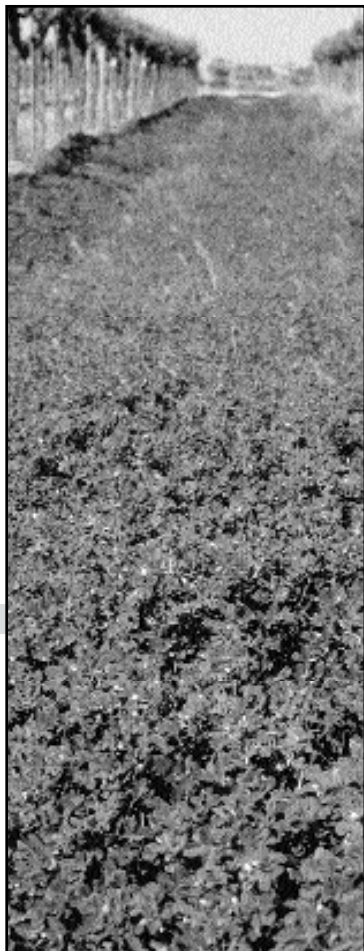


# Cover Crop Species and Descriptions

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Because grapes are grown in many agricultural regions and climates of California, cover crop characteristics vary depending on location. For example, cover crops generally mature earlier in Southern California than in Northern California; and growth and maturation may vary within and among regions due to variations in soil moisture availability, soil characteristics, and cultural practices. However, differences among species and cultivars are often consistent in a given location. Because of the widespread interest in cover cropping, new cultivars and accessions are introduced each year. In time, growers will have many more cover crops from which to choose.

The species descriptions in this chapter should be used as general guidelines only. A species or mix that has not been used in the vineyard should be tested on a few rows if there is uncertainty about its performance. Ideally, it should be tested for 2 or more years due to climatic variability from year to year. Table 2-1 provides information on the cover crop species described in this chapter (see also Bugg and Van Horn 1998), and table 2-2 provides seeding

information for these species.

## Monocultures versus Mixes

Monocultures of sown cover crops are often used in vineyards. Monocultures may be preferred where the species has a history of proven performance, enabling the grower to limit the seed purchase and culture to a single well-adapted species. The use of monocultures is a common practice with several species, such as cereals, 'Blando' brome, and bur medic. Self-reseeding stands of bur medic have persisted for over 40 years.

Single-species plantings should usually be rotated to reduce the potential for buildup of insects, pathogens, or weeds associated with that species. For example, vetch stands may be reduced by soilborne diseases if sown repeatedly. Cereal diseases often increase when the same crop or cultivar is used year after year. In some years, Egyptian alfalfa weevil can be a serious pest of bur medic. Local environmental variations, such as sandy or clay soils with differing soil nutrient availability or drain-

**Table 2-1. Selected characteristics of vineyard cover crops**

Scientific name	Common name	Relative seedling vigor	Growth habit	Maximum height (in)*	Time of flowering	Time of maturity
<b>Winter annuals for tilled vineyards</b>						
<b>Legumes</b>						
<i>Pisum sativum</i>	field pea	mod. to high	viny	18–30	Mar–May	May–Jun
<i>Trifolium alexandrinum</i>	berseem clover	mod.	erect	18–30	May–Jun	Jun–Jul
<i>Vicia benghalensis</i>	purple vetch	high	viny	18–24	Apr–May	May–Jun
<i>Vicia faba</i>	bell (fava) bean	high	erect	36–84	Mar–May	May–Jun
<i>Vicia sativa</i>	common vetch	mod.	viny	18–24	Apr–May	May–Jun
<i>Vicia sativa</i> × <i>Vicia cordata</i>	‘Cahaba White’ vetch	mod.	viny	18–24	Apr–May	May–Jun
<i>Vicia villosa</i>	hairy vetch	high	viny	18–24	Apr–May	May–Jun
<i>Vicia villosa</i> ssp. <i>dasycarpa</i>	woollypod vetch	high	viny	18–24	Mar–May	Apr–Jun
<b>Grasses</b>						
<i>Avena sativa</i>	oat	high	erect	24–60	Apr–May	May–Jun
<i>Hordeum vulgare</i>	barley	high	erect	24–36	Apr–May	May–Jun
<i>Lolium multiflorum</i>	annual ryegrass	high	erect	36–48	Apr–May	Jun–Aug
<i>Secale cereale</i> cv. ‘Merced’	cereal rye	high	erect	36–72	Feb–Apr	Apr–May
<i>Triticum aestivum</i>	wheat	high	erect	24–40	Apr–May	May–Jun
× <i>Triticosecale</i>	triticale	high	erect	24–60	Apr–May	May–Jun
<b>Forbs</b>						
<i>Brassica</i> spp.	brassicas	high	erect	24–60	Mar–May	Apr–Jun
<i>Phacelia tanacetifolia</i>	tansy phacelia	high	semierect	12–36	Mar–May	May–Jun
<b>Winter annuals for no-till vineyards</b>						
<b>Legumes</b>						
<i>Medicago polymorpha</i>	bur medic (burclover)	mod.	prostrate to erect	6–15	Feb–Apr	Apr–May
<i>Trifolium hirtum</i>	rose clover	mod.	erect	8–15	Mar–Apr	May–Jun
<i>Trifolium incarnatum</i>	crimson clover	mod.	erect	12–20	Apr–May	May–Jun
<i>Trifolium subterraneum</i>	subterranean clover	mod.	prostrate to semierect	6–15	Mar–May	Apr–Jun
<b>Grasses</b>						
<i>Bromus hordeaceus</i> ssp. <i>molliformis</i>	soft chess (‘Blando’ brome)	high	erect	12–30	Mar–Apr	Apr–May
<i>Vulpia myuros</i> var. <i>hirsuta</i>	foxtail fescue (‘Zorro’ fescue)	high	erect	12–24	Mar–Apr	Apr
<b>Perennials for no-till vineyards</b>						
<b>Legumes</b>						
<i>Lotus corniculatus</i>	birdsfoot trefoil	very low	semierect	12–24	Jun–Sep	Jul–Oct
<i>Trifolium fragiferum</i>	strawberry clover	low	prostrate	8–12	Jun–Jul	Jul–Aug
<i>Trifolium repens</i>	white clover	low	prostrate	8–12	May–Jul	Jul–Aug
<b>Grasses</b>						
<i>Bromus carinatus</i>	California brome	mod.	erect	20–47	Apr–May	May–Jun
<i>Dactylis glomerata</i>	orchardgrass	low	semierect to erect	24–48	Mar–Apr	Apr–May
<i>Elymus glaucus</i>	blue wildrye	mod.	erect	24–48	Apr–May	May–Jun
<i>Festuca arundinacea</i>	tall fescue	high	erect	24–48	Mar–Apr	Apr–May
<i>Festuca idahoensis</i>	Idaho fescue	very low	tufted	12–40	Apr–May	May–Jun
<i>Festuca ovina</i>	sheep/hard fescue	low	tufted	3–10	Mar–Apr	Apr–May
<i>Festuca rubra</i>	red fescue	very low	tufted to erect	16–40	Mar–Apr	Apr–May
<i>Hordeum brachyantherum</i> ssp. <i>brachyantherum</i>	meadow barley	mod.	erect	8–28	Mar–Apr	Apr–May
<i>Hordeum brachyantherum</i> ssp. <i>californicum</i>	California barley	mod.	semierect to erect	12–24	Mar–Apr	Apr–May
<i>Lolium perenne</i>	perennial ryegrass	high	semierect to erect	12–30	May–Sep	Jun–Oct
<i>Melica californica</i>	California melic	very low	erect	24–36	Apr	May–Jun
<i>Nassella cernua</i>	nodding needlegrass	very low	erect	24–36	Apr–May	May–Jun
<i>Nassella pulchra</i>	purple needlegrass	very low	tufted	16–40	Mar–Apr	Apr–May
<i>Poa secunda</i> ssp. <i>secunda</i>	pine bluegrass	very low	tufted	20–40	Mar–Apr	Apr–May

**Table 2-1. continued**

Summer annuals for tilled vineyards						
Scientific name	Common name	Relative seedling vigor	Growth habit	Maximum height (in)*	Time of first flowering (days after seed)	
<i>Fagopyrum esculentum</i>	buckwheat	high	erect	12–24	25–30	
<i>Sorghum sudanense</i>	sudangrass	high	erect	36–120	60–80	
<i>Sorghum vulgare</i> × <i>S. sudanense</i>	sorghum-sudangrass	high	erect	36–120	60–80	
<i>Vigna unguiculata</i> ssp. <i>unguiculata</i>	cowpea	high	erect to suberect	12–36	60–70	

Note: The characteristics listed apply to the most common varieties used in California. Characteristics may vary greatly by location and cultivar.  
 \* Maximum heights indicate typical height to top of plant or inflorescence in an unmowed monocultural stand.

**Table 2-2. Seeding information for vineyard cover crops**

Scientific name	Common name	Suggested cultivars*	Inoculant type <sup>†</sup>	Approximate number of seeds/lb	Seeding rate (lb/seeded acre) <sup>‡</sup>	Price (\$/lb) <sup>§</sup>	Approx. (\$/seeded acre) <sup>#</sup>
Winter annuals for tilled vineyards							
Legumes							
<i>Pisum sativum</i>	field pea	‘Austrian Winter,’ ‘Magnus,’ ‘Miranda’	C	1,800–3,000	70–100	0.40	28–48
<i>Trifolium alexandrinum</i>	berseem clover	‘Multicut,’ ‘Joe Burton’	special culture #1 for <i>Trifolium</i>	206,900**	15–20	1.65	25–33
<i>Vicia benghalensis</i>	purple vetch	—	C	10,000	40–60	0.75	30–45
<i>Vicia faba</i>	bell (fava) bean	—	Q	3,000	100–150	0.32	32–49
<i>Vicia sativa</i>	common vetch	—	C	8,000	40–80	0.65	26–52
<i>Vicia sativa</i> × <i>Vicia cordata</i>	‘Cahaba White’ vetch	—	C	—	50–80	0.94	47–75
<i>Vicia villosa</i>	hairy vetch	—	C	16,300	30–50	0.70	21–35
<i>Vicia villosa</i> ssp. <i>dasycarpa</i>	woollypod vetch	‘Lana’	C	11,400	40–60	0.90	36–54
Grasses							
<i>Avena sativa</i>	oat	‘California Red,’ ‘Cayuse,’ ‘Montezuma,’ ‘Ogle,’ ‘Swan’	—	16,000–22,800	100–120	0.23	23–28
<i>Hordeum vulgare</i>	barley	‘UC 476,’ ‘UC 603’	—	13,600	80–100	0.18	14–18
<i>Lolium multiflorum</i>	annual ryegrass	‘Common,’ ‘Gulf,’ ‘Wimmera 62’	—	190,000	20–35	0.50	10–18
<i>Secale cereale</i>	cereal rye	‘Merced’	—	18,200	60–120	0.32	19–38
<i>Triticum aestivum</i>	wheat	‘Anza’	—	11,400	100–120	0.18	18–22
× <i>Triticosecale</i>	triticale	‘Juan’	—	12,000	100–120	0.28	28–34
Forbs							
<i>Brassica</i> spp.	brassicas	—	—	104,000–570,000	5–12	1.00–2.00	5–24
<i>Phacelia tanacetifolia</i>	tansy phacelia	‘Phaci’	—	824,000	10–15	2.00	20–30
Mixes							
—	vetch-pea-bell bean	—	—	—	80–120	0.50	40–60
—	vetch-pea-bell bean-cereal	—	—	—	80–100	0.43	34–43

Table 2-2. continued

Scientific name	Common name	Suggested cultivars*	Inoculant type†	Approximate number of seeds/lb	Seeding rate (lb/seeded acre)‡	Price (\$/lb)\$	Approx. cost (\$/seeded acre)#
<b>Winter annuals for no-till vineyards</b>							
<b>Legumes</b>							
<i>Medicago polymorpha</i>	bur medic (burclover)	'Santiago,' 'Circle Valley,' 'Serena'	<i>Medicago</i>	170,400**	15–20 special # 1	1.80	27–36
<i>Trifolium hirtum</i>	rose clover	'Hykon,' 'Kondinin,' 'Overton,' 'Wilton'	WR	164,500**	15–20	2.20	33–44
<i>Trifolium incarnatum</i>	crimson clover	'Dixie,' 'Flame'	R	150,000**	15–25	1.70	26–43
<i>Trifolium subterraneum</i>	subterranean clover	'Clare,' 'Koala,' 'Karridale,' 'Mt. Barker,' 'Nungarin,' 'Trikkala'	WR	110,000**	20–25	1.80	36–45
<b>Grasses</b>							
<i>Bromus hordeaceus</i> ssp. <i>molliformis</i>	'Blando' brome (soft chess)	—	—	251,800	10–15	2.75	28–41
<i>Vulpia myuros</i> var. <i>hirsuta</i>	'Zorro' fescue (foxtail fescue)	—	—	990,000	8–12	7.00	56–84
<b>Mix</b>							
—	annual clovers-medics	—	—	—	25–30	2.00	50–60
<b>Perennials for no-till vineyards</b>							
<b>Legumes</b>							
<i>Lotus corniculatus</i>	birdsfoot trefoil	'Empire,' 'Viking'	K	375,100**	5–12	3.50	18–42
<i>Trifolium fragiferum</i>	strawberry clover	'Salina'	<i>Trifolium</i> special culture #6	288,100**	10–15	3.75	38–56
<i>Trifolium repens</i>	white clover	'New Zealand,' 'Dutch White,' 'Ladino,' 'Huia'	B	800,100**	5–12	2.75	14–33
<b>Grasses</b>							
<i>Bromus carinatus</i>	California brome	—	—	103,700	15–20	5.50–7.00	83–140
<i>Dactylis glomerata</i>	orchardgrass	'Berber'	—	425,000	20–25	2.60	52–65
<i>Elymus glaucus</i>	blue wildrye	'Anderson,' 'Berkeley'	—	134,900	20–25	8.50–11.00	170–275
<i>Festuca arundinacea</i>	tall fescue	'Fawn,' turf types ('Bonsai,' 'Rebel')	—	200,000	20–30	1.40	28–42
<i>Festuca idahoensis</i>	Idaho fescue	—	—	450,000	20	17.50–20.00	350–400
<i>Festuca ovina</i>	sheep fescue	'Covar'	—	530,300	15–20	3.75	56–75
<i>Festuca ovina</i> var. <i>duriuscula</i>	hard fescue	'Durar,' 'Eureka'	—	591,900	15–20	3.25	49–65
<i>Festuca rubra</i> var. <i>commutata</i>	chewings fescue	—	—	450,000	20–25	1.65	30–38
<i>Festuca rubra</i>	creeping red fescue	—	—	365,000	20–25	1.50	30–38
<i>Festuca rubra</i>	'Molate' fescue	—	—	450,000	20	8.00–10.00	160–220
<i>Festuca rubra</i>	'Mokelumne' fescue	—	—	450,000	20	10.00–20.00	200–400

Table 2-2, continued

Scientific name	Common name	Suggested cultivars*	Inoculant type†	Approximate number of seeds/lb	Seeding rate (lb/seeded acre)‡	Price (\$/lb)§	Approx. cost \$/seeded acre#
<i>Hordeum brachyantherum</i> ssp. <i>brachyantherum</i>	meadow barley	—	—	100,800	20–25	9.00–14.00	180–350
<i>Hordeum brachyantherum</i> ssp. <i>californicum</i>	California barley	—	—	127,000	20–25	9.50–14.00	190–350
<i>Lolium perenne</i>	perennial ryegrass	‘Elka’	—	240,000	25–35	1.30	33–46
<i>Melica californica</i>	California melic	—	—	450,000	15	15.00–22.00	225–330
<i>Nassella cernua</i>	nodding needlegrass	—	—	223,700††	15	25.00–35.00	375–525
<i>Nassella pulchra</i>	purple needlegrass	—	—	109,700††	15	27.00–35.00	405–525
<i>Poa secunda</i> ssp. <i>secunda</i>	pine bluegrass	—	—	1,047,000	15	15.00–25.00	225–375
<b>Mixes</b>							
—	“Big 3” (California brome, blue wildrye, California barley, meadow barley)	—	—	—	20–30	8.50–11.00	170–330
—	“Little 3” (Idaho fescue, ‘Molate’ fescue, ‘Mokelumne’ fescue, pine bluegrass)	—	—	—	15–25	12.50–17.00	188–425
—	perennial clovers	—	—	—	12–20	2.65	32–53
—	perennial grass sod	—	—	—	30–40	1.50	45–60
<b>Summer annuals for tilled vineyards</b>							
<i>Fagopyrum esculentum</i>	buckwheat	‘Mancan,’ ‘Manor’	—	20,400	20–30	0.70	14–21
<i>Sorghum sudanense</i>	sudangrass	‘Piper’	—	44,000	25–30	0.60	15–18
<i>Sorghum vulgare</i> × <i>S. sudanense</i>	sorghum-sudangrass	‘Sudax’	—	17,000	25–30	0.65	16–20
<i>Vigna unguiculata</i> ssp. <i>unguiculata</i>	cowpea	‘CB5,’ ‘Chinese Red,’ ‘Iron and Clay’	EL	2,000–4,000	40–60	0.85	34–51

\* When possible, choose cultivars that are adapted to local climate and soil.

† Legumes only.

‡ Seeding rates vary with local conditions and planting date. Check with local seed supplier for the most appropriate rates.

§ Average seed prices shown are for January 1998 and are included to show relative seed costs. Prices may vary greatly from year to year due to changing supply and demand, improved harvesting technology, or other factors. Prices may also vary among suppliers. Check with local seed supplier for current prices.

# To obtain cost per vineyard acre, multiply cost per seeded acre by percent of vine row spacing actually seeded.

\*\* Number of seeds per pound for small-seeded legumes is for seed that have not been preinoculated. To obtain numbers of preinoculated seed per pound, multiply by approximately 0.67 (e.g., in a 100-lb bag of preinoculated seed, about two-thirds of the weight is seed and one-third is inoculum).

†† Weights for nodding needlegrass and purple needlegrass are for de-awned seed. To obtain approximate weights of seed with awns still attached, multiply by approximately 0.6.

age characteristics, may also limit growth of a single species. Providing different species in a mix may enable one species to thrive in areas where another might be weak, increasing the chances for a healthy stand throughout the vineyard. Vigorous polyculture stands may also reduce weeds that would otherwise fill the voids in the stand and may also attract a diversity of beneficial arthropods that may aid in pest management. However, the effects of polycultures versus monocultures on arthropod pests have not been tested in California vineyards.

Legume-grass mixtures complement each other in their soil-improving functions. Although both plant types take up soil nitrogen, grasses are usually much more efficient at doing so. As a result, legumes derive more nitrogen from nitrogen fixation than from soil uptake when they are grown with grasses. Typically, though not always, such mixes result in less total nitrogen fixed than would be the case in pure legume stands, simply because less legume biomass is produced. Cereals such as oat and barley also provide structural support for the trailing vetches and peas. The fragile stems of 'Blando' brome and 'Zorro' fescue do not support vetch and are seldom used in mixes with vetches. However, these two species are compatible with bur medic and annual clovers and with low densities of vetch. Dozens of grass-legume blends and seeding rates have been used, including annual-perennial combinations.

California native perennial grasses grown in vineyard middles are typically used in mixtures, with plant species or accessions of like stature grouped together. Because some species are short-lived, it is important to allow them to reseed in the vineyard. Although individual native grass species have been evaluated, mixes have received limited attention from researchers, and there is currently no published data on their use in vineyards. These species are increasingly being sown in vineyards mainly from the northern San Joaquin Valley northward. Seedling growth of many species is relatively slow, so native grasses are susceptible to weed competition during establishment. The lower-growing mixes may contain pine bluegrass, Idaho fescue, 'Molate' fescue, or a prostrate form of California barley. These grasses mature relatively early and are summer-dormant in hot, dry climates, although 'Molate' fescue will persist with irrigation. This is

thought to reduce competition for water with the vines. Taller species include meadow barley, blue wildrye, California brome, California melic, and purple needlegrass. Due to greater seedling vigor, meadow barley, blue wildrye, and California brome are more easily established on sandy, droughty soils than are the low-growing species mentioned earlier. We have seen no examples of legumes included in mixtures of California native grasses, but annual clovers and bur medic may be appropriate. Use of California native grasses as vineyard cover crops is on the rise, making it increasingly important to conduct formal experiments on the issues mentioned above.

## Winter Annual Cover Crops for Tilled Vineyards

### LEGUMES

#### Field Pea

#### *Pisum sativum*

#### Plates 2-1-2-4

**Other Common Names:** common pea, garden pea

**Description:** Stems trailing, round, weak; leaves compound with 1 to 3 pairs of leaflets and terminated by a branched tendrils; leaflets oval or elliptic; stipules very large and leaflike; flowers solitary or in pairs, white or pink; pods variable in size and shape, containing 2 to 10 seeds.

Numerous field pea cultivars are available and are most often used in mixes. Those most commonly planted as cover crops include 'Austrian Winter,' 'Magnus,' and 'Miranda.' 'Austrian Winter,' which has pink and reddish flowers, is dormant during cold weather and produces most of its biomass during the spring (plate 2-1). However, it usually produces as much biomass as most other legumes if allowed to grow through the spring. 'Magnus' can be distinguished by its large light and dark pink flowers and its large tendrils (plate 2-2). Unlike 'Austrian Winter,' 'Magnus' grows rapidly through the winter and matures earlier and is therefore a better choice in vineyards disked early in the spring. 'Miranda' has white flowers, matures early, and usually produces less biomass than 'Austrian Winter' or 'Magnus' (plate 2-3).

**Berseem Clover**  
*Trifolium alexandrinum*  
Plates 2-5–2-6

**Other Common Name:** Egyptian clover

**Description:** Stems erect; leaves trifoliate; leaflets oblong to broadly elliptic; flowers clustered in dense elliptical heads, yellowish-white.

Berseem clover is a rapidly growing winter annual that flowers in late spring and early summer, much later than most annual clovers. It is very tolerant of waterlogging and can be used to remove excess soil moisture. It is an excellent forage plant and thus responds well to mowing, exhibiting basal branching and rapid regrowth from the crown. It can be mowed three to four times in late winter and spring. These clippings are nitrogen rich and may supply excessive nitrogen to vines. When mowed in this manner, they can produce up to 400 pounds of nitrogen per planted acre (448 kg/ha) per year under optimal growing conditions (Williams, Graves, and Cassman 1990), although under most conditions, they will probably produce less than 250 pounds per acre (280 kg/ha). Berseem clover is seldom used in vineyards. Where it is used it is often disked in the spring to conserve moisture and reduce the nitrogen contribution.

**Bell Bean**  
*Vicia faba*  
Plates 2-7–2-10

**Other Common Names:** faba bean, fava bean, small-seeded horse bean

**Description:** Stems coarse, upright; leaves compound, usually with 6 broad leaflets and no tendrils; dark purple extrafloral nectary on lower surface of stipule; flowers large and white with dark purple blotches; pods large and cylindrical, containing 6 to 8 seeds.

Although bell bean is a true vetch, it differs greatly from other vetches with its strong, upright growth (see below for discussion of other vetches). It also has a relatively shallow, thick taproot (plate 2-9), which may be useful for opening up heavy soils. Bell bean is often used in mixes with vetches, peas, or cereals. Because of its height and because it does not tolerate close mowing, it is often omit-

ted from mixes in frost-prone areas. Bell bean is frequently infested by the bean aphid (*Aphis fabae*), which seldom affects its use as a cover crop. The aphid, which does not attack grapes, and the presence of extrafloral nectaries may attract beneficial insects into vineyards. Bell bean is more susceptible to frost damage than other vetches. It is very similar in growth to broad bean (also known as Windsor or horse bean), which has a much larger, flat seed. The smaller seed size of bell bean makes it more economical to sow.

**Vetches**  
*Vicia spp.*

Vetches are among the most frequently planted cover crops in vineyards. The most commonly used vetches are 'Lana' woollypod, purple, common (plate 2-11), and 'Cahaba White' (plate 2-15); hairy vetch is occasionally used as well. Although bell bean is a true vetch, it is discussed separately above. Vetches are grown as monocultural stands or in mixes with other vetches (including bell beans), cereals, field pea, and occasionally clovers and medics. Vetches produce trailing stems with tendrils that allow them to climb erect plants and structures, including grape trellises (plates 2-12, 2-16). Whereas stems of some vetches often reach 5 feet (150 cm) or more in length, unsupported plants seldom attain a height of more than 2 feet (60 cm). They may produce slender taproots that are 1 to 3 feet (30 to 90 cm) deep, but are usually shallow rooted, with most roots in the top 8 inches (20.5 cm) of soil. Vetches can fix large quantities of nitrogen, which may prove excessive for vineyards if planted in every row or if grown in the absence of cereals. They are also susceptible to *Botrytis* disease if grown in monocultural stands year after year (Farr et al. 1989; A. Van Bruggen, personal communication). This disease is particularly damaging after periods of heavy rainfall. When planted every year for 3 to 4 years, the disease may largely kill the stand (plate 2-13).

Vetch species differ in several important ways. Hairy vetch is the most cold hardy, followed in descending order by common vetch, woollypod vetch, and purple vetch, the least cold hardy. However, all these species usually thrive in the major grape growing regions of California. The species also differ in rate of growth in winter and in overall aggressiveness. Whereas most of the biomass production of vetches occurs in the late winter and spring, woollypod, hairy, and purple vetches have



strong seedling vigor and grow substantially during the winter. Common vetch produces less growth during the winter and less total biomass during the season (Miller et al. 1989). Some grape growers prefer this slower growth because the vetch will not climb vines as readily; however, the vetch may be less effective at suppressing weeds during the winter. Because common vetch usually produces less biomass than woollypod and purple vetches, it often produces less nitrogen. Common vetch produces no hard seed, whereas other vetch species produce small proportions of hard seed and may therefore become weedy in vineyards.

Seed sizes of the various vetch species are variable, with common vetch being the largest followed in descending order by woollypod, purple, and hairy, the smallest. All vetches are relatively easy to establish. They are not compatible with close mowing after about late February if late-spring growth or reseeded is desired, and they are often not mowed until incorporated or are mowed once or twice in late winter or early spring to a height of no less than 5 inches (12.5 cm).

**Purple Vetch**  
*Vicia benghalensis*  
Plate 2-11

**Description:** Stems trailing; leaves compound with 10 to 16 leaflets and a tendril at the end of each leaf in place of a leaflet; leaflets hairy, slightly larger and more oblong than those of woollypod vetch; stipules rather large, tinted dark purple (hence the species name); flowers reddish-purple with tip very dark, 6 to 12 per inflorescence; pods plump, hairy, containing 3 to 5 seeds.

Purple vetch has been used commercially since the 1920s for forage, cover crops, and green manures. Like woollypod vetch, it produces excellent cool-season growth, but it blooms and matures later than woollypod vetch. Purple vetch leaves are markedly hairy, giving a silvery, downy appearance to shoot tips in the early spring. It also has reddish flowers, whereas other vetch cover crop species have purple flowers (plate 2-11). Although purple vetch is among the least cold hardy of the cultivated vetches, in most years it will thrive in all but the coldest mountain locations in California.

**Common Vetch**  
*Vicia sativa*  
Plates 2-11, 2-14

**Other Common Names:** Oregon vetch, spring vetch

**Description:** Stems trailing; leaves compound with 8 to 16 leaflets, with a tendril at the end of each leaf in place of a leaflet; leaflets truncated, with the midrib extended to form a distinct point; dark purple extrafloral nectary on lower surface of stipule; flowers usually in pairs, bluish purple; pods relatively small, nearly cylindrical.

Common vetch was once the most important vetch species in California, but now woollypod and purple vetches are also frequently used. Common vetch remains dormant through much of the winter, developing nearly all its biomass in March and April. For this reason, it is not the best choice in vineyards that will be disked in March. Some growers include common vetch in mixes because it has extrafloral nectaries on the stipules (plate 2-14), which provide a readily available source of nectar for beneficial insects. However, the role of nectaries in pest management has not been tested.

'Cahaba White' vetch, a hybrid cultivar (*Vicia sativa* × *V. cordata*) (plate 2-15), was developed at Auburn University. It has been shown to be resistant to most root knot nematode species except *Meloidogyne hapla*, which is not considered damaging to grapevines. It is therefore recommended for vineyard soils where these nematodes are a problem (Block 1990). Because the continued use of this cultivar over several years often results in soilborne diseases, it is advisable to blend or rotate it with other cover crop species.

**Hairy Vetch**  
*Vicia villosa*

**Other Common Name:** sand vetch

**Description:** Stems trailing; leaves compound with 8 to 24 leaflets, with a tendril at the end of each leaf in place of a leaflet; leaflets slightly narrower and more pointed than those of purple and common vetches; flowers purple to violet, 10 to 40 per inflorescence; pods plump, containing 2 to 8 seeds.



In California, hairy vetch is used far less often than common, purple, or woollypod vetch. Hairy and woollypod vetches were once distinct species but, because hairy vetch is very similar to woollypod vetch, the two are now combined into *Vicia villosa* on the basis of plant characteristics. Hairy vetch usually grows less during the winter than woollypod or purple vetches. According to Duke (1981), many cultivars have been developed for particular areas of the United States. The 'Madison Vetch' cultivar, developed in Nebraska, is quite cold tolerant. Cold-tolerant forms of hairy vetch were also grown in Michigan, but most hairy vetch is now grown in Oregon, where less hairy, heat-tolerant forms have dominated. This seems to suggest that the most cold-tolerant forms are less available now than formerly. Hairier cultivars are typically more winter hardy (McLeod 1982), but this correlation does not always hold (Duke 1981). Hairy vetch grows well on most well-drained soils and is especially well adapted to sandy or sandy loam soils. For this reason it is also called sand vetch.

### **Woollypod Vetch**

***Vicia villosa* ssp. *dasycarpa***

**Plates 2-11–2-12, 2-16–2-17**

**Other Common Names:** Lana vetch, winter vetch

**Description:** Stems trailing; leaves compound with 8 to 24 leaflets, with a tendril at the end of each leaf in place of a leaflet; leaflets slightly narrower and more pointed than those of purple and common vetches; flowers purple to violet, 6 to 12 per inflorescence; pods plump, containing 2 to 8 seeds.

'Lana' woollypod vetch is one of the most recently introduced vetch cultivar that grows successfully in California. It was selected and developed by the USDA Soil Conservation Service (now the USDA Natural Resources Conservation Service) in cooperation with the UC Davis Agronomy Department from material introduced from Turkey in 1937 (Williams et al. 1959). It is well adapted to many vineyards below 3,000 to 4,000 feet (915 to 1,220 km). It is the earliest flowering and maturing vetch available; in the warmest regions, it may mature by late April, but usually matures in mid- to late May. Woollypod and purple vetches usually produce similar quantities of biomass and nitrogen and are both quite vigorous (plate 2-11).

## **GRASSES**

### **Oat**

***Avena sativa***

**Plates 2-18–2-20**

**Description:** Culms erect, stout; leaves variable in size; auricles fairly small, upright, rounded or pointed at apex, whitish to transparent; inflorescence (panicle) loose, open, the slender branches usually horizontally spreading; awns often absent.

Oat is sown frequently in vineyards, often in mixes but also in monocultural stands. It is more tolerant than barley of wet and heavy soils and also tolerates a wide range of soil types. Under moderate fertility and drainage, it can tolerate a lower pH than barley; it tolerates a soil pH as low as 4.5 (Stoskopf 1985). However, oat is not as tolerant as other cereals of drought, sandy soils, or cold. Dozens of cultivars have been developed, primarily as forage species. Cultivars vary in their period of flowering—'Montezuma' heads the earliest, followed in descending order by 'Swan' 'Sierra,' 'Ogle,' 'California Red,' and 'Cayuse,' the latest (L. Jackson and R. Wennig, personal communication).

### **Barley**

***Hordeum vulgare***

**Plates 2-21–2-22**

**Description:** Culms erect, dense; auricles well developed, usually wrapping around the stem; inflorescence (spike) erect, consisting of sets of 3 stalkless spikelets; awns long, straight, and erect, those of beardless barley suppressed, 3-cleft, the central division converted into a hooded lobe.

Barley is an inexpensive, fast-growing cereal that produces substantial biomass and competes well against weeds. It produces more tillers at the base than cereal rye and oat. It is the most salt-tolerant cereal and is more drought tolerant than rye or oat. Barley is not as tolerant of wet soil conditions as cereal rye or oat; it will not grow well in heavy, poorly drained, or low-permeability soils, especially after periods of heavy rainfall. Although barley is frequently sown in mature vineyards, it is also used during the development of new hillside vineyards to prevent soil erosion. After the terraces are created, barley is planted prior to the fall rains and is worked into the soil in the spring when the vines are planted.

Many barley cultivars are available. 'UC 476' is a popular tall-growing cultivar that has good disease resistance but poor self-regeneration; 'UC603' is a short-statured cultivar that is frequently used. Care should be given to cultivar selection, avoiding those that are not tolerant or resistant to yellow dwarf virus and rust.

**Annual Ryegrass**  
***Lolium multiflorum***  
**Plates 2-23–2-25**

**Other Common Names:** common ryegrass, Italian ryegrass, Oregon ryegrass

**Description:** Culms dense, pale or yellowish at the base; leaves dark green, glossy; auricles usually prominent; inflorescence (panicle) erect, relatively narrow.

Annual ryegrass is a fast-growing, self-reseeding grass that is infrequently sown in vineyards but often volunteers as a weedy species. It has a densely fibrous root system that aids in holding soil, increasing water infiltration, and improving soil tilth. It is a heavy user of water and nitrogen and may perform poorly on droughty or infertile soils. Annual ryegrass will tolerate periods of flooding when established. Because it matures late (June to September), it competes strongly with grapevines for water and nutrients during the spring and early summer. Because the stems are erect but weak, they are typically not used with vetches.

**Cereal Rye**  
***Secale cereale***  
**Plates 2-25–2-27**

**Other Common Names:** cereal ryegrain, Merced rye, rye

**Description:** Culms erect; leaves blue-green; auricles very small; inflorescence (spike) somewhat nodding (curved), relatively slender, awned.

Cereal rye grows rapidly in cool weather and forms a dense, tall stand with a more extensive root system than other cereals. Among the cereals, it is the most cold tolerant and is one of the best species to use if planting is delayed until late fall or winter. It is also the most drought-tolerant cereal and is best for sandy or rocky soils. It is particularly preferred

on sandy soils in the San Joaquin Valley and is often planted by raisin growers, who incorporate it into the soil prior to the spring frost season. Cereal rye does not tiller heavily, so a relatively high seeding rate should be used, especially if it is seeded late. Residues of cereal rye clippings are more persistent than those of other cereals. The cultivar 'Merced' has been the most successful for cover cropping in California due to its excellent winter growth, early maturity, and wide soil adaptability.

**Wheat**  
***Triticum aestivum***  
**Plate 2-28**

**Description:** Culms erect, freely branching at base; auricles present; inflorescence (spike), long-awned to awnless.

Wheat is commonly cultivated as a small-grain crop and may be used as a forage crop. Like triticale, it is used in relatively few vineyards. It can be mixed with other species, such as other cereals and vetch. Wheat produces less fall biomass than oat, but is more drought tolerant and has more winter and early spring growth. Many types and cultivars are available.

**Triticale**  
× ***Triticosecale***

**Description:** Culms erect; auricles present; inflorescence a spike.

Triticale is a cross between wheat and cereal rye, and is similar in productivity to both these species. Many types are available, with widely differing growth habits and maturity dates. It is used in a small number of vineyards compared to other cereals.

**FORBS**  
**Brassicas**  
***Brassica spp.***  
**Plates 2-29–2-30**

**Description:** Stems erect, branched; basal leaves pinnately cleft into lobes, stem leaves toothed or undivided; flowers showy, yellow or whitish, with 4 petals; fruiting structures (capsules or siliques) many-seeded, narrow, round or 4-sided.

Brassicas used as cover crops include white mustard (*Brassica hirta*, plate 2-29), which is also cultivated for greens; brown mustard (*B. juncea*); black mustard (*B. nigra*); rape (*B. napus*); and turnip (*B. rapa*). Oilseed radish (*Raphanus sativus*), which is in the same family, has also been used in vineyards. Field mustard (*Brassica campestris*) readily volunteers in many North Coast vineyards and is managed as a resident cover crop; it is not currently available in the seed trade. Most species produce some hard seed (Madson 1951). Green peach aphids (*Myzus persicae*) often build up on mustards during winter and early spring. Although these aphids do not affect vineyards, they may disperse and carry virus diseases to other crops such as potatoes.

Brassicas grow well in loam to clay soils. Most have deep taproots that are often said to help aerate heavy soils, although in one study, they were not found to significantly increase water infiltration (Williams 1966). Brassicas are also very efficient at removing soil nitrate, thus reducing nitrate leaching. Because they have a relatively low carbon to nitrogen (C/N) ratio (usually intermediate between legumes and grasses), they quickly decompose after disking or mowing, resulting in little tie-up of soil nitrogen.

Black mustard and brown mustard allelopathically inhibit other annual plants; the compounds involved probably include various isothiocyanates (Bialy et al. 1990). Allelopathic effects on grapevines have not been tested. Some brassicas also have nematicidal properties—white mustard and oilseed radish cultivars have been developed in northern Europe for their nematicidal properties in sugar beet rotations (Miller et al. 1989).

**Tansy Phacelia**  
***Phacelia tanacetifolia***  
**Plates 2-31–2-32**

**Other Common Names:** bee phacelia, phacelia

**Description:** Stems semierect, succulent; leaves pinnately divided, finely hairy, bearing glands; inflorescence (cyme) compact, densely hairy, containing many flowers in each; flowers blue, showy.

A native California annual wildflower, tansy phacelia is occasionally used in vineyards, mainly as a rotation cover crop in the North Coast. It grows rapidly in the winter, forming a dense, succulent

stand. It takes up large amounts of nitrogen during the winter and rapidly decomposes after tillage due to its low C/N ratio.

## Winter Annual Cover Crops for No-Till Vineyards

### LEGUMES

**Bur Medic**  
***Medicago polymorpha***  
**Plates 2-33–2-36**

**Other Common Names:** burr medic, burclover, California burclover, toothed burclover

**Description:** Stems semierect or prostrate; leaves trifoliate, with middle leaflet extended on a stalk (petiolule); apical margins of leaflets obovate to heart shaped, slightly toothed or jagged, sometimes with purple and white flecks on upper surface or a small purple inverted V mark at the base; stipules rather small, many pointed; flowers very small, yellow; pods (burs) coiled 2 to 6 times, with spines hooked at the tip (burs of some cultivars are spineless), containing 3 to 11 seeds.

Bur medic is the most popular cover crop among the medics because it usually grows best and reestablishes reliably each year. Other medics that are seldom used or are included in mixes with bur medic include barrel (*Medicago truncatula*), snail (*M. scutellata*), gama (*M. rugosa*), and strand (*M. littoralis*) medics. Bur medic is in the same genus as alfalfa (*M. sativa*). Although it is frequently referred to as burclover, it is not a true clover (*Trifolium* spp.). It can be distinguished by its coiled burs and the short stalk extending from the middle leaflet—leaflets of the true clovers are attached basally at the same point (plate 2-35).

Bur medic is the most widely adapted of the medics to soils of different pH. With an abundance of acid-tolerant rhizobium bacteria indigenous to most California soils, bur medic will grow on most sites. Barrel and gama medics will grow and fix nitrogen only on soils with pH 7.5 or greater. In some areas, bur medic may be damaged by Egyptian alfalfa weevil (*Hypera brunneipennis*), and in extreme cases the weevil may skeletonize plants.

Bur medic is well adapted to California vineyard growing conditions. It lends itself well to drip-irrigated vineyards because it germinates readily in fall rains, grows rapidly during the winter, and produces many seeds by early May. Seedlings produce early taproot growth and therefore may be better adapted to early-season drought than subterranean clover. Because bur medic is low-growing and branches profusely at the base, it can tolerate frequent, relatively close mowing (to 3 to 5 in [7.5 to 12.5 cm] tall) and still reseed. It produces a large proportion of hard seed, which remain viable for many years. For this reason, it is particularly well suited to raisin vineyards, where a substantial amount of soil is moved to create terraces, burying some seed too deeply to germinate the following year. In later years tillage brings some of these seed to the surface layer of the soil where they may germinate.

## Clovers

### *Trifolium* spp.

Annual mixes of reseeding clovers are frequently used in no-till vineyards; these mixes often include bur medic as well (see plate 2-37). Although the various clover species and cultivars share several similarities, there are differences in some characteristics, such as growth habit and time of flowering and maturity. For example, because crimson and rose clovers grow upright and flower above the foliage, they do not need to be mowed to perform well and should not be mowed in late spring so they can reseed. Conversely, subterranean clover (and bur medic—see previous section) stems spread along the ground and should be mowed to reduce weed competition. Bur medic grows somewhat upright and may be mowed, but not as closely as subterranean clover.

Soil nutrition is important for the optimum performance of clovers. On highly fertile soils or where nitrogen fertilizers have recently been applied, clovers are often outcompeted by grasses or other nonlegume weeds. Also, clovers will benefit from addition of phosphorus, calcium, and sulfur.

### **Crimson Clover** *Trifolium incarnatum* Plates 2-37–2-39

**Other Common Name:** scarlet clover

**Description:** Stems erect but often leaning over at the base by the spring, branching at the base but largely unbranching above; leaves trifoliate; leaflets broad, obovate and pointed at the base, softly hairy, usually unmarked but sometimes with a few dark red spots; stipules large, sharply veined; flower heads terminal, solitary, elongated, containing dozens of flowers; flowers showy, scarlet or dark red.

Crimson clover performs well in annual clover mixes. Like other mowable clovers, it can be mowed to 3 to 5 inches (7.5 to 12.5 cm) tall during the winter and early spring. However, because it produces its flower heads above the foliage, it must be allowed to grow from mid-March or early April onward until the seed mature in late spring to ensure reseeding. Whether used alone or in mixes, crimson clover often produces a brilliant display of red flowers.

### **Rose Clover** *Trifolium hirtum* Plates 2-40–2-41

**Description:** Stems semierect, branching, softly hairy; leaves trifoliate; leaflets obovate, pointed at the base, light green, very hairy, marked with a pinkish-white watermark and sometimes with a few dark-red spots; stipules large, sharply veined; flower heads terminal, solitary, round, subtended by uppermost leaf, containing many flowers; flowers showy, pink to rose.

Rose clover is similar in stature and phenology to crimson clover but branches more and is slightly lower growing. It grows well on rocky, dry soils and in acid to neutral soils of low fertility but grows poorly on wet, heavy soils. Because it is well adapted to rangeland use, rose clover usually reseeds effectively, but weeds often encroach and reduce stands on fertile soils. It produces a high proportion of hard seed.

Several rose clover cultivars are available. According to Miller et al. (1989), 'Hykon' is the earliest maturing, and 'Kondinin' the most tolerant of soil acidity. 'Wilton' is the latest maturing and is adapted to areas with greater than 14 inches (35.5 cm) annual rainfall. 'Overton 18' is a relatively late and tall cultivar that produces a very high proportion of hard seed. 'Hykon' is popular and is used frequently in seed mixes; however, other cultivars also perform well.

**Subterranean Clover**  
*Trifolium subterraneum*  
Plates 2-42–2-44

**Other Common Name:** subclover

**Description:** Stems spreading; leaves often with a watermark that forms a circle with the three leaflets; leaflets broadly heart shaped but often flat or rounded at the apex; stipules rather small; inflorescence a few-flowered fascicle; flowers whitish, inconspicuous; pods (burs) formed on long peduncle, containing 2 to 5 seeds, variable in shape and size, with calyx teeth adhering, in some cultivars giving a shooting-star appearance, and in others the calyx of the numerous sterile flowers form an intertwined bur mass.

Subterranean clover is an excellent cover crop species for many vineyard sites. It is frequently used on pasture and rangeland sites and is relished by livestock. It performs well in mowable clover mixes and usually requires periodic mowing to stimulate vigorous growth. In the spring it often forms a dense mat of stems below the height of mowing, which helps reduce soil erosion and suppress weed seed germination. It is even more tolerant of very close mowing than bur medic due to its low, spreading habit. In addition, the peduncle reflexes and elongates downward after flowering, driving the seedhead slightly underground in some cultivars (plate 2-43).

There are dozens of subclover cultivars, and differences exist among them in the time of flowering and maturity (see Miller et al. 1989) and in soil pH requirements. In general, subclovers are best adapted to acid (no lower than about pH 5.0 to 5.5) or moderately acid to neutral soils. Some cultivars, particularly ‘Clare,’ ‘Koala,’ and closely related cultivars, also perform quite well on soils with high pH.

## GRASSES

**‘Blando’ Brome**  
*Bromus hordeaceus*  
Plates 2-45–2-48

**Other Common Names:** Blando brome grass, soft chess

**Description:** Culms erect; leaves softly hairy; auricles small, whitish, membranous; inflorescence (panicle) compressed; awns rather stout.

‘Blando’ brome is well suited to no-till vineyards, particularly drip-irrigated ones. It is a selection of soft chess that was cooperatively released by the USDA Soil Conservation Service (now the USDA Natural Resources Conservation Service) and the University of California Agricultural Experiment Station in 1960. It is low growing and mowable and matures early; in a Mendocino County trial, seeded ‘Blando’ brome matured earlier than the resident brome (Bugg, Zomer, and Auburn 1996). It also has strong seedling vigor, excellent reseeding ability, and dense, fibrous roots. For these reasons it can reduce soil erosion while not competing excessively with grapevines. ‘Blando’ brome is widely adaptable to a range of soils and climates. It is often grown in monocultural stands, but can also be mixed with clovers or other low-growing cover crop species.

**‘Zorro’ Fescue**  
*Vulpia myuros* var. *hirsuta*  
Plates 2-48–2-50

**Other Common Names:** annual fescue, foxtail fescue

**Description:** Culms erect; leaves very narrow; auricles absent; inflorescence (panicle) erect, narrow.

‘Zorro’ fescue is a fast-growing, early-maturing grass. It is a selection of foxtail fescue that was cooperatively released by the USDA Soil Conservation Service (now the USDA Natural Resources Conservation Service) and the University of California Agricultural Experiment Station in 1977. It is short statured and noninvasive. It is well suited to drip-irrigated vineyards with sandy, low-fertility, or serpentine soils, including soils containing rocks, gravel, and volcanic pumice. Good seedling vigor and early growth make it an excellent choice for obtaining quick initial erosion control with minimal seedbed preparation. It can be mowed to 4 inches (10 cm) but should not be mowed in April to allow for reseeding. ‘Zorro’ fescue can be used as a substitute for ‘Blando’ brome where quicker fall growth, earlier maturation, and greater drought tolerance are needed. Otherwise, ‘Blando’ brome is recommended because it is cheaper, reseeds more effectively, is more aggressive, and has seed that flows better through drills.

## Perennial Cover Crops for No-Till Vineyards

### LEGUMES

#### **Birdsfoot Trefoil** *Lotus corniculatus* Plates 2-51–2-52

**Description:** Stems arising from a single crown, well branched, spreading; leaves compound with 5 broad leaflets, the 2 lower leaflets stipulelike; inflorescence attached in clusters on long stalks, 4- to 8-flowered; flowers yellow, sometimes with orange; pods small, cylindrical, brown to almost black.

Birdsfoot trefoil is a long-lived, drought- and cold-tolerant perennial legume. It is strongly taprooted and tolerates a wide range of soils, including poorly drained, saline, and alkaline soils. Birdsfoot trefoil will grow well on clay to sandy loam soils and will survive flooding for more than a month.

Because birdsfoot trefoil has low seedling vigor, it should be mowed during stand establishment. Including a short-statured grass such as ‘Blando’ brome at seeding can aid in weed control and help reduce erosion during the establishment phase. When established, it should be mowed no lower than 2 to 4 inches (5 to 10 cm) tall so axillary buds can regrow.

#### **Strawberry Clover** *Trifolium fragiferum* Plate 2-53

**Description:** Stems (stolons) creeping, branching, rooting at nodes; leaves trifoliate; leaflets broadly elliptic to narrowly obovate, flower heads round, dense, many-flowered; flowers light pink.

Strawberry clover is a long-lived perennial that roots at the nodes of stolons and grows year-round. It tolerates saline and alkaline soils, wet or submerged soils, infrequent irrigation, and frequent, close mowing. When established, it often outcompetes weeds and is useful for erosion control; it is also very resistant to most herbicides. However, it is very invasive, competes with vines for water, and attracts pocket gophers. The cultivar ‘Salina’ is well

adapted to California conditions; it was developed in California from selections of ‘Palestine,’ a pro-

ductive Australian cultivar.

#### **White Clover** *Trifolium repens* Plates 2-54–2-55

**Other Common Names:** Dutch white clover, Ladino clover, New Zealand white clover

**Description:** Stems (stolons) creeping, branching, rooting at nodes; leaves trifoliate; leaflets obovate and pointed at the base to broadly oblong, green or with white V, sometimes with dark red flecks; stipules membranous, lance shaped; flower heads round, rather loose, many-flowered; flowers white, later turning pinkish then brown.

White clover is similar in habit and growth to strawberry clover but is less invasive and may attract fewer pocket gophers because of its smaller taproot. It tolerates a wide range of soil conditions but thrives best under cool, moist growing conditions; it is also shade tolerant once established. It performs better in heavy, moist soils than on sandy soils that may be droughty and contain less nutrients. It is the least drought tolerant of the perennial legumes discussed here.

White clover cultivars are arbitrarily classified by size of the plants: small, intermediate, and large (Duke 1981). The small types often have “wild white” in their names. Intermediate types often include the term “common” and indicate locally harvested or unknown cultivars; most unnamed U.S. cultivars are intermediate types. The large type was introduced from Italy into the United States as “Ladino” in the early 1900s. Seed derived from this ecotype were designated Ladino until the early 1950s, when new cultivars were developed in the United States.

### GRASSES

#### **California Brome** *Bromus carinatus* Plate 2-56

**Other Common Name:** Mokelumne brome

**Description:** Culms erect, stout; leaves flat, rough or sparsely hairy; inflorescence (panicle) with spreading or drooping branches; awns relatively long.

California brome is a large, leafy, short-lived perennial bunchgrass with strong seedling vigor. It grows in open and wooded sites in Central and Northern California. California brome has many varied forms.

**Orchardgrass**  
*Dactylis glomerata*  
Plates 2-57–2-58

**Other Common Name:** Berber orchardgrass

**Description:** Culms coarse-tufted, spreading with short rhizomes; leaves long, flat; inflorescence (panicle) with few distant, stiff, solitary branches.

Orchardgrass is a very vigorous perennial bunchgrass that is used mostly for hay and pasture. It is one of the more competitive cover crops and should only be used where extreme reduction of vine vigor is desired (Wolpert et al. 1993). It is fairly late maturing and does not respond well to close or frequent mowing. The cultivar ‘Berber’ is used most frequently in California vineyards.

**Blue Wildrye**  
*Elymus glaucus*  
Plate 2-59

**Description:** Culms erect, loosely to densely tufted; leaves rough, usually flat; inflorescence a spike, erect to somewhat nodding, dense; awns relatively long.

Blue wildrye is a large green or bluish perennial bunchgrass that has no rhizomes. It is found throughout much of California below 8,200 feet (2,500 m) and has many varied forms. It is common in the foothills and lower mountain slopes, usually in association with open stands of oaks and conifers. Blue wildrye is generally more drought tolerant than meadow barley. It will continue summer growth only when irrigated.

**Tall Fescue**  
*Festuca arundinacea*  
Plates 2-60–2-61

**Other Common Names:** Fawn tall fescue, turf-type tall fescue

**Description:** Culms erect, robust; leaves stout and

flat, with rough edges; inflorescence (panicle) narrow with numerous branches and spikelets.

Tall fescue is a fast-growing perennial bunchgrass that is occasionally planted to reduce excessive vine vigor. It is also planted in wet areas of vineyards to aid in wheel traction in the spring. Although it grows primarily in the cool season, it continues to grow in the summer if adequate water is provided. Tall cultivars of tall fescue are aggressive and will compete strongly against grapevines for water and nutrients. This grass requires frequent mowing and will often not survive in drip-irrigated vineyards. Some growers plant alternating rows of tall fescue for winter access and use green manure cover crops in the other rows. Tall fescue is very tolerant of alkali and waterlogged soils. The tall cultivar ‘Fawn’ is commonly planted. Short-statured (dwarf) turf cultivars are also available; these are less competitive and require mowing less frequently.

**Idaho Fescue**  
*Festuca idahoensis*  
Plates 2-62–2-63

**Other Common Name:** blue bunchgrass

**Description:** Culms densely tufted; leaves slender, firm, inrolled; inflorescence (panicle) narrow.

Idaho fescue is a densely tufted perennial bunchgrass that is very closely related to sheep fescue (*Festuca ovina*). Although it is one of the most common and widely distributed grasses in the western United States, it is rare in the southern portions of California, Nevada, and Arizona (U.S. Forest Service 1937). It is found in open woods and rocky slopes below 5,900 feet (1,800 m). Idaho fescue is very drought tolerant, with greatly reduced or no growth during the summer; it is also very shade tolerant. Its clumping nature can make it bumpy to drive over if planted sparsely.

**Sheep Fescue/Hard Fescue**  
*Festuca ovina*  
Plates 2-64–2-66

**Description:** Culms densely tufted; leaves slender, curved inward; inflorescence (panicle) narrow.

Sheep fescue is a short-statured, noncreeping bunchgrass that forms a dense turf. Because it is long-lived and relatively summer dormant, it is



suiting to coastal drip-irrigated vineyards. The cultivar 'Covar' is frequently used; it is somewhat slow to establish but is competitive once established.

Hard fescue (*F. ovina* var. *duriuscula*) establishes more slowly than sheep fescue and has little spreading tendency. It is more drought-tolerant than chewings or creeping red fescue, but less so than sheep fescue. It does not tolerate waterlogging. Both hard and sheep fescues perform well on sandy soils.

Like other fine-leaved fescues, sheep and hard fescues tolerate certain grass herbicides used to control most weedy grasses.

**Red Fescue**  
**(Creeping Red/Chewings/'Molate'/**  
**'Mokelumne' Fescues)**

***Festuca rubra***  
**Plates 2-67–2-68**

**Description:** Culms loosely or closely tufted, stems bent at the reddish or purplish base; leaves smooth, narrow, usually folded or curved inward, dark green (creeping red, chewings, 'Mokelumne') or bluish green ('Molate'); inflorescence (panicle) usually contracted and narrow, the branches mostly erect or ascending; spikelets pale green or yellow-green, often purple-tinged.

Red fescue is a low-growing, fine-leaved perennial grass that requires little mowing after establishment. It is found below 8,200 feet (2,500 m) in bogs, meadows, and marshes in the cooler parts of the northern hemisphere extending south in the Coast Range to Monterey County and in the Sierra Nevada to the San Bernardino Mountains. It grows on a wide range of soil types and is very tolerant of waterlogging. Red fescue is slow to establish and is susceptible to weed competition. It tolerates mowing to reduce weed growth.

Many red fescue cultivars have been developed and introduced for use in turf. Two of these, creeping red fescue and chewings fescue (*F. rubra* var. *commutata*) are also used in vineyards, mostly in Northern California. Creeping red fescue (plate 2-67) spreads by short rhizomes, whereas chewings fescue is a noncreeping bunchgrass that produces a firmer sod.

'Molate' and 'Mokelumne' fescues are drought-

tolerant California native selections that develop short underground rhizomes. 'Molate' fescue (plate 2-68) was originally collected on dry, well-drained, inland sea level slopes at Point Molate, California (Contra Costa County). It is planted in many North Coast vineyards as well as the Suisun and Delta regions. It will grow in summer only when irrigated.

**Meadow Barley**  
***Hordeum brachyantherum* ssp.**  
***brachyantherum***

**Plate 2-69**

**Description:** Culms erect; inflorescence (spike) erect or sometimes nodding, sometimes purplish.

Meadow barley is a short-lived bunchgrass with strong seedling vigor and loose green foliage. It grows in meadows, salt marshes, and grassy slopes below 8,000 feet (2,440 m). It is found throughout California, except in the desert areas. Meadow barley is particularly adapted to soils that are waterlogged in the spring. It is tolerant of alkaline soil and will establish on infertile and compacted sites. Generally, it will not persist on very dry sites.

**California Barley**  
***Hordeum brachyantherum* ssp. *californicum***  
**(syn. *Hordeum californicum*)**

**Plates 2-70–2-71**

**Description:** Culms densely tufted, erect; inflorescence (spike) erect, mostly purplish.

California barley is a short-lived bunchgrass that has adapted to very dry conditions. It is found in meadows, dried creek beds, and brushy flats and slopes in Oregon and California. The prostrate type (plate 2-71) has finer, light green foliage, is much lower growing, and requires less mowing than do erect forms.

**Perennial Ryegrass**  
***Lolium perenne***

**Plate 2-72**

**Other Common Name:** English ryegrass, Lynn ryegrass

**Description:** Culms erect or reclining at the usually reddish base; leaves glossy; inflorescence (spike) often somewhat sickle shaped.

Perennial ryegrass is a short-lived (3 to 4 years)

perennial bunchgrass that is frequently used in lawns. Of the many cultivars, 'Elka,' a short-statured cultivar, has been the most frequently used in cover crop mixtures. It grows well on heavy soils but needs a large amount of extra water. Although it is similar to tall fescue in growth and management, it is less aggressive and not as well adapted to poor or submerged soils.

**California Melic**  
*Melica californica*

**Plate 2-73**

**Other Common Name:** California oniongrass

**Description:** Culms densely tufted, stems reclined and more or less bulbous at the base; leaves blue-green; inflorescence (panicle) narrow, rather dense, brownish to purplish.

California melic is a medium-sized, loosely tufted perennial that spreads from the base with rhizomelike stems that curve upward. It is also called oniongrass because it produces a small, edible onionlike thickening at the crown. It grows in the lower elevations of the foothill rangeland throughout California below 6,900 feet (2,100 m). Seedlings of California melic germinate slowly and lack vigor; but once established it is a very robust plant that competes well against weeds. It exhibits strong summer dormancy and is very drought tolerant. It does not form strong tufts and therefore provides an even driving surface.

**Nodding Needlegrass**  
*Nassella cernua* (syn. *Stipa cernua*)

**Plate 2-74**

**Other Common Name:** nodding stipa

**Description:** Culms erect, clumping; leaves blue-green; inflorescence (panicle) open with slender flexuous branches.

Nodding needlegrass is generally smaller and has a finer leaf than purple needlegrass. It is found in chaparral, juniper, woodland, and grasslands below 4,600 feet (1,400 m). Although it is adapted to many soil types, the soil must be well drained. Commonly found on poor soils throughout the state including those in Southern California, nodding needlegrass is a better choice for low rainfall areas than purple needlegrass. The two species are also commonly found in grass savannas and can therefore be used in combination.

**Purple Needlegrass**  
*Nassella pulchra* (syn. *Stipa pulchra*)  
**Plate 2-75**

**Other Common Name:** stipa

**Description:** Culms erect; leaves long, narrow, flat or curved inward; inflorescence (panicle) nodding, loose, with spreading slender branches.

Purple needlegrass is a large, long-lived bunchgrass that is well adapted to many soil types. It is found in oak woodland, chaparral, and grasslands in the Coast Range and in the Sacramento Valley from Sacramento County north to Tehama County. It is tolerant of extreme summer drought and heat and is therefore well suited to drip-irrigated vineyards throughout much of California. It is slow to establish and does not compete well against weeds on highly fertile soils, making weed control important until it is well established.

**Pine Bluegrass**  
*Poa secunda* ssp. *secunda* (syn. *Poa scabrella*)  
**Plate 2-76**

**Other Common Name:** one-sided bluegrass

**Description:** Culms erect, slender; leaves mostly basal, soft; inflorescence (panicle) usually narrow, contracted.

Pine bluegrass is a small, tufted bunchgrass with soft, basal foliage that is found throughout California from sea level to timberline and into the desert. At low elevations pine bluegrass becomes dormant with the onset of hot weather; in the mountains, it grows all summer. It is thought to have once been abundant in the Central Valley (Bishop 1996) and has excellent persistence in drip-irrigated vineyards. Pine bluegrass is relatively shallow-rooted and persists on shallow, gravelly soils. It does not compete well against weeds on fertile soils.

## Summer Annual Cover Crops for Tilled Vineyards

**Buckwheat**  
*Fagopyrum esculentum* (syn. *Fagopyrum saggitatum*)  
**Plates 2-77–2-78**

**Description:** Stems erect, succulent; leaves arrow-head shaped but with basal lobes turned outward;

flowers several per cluster, white, with 5 petals and nectar-bearing yellow glands between the stamens.

Buckwheat is a fast-growing summer annual that is occasionally used in vineyards as a green manure cover crop or to attract beneficial insects. Although it is fairly drought tolerant, it can often be seen wilting in vineyards on hot days but recovering by morning. It produces less biomass than many other cover crops and breaks down rapidly after incorporation. Flowering can begin within a month of seeding. Numerous insect parasitoids have been documented visiting buckwheat flowers, but the effects of using buckwheat on grape pest management have not been tested.

### **Sudangrass**

#### ***Sorghum sudanense***

**Other Common Name:** Sudan grass

### **Sorghum-Sudangrass**

#### ***Sorghum bicolor* (syn. *Sorghum vulgare*) × *S. sudanense***

**Plate 2-79**

**Description:** Culms coarse, erect; leaves flat, long, either wide or narrow; inflorescence (panicle) relatively compact.

Sudangrass and sorghum-sudangrass hybrids are fast-growing tall summer annual grasses. Sorghum-sudangrass is a hybrid of grain sorghum (*Sorghum bicolor*) and sudangrass (*S. sudanense*).

Sudangrass and sorghum-sudangrass are occasionally used in vineyards to reduce dust, sunburn, and heat problems and to add large amounts of organic matter to the soil. They can also be used to reduce vine vigor, as they compete with vines for water and nutrients. However, nitrogen fertilizer should be added if reduced competition for nitrogen is desired. Sudangrass and hybrids can be mowed as close as 4 to 6 inches (10 to 15 cm) to reduce competition and improve vineyard access; or they can be allowed to grow unmowed and disked when a desirable stage of growth has been reached. They usually flower 2 to 3 months after planting.

### **Cowpea**

#### ***Vigna unguiculata* ssp. *unguiculata***

**Plate 2-80**

**Other Common Names:** blackeyed pea, crowder pea, southern pea.

**Description:** Stems erect or suberect and spreading, often purple-tinged; leaves trifoliate, alternating,

the terminal leaflet often bigger than the two asymmetrical lateral leaflets; leaflets ovate to diamond shaped, sometimes slightly lobed; flowers 2 to 4 per cluster, dull white to yellow or violet; pods curved, straight or coiled.

Cowpea is a legume that is occasionally planted as a summer green manure crop to add nitrogen. It often harbors lygus bugs that may attack grapevines.

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