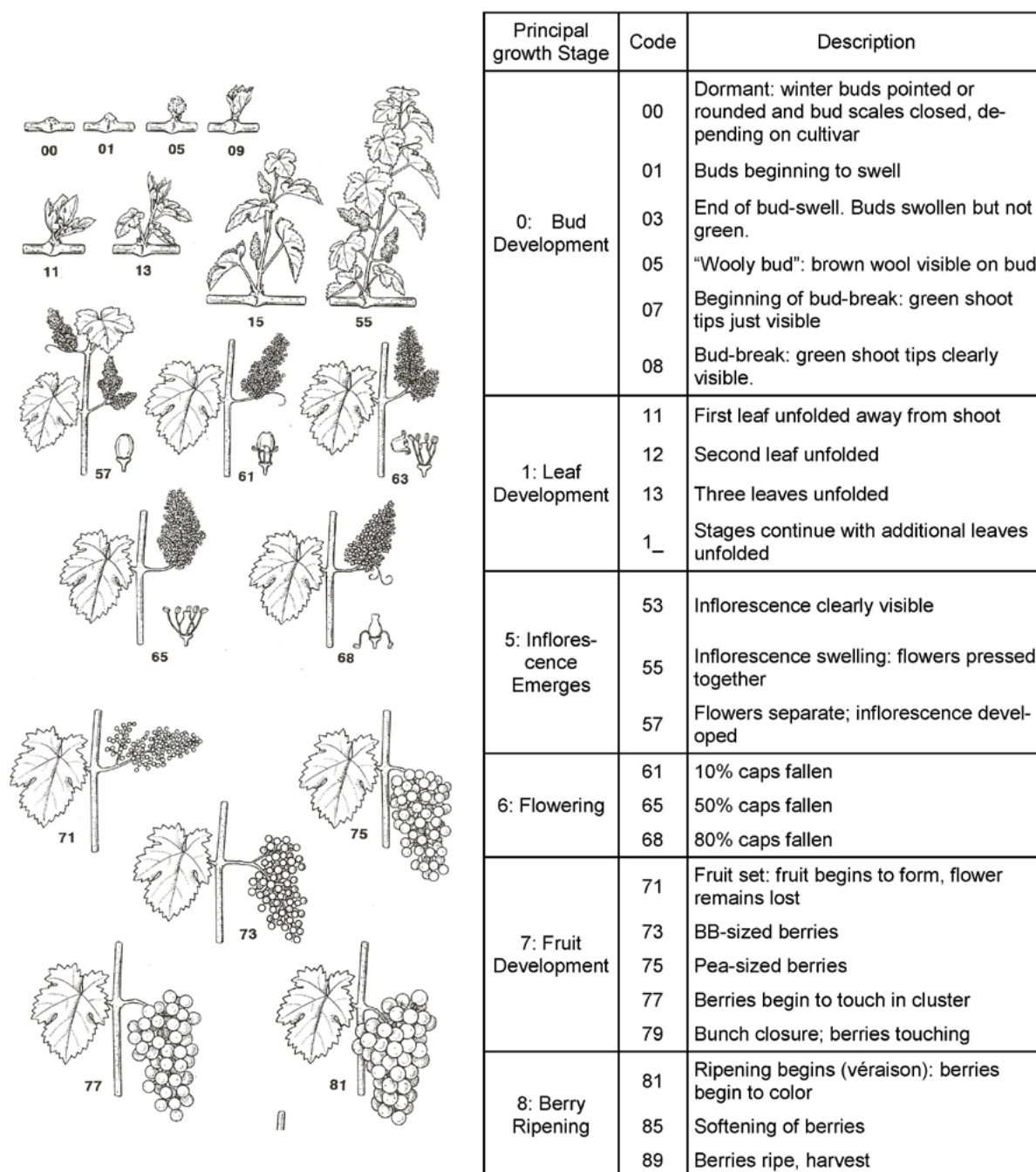


Figure 2. Principal vine growth stage scheme for grapes, adapted from Phenological Growth Stages and BBCH-Identification Key of Grapevine in BBCH Monograph, Meier 1997. (Lorenz et al., 1994)

for its use. Using the product in ways other than those described on the label is a violation of the law.

Two questions frequently asked about the chemical control of insects and diseases are, “How much chemical do I use per acre?” and “What is the least amount of water per acre I will need to apply in my concentrate sprayer?” Table 1 (page 5) offers suggestions for the amount of formulated product to use per acre. Rates are based on a 7- to 15-year-old producing vineyard planted at a moderate density (5-foot vine spacing, 7-foot row spacing) with moderate pest pressure.

A lower amount of total chemical material (volume) may be needed for vineyards with smaller canopies, vineyards that are 1 to 4 years old, and locations with less severe pest pressure and infestations. A higher volume (within label limits) may be required for large vines with dense canopies or heavy pest pressure.

Many insecticide labels indicate the minimum water volume needed per acre to apply concentrate sprays and how to calculate the amount of chemical needed per acre in a concentrate sprayer. Read and follow the product label before spraying.

Some label directions may indicate dilute applications. Be sure to do the following:

- Make sure tank-mixes of pesticides are compatible. For example, an elevated pH of some boron spray solutions can weaken many insecticides, leading to lower efficacy.
- Use adjuvants and spreader-stickers with caution. Most contact herbicides applied to growing weeds require a surfactant or adjuvant to maximize efficacy.

Vineyard pest management timing

The seasonal layout used in this guide is based on vine phenology (growth stage) throughout the year. Optimal pest management should be timed to coincide with vine phenology, pest presence and population levels, and climate conditions.

At each vine phenology stage, we refer to a descriptor for vine growth and its growth stage number.

Figure 1 (page 2) provides an overview of the seasonal growth stages and management timing. Please refer to the specific growth stages illustrated in Figure 2 (page 3).

These growth stage numbers and descriptors should be used in vineyard management record keeping, as they provide a uniform method to report data for historical reference.

Table 1. Seasonal vineyard pest management: weeds, insects, mites, and fungal diseases

This table provides information on some of the effective pesticides currently on the market for growers who choose to use chemical controls for pest management. Not all commercially available pesticides are listed. Products are listed with their application rates, mode of action group, re-entry interval (REI), preharvest interval (PHI), and important considerations. The application rates are listed in units provided by the product label or by active ingredient (ai). The group codes refer to the product's mode of action classification based on how the chemical is used: Weed Science Society of America (WSSA) for herbicides, Fungicide Resistance Action Committee (FRAC) for fungicides, and Insecticide Resistance Action Committee (IRAC) for insecticides. Footnotes provide further information on pages 30–31. Remember these points:

1. Depending on the region, insect/mite pests only occasionally pose an economic impact on vineyards in Oregon. Do not use insecticide sprays unless the insect/mite pest has been identified, a negative economic impact is probable, and pest pressure has reached an action threshold.
2. Alternative management strategies (non-chemical) may be available. See footnote 4, page 31.
3. Pesticide labels are subject to alteration or cancellation at any time; always consult a current product label for usage and application rates. You can access labels from various online sources, including the following:
 - Mobile Access to Pesticides and Labels (MAPL): <http://pi.ace.orst.edu/mapl/>
 - Crop Data Management Systems (CDMS): <http://www.cdms.net/LabelsMsds/LMDefault.aspx>

More database options are available under “Pest Management Resources” on pages 41–43 of this guide.

4. Contact the Oregon Department of Agriculture at (503) 986-4635 for further information about pesticide registration and legal use of products.

Dormant (before bud break, stage 00)					
Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Dormant-season weed control					
Alion/indaziflam	0.046–0.065 lb ai	29	12 hr	14 d	Rate is dependent on percent of soil organic matter. Apply in fall to early spring to firmed soil that does not have cracks. Vines must be 5 years old and planted more than 12 inches deep. Existing vegetation must be controlled with glyphosate or burndown herbicides, such as glufosinate or paraquat. Rainfall or irrigation of 0.25 inches or more within 3 weeks of application is required for maximum efficacy. Avoid direct contact with foliage, green bark, or roots of vines. Do not apply to sand or soil that is more than 20% gravel. Clean spray tank thoroughly after use. Provides long-term preemergent control of most annual weeds. Controls annual broadleaf and grass weeds, but perennial weeds are controlled from seedlings only.
Casoron 4G/dichlobenil	4–6 lb ai	20	12 hr	—	Apply fall through spring, before weeds germinate, or apply foliar-active herbicide to control existing vegetation. Apply prior to a cold rain to reduce losses due to volatilization. Weigh and uniformly distribute exact quantities over precisely measured areas to ensure accurate applications. Use in vineyards established at least 4 weeks, preferably the winter after planting. Results of Oregon-based research over 9 years suggest perennial weeds can be suppressed with 4-, 3-, and 2-lb ai/A rates applied during three consecutive years. Grazing livestock is prohibited. Useful for controlling perennial weeds such as Canada thistle (at 6 lb ai/A rate).

Dormant (before bud break, stage 00) continues next page

CONTINUED— Dormant (before bud break, stage 00)

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Dormant-season weed control (continued)					
Chateau/flumioxazin	Refer to label for condition-based rates	14	12 hr	60 d	Rates are dependent on organic matter, soil type, weed population, and pre- or postemergent control. Residual or postemergent weed control can be achieved by adjusting rates or by using tank-mixes (see label). Do not apply to vines established less than 2 years, unless they are trained 3 feet high or protected by nonporous wraps. Vines can be planted within 2 months after application in newly established vineyards. Follow the most restrictive label requirements and avoid direct or indirect spray contact with foliage or green bark.
Devrinol 50 DF/napropamide	4 lb ai	3	24 hr	35 d	Apply fall through spring before weeds germinate. Irrigation or shallow incorporation is recommended for treatments made November through February, if no rain falls within 3 weeks after application. Irrigate within 24 hours to wet soil 2 to 4 inches deep if applied March through October. Shallow mechanical incorporation enhances activity. Excessive plant residues on soil surface reduce performance. Apply once per season.
Diuron 4L/diuron	1.6–3.2 lb ai	6	12 hr	—	Winter application that persists in soil. Apply in winter as single application, or half doses in October and March. Use only when vines are dormant or they will suffer damage. Do not apply on very sandy or gravelly soils or soils with less than 1% organic matter. Use only in vineyards that are at least 3 years old and with trunk diameters greater than 1.5 inches.
Goal 2XL/oxyfluorfen	0.5–2 lb ai	14	24 hr	—	Controls broadleaf weeds pre- and postemergence depending on rate of application and weed species. Apply only to healthy vineyards. Vines should be trained to a trellis, and the canopy should be 3 feet above the soil surface in vineyards where this product will be used. Direct spray toward base of vines, avoiding direct plant contact. Acts as a contact herbicide, either directly on broadleaf weeds or at soil surface as weeds emerge. Do not apply more than 1.5 lb ai (6 pints)/A per year when applied as broadcast. Do not apply between bud swell and final harvest.
Kerb 50W/pronamide	1–4 lb ai	3	24 hr	—	A restricted-use pesticide. Apply only once in fall or winter, preferably October to December when air temperatures are 55°F or below. Use lower rates on annual grasses and coarse textured soils; higher rates on perennial grasses such as quackgrass and fine-textured soils. Requires moisture from rain or irrigation for activation. Use only on vineyards established at least 1 year or to spring-planted grapes established at least 6 months. No more than 4 lb ai/A and one application per year.
Matrix FNV/rimsulfuron	0.063 lb ai or 1 oz ai (4 oz product)	2	4 hr	14 d	Preemergence or postemergence control depending on species. Preemergence control is best if soil is moist at time of application and receives 0.5 inch of rain or irrigation within 2 weeks after application. Do not disturb the soil after application or weed control will be compromised. Controls puncturevine, quackgrass, mallow, and common dandelion from seed; suppresses yellow nutsedge. Avoid spray contact with foliage or fruit (except undesirable suckers) or drift onto adjacent crops. Clean spray tank carefully.

Dormant (before bud break, stage 00) continues next page

CONTINUED—Dormant (before bud break, stage 00)

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Dormant-season weed control (continued)					
Mission/flazasulfuron	0.033–0.0450 lb ai (2.14–2.85 oz)	2	12 hr	75 d	Pre- and postemergence control of broadleaves and grass weeds up to 4 inches tall, and before grasses tiller. Controls many grasses and broadleaf weeds, including annual ryegrass, common mallow, wild carrot, clover, and willowherb. Apply as a directed; spray to the soil beneath the vines to prevent injury to the foliage and bark of young vines. Must be activated with rainfall or irrigation of 0.25 to 0.5 inch for preemergent control. Preemergent efficacy is best if applied to bare soil. Do not disturb the soil after activation.
Princep Caliber 90/ simazine	1.98–3.96 lb ai	5	12 hr	—	Apply in winter as single application, or apply half doses in October and March. Reduce rate or rotate with other herbicides after achieving weed control. Requires surface moisture to activate. Do not use in vineyards less than 3 years old, or crop damage may occur. Do not apply more than two applications or exceed 4 lb ai/A per 12-month period. Do not apply on very sandy or gravelly soils.
Solicam DF/ norflurazon	2–4 lb ai	12	12 hr	60 d	Rate depends on soil textures; consult the label. Apply to weed-free soil in fall to early spring when soil surface is reasonably free from plant residue. Requires ample rain to activate. Do not use on grapes established less than 2 years in the field. Do not use on gravelly, sandy, or loamy sand soils. Wait 3 months before attempting to plant any cover crop.
Surflan A.S./oryzalin	2–6 lb ai	3	24 hr	0 d	Apply late fall or early spring to bare soil, or after existing weedy vegetation has been destroyed by tillage or tank mix with nonselective herbicides, such as glyphosate. Use higher rates or split treatments, and apply in fall and spring for longer residual control. Apply before rainfall or irrigate with at least 0.5 inch of water or rain to activate herbicide (1 or more inches in fine soil with high organic matter content). Do not use on soils with more than 5% organic matter. Shallow cultivation can provide control of newly germinated weeds without reducing herbicide activity.
Trifluralin 4 EC/ trifluralin	0.5–2 lb ai (1–4 pt)	3	12 hr	60 d	Check label for specific rates suited to soil type. Apply before transplanting or prior to periods of weed germination or immediately after existing weeds are controlled. Apply and immediately incorporate 1 to 2 inches deep, using equipment that will not injure roots.
Venue/pyraflufen	0.001–0.006 lb ai (0.7–4 fl oz)	14	12 hr	0 d	This product is a contact, nonselective, broadleaf herbicide. Avoid contact with desirable foliage, green bark, or fruit. Apply postharvest, until bloom, as a directed application to actively growing weeds less than 4 inches high or to rosettes less than 3 inches in diameter. Tank mix this herbicide with other herbicides to broaden the spectrum of other contact herbicides or to reduce the selection pressure for glyphosate-resistant weeds when applying glyphosate. Will control willow weed (a weed that is often not controlled by glyphosate) that is 3 to 6 inches tall. This product can also be used to control suckers.

Dormant (before bud break, stage 00) continues next page

CONTINUED—Dormant (before bud break, stage 00)

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Dormant-season weed control (continued)					
Zeus XC/ sulfentrazone	0.25–0.375 lb ai/A (8– 12 oz/A)	14	12 hr	3 d	Apply to grapes that have been established for a minimum of three years. Apply as a dormant application in the fall through bloom the next spring. If applied after bloom, a shielded sprayer must be used. The product should be applied as a uniform broadcast soil application to vineyard floors and furrows, or as a uniform band directed at the base of the vines. Precipitation of at least 0.5 inches is required for activation and residual control. For enhanced burndown of emerged weeds, carfentrazone, glufosinate, and glyphosate can be added. May tank mix with other labeled herbicides to broaden weed control spectrum. Do not apply to frozen soils. Avoid direct and indirect contact with green foliage or bark. Wrap with non-porous wrap material to keep spray solution off of green tissues.

Mealybugs and scale insects

Currently, the most often-used and most effective pesticides for mealybugs are not optimal during the dormant period. For more effective timing, action should begin during the delayed-dormant period.

Crown gall, Eutypa dieback, and other trunk diseases

Remove and destroy galled or cankered vines. Bring up suckers only if originating well below the damaged area and above the graft union on grafted vines. For prevention of trunk disease infection: If you are making large cuts when retraining vines, consider leaving long stubs to be cut away in the summer, when conditions are dry, to allow healing and prevent infection (double pruning).

Mettle 125 ME + adjuvant	5 fl oz in 25-50 gal water/A	3	varies	14 d	Spray onto cuts within 24 hours of pruning. A second spray 2 weeks later is recommended. Do not use more than 10 oz/A per year for this and in-season powdery mildew treatments. The REI varies for vineyard activities; consult label. Note: This is for canker diseases only, not crown gall.
Rally 40 WSP + adjuvant	5 oz in 50 gal water/A	3	24 hr	14 d	Spray onto cuts within 24 hours of pruning. A second spray 2 weeks later is recommended. Do not use more than 24 oz/A per year for this and in-season powdery mildew treatments. Note: This is for canker diseases only, not crown gall.
Topsin M WSB + adjuvant	1.5 lb in 50 gal water/A	1	2 d	7 d	Special use label for trunk diseases (SLN OR-150009A). Spray onto cuts within 24 hours of pruning. A second spray 2 weeks later is recommended. May also be used at 3.2 oz/1 gal water and painted onto the surface of large pruning cuts. Use when rain is not expected after application. Note: This is for canker diseases only, not crown gall.

Powdery mildew

The application of lime sulfur during the dormant season or micronized sulfur at 100% bud break has reduced early season inoculum in California and New York. However, the application of these materials may not provide an economic benefit in the Willamette Valley of Oregon.

Phomopsis cane and leaf spot

Remove canes that are bleached or showing symptoms of this disease during dormant pruning.

Delayed dormant (Stages 1–13)

Apply from before bud break up to the time shoots are 4 inches long

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Early spring weed control					
Basagran/bentazon	0.75–1 lb ai	6	48 hr	365 d	This is a supplemental label for nonbearing grapes only. Apply as a directed spray, away from the crop, in spring to early summer to control/suppress Canada thistle, musk thistle, and yellow nutsedge. For Canada thistle, apply 2 pt/A (2 lb/A) when plants are between 8 inches tall and bud stage. Apply a second application 2 weeks later, if needed. For nutsedge, apply 1.5–2 pt/A when plants are 6 to 8 inches tall. Make a second application 7 to 10 days later, if needed. Always add a crop oil concentrate. Do not apply more than 2 lb ai/A per year. Weeds growing under drought conditions may not be adequately controlled; be sure to irrigate to make sure plants are actively growing before applying this product. Do not cultivate or mow for 5 days after application.
glyphosate wiper solution/several products	Prepare a 33% solution of product	9	4 hr	14 d	See label rate and time of application, particularly for perennial weed control. Mix product to 33% solution as directed on label and wipe weeds. Use appropriate equipment. Avoid contact with grape foliage.
paraquat	Consult label	22	12 hr	—	A restricted-use pesticide. Apply when weeds are growing vigorously and new growth is 1 to 6 inches high. Apply as a directed-shielded spray toward base of vines. Add a nonionic surfactant or crop oil concentrate according to label; avoid anionic formulations that react in the tank to form insoluble precipitates. Avoid windy conditions.
Poast/sethoxydim	0.28–0.47 lb ai (1.5–2.5 pt)	1	12 hr	50 d	Identify susceptible grasses and apply at optimum growth stage listed on label. Add 2 pt/A of a nonphytotoxic crop oil concentrate to improve leaf absorption. Control is often erratic on grasses stunted or stressed by drought, high temperatures, or low fertility. Resistant grasses include annual bluegrass and all fine fescues; quackgrass can be suppressed. Do not exceed 5 pt/A per season.
Rely 200/glufosinate ammonium	0.75–1.25 lb ai	10	12 hr	14 d	Apply to actively growing weeds as directed spray or spot treatment according to stage of weed growth. Avoid drift to or treatment of desirable foliage or green bark during establishment year. Do not exceed 4.5 lb ai/A per year.

Delayed dormant (stages 1-13) continues next page

CONTINUED—Delayed dormant (Stages 1–13)

Apply from before bud break up to the time shoots are 4 inches long

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Early spring weed control (continued)					
Roundup and other product names/ glyphosate	Consult label	9	4 hr	14 d	See label for rate and time of application, especially for perennial weeds. Do not allow mist to contact green foliage, green bark, suckers, or vines and renewals less than 3 years old. When repeat applications are needed, do not exceed label rate. Alternate weed management to avoid weed resistance.
Zeus XC/ sulfentrazone	0.25–0.375 lb ai/A (8–12 oz/A)	14	12 hr	3 d	Apply to grapes that have been established for a minimum of three years. Apply as a dormant application in the fall through bloom the next spring. If applied after bloom, a shielded sprayer must be used. The product should be applied as a uniform broadcast soil application to vineyard floors and furrows or as a uniform band directed at the base of the vines. Precipitation of at least 0.5 inches is required for activation and residual control. For enhanced burndown of emerged weeds, carfentrazone, glufosinate, and glyphosate can be added. May tank mix with other labeled herbicides to broaden weed control spectrum. Do not apply to frozen soils. Avoid direct and indirect contact with green foliage or bark. Wrap trunks with nonporous wrap material to keep spray solution off of green tissues.
Cutworms (e.g., climbing, spotted, redbacked, winter) and other Lepidoptera larvae (grape leafroller, orange tortrix, and omnivorous leaffolder)					
For all products, thorough coverage of vines and the immediate basal area is important. Cutworms can cause damage to either the vines (newly emerging buds/shoots) or vineyard floor vegetation (including cover crops such as clover, grasses, and broadleaf and grass weeds). The climbing, spotted, and redbacked cutworm species can cause damage by feeding on newly emerging buds and young shoots in vineyards. While the winter cutworm has less ability to climb up the vine, it was recently (fall 2012 and winter 2016) found in high populations causing damage to vineyard floor vegetation. For more details on cutworm management, see “Grape – Cutworm” in the Pacific Northwest Insect Management Guide (http://insect.pnwhandbooks.org/small-fruit/grape/grape-cutworm).					
Brigade 2EC/ bifenthrin	3.2–6.4 fl oz	3A	12 hr	30 d	A restricted-use pesticide. Use as a barrier spray during the delayed-dormant to bud-break stage to prevent movement of cutworms to newly emerging buds and shoots. Apply as a directed spray at the vine-soil interface, making sure to obtain good spray coverage of trunks and posts. Adequate water volume should be used for thorough coverage. Do not apply more than 0.1 lb ai/A per season.
Danitol 2.4 EC/ fenoprophathin	10.6–21.3 fl oz	3	24 hr	21 d	A restricted-use pesticide. Use as a barrier spray during the delayed-dormant to bud-break stage to prevent movement of cutworms to newly emerging buds and shoots. Apply as a directed spray at the vine-soil interface, making sure to obtain good spray coverage of trunks and posts. Adequate water volume should be used for thorough coverage. Do not apply more than once every 7 days, and do not exceed 0.8 lb ai per season. Do not apply more than two times per season.
Delegate WG/ spinetoram	3–5 oz	5	4 hr	7 d	Re-treatment interval 4 days. Do not make more than two consecutive applications or apply more than five total applications per season (not to exceed 0.305 lb ai/A or 19.5 oz product/A per year).

Delayed dormant (stages 1-13) continues next page

CONTINUED—Delayed dormant (Stages 1–13)

Apply from before bud break up to the time shoots are 4 inches long

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Cutworms (continued)					
Sevin 4F/carbaryl	1–2 quarts; 1–2 lb ai	1A	6 d	7 d	Do not apply more than 10 lb ai/A per year (no more than five applications). Observe bee caution. Do not apply if weeds or cover crop are in bloom. Mow vineyard floor prior to applying. Do not concentrate spray on cluster because visible residues may result. Carbaryl is a broad-spectrum insecticide. Its use may adversely affect beneficial insects and predatory mites and may result in secondary outbreaks of spider mites or other insect pests. To minimize nontarget effects, use spot treatments applied only to affected areas.
Success or Entrust/spinosad	4–8 fl oz (Success) 1.25–2.5 oz (Entrust)	5	4 hr	7 d	Treat when pests appear. Heavy infestations may require repeated applications. Do not exceed 0.45 lb ai/A per year of spinosad (9 oz/A of Entrust or 29 fl oz/A of Success). Do not make consecutive sprays of group 5 products. Do not exceed 3 applications in a 30-day period (allow at least 5 days between applications), and do not make more than 5 applications per year.

Grape rust and bud mites (eriphyid mites), and spider mites

Note: Rust mites may cause stunted shoot growth and tissue scarring early in the spring. Be aware that other factors (e.g., nutrient deficiencies, vine stress, thrips, and climatic conditions such as spring frost) can cause similar symptoms of stunting and distorted growth in spring. Monitor vines closely for presence of these microscopic pest mites. Feeding damage is believed to start when buds begin to swell and expand, shortly after the wooly bud stage and when mites are moving from overwintering sites (outer bud scales, bark, and crevices on trunks and cordons). This period of migration increases the chance of direct pesticide contact with mites. Sulfur may be less effective when air temperatures are below 60°F. Bud mites are different from rust mites as they are found within buds during winter, and their feeding can destroy bud tissues before bud break. Bud mites have been found in limited locations in Oregon. Rust mites are more commonly found in vineyards experiencing mite-related stunting. High spray volumes and good coverage are essential early in the season to manage rust mites in vineyards where high postharvest pressure was observed the previous year and verified in the late dormant period. A large proportion of rust mites may not survive the winter. Examination of dormant buds in winter may be used to determine mite presence and whether pesticide applications are warranted in spring. Making one spray application in a time period from wooly bud to just after bud break and then another 7 to 14 days later is the best recommendation to control mite populations. Oils and contact miticides may be more effective than sulfur during cool conditions in spring. Sulfur has been found to be more effective at reducing grape rust mite populations when combined with an adjuvant. Spider mites (e.g., McDaniel, two-spotted spider mites, Willamette, and yellow) may cause damage to grape leaves but are not consistently a problem. However, problems can arise when: 1) their predators are killed off by multiple applications of sulfur or broad-spectrum insecticides; 2) conditions are hot, dry, and dusty; and 3) plants are under water stress.

Envirdor 2 SC/spirodiclofen	16–34 fl oz	23	12 hr	14 d	One application per season allowed; 34 fl oz maximum allowed per crop season. For best results, adequate canopy surface area should be available for maximum coverage and contact. Use the higher dosage rate when mite pressure is high and environmental conditions favor continued pressure.
JMS Stylet oil	1–2 gal/100 gal water	UN	4 hr	0 d	Do not use within 14 days of a sulfur application, when air temperature is near freezing or above 90°F, or when foliage is wet. Do not use copper and oil together when fruit is present.
M-Pede	1–2 gal/100 gal water	UN	12 hr	0 d	Do not use within 3 days of a sulfur application.

Delayed dormant (stages 1–13) continues next page

CONTINUED—Delayed dormant (Stages 1–13)

Apply from before bud break up to the time shoots are 4 inches long

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Grape rust and bud mites (eriophyid mites), and spider mites (continued)					
sulfur (micronized sulfur)	Check label	UN	24 hr	—	Repeat as necessary based on mite presence. All sulfur products listed have rates given in formulated product.
Kumulus DF	2–10 lb	UN	24 hr	0 d	
Microthiol Disperss	3–10 lb	UN	24 hr	0 d	

Thrips

May cause scarring, stunting, and shoot dieback on newly developing shoots and leaves that appears similar to that of early season rust mite damage. Monitor for presence before taking action. Where thrips are a problem, they are generally managed early season, prior to bloom. Consider avoiding mowing or tilling cover crop/vegetation on the vineyard floor during spring when populations are high, as they may move into the vine canopy.

Delegate WG/spinetoram	3–5 oz	5	4 hr	7 d	Do not apply more than five times per crop year (not to exceed 0.305 lb ai/A). Do not space applications closer than 4 days.
Entrust or Success/spinosad	1.25–2.5 oz (Entrust) 4–8 oz (Success)	5	4 hr	7 d	Do not exceed 0.45 lb ai/A per year (9 oz product/A Entrust or 29 oz product/A Success).
Surround CF/kaolin clay	25–50 lb product	—	4 hr	0 d	The preferred rate is 0.25–0.5 lb of product per 1 gal water/A. For suppression only. Supplemental controls may be needed for complete control. Make one or two applications 7 days apart, starting at bud break.

Phylloxera

Before treating, check that phylloxera is present by sampling soil and vine roots during late summer through the postharvest period. If sampling shows presence the year prior, prepare to take action during the following season. Note that soil drench treatments may result in variable levels of control and are generally ineffective for eradication due to poor penetration, especially in clay soils. See later stages for materials and remarks. See footnote 5, page 31.

Platinum 75 SG/thiamethoxam	2.67–5.67 oz	4A	12 hr	60 d	Can be applied through dripper or low-pressure micro-irrigation lines. The vineyard must be irrigated to field capacity before application to ensure proper absorption into actively growing roots. The higher rate may provide some control during the following season. This compound has good water solubility compared with other systemic, root-applied compounds. Do not exceed 0.266 lb ai/A per season.
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Delayed dormant (stages 1-13) continues next page

CONTINUED—Delayed dormant (Stages 1–13)

Apply from before bud break up to the time shoots are 4 inches long

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Mealybugs, scale, and other insects					
Ants that feed on mealybug and scale honeydew secretions must be controlled in order for beneficial organisms to aid in control of mealybugs.					
Admire Pro/imidacloprid	1–14 fl oz	4A	12 hr	30 d	Do not apply more than 14 fl oz/A per year. Apply in one or two drip irrigations between bud break and pea-size stage of berry development. Applications should be done on a 30 to 45 day interval. Consult label for restrictions.
Applaud/buprofezin	9–12 oz (varies by pest)	16	12 hr	7 d	No more than two applications per season; do not apply more than 24 oz or 1.5 lb ai/A per year. Allow 14 days between applications. Use rate of 9 to 12 oz for mealybug and leafhopper. Use rate of 12 oz for scale.
Platinum 75 SG/thiamethoxam	2.67–5.67 oz	4A	12 hr	60 d	Can be applied through low-pressure dripper or micro-irrigation lines. Assure that the vineyard is irrigated to field capacity before application to ensure proper absorption into actively growing roots. The higher rate may result in some control during the following season. This compound has good water solubility compared with other systemic, root-applied compounds. Do not exceed 17 fl oz/A (0.266 lb ai/A) per season.
Superior-type oil (several brands)	—	—	—	—	Consult label for rates. Do not apply oil after bud break.

Shoots 1–5 inches long (stages 9–14)

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Phomopsis cane and leaf spot					
This disease may be called “dead arm” on some labels.					
Abound	10–15.5 oz	11	4 hr	14 d	Do not apply with silicon-based surfactants.
Adament 50 WG	6 oz	3+11	12 hr	14 d	See footnote 8, page 31.
Aprovia	8.6–10.5 fl oz	7	12 hr	21 d	Use with an adjuvant.
Captan 80WDG	2.5 lb	M4	48 hr	0 d	
Dithane M45	1.2–2.5 lb	M3	24 hr	66 d	
Flint 50WG	3 oz	11	12 hr	4 d	Do not make more than two consecutive applications.
Penncozeb 75DF	1.2–2.5 lb	M3	24 hr	66 d	
Pristine	8–12.5 oz	7+11	varies	14 d	Do not make more than two consecutive applications. Do not use for this disease if planning to use for other diseases later in the growing season. The REI varies with vineyard activities; consult label.
Quadris Top	12–14 fl oz	3+11	12 hr	14 d	Do not make more than two consecutive applications.
Sovran	3.2–4.8 oz	11	12 hr	14 d	Do not make more than two consecutive applications. See footnote 9, page 31.
Ziram 76 DF	3–4 lb	M3	4 d	10 d	Do not apply after bloom.

Shoots 1–5 inches long (stages 9–14) continues next page

CONTINUED—Shoots 1–5 inches long (stages 9–14)

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Branch, cane, or twig borer					
While chemicals are registered for use on these borers, the borers are often protected from chemical controls because of location inside of canes. Be sure that adults and/or larvae can be directly controlled before pursuing the use of the following chemical products.					
Dipel DF/ <i>Bacillus thuringiensis</i>	0.5–2 lb	11A	4 hr	0 d	Rate depends on insect; be sure to check label. The pest must feed on this product to be affected. Apply on a 4- to 5-day schedule as new larvae emerge.
Sevin Brand 4F/carbaryl	1–2 quarts (1–2 lb ai)	1A	6 d	7 d	Chemical control normally is not necessary if cultural practices, such as removal of pruned wood, are observed. If large populations of adults occur in the vineyard (late April to early June), carbaryl applied two to three times at 7- to 10-day intervals has given control. Do not use more than five applications per year at 7-day intervals, or more than 10 quarts/A. See footnote 4, page 31.
Cutworms (e.g., climbing, spotted, redbacked, winter) and other Lepidopteran insects (e.g., grape leafroller, orange tortrix, and omnivorous leafroller)					
See materials and remarks for earlier growth stages.					
Thrips					
See materials and remarks for earlier growth stages.					
Spider mites					
See materials and remarks for earlier growth stages.					
Envidor 2 SC/spirodiclofen	16–34 fl oz	23	12 hr	14 d	One application and a maximum of 34 fl oz are allowed per season. For best results, adequate canopy surface area should be available for maximum coverage and contact. Use the higher dose rate when mite pressure is high and environmental conditions (hot and dry) are favored.
Mealybugs, scale, and other insects					
See materials and remarks for earlier growth stages.					
Weed control					
See “Delayed Dormant” section (page 9) for list of herbicides. Time applications with weed and vine growth stage in mind. Some herbicides can be applied into early spring post-bud break, and into the season.					

Shoots 6 inches long (stages 14–15)					
Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Vine sucker control					
GoalTender/oxyfluorfen	0.25–0.5 lb ai	3	24 hr	60 d	Apply in a 3-foot band directed at suckers emerging from plant base up to 12 inches tall. Immature, expanding leaves at time of contact are most susceptible. Complete sucker control requires removing canes by hand. The highest rate or a second application may be required for acceptable control or suppression of grape suckers. Do not apply more than 1.5 lb ai/A per season. Applications can be made up to 3 weeks after bloom. Use a minimum of 50 gallons of water per treated acre. May tank mix with glufosinate.
Powdery mildew, grape erineum mite, grape rust mite					
See Table 2 (page 32) and Figure 3 (page 34)					
JMS Stylet oil	1–2 gal/100 gal water	—	4 hr	0 d	Do not use within 2 weeks of a sulfur application, near freezing temperatures, above 90°F, or when foliage is wet.
M-Pede	1–2 gal/100 gal water	—	12 hr	0 d	Do not use within 3 days of a sulfur application.
Sulfur	Check labels				
Cosavet DF	2–5 lb	M2/ UN	24 hr	—	Repeat as necessary at 10- to 14-day intervals. Wettable sulfur seems to be more effective in controlling the grape erineum mite than flowable sulfur formulations. See footnotes 1 and 2, page 30.
Kumulus DF	2–10 lb	M2/ UN	24 hr	—	
Microthiol Disperss	3–10 lb	M2/ UN	24 hr	—	
Powdery mildew only					
See Table 2 (page 32) and Figure 3 (page 34)					
Abound	10–15.5 oz	11	4 hr	14 d	Do not apply more than two sequential sprays before alternating with a fungicide that has a different mode of action. Do not apply with silicon-based surfactants.
Adament 50 WG	3–4 oz	3+11	12 hr	14 d	See footnote 8, page 31.
Kaligreen	2.5–5 lb	NC	4 hr	1 d	Use as a supplement to a regular fungicide program; apply only when powdery mildew is first observed. NC=FRAC code not classified
M-Pede	1–2 gal/100 gal water	28	12 hr	0 d	Do not use within 3 days of a sulfur application.
Pristine	8–12.5 oz	7+11	varies	14 d	The REI varies with vineyard activities; consult label.
Sovran	3.2–4.8 oz	11	12 hr	14 d	Do not make more than two consecutive applications. See footnote 9, page 31.
Sulfur	Check labels				
Cosavet DF	2–5 lb	M2	24 hr	—	Repeat as necessary at 10- to 14-day intervals. See footnotes 1 and 2, page 30.
Kumulus DF	2–10 lb	M2	24 hr	—	
Microthiol Disperss	3–10 lb	M2	24 hr	—	
Thiosperse	6–20 lb	M2	24 hr	—	

Shoots 6 inches long (stages 14–15) continues next page

CONTINUED—Shoots 6 inches long (stages 14–15)

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Mealybugs, scale, and other insects					
See materials and remarks for earlier growth stages.					
Movento/ spirotetramat	6–8 fl oz	23	24 hr	7 d	Do not apply more than 12.5 fl oz/A per season. Use an adjuvant to obtain effective full canopy applications for this systemic product. A high-quality adjuvant should be used, but the adjuvant Induce is prohibited on grapes. Ensure application when there is adequate canopy for uptake through tissues. Interval between applications is 30 days.

Phylloxera

See remarks for earlier growth stages and footnote 5, page 31.

Thrips

Where thrips are a problem, they are generally managed early season, prior to bloom. See materials and remarks for earlier growth stages.

Yellow jackets

Control of wasps can be managed by trapping. Ongoing effort needs to start in spring and continue into fall, especially if the yellow jacket population was large the previous year. In spring, there is a 30- to 45-day period when new queens first emerge, before they build nests. Trapping queens during this period has the potential to provide an overall reduction in the yellow jacket population for the season. A greater number of traps may reduce the likelihood of pest numbers building up later in the season. Use appropriate baits/traps for species present.

Prebloom (stage 17)

Cutworms

Cutworm control is most effective when conducted prior to bloom; this is the period in which they can cause the most damage. See materials and remarks listed for earlier growth stages.

Mealybugs, scale, and other insects

See materials and remarks for earlier growth stages.

Thrips

See materials and remarks for earlier growth stages. Where thrips are a problem, they are generally managed early season, prior to bloom.

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Grape rust and bud mite (eriophyid mites), and spider mites					
JMS Stylet oil	1–2 gal/100 gal water	—	4 hr	0 d	Do not use within 2 weeks of a sulfur application.
M-Pede	1–2 gal/100 gal water	—	12 hr	0 d	Do not use within 3 days of a sulfur application.
Sulfur	Check labels				Formulated product rate shown for sulfur products. Repeat as necessary at 10- to 14-day intervals. Wettable sulfur seems to be more effective in controlling the grape erineum mite than the flowable sulfur formulations. See footnotes 1 and 2, page 30.
Cosavet DF	2–5 lb	UN	24 hr	—	
Kumulus DM	2–10 lb	UN	24 hr	—	
Microthiol Disperss	3–10 lb	UN	24 hr	—	

Prebloom (stage 17) continues next page

CONTINUED—Prebloom (stage 17)

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Phylloxera					
Foliar applied insecticides (shown below) have greater efficacy when applied to adequate canopy (at least 2 feet of shoot growth). See additional materials and remarks for other growth stages. See footnote 5, page 31.					
Movento/ spirotetramat	6–8 fl oz	23	24 hr	7 d	Do not apply more than 12.5 fl oz/A per season. Use an adjuvant to obtain effective full canopy applications. A high-quality adjuvant should be used. Ensure application when there is adequate canopy for uptake through tissues. Interval between applications is 30 days.
Powdery mildew					
See Table 2 (page 32) and Figure 3 (page 34)					
Abound	10–15.5 oz	11	4 hr	14 d	Do not apply with silicon-based surfactants.
Adament 50 WG	3–4 oz	3+11	12 hr	14 d	See footnote 8, page 31.
Aprovia	8.6–10.5 fl oz	7	12 hr	21 d	Use with an adjuvant.
Flint 50WG	1.5–2 oz	11	12 hr	14 d	Do not make more than two consecutive applications. Do not apply more than 4 times per year. See footnote 8, page 31.
Fracture (BLAD)	20.5–24.4 fl oz	NC	4 hr	1 d	Reapply if rain occurs within 12 hours of application. NC=FRAC code not classified
Inspire Super	16–10 fl oz	3+9	12 hr	14 d	
JMS Stylet oil	1–2 gal/100 gal water		4 hr	0 d	Do not use within 10 days of a sulfur application.
Kaligreen	2.5–5 lb	NC	4 hr	1 d	Use as a supplement to a regular fungicide program; apply only when powdery mildew is first observed. NC=FRAC code not classified
Kenja 400 SC	20–22 fl oz	7	12 hr	14 d	
Luna Experience	5.0–8.6 fl oz	3+7	varies	14 d	The REI varies for vineyards: a 5-day REI for hand labor of the canes/canopy and 12-hr REI for other activities.
Mettle 125 ME	3–5 fl oz	3	24 hr	14 d	Do not use more than 10 fl oz/A per year. The REI varies for vineyard activities; consult label.
M-Pede	1–2 gal/100 gal water	28	12 hr	0 d	Do not use within 3 days of a sulfur application. Use as a supplement to a normal program.
Oso SC	3.75–13 fl oz	19	4 hr	7 d	
Pristine	8–12.5 oz	7+11	varies	14 d	The REI varies for vineyards: a 5-day REI for hand labor of the canes/canopy and 12-hr REI for other activities.
Procure 480SC	4–8 fl oz	3	12 hr	7 d	Do not use more than 32 fl oz/A per year.
Quadris Top	10–12 fl oz	3+11	12 hr	14 d	
Quintec	3–6.6 oz	13	12 hr	14 d	Do not apply more than five times per year. A surfactant is not required when used alone, but a non-ionic surfactant is preferred if needed for tank mixes.
Rally 40WSP	3–5 oz	3	24 hr	14 d	Do not apply more than 1.5 lb/A per year.
Regalia	1–4 qt	P5	4 hr	0 d	Supplemental to a normal program only when powdery mildew is first observed. Use on a 7-day interval.

Prebloom (stage 17) continues next page

CONTINUED—Prebloom (stage 17)

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Powdery mildew (continued)					
See Table 2 (page 32) and Figure 3 (page 34)					
Sovran	3.2–4.8 oz	11	12 hr	14 d	Do not make more than two consecutive applications. See footnote 8, page 31.
sulfur	Check labels				
Cosavet DF	2–5 lb	M2	24 hr	—	
Kumulus DF	2–10 lb	M2	24 hr	—	Repeat as necessary at 7- to 10-day intervals. See footnotes 1 and 2, page 30.
Microthiol Disperss	3–10 lb	M2	24 hr	—	
Thiosperse	6–20 lb	M2	24 hr	—	
tebuconazole products	Check labels	3			Tank mix tebuconazole products with a different fungicide group (FRAC code).
Orius 20 AQ	4–8.6 oz	3	12 hr	14 d	Includes sulfur in the formulation. Use with a non-ionic surfactant.
Unicorn DF	1.75–2.5 lb	3+M2	24 hr	14 d	
Torino	3.4 oz	U6	4 hr	3 d	Do not make more than two applications per year.
Vivando	10.3–15.4 fl oz	U8	12 hr	14 d	Do not use with oil.

Eutypa dieback, Bot canker, and other wood rot diseases

Scout for vines showing symptoms of these diseases. Mark for removal in summer, during dry weather, or during the dormant season. Removal during rainfall early in the season can lead to further spread of the disease.

Weed control

Refer to previous section (Delayed Dormant, page 9) for list of herbicides. Time applications with weed and vine growth in mind. Some herbicides can be applied into early spring post-bud break, and into the season.

Bloom (stages 61–69)

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Powdery mildew					
Use materials at the shortest recommended intervals during this period. Fungicide application does not create problems with fruit set. Powdery mildew is a significant concern during this time and should be prevented with the use of fungicides. See also Table 3 (page 34) and Figure 2 (page 3).					
Abound	10–15.5 oz	11	4 hr	14 d	Do not apply with silicon-based surfactants.
Adament 50 WG	3–4 oz	3+11	12 hr	14 d	See footnote 8, page 31.
Aprovia	8.6–10.5 fl oz	7	12 hr	21 d	Use with an adjuvant.
Flint 50WG	1.5–2 oz	11	12 hr	14 d	Do not make more than two consecutive applications. Do not apply more than four times per year. See footnote 8, page 31.
HMOs such as JMS Stylet oil, Saf-T-Side, SuffOil, Trilogy	1–2 gal/100 gal water	NC	4 hr	0 d	Do not use within 10 days of a sulfur application. NC=FRAC code not classified
Inspire Super	16–20 fl oz	3+9	12 hr	14 d	

Bloom (stages 61–69) continues next page

CONTINUED—Bloom (stages 61–69)

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Powdery mildew (continued)					
Kenja 400 SC	20–22 fl oz	7	12 hr	14 d	
Luna Experience	5–8.6 fl oz	3+7	varies	14 d	The REI varies for vineyards: a 5-day REI for hand labor of the canes/canopy and 12-hr REI for other activities.
Mettle 125 ME	3–5 fl oz	3	varies	14 d	Do not use more than 10 fl oz/A per year. The REI varies for vineyard activities; consult label.
Pristine	8–12.5 oz	7+11	varies	14 d	The REI varies with vineyard activities; consult label.
Procure 480SC	4–8 fl oz	3	12 hr	7 d	Do not use more than 32 fl oz/A per year.
Quadris Top	10–12 fl oz	3+11	12 hr	14 d	
Quintec	3–6.6 oz	13	12 hr	14 d	Do not apply more than 5 times per year. A surfactant is not required when used alone, but a non-ionic surfactant is preferred if needed for tank mixes.
Rally 40WSP	3–5 oz	3	24 hr	14 d	Do not apply more than 1.5 lb/A per year.
Sovran	3.2–4 oz	11	12 hr	14 d	Do not make more than two consecutive applications. See footnote 9, page 31.
sulfur	Check labels				
Cosavet DF	2–5 lb	M2	24 hr	—	Repeat as necessary at 7- to 10-day intervals. See footnotes 1 and 2, page 30.
Kumulus DF	2–10 lb	M2	24 hr	—	
Microthiol Disperss	3–10 lb	M2	24 hr	—	
Thiosperse	6–20 lb	M2	24 hr	—	
tebuconazole products	Check labels				Tank mix tebuconazole products with a different fungicide group (FRAC code).
Orius 20 AQ	4–8.6 oz	3	12 hr	14 d	Includes sulfur in the formulation. Use a non-ionic surfactant.
Unicorn DF	1.75–2.5 lb	3+M2	24 hr	14 d	
Torino	3.4 oz	U6	4 hr	3 d	Do not make more than two applications per year.
Vivando	10.3–15.4 fl oz	U8	12 hr	14 d	Do not use with oil.
Botrytis bunch rot					
See Table 2 (page 32) and Figure 3 (page 34)					
Captan 80WDG	2.5 lb	M4	48 hr	0 d	Do not use with oil.
Elevate 50WDG	1 lb	17	12 hr	0 d	Do not use more than 3 lb/A per season. See footnote 3, page 31.
Endura	8 oz	7	12 hr	14 d	Do not use more than 2 times per year. Do not use for Botrytis bunch rot control if Pristine was used for powdery mildew.
Inspire Super	16–20 fl oz	3+9	12 hr	14 d	Do not use for Botrytis bunch rot control if it was used for powdery mildew.
JMS Stylet oil	1–2 gal/100 gal water		4 hr	0 d	May aid Botrytis bunch rot control. Tank mix with another fungicide. Do not use within 10 days of a sulfur application.
Kenja 400 SC	20–22 fl oz	7	12 hr	14 d	See footnote 3, page 31.

Bloom (stages 61–69) continues next page

CONTINUED—Bloom (stages 61–69)

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Botrytis bunch rot (continued)					
Luna Privilege	6.84 fl oz	7	12 hr	7 d	Do not use more than two times per year. Do not use for Botrytis bunch rot control if Luna Experience was used for powdery mildew.
Luna Tranquility	16–14 oz	7+9	12 hr	7 d	Do not use for Botrytis bunch rot control if used for powdery mildew. New product will not have grape on the label for 2016, but old product with grapes on the label is still legal to use.
Protexio SC	14.5–19 fl oz	17	12 hr	3 d	See footnote 3, page 31.
Pristine	18–23 oz	7+11	varies	14 d	Higher rate based on supplemental label. Do not use for Botrytis bunch rot control if was used for powdery mildew. The REI varies with vineyard activities; consult label.
Rovral 4F (generic products are available)	1–2 pt	2	4 d	7 d	Tank mix with another fungicide from a different group (FRAC code). Do not use more than twice per season. See footnote 3, page 31.
Scala SC	9–18 oz	9	12 hr	7 d	See footnote 3, page 31.
Switch 62.5 WG	11–14 oz	9+12	12 hr	7 d	Do not use with an adjuvant.
Vanguard WG	5–10 oz	9	12 hr	7 d	Buffer to a pH of 5 to 7 when tank mixing with Rovral. See footnote 3, page 31.

Mealybugs, scale, and other insects

See materials and remarks for earlier growth stages.

Vine sucker control

GoalTender/oxyfluorfen	0.25–0.5 lb	3	24 hr	60 d	Apply in a 3-foot band directed at suckers emerging from plant base up to 12 inches tall. Immature, expanding leaves at time of contact are most susceptible. Complete sucker control requires removing canes by hand. The highest rate or a second application may be required for acceptable control or suppression of grape suckers. Do not apply more than 1.5 lb ai/A per season. Applications can be made up to 3 weeks after bloom. Use a minimum of 50 gallons of water per treated acre. May tank mix with glufosinate.
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Weed control

Refer to “Dormant” and “Delayed Dormant” sections (pages 5 and 9, respectively) for list of herbicides and timing of applications with weed and vine growth in mind. Some herbicides can be applied into early spring post-bud break and into the season, based on application use and weed age. Could consider use of Alion, Chateau, Matrix or Zeus at this stage.

Late spring, bloom through fruit set (stages 65–70)					
Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Powdery mildew					
See Table 2 (page 32) and Figure 3 (page 34). Use materials at the shortest recommended intervals during this period. Fungicide application does not create problems with fruit set. Powdery mildew is a significant concern during this time and should be prevented with the use of fungicides.					
Abound	10–15.5 oz	11	4 hr.	14 d	Do not apply with silicon-based surfactants.
Adament 50 WG	3–4 oz	3+11	12 hr	14 d	See footnote 8, page 31.
Aprovia	8.6–10.5 fl oz	7	12 hr	21 d	Use with an adjuvant.
Flint 50WG	1.5–2 oz	11	12 hr	14 d	Do not make more than two consecutive applications. Do not apply more than four times per year. See footnote 8, page 31.
Fracture (BLAD)	20.5–24.4 fl oz	NC	4 hr	1 d	Reapply if rain occurs within 12 hours of application. NC=FRAC code not classified
HMOs such as JMS Stylet oil, SuffOil, Trilogy	1–2 gal/100 gal water	—	4 hr	0 d	Do not use within 10 days of a sulfur application.
Inspire Super	16–20 fl oz	3+9	12 hr	14 d	
Kaligreen	2–3 lb	NC	4 hr	1 d	Use as a supplement to a regular fungicide program; apply only when powdery mildew is first observed. NC=FRAC code not classified
Kenja 400 SC	20–22 fl oz	7	12 hr	14 d	
Luna Experience	5–8.6 fl oz	3+7	varies	14 d	The REI varies for vineyards: a 5-day REI for hand labor of the canes/canopy and 12-hr REI for other activities.
Mettle 125 ME	3–5 fl oz	3	varies	14 d	Do not use more than 10 fl oz/A per year. The REI varies for vineyard activities; consult label.
M-Pede	1–2 gal/100 gal water	28	12 hr	0 d	Do not use within 3 days of a sulfur application. Use as a supplement to a normal program.
Oso SC	3.75–13 fl oz	19	4 hr	7 d	
Prev-Am Ultra	50 fl oz	—	12 hr	—	Do not use within 14 days of a sulfur application, when ambient temperatures are above 90°F, or when plants are under heat or moisture stress.
Pristine	8–12.5 oz	7+11	varies	14 d	The REI varies with vineyard activities; consult label.
Procure 480SC	4–8 fl oz	3	12 hr	7 d	Do not use more than 32 fl oz/A per year.

Late spring, bloom through fruit set (stages 65-70) continues next page

CONTINUED—Late spring, bloom through fruit set (stages 65–70)

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Powdery mildew (continued)					
Quadris Top	10–12 fl oz	3+11	12 hr	14 d	
Quintec	3–6.6 oz	13	12 hr	14 d	Do not apply more than five times per year. A surfactant is not required when used alone, but a non-ionic surfactant is preferred if needed for tank mixes.
Rally 40WSP	3–5 oz	3	24 hr	14 d	Do not apply more than 1.5 lb/A per year.
Regalia	1–4 quarts	P5	4 hr	0 d	Use as a supplement to a regular fungicide program; use only when powdery mildew is first observed. Use on a 7-day interval.
Sovran	3.2–4.8 oz	11	12 hr	14 d	Do not make more than two consecutive applications. See footnote 9, page 31.
sulfur	Check labels				
Cosavet DF	2–5 lb	M2	24 hr	—	Repeat as necessary at 7- to 10-day intervals. See footnotes 1 and 2, page 30.
Kumulus DF	2–10 lb	M2	24 hr	—	
Microthiol Disperss	3–10 lb	M2	24 hr	—	
Thiosperse	6–20 lb	M2	24 hr	—	
tebuconazole products	Check labels				Tank mix tebuconazole products with a different fungicide group (FRAC code).
Orius 20 AQ	4–8.6 oz	3	12 hr	14 d	Includes sulfur in the formulation. Use with a non-ionic surfactant.
Unicorn DF	1.75–2.5 lb	3+M2	24 hr	14 d	
Torino	3.4 oz	U6	4 hr	3 d	Do not make more than 2 applications per year.
Vivando	10.3–15.4 fl oz	U8	12 hr	14 d	Do not use with oil.

Black vine weevils

This pest can be an economic problem in young vineyards due to potential for extensive damage by black vine weevil larvae. However, it is rare in Oregon. Areas previously planted to strawberries are potentially higher risk. Before planting new vineyards, inspect the roots of a random sample of vines before planting.

Aza-Direct/ azadirachtin	16–32 fl oz	—	4 hr	—	Apply 7 to 10 days apart. For heavy pest pressure, use up to 56 fl oz/A.
Brigade 2 EC/ bifenthrin	6.4 fl oz	3A	12 hr	30 d	Restricted-use pesticide. Do not apply more than 6.4 fl oz/A per season. Thorough coverage is essential.

Branch, cane, and twig borers

See materials and remarks for earlier growth stages.

Grape erineum (blister) mites

The erineum mite, also known as blister mite, is not typically an economic pest on grapes in Oregon. However, certain conditions may lead to high populations, which may reduce yield if they are found damaging flower clusters prebloom. Sulfur used in spring for grape powdery mildew control should adequately manage this pest. However, erineum mites have become more prevalent in vineyards where little to no sulfur has been used in spring.

Late spring, bloom through fruit set (stages 65–70) continues next page

CONTINUED—Late spring, bloom through fruit set (stages 65–70)

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Leafhoppers, sharpshooters and other xylem-feeding insects					
<p>Leafhoppers can cause significant damage to the grapevine canopy, reducing vine photosynthesis, particularly in warmer, arid regions of the state (southern and eastern Oregon). Scout vineyards for leafhoppers to determine if management is necessary. Management action is recommended when a mean of 20 nymphs are found per leaf. Efforts should be made to protect beneficial insects, such as the parasitic wasp <i>Anagrus</i> sp. that keeps leafhopper populations in check. For more details on leafhopper management, see “Grape-Leafhopper” in the PNW Insect Handbook (http://insect.pnwhandbooks.org/small-fruit/grape/grape-leafhopper).</p> <p>Note: Xylem-feeding insects, such as some leafhoppers, sharpshooters, spittlebugs, or froghoppers, can vector certain diseases such as Pierce’s disease in grape (bacterium = <i>Xylella fastidiosa</i>) that affects a variety of hosts. The bacterium was found in Oregon in fall 2015. See the ODA Plant Disease Alert: <i>Xylella fastidiosa</i> for more details on this bacteria and potential vectors (http://www.oregon.gov/ODA/shared/Documents/Publications/PlantHealth/XylellaFastidiosaBrochure.pdf). Several compounds are registered for use on leafhoppers in grapes. A list of compounds that are regularly used is presented below.</p>					
Actara/thiamethoxam	1–2 pt	4A	12 hr	5 d	Do not exceed 7 oz/A (0.109 lb ai/A) per season. Allow 14 days between applications. Take precautions to prevent nontarget effects on pollinators and bees.
Admire Pro/imidacloprid	1–14 fl oz	4A	12 hr	varies	Soil and foliar application methods allowed. Refer to label for rates. Chemigation should be applied between bud break and pea-sized berry stages. See label for restrictions. Frequent use of imidacloprid may lead to spider mite outbreaks. 0-day PHI for foliar applications and 30-day PHI for soil/chemigation applications. Take precautions to minimize nontarget effects on pollinators and bees.
Assail 70					
WP/acetamiprid	1.1–2.3 oz	4A	12 hr	3 d	Rates are dependent on formulation. Do not exceed two applications per season (4.6 oz product/A per year limit). Allow at least 14 days between applications. Do not use with adjuvant on grape.
Applaud 70 DF/buprofezin	9–12 oz	16	12 hr	7 d	Rates are dependent on formulation. Do not exceed two applications per year (24 oz/A). Apply when the leafhoppers are at the early nymph stage.
Baythroid XL/β-cyfluthrin	2.4–3.2 fl oz	3	12 hr	3 d	Restricted-use pesticide. Do not apply more than 0.1 lb ai/A per season.
Danitol 2.4 EC/fenoprophathin	5.3–10.3 fl oz	3	24 hr	21 d	Restricted-use pesticide. Do not exceed 0.8 lb ai/A per season (42.66 oz product/A per year). Apply with 25 to 200 gal water/A to ensure good coverage; 7-day spray interval. Apply when pest populations are highest. For resistance management, it is best not to use more than two sprays per season.
M-Pede	2% solution	UN	12 hr	0 d	Consult label for rates. Do not use within 3 days of a sulfur application.
Surround WP/kaolin clay	25–50 lb product	UN	4 hr	0 d	The preferred rate is 25 lb of product in 50 gal/A water. Suppression only; supplemental controls may be needed for complete control. Apply at least two to three applications at 7- to 14-day intervals.

Late spring, bloom through fruit set (stages 65-70) continues next page

CONTINUED—Late spring, bloom through fruit set (stages 65–70)

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Phylloxera					
Foliar applied insecticides (shown below) have greater efficacy when applied to adequate canopy (at least 2 feet of shoot growth). See additional materials and remarks for other growth stages. See footnote 5, page 31.					
Movento/ spirotetramat	6–8 fl oz	23	24 hr	7 d	Do not apply more than 12.5 fl oz/A per season. Use an adjuvant to obtain effective full canopy applications. A high-quality adjuvant should be used. Ensure application when there is adequate canopy for uptake through tissues. Interval between applications is 30 days.

Stink bugs including brown marmorated stink bug (BMSB)

The products listed below provide control for several different species of stink bug, including brown marmorated stink bug (BMSB). If damaging populations have been found in the vineyard, early season control is recommended. For more information on the identification of this pest, see OSU Extension publications EM 9054 and EM 9054-S (Spanish) at: <https://catalog.extension.oregonstate.edu/>.

Aza-direct/ azadirachtin	8–16 fl oz	—	4 hr	0 d	Apply as a foliar spray. Under very heavy infestation, 0.04 lb ai/A can be used.
Pyganic EC 1.4II/ pyrethrins	16–64 fl oz	3A	12 hr	varies	Use with 100 gal water/A for conventional airblast sprayers. Do not wait until plants are heavily infested to treat. Note: Product is highly toxic to aquatic organisms, so avoid runoff/drift as much as possible. Take precautions to prevent nontarget effects on pollinators and bees. Refer to label for PHI.
Scorpion 35 SL/ dinotefuran	2–5 fl oz	4A	12 hr	varies	Use high water volume to ensure good coverage and control. Start spraying once pest activity is noticed and/or thresholds are reached but before a large population has established (contact local Extension agent for thresholds in your area). Do not apply within 7 days of prior application and do not exceed 10.25 fl oz/A per season. 1-day PHI for foliar applications. Do not apply within 1 day of harvest.

Thrips

See materials and remarks for earlier growth stages.

Postbloom (stage 71)

Botrytis bunch rot

See Table 2 (page 32) and Figure 3 (page 34)

Cluster-zone leaf removal

Removing the basal leaves that cover the flower/grape cluster will increase spray penetration, increase air flow to prevent infection early in the season, and help reduce persistence of caps and other floral parts post-fruit set that may otherwise serve as breeding grounds for initial Botrytis bunch rot infections. Early leaf removal should not result in sunburn of fruit if climatic conditions are not subject to high temperatures and sunlight intensity. Late leaf removal (near véraison or later) can cause sunburn, particularly when combined with hot, dry weather.

Summer (fruit growth stages 71–77)

Powdery mildew

See Table 2 (page 32) and Figure 3 (page 34). Use materials at the shortest recommended intervals during this period. Fungicide application does not create problems with fruit set. Powdery mildew is a significant concern during this time and should be prevented with the use of fungicides.

Summer (fruit growth stages 71–77) continues next page

CONTINUED—Summer (fruit growth stages 71–77)

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Spider mites					
Acramite-50WS/ bifenazate	0.75–.01 lb	UN	varies	14 d	There is a 12-hr or 5-day REI depending on the work being conducted by laborers (see label). Make only one application per season. Relatively safe to mite predators.
Envirdor 2 SC/ spiroticlofen	16–34 fl oz	23	12 hr	14 d	Rate depends on target mite species. Apply with at least 100 gal/A of water for adequate coverage. Do not use more than once per season (do not exceed 34 fl oz/A). Relatively safe to mite predators.
Fujimite 5EC/ fenpyroximate	1.5–2 pt	21A	12 hr	14 d	Apply in a minimum of 50 gal water/A. Do not apply more than two applications or 2 pt product/A per season (0.1 lb ai/A per year). Use higher rate for more dense canopies. Not for use through irrigation systems.
M-Pede/insecticidal soap	1.5–2 gal/100 gal water (1-2% v/v)	—	12 hr	0 d	Do not use within 3 days of sulfur application.
Nexter (GWN-1715)/ pyridaben	5.2–10.67 oz	21	12 hr	25 d	Rate depends on target mite. Do not apply more than twice per season. Allow a minimum of 30 days between applications. Harmful to predatory mites.
Omite 30WS/ propargite	5–9 lb	12C	16 d	21 d	Minimum reapplication interval is 21 days. Apply higher rates only when infestations are high or have been historically high. Do not use more than twice per season.
Vendex 50WP/ fenbutatin-oxide	1–2.5 lb	12B	—	28 d	Restricted-use pesticide. Apply when mites first appear. Do not use more than twice per season (4 lb ai/A per year) Do not spray in less than 21-day intervals.
Phylloxera					
Voliam Flexi/ thiamethoxam + chlorantraniliprole	4.5 oz	4A+28	12 hr	14 d	Apply before pest populations reach damaging levels (summer). Do not use more than two applications per season (not to exceed 9 oz of product/A = 0.109 lb ai/A of thiamethoxam or 0.2 lb ai/A of chlorantraniliprole products). Do not use an adjuvant. Do not apply through an irrigation system. Allow 14 days between applications. This product is a risk to bees and other insect pollinators.

Late summer (pea-size berries to véraison, stages 75–81)

Powdery mildew

See Table 2 (page 32) and Figure 3 (page 34). See materials and remarks for “Late spring, bloom through set” stage (page 21). Pay close attention to preharvest restrictions (PHI).

Mealybugs, scale, and other insects

See materials and remarks for earlier growth stages.

Thrips

See materials and remarks for earlier growth stages.

Leafhoppers

See materials and remarks for earlier growth stages.

Late summer (pea-size berries to véraison, stages 75–81) continues next page

CONTINUED—Late summer (pea-size berries to véraison, stages 75–81)

Spider mites

See materials and remarks for earlier growth stages.

Stink bugs, including Brown marmorated stinkbug (BMSB)

See materials and remarks for earlier growth stages.

Grape rust mite

See materials and remarks for earlier growth stages.

Yellow jackets

See materials and remarks for earlier growth stages.

Beginning of berry touch (Stage 77)

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Botrytis bunch rot					
See Table 2 (page 32) and Figure 3 (page 34).					
Captan 80 WDG	2.5 lb	M4	48 hr	0 d	Do not use with oil.
Elevate 50 WDG	1 lb	17	12 hr	0 d	Do not use more than 3 lb/A per season. See footnote 3, page 31.
Endura	8 oz	7	12 hr	14 d	Do not use more than two times per year. Do not use for Botrytis bunch rot control if Pristine was used for powdery mildew.
Inspire Super	16–20 fl oz	3+9	12 hr	14 d	Do not use for Botrytis bunch rot control if was used for powdery mildew.
JMS Stylet oil	1–2 gal/100 gal water	—	4 hr	0 d	May aid Botrytis bunch rot control if used for powdery mildew. Tank mix with another fungicide.
Kenja 400 SC	20–22 fl oz	7	12 hr	14 d	See footnote 3, page 31.
Luna Privilege	6.84 fl oz	7	12 hr	7 d	Do not use more than two times per year. Do not use for Botrytis bunch rot control if Luna Experience was used for powdery mildew.
Luna Tranquility	16–24 fl oz	7+9	10 d	14 d	Do not use for Botrytis bunch rot control if also used for powdery mildew. New product will not have grape on the label for 2016, but old product with grapes on the label is still legal to use.
Protexio SC	14.5–19 fl oz	17	12 hr	3 d	See footnote 3, page 31.
Rovral 4F	1–2 pt	2	4 d	7 d	Do not use more than twice per season. See footnote 3, page 31.
(generic products are available)					
Scala SC	9–18 oz	9	12 hr	7 d	See footnote 3, page 31.
Switch 62.5 WG	11–14 oz	9+12	—	7 d	Do not use with an adjuvant.

Leafhoppers

See materials and remarks for earlier growth stages.

Spider mites

See materials and remarks for earlier growth stages.

Stink bugs, including Brown marmorated stinkbug (BMSB)

See materials and remarks for earlier growth stages.

Véraison (Stage 81)					
Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Botrytis bunch rot					
See Table 2 (page 32) and Figure 3 (page 34)					
Captan 80WDG	2.5 lb	M4	48 hr	0 d	Do not use with oil.
Elevate 50WDG	1 lb	17	12 hr	0 d	Do not use more than 3 lb/A per season. See footnote 3, page 31.
Endura	8 oz	7	12 hr	14 d	Do not use more than two times per year. Do not use for Botrytis bunch rot control if Pristine was used for powdery mildew.
Inspire Super	16–20 fl oz	3+9	12 hr	14 d	Do not use for Botrytis bunch rot control if was used for powdery mildew.
JMS Stylet oil	1–2 gal/100 gal water	—	4 hr	0 d	May aid Botrytis bunch rot control if used for powdery mildew. Tank mix with another fungicide.
Kenja 400 SC	20–22 fl oz	7	12 hr	14 d	See footnote 3, page 31.
Luna Privilege	6.84 oz	7	12 hr	7 d	Do not use more than two times per year. Do not use for Botrytis bunch rot control if Luna Experience was used for powdery mildew.
Luna Tranquility	16–24 fl oz	7+9	10 d	14 d	Do not use for Botrytis bunch rot control if also used for powdery mildew. New product will not have grape on the label for 2016, but old product with grapes on the label is still legal to use.
Protexio SC	14.5–19 fl oz	17	12 hr	3 d	See footnote 3, page 31.
Pristine	18.5–23 oz	7+11	varies	14 d	Higher rate based on supplemental label. Do not use for Botrytis bunch rot control if was used for powdery mildew. The REI varies with vineyard activities, consult label.
Rovral 4F (generic products are available)	1–2 pt	2	4 d	7 d	Tank mix with another fungicide from a different group (FRAC code). Do not use more than twice per season. See footnote 3, page 31.
Scala SC	9–18 oz	9	12 hr	7 d	See footnote 3, page 31.
Switch 62.5 WG	11–14 oz	9+12	12 hr	7 d	Do not use with an adjuvant.
Leafhoppers					
See materials and remarks for earlier growth stages.					
Spider mites					
See materials and remarks for earlier growth stages.					
Stink bugs, including Brown marmorated stinkbug (BMSB)					
See materials and remarks for earlier growth stages.					

Preharvest (Stages 81–88)

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Botrytis bunch rot					
See Table 2 (page 32) and Figure 3 (page 34).					
Captan 80 WDG	2.5 lb	M4	48 hr	0 d	Do not use with oil
Elevate 50 WDG	1 lb	17	12 hr	0 d	Do not use more than 3 lb/A per season. See footnote 3, page 31.
Endura	8 oz	7	12 hr	14 d	Do not use more than two times per year. Do not use for Botrytis bunch rot control if Pristine was used for powdery mildew.
Inspire Super	16–20 fl oz	3+9	12 hr	14 d	Do not use for Botrytis bunch rot control if used for powdery mildew.
Kenja 400 SC	20–22 fl oz	7	12 hr	14 d	See footnote 3, page 31.
Luna Privilege	6.84 fl oz	7	12 hr	7 d	Do not use more than two times per year. Do not use for Botrytis bunch rot control if Luna Experience was used for powdery mildew.
Luna Tranquility	16–24 fl oz	7+9	10 d	14 d	Do not use for Botrytis bunch rot control if also used for powdery mildew. New product will not have grape on the label for 2016, but old product with grapes on the label is still legal to use.
Oso SC	3.75–13 fl oz	19	4 hr	7 d	
Protexio SC	14.5–19 fl oz	17	12 hr	3 d	See footnote 3, page 31.
Pristine	8–10.5 oz	7+11	varies	14 d	Do not make more than two consecutive applications. Do not use for Botrytis bunch rot control if used for powdery mildew. The REI varies with vineyard activities, consult label.
Rovral 4F (generic products are available)	1–2 pt	2	4 d	varies	Tank mix with another fungicide from a different group (FRAC code). Do not use more than twice per season. 7-day PHI. See footnote 3, page 31.
Scala SC	9–18 oz	9	12 hr	7 d	See footnote 3, page 31.
Switch 62.5 WG	11–14 oz	9+12	12 hr	7 d	Do not use with an adjuvant.
Vanguard 75WG	5–10 oz	9	12 hr	7 d	Buffer to a pH of 5 to 7 when tank mixing with Rovral. See footnote 3, page 31.

Stink bugs, including brown marmorated stink bug (BMSB)

BMSBs have been found in areas of the north Willamette Valley within commercial farms, and may pose a concern for growers at harvest. Wine quality can be compromised due to a wine taint caused by defense volatiles released by BMSBs when disturbed during wine processing. For more information on the identification of this pest, see OSU Extension publications EM 9054 and EM 9054-S (Spanish) at: <https://catalog.extension.oregonstate.edu/>.

Lady beetles

The multicolored Asian lady beetle and other lady beetle species are not economic pests of importance for Oregon grape and wine producers. However, they have been found in grape clusters at harvest (as they seek shelter and feed on late season grapes) and may be of concern to growers. If there are significant populations present during harvest and processing, they can cause off aromas due to defense volatiles produced by the bugs when they are disturbed (can lead to wine taint). If large populations of these beetles are found preharvest, consult a local OSU Extension horticulturist or entomologist to determine if population levels warrant management.

Leafhoppers

See materials and remarks for earlier growth stages.

Preharvest (Stages 81–88) continues next page

CONTINUED—Preharvest (Stages 81–88)

Timing, pest, and control material	Amount of product/A	Group (WSSA, FRAC, IRAC)	REI	PHI	Remarks
Viruses: Grapevine Leafroll Virus and Grapevine Red Blotch Disease					
Symptoms of these two viruses can be similar, including reddening of leaves of red cultivars and lack of ripening (any cultivar). Learn more about symptoms by reading “Grape Virus Diseases” in the PNW Disease Management Handbook (http://pnwhandbooks.org/plantdisease/grape-vitis-spp-virus-diseases). Vines that exhibit symptoms should be tested for virus. Collect tissue samples (petioles from the oldest leaves) from symptomatic vines during late season or postharvest. See Figure 1 (page 2) for potential sampling time points based on virus. Submit samples to a lab that conducts grapevine virus testing, making sure to follow their sampling protocols. Also determine the presence of potential insect vectors of the virus (e.g., mealybugs and scale insects for grapevine leafroll virus). Read the following OSU Extension publications for tips on how to scout for and manage virus and vectors: EM 8985 and EM 8985-S (Spanish), EM 8990 and EM 8990-S (Spanish), and EM 8998, available through the OSU Extension Catalog at: https://catalog.extension.oregonstate.edu/ .					
Phylloxera					
Before treating, check that phylloxera is present by sampling soil and vine roots during late summer through the postharvest period. If sampling shows presence, take action during the early part of the following season. Note that soil drench treatments may result in variable levels of control and are generally ineffective for eradication due to poor penetration, especially in clay soils. See footnote 5, page 31.					
Spotted wing drosophila (SWD)					
Grapes are less susceptible to economic damage by SWD in the PNW compared to other berry crops, and treatment with pesticides may not be necessary. For identification, monitoring, and recognizing damage of SWD, consult OSU Extension publications EM 8991, EM 9021, EM 9096, and EM 9097, available through the OSU Extension Catalog at: https://catalog.extension.oregonstate.edu/ . If significant infestation is creating problems in vineyards, the products listed below can be used to manage adult stages of SWD.					
Danitol 2.4 EC/ fenpropathrin	10.6–21/3 fl oz	3	24 hr	21 d	Restricted-use pesticide. Do not exceed two applications per season. Toxic to bees and should not be used when bees are foraging. Toxic to fish and other aquatic invertebrates. Synthetic pyrethroids may achieve high mortality of SWD and can provide about 10 to 14 days residual control in the field.
Delegate WG/ spinetoram	3–5 oz	5	4 d	7 d	Do not make more than five applications per season (not to exceed 19.5oz/A per year). Toxic to bees for 3 hours following treatment. Do not apply when bees are foraging. May achieve high mortality of SWD and provide about 5 to 7 days residual control in the field.
Mustang Maxx/zeta- cypermethrin	Consult label	3A	12 hr	1 d	Restricted-use pesticide. Do not apply more than 24 fl oz/A per season. Labeled for use in Drosophila, not specifically SWD.
pyrethrin (several brands)	Consult label	—	—	—	Provides good control of SWD but has no residual activity. Toxic to bees; do not apply when bees are foraging. Highly toxic to fish.
Success or Entrust/ spinosad	4–8 fl oz	5	4 hr	7 d	May achieve high mortality of SWD and provide about 5 to 7 days residual control in the field. Toxic to bees for 3 hours following treatment. Do not apply when bees are foraging.
Yellow jackets					
See materials and remarks for earlier growth stages.					

Table 1 footnotes

1. The sulfur spray schedule listed is not intended for use on *Vitis labrusca*, some American *Vitis* species, or some interspecific hybrid cultivars, which are genetically sensitive to sulfur even at low temperatures. Sulfur products used for powdery mildew control can burn foliage of any grapevine, whether *Vitis vinifera* or other *Vitis* spp., when applied above 85°F. The relationship is correlated with increases in the daily maximum temperature within a few days after application. Grapes in California and other warm production regions can withstand sulfur applications (at lower rates) above 85°F if there is no major short-term change in the daily maximum. Once vines are acclimated to higher temperatures, the chance of burn is greatly reduced. Hydrogen sulfide can form in wine produced from grapes if sulfur is used within 35 days of harvest for white grapes or within 50 days of harvest for red grapes. Wettable powder formulations are less likely to result in hydrogen sulfide in the wine than micronized formulations.
2. Control of powdery mildew in susceptible *Vitis vinifera* cultivars involves the regular application of fungicides. It is impossible to give an exact schedule since the timing, intensity, and frequency of applications depends on weather, vine growth, and potential inoculum due to previous infestations, which vary from year to year and region to region. (See Table 2, page 32, and Figure 3, page 34.) Early season weather in the Willamette Valley is often cold and rainy, which is not conducive to powdery mildew. However, the transition period between the heavy spring rains and the dry summer months is ideal for the start of powdery mildew epidemics. By that time of the year, a powdery mildew prevention program already should have been implemented, and the interval between applications shortened to accommodate these environmental conditions that may lead to an infection.

In the valleys of southern Oregon, this period may start much earlier in the growing season. The length of the period of powdery mildew infestation can change from year to year with variations in weather.

All green portions of the vine are susceptible to infection by the powdery mildew fungus. At times of rapid vine growth, shoots can “out-grow” their chemical protection and quickly be susceptible to new infections. This is especially true if you are using sulfur. Berries are most susceptible at bloom and shortly after. During the growing season, the developing berries become resistant to new infections when they reach 8°Brix. Some sporulation can occur on berries with established infections up to 15°Brix. However, shoots can still be infected and continue to produce overwintering inoculum through harvest.

The use of fungicides containing sulfur or lime sulfur during dormancy or at bud break has not been economically practical. The rates needed are excessive, and the resulting control must be supplemented with a regular full-season program. Acceptable control can be achieved without these dormant or delayed-dormant applications. You may want to consider these sprays if you are attempting to bring a vineyard back into production following a year with severe powdery mildew.

Fungicides vary as to the length of time they are effective at preventing infection by powdery mildew. A range of 7 to 14 days usually is given for sulfur; 14 to 21 days for Group 3 fungicides (such as Rally) and for Group 11 fungicides (such as Abound or Flint). Use the shorter interval during rapid vine growth early in the season or when weather conditions are favorable for powdery mildew development. Careful planning also will avoid the use of too much chemical, as many of the fungicides have seasonal limits on how much can be used. Your overall spray schedule should take into account early vine growth, weather conditions that favor powdery mildew, and the properties of the various fungicides available for use.

There are several disease modeling programs available that monitor the weather and can help growers make fungicide application decisions. These programs have been effective in western Oregon. Such models are available online through USPEST.org.

3. Fungal pathogen resistance to many fungicides is highly likely if only one product is used exclusively to control the disease. Applications at bunch close and/or véraison are the most important for disease control. Bloom applications are important when the weather is wet. Tank mix or alternate materials that have a different mode of action (different FRAC code). Switch is already a mix of two different fungicides.
4. This publication lists chemical products and some non-chemical methods of pest control. It is intended to serve as a supplement to other pest management guides, including Oregon Viticulture and Field Guide for Integrated Pest Management in Pacific Northwest Vineyards (PNW 654) and the Pacific Northwest Disease, Insect, and Weed Management Guides, available through the OSU Extension Catalog at: <https://catalog.extension.oregonstate.edu/>. These resources provide more complete descriptions of pests and cultural methods of pest control in vineyards.
5. Symptoms of phylloxera infestation include low vigor, chlorotic foliage, reduced yields, lack of fruit ripening, and early leaf drop. Symptomatic vines appear in a lens-shaped area of the vineyard, and the size of the affected area increases annually. To verify infestation, you must inspect vine roots for the pest. Population levels are highest in mid- to late summer. There is no effective chemical product that can be used for complete control of this pest. Avoid movement of soil and plant materials from infested vineyards to non-infested, own-rooted vineyards to prevent spread. Refer to Grape Phylloxera: Biology & Management in the Pacific Northwest (EC 1463) available online at: <https://catalog.extension.oregonstate.edu/ec1463>
6. Pruning during the dormant season alone should control Phomopsis cane and leaf spot in most vineyards in Oregon.
7. Use materials at shortest recommended intervals during this period. Other products not listed also are registered for powdery mildew control. They are not recommended due to resistance problems (such as Topsin) or lack of efficacy in research conducted in the Pacific Northwest (such as Kaligreen).
8. Do not use Flint, Luna Experience, or Luna Privilege on Concord or other sensitive Vitis labrusca (American) grapes.
9. Sovran drift may injure some sweet cherry cultivars such as Van; be very careful when spraying near cherry orchards.
10. Descriptions for all herbicides listed in this guide include the Weed Science Society of America (WSSA) mode of action. These groups are used to distinguish herbicide products so that growers may alternate products to prevent resistance development in weed populations.
11. Important note on herbicide use: Herbicides must be applied at exactly the correct rate and time to selectively control weeds with minimal chance of injuring vines. You will get more consistent results when making applications based on the information found on the product label (e.g., timing, rate, and target weeds). See Figure 4 (page 35) for more details. Suggested rates listed in this guide are stated as pounds of active ingredient per acre (lb ai/A) or pounds of acid equivalent per acre (lb ae/A). See the product label for specific amounts of a particular formulation to apply per treated acre.
12. For band applications of herbicides under vine rows, reduce the quantity of herbicide applied proportionally to the actual area within the row being treated. Numerous tank mixes are labeled for vineyard use, or growers can assume responsibility and mix products, unless the label prohibits mixing.
13. Livestock grazing in vineyards is often prohibited if herbicides have been applied for weed control.

Table 2. Effectiveness of fungicides for control of grape diseases**Products with single active ingredient**

Fungicide	Fungicide group	Phomopsis cane and leaf spot	Powdery mildew	Botrytis bunch rot
iprodione (Rovral, Nevado)	Group 2	Not effective	Not effective	Slight–fair
fenarimol (Focus, Vintage)	Group 3	Not effective	Good	Not effective
myclobutanil (Rally)	Group 3	Not effective	Good	Not effective
tebuconazole (Orius, Tebucon)	Group 3	Not effective	Fair–good	Not effective
tetriconazole (Mettle)	Group 3	Not effective	Good	Not effective
triadimefon (Bayleton)	Group 3	Not effective	Good	Not effective
triflumizol (Procure)	Group 3	Not effective	Good	Not effective
boscalid (Endura)	Group 7	Not effective	Good–excellent	Good–excellent
fluopyram (Luna Privilege)	Group 7	Not effective	Good–excellent	Good
isofetamid (Kenja)	Group 7	Not effective	Good–excellent	Good
solatenol (Aprovia)	Group 7	Good	Good–excellent	Slight
cyprodinil (Vangard)	Group 9	Not effective	Not effective	Good
Scala	Group 9	Not effective	None	Good
azoxystrobin (Abound)	Group 11	Fair–good	Excellent	Slight–fair
kresoxim-methyl (Sovran)	Group 11	Good	Excellent	Slight–fair
trifloxystrobin (Flint)	Group 11	Fair	Excellent	Slight–fair
Quintec	Group 13	Not effective	Excellent	Not effective
DCNA (Botran)	Group 14	?	Not effective	Slight
fenhexamid (Elevate)	Group 17	Not effective	Not effective	Good–excellent
fenpyrazamine (Protexio)	Group 17	Not effective	Not effective	Good–excellent
polyoxin-D (Ph-D, Oso)	Group 19	?	Fair–good	Fair–good
fixed copper (several formulations)	Group M1	Slight	Moderate	Slight–none
sulfur (several formulations)	Group M2	Slight	Good–excellent	Not effective
ziram (Ziram)	Group M2	Good	Not effective	Slight
mancozeb (Dithane, Manzate, Penncozeb)	Group M3	Excellent	Not effective	Not effective
captan (Captan, Captec)	Group M4	Excellent	Not effective	Fair
potassium bicarbonates (Kaligreen)	Not classified	Not effective	Slight	Slight
Fracture	Not classified	Not effective	? (Slight)	?
Horticultural Mineral Oils (HMOs) (JMS Stylet Oil)	Not classified	Not effective	Good	Slight
Regalia	P5	Not effective	Fair–good	Not effective
soap (M-Pede, Prev-Am)	Not classified	?	Good	?
cyflufenamid (Torino)	Unknown (U6)	Not effective	Excellent	Not effective
Vivando	Unknown (U8)	Not effective	Excellent	Not effective
Bacillus sp. (Companion, Double Nickel, Serenade)	Group 44	?	Slight–Good	Slight

CONTINUED—

Table 2. Effectiveness of fungicides for control of grape diseases

Products with multiple active ingredients

Fungicide	Fungicide group	Phomopsis cane and leaf spot	Powdery mildew	Botrytis bunch rot
Adament	Group 3 + 11	Fair–good	Excellent	Slight–fair
Inspire Super	Group 3 + 9	None–slight	Good–excellent	Excellent
Luna Experience	Group 3 + 7	?	Good	Fair–good
Luna Tranquility	Group 7 + 9	?	Good	Good
Pristine	Group 11 + 7	Good	Excellent	Good
Quadris Top	Group 3 + 11	Fair–good	Excellent	Slight–fair
Switch	Group 9 + 12	Not effective	Not effective	Good
Unicorn	Group 3 + M2	Slight	Good–excellent	Not effective

Follow the R.U.L.E.S. for fungicide stewardship:

- R**otate or mix fungicides of different chemical groups.
- U**se labeled rates.
- L**imit total number of applications.
- E**ducate yourself about fungicide activity, mode of action, and class—as well as resistance management practices.
- S**tart a fungicide program with multi-site mode of action materials.

Powdery mildew strategy (See figure 3, page 34)

The powdery mildew spray program is based on sulfur, alternated with fungicides of various groups: DMI (Group 3), Quintec (Group 13), strobilurin (Group 11), or Groups U6 or U8.

Short (7-day) spray intervals and high rates of sulfur are used during the most critical infection periods near bloom and post-fruit set. Spray adjuvants may improve efficacy of sulfur. Alternate the use of a DMI (Group 3) fungicide (Elite, Mettle, Procure, or Rally), Quintec (Group 13), or a strobilurin (Group 11) fungicide (Abound, Flint, or Sovran) between sulfur applications. Rally and Flint resistance is suspected in the Willamette Valley. New York recommends tank mixing Group 3 or Group 11 fungicides with sulfur. M-Pede or JMS Stylet oil can be used to slow an infection when protectant fungicides fail to provide complete control. CAUTION: Stylet oil

cannot be used within 10 days of a sulfur application, and M-Pede cannot be used within 3 days of a sulfur application.

- Several products may already contain two different fungicides, such as Adament, Inspire Super, Luna Experience, Pristine, Quadris Top, or Unicorn. These also may be used in rotation, but be careful not to rotate them with products that contain the same fungicide group (FRAC code).
- Potassium bicarbonate-based materials could be used to supplement a normal, season-long program. They will not eradicate powdery mildew once an epidemic has started.

Botrytis bunch rot strategy (See figure 3, page 34)

- Cultural control practices alone have been as effective against Botrytis bunch rot as fungicides alone, particularly during years of dry weather during harvest.
- Rain events dictate incidence and severity of Botrytis bunch rot observed. Use rain forecasts to guide applications during bloom and preharvest.
- Fungicides work best when used before a rain event.
- Primary products to consider in rotation and/or for tank mixing include Elevate, Endura, Luna Tranquility (Group 7 + 9 fungicide), Kenja, Protexio, Scala, Switch (Group 9 + 12 fungicide), and Vanguard.
- JMS stylet oil can be tank mixed with Rovral.

Table 3. Botrytis bunch rot of grapes

Botrytis cinerea will infect grape berries from 53°F with as few as 4 hours of berry wetness. However, the number of berries infected rises with increased hours of berry wetness. The following table is based on a Botrytis bunch rot infection model (Broome, J.C. et al., 1996. "Development of an infection model for Botrytis bunch rot of grapes based on wetness duration and temperature." *Phytopathology* 85:97-102). Fungicide applications are to be initiated after a medium risk occurs during the growing season.

Temperature (°C)	Temperature (°F)	Minimum number of hours of berry wetness* (Medium risk)	Minimum number of hours of berry wetness* (High risk)
30	86	28.8	32.2
29	84.2	22.4	25.9
28	82.4	19.0	22.1
27	80.6	16.9	19.5
26	78.8	15.3	17.8
25	77	14.3	16.5
24	75.2	13.5	15.6
23	73.4	13.0	15.0
22	71.6	12.6	14.7
21	69.8	12.5	14.5
20	68	12.5	14.4
19	66.2	12.6	14.6
18	64.4	12.9	14.9
17	62.6	13.4	15.5
16	60.8	14.1	16.3
15	59	15.1	17.4
14	57.2	16.5	19.1
13	55.4	18.5	21.4
12	53.6	21.5	24.9

* If berries are dry for fewer than 4 hours, the wet periods are considered one event. If berries are dry for more than 4 hours, the wet periods are considered separate events.

Growth Stage	Dormant— Early growth	6" shoots	Pre-bloom	Bloom	Fruit Set	Fruit Growth (summer)		Véraison	Pre-harvest
EL Stage	00-12	14-15	17–60	61-69	71	71-79		83-85	85-88
	POWDERY MILDEW								
Primary Applications		Sulfur: high label rate (7-10 days)	DMI (Group 3), Quintec (Group 13), strobilurin (Group 11), or Group U6 or U8 products		Sulfur: high rate (7 days)	Groups 3, 13, 11, U6 or U8	Sulfur: half rate (7-14 days)	Groups 3, 13, 11, U6 or U8	
Supplemental Applications		M-Pede or JMS Stylet Oil; Use caution with sulfur.							
Cultural Methods		Shoot thinning and positioning			Pull leaves in cluster-zone	Shoot positioning and hedging			
	BOTRYTIS								
Primary Applications				Spray if necessary (rainy weather)			Critical to spray at bunch closure (EL 79) and véraison (EL81-83).	Spray if necessary	
	During these stages, rotate and/or tank mix fungicides that have different mode of action (FRAC) groups so that no product is used more than two times per season to prevent fungicide resistance from developing. Always use a product with a different FRAC group than was used for the previous application.								
Supplemental Applications			Fungicides that have botrytis efficacy can be considered based on weather and cultivar susceptibility to Botrytis. Heed to warning under “Primary Actions.”						
Cultural Methods		Shoot thinning and positioning			Pull leaves in cluster-zone	Shoot positioning and hedging			

Figure 3. Example strategy for powdery mildew and Botrytis bunch rot control. Figure by Patricia A. Skinkis, © Oregon State University

		<div> <div>Dormant</div> <div>Prebloom</div> <div>Bloom</div> <div>Fruit set to preharvest</div> <div>Harvest</div> </div>											
		Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct
		00			00			1-60		61-9		71-88	
Soil-active Herbicides		PHI											
dichlobenil		-											
diuron	Apply in winter as single application or	-											
indaziflam	rainfall needed	14											
isoxaben		165											
napropamide		70											
norflurazon		60											
oryzalin	needs rainfall	na											
oxyfluorfen	dormant/from bloom to 14 days before	14											
pendimethalin	anytime after harvest, dormant, spring	90											
pronamide	in fall after harvest but before soil freezes	-											
simazine	harvest to spring	-											
trifluralin		60											
Contact/Translocated Herbicides													
bentazon	nonbearing	365											
carfentrazone	all year, avoid spotting on fruit	3											
clethodim	nonbearing	365											
diquat	nonbearing	365											
fluaizifop		50											
glufosinate		14											
glyphosate	applications must not be made when	14											
paraquat		na											
pyraflufen	post harvest, dormant,	0											
sethoxydim	anytime when weeds are actively growing	50											
Soil and Foliar Active													
flazasulfuron	spring	75											
flumioxazin	shielded sprayers required from budbreak	60											
oxyfluorfen	dormant/from bloom to 14 days before	14											
rimsulfuron		14											
sulfentrazone	fall through bloom, or after bloom with a	3											

Figure 4. Herbicide product active ingredients listed by seasonal use. Postharvest interval (PHI) is listed and the period by which the product may be used within the vineyard. Special remarks are listed after the product ingredient. Figure by Ed Peachey, Oregon State University

Weed management: pre-plant and vineyard establishment

Table 5 highlights the herbicide products available for weed control during pre-plant and vineyard establishment (termed nonbearing). Herbicide use is often contingent upon the age of the vineyard. Some products can only be used in nonbearing vineyards, or have restrictions with regard to timing and the first harvest year. Read product labels closely to ensure proper use of the product.

Other herbicide recommendations for bearing vineyards are listed in Table 1 (page 5).

Table 4. Weed control pre-plant and in establishment years

Pre-Planting (year 0)					
Weed control timing, and herbicide materials	Amount of material/A	Mode of Action Group	REI	PHI	Remarks
Reglone/diquat dibromide	24–32 oz	22	24 hr	1 yr	For use in nonbearing vineyards only. Apply to completely cover foliage of rapidly growing weeds. Add a nonionic surfactant. Best control when weeds are 1 to 6 inches high.
Roundup and other products/ glyphosate	Consult label	9	4 hr	14 d	Apply to weeds at least 10 days before planting the crop. Use highest rate on field bindweed. Rain within 6 hours after application may reduce effectiveness. Do not apply if weeds are in mature growth stages (e.g., producing seeds) or under stress from drought.
Treflan/trifluralin	0.5–1 lb ai	3	12 hr	60 d	Apply pre-plant and incorporate immediately by cross-disking or rototilling. Use lower rates on sandy soils or soil containing low organic matter levels, and use higher rates in soils with 2 to 10% organic matter.
New plantings (years 1–3)					
Basagran/bentazon	0.5–1 lb ai	6	48 hr	1 yr	For use in nonbearing vineyards only. Provides postemergence control of broadleaf weeds, Canada thistle, yellow nutsedge, and musk thistle either before or during nonbearing stages of vineyard establishment. Two treatments applied 7 to 10 days apart may be required for Canada thistle or yellow nutsedge. Temperatures below 55°F, drought, or rain within 8 hours will reduce activity. Add 2 to 4 pt/A of a crop oil concentrate to enhance activity (see label). Direct sprays toward actively growing weed foliage coinciding with weed size, as described on the label. Do not cultivate or mow within 5 days before or after application. Do not apply within 1 year of anticipated harvest. Do not exceed 4 lb/A total per season.
Devrinol 50 DF/ napropamide	4 lb ai	15	24 hr	—	Preemergent herbicide. Apply after planting to firm soil, before weeds germinate. Requires rain or irrigation the day of treatment to wet the soil 2 to 4 inches deep to reduce degradation by the sun and to activate the herbicide. Where convenient, shallow tillage improves activity. Avoid exposure of transplant roots contacting soil. Light-sensitive and can photo-decompose after 4 days. Do not leave on soil surface for more than 3 weeks in winter and 24 to 72 hours in summer. XT formulation may allow longer times to incorporation without reducing efficacy. Low residual activity. Only one application can be made annually.
Envoy/clethodim	9–16 fl oz	1	24 hr	0 d	For use in nonbearing vineyards only. Apply to actively growing grass weeds, including annual bluegrass, at growth stage listed on label. Read label carefully for adjuvant instructions and for information about effects of rain within 1 hour, applications of other pesticides, or cultivation. Do not apply more than 64 fl oz/A per season.

New plantings (years 1–3) continues next page

CONTINUED—New plantings (years 1–3)

Weed control timing, and herbicide materials	Amount of material/A	Mode of Action Group	REI	PHI	Remarks
Fusilade DX/fluazifop	Refer to label for rate based on grass species to be controlled, 0.25–0.375 lb ai/A (16–24 oz/A Fusilade)	1	12 hr	50 d (bearing) 1 yr (non-bearing)	Can now be applied to bearing grapes under supplemental label. Apply to actively growing grasses, or within 7 days after irrigation as a directed spray with 1% crop oil or 0.25% nonionic surfactant. Identify grass weeds and adjust rates, depending on susceptibility and stage of growth, as label instructs. Results often are erratic on grasses stressed from lack of vigor, drought, high temperature, or low fertility. More mature grasses and quackgrass can be controlled but may require two applications. Annual bluegrass and all fine fescues resist treatment. Do not apply more than 24 fl oz/A per application. Do not exceed 72 fl oz/A per season. Do not apply twice within 14 days.
Gallery 75/isoxaben	0.495–0.998 lb ai	3	12 hr	0 d	Labeled for bearing and nonbearing vineyards. Apply after harvest in fall until 6 months before the next harvest, or immediately after cultivation, to debris-free soil. Limited to two applications per year, up to 1.33 lb product/A per year. Activate with 0.5 inches of water or shallow cultivation before weeds begin to emerge. Chemical stability remains adequate when left on the soil surface for 21 days. Identify weeds and adjust rates according to charts on label. Do not apply to newly transplanted vines until soil has settled and cracks disappear.
Goal 2XL/oxyfluorfen	0.5–2 lb ai (2–8 pts product)	14	24 hr	—	Apply only to vineyards with healthy vines and while dormant. Direct the spray toward the base of vines, avoiding direct plant contact. Use only on vines that are trained to a trellis and at least 3 feet above the soil surface. (Acts on contact, either directly on broadleaf weeds or at soil surface as weeds emerge.) Controls broadleaf weeds pre- and postemergence depending on rate of application and weed species.
Poast/sethoxydim	0.28–0.47 lb ai (1.5–2.5 qt product)	1	12 hr	50 d	Identify susceptible grasses and apply at optimum growth stage listed on label. Add 2 pt/A of a non-phytotoxic crop oil concentrate to improve leaf absorption. Control often is erratic on grasses stunted or stressed from drought, high temperatures, or low fertility. Resistant grasses include annual bluegrass and all fine fescues; quackgrass can be suppressed. Do not exceed 5 pt/A per season.
Prowl or Pendulum/pendimethalin	Check labels for rates	3	24 hr	0 d	Preemergent herbicide. Apply to newly planted grapes before buds swell and after soil settles around vines and cracks are gone. Spray directly on the soil surface below vines. Overhead irrigation or rain is required within 7 days for herbicide activation. Weeds are affected as they germinate. For use in either nonbearing vineyards only or in bearing and nonbearing vineyards, depending on product and formulation. Check the label for details.
Rely/glufosinate	0.8–1.5 lb ai	10	12 hr	14 d	Apply to actively growing weeds as a directed spray or spot treatment. Green tissue or bark must be shielded from contact, or injury will occur. Do not exceed 4.5 lb ai/A per season (12 months).

New plantings (years 1–3) continues next page

CONTINUED—New plantings (years 1–3)					
Weed control timing, and herbicide materials	Amount of material/A	Mode of Action Group	REI	PHI	Remarks
Roundup and other products/ glyphosate	Consult label	9	—	—	Apply to actively growing weeds for site preparation, or in nonbearing crops 1 year before first harvest. Avoid contact with green vine foliage or suckers. Do not apply more than 12.8 pt product/A per year. Follow all precautions on label. To avoid weed resistance, rotate and mix weed control practices.
Snapshot 2.5 TG/isoxaben + trifluralin	100–200 lb product	3	12 hr	0 d	Identify weeds and determine rate of application based on label. For use in nonbearing vineyards only. Apply to weed- and debris-free soil. Do not apply at the time of planting. Soil must be settled with water and free from cracks following transplanting before the product can be used. Activate within 21 days using 0.5 inch of water or shallow cultivation before weeds begin to emerge. Follow label instructions for repeat treatments.
Surflan A.S./ oryzalin	2–6 lb ai	3	24 hr	0 d	Preemergent herbicide. Apply after transplanting to firm soil before weeds germinate. Requires irrigation, rain, or shallow cultivation (1 to 2 inches) to activate. Rate depends on duration of weed control desired. Do not exceed 12 lb ai per year.

Vineyard airblast sprayer calibration worksheet

Sprayers must be calibrated at least once per season. This is vital to ensure that there is adequate product delivered in applications to the vineyard. Sprayer calibration should be conducted every time there is a significant difference in the desired spray volume (gal/A). For example, early season applications cover a small canopy and therefore require a lower spray volume for thorough coverage, compared with later applications to a full canopy. This worksheet is intended to take you through the calibration process.

1. Determine tractor speed.

Establish a preferred operating speed in a preset gear. Note gear and throttle settings. Fill spray tank half full with water for a speed test. Insert numbers into the equation below, then calculate the result.

- A. Measure the length of a vineyard row selected for the test run. (A) _____ ft
- B. Determine the time required to travel the row at the preferred speed. (B) _____ sec
- $[(A) \text{ ft} \times 60 \text{ sec/min}] \div [(B) \text{ sec}] = (C) \text{ _____ ft/min preferred tractor speed}$

2. Check spray pressure and spray pattern.

Fill the tank with water. Engage the fan and turn on the manifold, then make a test run in your vineyard at your preferred operating speed. Before you start, observe the spray pattern and turn off nozzles that do not spray the plant canopy. Record the pressure gauge reading while spraying. Visually check the accuracy of your spray pattern and the completeness of your spray coverage by putting water-sensitive paper in the grapevine canopy. Poor or excessive coverage requires adjustment of tractor speed, spray pressure, or nozzle size. If speed or pressure is subsequently adjusted, record the new figures in the appropriate blanks below.

Spray pressure = (D) _____ psi

3. Determine required total nozzle output in gal/min (gpm).

Fill in the following known quantities, insert into the equation below, and calculate the result.

- (C) _____ ft/min **Preferred tractor speed**, measured above
- (E) _____ gal/A **Desired spray volume per acre** for thorough coverage.
- See pesticide label for instructions for use.
- Consider differences in canopy size through the season.
- (F) _____ ft **Distance between rows**

Calculate required total nozzle output in gal/min:

$$[(C) \text{ _____ ft/min} \times (E) \text{ _____ gal/A} \times (F) \text{ _____ ft}] \div 43,560 \text{ sq ft/A} = (G) \text{ _____ gpm total required nozzle output}$$

4. Do you currently have the correct size nozzles in your sprayer?

Determine the expected output of each nozzle at your selected spray pressure (D) from the manufacturer's catalog. Enter output in the spaces below. Enter a zero for nozzles turned off for the upcoming application.

Left side

Nozzle #1 _____ gal/min

Nozzle #2 _____ gal/min

Nozzle #3 _____ gal/min

Nozzle #4 _____ gal/min

Nozzle #5 _____ gal/min

Nozzle #6 _____ gal/min

Nozzle #7 _____ gal/min

Right side

Nozzle #1 _____ gal/min

Nozzle #2 _____ gal/min

Nozzle #3 _____ gal/min

Nozzle #4 _____ gal/min

Nozzle #5 _____ gal/min

Nozzle #6 _____ gal/min

Nozzle #7 _____ gal/min

Left side total _____ gal/min + Right side total _____ gal/min = (H) _____ gpm total expected output

Vineyard airblast sprayer calibration worksheet (continued)

Compare the total expected output with the total required output.

(G) _____ gpm **Total required output**

(H) _____ gpm **Total expected output**

If the difference between expected and required output is greater than 10%, replace with appropriate disc-core nozzle combinations that will provide the required output at your operating pressure. Keep in mind that all nozzles do not need to have equal output. You may want to have higher output nozzles pointing at the fruit zone of the vines. Remember that total expected output still must equal total required output, so use lower output nozzles elsewhere on the boom. Repeat this procedure on the other side of the sprayer.

5. Is your sprayer delivering the desired spray volume?

With the correct discs and cores determined and installed, fill the spray tank with water. Park the sprayer on level ground and mark the water level on the spray tank's sight gauge. Using your preferred tractor speed with the airblast fan engaged and both sides spraying, make a trial application-run down your vineyard test row. Return to the same place and position where you marked the sprayer water level. Using a calibrated 5-gallon container, measure the amount of water required to refill the tank to your mark on the sight gauge. Record as test gallons applied (I).

Fill in the following known quantities, insert into the equation below, and calculate your result.

(A) _____ ft **Length of vineyard test row, recorded above**

(F) _____ ft **Distance between rows, recorded above**

(I) _____ gal **Test gallons applied**

$[43,560 \text{ sq ft} \times (I) \text{ gal}] \div [(F) \text{ ft} \times (A) \text{ ft}] = (J) \text{ gal/A actual spray volume}$

6. Compare your actual spray volume with your desired spray volume.

Actual spray volume: (J) _____ gal/A

Desired spray volume: (E) _____ gal/A

If the difference is within 10%, the sprayer is properly calibrated. If actual spray volume exceeds desired spray volume by more than 10%, nozzles may be worn and need replacement. Change disc and core accordingly for each nozzle and repeat step 5. If actual spray volume is less than desired spray volume, double check calculations, repeat steps 4, 5, and 6, and replace discs and cores if necessary.

7. Prepare the spray mixture.

Actual spray volume (gal/A), recorded above: (J) _____ gal/A

Total volume of spray mixture desired: (K) _____ gal

Pesticide application rate, quantity per acre from the label: (L) _____ (lb, oz, gal, etc.)/A

$[(K) \text{ gal total volume}] \div [(J) \text{ gal/A}] = (M) \text{ acres treated} \times (L) = \text{quantity of pesticide needed in spray mixture}$

Pest management resources

OSU Extension pest management guides and websites

Brown Marmorated Stink Bug

EM 9054 & EM 9054-S—Brown Marmorated Stink Bug

<https://catalog.extension.oregonstate.edu/em9054> (English)

<https://catalog.extension.oregonstate.edu/em9054s> (Spanish)

Herbicide Drift

EM 8860—Preventing Herbicide Drift and Injury to Grapes

<https://catalog.extension.oregonstate.edu/em8860>

Mealybug & Grapevine Leafroll Virus

EM 8985 & EM 8985-S—Field Monitoring for Grapevine Leafroll Virus and Mealybug in Pacific Northwest Vineyards

<https://catalog.extension.oregonstate.edu/em8985> (English)

<https://catalog.extension.oregonstate.edu/em8985s> (Spanish)

EM 8990 & EM 8990-S—Grapevine Leafroll Virus and Mealybug Prevention and Management in Oregon Vineyards

<https://catalog.extension.oregonstate.edu/em8990> (English)

<https://catalog.extension.oregonstate.edu/em8990s> (Spanish)

EM 8998—Trapping and Identifying Mealybugs in Oregon Vineyards

<https://catalog.extension.oregonstate.edu/em8998>

Phylloxera

EC 1463-E—Grape Phylloxera: Biology and Management in the Pacific Northwest

<https://catalog.extension.oregonstate.edu/ec1463>

Rodent Control

EC 1641—Attracting Birds of Prey for Rodent Control

<https://catalog.extension.oregonstate.edu/ec1641>

Spotted Wing Drosophila

OSU Spotted Wing Drosophila Website

<http://spottedwing.org/>

OSU-IPPC Spotted Wing Drosophila: Information, Incidence, Forecasts, and Prediction Models of Activity

<http://uspest.org/swd/>

Pacific Northwest Insect Management Handbook—Spotted Wing Drosophila

<http://insect.pnwhandbooks.org/pnw-insect-management-handbook/emerging-pest-spotted-wing-drosophila>

EM 9021—Recognize fruit damage from spotted wing drosophila

<https://catalog.extension.oregonstate.edu/em9021>

EM 9097—SWD: A quick, 7-step guide for detecting SWD larvae in fruit

<https://catalog.extension.oregonstate.edu/em9097>

EM9096—SWD: A detailed guide for testing fruit for the presence of spotted wing drosophila (SWD) larvae

<https://catalog.extension.oregonstate.edu/em9096>

Pest management handbooks

A number of useful pest management handbooks are available online, and updated annually. They can be ordered from OSU Extension & Experiment Station Communications (e-mail: puborders@oregonstate.edu; phone: 541-737-2513 or 800-561-6719; Web: <https://catalog.extension.oregonstate.edu/>

Pacific Northwest Plant Disease Management Handbook

<http://pnwhandbooks.org/plantdisease/>

Pacific Northwest Insect Management Handbook

<http://pnwhandbooks.org/insect/>

Pacific Northwest Weed Management Handbook

<http://pnwhandbooks.org/weed/>

Field Guide for Integrated Pest Management in Pacific Northwest Vineyards

<https://catalog.extension.oregonstate.edu/pnw644>

Relative toxicities of pesticides and miticides to natural enemies and pollinators

Relative Toxicities of Insecticides and Miticides Used in Grapes to Natural Enemies and Honey Bees (table): <http://www.ipm.ucdavis.edu/PMG/r302900111.html>

Natural Enemies Handbook: An Illustrated Guide to Biological Pest Control, ANR Publication 3386: http://www.ipm.ucdavis.edu/IPMPROJECT/ADS/manual_naturalenemies.html

Pesticide labels and registration information

Chemical registrations for pesticides can change at any time. To be sure that a product is registered for use in Oregon, use one of the following online databases. You can download product labels from many of them:

Oregon Department of Agriculture, Pesticides Program

<http://www.oregon.gov/ODA/programs/Pesticides/Pages/AboutPesticides.aspx>

Search for pesticides registered in Oregon

http://oda.state.or.us/dbs/pest_productsL2K/search.lasso

MAPL - Mobile Access to Pesticides and Labels

<http://pi.ace.orst.edu/mapl/>

PICOL—Pesticide Information Center Online

<http://picol.cahe.wsu.edu/LabelTolerance.html>

CDMS—Crop Data Management Systems

<http://www.cdms.net/LabelsMsds/LMDefault.aspx>

Agrian Label Look Up

<http://www.agrian.com>

Grape production

Oregon Wine Research Institute

OSU <http://owri.oregonstate.edu>

eViticulture is an online resource developed by the national Viticulture Extension Working Group. It provides scientifically based articles for all aspects of vineyard production. <http://eViticulture.org> or <http://www.extension.org/grapes/>

National Clean Plant Network—Grapes This website has useful information about grapevine certification. Obtain up-to-date information on the newest virus concerns such as Grapevine red blotch associated virus. <http://nationalclean-plantnetwork.org/>

Organic, sustainable, and integrated production resources

Demeter Association

Web: <http://www.demeter-usa.org>

Purpose: The mission of the Demeter Association is to foster, encourage, and improve biodynamic methods and practices by certifying growers, processors, and manufacturers of biodynamic foodstuffs, and by carrying out other activities and education programs as may be appropriate. Demeter operates exclusively for agricultural and

horticultural purposes. Demeter certifies farms as either biodynamic or in conversion to biodynamic.

Evaluation criteria: Demeter certification is in accord with many practices that characterize the certification of organic farms. However, certain practices are unique to biodynamic agriculture. For technical guidelines and standards, visit: <http://demeter-usa.org/for-farmers/farm-processing-standards.asp>

Food Alliance

Web: <http://www.foodalliance.org>

E-mail: info@foodalliance.org

Purpose: Promotes sustainable agriculture by recognizing farmers who produce food in environmentally and socially responsible ways and educating consumers and others in the food system about the benefits of sustainable agriculture.

Evaluation criteria: Certifies a wide variety of farm and ranch products in the Northwest and Midwest. Practices are ranked in a point system with four levels of achievement within each category of evaluation.

International Organization for Biological and Integrated Control of Noxious Animals and Plants (IOBC)

Web: <http://www.iobc-wprs.org>

Purpose: IOBC/WPRS promotes the use of sustainable, environmentally safe, economically feasible, and socially acceptable control methods of pests and diseases of agricultural and forestry crops. IOBC/WPRS encourages collaboration in the development and promotion of biological and integrated production systems.

Evaluation criteria: All farms certified by an IOBC-endorsed organization must be supervised and their achievements monitored, evaluated, and documented according to international rules. Evaluation is based on farm inspection and submitted farm records. Evaluation of farm records is based on completeness and plausibility of records taken, nutrient balance (N and P), all agrichemical inputs, and all disqualification criteria. All farm records are evaluated regardless of the field inspection. Technical Bulletins detailing guidelines can be ordered.

Low Input Viticulture & Enology (LIVE)

Web: <http://liveinc.org>

E-mail: info@liveinc.org

Purpose: A sustainable agriculture program providing vineyards and wineries with official certification for agricultural practices that are modeled after international standards of integrated production. The intent is to increase vineyard

and winery sustainability and best management practices while maintaining fruit and wine quality. Education regarding sustainable production practices is also a component of this program.

Evaluation criteria: It is the intent of the LIVE organization to certify vineyards and wineries that have complied with the requirements of the integrated production program based on best management practices with respect to vineyard efficiency and environmental standards. The success of the program relies on strict adherence to the philosophy and rules of the program. Semiannual site inspections, review of required farm documents, and periodic sampling form the basis for assuring the public that members certified by LIVE have complied with all aspects of the program. Evaluation criteria are based on LIVE Technical Guidelines.

Oregon Department of Agriculture—Organic Certification Program

Web: <http://www.oregon.gov/ODA/programs/MarketAccess/MACertification/Pages/NationalOrganicProgram.aspx>

E-mail: cid-organic@oda.state.or.us

Purpose: This state program administers the regulations outlined by the National Organic Program (NOP) for agricultural producers who wish to certify their land and agricultural products as “organic” or “made with organic.”

Evaluation criteria: Organic standards outlined by the NOP are enforced. The website has direct links to information from the NOP, including program standards, a national list of approved and prohibited substances, and links to the Organic Material Review Institute (OMRI). Contents of the National List are based upon a Proposed National List, with annotations, as recommended to the Secretary by the National Organic Standards Board (NOSB).

Oregon Tilth

Web: <http://tilth.org>

E-mail: organic@tilth.org

Purpose: Tilth is a nonprofit research and education organization certifying organic farmers, processors, retailers, and handlers throughout Oregon, the United States, and internationally.

Evaluation criteria: OTCO provides certification to ensure that the agreed-upon conventions of organic agriculture systems are being practiced. Uses a National List of Allowed and Prohibitive Substances based on the National Organic Program (NOP) final rule and Organic Production Act of 1990.

Organic Material Review Institute (OMRI)

Web: <http://www.omri.org>

To view organic materials list online, go to “OMRI Products List”. The list can be purchased or viewed online. For direct access to the online searchable list, go to: http://omri.org/OMRI_datatable.php

E-mail: info@omri.org

Purpose: Provides information about organic materials used in production, processing, and handling. Serves as a reference, providing comprehensive interpretation of materials used on other organization lists.

Evaluation criteria: Rates crop production materials as “Allowed” or “Regulated.” Annual subscriptions are available to receive materials lists, and certifiers can receive certifier subscriber information.

Salmon-Safe

Web: <http://www.salmonsafe.org>

E-mail: info@salmonsafe.org

Purpose: Works with leading farmers throughout the Northwest to help restore salmon habitat on farmland by planting trees, growing cover crops, improving irrigation systems, and applying natural methods to control weeds and pests.

Evaluation criteria: The certification process can be downloaded online from the website. Salmon-Safe works in collaboration with the certifiers of LIVE and Oregon Tilth, providing additional certification to those who are certified under these organizations.

Using pesticides safely

Always read the label

The single most important approach to pesticide safety is to read the pesticide label before each use and then follow the directions. If still in doubt after reading the label, contact a person qualified to help evaluate the hazard of the chemical and its use. Qualified people include extension specialists, county educators, pesticide product representatives, and retailers.

Pesticides are toxic and should be handled with care—but can be used safely if you follow recommended precautions. Follow all label requirements, and strongly consider any recommendations for additional personal protective clothing and equipment. In addition to reading and following the label, other major factors in the safe and effective use of pesticides are the pesticide applicator's qualifications, common sense, and positive attitude. Always take all safety precautions when using pesticides.

In case of accidents involving pesticides, see your doctor at once. It will help your doctor to know exactly which pesticide is involved. The label on the container gives this information. Take to the physician the pesticide label or information from the label, such as the product name, registration number of the U.S. Environmental Protection Agency (EPA), common name and percentage of active ingredient, and first aid instructions. If the label cannot be removed, take along the pesticide container (if not contaminated), but do not take it into the hospital or doctor's office.

Pesticide safety checklist

- Use pesticides only when necessary and as part of an Integrated Pest Management (IPM) program.
- Always read the label and follow the instructions.
- Do not allow children to play around sprayers or mixing, storage, and disposal areas.
- Wear appropriate protective clothing and equipment.
- Never eat, drink, or smoke while handling pesticides.
- Avoid drift into non-target areas and pesticide runoff into streams, rivers, lakes, irrigation ponds and canals.
- Avoid spilling materials on skin or clothing.
- Have access to clean water, soap, and first aid supplies.
- Keep pesticides in a dry and locked storage area away from food and feed.
- Triple rinse or pressure rinse empty containers and dispose or recycle in accordance with state and local regulations.
- Stay out of recently sprayed areas until the spray has dried, and observe the restricted entry intervals (REI) specified on the pesticide label.

Follow the pre-harvest interval (PHI) on the pesticide label before harvesting crops or gardens and before allowing livestock to graze fields.

Oregon Poison Center

The Oregon Health & Science University
3181 S.W. Sam Jackson Park Road
Portland, OR 97239
Phone: 1-800-222-1222

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Trade-name products and services are mentioned as illustrations only. This does not mean that the Oregon State University Extension Service either endorses these products and services or intends to discriminate against products and services not mentioned. Due to constantly changing laws and regulations, the Oregon State University Extension Service can assume no liability for the suggested use of chemicals contained in this guide. Pesticides should be applied according to the label directions on the pesticide container.

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