NebGuide

Nebraska Extension

Research-Based Information That You Can Use

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Growing Commercial Wine Grapes in Nebraska

Paul E. Read, Extension Horticulturist and Professor of Horticulture
Stephen J. Gamet, Research Technologist

In recent years, interest in grape production and winery development has increased tremendously in Nebraska and the Midwest. This increased interest has led to a need for detailed information on vineyard establishment and commercial grape production.

A successful winery must have a ready source of consistently high-quality fruit that is available every year. Fortunately for Nebraska growers, many locations throughout the state provide the essential resources of quality soil, water, and abundant sunshine. The experience of growers and University of Nebraska–Lincoln research have demonstrated that many sites are suitable for growing grapes of excellent quality that can be finished into wines of exceptional quality.

Do your homework: Before embarking upon the potentially risky venture of growing grapes for wine production, garner as much information as you can. Read trade journals and research articles. Attend grower workshops and conferences, and visit other growers' vineyards to discuss these growers' approaches and learn from their experiences. Focus your research on Midwest regional resources, ask questions, and study some more.

Develop a business plan that will provide you with a road map of where you are going and how you will get there. Ask the question: "Where do I want to be in 5 years, in 10 years?" Viticulture (the culture of grape growing) is not like most other types of agriculture; thus it is critical that you "do your homework."

Site Selection

Selection of an appropriate site is essential to the success of the grape production enterprise. Indeed, poor site selection is probably the most frequent cause of vineyard failure. In the Midwest, three main factors are critical to the selection of a vineyard site: Cold temperatures, air movement, and soil drainage. Low winter temperatures can directly damage the vines and buds or even kill the grape plants, while abrupt temperature drops in the fall or spring may also cause severe injury. Of special concern are temperature fluctuations in late winter and early spring that lead to early bud break and subsequent bud damage.

Figure 1. Sloping sites facilitate air drainage since cold air is heavier than warm air and flows downhill (air drainage).

Sites that facilitate air drainage and air movement will aid in diminishing the negative effects of cold temperature events such as frosts and freezes, as well as diseases of the foliage, fruit, and stems (*Figure 1*). Of equal importance is good soil drainage. The old adage that grapevines cannot stand "wet feet" is on target; that is, poor water drainage

through the soil profile reduces available air to the roots. This lack of air means that oxygen is not available to the root cells and may lead to root death.

Climate

Climatic characteristics are generally broken down into **macroclimate**, **mesoclimate**, and **microclimate**.

Macroclimate is primarily dictated by geography, e.g., eastern Nebraska vs. western Nebraska. Minimum winter temperatures, length of growing season, growing-degree days, and rainfall amount and distribution are all macroclimatic factors.

Microclimate is the climate in the immediate vicinity of the grapevine, affecting the roots, stems, and especially in the plant canopy. The microclimate in the canopy can be modified by vineyard practices such as a training or trellising system, pruning practices, fertilizer applications, selective leaf removal, and shoot positioning. Disease severity and fruit quality can be improved dramatically by practices that influence the microclimate.

Microclimate is mostly a result of **mesoclimate** factors, including topography and slope, the elevation above surrounding land, soil type, and aspect or direction of slope. Generally, the best vineyard site is one with full sun exposure (at least nine uninterrupted hours), good air drainage, good soil drainage, and freedom from late spring frosts and from harsh winter temperatures.

Winter temperature minimums vary greatly from eastern Nebraska to western Nebraska and from south to north. For most grapes grown in the Midwest, temperatures should not fall below-20F (-28C) for an extended period of time or the plants may die. Cultivars ("varieties") vary greatly in their tolerance of cold winter temperatures. Therefore, cultivars should be carefully selected to match their cold-hardiness to the selected site. For further notes on selecting cultivars, see *Table 1*, Features of Grape Cultivars for Commercial Vineyards and Range of Adaptability.

Compound Buds

Grapevines have compound buds; that is, each bud found at a node on a grapevine stem will usually contain three buds–a **primary bud**, a **secondary bud,** and a **tertiary bud**. The upcoming season's growth—shoots, leaves, tendrils, and flower clusters—is contained in the primary bud. If damage from cold, insects, or physical injury occurs to the primary bud, then the secondary bud will grow. However, shoots that develop from a secondary bud are usually less fruitful.

Figure 2. Compound bud—the large bud in the center is the primary bud, the secondary bud is at the right, and the tertiary bud is the small one at the left.

In extreme cases, when both the primary and secondary buds are killed, the tertiary bud will grow. This shoot will probably have no flower clusters, resulting in little to no yield. However, the foliage produced will sustain the plant and help it grow, which provides for survival of the vine, sort of nature's "insurance policy" (see *Figure 2*).

Site and Vineyard Topography

Choosing a site that is likely to offer freedom from spring frosts is determined by the mesoclimate or vineyard site characteristics. Ideally, the site should be gently sloping and at a higher elevation than surrounding areas. Because cold air is heavier than warm air, cold air flows downhill to lower areas, thus reducing frost risk. In addition, air drainage during the growing season leads to rapid drying of foliage following rain or heavy dew. This in turn reduces conditions favorable to disease development.

Steep slopes should be avoided because of potential soil erosion problems. Furthermore, obstructions such as wooded areas and windbreaks at the edges of the vineyard site should be avoided so that the cold air will not "pool" into frost pockets in the lower parts of the vineyard (*Figure 3*). Such areas may also harbor wildlife that could cause damage, including birds, deer, and other pest species.

The aspect of the slope is also important in site selection. Although a south-facing slope is warmer, it may cause early bud break in the spring, which may lead to bud damage from late frosts. Early fruit maturation will often occur on southern slopes, which may lead to ripening during excessively hot periods, resulting in undesirable fruit characteristics for winemaking. Eastern slopes dry faster in the morning following dew or rain, reducing disease problems.

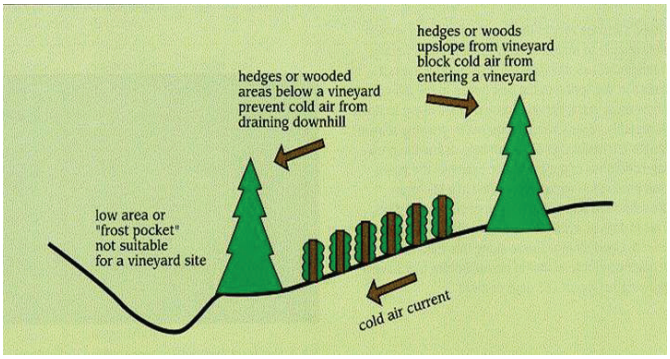


Figure 3. Topography and adjacent vegetation influence the susceptibility of a vineyard site to spring and fall freeze damage.

Northern slopes will have later bud break in the spring, but will be colder in the winter. Winds may have potentially damaging impacts on western or southwestern exposures, depending on the direction of the prevailing winds. Choice of slope may relate to cultivar selection; that is, cultivars exhibiting early bud break will benefit from northern or eastern exposures.

Soils

A wide range of soil types is satisfactory for growing grapes, with the exception of poorly drained soils (the "wet feet" problem mentioned earlier). Soils that best support root growth possess good aeration, moderate fertility, loose texture, good drainage (both internal and surface) and acceptable depth (preferably at least 40 inches or 100 cm, with no impeding layer). A well-drained sandy loam soil is ideal for grape root development.

Soil drainage is one of the most critical factors in site selection. Poorly drained soils causes poor root growth, resulting in slow vine growth, poor yields, reduced vine vigor, and ultimately a lack of longevity. Grape roots may penetrate to depths of 10 feet or more in well-drained soils, but may be restricted to 2 feet or less in poorly drained soils.

If the poor drainage is the result of an impervious layer such as a hardpan, plow pan, or similar, "ripping" (subsoiling) the soil exactly where you will place the rows is recommended. It may also be helpful to rip at right angles to the row orientation. If the poor drainage problem is related to heavy soils with inadequate internal drainage, it may be advantageous to install drainage tile. Consult the Natural Resources Conservation Service Nebraska or your local extension office for advice regarding solutions to moderate drainage problems. Avoid soils with extremely poor drainage, as the cost to correct the drainage will be prohibitive.

Conduct a soil test: Grapes grow well over a relatively wide range of pH, organic matter, and fertility levels. However, if the soil is extremely infertile or possesses very acid or alkaline characteristics, it will be important to amend the soil to achieve a desirable pH range. Generally, grapevines tolerate soil pH levels of 5.0 to 8.0, but the ideal is between pH 5.5 and 6.5. A few cultivars are more sensitive to high pH-induced nutrient deficiencies, e.g., iron, and should not be grown on soils of pH in excess of 7.0. Highly pH sensitive cultivars are noted in *Table 1*.

A good range for organic matter is from 1 to 3 percent. Very high organic matter may provide excess nitrogen, resulting in vegetative soft growth that is highly susceptible to winter injury and often may cause low fruit yields and reduced fruit quality.

Phosphorous is very immobile in the soil, so if phosphorous levels are low (below 40 pounds per acre), it is essential that phosphorous fertilization be applied prior to planting. It should be worked into the soil as deeply as possible because it will remain where it is placed.

Although most Nebraska soils have relatively high amounts of potassium, if soil tests indicate levels of exchangeable potassium well below 200 pounds per acre, the recommendation is to apply potassium fertilizer before planting. Since potassium is more soluble than phosphorous, and thus more mobile, it can also be added after planting.

Occasionally magnesium, zinc, and boron levels may be below optimum amounts, especially where field leveling was conducted, or other grade changes or modifications have taken place. In such cases, appropriate additions should be made. Exchangeable magnesium should be between 200 and 250, while amounts of actual zinc and boron should range from 8 to 10, and 1.5 to 2 pounds per acre, respectively.

If levels of these elements are close to the recommended ranges, the grower may wish to defer application until after the first year of growth. Nutrient status of the vines should be monitored yearly by conducting foliar tissue tests. These tests will assist the grower in future years' fertilization practices. For details regarding tissue testing, see http://viticulture.unl.edu/.

Vineyard Design

Because grapevines are potentially long-lived, it is important that site preparation and vineyard design be completed carefully and thoroughly. You will live a long time with your vineyard, including any mistakes. As noted previously, pH adjustment and most fertilization should

Figure 4. Tilled beds prepared for planting between existing sod strips.

Figure 5. Bare-root plants as received from the nursery.

be done prior to planting. Correction of drainage problems and control of persistent perennial weeds must also be implemented before planting.

Planning at least one year ahead of establishment of the planting should facilitate accomplishing site preparation requirements. Prepare the soil a year before planting by plowing or rototilling the entire site, fertilizing, liming (if needed) and using weed management practices.

A cover crop can be seeded in late summer or early fall, with grape planting the following spring. If planting in sod, such as an old pasture, it may be desirable to only plow the location of the rows to be planted (*Figure 4*). The sod left between the rows will reduce erosion and aid equipment use following a rain.

Planting

It is a good idea to survey the vineyard prior to development of a planting plan. Make a scale drawing or map of your planting plan—it will prove to be a valuable record as your vineyard develops. Grapevine rows are normally planted in a north-south orientation with straight rows preferred. Occasionally it may be necessary to plant rows on a contour or across a slope. However, curved rows usually lead to problems with trellis stability. Differences in light interception between north-south and east-west row orientation can lead to different ripening times.

Spacing of plants varies with the cultivars and equipment. A common spacing is 10 feet between rows with plants 8 feet apart in the row. Wider row spacing may be dictated by the equipment available or the trellis style. Greater spacing between plants in the row may be appropriate for cultivars of exceptional vigor (e.g., 'Edelweiss', 'St. Vincent', 'Frontenac') or on sites that stimulate strong vine growth. Wider row spacings intercept less sunlight with more light hitting the ground and thus reducing yield per acre. Narrower row spacings may impede equipment and reduce air flow through the vineyard, which will lead to greater disease pressure. Close row and plant spacings will increase costs of establishment, since more plants and trellising will need to be purchased. For example, 8-by-10-foot spacing = 545 plants per acre, while 8-by-12-foot spacing = 454 plants per acre.

Preparation for planting: Planting is best undertaken in early spring after the last average hard freeze date. Generally, dormant bare-root plants are used, but rooted cuttings and green plants are sometimes employed. Certified, #1 size or better, virus-free planting stock is most desirable. If planting stock has leafy growth, planting should be delayed until after the last frost date. Because many cultivars are in great demand, orders for planting stock should be placed **one year in advance** of the desired planting date. This is especially true for newly available cultivars such as 'Petite Pearl', 'Verona', 'Itasca', 'Aromella', and 'Arandel'.

When the shipment of plants arrives, bare-root dormant planting stock should be inspected immediately for damage or other problems such as mold (*Figure 5*). Make sure plants are kept moist and stored in a cool place (less than 40° F, but above freezing) until ready to plant.

Prior to planting, soak the roots of dormant bare-root plants in water overnight or up to 24 hours. Prune off any broken or excessively long roots and dig a planting hole that will easily accommodate the root system. The roots should be spread out in the hole, covered with soil, and the soil

Figure 6. Young vine after removal of grow tube used in first growing season.

Figure 7. A grapevine should be watered after planting.

Figure 8. Productive 'Frontenac' vines in a 2014 Medicine Creek Vineyard, Elsie, Nebraska.

firmed well around the roots. Some experts suggest setting the plant to a depth where the first shoot is at ground level, while others suggest planting deeper and/or mounding soil around the base of the plant—both seem to work well in Nebraska soils. It is recommended that the plants be watered following planting, even if the soil moisture seems adequate (*Figures 6 and 7*). This aids in settling the soil around the roots, eliminating air pockets and ensuring adequate moisture for the development of the new roots.

The young vine should be provided support; often this is accomplished by placing a stout bamboo stake next to each vine and loosely tying the vine to the stake as the vine grows. Alternatively, use of "grow tubes" may help the vine establish a single vertical shoot and protect the developing vine from herbicide and vertebrate pest damage. Ideally, the trellis should be established soon after planting to aid in supporting the developing trunk. Trellis system design is discussed in the NebFact, "Trellising Systems for Nebraska Vineyards" (http://viticulture.unl.edu/).

Care of Young Vines

Weed control in the year of vineyard establishment is critical. Control of perennial weeds by using an appropriate herbicide should be undertaken in the year prior to planting. Approved pre- and post-emergence herbicides will help with annual weed control (Midwest Fruit Pest Management Guide–Purdue Agriculture, https://ag.purdue.edu/hla/Hort/Documents/ID-465.pdf.) Always read and carefully follow all label directions for any pesticide or herbicide.

Young vines may benefit from application of nitrogen fertilizer after growth has commenced. A rate of 20 to 30 pounds of actual nitrogen per acre may be appropriate, depending on inherent soil fertility and organic matter. Placing the fertilizer in a circle of about 20 to 24 inches in radius should work well, or in bands along each side of the row at a similar distance from the plant. Care should be taken to avoid direct contact with the plant because nitrogen fertilizer has a great potential to "burn" the living tissue contacted. Split applications of nitrogen can be applied at monthly intervals, but in no case should they be applied after mid-July to avoid soft growth that will be vulnerable to winter damage.

Successfully developing a commercial grape growing enterprise can be achieved through careful planning, thorough preparation, and diligent attention to detailed implementation of the viticultural practices discussed in this NebGuide, together with an ongoing study of successful vineyard and winery businesses in the upper Midwest (*Figure 8*).

For additional information, visit the University of Nebraska Viticulture Program website: http://agronomy.unl.edu/viticulture

Table 1. Features of Grape Cultivars for Nebraska and Range of Adaptability

Features of Grape Cultivars for Nebraska						
Cultivar	*Skin Color#*	*Uses*	*Range of Adaptability¥*	*Disease Tolerance°*	*Suggested Trellising Style●*	*Special notes*
Alpenglow	R	Wine	A-C	G	TWC	Ripens early; low acid, mildly fruity wines; good blender
Arandell*	B	Wine	A-C	G	TWC	Developed from Cornell University's "No Spray" program
Aromella	W	Wine	A-B	F	VSP	Very aromatic, muscat-like wines
Baco Noir	B	Wine	A-B	F	TWC	Wines are fruity and deeply colored
Beta	B	Juice, Jams, Jellies	A-E	G	TWC	One of the most cold-hardy grapes, poor wine quality
Bluebell*	B	Juice, Jams, Jellies	A-E	G	TWC, GDC	Similar to Concord, smaller berries, more cold hardy
Brianna*	W	Wine	A-C	F-G	TWC, GDC	Fruity white wines, growing popularity in the Midwest
Cabernet Franc**	B	Wine	A	P	VSP	One of the most cold hardy vinifera
Canadice*	P-R	Table	A-B	F	MWC	Seedless, deep pink if exposed to sunlight
Cayuga White	W	Wine	A-C	G	TWC	Large open clusters
Chambourcin*	B	Wine	A	F	TWC	Hardy in only the best sites
Concord & Concord Seedless*	B	Juice, Jams, Jellies, Pies	A-C	P-F	TWC, GDC	Standard for commercial juice, jams, and jellies
Crimson Pearl	R	Wine	A-C	G	TWC	Tom Plocher selection, winter hardy, early wood ripening
deChaunac*	B	Wine	A-E	F	MWC	Can become bushy in growth habit
Delaware	P-R	Wine	A-C	F	TWC	Pink color develops if exposed to sunlight
Dornfelder**	B	Wine	A	P	VSP	Advanced product of German breeding program
Edelweiss*	W	Wine, Table	A-D	G	TWC, GDC	Introduced as a table grape; harvest early (14–15 °Brix) for crisp fruity wines
Elvira	W	Wine	A-E	F	TWC	Very cold hardy, performs best in western Nebraska
Esprit	W	Wine	A-C	F	TWC	Large clusters, adapted to Southeast Nebraska
Frontenac	B	Wine	A-E	G	TWC, GDC	Wines highly acidic, makes excellent port-style wines
Frontenac Blanc	W	Wine	A-E	G	TWC, GDC	Better for white wine than Frontenac Gris
Frontenac Gris	G	Wine	A-E	G	TWC, GDC	Frontenac sport
Geneva Red	B	Wine	A-C	F	TWC, GDC	Previously known as GR7
Himrod	W	Table	A-B	F-P	MWC	Seedless
Kerner**	W	Wine	A	F	VSP	Highly regarded product of German breeding program
Kay Gray	W	Wine	A-E	F-G	TWC	Harvest early, similar to Edelweiss (14–16 °Brix) reputed to be hardier than Edelweiss
King of the North	B	Juice, Jams, Jellies	A-E	G	TWC	Very cold hardy
La Crescent	W	Wine	A-C	F	TWC	Fruity wines; clusters may shatter
Lacrosse	W	Wine	A-E	F-P	TWC	Very susceptible to Black Rot; produces well on secondary buds
Landot Noir (Landot 4511)	R	Wine	A-C	F	TWC	Late bud break, popular in the New England wineries
Lemberger**	B	Wine	A	P	VSP	Crown Gall susceptible
Leon Millot*	B	Wine	A-E	F	TWC	Maréchal Foch sibling
Louise Swenson	W	Wine	A-E	G	TWC	Dependable; one of hardiest of Swenson whites, good juice chemistry
Maréchal Foch*	B	Wine	A-E	F	TWC	Leon Millot sibling
Marquette*	B	Wine	A-E	G	TWC	Excellent wine grape from University of Minnesota breeding program
Marquis*	W	Table	A-B	F	MWC	Seedless
Mars	B	Table	A-C	G	MWC	Clusters hold well for extended harvest season
Niagara	W	Juice, Jams, Jellies	A-C	F	TWC, GDC	Most common white juice grape grown
Noiret	B	Wine	A-C	F-G	TWC, GDC	Deeply colored full bodied wines
Petite Amie*	W	Wine	A-C	F	TWC	Wine exhibits floral bouquet; muscat flavors

Features of Grape Cultivars for Nebraska

Cultivar	*Skin Color#*	*Uses*	*Range of Adaptability¥*	*Disease Tolerance°*	*Suggested Trellising Style●*	*Special notes*
Petite Jewel	R	Table, Wine, Jellies	A-B	F-G	TWC	Very early, small sweet ruby-red fruit; birds love it!
Petite Pearl	B	Wine	A-D	G	TWC	Excellent winter hardiness, late bud break. High quality red wine with low acidity (TA≈ .7); Tom Plocher introduction
Prairie Star	W	Wine	A-E	G	TWC	Excellent blending grape for white wine, imparts good body
Regent**	B	Wine	A	F	VSP	Recent German hybrid, mostly vinifera
Reliance	R	Table	A-C	P	TWC	Seedless
Riesling**	W	Wine	A	P	VSP	One of the most cold-hardy vinifera grapes
Sabrevois	B	Wine	A-E	F	TWC, GDC	Sister to St. Croix; popular in Quebec; variable performance in Midwest
Saint Croix	B	Wine	A-E	F	TWC, GDC	Wine may exhibit green, vegetal flavors; reliably cold hardy
Saint Pepin	W	Wine, Table	A-E	F-G	TWC	Pistillate (all female), requires nearby pollen source, variable yields, has made excellent ice wines
Seyval Blanc	W	Wine	A-C	P	TWC	Produces large compact clusters
Somerset Seedless	R	Table	A-E	F	TWC	Seedless, very cold-hardy; color varies (like Canadice)
Swenson Red	R	Table	A-D	F	TWC	Has few small seeds, outstanding flavor; Downy Mildew susceptible
Swenson White	W	Wine, Table	A-C	F	TWC, GDC	Best as table grape, neutral wine, useful as blender
Thomcord*	B	Table	A	F	TWC	Hybrid between Thompson Seedless and Concord
Traminette	W	Wine	A-B	F	TWC	Gewurztraminer is one of Traminette's parents
Valiant*	B	Juice, Jams, Jellies, Wine	A-E	F	TWC	South Dakota State University introduction
Vanessa	R	Table	A-B	P	MWC	High quality, seedless
Verona	B	Wine	A-C	F-G	TWC	Dry red wine with soft tannins and finish; Tom Plocher introduction
Vignoles	W	Wine	A-C	F-P	VSP	Tight bunches prone to bunch rot
Zweigelt**	B	Wine	A	P	VSP	Developed in Austria, widely planted there

* Sulfur sensitive; do not use sulfur sprays

**Vinifera; plant only grafted vines; protect graft union over winter

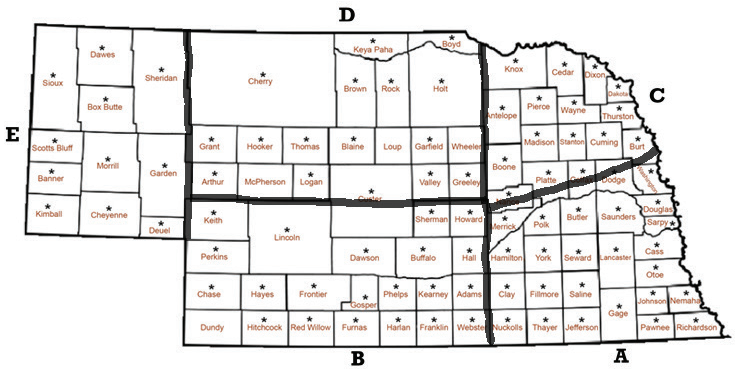
● TWC = Top-wire cordon; GDC = Geneva Double Curtain; MWC = Mid-wire cordon; VSP = Vertical Shoot Positioned

° G = Good Tolerance, F = Fair Tolerance, P = Poor Tolerance

B = Blue/Black, R = Red, W = White, G = Gray or Bronze,

¥Locations where cultivars noted are likely to do well (see map, Range of Cultivar Adaptability)

Range of Cultivar Adaptability



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