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2010 Pest Management Guide for Wine Grapes in Oregon

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Photo by Patricia A. Skinkis, © Oregon State University.

Introduction

This is a pest management guide developed for use by vineyard managers in Oregon. This guide represents some of the best recommendations for chemicals, formulations, and usage rates of products that are intended to prevent, manage and control vineyard diseases, insects, weeds, and vertebrate pests. These recommendations are based on research, label directions, and vineyard-use experience for Oregon vineyards. For optimum pest control, selecting appropriate chemicals, application rates, amount of water per acre, and application methods also depends on a thorough knowledge of the region and the vineyard, as well as cultivars, planting density, vine vigor, canopy characteristics, pest complex, and past pest problems.

This guide does not intend to discriminate against products. Occasionally, different formulations of a product (or similar formulations containing a different concentration of an active ingredient) are registered and effective for use on grapes and the pests listed. Such products may be used even though they are not included in this guide.

You may wish to 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 at any time. For this reason, the details given in this document are accurate as of the date of release. As a grower, it is your responsibility to check label rates of all products used on your farm and verify current registration status with the Oregon Department of Agriculture. To do so, visit: http://oda.state.or.us/dbs/pest_productsL2K/search.lasso

Always refer to the pesticide label for instructions on the use of the specific product. The label is a legal

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document for the product that explains effective rates and methods 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?" The figure below offers suggestion for the amount of formulated product to use per acre. This amount is based on a "typical" middle aged (7 to 15 years old) vineyard with moderate density (spacing of 5 to 7 feet) with moderate pest pressure.

Please note: a lower amount of total chemical material (volume) may be needed for vineyards with smaller canopies, younger vineyards of 1-4 years old, and locations with less severe pest infestations. A greater volume (within label limits) may be required for large vines with dense canopies or in mature vines experiencing heavy pest pressure from multiple pests.

Many insecticide labels indicate the minimum amount of water needed per acre to apply concentrate sprays, as well as how to calculate the amount of chemical needed per acre in a concentrate sprayer. **Check the product label before spraying.** Some label directions may indicate dilute applications. Also:

- Make sure tank mixes of pesticides are compatible. For example, the elevated pH of some boron spray solutions weakens many insecticides.
- Use adjuvants and spreader stickers with caution.

Vineyard Pest Management Timing

In vineyards, pest management timing should coincide with vine phenology (growth stage), pest presence, populations of the pest, and climate conditions. The seasonal layout used in this guide is based on vine phenology throughout the year. At each stage, we refer to a number and descriptor for vine growth.

Figure 1, below, provides an overview of the season, management timing, and growth stage. Please refer to the specific growth stages illustrated in Figure 2. These stages also should be used in vineyard management record-keeping.

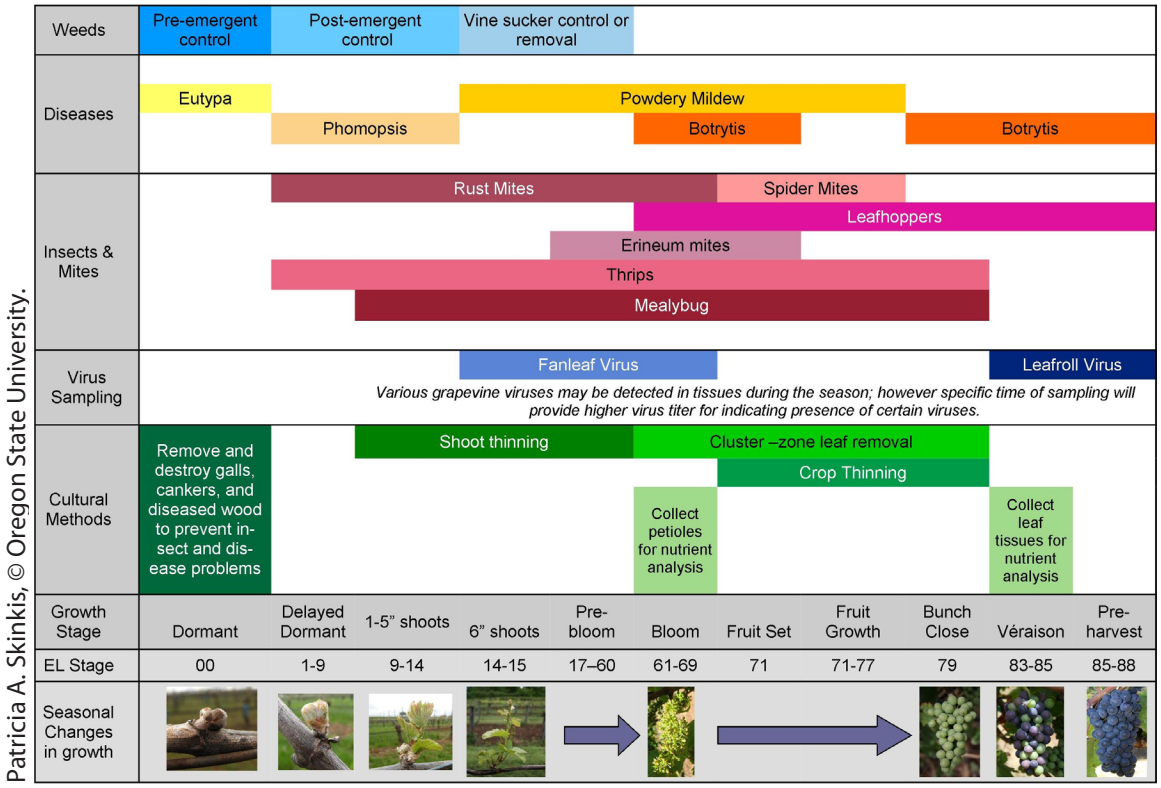
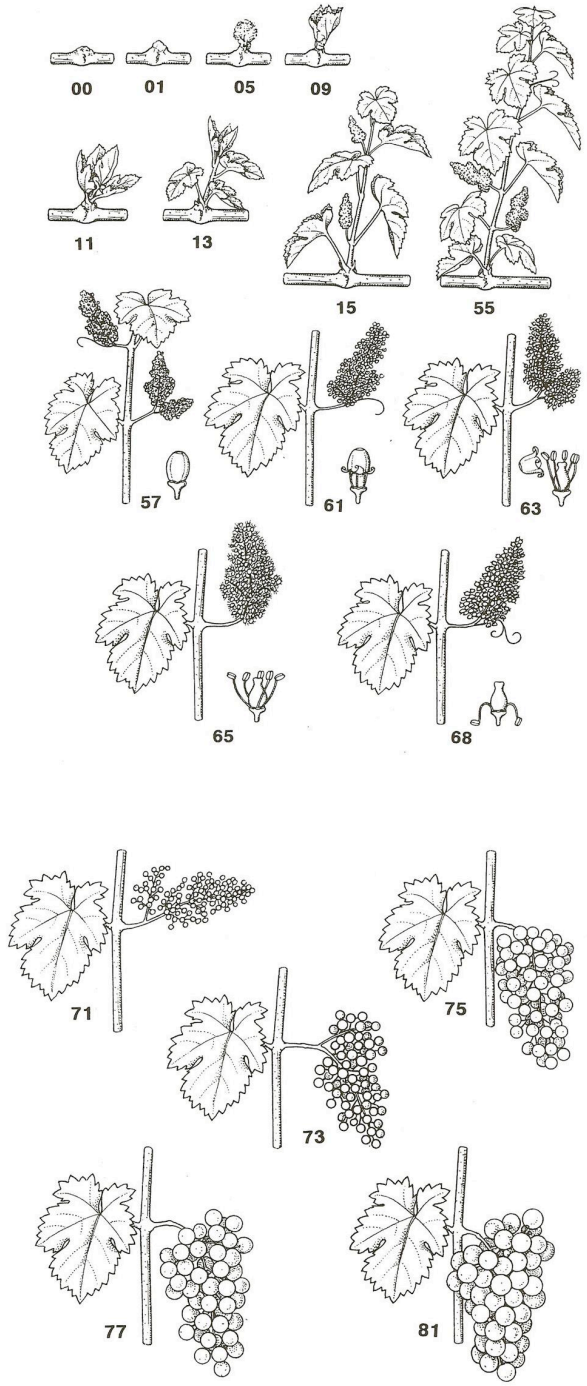


Figure 1. Seasonal timing for vineyard management of weeds, diseases, insect and mite pests. This figure includes only the main pests of concern for Oregon's diverse growing regions. Principal growth stages are based on the extended BBCH scheme.



Principal growth Stage	Code	Description
0: Bud Development	00	Dormant: winter buds pointed or rounded and bud scales closed, depending on cultivar
	01	Buds beginning to swell
	03	End of bud-swell. Buds swollen but not green.
	05	"Wooly bud": brown wool visible on bud
	07	Beginning of bud-break: green shoot tips just visible
	08	Bud-break: green hoot tips clearly visible.
1: Leaf Development	11	First leaf unfolded away from shoot
	12	Second leaf unfolded
	13	Three leaves unfolded
	1_	Stages continue with additional leaves unfolded
5: Inflorescence Emerges	53	Inflorescence clearly visible
	55	Inflorescence swelling: flowers pressed together
	57	Flowers separate; inflorescence developed
6: Flowering	61	10% caps fallen
	65	50% caps fallen
	68	80% caps fallen
7: Fruit Development	71	Fruit set: fruit begins to form, flower remains lost
	73	BB-sized berries
	75	Pea-sized berries
	77	Berries begin to touch in cluster
	79	Bunch closure; berries touching
8: Berry Ripening	81	Ripening begins (véraison): berries begin to color
	85	Softening of berries
	89	Berries ripe, harvest

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

Management Strategies by Vine Growth Stage

Dormant (before April, stage 00)
Delayed dormant (stages 1-13)
Shoots 1-5 inches long (stages 9-14)
Shoots 6 inches long (stages 14-15)
Prebloom (stage 17)
Bloom (stages 61-69)
Postbloom (stage 71)
Late spring, bloom through set (stages 65-70)
Summer (late June/July, stages 71-77)
Late summer (July/August, stages 76-81)
Beginning of berry touch (stage 77)
Véraison (stage 81)
Preharvest (stages 81-88)

Photo by Patricia A. Skinkis, © Oregon State University.

Table 1. Seasonal Vineyard Pest Management: Diseases, Insects and Weeds

The table below provides information on some of the more effective pesticides currently on the market, along with their application rates. Amounts are listed either by product formulation or by active ingredient (ai) as noted. Appropriate timing of applications listed below are designed for growers who choose to use chemical controls for disease, insect and weed management. Footnotes are listed on page 19.

Remember these points:

1. Insect/mite pests rarely pose an economic impact on vineyards in Oregon. Do not use insecticide sprays unless a problem is known to cause a negative economic impact and pest pressure has reached an economically damaging threshold.
2. Alternative control strategies may be available.[4] Be aware that pesticide labels are subject to alteration or cancellation at any time; always consult a current product label for usage and application rates. You can obtain electronic labels online from the Crop Data Management Systems website: http://www.cdms.net/LabelsMsds/LMDefault.aspx?t=

Insect, weed, or disease/ Materials	Amount (ai or formulated) material/A	Remarks and minimum days from last application to harvest (PHI)
Dormant (before bud-break, stage 00)		
Dormant-Season Weed Control		
dichlobenil (Casoron)	4-6 lb ai/A	Apply fall through spring, before weeds germinate, or apply foliar-active herbicide to control existing vegetation. Weigh and uniformly distribute exact quantities over precisely measured areas to ensure accurate applications. Use in vineyards established at least four weeks, preferably the winter after planting. Results of Oregon-based research over nine 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.

Insect, weed, or disease/ Materials	Amount (ai or formulated) material/A	Remarks and minimum days from last application to harvest (PHI)
diuron	1.6-3.2 lb ai/A	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. Use only in vineyards that are at least three years old.
napropamide (Devrinol)	4 lb ai/A	Apply fall through spring before weeds germinate. Irrigation or shallow incorporation is recommended for treatments made November through February if there is no rain falls within two 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. 35-day PHI.
norflurazon (Solicam)	2-4 lb ai/A	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 two years in the field. Do not use on gravelly, sandy, or loamy sand soils.
oryzalin (Surflan)	2-6 lb ai/A	Apply late fall or early spring to bare soil or after existing vegetation has been destroyed by tillage. Use higher rates or split treatments, and apply in fall and spring for longer residual control. Irrigate with at least 0.5 inch of water or rain to activate herbicide. Shallow cultivation can provide control of newly germinated weeds without reducing herbicide activity. Do not use on soils with more than 5% organic matter.
pronamide (Kerb)	1-4 lb ai/A	Apply only once in fall or winter, preferably October to December when temperatures are 55°F or below. Use lower rates on annual grasses and light soil textures; 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 one year or to spring-planted grapes established at least six months. **Caution: restricted use.**
simazine (Princep)	1.0-2.0 lb ai/A	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. Use in vineyards at least three years after establishment. Do not apply more than 4 lb ai/A per 12-month period. Do not apply on very sandy or gravelly soils.
trifluralin	0.5-2.0 lb ai/A	Check label for specific rates suited to soil type. Apply and immediately incorporate 1 to 2 inches deep, using equipment that will not injure roots. 60-day PHI.

Insect, weed, or disease/ Materials	Amount (ai or formulated) material/A	Remarks and minimum days from last application to harvest (PHI)
Grape mealybug, scales		Currently the most often-used and most effective pesticides for mealybug are not optimal during this period. For more effective timing, action should begin during the delayed-dormant period.
Crown gall and Eutypa dieback		Remove and destroy galled or cankered vines. Bring up suckers only if well below the damaged area and above the graft union on grafted vines. If you are making large cuts when retraining vines, consider leaving long stubs to be cut away in the summer when conditions are dry (double pruning).
Topsin M WSB + adjuvant	1.5 lb/50 gal water/A	2 -day REI
Rally 40 WSP	5 oz/50 gal water/A	Spray application to thoroughly wet vines and freshly cut surfaces. Use an additional application two weeks later. **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% budbreak 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 when doing dormant pruning.[7]
Delayed dormant (Stages 1-13) Apply from before budbreak up to the time shoots are 4 inches long		
Early Spring Weed Control		
clove or clove leaf oil (Matran EC, Matratec)	5-8%	Use on annual weeds from emergence to 6 inches in height. OMRI listed and WSDA approved herbicide for in-crop use. Avoid contact with grape foliage. Performance may be erratic depending on environmental conditions. Bright sunlight improves efficacy. No preharvest or re-entry interval.
flumioxazin (Chateau)	Refer to label for condition-based rates	Rates conditioned on organic matter, soil type, and weed population. Consult label for details. Direct spray within vine row strip to weed foliage; add burn-down herbicide listed on label if weeds are established. Residual or postemergence weed control can be achieved by adjusting rates or by using labeled tank-mixes (see label). Do not apply to vines established less than one year unless protected by nonporous wraps, grow tubes, or waxed containers. Do not make sequential applications within 30 days or harvest fruit within one year of treatment. Follow the most restrictive label requirements, and avoid direct or indirect spray contact with foliage or green bark.

Insect, weed, or disease/ Materials	Amount (ai or formulated) material/A	Remarks and minimum days from last application to harvest (PHI)
glufosinate ammonium (Rely)	0.75-1.25 lb ai/A	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. 14-day PHI.
glyphosate (Roundup and numerous other product names)	Consult label	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 three years old. When repeat applications are needed, do not exceed 10.6 lb ai/A in one year. Alternate weed management to avoid weed resistance. 14-day PHI.
glyphosate wiper solution (several products)	33%	See label rate and time of application, particularly for perennial weed control. Mix 1 gal product with 2 gal water and wipe weeds. Avoid contact with grape foliage. 14-day PHI.
limonene (lemon grass oil) (Green Match)	14%	Use 20% dilution rate for spot treatment of weeds that are difficult to control. Effective on annual weeds. Use up to fruit set, but when weeds are less than 6 inches in height. Broad spectrum, non-selective and contact. Ensure good coverage for control. Leaf damage is visible within hours. Cool weather may slow activity. No re-entry interval. Do not apply to grape foliage as it will be damaged. 7-day PHI on bearing grapes. Do not exceed 8.5 gal/A in a 12-month period. OMRI listed, NOP compliant, and WSDA approved organic burn-down herbicide for use in crop and non-crop sites.
oxyfluorfen (Goal 2XL)	0.5-2.0 lb ai/A	Controls broadleaf weeds pre- and post-emergence depending on rate of application and weed species. Apply only to healthy vineyards. Vines should be trained to a trellis and should be 3 feet above the soil surface in vineyards where this product will be used. Direct the 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.
paraquat (Gramoxone Max)	Consult label	Apply when weeds are growing vigorously, and new growth is 1 to 6 inches in height. 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. **Caution: A restricted-use pesticide.**
sethoxydim (Poast)	0.28-0.47 lb ai/A (1.5-2.5 pt/A)	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. 50-day PHI. Do not exceed 5 pt/A per season.

Insect, weed, or disease/ Materials	Amount (ai or formulated) material/A	Remarks and minimum days from last application to harvest (PHI)
Cutworms (grape leafroller, orange tortrix, omnivorous leaffolder)		**Note**: For all products, thorough coverage of vines and immediate basal area is important. Cutworms are particularly troublesome in vineyards with heavy broadleaf and grass weeds.
carbaryl 4F (Sevin and other brands)	1 lb ai	7-day PHI.
chlorpyrifos (Lorsban)	1 qt	Do not apply after bloom stage of growth. Do not exceed 2 qt/A or two applications per crop growing season. Do not apply this product through any type of irrigation system. OR 24c. Use on nonbearing grapes only. 1-day REI. 90-day PHI.
methomyl (Lannate LV)	1.5-3 pt	**Restricted use pesticide.** 7-day REI. 14-day PHI.
phosmet (Imidan)	2.1 lb	Apply as a prebloom spray only. Apply no more than three times per season.
spinetoram (Delegate WG)	0.0469-0.781 lb ai	Re-treatment interval four days. Do not make more than five applications per season. 7-day PHI.
spinosad (Success or Entrust)	0.062-0.125 ai	Treat when pests appear. Heavy infestations may require repeat applications. Do not exceed 7.5 oz/A of Entrust (0.375 lb ai/A) or 29 fl oz/A of Success (0.45 lb ai/A) per season. Do not exceed three applications in any 30-day period; allow at least 5 days between applications. Entrust is approved for organic production. 7-day PHI.
Note: Carbaryl, chlorpyrifos, methomyl, and phosmet are broad-spectrum insecticides. Their use on foliage may adversely affect beneficial insect and mite populations, resulting in secondary outbreaks of spider mites and other pests. Apply insecticides to the trunks, wire, posts, and the ground immediately beneath the vines, avoiding foliage as much as possible. Apply late in the day to maximize contact toxicity to nocturnal larvae.		
Grape rust and bud mite (eriophyid mites)		
Envidor (spirodiclofen)	16-18 fl oz	One application per crop season allowed; 18 fl oz maximum allowed per crop season. 14-day PHI.
JMS Stylet oil (paraffinic oil)	1-2 gal/100 gal water	Do not use within two weeks of a sulfur application, near freezing temperatures, above 90°F, or when foliage is wet.
M-Pede (potassium salts of fatty acids)	1-2 gal/100 gal water	Do not use within three days of a sulfur application.
sulfur (micronized sulfur)	Check label	Repeat as necessary at 7- to 14-day intervals, depending on label.
Kumulus DF	2-10 lb	
Microthiol Disperss	3-10 lb	
Thiolux Jet	6 lb	
Rust mites may cause Short Shoot Syndrome (SSS), which may result in crop losses. Feeding damage is believed to start when buds become less tightly packed. Mites move to newly growing tissues from surrounding overwintering sites, such as outer bud scales, bark, crevices and large pruning wounds. Less tightly packed bud tissues allow mites to enter between bud tissues; feeding on susceptible developing tissues commences during this period. Bud mites occur within buds during winter and can destroy bud tissues before wooly bud. Currently, bud mites are found in limited locations, and rust mites were found in the majority of cases where SSS was recorded. High spray volumes and good coverage are essential. Two sprays 7-14 days apart are essential to control continually emerging mites. Sulfur may be less effective during cold temperatures (below 50°F). Oils and other contact insecticides may be more effective under these circumstances. Sulfur has been found to be more effective at reducing grape rust mite populations on young tissue when combined with an adjuvant.		

Insect, weed, or disease/ Materials	Amount (ai or formulated) material/A	Remarks and minimum days from last application to harvest (PHI)
Thrips		May cause scarring similar to that of early-season rust mite. Monitor for presence before action.
kaolin clay (Surround WP)	11.9-47.5 lb ai (12.5-50 lb product)	The preferred rate is 25 lb of product in 50 gal/A water. For suppression only. Supplemental controls may be needed for complete control. Make 1 or 2 applications seven days apart, starting at budbreak.
spinetoram (Delegate WG)	3-5 oz	Do not apply more than five times per crop year. Do not apply within seven days of harvest. Do not space applications closer than four days.
spinosad (Entrust, Success)	4-8 oz	Do not exceed three applications in any 30-day period. Allow five days between treatments. Do not exceed 29 fl oz of product per crop per season. 7-day PHI.
Phylloxera		Before treating, ensure that phylloxera is present by sampling during the previous season. If sampling shows presence, take action during the early part of the following season.
thiamethoxam (Platinum)	8-17 oz	Can be applied through dripper or microirrigation lines. Assure that the vineyard is irrigated to field capacity before application in order to ensure proper absorption into actively growing roots. The higher rate may give a second season of control. This compound has good water solubility compared to other systemic root-applied compounds. 30-day PHI.
Grape mealybug		
buprofezin (Applaud)	12-24 oz	No more than two applications per season. Allow 14 days between applications. Do not apply more than 24 oz/A per crop cycle. Do not apply within seven days of harvest.
imidacloprid (Provado 1.6 F, Solupak, others)	3-4 fl oz	Allow 14 days between applications. Maximum 8 fl oz/A allowed per season. 0-day PHI.
Provado Solupak	0.75-1 oz	Do not use more than 2 oz/A per year. Allow 14 days between sprays. 0-day PHI.
phosmet (Imidan)	1.125-1.333 lb	Do not apply more than 6.5 lb/A per season.
thiamethoxam (Platinum and others)	8-17 oz	Can be applied through dripper or microirrigation lines. Assure that the vineyard is irrigated to field capacity before application to ensure proper absorption into actively growing roots. The higher rate may give a second season of control. This compound has good water solubility compared with other systemic root-applied compounds. 30-day PHI.
Shoots 1-5 inches long (stages 9-14)		
Phomopsis cane and leaf spot		**Note**: This disease may be called "deadarm" on some labels.
Abound	10-15.5 oz	14-day PHI.
Adament 50 WG	6 oz	Combines group 3 and 11 fungicides. 14-day PHI. [9]
Captan 80WDG	2.5 lb	0-day PHI.
Dithane DF (75% mancozeb)	1.5-2.5 lb	66-day PHI.

Insect, weed, or disease/ Materials	Amount (ai or formulated) material/A	Remarks and minimum days from last application to harvest (PHI)
Flint 50WG	3 oz	Do not make more than two consecutive applications. 14-day PHI.
Penncozeb 75DF	1.5-2.5 lb	66-day PHI.
Pristine	8-12.5 oz	Do not make more than two consecutive applications. 14-day PHI.
Sovran	3.2-4.8 oz	Do not make more than two consecutive applications. 14-day PHI.[10]
Ziram 76DF	3-4 lb	—
Branch, cane, or twig borer		
Bacillus thuringiensis (Bt)	0.5-2 lb	Apply on 3-7 day schedule. Also available as organic compound.
carbaryl (Sevin and other brands)	1-2 lb	Chemical control normally not necessary if cultural practices are observed. If large populations of adults occur in vineyard (late April-early June), carbaryl applied 2 to 3 times at 7- to 10-day intervals has given control. 7-day PHI. [4]
Cutworms		See materials and remarks for earlier growth stages.
Thrips		See materials and remarks for earlier growth stages.
Grape rust mite		See materials and remarks for earlier growth stages.
Grape mealybug		See materials and remarks for earlier growth stages.
Weed control		See "Delayed Dormant" section 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)		
Vine Sucker Control		
oxyfluorfen (Goal)	0.25-0.5 lb ai/A	Apply as directed ground spray to suckers growing from plant base up to 12 inches tall. Immature, expanding leaves are most susceptible. Special local needs label OR-000001. Complete sucker control requires hand cane removal. The highest rate or a second application may be required for acceptable control or suppression of grape suckers. Do not apply more than 2 lb ai/A per season. 60-day PHI. Applications can be made up to 3 weeks after bloom.
Powdery mildew, grape erineum mite, rust mite		See Table 2 and Figure 3
JMS Stylet oil	1-2 gal/100 gal water	Do not use within two weeks of a sulfur application, near freezing temperatures, above 90°F, or when foliage is wet.
M-Pede	1-2 gal/100 gal water	Do not use within three days of a sulfur application.
Sulfur	Check label	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. Sulfur's activity is effective from 57° to 83°F. [1, 2]
Kumulus DF	2-5 lb	
Microthiol Disperss	3-10 lb	
Thiolux Jet	6 lb	

Insect, weed, or disease/ Materials	Amount (ai or formulated) material/A	Remarks and minimum days from last application to harvest (PHI)
Powdery mildew only		See Table 2 and Figure 3
Abound	10-15.5 oz	Do not apply more than two sequential sprays before alternating with a fungicide that has a different mode of action. 14-day PHI.
Adament 50 WG	3-4 oz	Combination of group 3 and 11 fungicides. 14-day PHI.[9]
JMS Stylet oil	1-2 gal/100 gal water	Do not use within 10 days of a sulfur application, near freezing temperatures, or when foliage is wet.
Kaligreen	2-3 lb	Supplemental to a normal program only when powdery mildew is first observed.
M-Pede	1-2 gal/100 gal water	Do not use within three days of a sulfur application.
Ph-D WDG	6.2 oz	0-day PHI
Pristine	8-12.5 oz	14-day PHI
Sovran	3.2-4.8 oz	Do not make more than two consecutive applications. 14-day PHI. [10]
Sulfur	Check label	Repeat as necessary at 10- to 14-day intervals. Sulfur's activity is effective from 57° to 83°F. [1, 2]
Kumulus DF	2-5 lb	
Microthiol Disperss	3-10 lb	
Thiolux Jet	6 lb	
Grape mealybug		See materials and remarks for earlier growth stages.
spirotetramat (Movento)	6.0-8.0 oz/A	Do not apply more than 12.5 oz/A per season. Use an adjuvant to obtain effective full canopy applications. Ensure application when there is adequate canopy for uptake through tissues. Interval between applications is 30 days. 7-day PHI.
Yellowjackets		Control of wasps can by managed by: • Trapping: Ongoing effort needs to start in spring and continue into fall, especially if the yellowjacket 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 yellowjacket population for the season. A greater number of traps may reduce the likelihood of pest numbers building up later in the season. One trap/A is adequate in spring. For optimal control, follow instructions on the product and labels. • Early-season removal of nests • Spraying the nest or nesting site with an insecticide labeled for that use.
Phylloxera		See materials and remarks for earlier growth stages.
Thrips		See materials and remarks for earlier growth stages.

Insect, weed, or disease/ Materials	Amount (ai or formulated) material/A	Remarks and minimum days from last application to harvest (PHI)
Prebloom (stage 17)		
Cutworms		**Note**: This timing for cutworm control usually is less effective than earlier season control. See materials and remarks for earlier growth stages.
Grape mealybug		See materials and remarks for earlier growth stages.
Thrips		See materials and remarks for earlier growth stages.
Grape erineum and rust mite		
JMS Stylet oil	1-2 gal/100 gal water	Do not use within 10 days of a sulfur application.
M-Pede	1-2 gal/100 gal water	Do not use within three days of a sulfur application.
Sulfur 80 to 90%	3-6 lb	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. [1, 2]
Kumulus DM	2-5 lb	
Microthiol Disperss	3-10 lb	
Thiolux Jet	6 lb	
Phylloxera		See materials and remarks for earlier growth stages.
Powdery mildew		See Table 2 and Figure 3
Abound	10-15.5 oz	14-day PHI.
Adament 50 WG	3-4 oz	Combination of a group 3 and 11 fungicide. 14-day PHI. [9]
Flint 50WG	1.5-2 oz	Do not make more than two consecutive applications. Do not apply more than four times per year. 14-day PHI. [9]
JMS Stylet oil	1-2 gal/100 gal water	Do not use within 10 days of a sulfur application.
Kaligreen	2-3 lb	Supplemental to a normal program only when powdery mildew is first observed. 1-day PHI.
Mettle 125 ME	3-5 fl oz	14-day PHI. Do not use more than 10 fl oz/A per year.
M-Pede	1-2 gal/100 gal water	Do not use within three days of a sulfur application. Use as a supplement to a normal program.
Ph-D WDG	6.2 fl oz	0-day PHI
Pristine	8-12.5 oz	14-day PHI
Procure 480SC	4-8 fl oz	Do not use more than 32 fl oz/A per year. 7-day PHI.
Quintec	3-6.6 oz	Do not apply more than five times per year. 14-day PHI.
Rally 40WSP	3-5 oz	Do not apply more than 1.5 lb/A per year. 14-day PHI.
Rubigan EC	2 oz	Do not apply more than 19 oz/A per year. Must have a minimum concentration of 2 oz/100 gal and use a surfactant. Use lower rates early in the season. 30-day PHI.[5]
Sovran	3.2-4.8 oz	Do not make more than two consecutive applications. 14-day PHI. [10]
Sulfur	Check label	Repeat as necessary at 7- to 10-day intervals. Sulfur's activity is effective from 57° to 83°F. [1,2]
Kumulus DF	2-5 lb	
Microthiol Disperss	3-10 lb	
Thiolux Jet	6 lb	

Insect, weed, or disease/ Materials	Amount (ai or formulated) material/A	Remarks and minimum days from last application to harvest (PHI)
tebuconazole products		Do not apply more than 2 lb per year. 14-day PHI.
Elite 45DF	4 oz	
Orius 45 DF	4 oz	
Tebuzol 45 DF	4 oz	
Unicorn	1.75 – 2.5 lb	Includes sulfur in the formulation.
Eutypa dieback		Scout for vines showing symptoms of this disease. Mark for removal later in the year during dry weather or during the dormant season. Removal earlier in the season, when rainfall is available, can lead to further infection.
Weed control		Refer to previous sections (Delayed Dormant) 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). [7]		
Powdery mildew		See Table 3 and Figure 2
Abound	10-15.5 oz	14-day PHI.
Adament 50 WG	3-4 oz	Combination of a group 3 and 11 fungicide. 14-day PHI. [9]
Flint 50WG	1.5-2 oz	Do not make more than two consecutive applications. Do not apply more than four times per year. 14-day PHI. [9]
JMS Stylet oil	1-2 gal/100 gal water	Do not use within 10 days of a sulfur application.
Mettle 125 ME	3-5 fl oz	14-day PHI. Do not use more than 10 fl oz/A per year.
Pristine	8-12.5 oz	14-day PHI.
Procure 480SC	4-8 fl oz	Do not use more than 32 fl oz/A per year. 7-day PHI.
Quintec	3-6.6 oz	Do not apply more than 5 times per year. 14-day PHI.
Rally 40WSP	3-5 oz	Do not apply more than 1.5 lb/A per year. 14-day PHI.
Rubigan EC	4-6 oz	Do not apply more than 19 oz/A per year. Must have a minimum concentration of 2 oz/100 gal. Use lower rates early in the growing season. 30-day PHI. [5]
Sovran	3.2-4 oz	Do not make more than two consecutive applications. 14-day PHI. [10]
Sulfur	Check label	Repeat as necessary at 7- to 10-day intervals. Sulfur's activity is effective from 57° to 83°F. [1,2]
Kumulus DF	2-5 lb	
Microthiol Disperss	3-10 lb	
Thiolux Jet	6 lb	
tebuconazole products		
Elite 45DF	4 oz	Do not apply more than 2 lb per year. 14-day PHI.
Orius 45 DF	4 oz	
Tebuzol 45 DF	4 oz	
Unicorn	1.75-2.5 lb	Includes sulfur in the formulation.

Insect, weed, or disease/ Materials	Amount (ai or formulated) material/A	Remarks and minimum days from last application to harvest (PHI)
Botrytis bunch rot		See Table 2 and Figure 3
Botran 75WSB	2-4.7 lb	Fruit marking can occur on some cultivars when combined with sulfur.
Captan 80WDG	2.5 lb	Do not use with oil. 0-day PHI.
Elevate 50WDG	1 lb	Do not use more than 3 lb/A per season. 0-day PHI. [3]
Endura	8 oz	Do not use more than three times per year. 14-day PHI.
JMS Stylet oil	1-2 gal/100 gal water	May aid botrytis control. Tank mix with another fungicide. Do not use within 10 days of a sulfur application.
Pristine	18.5-23 oz	Higher rate based on supplemental label. 14-day PHI.
Rovral 4F	1-2 pt	Do not use more than twice per season. 7-day PHI. [3]
Scala SC	9-18 oz	7-day PHI. [3]
Switch 62.5 WG	11-14 oz	Do not use with adjuvant. 7-day PHI.
Vangard 75WG	5-10 oz	Buffer to a pH of 5-7 when tank mixing with Rovral. 7-day PHI. [3]
Grape mealybug		See materials and remarks for earlier growth stages.
Vine Sucker Control		
oxyfluorfen (Goal)	0.25-0.5 lb/A	Apply as a directed ground spray to suckers growing from plant base up to 12 inches tall. Immature, expanding leaves at time of contact are most susceptible. Special local needs label OR-000001. 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 2 lb ai/A per season. 60 day PHI. Applications can be made up to three weeks after bloom.
Weed control		Refer to "Delayed Dormant" section 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.
Postbloom (stage 71)		
Botrytis bunch rot		See Table 2 and Figure 3
Cluster-zone leaf removal		
Removing basal leaves on the shoot 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 infections. **Note**: Early leaf removal should not result in sunburning of fruit if climatic conditions are not subject to high temperatures and sunlight intensity when conducting this management practice. Late leaf removal (near véraison or later) combined with hot, dry weather results in fruit sunburn.		

Insect, weed, or disease/ Materials	Amount (ai or formulated) material/A	Remarks and minimum days from last application to harvest (PHI)
Late spring, bloom through berry set (stages 65-70)		
Powdery mildew		See Table 2 and Figure 3. Use materials at shortest recommended intervals during this period. Fungicides are not a problem when used during bloom, but powdery mildew is.
Abound	10-15.5 oz	14-day PHI.
Adament 50 WG	3-4 oz	Combination of a group 3 and 11 fungicide. 14-day PHI. [9]
Flint 50WG	1.5-2 oz	Do not make more than two consecutive applications. Do not apply more than four times per year. 14-day PHI. [9]
JMS Stylet oil	1-2 gal/100 gal water	Do not use within 10 days of a sulfur application.
Kaligreen	2-3 lb	Supplemental to a normal program only when powdery mildew is first observed. 1-day PHI.
Mettle 125 ME	3-5 fl oz	14-day PHI. Do not use more than 10 fl oz/A per year.
M-Pede	1-2 gal/100 gal water	Do not use within three days of a sulfur application. Use as a supplement to a normal program.
Ph-D WDG	6.2 oz	0-day PHI.
Pristine	8-12.5 oz	14-day PHI.
Procure 480SC	4-8 fl oz	Do not use more than 32 fl oz/A per year. 7-day PHI.
Quintec	3-6.6 oz	Do not apply more than five times per year. 14-day PHI.
Rally 40WSP	3-5 oz	Do not apply more than 1.5 lb/A per year. 14-day PHI.
Rubigan EC	4-6 oz	Do not apply more than 19 oz/A per year. Must have a minimum concentration of 2 oz/100 gal and use a surfactant. Use lower rates early in growing season. 30-day PHI. [5]
Sovran	3.2-4.8 oz	Do not make more than two consecutive applications. 14-day PHI. [10]
sulfur	Check label	Repeat as necessary at 7- to 10-day intervals. Sulfur is most effective from 57-83°F. [1,2]
Kumulus DF	2-5 lb	
Microthiol Disperss	3-10 lb	
Thiolux Jet	6 lb	
tebuconazole products		Do not apply more than 2 lb per year. 14-day PHI.
Elite 45 DF	4 oz	
Orius 45 DF	4 oz	
Tebuzol 45 DF	4 oz	
Unicorn	1.75 to 2.5 lb	Includes sulfur in the formulation.
Black vine weevil		
azadirachtin	10 oz	This active ingredient is also available as organic compounds. For best results, apply 7-10 days apart.
bifenthrin	0.1 lb	30-day PHI.

Insect, weed, or disease/ Materials	Amount (ai or formulated) material/A	Remarks and minimum days from last application to harvest (PHI)
Guthion 50WSP	1.5-2 lb	**Restricted use pesticide.** Apply in July and August if shoot injury is present. Do not apply more than three times per season. This is a legal pesticide use not found on the label. 21-day worker reentry interval for certain activities. 21-day PHI.
Surround WP	20-40 lb/100 gal water	This is a kaolin clay product that is registered for organic production use as a crop protectant.
Branch and twig borer		See materials and remarks for earlier growth stages.
Leafhopper		Several compounds are registered for use on leafhoppers in grapes. A list of compounds that are regularly used is presented below.
acetamiprid (Assail)	0.05 lb ai	Do not exceed two applications per season. Allow at least 14 days between applications. 7-day PHI.
actara	1.5-3.5 oz	Do not exceed 7 oz/A per season. Allow 14 days between applications. 7-day PHI.
baythriod	2.4-3.2 fl oz	Maximum allowed per field season: 12.8 fl oz. 3-day PHI.
buprofezin (Applaud)	0.4-0.5 lb ai	Use 50-200 gal/A water. Do not exceed two applications per season, and allow 14 days between applications. 30-day PHI.
Guthion 50WSP	1.5-2 lb	Restricted use pesticide. 21-day worker reentry interval for certain activities. 21-day PHI.
imidacloprid (Provado Solupak and others)	0.035-0.05 lb ai	Each packet contains 1 oz of product. Do not exceed 2 oz/A of product per year. Allow 14 days between applications. 0-day PHI.
Provado 75WP Solupak	0.75-1 oz	Apply higher rate for heavy mealybug infestations. Do not apply more than 2 oz/A per year. Allow at least 14 days between applications. 0-day PHI.
insecticidal soap (M-Pede, others)	2% solution	Consult label for rates. 0-day PHI.
malathion (several brands)	1-2.5 lb ai	Certain grape varieties may be injured after clusters appear; check label. 3-day PHI.
malathion 5EC	3 pt	Apply as needed from mid-May to June. Leafhoppers are more common on *vinifera* and hybrid grapes. Mealybugs often are a problem in the summer. Malathion gives marginal control of leafhopper and mealybug. The EC formulation may cause phytotoxicity on leaves and fruit of certain varieties. 3-day PHI.
malathion 8EC	1-2.5 pt	
Thrips		See materials and remarks for earlier growth stages.
Grape erineum mite		The leaf strain of erineum mite has no effect on yield or quality. Heavy infestations, however, are unsightly. Sulfur used earlier for mildew control should adequately control this pest.
Stinkbugs		
endosulfan 3C (Thiodan)	1.33-2 qt	Check label before use. Severe burning may result on certain varieties. This is a legal pesticide use not found on the label. 1-day worker reentry interval. 7-day PHI.

Insect, weed, or disease/ Materials	Amount (ai or formulated) material/A	Remarks and minimum days from last application to harvest (PHI)
Leafhoppers only		
carbaryl 4F, 4L (Sevin)	2-4 pt	7-day PHI.
diazinon	1-2 pt	Restricted use pesticide. 1-day worker reentry interval. 28-day PHI.
M-Pede	1.5-2 gal/100 gal water	Do not use within three days of a sulfur application. Also provides contact kill of powdery mildew.
Provado 75WP	0.75-1 oz	Use no more than 2 oz/A per year. 0-day PHI.
Summer (late June and July, stages 71-77)		
Powdery mildew		See Table 2 and Figure 3. See Materials and Remarks for "Late spring, bloom through set" stage.
Spider mites		
Acramite 50WS	0.75-1 lb	5-day worker reentry interval for certain activities. Make only one application per season. 14-day PHI.
Fujimite	1-2 pt	Do not apply more than 50 gal water per acre. Do not apply more than 2 pt per season. 14 day-PHI.
Kelthane 50 WSP	2.5 lb	7-day PHI. Do not make more than two applications per season.
M-Pede	1.5-2 gal/100 gal water	Do not use within three days of sulfur application.
Omite 30W	5-9 lb	14-day worker reentry interval. Do not use more than twice per season. 21-day PHI.
pyridaben (Nexter and other trade names)	5.2-10.67 oz	Do not apply more than twice per season. Harmful to predatory mites. 7-day PHI.
spirodiclofen (Envidor)	0.25-0.28 lb ai	Use in at least 100 gal/A of water. Do not use more than once per season. 14-day PHI.
Vendex 50WP	1-2.5 lb	Do not use more than twice per season. 28-day PHI.
Late summer (July to August, stages 76-81)		
Powdery mildew		See Table 2 and Figure 3. See materials and remarks for late spring, bloom through set stage. Pay close attention to preharvest restrictions.
Grape mealybug		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.
Mites		See materials and remarks for earlier growth stages.
Grape rust mite		See materials and remarks for earlier growth stages.
Yellowjackets		See materials and remarks for earlier growth stages.
Beginning of berry touch (Stage 77)		
Botrytis bunch rot		See Table 2 and Figure 3
Captan 80 WDG	2.5 lb	Do not use with oil. 0-day PHI.
Elevate 50 WDG	1 lb	Do not use more than 3 lb/A per season. 0-day PHI. [3]
Endura	8 oz	Do not use more than three times per year. 14-day PHI.
JMS Stylet oil	1-2 gal/100 gal water	May aid botrytis control if used for powdery mildew. Tank mix with another fungicide.

Insect, weed, or disease/ Materials	Amount (ai or formulated) material/A	Remarks and minimum days from last application to harvest (PHI)
Rovral 4F	1-2 pt	Do not use more than twice per season. 7-day PHI. [3]
Scala SC	9-18 oz	7-day PHI. [3]
Switch 62.5 WG	11 to 14 oz	Do not use with an adjuvant. 7-day PHI.
Véraison (Stage 81)		
Botrytis bunch rot		See Table 2 and Figure 3
Captan 80WDG	2.5 lb	Do not use with oil. 0-day PHI.
Elevate 50WDG	1 lb	Do not use more than 3 lb/A per season. 0-day PHI. [3]
Endura	8 oz	Do not use more than 3 times per year. 14-day PHI.
JMS Stylet oil	1-2 gal/100 gal water	May aid botrytis control if used for powdery mildew. Tank mix with another fungicide.
Pristine	18.5-23 oz	Higher rate based on supplemental label. 14-day PHI.
Rovral 4F	1-2 pt	Do not use more than twice per season. 7-day PHI. [3]
Scala SC	9-18 oz	7-day PHI. [3]
Switch 62.5 WG	11 to 14 oz	Do not use with an adjuvant. 7-day PHI.
Preharvest (Stages 81-88)		
Botrytis bunch rot		See Table 2 and Figure 3
Botran 75W	2-4.7 lb	Fruit marking can occur on some cultivars when combined with sulfur.
Captan 80 WDG	2.5 lb	Do not use with oil. 0-day PHI.
Elevate 50 WDG	1 lb	Do not use more than 3 lb/A per season. 0-day PHI. [3]
Endura	8 oz	Do not use more than three times per year. 14-day PHI.
Pristine	8-10.5 oz	Do not make more than two consecutive applications. 14-day PHI.
Rovral 4F	1-2 pt	Do not use more than twice per season. 7-day PHI. [3]
Scala SC	9-18 oz	7-day PHI. [3]
Switch 62.5 WG	11 to 14 oz	Do not use with an adjuvant. 7-day PHI.
Vangard 75WG	5-10 oz	Buffer to a pH of 5-7 when tank mixing with Rovral. 7-day PHI. [3]
Leafroll virus		If you are concerned about vines exhibiting combined symptoms often associated with leafroll virus, such as low vigor, lack of ripening, curled leaves and red leaf discoloration (of red cultivars), collect samples for tissue virus analysis. These samples should consist of petioles from the oldest leaves, collected in August to September. Submit samples to a virus testing lab for verification. Samples may be submitted directly to the OSU Plant Clinic (http://www.science.oregonstate.edu/bpp/Plant_Clinic/index.htm). Sample submission forms can be found online.
Leafhoppers		See materials and remarks for earlier growth stages.
Phylloxera		Scout for possible infestations. Do not use soil drenches as they are ineffective for eradication due to poor penetration, especially in clay soils. [6]
Yellowjackets		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 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.

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 and Figure 3.)

   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. At this time, 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 "outgrow" 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 budbreak 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, however, when attempting to bring a vineyard with severe powdery mildew the prior year back into production.

   Fungicides vary as to the length of time they are effective at preventing infection by powdery mildew. A range of 7-14 days usually is given for sulfur, and 14-21 days for Group 3 fungicides such as Rally or Rubigan 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.

   Several programs that monitor the weather and can help growers make fungicide application decisions are available. These programs have been effective in western Oregon.

3. Fungal pathogen resistance to Elevate, Rovral, Scala, or Vangard is highly likely if only one of these products is used exclusively to control the disease. Applications at bunch close and/or véraison are the most important for disease control. Tank mix or alternate materials that have a different mode of action. Switch is already a mix of two different fungicides.

4. This publication lists chemicals as well as some other methods of pest control. It is intended to serve as a supplement to the pest management chapters published in *Oregon Viticulture* (2003). These chapters offer more complete descriptions of pests and cultural methods of pest control. This book can be purchased online through the OSU Bookstore: http://www.osubookstore.com

5. High rates of Rubigan early in the season may cause a burning of the leaf margin.

6. Symptoms of phylloxera infestation include low vigor, chlorotic foliage, 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 will increase 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 control for this pest. Avoid movement of soil and plant materials from infested vineyards to uninfested, own-rooted vineyards to prevent spread. Refer to *Grape Phylloxera: Biology & Management in the Pacific Northwest* (2009) available online at: http://extension.oregonstate.edu/catalog/pdf/ec/ec1463-e.pdf

7. Pruning during the dormant season alone should control phomopsis cane and leaf spot in most vineyards.

8. 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 (Topsin) or lack of efficacy in research conducted in the Pacific Northwest (Kaligreen).

9. Do not use Flint on Concord (*Vitis labrusca*) grapes.

10. Sovran drift may injure some sweet cherry cultivars such as Van; be very careful when spraying near cherry orchards.

11. **Herbicide Warning**: Using herbicides that contain 2,4-D or similar materials on farms involves risk, not only to the crop to which it is applied but also to crops in nearby fields. Grapevines are particularly sensitive to phenoxy herbicide damage. Phenoxy herbicides (ALS inhibitors) are synthetic plant hormones that can severely impact vine leaf and canopy development, as well as flowering and fruit set if application/drift occurs at critical times at or before bloom. However, there may be instances in which guidance in 2,4-D use will enhance weed control with minimal chance for crop injury. Be careful to clean all 2,4-D from your equipment, or use separate sprayers to avoid possible crop injury. Never use a volatile formulation of 2,4-D or similar material. Buy only a product that lists the intended crop on the label. See *Preventing Phenoxy Herbicide Damage to Grape Vineyards* (http://extension.oregonstate.edu/catalog/html/em/em8737-e/) for more information.

12. **Important note on herbicides**: Herbicides must be applied at exactly the correct rate and time to selectively control weeds with minimal chance for injuring vines. You will get more consistent results by reading the label and other information about the proper application and timing of each herbicide. 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.

13. For band applications of herbicides under vine rows, reduce the quantity of herbicide applied proportionally to the area within the row actually sprayed. Numerous tank mixes are labeled for vineyard use, or growers can assume responsibility and mix products unless the label prohibits mixing.

14. Livestock grazing in vineyards often is prohibited if herbicides have been applied for weed control.

Table 2. Effectiveness of Fungicides for Control of Grape Diseases

Fungicide	Fungicide group	Phomopsis cane and leaf spot	Powdery mildew	Botrtyis bunch rot
Adament	Group 3 + 11	Fair to good	Excellent	Slight to fair
azoxystrobin (Abound)	Group 11	Fair to good	Excellent	Slight to fair
captan (Captan, Captec)	Group M4	Excellent	Not effective	Slight
cyprodinil (Vangard)	Group 9	Not effective	Not effective	Good
DCNA (Botran)	Group 14	?	Not effective	Slight
Endura	Group 7	Not effective	Excellent	Good to excellent
fenarimol (Rubigan)	Group 3	Not effective	Good	Not effective
fenhexamid (Elevate)	Group 17	Not effective	Not effective	Good to excellent
fixed copper (several formulations)	Group M1	Slight	Moderate	Slight to none
iprodione (Rovral, Nevado)	Group 2	Not effective	Not effective	Slight to fair
kresoxim-methyl (Sovran)	Group 11	Fair to good	Excellent	Slight to fair
mancozeb (Dithane, Manzate, Penncozeb)	Group M3	Excellent	Not effective	Not effective
myclobutanil (Rally)	Group 3	Not effective	Good	Not effective
polyoxin-D (Ph-D)	Group 19	?	Good	?
potassium bicarbonates (Kaligreen)	Not classified	Not effective	Slight	Slight
Pristine	Group 11 and 3	? (fair to good)	Excellent	Good
Quintec	Group 13	Not effective	Excellent	Not effective
Scala	Group 9	Not effective	None	Good
soap (M-Pede)	Not classified	?	Good	?
sulfur (several formulations)	Group M2	Slight	Good to excellent	Not effective
Switch	Group 9 + 12	Not effective	Not effective	Good
Stylet oil (JMS)	Not classified	Not effective	Good	Slight
tebuconazole (Elite, Orius, Tebuzol)	Group 3	Not effective	Good	Not effective
Tetriconazole (Mettle)	Group 3	Not effective	Excellent	Not effective
triadimefon (Bayleton)	Group 3	Not effective	Good	Not effective
trifloxystrobin (Flint)	Group 11	Fair to good	Excellent	Slight to fair
triflumizol (Procure)	Group 3	Not effective	Excellent	Not effective
Unicorn	Group 3 + M2	Not effective	Good to excellent	Not effective
ziram (Ziram)	Group M2	Good	Not effective	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 multisite mode of action materials.

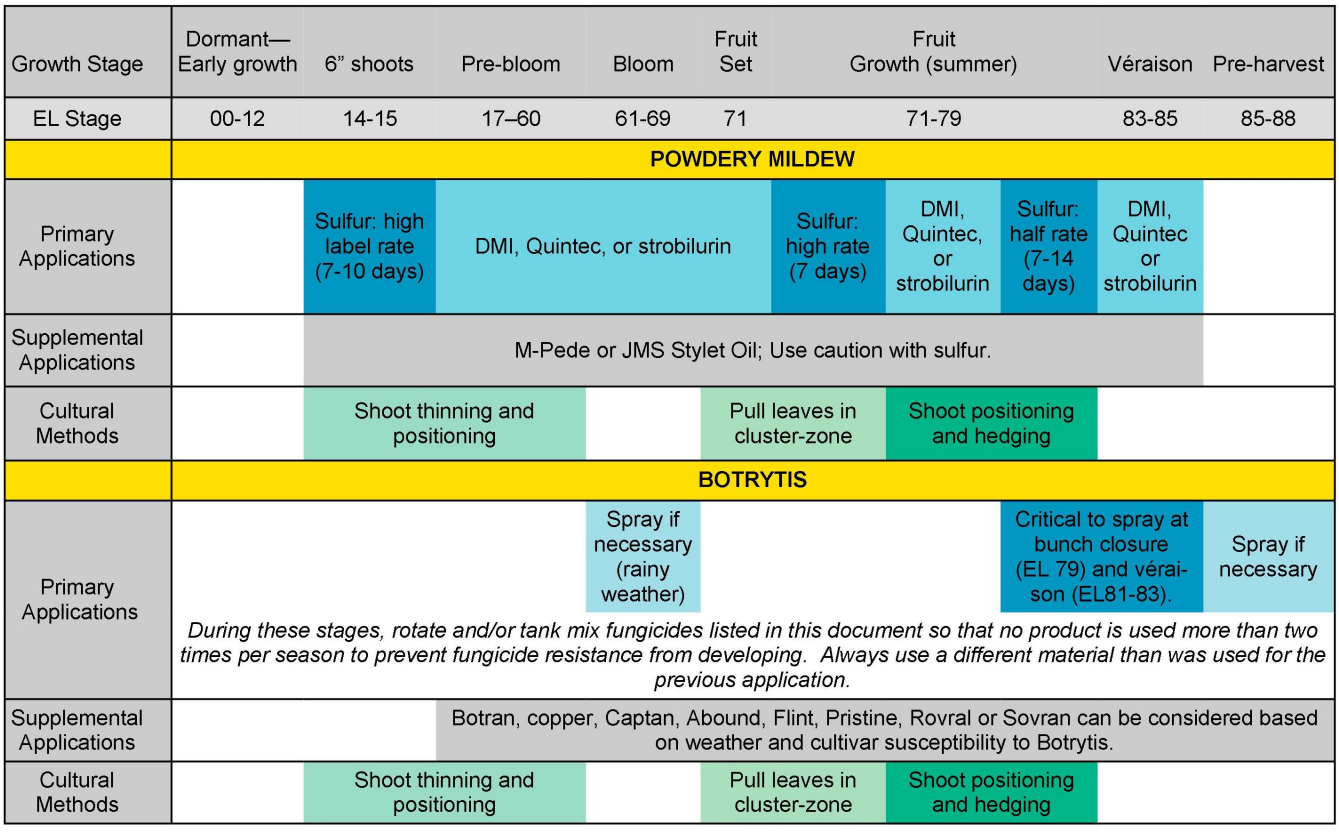
For more information about fungicides registered for use on grape and their specific modes of action, consult the following OSU Extension publication: *How to Reduce the Risk of Pesticide Resistance in Winegrape Pests in Oregon*, EM 8968, which is available online at: http://extension.oregonstate.edu/catalog/pdf/em/em8968.pdf

Powdery Mildew Strategy

- The powdery mildew spray program is based on sulfur, alternated with fungicides of various groups: DMI (Group 3), Quintec (Group 13) or strobilurin (Group 11).
- The activity of sulfur is effective from 57° to 83°F. Short (7 days) spray intervals and high rates 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, Rally, and Rubigan), Quintec (Group 13), or a strobilurin (Group 11) fungicide (Abound, Flint, or Sovran) between sulfur applications. Rally 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 three days of a sulfur application.
- Several products may already contain two different fungicides such as Adament, Pristine, or Unicorn. These also may be used in rotation, but be careful not to rotate them with products that contain the same fungicide group.
- 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 Strategy

- Cultural control practices alone have been as effective against bunch rot as fungicides alone, particularly during years of dry weather during harvest.
- Rain events dictate incidence and severity of botrytis observed. Use rain forecasts to guide applications during bloom and pre-harvest.
- Fungicides work best when used before a rain event.
- Primary products to consider in rotation and/or for tank mixing include Elevate, Endura, Scala, Switch (a mix of contact and systemic fungicides) and Vangard.
- JMS stylet oil can be tank mixed with Rovral.



Patricia A. Skinkis, © Oregon State University.

Figure 3. Example strategy for powdery mildew and botrytis control.

Table 3. Botrytis Bunch Rot of Grapes

Botrytis cinerea will infect grape berries from 53°F with as few as four 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 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 four hours, the wet periods are considered one event. If berries are dry for more than four hours, the wet periods are considered separate events.

Diseases and Pests that Require Pre-Plant Action and Continued Prevention

Some pests cause fundamental problems in vineyard survivability and can't be managed through cultural practices or pesticide spray programs as can the disease, insect and weed pests described above. Below are some major considerations with regard to two vineyard pests: viruses and nematodes. Both should be considered prior to planting a vineyard and in sustainability and longevity of vineyard blocks once established.

Grapevine Viruses

Several grapevine viruses can be detrimental to vineyard productivity. Many viruses found in infected vineyards in Oregon stem from unclean plant materials, meaning the viruses were already in the vines when they were planted. Some of the problematic viruses include grapevine leafroll virus (GLRaV), fan leaf, and rupestris stem pitting.

Not all viruses are equally destructive. In general, grapevine response to viruses can include reduced growth, reduction in fruit ripening, chlorosis, reduced photosynthesis rates, and general decline. Some viruses may even cause incompatibility between rootstock and scion, leading to rejection and death of the vine.

Vine viruses have no cure. Prevention is key. Growers are advised to plant vineyards with certified clean plant materials. Certified plants are cultured and tested to be free from specific grapevine viruses. Not all grapevines are certified. If vines are not certified, there is no guarantee they are free from viruses. Because detection methods for viruses are increasingly precise, and because new strains of viruses are being identified, there is no way to guarantee certified plant materials will always be free from virus either. Still, the first line of defense is to purchase certified stock.

When contacting nurseries to purchase plant materials, be sure to ask about their certified stock. Order well in advance to ensure availability.

Finally, certain insects and nematodes can vector (carry) viruses and infect healthy vines. Preventing infestation and movement of insect pests can help reduce the spread of viruses.

If you suspect virus in your vineyard, submit samples to a virus testing lab. See Figure 1 above for timing of sample collection. To determine whether your vineyard has grapevine leafroll virus, it is best to sample later in the season; older leaf tissues or stem tissues should be collected and submitted. Rupestris stem pitting can also be detected in late season sampling. Fanleaf virus is best detected in tissues during the spring.

Some testing labs have panels of assays to detect various viruses; inquire with each lab regarding these tests. Be sure to follow appropriate sampling timing and methods to submit tissue for specific tests. The lab you choose should provide you with sampling methods and submission. Be aware that PCR testing can be more definitive than ELISA tests.

Plant-Parasitic Grape Nematodes

Several plant-parasitic nematodes can be detrimental to vineyard productivity. In western Oregon, the ring nematode (*Mesocriconema xenoplax*) is the most commonly encountered plant-parasitic nematode. It is found in 85% of surveyed vineyards. Many of these vineyards had high population densities of the ring nematode, which may have had an impact on the establishment and growth of young vines. The ring nematode is a migratory ectoparasite that feeds on the roots of vines.

Another migratory ectoparasite commonly encountered in western and eastern Oregon is the dagger nematode (*Xiphinema americanum*). Direct feeding on grape roots by this pest may not result in direct damage to the plant, but damage can occur if it transmits tomato ringspot virus to the grapevines.

Another nematode of economic importance in Oregon vineyards in the root-knot nematode (*Meloidogyne hapla*). This nematode is more commonly found in vineyards in eastern Oregon. The root-knot nematode is a sedentary endoparasite that invades roots and causes them to gall, reducing the plant's ability to take up water and nutrients.

Other nematodes reported to be associated with grapevines in Oregon include root lesion (*Pratylenchus* spp.) and pin (*Paratylenchus* spp.) nematodes.

Once a plant-parasitic nematode population is established in a vineyard it is very difficult to eliminate. Therefore, prevention is critical. Only planting stock certified free from plant-parasitic nematodes should be used. Care should be taken not to transport nematodes from vineyard to vineyard on dirty equipment. Prior to establishing a vineyard, soil samples should be collected and sent to a commercial nematode diagnostics laboratory to determine if plant-parasitic nematodes are present and, if so, at what density. In eastern Oregon the best time to sample for nematodes is in the fall, while in western Oregon *X. americanum* populations tend to be at their highest in the spring. The only time when broad-spectrum fumigants can be applied to manage plant-parasitic nematode populations is prior to establishing vines.

Rootstock selection is another key consideration prior to establishing a vineyard, if plant-parasitic nematodes are detected. Current information about rootstock nematode resistance is available only for the ring nematode. The rootstocks "420A" and "101-14" are highly resistant to ring nematode, while "110R" is moderately resistant to ring nematode.

Once a vineyard is established there are few post-plant management practices that consistently and effectively reduce plant-parasitic nematode damage to established vines.

Table 4. Control of Vertebrate Pests in Grapes

Control method/Product	Time of application	Remarks
Birds (late summer, fall—during ripening)		
Scare devices and hazing	Before damage occurs	Place in vineyard: distress calls, exploder guns, cracker shells, foil, kites, eye spot balloons. The USDA-APHIS (Animal and Plant Health Inspection Service) can be a valuable resource for management of wildlife damage to agricultural crops. Contact a local or regional specialist for assistance: http://www.aphis.usda.gov/wildlife_damage/
Shooting and other direct control	Before grapes ripen	It's illegal to shoot *migratory* birds without a permit from the U.S. Fish and Wildlife Service. See comment above about APHIS.
Netting	Before grapes ripen	Place on each side of canopy or drape over canopy; support above vines on a frame. Remove just before harvest. Labor costs may be high. Net costs $800/A or more. Add labor costs for installation and removal. Net life: 7-15 years. Nearly 100% effective.
Predators	Before grapes ripen	Raptors have been used with limited efficacy in some vineyard sites. They take a long time to establish residence (nesting) in the vineyard and can be costly.

Control method/Product	Time of application	Remarks
Deer (spring, fall)		
Repellents		
Thiram (TMTO) Repel Deer-Away	—	Spray on shoots browsed by deer. Repeat applications necessary as new shoots grow. Most repellents require reapplication following precipitation.
Blood meal, human hair, soaps	—	Deer may become habituated to smells.
Fences		
- Electric (several strands, 6-8' high) - Woven wire (6" woven wire to 7' high, topped with barbed wire).	—	Height of fence may need to be 8' or higher in areas where topography creates crossing opportunities.
Ground squirrels		
Trapping		
#110 Conibear trap	—	Don't use in areas frequented by pets or children.
Gassing		
Rotox AP or AT [1]		
The Giant Destroyer	—	Close burrows in morning, reopen, place toxin, and reclose. Repeat daily until activity ceases.
Poison baiting		**Note**: Place bait in runways and burrow openings. Bait may poison nontarget animals. Apply baits only in bait stations in areas inaccessible to pets and children. Refill stations daily until bait no longer is consumed. Bury or burn all carcasses. Restrict all grazing animals from pastures for at least 30 days after completing baiting operations.
Ramik Green (0.005% diphacinone)	—	Check legal use dates: http://www.oregon.gov/ODA/PEST/
Zinc phosphide 2% [1]	—	—
ORCO Patrol Ground Squirrel Bait (0.005% chlorophacinone)	—	—
Voles (meadow mice)		
Hand baiting		**Note**: Place bait in runways and burrow openings. Bait may poison nontarget animals.
Zinc phosphide [1]	When voles are active	—
Diphacinone	When voles are active	—
Cholecalciferol	When voles are active	—
Mechanical burrow baiting		
Zinc phosphide [1]		Soil must be moist so that artificial runways, 12-14" deep, remain intact. Build burrows close to trunks on each side of the row.
Mountain beaver		
Trapping		
#110 Conibear	Preferably before breeding in spring	Most trapping will occur October–February.
Pocket gophers		
Trapping		
Victor or Macabee, cinch trap	Autumn or spring	[3]

Control method/Product	Time of application	Remarks
Poison baiting		**Note**: Apply in fresh burrow systems and check for reinvasion. Poisons are mixed with seeds and impregnated with wax. Place in main runways.
Strychnine [1, 2]	Late winter, early spring	—
Chlorophacinone	Late winter, early spring	—
Diphacinone	Late winter, early spring	—
Mechanical burrow baiting		
1 oz strychnine [1, 2] in steam-crushed oat or milo grains added to 10 lb grain (1-2 lb bait/A)	Late winter, early spring	Use burrow builder for large areas. [3] Build tunnels 6-10" deep in moist soil. Dispense bait every 5-10' in burrows 20-30' apart.
Gassing		**Note**: Not recommended for sandy or dry soils. Two cartridges or small piles of pellets per tunnel. If you use gas cartridges, cover breathing holes of burrows.
The Giant Destroyer (46% sodium nitrate, 35% sulfur, and 87% carbon)	—	—
Detia Rotox AP (pellets) and AT (tablets), 57% aluminum phosphide [1]	—	—
Propane burner		
0.5 cup dusting sulfur per burrow	—	More effective than gassing. Ignite with propane burner. Avoid inhaling sulfur fumes. Seal all entrances to burrow. Soil should be damp.
Rabbits		
Fencing	—	Use a sturdy small mesh. Most effective when constructed to prevent under-digging. Extend fencing 2' above ground and 8" below ground.
Vine guards	—	—
Repellents		
Thiram (TMTO)	—	Spray on shoots browsed by rabbits. Repeat applications necessary as new shoots grow.

Table 4. Footnotes

1. Restricted use.
2. Check with your farm consultant, farm co-op or local Extension agent for sources; registered for below-ground use only.
3. This publication lists chemicals as well as other methods of pest control. It's intended to serve as a supplement to the pest management chapters published in *Oregon Viticulture* (2003). These chapters have more complete descriptions of pests and more complete information on cultural methods of pest control. The book is available at: http://www.osubookstore.com

Pest Management Strategies: Pre-Plant and Vineyard Establishment

Prior to planting a vineyard, the land needs to be managed for key pests to achieve successful plant growth in the first few years. We assume a vineyard has been selected based on appropriate suitability and has no limiting nematode populations.

The information in Table 5, below, is meant to supplement other guides with basic vineyard establishment information on soil testing, fence construction, and more. In this section, we highlight the herbicide products available for weed control during pre-plant and establishment. Other herbicide recommendations for bearing vineyards are listed in Table 2.

Herbicide-use is often contingent upon the age of the vineyard. Some products can only be used in non-bearing vineyards, or have restrictions with regard to timing and the first harvest year. Read product labels closely to ensure proper use of the product.

Table 5. Weed Control Pre-Plant and in Establishment Years

Insect or disease/Materials	Amount (ai or formulated) material/A	Remarks and minimum days from last application to harvest (PHI)
Pre-Planting (year 0)		
diquat (Reglone)	24-32 oz/A	For use in non-bearing vineyards only. Apply to completely cover foliage of rapidly growing weeds. Add a nonionic surfactant.
glyphosate (Roundup and other products and formulations)	Consult label	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 under stress from drought, weather, or maturity.
trifluralin (Treflan and others)	0.5-1.0 lb ai/A	Apply pre-plant and incorporate immediately by cross-disking or rototilling.12-hour reentry. Use lower rates on sandy soils or soil containing low organic matter levels.
New plantings (years 1-3)		
bentazon (Basagran)	0.75-1.0 lb ai/A	For use in non-bearing vineyards only. Provides post-emergence control of broadleaf weeds, Canada thistle, yellow nutsedge, and musk thistle either before or during nonbearing stages of crop 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 apply within 1 year of harvest. Do not exceed 4 lb/A total per season.
clethodim (Prism or Envoy)	12-32 fl oz/A	For use in non-bearing 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.
glufosinate (Rely)	0.75-1.25 lb ai/A	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).
glyphosate (Roundup and other products)	Consult label	Apply to actively growing weeds either as site preparation or in non-bearing 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.

Insect or disease/Materials	Amount (ai or formulated) material/A	Remarks and minimum days from last application to harvest (PHI)
fluazifop (Fusillade DX)	Refer to label for rate based on grass species to be controlled.	For use in non-bearing vineyards only. Apply to actively growing grasses, or within seven 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 to vineyards that will be harvested within one year of treatment.
isoxaben + trifluralin (Snapshot 2.5 TG)	100-200 lb product/A	For use in non-bearing 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.
napropamide (Devrinol)	4 lb ai/A	Preemergent herbicide. Apply after planting to firm soil, before weeds germinate. Requires rain or irrigation the day of treatment to wet the soil 2-4 inches deep to reduce degradation by the sun and to activate the herbicide. Where convenient, shallow mechanical incorporation appears to improve activity. Avoid exposure of transplant roots contacting soil. Light-sensitive and can photo-decompose after 4 days. Low residual activity. Only one application can be made annually.
oryzalin (Surflan)	2-4.7 lb ai/A	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.
oxyfluorfen (Goal 2XL)	0.5-2.0 lb ai/A (1-4 qt product/A)	Apply only to vineyards with healthy vines. 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 three 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 post-emergence depending on rate of application and weed species.
pendimethalin (Prowl or Pendulum)	2-4 lb ai/A	For use in non-bearing vineyards only. Pre-emergent herbicide. Apply to newly planted grapes before buds swell, and after ground settles around vines and cracks are gone. Spray directly on the ground beneath vines. Overhead irrigation or rain is required within seven days for herbicide activation. Affects weeds as they germinate. Do not feed forage or graze livestock.
sethoxydim (Poast)	0.28-0.47 lb ai/A (1.5-2.5 qt product/A)	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. 50-days PHI. Do not exceed 5 pt/A per season.

Vineyard Airblast Sprayer Calibration Worksheet

Sprayers must be calibrated at least once per season. This is vital to ensure 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)_____ft x 60 sec/min] ÷ [(B)_____sec] = (C) _____**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)_____ft/min x (E)_____gal/A x (F)_____ft] ÷ 43,560 sq ft/A = **(G)** _____ **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		**Right side**	
Nozzle #1	_____ gal/min	Nozzle #1	_____ gal/min
Nozzle #2	_____ gal/min	Nozzle #2	_____ gal/min
Nozzle #3	_____ gal/min	Nozzle #3	_____ gal/min
Nozzle #4	_____ gal/min	Nozzle #4	_____ gal/min
Nozzle #5	_____ gal/min	Nozzle #5	_____ gal/min
Nozzle #6	_____ gal/min	Nozzle #6	_____ gal/min
Nozzle #7	_____ gal/min	Nozzle #7	_____ gal/min

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

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 sq ft x (I)_____gal] ÷ [(F)_____ft x (A)_____ft] = (J) _____ **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.) per acre

[(K) _____ gal total volume] ÷ [(J) _____ gal/A] = (M) _____ acres treated x (L) _____ = **quantity of pesticide needed in spray mixture**

Pest Management Resources

Grape production

OSU Viticulture & Enology Program
http://wine.oregonstate.edu

Northwest Berry & Grape Information Network
http://berrygrape.org

Oregon Viticulture, a reference book edited by Ed Hellman, serves as a good introduction and practical guide to vineyard production in Oregon.

Pest management handbooks

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

Pacific Northwest Plant Disease Management Handbook
http://plant-disease.ippc.orst.edu/index.cfm

Pacific Northwest Insect Management Handbook
http://uspest.org/pnw/insects/07SMFR08.dat

Pacific Northwest Weed Management Handbook
http://weeds.ippc.orst.edu/pnw/weeds

Note: All chemicals marked with (O) in the Pacific Northwest Plant Disease Management Handbook are allowed products listed by the Organic Materials Review Institute (OMRI) and/or the USDA Organic Program. The listed cultural and biological management tactics are also organically acceptable.

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 the following online databases for information. Product labels can also be downloaded on many of the following sites:

PICOL – Pesticide Information Center Online
http://picol.cahe.wsu.edu/LabelTolerance.html

CDMS – Crop Data Management Systems
http://www.cdms.net/LabelsMsds/LMDefault.aspx

Oregon Department of Agriculture – Pesticide Division
http://www.oregon.gov/ODA/PEST/

Search for pesticides registered in Oregon:
http://oda.state.or.us/dbs/pest_productsL2K/search.lasso

Organic, Sustainable, and Integrated Production Resources

Demeter Association

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

Mailing address

Demeter Association, Inc.
P.O. Box 1390
Philomath, OR 97370

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/files/DemeterFarmStandardsm1.pdf

Food Alliance

Web: http://www.foodalliance.org

E-mail: info@foodalliance.org

Mailing address:

Food Alliance
1829 NE Alberta, Suite 5
Portland, OR 97211

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

E-mail: Check website for officer contact information.

Mailing address: Check website for contact information.

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

Phone: 503-584-7274

Mailing address:
LIVE
P.O. Box 5185
Salem, OR 97304

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.

National Organic Program (NOP)

Online standards:
http://www.ams.usda.gov/nop/indexIE.htm

Go to: Subpart G Administrative, page 246, The National List of Allowed and Prohibitive Substances
http://www.ams.usda.gov/nop/NOP/standards/ListReg.html
Description of Regulations

E-mail: NOPAQSS@usda.gov

Mailing address:
National Organic Program
Room 4008-South Building
1400 Independence Avenue, SW
Washington, DC 20250-0020

Purpose: Subpart G contains criteria for determining which substances and ingredients are allowed or prohibited in products to be sold, labeled, or represented as "organic" or "made with organic (specified ingredients or food group(s))."

Evaluation criteria: The National List identifies specific substances that may or may not be used in organic production and handling operations. 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://www.tilth.org

E-mail: organic@tilth.org

Mailing address:
Oregon Tilth, Main Office
260 SW Madison Ave, Ste 106
Corvallis, OR 97333
Phone: 503.378.0690
Fax: 541.753.4924

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

Mailing address:
OMRI
P.O. Box 11558
Eugene, OR 97440

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

Mailing address:
Salmon-Safe, Inc.
805 S.E. 32nd Ave.
Portland, OR 97214

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.

Basic Elements of Safe Pesticide Use

- Always read the label with care. This is the first step in selecting the right material for the job. Never rely on your memory. Before opening the container, pay strict attention to warnings and cautions printed on the label.
- Keep all pesticide and spray materials out of the reach of children, pets, and irresponsible persons. Storage outside of the home, away from food and feed, and under lock and key is the safest method.
- Store pesticides only in the original container. Keep tightly closed.
- NEVER smoke, eat, or drink while applying pesticides.
- Avoid inhalation or direct contact. Always wear protective clothing and safety devices as recommended on the label.
- Avoid spills. If spills occur, take immediate action to remove contaminated clothing and wash thoroughly.
- After each application, bathe and change to clean clothing. Wash clothing after each use. Always use fresh clothing when starting new application.
- Avoid contamination of fish ponds and water supplies. Cover feed and water containers when treating around livestock or pet areas.
- Keep separate equipment for use with hormone-type herbicides to avoid accidental injury to susceptible plants. Also avoid applications under wind conditions that could create drift to nontarget areas.
- Rinse empty containers three times before disposing of them. Add the rinse to the spray tank and dispose of containers according to local regulations to avoid hazard to humans, animals, and the environment.
- Follow label directions for mixing and application to keep residues within the limits prescribed by law.
- Plan ahead. Discuss with your physician the materials you will be using during the season so that he or she can be prepared to provide the appropriate treatment in case of accidental exposure. If symptoms of illness occur, call the physician or get the patient to a hospital immediately. Always provide the medical personnel with as much information as possible.
- Be cautious when you apply pesticides. Know your legal responsibility as a pesticide applicator. You may be liable for injury or damage resulting from pesticide use.

Oregon Poison Center
The Oregon Health and Science University
Room CB 550
3181 S.W. Sam Jackson Park Road
Portland, OR 97201
Phone: 503-494-8600
Toll Free: 1-800-222-1222

If a person has collapsed or has stopped breathing, dial 911.

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