3.1 Site Selection

The key to an economically viable vineyard lies in the careful choice of the vineyard site. Good site selection increases viability through the growing of premium fruit and the decreased risk of failed crops. Varieties should be chosen carefully to ensure that they will achieve full maturity at harvest at the desired quality level at an economically sustainable crop load. Major considerations should be climate, soil, topography and water.

Climate

In contrast to the coastal area of British Columbia, the climate of the Okanagan and Similkameen valleys is very dry. It characteristically has hot, dry summers and crisp, largely overcast, snow-free winters with air temperatures below freezing for about ten weeks. The region lies in the rain shadow of the Coast Mountains on which eastward moving moist Pacific air masses rise and lose their moisture. Cold arctic air occasionally intrudes into the valleys during the winter allowing temperatures to drop to -25°C. The dry, hot summers lead to soil moisture deficits during the growing season and irrigation is required for the production of most agricultural crops. Frost during the winter can penetrate soils to a depth of about 50 cm.

Minimum Site Requirements for the Planting of Vitis vinifera

- Frost free season exceeding 150 days
- Minimum mid-winter temperatures no lower than minus 25°C
- Minimum temperatures during the shoulder months of November and March no lower than minus 20°C (minus 10 – 15°C may cause damage at this time depending on the dormancy stage of the plant)
- A minimum of 1200 growing degree days >10°C are needed to mature the fruit for Bordeaux red wine grapes
- Well drained soils
- Sunshine between April 1 and October 31 to exceed 1250 hours

Solar Radiation

Solar energy is the primary source for all biological processes. Radiation from the sun has an effect on air and soil temperature, transpiration, soil moisture, atmospheric humidity, and all plant processes such as photosynthesis, cell division and flowering. It also affects sugar accumulation, bud fertility, wood maturity, and crop yield and quality. The amount of solar radiation received at a site and the duration of sunshine during the growing and harvesting season has a direct influence on all these factors.

In general, most regions of the Okanagan and Similkameen Valleys receive adequate solar radiation for grape production. However, shading from the afternoon and evening sun in mountainous areas caused by topography or nearby trees decreases the amount of solar radiation intercepted and impacts on grape development. Solar radiation is associated with growing degree days at particular sites. Factors such as the length of growing season, although not directly related with heat accumulation, are associated with solar radiation. Long growing seasons with low heat unit accumulations are found in cool grape growing areas such as coastal climates where solar radiation is limited. Development of flavour components in grapes suitable for cooler climates is generally enhanced in such climates. Flavour components for the same varieties are often destroyed or nearly non-existent in areas of too much solar radiation. The selection of grape varieties in cool climate areas is therefore limited to early or mid season maturing varieties with economical yields, or later maturing varieties with uneconomic yields.

Growing Degree Days

Growing degree days (GDD) is an expression of heat summation and is a measurement of physiological time. Growing degree days is an expression of the amount of heat the plant receives that is above the basal development temperature. The more degree days accumulated, the faster the rate of production. One growing degree day is accumulated for each degree the mean daily temperature is above 10°C. Accumulations are measured throughout the entire growing season. The formula for calculating Growing Degree Days is listed below:

$$\text{Growing Degree Days (GDD > 10°C)} = \frac{(T_{max} - T_{min})}{2} - 10$$

Each daily accumulated GDD is added to previous GDD accumulations to give the total GDD accumulated in the season. If the daily average temperature is below the basal limit, the GDD for that day is 0. There are no negative GDD values. Early ripening varieties require fewer GDD than late ripening varieties and therefore are best suited in the cooler regions of the valley. Late ripening varieties require more GDD which for some varieties limits the regions in which they can be produced successfully. Below are typical Growing Degree Day accumulations in the regions of the Okanagan and Similkameen Valleys.

Table 3.1 GDD > 10°C in the Okanagan and Similkameen Valleys

Region	Location	Degree Days (*C)
1	Kelowna	950 – 1360
2	Penticton	1140 – 1500
3	Vaseaux Lake	1320 – 1490
4	Golden Mile	1340 – 1630
5	Black Sage	1360 – 1630
6	Similkameen	1180 – 1540

Source: Dr Pat Bowen and Carl Bogdanoff (AAFC PARC Summerland, BC)

Precipitation

The average annual rainfall in the Okanagan and Similkameen valleys range from 315mm to 380mm with nearly half of the precipitation falling outside of the grape growing season. In general, the amount of precipitation received in the Okanagan and Similkameen is ideal for growing grapes. However, significant amounts of rainfall during the growing season can have adverse effects upon disease development and grape quality. Grapes grow best under mild, dry spring weather conditions, followed by long, warm dry summers after bloom. Cold temperatures and rainfall during the flowering period may interfere with fruit set. Rain and wet weather at any time can create climate conditions conducive to the growth of pathogens detrimental to crop production and vine health. Rain at harvest may also reduce fruit quality. The advantages or disadvantages of rain depend on when, how long and how much it rains.

Slope

The amount of heat accumulated at a site varies depending on the slope of the land and the direction of the slope. In the northern hemisphere, south facing slopes are the best choice to gain increased solar radiation. North facing slopes gain the least while west facing slopes intercept more solar radiation than east facing slopes. Total accumulated heat units are generally greatest near the mid-slope, less on the hilltops and lowest near the base of the slope. Exposed hilltops have lower maximum temperatures and slightly cooler minimum temperatures than mid-slopes. The angle of the slope, in relation to the location of the sun, is very important to maximize the amount of solar radiation collected at a site. Cold air flows down slopes and collects at the base creating frost pockets and areas with late spring frost and early fall frost. The most suitable slopes for grape production have a gentle slope that provides good air drainage and maximizes heat accumulation.

Elevation

Grapes are grown over a wide range of elevations in B.C. (9 to 490 meters above sea level). There are limits in elevation above sea level where grapes are grown economically. Increases in elevation of 100 meters may reduce the average annual temperature by as much as 1°C. Exceptions have been noted on south slopes and in areas where air inversions may form. Vineyards at higher elevations are therefore generally cooler than vineyards at lower elevations in the same region. Higher elevations are generally wetter due to increased precipitation during the growing season and winter months. Cooler temperatures at higher elevations delay bud break, flowering and ripening dates. The list of varieties suitable for viticulture at higher elevations becomes shorter and more restrictive. Complete maturity may not occur for some varieties in all years.

Wind

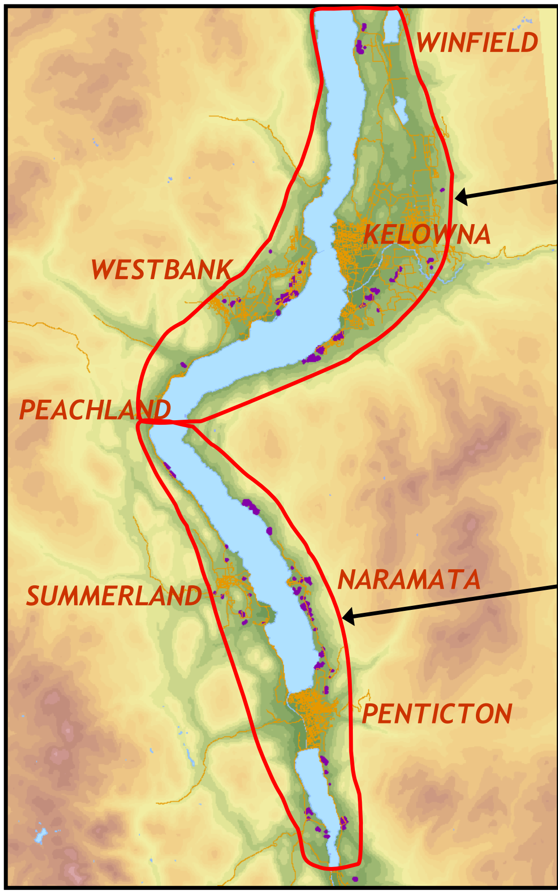
Moderate air flow is beneficial to grapevines as it generally results in reduced disease pressure. However, significant winds can cause serious damage to grapevines. Many studies illustrate the negative effects of high wind on vine growth, production and fruit quality. Vines create a special climate between the rows and in the leaf canopy that is altered or destroyed by winds.

Exposure to moderate and high winds has a desiccating effect due to the high evapotranspiration rates, which causes physical damage. High winds often result in tattered leaves, smaller leaves, broken shoots, extensive lateral growth, shorter and fewer shoots, and smaller clusters. Winds in excess of 12 km/hr cause stomata to close, resulting in reduced photosynthesis. Stomata are reported to recover slowly if the reason for their closure was high winds (up to 4 days required to recover) and more quickly if the wind speeds were moderate (up to 1 day required to recover). In the winter, wind removes snow cover which may increase the risk of soil drying and root desiccation.

In regions with significant wind issues, row direction should run parallel to the prevailing wind where possible in order to reduce shoot damage. Windbreaks with 50% reduction of wind may be beneficial for areas of the Similkameen and South Okanagan Valley where strong daily winds are typical in the spring and summer. Studies in other areas show that sheltered vines protected by artificial or natural windbreaks have higher percentages of bud break, more shoots, higher pruning weights, larger clusters and more berries per cluster, lower pH, and potassium. Yield increases have been reported when vines were protected from strong winds. The benefits of wind shelters will vary with the frequency and the degree of high winds.

Water

Large bodies of water, such as Okanagan Lake, moderate temperature effects on surrounding areas. Such bodies of water have a large heat storage capability which has a cooling effect in the summer and warms the surrounding area in the winter. In addition to this moderating effect, vineyards located on slopes close to large lakes or rivers benefit from the reflection of solar radiation from the water surface increasing the length of frost free period. Lakes or large rivers can also increase the surrounding area humidity and cloud cover. All of these factors reduce the risk of late spring or early fall frosts and extend the growing season.



Region 1: Kelowna

950 – 1360 Growing Degree Days

Soil Type	% of Region	Soil Type	% of Region
Loamy sand	13%	Silt loam	24%
Sandy loam	45%	Clay loam	18%

Top Varieties

White	Red
Riesling	Pinot noir
Chardonnay	Gamay noir
Gewurztraminer	Merlot
Pinot gris	Marechal Foch
Pinot blanc	Cabernet Sauvignon

Total planted area (approx.): 990 acres

Region 2: Penticton

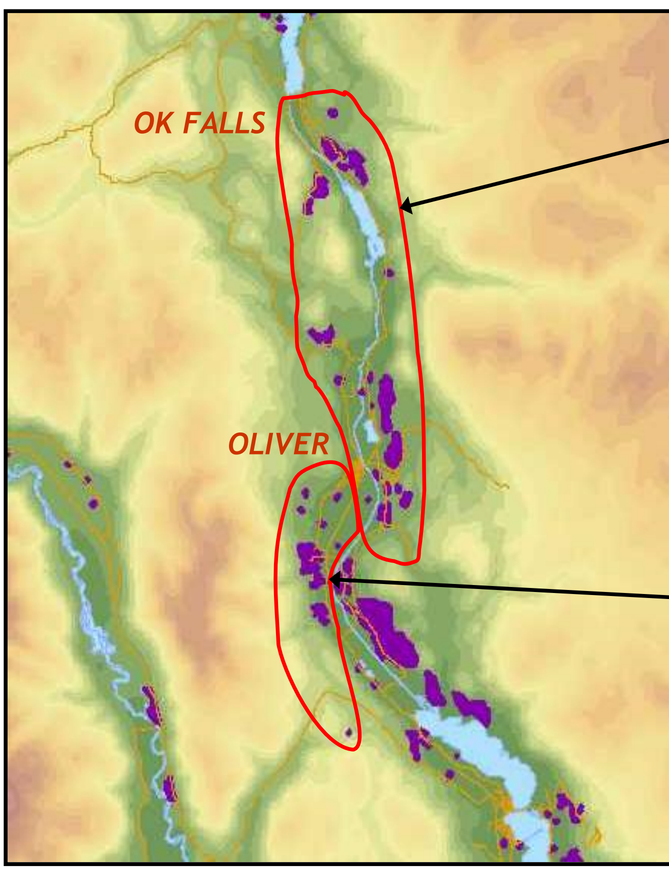
1140 – 1500 Growing Degree Days

Soil Type	% of Region	Soil Type	% of Region
Loamy sand	11%	Silt loam	42%
Sandy loam	46%	Clay loam	1%

Top Varieties

White	Red
Chardonnay	Merlot
Pinot gris	Pinot noir
Gewurztraminer	Cabernet Franc
Pinot blanc	Cabernet Sauvignon
Riesling	Shiraz / Syrah

Total planted area (approx.): 1,290 acres



Region 3: Vaseaux - Oliver

1320 – 1490 Growing Degree Days

Soil Type	% of Region	Soil Type	% of Region
Loamy sand	61%	Silt loam	9%
Sandy loam	30%	Clay loam	0%

Top Varieties

White	Red
Chardonnay	Merlot
Gewurztraminer	Pinot noir
Riesling	Cabernet Sauvignon
Pinot gris	Gamay noir
Sauvignon blanc	Cabernet Franc

Total planted area (approx.): 1,860 acres

Region 4: Golden Mile

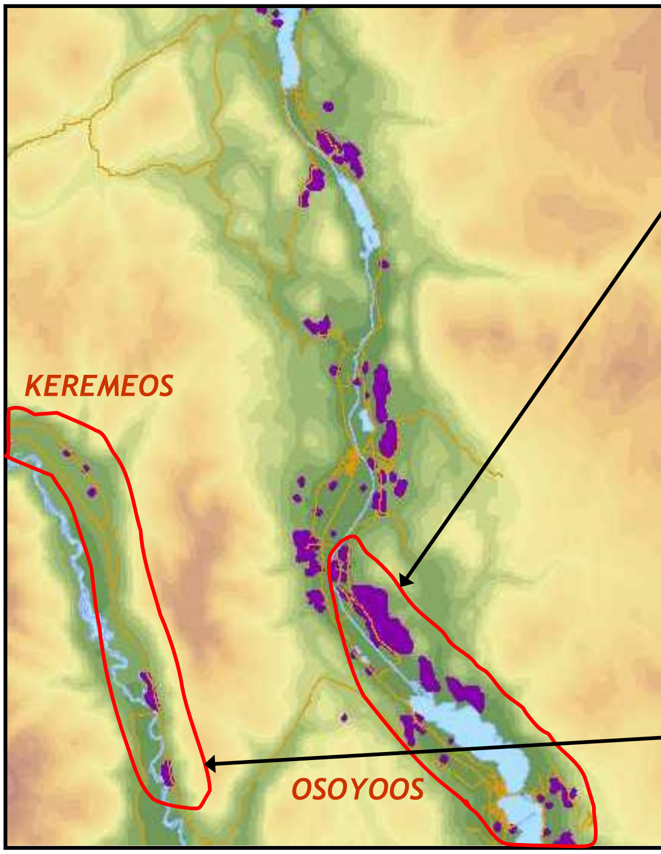
1340 – 1630 Growing Degree Days

Soil Type	% of Region	Soil Type	% of Region
Loamy sand	23%	Silt loam	14%
Sandy loam	63%	Clay loam	0%

Top Varieties

White	Red
Chardonnay	Merlot
Gewurztraminer	Pinot noir
Pinot blanc	Cabernet Franc
Pinot gris	Cabernet Sauvignon
Sauvignon blanc	

Total planted area (approx.): 660 acres



Region 5: Black Sage – Osoyoos

1360 – 1630 Growing Degree Days

Soil Type	% of Region	Soil Type	% of Region
Loamy sand	91%	Silt loam	1%
Sandy loam	8%	Clay loam	0%

Top Varieties

White	Red
Chardonnay	Merlot
Sauvignon blanc	Cabernet Sauvignon
Pinot gris	Shiraz/Syrah
Pinot blanc	Cabernet Franc
Semillon	Pinot noir

Total planted area (approx.): 3,900 acres

Region 6: Similkameen

1180 – 1540 Growing Degree Days

Soil Type	% of Region	Soil Type	% of Region
Loamy sand	0%	Silt loam	11%
Sandy loam	89%	Clay loam	0%

Top Varieties

White	Red
Chardonnay	Merlot
Pinot gris	Cabernet Sauvignon
Pinot blanc	Cabernet Franc
Riesling	Pinot noir
Gewurztraminer	Gamay noir

Total planted area (approx.): 450 acres

Production Practices

Pruning Style	Percent of Total Acreage
Spur	52.24%
Cane	31.50%
Mix (cane + spur)	3.83%
Not yet pruned (young vines)	9.23%
Other and unknown	3.20%

Training / Trellis Style	Percent of Total Acreage
Bilateral cordon (vertical shoot positioning)	87.52%
Vertically divided canopy (eg. Scott Henry, Smart-Dyson)	2.21%
T-Bar	2.11%
Vertically + horizontally divided canopy (eg. quadrilateral)	0.88%
Horizontally divided canopy (eg. Geneva Double Curtain, Open Lyre)	0.21%
Unknown and new plantings	7.08%

3.2 Soils

Soil is defined as the naturally occurring mineral or organic material on the earth's surface capable of supporting plant growth. The type of soil formed in any one place is the result of the interaction of climate, organisms and topography acting on the soil parent material over time. Soils display a continuum of properties and reflect the variation of these soil forming factors.

Vine health and productivity is dependent on a healthy root system. Roots operate most effectively in neutral, deep, well drained, and well aerated soil with good organic matter and an adequate supply of nutrients. Grape vines are deep rooted plants requiring adequate soil depth and are not suited to shallow soils.

Most soils in the Okanagan - Similkameen area have developed under grassland – forest vegetation and semi-arid climatic conditions. In the grasslands, organic matter is mainly added to the soil by the decomposition of grasses and herbaceous plant materials and accumulation in the A horizons of these soils. Under these conditions, Brown and Dark Brown Chernozemic soils are prevalent on well and rapidly drained sites. At higher elevations, within the forested area relatively cooler conditions persist and Brunisollc soils occur on well and rapidly drained sites. In these soils, organic matter additions to the topsoil are limited and well structured and deep A horizons are either thin or absent. Under the same climatic conditions the soils also show differences due to both texture and mineral composition. Luvisolic soils have developed in clay rich parent materials in which clay is translocated to a subsurface layer. Gleysolic soils have developed in poorly drained areas on a variety of parent materials from clay to sand. Saturated conditions are reflected in these soils by dull gray colours and/ or iron mottles. Regosolic soils are 'young soils' and in the map area are confined mainly to the Okanagan and Similkameen river floodplains and to a few other steeply sloping sites. Organic soils have developed in very low areas which are usually moderately decomposed and range from shallow to deep.

Due to non-uniform glacial and river deposits of gravels and sand, the sub-surface composition of some soils can vary greatly. It is important to take these factors into consideration, when designing the irrigation system, since these sand or gravel banks can greatly impact the water holding capacity of the soil in the affected area. Often areas of poor vine vigour can be traced back to gravel deposits, which are not visible at the soil surface. For irrigation water to penetrate the gravel, the surface soil must first be brought to full field capacity!

SOILS OF THE OKANAGAN AND SIMILKAMEEN is a comprehensive study mapping the soils of the Okanagan and Similkameen Valley. This publication is available online at http://sis.agr.gc.ca/cansis/publications/bc/bc52/.

Soil Survey

A detailed soil survey should be completed prior to vineyard development. The goal of the survey is to identify where changes of the soil type occur and characterize the physical properties of each different classification. The vineyard blocks should be designed based on the changes in soil type. Each block or irrigation valve should contain the same soil type in order to maximize vineyard uniformity. Once the survey is complete a soil sample from each region with a different soil type can be taken. The soil sample will determine the physical, chemical and biological properties of the soil.

The survey should be performed by a qualified professional. The results of this survey are used to decide what irrigation system, rootstock, and variety is most appropriate for the specific soil type. This process should be performed the year before planting, prior to ordering vines.

Soil Amendments

On the completion of the soil survey amendments can be added and incorporated into the soil where necessary. The soil sample results will determine what soil amendments may be necessary. Recommendations for soil amendments will be given along with the soil analysis but should be reviewed with a qualified professional. For more information on amendments see Section 4.3 Nutrition in this production guide.

Land Preparation

The first step in developing a vineyard is to remove any existing vegetation or structures that obstruct development. Obstructions such as trees, posts and rocks need to be removed. Once removed, light cultivation and leveling with a tractor to remove any irregularities will leave a relatively even surface. Low areas which may be prone to frost should be filled in at this time. Mounds or hollows left will become a permanent fixture once the plants and posts are in. The land should be even enough to facilitate smooth tractor operation. During the design of the vineyard roadways and the perimeter of the blocks should be relatively level if possible to ensure safe equipment operation. Significant movement of soil in preparation for planting is generally not recommended. Most of the soils in the Okanagan have limited top soil and organic matter.

Significant land alteration changes the structure of the soil horizons, nutrient availability as well as the drainage characteristics of the soil. However, in some cases change to the slope of the land is necessary to facilitate production. This is usually due to frost pockets, gullies, steep slopes, or other impediments. It is important to consult with a professional prior to any land movement and use a reputable contractor that is experienced in land preparation.

Pre Plant Cover Crops

There are a number of advantages to growing a cover crop before planting: cover crops can improve soil structure, contribute some nutrients (mainly potassium and possibly nitrogen, depending on crop choice), improve water holding capacity of the soil and suppress weed growth. Cover crops can add considerable amounts of organic matter, which provides food for micro and macro organisms in the soil. Many soil organisms help to make nutrients more readily available to plants.

If the cover crop is planted in the fall, rye or winter wheat, possibly in combination with a winter annual legume (e.g. hairy vetch or winter peas, which need to be cut or incorporated into the soil before they start to set seed in late spring/early summer), produce a fair amount of bio mass and can help in suppressing weed populations. If land leveling or movement of the soil is required it is generally recommended that the land be left fallow for at least 1 year in order to grow a cover crop to improve soil conditions.

If cover crops are planted in spring, after risk of frost is past, there are a number of suitable plants: buckwheat together with oats and a legume (summer vetch, crimson clover, berseem clover, persian clover, etc.) pose little risk of becoming weeds in the interior of BC because of their limited winter hardiness. Oats contain less lignin than most other cereal crops and do not tie up as much nitrogen when they break down in the soil. Annual rye grass grows very fast and can also be used in mixes with a legume.

Nitrogen Contribution of Cover Crops

Many legume cover crops can contribute considerable amounts of nitrogen to the soil through nitrogen fixing bacteria on the roots and through the protein content of the biomass. The actual amount will however vary with soil conditions, irrigation, species of legume, and timing of incorporation. For maximum nitrogen contribution seeds should be inoculated with the appropriate rizobia bacteria and incorporated into the soil at bloom time. See also chapter 4.5 for more information.

Site Development

A site plan is an invaluable tool in planning a vineyard. The position of buildings, irrigation, power supply, roadways and row direction and length should be indicated on a scale drawing.

Buildings must include storage facilities for equipment, lunchroom and restroom facilities, a ventilated pesticide storage area and a fuel tank storage area. A separate area for sprayer loading and sprayer wash down is required. Check WCB regulations and local by-laws for suggestions on construction and ventilation requirements. Potable water for employees and an emergency shower and eyewash station should be close to the chemical loading area.

When establishing an irrigation system ensure the supply is adequate to fulfill your needs during the highest demand period of the summer. Irrigation should be delivered to an area convenient for distribution to the blocks of the vineyard with power for pumping, filtration and automated control devices. The plan should address the type of irrigation to be employed and whether frost protection is anticipated. The soil survey is an integral part of the planning of the irrigation system since variations in soils demand varying volumes of water. Future water availability should be considered when choosing an irrigation system. Drip systems and under canopy micro-jet systems are more efficient in supplying water than overhead systems, and require smaller pumping systems. Use an experienced and reputable professional to design the vineyard irrigation system.

The size of vineyard blocks and the row directions of the blocks must be determined prior to the design of the irrigation system. Once the row direction and width is established the rows can be laid out and if necessary deep ripping performed. Ripping is best performed when the soil is dry and is quite useful in heavy or layered soils but not of much use in gravely and sandy soils. Ripping clears a way for the plant to develop a rooting system, aerates the soil, and makes it easier to plant vines and pound posts.

Row Direction

In general rows should be planted north-south if the slope of the site allows. North-south row orientation allows for the canopy to maximize the amount of solar radiation it intercepts. The fruit on the east and west sides of the canopy will develop at the same rate, increasing the vineyard uniformity and quality. East-west row orientation exposes the southern facing fruit to more heat and sunlight which results in uneven development between the north and south sides of the canopy. In areas with very high wind speeds the row orientation should be parallel to the wind in order to minimize damage to the canopy. In areas with a high frost risk the rows should run parallel with the slope to increase air drainage.

Vine Spacing

The decision on plant density should be determined by how well the vine's roots will exploit the soil.

There is little evidence to suggest a higher density results in a higher quality wine. However, the higher densities do allow for a lower yield per plant to achieve production goals and this could offer a greater chance of survival from a severe winter.

Vineyard establishment costs, as far as vine spacing is concerned, are influenced more by the number of rows per hectare than by the number of vines per hectare. The cost of vine planting and training is influenced by vine density, but these costs are minor. Between-vine spacing in the row should be designed to spread the wood of a vine on a trellis in such a way that the vines produce the desired yield without crowding. The pruning system (cane or spur) that will be used will influence the in-row spacing. Cane pruned vines will need room for 12 to 14 bud canes when laid along the wire, with 10 cm between cane ends to prevent shoot and fruit crowding. Cordons with spur pruning do not need as much space on the wire.

Between row-spacing of the present acreage varies between 2.3 meters to 2.7 meters and between plant spacing from 0.6 meters to 1.5 meters. The most common is 2.4 meters by 1.2 meters.

3.3 Planting Grapevines

After a soil survey and soil analysis add any amendments to balance the soil and incorporate the material into the soil. If the soil tends to compact or is rocky, deep ripping where the row will be placed is beneficial. This will allow ease of post placement, vine planting and ensures good aeration of the soil. If practical install irrigation and water in any added fertilizer and offer the newly planted vines a moist bed.

Increased plant density requires row spacing to be narrower and with this the necessity of straight rows. The use of a laser system will help ensure this.

Strong healthy plants of desirable clones should be purchased.

Greenhouse grown plants should be planted as soon as the risk of frost is past. Dormant vines should be planted as soon as possible, preferable in March. Remove from cold storage only two days supply at one time. Soak in water until planted and ensure the root system does not dry out. A small amount of a balanced fertilizer such as 20-20-20 may be added to the water used for soaking. When planting ensure the roots are distributed in the soil and aimed downward to ensure good growing characteristics with all roots functioning. If necessary plant a little deeper and pull the vine up to the required level. Ensure the graft union is 4-6 cm. above the soil level. A rigid stake should be planted with or added shortly after the vine is planted.

Immediately after planting irrigate or provide enough water to completely soak the soil around the vine roots. This eliminates large air pockets and brings the soil in contact with the root. Young vines should be protected from stress and competition from weeds. Milk cartons, plastic tubes or other devices will help protect young vines from wind, weed spray or mechanical weeders. Ensure young vines are weed free and do not suffer water stress – at least for the first two years.

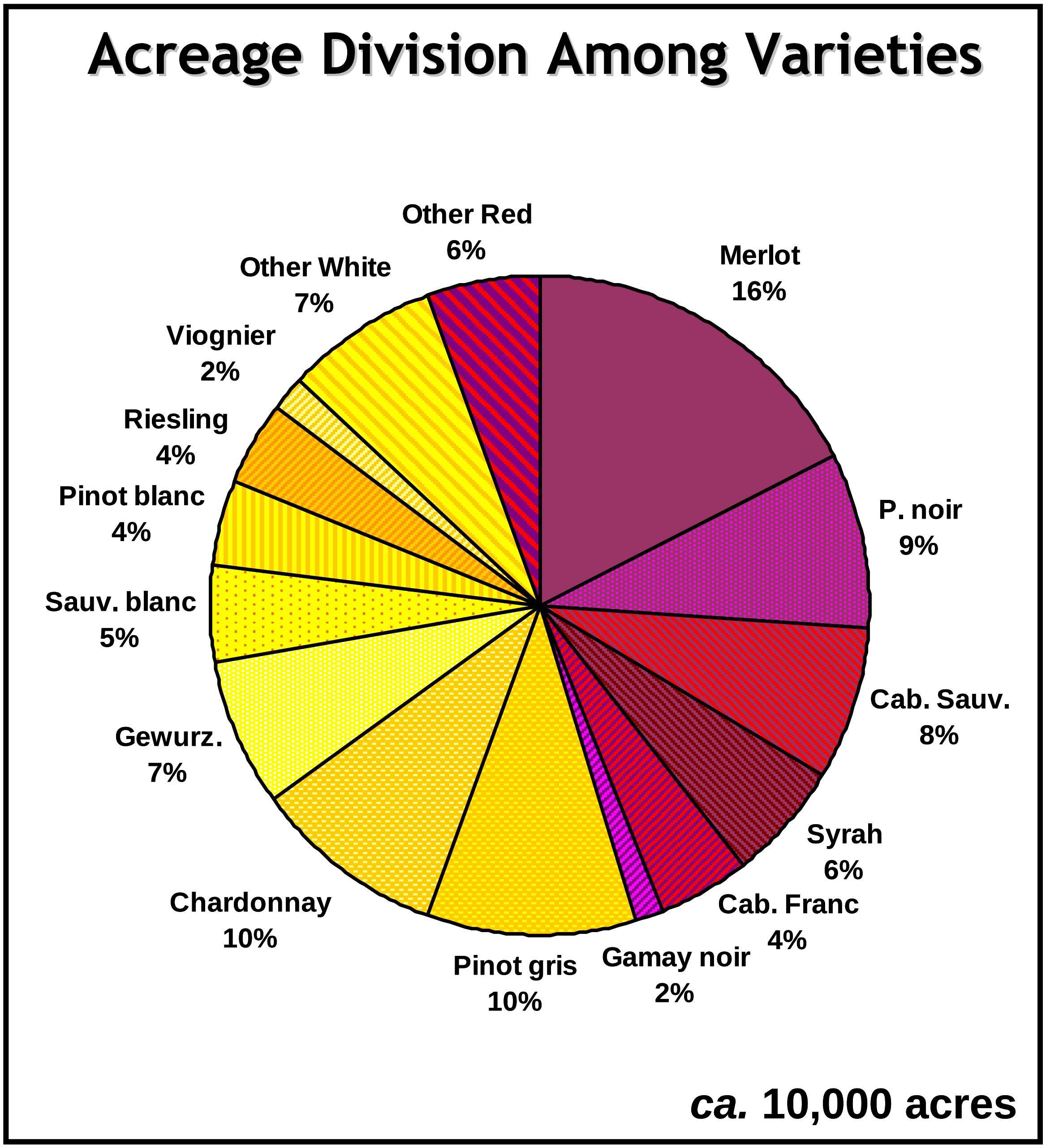
As the young plant grows tie to the rigid stake every 10 – 15cm of growth to ensure a straight trunk and minimize wind damage. Regularly check for pests and disease. Mildew, leafhopper and species of flea beetle can cause extensive damage to the developing plants.

The goal of the first year is to establish the vine with a trunk of at least pencil thickness (8-10 mm) and trained for at least 30cm along the fruiting wire.

3.4 Variety and Rootstock Selection

In order to maximize profitability varieties chosen must produce an economic yield, achieve the quality standard of the receiving winery, have fair market value, and be in demand. The selection of the grape variety to plant must first match the growing conditions of the site. Local temperature data should be analyzed to determine what varieties are best suited for the particular site. In addition to matching the site conditions, the variety should meet the long term market demand of the winery for which the grapes are grown. Choose a variety that is in high demand, or is a widely accepted variety. This will ensure the long term sustainability of the vineyard.

Figure 3.2 2010 Varieties by Percentage Planted in the Okanagan and Similkameen Valleys



Source: Dr Pat Bowen and Carl Bogdanoff (AAFC PARC Summerland, BC)

Grape Variety Descriptions

The following variety descriptions are provided as information only and are not variety recommendations. Always consult a number of sources including your winery before selecting varieties to grow. Information for these descriptions was gathered from a number of sources*. Not all the information presented may be applicable to grape growing areas in British Columbia.

Vitis vinifera

White Varieties

AUXERROIS

- ***Synonyms –*** Pinot Auxerrois
- ***Origin –*** Thought to have originated in Moselle area, east France.
- ***Maturity –*** Mid season
- ***Plant Characteristics –*** Adapted to cooler areas. Fairly vigorous. Clusters and berries small. Yields low in France. Good winter hardiness
- ***Insects & Diseases –*** Susceptible to powdery mildew and Botrytis.
- ***Wine Potential –*** Wines full bodied, and fruity, but neutral with neutral acidity. Often blended. Not in demand in British Columbia.
- ***Clones –*** Various Clones. Two certified in France.

BACCHUS

- ***Origin –*** Cross derived from Muller-Thurgau, Riesling and Sylvaner
- ***Maturity –*** Early
- ***Plant Characteristics –*** Adapted to a wide range of climates. Vigorous. Easily sunburned. Large clusters.
- ***Insects & Diseases –*** Sensitive to powdery mildew and Botrytis.
- ***Wine Potential –*** Low acidity, usually used for sweet wines. Muscat like or Sylvaner flavours. Often blended. Used to produce a dry, fruity wine in British Columbia. (Not in demand in BC)

CHARDONNAY

- ***Synonyms –*** Pinot Chardonnay
- ***Origin –*** Ancient variety. Probably in the Middle East.
- ***Maturity –*** Mid-late season
- ***Plant Characteristics –*** Moderate vigour, does best on fertile soils. Early budbreak. Moderately hardy. Sensitive to drought. Yields well.
- ***Insects & Diseases –*** Susceptible to powdery mildew. Susceptible to Botrytis when vigour is high and grapes are ripe.
- ***Wine Potential –*** Most popular white grape in the world. High quality variety. Wide range of wine styles. Can be used for dry, sparkling or sweet wines. Ages well in barrels. Crisp, fruity wines produced in British Columbia.
- ***Clones –*** Many clones. 31 certified in France. Early clones desirable.

CHENIN BLANC

- ***Synonyms –*** *Pineau d'anjou, Verderant, Franc-Blanc*
- ***Origin –*** Likely originated in Anjou area in the Loire Valley of France.
- ***Maturity –*** Late
- ***Plant Characteristics –*** Vigorous variety that produces good yields. Early budbreak. Winter tender. Sensitive to sunburn. Early budbreak increases sensitivity to spring frost. Yields high. Clusters medium to large but berries small to medium.
- ***Insects & Diseases –*** Quite susceptible to Botrytis. Sensitive to powdery mildew.
- ***Wine Potential –*** Produces dry, sparkling or sweet wines. Acidity high. Fruity. Generally ordinary wines.
- ***Clones –*** Different phenotypes. Eight clones certified in France.

EHRENFELSER

- ***Origin –*** Riesling x Sylvaner clone hybrid developed at Geisenheim.
- ***Maturity –*** Mid season.
- ***Plant Characteristics –*** Not hardy. Low vigour. Yields poor.
- ***Insects & Diseases –*** Disease susceptibility low.
- ***Wine Potential –*** Low acidity. Ages only for a short period. Full bodied, fruity and pleasant wines. Riesling characteristics. Not in demand in British Columbia.

GEWÜRZTRAMINER

- ***Synonyms*** – Traminer (but not correct)
- ***Origin*** – One source indicates that origin is believed to be Termeno, Italy, another the Pflalz region of Germany.
- ***Maturity*** – Early
- ***Plant Characteristics*** – Moderately vigorous variety. Sensitive to iron deficiency. Early budbreak. Sensitive to spring frost. Yields moderate. Clusters and berries are small. Hard to pick. Moderate winter hardiness.
- ***Insects & Diseases*** – Slight susceptibility to powdery mildew and Botrytis.
- ***Wine Potential*** – Sugar content high. High quality, low acid, scented, strong and robust wines can be produced. In demand.

GRENACHE

- ***Synonyms*** – Garnacho, Tinto, Tinto Menudo, Alicante
- ***Origin*** – One source suggests the origin is the Rioja Valley in Italy
- ***Maturity*** – Late season and loves heat
- ***Plant Characteristics*** – Upright and vigorous tending toward biennial crops. Does well in dry rocky slopes or fine sandy soils. Seems to do well in dry and windy conditions.
- ***Insects and Diseases*** – Prone to bunch rot and if too vigorous is prone to coulure.
- ***Wine Potential*** – Good blender, low in colour.

KERNER

- ***Synonyms*** – Trollinger x Riesling
- ***Origin*** – Riesling x Trollinger cross at Wurttembeurg, Germany.
- ***Maturity*** – Mid season.
- ***Plant Characteristics*** – Suited to cooler locations, but adapted to a wide range of sites. Hardy. Late budbreak,
- ***Wine Potential*** – Produces a Riesling type white wine. High acid. Can be high quality. Icewines produced in BC with Kerner. Low demand.

MALVASIA

- ***Synonyms*** – Malvasia Bianca
- ***Origin*** – Probably Greece or Asia Minor
- ***Maturity*** – Mid-late season
- ***Plant Characteristics*** – Vigorous. Adapted to drier soils. Moderate yields. Not hardy.
- ***Insects & Diseases*** – Susceptible to powdery mildew and Botrytis.
- ***Wine Potential*** – Produces dry and sweet white and light red wines with high alcohol content and residual sugar.
- ***Clones*** – Many clones.

MORIO-MUSCAT

- ***Synonyms*** – Muscat
- ***Origin*** – Probably a Silvaner x Pinot Blanc cross.
- ***Maturity*** – Early to mid season
- ***Plant Characteristics*** – Adapted to cooler climate regions. Good production. Berries have thin skin, prone to cracking and subsequent spoilage.
- ***Wine Potential*** – Not a true Muscat type, but very pronounced Muscat flavour. Acids medium to high. Often blended.

MUSCAT BLANC

- ***Synonyms*** – Many synonyms. Muskateller, Gelber Muskateller
- ***Origin*** – May be the oldest known grape, grown in the Mediterranean area for centuries.
- ***Maturity*** – Mid season.
- ***Plant Characteristics*** – Vigorous. Low yields. Early budbreak. Best in warmer sites. Not hardy.
- ***Insects & Diseases*** – Very susceptible to powdery mildew. Very attractive to wasps.
- ***Wine Potential*** – Makes semi sweet and sweet dessert wines with Muscat flavour.
- ***Clones*** – Coloured strains.

MUSCAT-OTTONEL

- ***Synonyms*** – Muscat
- ***Origin*** – Seedling of Robert Moreau.
- ***Maturity*** – Early
- ***Plant Characteristics*** – Low vigour. Adapted to heavier soils. Sensitive to blossom drop. Good spring frost resistance. Somewhat winter tender. Clusters are small to medium and berries medium to large. Yields low. Not hardy.
- ***Insect & Diseases*** – Susceptible to Botrytis.
- ***Wine Potential*** – Produces dry and sweet wines. Wines are alcoholic, perfumy and aromatic. Also used as a table grape.
- ***Clones*** – One clone certified in France.

MULLER THURGAU

- ***Origin –*** Possibly a Riesling x Sylvaner or Chasselas cross. Developed by Hermann Muller at Geisenheim, Germany.
- ***Maturity –*** Mid-late season
- ***Plant Characteristics –*** Vigorous plant. High yields. Sensitive to iron deficiency. Adapted to cool areas. Moderate spring frost resistance. Low winter hardiness. Clusters & berries medium size.
- ***Insects & Diseases –*** Sensitive to powdery mildew and very susceptible to Botrytis.
- ***Wine Potential –*** Wines are alcoholic, aromatic with low acidity. Quality between Riesling and Sylvaner. Not in demand in British Columbia.
- ***Clones*** – Seven clones certified in France.

OPTIMA

- ***Origin –*** Riesling x Sylvaner x Muller Thurgau.
- ***Maturity –*** Early
- ***Plant Characteristics –*** High vigour. Yields moderate. Late budbreak. Winter hardy. Suited to a wide range of soils
- ***Insects & Diseases –*** Very susceptible to Botrytis.
- ***Wine Potential –*** Used for blending purposes in the Mosel-Saar. Ruwer region of Germany. Low acid. Used for dry and dessert wines in British Columbia.

ORTEGA

- ***Origin –*** Muller Thurgau x Siegerrebe cross at Wurzberge.
- ***Maturity –*** Early-mid season
- ***Plant Characteristics –*** Cold hardy. Berries medium size. Drought sensitive. Splits in the rain. Grown in North Okanagan and at the Coast.
- ***Insects & Diseases –*** Moderate susceptibility to Botrytis. Sensitive to late spring frost. Attractive to wasps.
- ***Wine Potential –*** Produces full bodied, flavourful wines of high quality in good years. Low acid. Wines keep well. Delicate aromas. It has some Riesling characteristics. Often blended with Riesling.

PINOT BLANC

- ***Synonyms –*** Weissburgunder, Pinot Bianco
- ***Origin –*** Burgundy, France. Mutation of Pinot Noir.
- ***Maturity –*** Mid-late season
- ***Plant Characteristics –*** Productive with medium vigour. Adapted to light soils. Requires good site. Moderately hardy. Clusters are medium and berries medium.
- ***Insects & Diseases –*** Sensitive to powdery mildew and Botrytis.
- ***Wine Potential –*** Produces wines similar to Chardonnay. Important variety in Germany. Wines are slightly robust and fruity. Also used for sparkling wines. Used to blend.
- ***Clones –*** Various clones. Two clones certified in France.

PINOT GRIS

- ***Synonyms –*** Pinot Grigio
- ***Origin –*** Mutation of Pinot Noir. Burgundy, France.
- ***Maturity –*** Mid season
- ***Plant Characteristics –*** Vigorous with moderate production. Yields of newer clones better. Adapted to cool areas and dry soils. Requires good site. Hardy. Easy to grow. Clusters and berries are small.
- ***Insects & Diseases –*** Slightly susceptibility to powdery mildew and Botrytis.
- ***Wine Potential –*** Large plantings in northern Italy. Pinot Gris produces high quality wines that are robust and aromatic, intensely perfumed. Can produce pink coloured wines.
- ***Clones –*** Various clones. Three certified in France.

RIESLING

- ***Synonyms –*** Many. White Riesling.
- ***Origin –*** Origin is thought to be the Rhine river area in Germany, but not determined with accuracy.
- ***Maturity –*** Late
- ***Plant Characteristics –*** Adapted to a wide range of soils. Winter hardy. Vigour moderate to high. Yields can be variable. Budbreak late. Clusters and berries are medium.
- ***Insects and Diseases –*** Some susceptibility to powdery mildew and very susceptible to Botrytis. Berry drop sometimes from grape stem rot.
- ***Wine Potential –*** Wines age well. Acidity high. Alcohol content not high. Late harvested or Botrytis affected grapes can produce excellent sweet wines. Trend to drier style Rieslings.
- ***Clones –*** Only one clone certified in France.

SANGIOVESE GROSSO

- ***Synonyms*** – Sangiovese Dolce, Sangiovese Toscano, Prugnolo, Brunello
- ***Origin –*** Italy

- ***Maturity*** **–** Mid season
- ***Plant Characteristics*** **–** Enjoys calcareous well drained soils, average vigour.
- ***Insects and Diseases*** **–** Relatively resistant to disease
- ***Wine Potential*** **–** Variable depending on yield

SANGIOVESE PICCOLO

- ***Synonyms*** **–** Sangiovese Forte, San Gioveto
- ***Origin*** **–** Italy
- ***Maturity*** **–** Mid Season
- ***Plant Characteristics*** **–** Enjoys calcareous well drained soils, low vigour.
- ***Insects and Diseases*** **–** Thin skinned grapes therefore prone to bunch rot.
- ***Wine potential*** **–** Variable depending on yield.

SAUVIGNON BLANC

- ***Synonyms*** **–** Fume Blanc is oaked Sauvignon Blanc.
- ***Origin*** **–** Southwest or central France
- ***Maturity*** **–** Mid-late season
- ***Plant Characteristics*** **–** Very vigorous variety, best on low fertility soils and warm sites. Suited to South Okanagan. Mid season budbreak. Winter tender because of late wood maturity. Yields moderate.
- ***Insects & Diseases*** **–** Very susceptible to Botrytis because of tight clusters. Susceptible to powdery mildew. Very susceptible to erineum mite.
- ***Wine Potential*** **–** Makes some of Europe's most popular wines. Dry wines are very pleasant, aromatic, fine and balanced. Late harvested and Botrytis affected grapes produce high quality sweet wines.
- ***Clones*** **–** 20 clones certified in France.

SCHONBURGER

- ***Origin*** **–** Bred at Geisenheim.
- ***Maturity*** **–** Early-mid season.
- ***Plant Characteristics*** **–** Adapted to cooler locations protected from wind. Not fully hardy.
- ***Insects & Diseases*** **–** Low susceptibility to Botrytis. Moderate winter hardiness. Medium yield.

SEMILLON

- ***Synonyms*** **–** Semillon Blanc
- ***Origin*** **–** Bordeaux area of France.
- ***Maturity*** **–** Late
- ***Plant Characteristics*** **–** Fairly vigorous and productive variety. Adapted to lighter soils but sensitive to fertility. Clusters large and berries large. Budbreak mid season. Winter tender.
- ***Insects & Diseases*** **–** Susceptible to Botrytis. Susceptible to mites and leafhoppers. Low susceptibility to powdery mildew.
- ***Wine Potential*** **–** Produces Sauternes wines. Often blended with Sauvignon Blanc. Dry wines of high quality and good keeping and aging potential. Good sweet wines can be produced from Semillon. Often blended. Used for dry and blended wines in British Columbia.
- ***Clones*** **–** Seven clones certified in France.

SIEGERREBE

- ***Origin*** **–** Gewürztraminer x Madeline Angevine cross.
- ***Maturity*** **–** Very early.
- **Plant *Characteristics*** **–** Adapted to cool short growing season areas Low vigour. Hardy. Productive, can over crop. Chlorosis on heavy soils. Very attractive to wasps and birds.
- ***Insects & Diseases*** **–** Susceptible to powdery mildew. Slightly susceptible to Botrytis.
- ***Wine Potential*** **–** Heavy perfume aroma and spicy taste. High sugar. Low acid. Best as a late harvest wine in Washington State.

VIOGNIER

- ***Origin*** **–** Unknown
- ***Maturity*** **–** Mid-late season
- ***Plant Characteristics*** **–** Low yields.
- ***Wine Potential*** **–** Produces a highly intense, floral and spicy wine. Muscat characteristics. Becoming popular in North America and Southern France. Has potential in B.C. Does not age well.
- ***Clones*** **–** One certified clone in France.

Red Varieties

CABERNET FRANC

- ***Origin* –** Likely a native of Bordeaux, southwest France.
- ***Maturity* –** Late, after Cabernet Sauvignon. Maturity difficult in North Okanagan.
- ***Plant Characteristics* –** Quite vigorous. Very productive. Early budbreak. Moderate winter hardiness. Clusters medium size and berries medium.
- ***Insects & Diseases* –** Sensitive to grape leafhoppers. Fairly susceptible to Botrytis. Susceptible to powdery mildew.
- ***Wine Potential* –** Wines are very aromatic. Age well. Alcohol, acidity and polyphenols medium. Often blended with Cab. Sauvignon and Merlot.
- ***Clones* –** 35 certified clones in France.

CABERNET SAUVIGON

- ***Origin* –** Originated in the Bordeaux area of France or perhaps Italy.
- ***Maturity* –** Late
- ***Plant Characteristics* –** Late bud break. Winter hardy. Low yields. Vigorous variety. Small berries and clusters medium but light weight. Low to moderate winter hardiness. Requires rootstocks to control vigour.
- ***Insects & Diseases* –** Very susceptible to powdery mildew. Some resistance to Botrytis.
- ***Wine Potential* –** The world's most renowned grape variety for the production of fine red wines. Wines are dark and high in tannins when harvested at full maturity. Good keeping qualities. Age well in barrels.
- ***Clones* –** 25 certified clones in France.

GAMAY NOIR

- ***Synonyms* –** Gamay
- ***Origin* –** Burgundy, France
- ***Maturity* –** Late due to high acid.
- ***Plant Characteristics* –** Low - moderate vigorous with good production. Hardy. Can be sensitive to sunburn and shot berries. Needs to be thinned well. Clusters medium large and berries medium large size. Early budbreak.
- ***Insects & Diseases* –** Susceptible to powdery mildew and Botrytis.
- ***Wine Potential* –** Wines of Beaujolais produced with this variety. Clone selection has improved wine quality. Wines are light, fruity, with good bright red colour but can lack tannins and aromatic complexity. High acid.
- ***Clones* –**Various clones available.

LEMBERGER

- ***Synonyms* –** Limberger, Blaufrankisch
- ***Maturity* –** Mid season.
- ***Plant Characteristics* –** Cold Hardy. Early budbreak. Vigorous.
- ***Wine Potential* –** "Merlot like", fruity wines with mild tannins. Reportedly has low levels of histamines.

MALBEC

- ***Synonyms* –** Cot, Pressac
- ***Maturity* –** Mid-late season
- ***Plant Characteristics* –** Not hardy. Moderately vigorous.
- ***Insects & Diseases* –** Susceptible to powdery mildew and Botrytis.
- ***Wine Potential* –** Produces an inky red intense wine. Used in blends with Merlot and Cabernet Sauvignon to produce Claret.

MERLOT

- ***Synonyms* –**Merlot Noir
- ***Origin* –** Origin unknown, possibly Bordeaux, France.
- ***Maturity* –** Late
- ***Plant Characteristics* –** Low to moderate vigour. Not hardy. Sets good crops. Very sensitive to winter injury, spring frost and drought. Clusters are winged, fairly large. Berries medium size. Sensitive to boron deficiency. Best spur pruned.
- ***Insects & Diseases* –** Good tolerance of powdery mildew. Susceptible to Botrytis. Susceptible to leafhoppers and crown gall.
- ***Wine Potential* –** Most widely planted variety in Bordeaux. Wines are mild, well coloured, soft tannins and slightly acidic with a soft delicate flavour. . May be consumed young, but benefits from aging in oak. Often blended with other reds, used in most Bordeaux blends. Good quality Merlots being produced in British Columbia.
- ***Clones* –** 15 certified clones in France.

PETIT VERDOT

- ***Origin* –** Bordeaux, France.
- ***Maturity* –** Very late
- ***Plant Characteristics* –** High vigour. Adapted to light soils. Clusters small and compact. Moderately winter hardy.
- ***Insects & Diseases* –** Tolerant of Botrytis.
- ***Wine Potential* –** Produces powerful wines with

high colour and spicy flavour. High acidity. Important variety to blend with Merlot and Cabernet Sauvignon. Used for colour.

- ***Clones*** **–** Only one certified in France.

PINOTAGE

- ***Origin*** **–** Pinot Noir clone x Cinsault cross developed in 1925 in South Africa.
- ***Maturity*** **–** Mid season.
- ***Plant Characteristics*** **–** Widely grown in South Africa. Difficult grape to grow. Small planting in British Columbia.
- ***Insects & Diseases*** **–** Low susceptibility to diseases.
- ***Wine Potential*** **–** Hearty dark red wine that ages well, often requiring aging. Pinotage has an unusual earthy character. Wines in demand

PINOT MEUNIER

- ***Synonyms*** **–** Meunier, Black Riesling.
- ***Origin*** **–** Clone of Pinot Noir.
- ***Maturity*** **–** Mid season
- ***Plant Characteristics*** **–** Late budbreak. Clusters large. Productive. Good winter hardiness.
- ***Insects & Diseases*** **–** Susceptible to powdery mildew and Botrytis.
- ***Wine Potential*** **–** Grown to produce champagne in France. Blended with Chardonnay to make "Blanc de Noir" sparkling wines. Produced as a varietal and for sparkling wines in BC.

PINOT NOIR

- ***Synonyms*** **–** Spatburgunder
- ***Origin*** **–** Native of Burgundy, France. There are many different phenotypes.
- ***Maturity*** **–** Late
- ***Plant Characteristics*** **–** Adapted to cooler areas. Not fully hardy. Difficult to grow. Sensitive to sunburn. Yields low. Best results when vigour ad yield are controlled. Clusters and berries are very small to small. Budbreak early. Winter tender.
- ***Insects & Diseases*** **–** Very susceptible to Botrytis and grape leafhoppers. Moderate susceptibility to powdery mildew.
- ***Wine Potential*** **–** Difficult variety. Pinot Noir makes the finest wine in Burgundy. Wines age well. Sugar content is high and acidity low to medium. Colour intensity is moderate. Also used for sparkling wines. B.C. produces a variety of styles. In demand.
- ***Clones*** – Many clones. 50 certified in France. Use early clones.

ROTBERGER

- ***Origin*** **–** Trollinger x Riesling cross. Germany
- ***Maturity*** **–** Late season.
- ***Plant Characteristics*** **–** Adapted to cool areas of the Okanagan Valley. Winter tender. Grows well.
- ***Wine Potential*** **–** Produces light red, fruity, early maturing wines. Also rose wines.

SYRAH

- ***Synonyms*** **–** Shiraz
- ***Origin*** **–** Not known with certainty. Possibly originated in Persia, introduced to the northern Cotes du Rhone or Dauphine areas of France. Cultivated since Roman times. Should not be confused with Petit Syrah (Durif).
- ***Maturity*** **–** Very late
- ***Plant Characteristics*** **–** Weak shoots that break easily. Sensitive to drought. Very susceptible to iron deficiency. Yields well. Winter tender. Budbreak fairly late. Clusters medium large and berries medium large.
- ***Insects & Diseases*** **–** Susceptible to Botrytis when ripe. Sensitive to mites. Some resistance to powdery mildew.
- ***Wine Potential*** **–** Wines are good quality with high alcohol. Aging improves quality. Characteristic fragrance. Wines are dark, strong and complex. Fruity rose wines can be produced with this variety.
- ***Clones*** **–** 16 clones certified in France.

ZINFANDEL

- ***Synonyms*** **–** Primativo
- ***Origin*** **–** Probably Italy
- ***Maturity*** **–** Late
- ***Plant Characteristics*** **–** Moderately vigorous, thin skinned, large bunches, spur pruned or cane pruned
- ***Insects and Diseases*** **–** Susceptible to bunch rot and raisining
- ***Wine Potential*** **–** Potentially very high quality.

Hybrid Varieties

White Varieties

VIDAL BLANC

- ***Synonyms –*** Vidal
- ***Origin –*** Ugni Blanc x S4986 French Hybrid
- ***Maturity –*** Mid –late season
- ***Plant Characteristics –*** Moderate cold hardiness. Moderately vigorous. Good production but fruit set can be poor sometimes. Winter hardy in New York. Clusters large, berries medium in size.
- ***Wine Potential –*** Used to produce a range of wines from dry; to sweet, including late harvest and ice wines. Can have a Riesling like character. Wines have higher alcohol content. Used almost exclusively for ice wine in BC.

Red Varieties

MARECHAL FOCH

- ***Synonyms –*** Foch
- ***Origin –*** French Hybrid
- ***Maturity –*** Mid Season
- ***Plant Characteristics –*** Cold hardy. Adapted to cool areas and light soils. Small clusters and small berries. Attractive to birds.
- ***Wine Potential –*** Can produce light, deeply coloured and strongly varietal, "Burgundy-like" red wine. Produces a medium dry wine in BC.

MICHURINETZ

- ***Origin –*** East Europe
- ***Maturity –*** Early
- ***Plant Characteristics –*** Very vigorous. Early vine maturity. Subject to fruit drop.
- ***Insects & Diseases –*** Susceptible to powdery mildew
- ***Wine Potential –*** Can produce high quality Cabernet Sauvignon style wine. High acid and low sugar in poor seasons.

****Sources of Information***

1. Catalogue of Selected Wine Grape Variety and Clones Cultivated in France. 1995. Ministry of Agriculture, Fisheries and Food, France.
2. Vines, Grape and Wines. 1986. Jancis Robinson
3. A Concise Guide to Wine Grape Clones for Professionals. 1998. John Caldwell.
4. Chardonnay and Friends. 1998. John Schreiner.
5. Various internet sites.
6. Personal communication with individuals involved in the BC grape industry.

Rootstock Description

The use of grape rootstocks in British Columbia has come about as a result of literature claims for influences that assist earlier fruit maturity; adaptability of some rootstocks to particular soil types; increased vine hardiness due to vigour control; and the introduction of grape phylloxera.

Selection of a rootstock for grape producers in British Columbia is not a simple matter. Grapes are not native to our province and we do not have a long history of traditional wine grape production. Our grape rootstalk research is limited but on going.

The first planting in the interior employed the use of 5BB, S04, 5C, and C-3309. There have not been any scientific studies in the valley showing comparisons of these rootstocks. However, there seem to be few, if any, reasons for complaints. Experience in the valley so far suggests that Riparia gloire, 3309, 101- 14, and S04 are suitable for the Interior. Each rootstock should be used with a full understanding of the soil it will be planted on and the irrigation management that will be used. Selection for the coastal areas requires some consideration of soil acidity and whether or not irrigation is used, as well as rootstock influence on fruit maturity.

Grape rootstocks were first developed in Europe to protect vineyards from grape phylloxera. Compatibility between rootstock and scion, plus ease of rooting, were also considerations. The North American species *Vitis rupestris* met these conditions. Plant breeders also needed a species that would adapt to the limestone soils found in many European vineyards. The North American species *Vitis berlandieri* was found to be the most useful, even though it is difficult to root. Today there are many rootstocks with various combinations of species. This range of rootstocks available presents possibilities to address many vineyard problems.

Climate and soils in British Columbia vary widely even within small parcels of land. There is no such thing as a single rootstock to serve all situations. Selection of more than one rootstock for a vineyard is therefore reasonable. Vigor control, for example, may best be achieved by selecting rootstocks which increase vigor on very sandy or gravelly areas, while rootstocks which reduce vigour are selected for areas with rich soils.

Understanding the parents for most rootstocks of concern to British Columbia grape growers is a basic requirement to understanding the characteristics of grape rootstocks. Fortunately, such understanding requires knowledge of only three species.

Vitis Rupestris

This is a species whose native soils are gravels and banks of mountain streams. It has a strong vertical root system. It is somewhat drought resistant. *Rupestris,* like *Vitis berlandieri* has a long vegetative cycle and matures late. It is tolerant to some lime conditions. Because of its long vegetative cycle, crosses of *Vitis rupestris* and *Vitis berlandieri* are best suited to warm climates with long growing seasons.

Vitis Riparia

Riparia is found in Eastern Canada and ranges as far as Mexico. It is found on river banks, islands or upland ravines. It is fond of water, but does not grow in swamps. It likes rich soils, but not lime. It is more tolerant of lime than *Rupestris. Riparia* has a short vegetative cycle and ripens early. It has excellent cold resistance. It has low vigour. *Riparia X berlandieri* crosses are quite vigourous, although they are less so than *berlandieri X riparia* crosses. *Riparia* Gloire de Montpellier is the only commercial pure *riparia* rootstock used today. It has low vigour and ripens its fruit and wood early. Crosses of *Vitis riparia X Vitis rupestris* include C-3309, C-3306, 101-14 mgt, Gravesac and Schwarzmann.

Vitis Berlandieri

V. berlandieri is native to the limestone hills of western Texas and neighbouring parts of Mexico. It is a cold and drought resistant species. It has hard, deep penetrating roots that branch little. *V. berlandieri is* long lived and phylloxera resistant. The vines of *berlandieri* bud out late and its fruit ripens late. There are no pure rootstock selections of *V. berlandieri.* It is very difficult to root from cuttings. *Vitis berlandieri X Vitis riparia* crosses include 5BB, S04, 5C, C-191-49, 420 A and 34 EM. *Vitis berlandieri X Vitis rupestris* crosses include 99 R, 110 R, 1103 P, 140 RU, and 1447 P.

Some of the characteristics to look for in a grape rootstock:

1. **Tolerance to phylloxera:** All soils with 3% clay or more are potential sites for phylloxera. Soils with 7% or more clay will support the growth of phylloxera populations.
2. **Tolerance to nematodes:**
   a. Root-knot nematodes *(Meloidogyne sp.)* cause abnormal swellings on grape roots, which resemble swellings caused by phylloxera. On young roots phylloxera galls are hook-shaped, while nematode galls appear as an enlargement of the whole root. Root knot nematodes are more common in sandy soils.
   b. Root-lesion nematodes *(Pratylenchus sp.)*. These do not produce swellings. High numbers simply cause roots to deteriorate.
   c. Dagger nematodes *(Xiphanema sp.)*. *Xiphanema bricolensis is* the most common dagger nematode found in BC.

   A quarantine exists to prevent entry into BC of *Xiphanema index,* a virus transmitting nematode.
3. **Adaptation to calcarious soils**: Most soils in the Okanagan have a pH of 6.0 to 7.5. Some have pH values well above 8.0. Most labrusca and hybrid vines will develop yellow leaves (chlorosis) and will have reduced berry set as a result of high pH soils. *Vitis vinifera,* in addition to being more drought resistant than the labrusca species, is also more lime tolerant. However, in areas where soil pH exceeds 7.9 (this is the point at which free lime begins to accumulate in soils), it is wise to consider rootstocks that are better adapted to soils high in lime content
4. **Adaptation to acid soils:** *Vitis riparia* and *Vitis labrusca* are more tolerant of acid soil conditions (pH 5 to 6). Toxicities of aluminum and magnesium to grapes are common in soils with pH values of less than 5.5. The rootstocks Castel 196-17,101-14 Mgt., C-3309, 5C, 5BB and S04 are better adapted to well drained acid soils. A new rootstock, Gravesac, released from Dijon, France, is said to be suitable to cool climate areas and acid soils.
5. **Resistance to drought:** *Vitas vinifera* on its own roots is quite drought tolerant. However when grafted onto another rootstock the drought tolerance changes. Tolerance to drought does not mean high production or high vigour if vines are placed under stress due to a lack of water. Rootstocks with a drought tolerant characteristic are usually able to "find" water in deeper soil regions or "store" water in its tissue due to a rapid thickening of root tissue. Crosses of *V. berbandieri* and *V. rupestris* are more drought tolerant than crosses of *V. rupestris* X *V. riparia* or *V. berbandieri* X *V. riparia*.
6. **Vigour**: Different rootstocks do not all absorb water and nutrients in the same quantity or the same proportions. Grafted vines therefore vary in vigour and production. Compatibility between vine and rootstocks also vary.

Rootstock Characteristics

The listing in Table 3.2 of grape rootstocks and their characteristics is not intended to be all inclusive. However, Table 3.2 will point out what is known about the adaptive features of many rootstocks.

Only a few of the rootstocks listed in Table 3.2 are actually used in British Columbia. Rootstocks used in BC include Riparia Gloire, SO4, 5BB, 5C, 101- 14Mgt. and 3309C. Producers should use care in selecting rootstocks so that specific concerns for their vineyard are addressed.

In 1927, A.I. Perold said in a treatise on Viticulture that the highest fruit quality could be achieved only if the best cultivars scions were grafted to moderately vigorous rootstocks, then cultivated in a manner to limit crop size.

Table 3.2 Characteristics of Important Grape Rootstocks

Rootstock	Scion Vigour	Resistance to*: Phylloxera	Drought	CrownGall	Phytophthora	Acid Soil	Water Logging
Riparia Gloire	2	5	1	—-	—-	2	—-
SO4	3	4	1	2	1	2	3
5BB	3	4	1	2	—-	—-	—-
5C	3	4	1	4	—-	—-	—-
101-14 Mgt	2	4	3	5	2	1	4
420 A	4	4	2	—-	1	—-	2
1130 P	3	4	3	2	1	2	3
3309 C	2	4	2	4	1	2	3

** 5-very resistant; 1-very susceptible, scion vigour – 1- low vigour, 5 – high vigour*

Characteristics of Important Grape Rootstocks

Rootstock	Tolerance for: Free Lime (%)	Salt (g/litre)	Vigour[a]	Effect on maturiy[c]	Dry, Shallow, Wet soil	Adaptability to[b] Deep Silt or dense clay	Deep, Dry loam	Sandy Soil
Riparia Gloire	6	0.7	2	+	3	1	2	2
SO4	17	0.6	3	+	3	1	2	1
5BB	20	—-	3	+	3	2	2	1
5C	17	—-	2	+	—-	3	3	1
101-14 Mgt	9	—-	2	+	3	2	2	1
420 A	20	—-	2	+	2	3	2	2
1130 P	17	0.6	3	-	3	3	3	3
3309 C	11	0.4	2	+	3	2	2	2

a) 4-high; 1-low
b) 4-good; 1-poor
c) + advance; - delay

Importing Grapevines

Canada has specific grapevine import regulations that help to protect grape growers from the introduction and spread of virus diseases and other pests which are not yet established in British Columbia. Selected grapevine varieties/clones and rootstocks from Canadian-approved nurseries in France and Germany are currently approved for importation into Canada. Grapes may also be imported from approved sources in the United States. Note that the requirements for importation from France and Germany were changed in December 2005 due to the increased prevalence of flavescence dorée in France.

Contact the *Canadian Food Inspection Agency* (CFIA) for more information on importing grapevines. Information on obtaining import permits may also be found at: http://www.inspection.gc.ca/english/plaveg/importe.shtml.

3.5 Trellis Systems

The function of a trellis system is to support the vine to achieve an optimum production that is dependent on the capacity (productivity) and vigor (rate of growth) of the vine. The capacity of a vine is generally linked to the type of soil and the variety and rootstock used. A low vigorous site requires a simple trellis system along with higher plant density. A high vigor site may require a more complex trellis system and lower plant density in order to manage the vigour produced by the vine.

Trellis Design

Trellis designs vary from low vertical shoot positioning (VSP) to the high overhead T-bar system such as Geneva Double Curtain(GDC). When deciding on the height of the trellis system some consideration should be given to the following points:

- in many cases the lower the fruiting wire to the ground the lower the acid level of the harvested fruit
- in areas of frost risk the lower fruiting wire increases the risk of damage by frost as well as inhibiting air flow
- hand harvesting and pruning become back breaking chores with both the very high trellis and the very low trellis

The optimal fruiting wire height is suggested to be between 90cm-1.2meters. This is comfortable for workers, allows good air drainage and is adaptable to mechanical harvesting.

The choice of a training system is determined by a vine's growth habit, vigour, fruitfulness of its base buds, soil type, soil fertility, site selection, and economics of harvesting. Most vinifera are more upright in their growth habit, so a low renewal zone is best. If mechanized **pruning is contemplated, only certain training systems are appropriate.**

A good training system:

1. spreads canes on a trellis to allow movement of equipment through the vineyard;
2. arranges trunks and canes to avoid competition between vines;
3. provides a renewal zone for pruning that keeps the vine form and yield;
4. minimizes shoot crowding, leaf and fruit shading leading to high fruit quality, good disease control, and steady yields;
5. places the fruit in a position to allow ease of harvest, adequate spray penetration, and exposure to sunlight;
6. develops a continuous area of foliage with well exposed leaves;
7. encourages uniform and high bud break.
8. maximizes leaf and nodes to be retained at pruning to maximum sun exposure.

Training Systems

Training systems for vinifera must take into consideration the upright growth habit, relatively winter-tender trunks, and close vine and row spacing. These features require systems that minimize permanent wood, use double trunks, keep renewal zones close to the ground (c. 90cm-1.2m), and provide trellising to control and contain shoot growth. These criteria are met by training systems which keep the cropping area close to the ground: e.g. the pendelbogen system (European Loop), VSP and vertically divided canopy systems such as the Scott Henry System or modifications of this system. Trellising to systems with high trunks such as the GDC are justified if vine vigour is very high and the risk of winterkill of trunks is very low. Below is a list of the most common types of trellis systems and pruning practices used in the Okanagan and Similkameen Valleys.

Table 3.3 Percentages of Production Practices used in the Okanagan and Similkameen Valleys

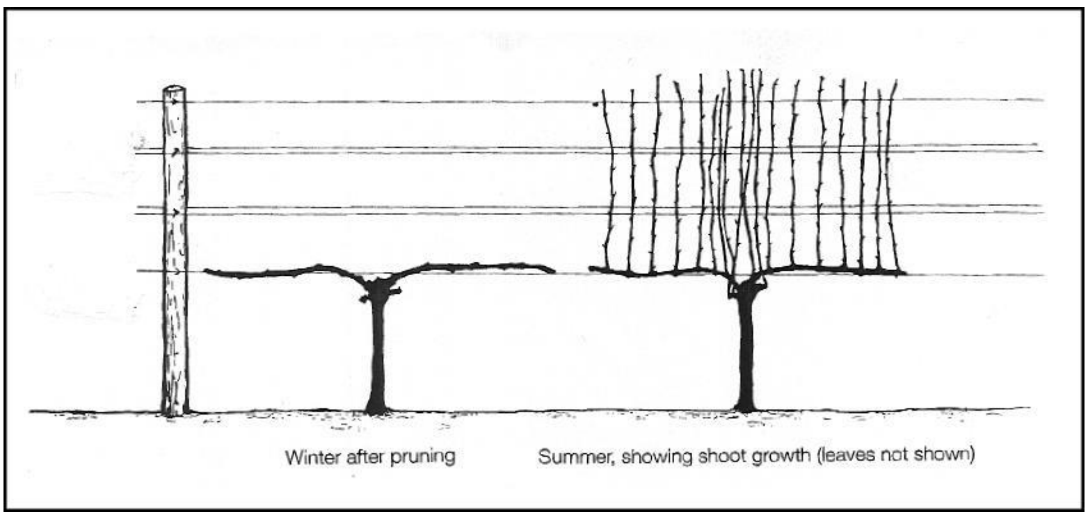
Production Practices

Pruning Style	Percent of Total Acreage
Spur	52%
Cane	32%
Mix (cane + spur)	4%
Not yet pruned (young vines)	9%
Other and unknown	3%

Training / Trellis Style	Percent of Total Acreage
Bilateral cordon (vertical shoot positioning)	88%
Vertically divided canopy (eg. Scott Henry, Smart-Dyson)	2%
T-Bar	2%
Vertically + horizontally divided canopy (eg. quadrilateral)	1%
Horizontally divided canopy (eg. Geneva Double Curtain, Open Lyre)	>1%
Unknown and new plantings	7%

Source: Dr Pat Bowen and Carl Bogdanoff (AAFC PARC Summerland, B.C.)

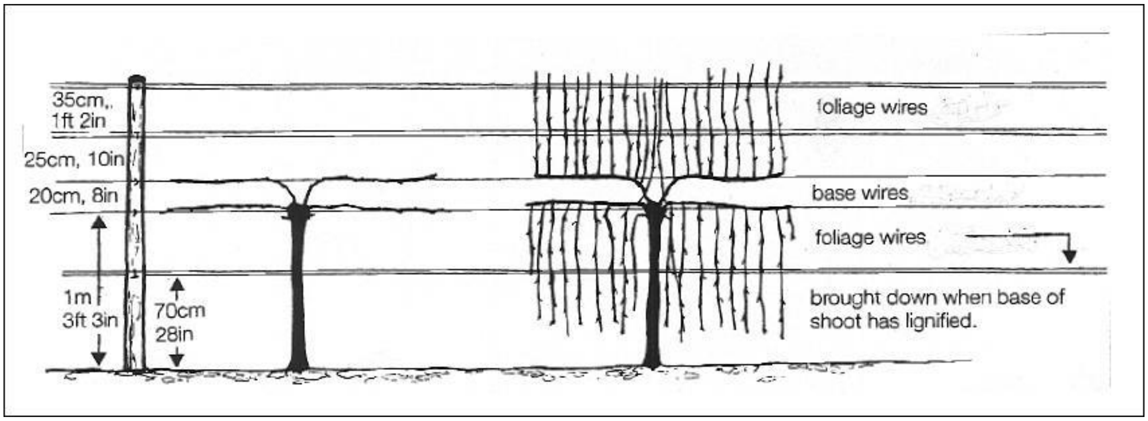
Figure 3.3 Vertical Shoot Position System



Vertical Shoot Positioned Canopy

Vertical systems consist of a single fruiting wire located at about 1 metre above ground, plus several “catch” wires which are either paired opposite each other or single on one side of the post or alternate on opposite sides, and are either permanently attached or movable paired wires. Spacing of the “catch” wires depends on the variety and environment. Windy locations should have the first foliage wire at 20 cm above the fruiting wire, on the lee side of the wind with other foliage wires spaced at 30 cm from there on. Hooks or slanted nails are used to hold movable wires in place. Permanent single wires should be attached on the wind side of the posts so that they are pushed against the post rather than pulled away from it by the wind.

Figure 3.4 Scott Henry System



Scott Henry Canopy

Developed in Oregon, this system consists of two fruiting wires, one at 96 cm on one side of the post and the second at 126 cm on the other side of the post. Thirty (30) cm separate the two wires. This was originally a cane pruned system. The shoots on the upper wire are trained upwards between the foliage wires and the bottom shoots are turned downwards. Separation of the two fruiting areas should begin before bloom with placement of the foliage wire outside the bottom fruiting wire shoots. During bloom these shoots are turned downward. The wide space between the two fruiting wires is needed to permit good air circulation and light penetration. This "window" should be kept open at all times. The Scott Henry system can be modified by placing the fruiting canes of one plant on the lower fruiting wire and the next plant on the higher fruiting wire, avoiding the competition of upper and lower wires when one vine is used to produce canes for both fruiting wires. This will also help to prevent one level from being dominant over the other. Other modifications consist of placing one cane on the higher fruiting wire and developing this into a cordon with spurs alternating into an upper and lower direction.

Smart Dyson System

This system uses a single cordon with half the shoots allowed to be trained downward and half trained upward. Each shoot position is alternately train up and down. This had the advantage of decreasing the canopy density thus allowing good spray penetration and keeping yields at a high level. The labour costs of this system are higher than that of the Scott Henry or VSP systems.

Horizontally Divided Canopy System

There is no positive response to any divided canopy training system by vines that have a low canopy density (less than 0.7 kg cane prunings per metre of row). There is a major response when divided canopy training is used with vines of high density canopy (more than 0.7 kg prunings per metre of row). The major response is the illumination of the renewal areas of the canes or spurs and all the benefits that this brings. To obtain the full benefit of this response, shoots must be positioned to permit sunlight to reach the renewal areas.

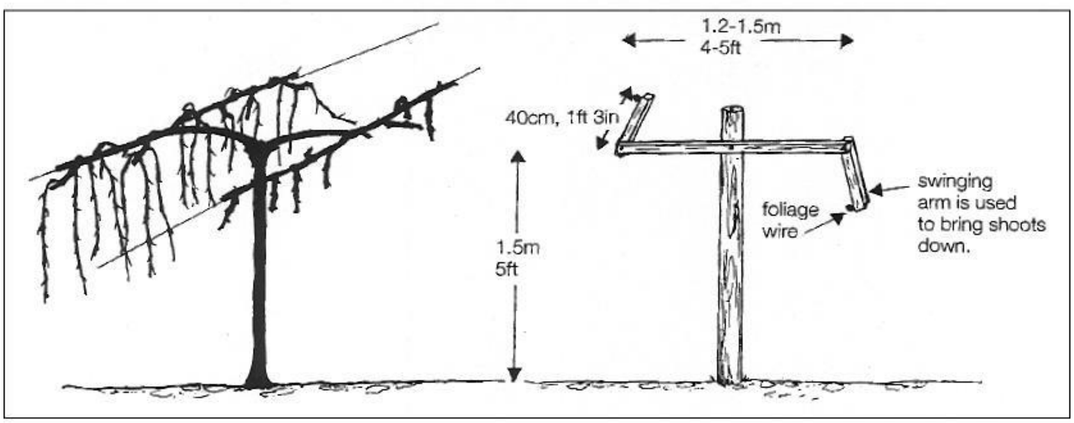
A divided canopy with shoot positioning:

- reduces shading in the renewal zone;
- doubles the canopy area;
- provides good fruit and leaf exposure;
- often increases yields;
- improves wood and fruit quality;
- may cause some sunburn on clusters near the top of the renewal zone.

The "heart" of the divided canopy training system is the shoot and leaf exposure to light. **Without shoot positioning, the structure of a divided canopy training system is meaningless.** Shoot positioning takes time—usually 80 hours of work per hectare. Divided canopy systems should not be attempted unless you are willing to do shoot positioning.

Shoot positioning should be done twice—the first time early in the 4-week period after bloom; the second time in 2 to 3 weeks as the shoots again try to become horizontal.

Figure 3.5 Horizontally Divided Canopy System



Geneva Double Curtain

The Geneva Double Curtain (GDC for short) trellis was originally designed for Concord grapes, but now it is also used for French hybrids and vinifera varieties. The GDC system has fruiting wires 1.2 metres apart and 1.8 metres above the ground. The system usually has two cordons of between 1.8 to 2.4 metres long trained alternatively to the right and left cordon wires. Spur pruning is used. Downward pointing spurs direct growth away from the centre of the trellis and not into the ally where tractors work. Vinifera varieties generally (but not always) have upright growth habits, requiring the use of a movable foliage wire to downward shoot positioning devigorates the shoots and promotes good basal node exposure. Sometimes fruit is sunburned when it is over exposed.

The GDC system requires the maintenance of two distinct curtains of leaves. This is done through shoot positioning, a process of "combing" outward and downward all the upright-growing shoots and those growing into the centre of the canopy. This is best done after bloom and again 10 days to two weeks later. The centre of the vine is opened up to sunlight, and maximum leaf and fruit exposure is maintained.

Wide T Trellis System

Similar in structure to the GDC it has two horizontal wires 0.9-1.2m separation. It is traditionally not shoot positioned but leafwork must be done to keep the canopy open and allow basal buds and fruit exposure.

The advantage is greater yield per plant with good sun exposure. The disadvantage is the difficulty in working with the height of the canopy, and is not conducive to mechanical harvesting. Unless rows are very wide the growth causes problems with tractor movement.

Posts and Wire

The vine trellis is a structure that has to support large loads. The various load components include the vertical load which includes the weight of the fruit, vine and wire. The lateral load is composed of wind forces and machinery errors. Longitudinal load consists of the tension placed on the wire to prevent the trellis from sagging.

The fruiting wire is expected to take the most stress and should be at least 12 gauge galvanized high tensile wire. The training or support wires should be 13 or 14 gauge galvanized high tensile wire.

Posts are normally sharpened treated wooden posts 8-9 feet in length. They are long lived (20 years) and very strong and flexible. The use of 3-4inch posts for in row support and 4-5 inch or 5-6 inch for end posts is common practice. Metal posts may also be used and can be air vibrated into the soil but do not have the strength or flexibility of the wooden posts and are more expensive.

Anchor Systems

There are many systems in use to offer the strength for tensioning the trellis wire. A few examples include:

Angling the end posts 7-10° away from the planted side. This is then secured to a concrete block or some other 'dead head' buried in the soil. There are also anchors designed for rocky soil that can be driven into the earth and attached to the angled end post. The advantage of this type of anchor is the soil is not disturbed and offers immediate strength once attached. The end post should be driven into the soil one meter to ensure stability.

Braced assemblies – this is a brace between the end post (upright) and the ground. The lower the brace is on the end post the less likely the end post will be 'jacked' out of the ground. The brace should be at least 3 meters and have an angle to the ground of 25- 30°. It should also be set against a suitable base plate set in firm soil.

Horizontal box anchor – this consists of a pair of end posts 2-3 meters apart. A horizontal post or rail is fitted between the tops of the end posts. There is also a wire loop from the base of the end post to the top of the second post to stabilize the system.

There are a number of different steel anchors on the market, which are either buried or screwed into the ground and attached to the end post; they perform very well, if properly installed. It is important that the anchor chosen will be suitable for the type of soil it is going into. Some anchors that are screwed or spun into the ground perform very well on sand or loam soils that have very few rocks. For rocky ground there is a special expanding type anchor available, which works surprisingly well. There are also anchors that can be drilled into the ground that are suitable for rocky soil.

Longer rows and heavier crops need better anchor systems!

Figure 3.6 Sample of a Braced Assembly without the Angled End Post