

Grapevine Canopy Management

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Wine quality begins in the vineyard. All premium wines are consistently produced on healthy vines; not overcropped or over vigorous. Years of applied research are required to consistently obtain healthy vines, maximum yields, and quality fruit. Growers should not select a canopy because it is used in a famous vineyard or simply because it is wanted.

Factors Influencing Canopy Selection

Winegrapes are grown in cool, moderate, and warm climates on various soils and with various forms of management; thus, one needs to learn the canopy system which best fits these factors for each cultivar, rootstock, and vine age.

Cool climate vineyards ripen from September 15 to October 15 with low vine vigor.
Moderate climate vineyards ripen from August 15 to September 15 with moderate vigor.
Warm climate vineyards ripen from July 15 to August 15 with high vigor.

Cool climates with no irrigation, limited growing season rainfall, and non-fertile soils such as Bordeaux or Burgundy results in low vine vigor and allows very close vine spacing with limited trellising. However, Australia, Texas and the central valley of California with warm climates, irrigation, deep fertile soils, and high light intensity require more space per vine and larger trellises.

The objective of canopy management is to prune with the proper number of buds per mature vine to obtain perfect size shoots. Australian, David Jackson, calls this correct bud count, "The Magic Number". This number of buds is important, but not magic, it needs to be learned through research and/or experience at the vineyard site.

If vines are growing on shallow low vigor soils in a cool or moderate climate, a closer spacing with reduced buds per vine can be used. In the warm Texas climate, it is impossible to force a large vine into a small space by heavy pruning or overcropping. This is to say, what works in a cool climate as in Bordeaux or Burgundy does not work in a warm climate as in Texas.

Canopy management is complex. Vineyard managers need to learn what is the best canopy, spacing, trellis, and pruning level bud count for each variety vigor, variety

cluster size, clusters per shoot, rootstock vigor, site, climate, soil, irrigation, management, and more. For the last 10 years, the commercial vineyards of Napa and Sonoma represent a large applied research project where many canopy systems are in production and being evaluated in an effort to learn which is best for each specific need.

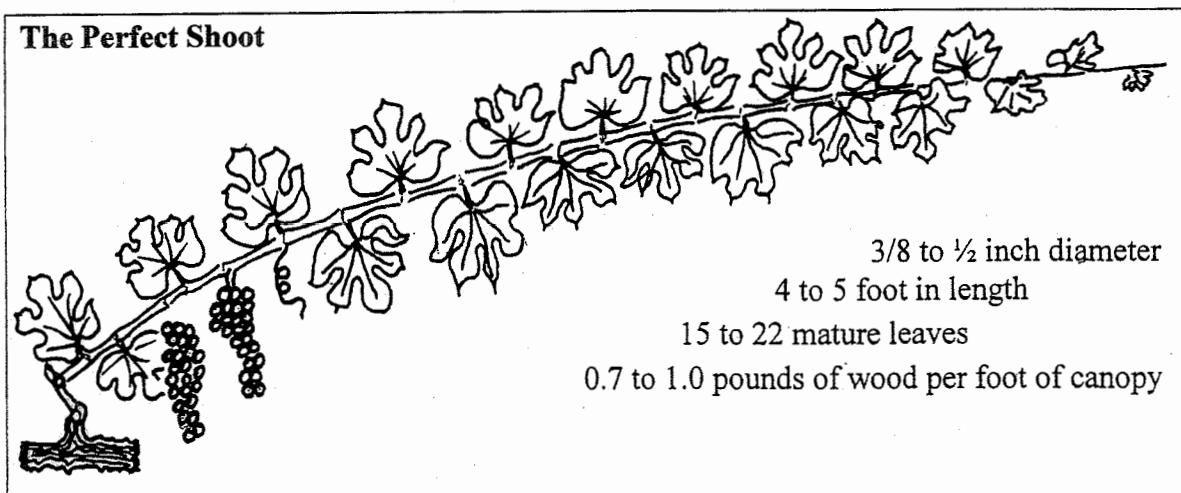
Vigorous varieties such as Cabernet Sauvignon, Sauvignon Blanc, Sangiovese, Syrah/Shiraz, Chenin Blanc, Cabernet Franc, Ruby Cabernet and others all require more space in a warm climate with good soil and management. On sites where growth is slow, a closer row and vine spacing is needed.

Potential, new, or vineyards which are being replaced under new management will need trial plantings with pruning research to determine the growth potential of varieties. Within one or two years, one will know if the vine growth will be vigorous or slow at the site.

Mature bearing vineyards which are not producing the perfect size shoots, maximum yields, and healthy fruit require applied research to determine the level of pruning, row and vine spacing, trellis, and more. Only when a grower knows the number of buds to leave on the vine at pruning will sustainable quality fruit be obtained.

The Perfect Shoot Concept

At harvest in a warm climate, the optimum shoot diameter is 3/8 to 1/2 inch in diameter. The shoot length should be 4 to 5 feet with 15 to 22 leaves. When one prunes mature vines in a warm climate, the pruning weight of the wood removed needs to be 0.7 to 1.0 pounds per foot of row. In a cool climate, where vines have significantly less respiration rate and slower growth need only obtain a pruning weight of 0.3 to 0.5.



Warm climate vines are large because of high sunlight, low relative humidity, and hot nights. These warm climate grapevines need better soil, good moisture, and a large root system to facilitate high water absorption and transpiration to keep the foliage cool.

Over cropped vines with short shoots and too few leaves will not have sufficient food from photosynthesis for adequate fruit ripening. Such vines develop sugar to an insufficient level of 16 to 18 degree Brix and the sugar does not increase regardless of the length of hang time. Some cool or moderate climate wine authorities feel vines weak or dying produce superior fruit. In a warm climate, weak overcropped vines can die.

Excess vigor with long-flat-bull canes, though strong, do not bear fruit. They develop from leaving too few buds on the vine at pruning.

The goal of vineyard managers is to have vines with perfect size shoots at the most productive row and vine spacing for the climate, soil, and level of management. A vine with perfect size shoots and a healthy crop are said to be in balance.

Vegetative, Fruiting, and Storage Sinks

The term balance is used too frequently in viticulture and wine. With the perfect shoot and good vine balance, food from photosynthesis goes first to the growing shoot, second to the developing and ripening fruit, and finally to storage in the cordons, trunks, and large roots.

When the correct number of buds remain after pruning on the dormant vine and when management practices are correct; the vine will produce perfect size shoots, high quality healthy fruit, and sufficient food storage for next years growth.

Vegetative Sink

In the spring as new growth begins, apical dominance on vigorous shoots pulls food via hormone action to the growing point rather than to the cluster. Thus a vegetative sink results.

If too few buds remain at pruning and if too much nitrogen and/or irrigation are applied to vines on fertile soil with good management the vegetative sink will continue. This excess vegetative growth results in limited production of low quality fruit and too much shade.

Bad things happen when a vine is too vigorous; poor fruit set next year, poor berry development, reduced berry skin color, slow or incomplete fruit ripening, and more.

In addition, it has been reported by David Jackson that excess shade of the cluster encourages potassium accumulation and high pH in the must. Furthermore, fruit on vigorous vines, can have a pronounced vegetative character of bell pepper or methoxy-pyrazine in the wine.

Excess vigor can be a challenge for wine growers in all climates. To correct excess vigor, more buds need to remain of the vine after pruning. This will result in a larger vine, higher yields, and acceptable shoot / fruit balance.

Warm climate vines, such as Texas, have large high vigor vines which need good soil, a large root system, good management, high vigor varieties and rootstocks. Small or weak vines cannot be sustainable in a warm climate. Excessive vigor with a strong vegetative sink can prevent food from moving to young developing clusters and flower drop or blast can occur. These bull shoots can have zero production. Warm climates can have serious canopy management needs.

Cool and moderate climates have a less vegetative sink challenge. With the correct canopy they can grow smaller vines with less sunlight, less soil, less water, and less roots because heat, drought, and wind stress are typically less. These climates can have a long hang time because fruit ripening is later in the season during optimum temperatures.

Fruiting Sink

A good supply of stored food and good sunlight in the fruiting zone in May will result in the initiation of two or three healthy microscopic clusters in axillary buds at the base of the leaf petiole. The vegetative sink will develop a strong shoot in spring and early summer. But, shoot growth needs to slow and there needs to be a physiological shift within the vine with food moving to the clusters and less to the vegetative growth. This is 50 to 90 days after budbreak when **veraison**, ripening, and seed maturation begins.

If too many buds were left on the vine at pruning, and if too many clusters set, there will not be sufficient vegetative shoot length or leaf number and photosynthesis to properly ripen the fruit. The sugar level in the berries on overcropped vines will stop at 16 to 18 degree Brix and the sugar will not increase regardless of how long harvest is delayed. Therefore, the correct number of buds must be left at pruning to insure a balance in both vegetative and fruiting sinks.

Overcropping on low vigor or small vines in warm climates have more problems than insufficient sugar at ripening. Acids, proteins, and other food which the yeast feed upon during fermentation are insufficient as well. Many winemakers frequently need to feed the yeast with extra sugar, extra acid, and commercial yeast food to obtain complete fermentation. The correct bud count at pruning and resulting perfect size shoots will naturally produce all the food yeast require and produce better wine.

Storage Sink

In the spring new growth is entirely from stored food. Therefore, the vine must have a sufficient supply of stored food to stimulate strong spring growth, flower development, and berry set. Post harvest vine and foliage health are critical for supplying food for storage in the cordons, trunks, and large roots. Late season irrigation with disease and insect management cannot be taken lightly or avoided. Premature defoliation in late

summer or early fall in a warm climate is not good. The season is not over at harvest, healthy foliage is needed until first frost or November to supply the storage sink.

Count Canes to Determine Bud Count

In mature vineyards, to determine the ideal bud number to leave after pruning; count the number of canes on the vine which are 3/8 inch in diameter before pruning. This cane count is the number of buds which need to be left on the vine after pruning. This concept was established by A.J. Winkler in the early 1930's as a new viticulturist at UC-Davis.

The key is to not leave more buds after pruning than there were 3/8 inch shoots or canes the year before. This is to say; a vine will grow and bear according to past performance. For example, if a vine has 16 canes 3/8 inch before pruning, leave only 16 buds after pruning. This could be 8 spurs with two buds each or 16 spurs with one bud each, or two canes with 8 buds each. In using the cane count system; do not count canes smaller than 1/4 inch in diameter and canes over 1/2 inch in diameter should be counted as two canes.

In addition, all shoots which arise from non-count shoots should be removed by shoot thinning at post bloom. The French call this green pruning. Shoot thinning non-count shoots forces growth into the most productive buds which have been selected.

Applied Research for Bud Count Confirmation

Obtaining the perfect shoot requires learning the number of buds to leave after pruning.

Every vineyard block by age or variety or canopy will require specific applied research to learn this ideal post pruning bud count. Three or more years of record keeping needs to be conducted on mature vineyards to confirm the ideal bud count. This applied research was conducted with success at Messina Hof Vineyards at Bryan, Texas from 1988 through 1994 by the senior author.

Use the Cane Count - Bud Count system for a starting point and control treatment. Once a bud/cane count is estimated; select three rows to test three levels of pruning. Prune one row with the bud/cane count level of pruning. Prune a second row with more buds and a third row with fewer buds. With each additional year of data, the exact number of buds needed for the site, variety, and management level will be learned.

Using the Messina Hof example, the cane/bud count learned was 16 ideal size canes. This was the standard or control treatment. A second pruning treatment of 25% more buds was used with 20 buds per vine. A third pruning treatment of 25% less buds or 12 buds per vine after pruning was used.

Record shoot growth, fruit quality, and fruit yield and pounds of pruning wood per foot of row for each of the three treatments for three to 7 years. This will allow for variations in weather and vine age.

With each new years data, adjust the ideal or standard pruning level to the best average bud count level. This applied research will allow the vineyard manager to determine the ideal number of buds which gives growth, production, and vine health.

Three Propositions for Managing Vine Vigor

Proposition 1 This is for vigorous vines, the objective is to leave more buds on the vine after dormant pruning which increases yield and reduces vigor. Continue the bud count research to confirm ideal shoot size, yield, fruit quality, and vine health.

Proposition 2 This is for overcropped or small vines with weak growth, the objective is to leave fewer buds to obtain ideal shoot size, yield, fruit quality and vine health.

Proposition 3 This is for vines with perfect size shoots, good yields, quality fruit and ideal pruning wood weights per foot of row, the objective is to not change the bud count. These vines will bear optimum tonnage of quality fruit while sustaining a healthy vine for ideal growth year after year.

Vine and Pruning Terms

The **bud** is the center of importance when pruning. The bud is sometimes called the eye or node. It contains 3 to 4 growing points; the primay bud, seconday bud, tertiary bud, etc. The number of clusters and cluster size are set in the early growing season inside the bud which is located in the axil of leaves.

The space between the buds is called the **internode**. Short internodes indicate limited growth during the current season. Long internodes indicate rapid growth. Internodes can be short during drought periods, and long when rainfall is frequent. Pruning cuts are usually made just below a bud, leaving a long internode which helps protect the top bud from drying out before growth begins.

The **shoot** is the green vegetative growth form a bud, expanding to become three to 5 feet long with 15 to 22 leaves and one to four clusters in warm climates.

The **cane** is the current seasons growth during the dormant season. It is reddish brown when fully mature and best when perfectly round.

When pruning grapes; the vine dresser works only with **one year old** canes.

Old wood is over one year in age and usually does not have strong productive buds. It is easy to identify via grey color and rough flaking bark.

One has two choices when pruning; cut the cane to leave only one spur with two buds.

Or prune to form a cane with six or more buds.

A **bull cane** is too large, over 1/2 inch in diameter and over seven foot long. They can grow to over 20 feet in one season in warm climates.

A **weak cane** is too small, under 1/4 inch in diameter and less than three feet with small leaves. They should not be selected for pruning, unless they are the only canes available, and then pruned to only one bud.

Oval or flat canes developed during rapid growth and usually have less fruitful buds. They should not be selected for spurs or canes, unless they are the only choice.

A **spur pruning** can have 1,2, or 3 buds per spur. Two buds is the normal size spur.

A **cane pruning** can have 6 or more buds per cane. In warm climates leaving more than six buds will result in strong growth at the base and end of the cane and with weak shoot growth from the buds in the middle of the cane and/or the middle of the future cordon.

The **diameter** of the spur or cane at the pruning cut is important, the minimum size is 1/4 inch in diameter and 1/2 inch diameter as maximum. The ideal size is 3/8 inch and round. Oval or flat wood is less or non fruitful.

The **trunk** grows from the roots or graftunion upward. The use of double trunks are being used to reduce freeze injury and are much easier to train.

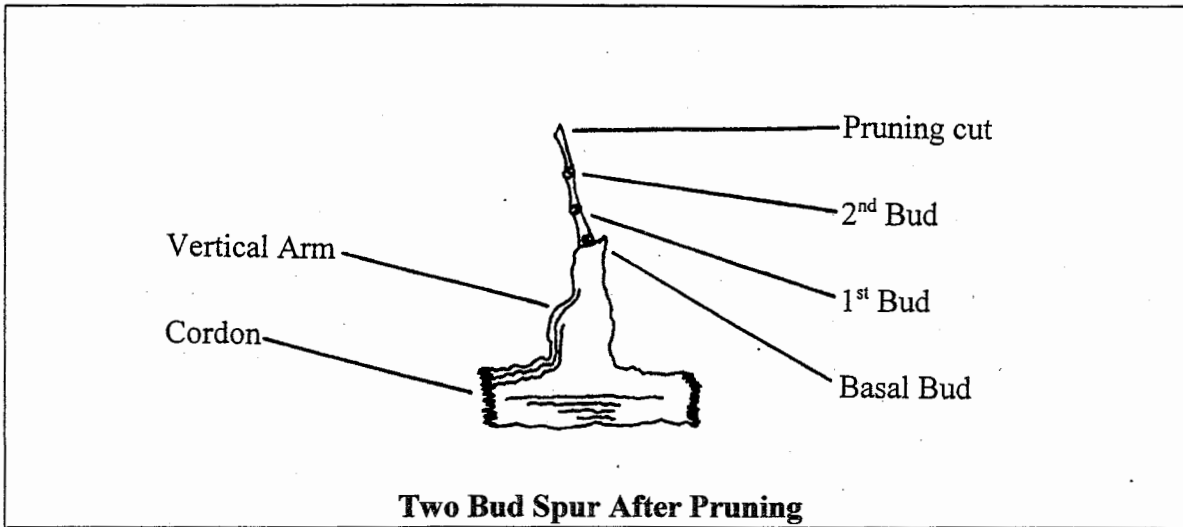
Plastic grow tubes are used to protected the young trunk shoots from herbicides and rodent damage. In cool climates grow tubes stimulate fast early season growth.

Cordons are horizontal trunks with spurs every 2 to 6 inches. Cordons are established along the main wire 12 to 66 inches above the ground, depending on what type of canopy system is being used. Cordons are trained no more than six buds at a time, longer attempts have a dead or blank space in the middle of the cordon when mature.

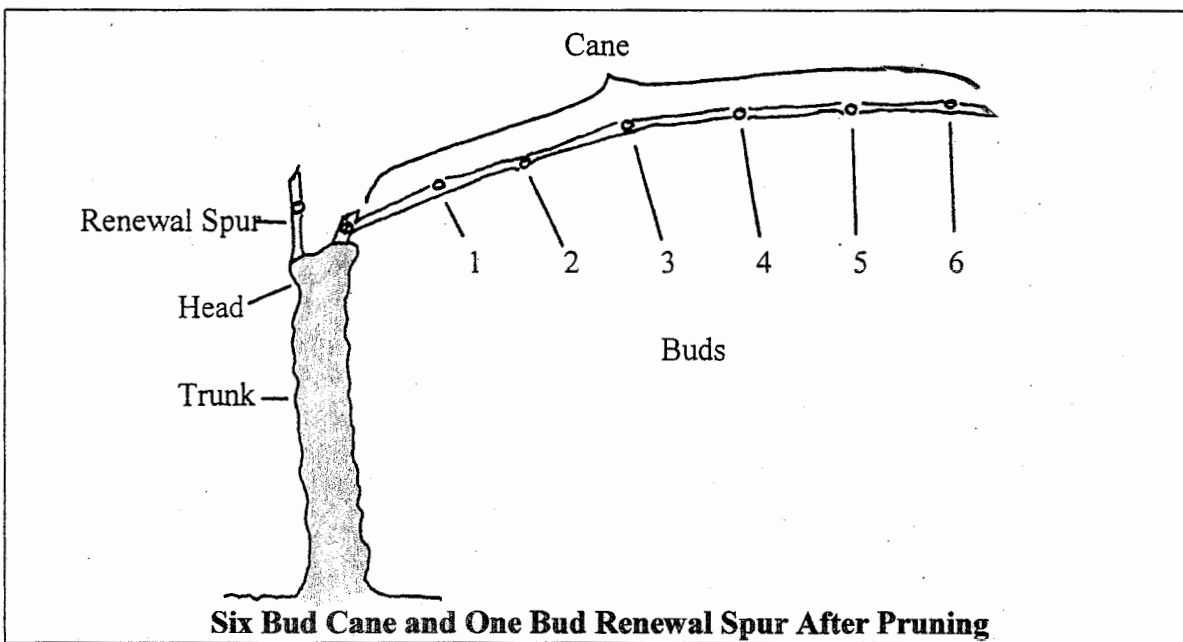
Spur vs Cane Pruning

A **Spur** can have one, two, or three buds. If four or five buds are used, the apical and basal shoots will grow, while the 2nd and 3^{ed} buds remain dormant and of no production value. Spur pruning is very easy, typically the canes are rough pruned to 6 inches prior to final pruning where the spurs are reduced to only 2 buds and 1 basal bud. When all of the spurs are pruned to 2 buds each, the best spurs are selected for remaining and production.

The weak or oversize spurs are removed. Space the spurs approximately 6 inches apart on a horizontal trunk called a cordon.

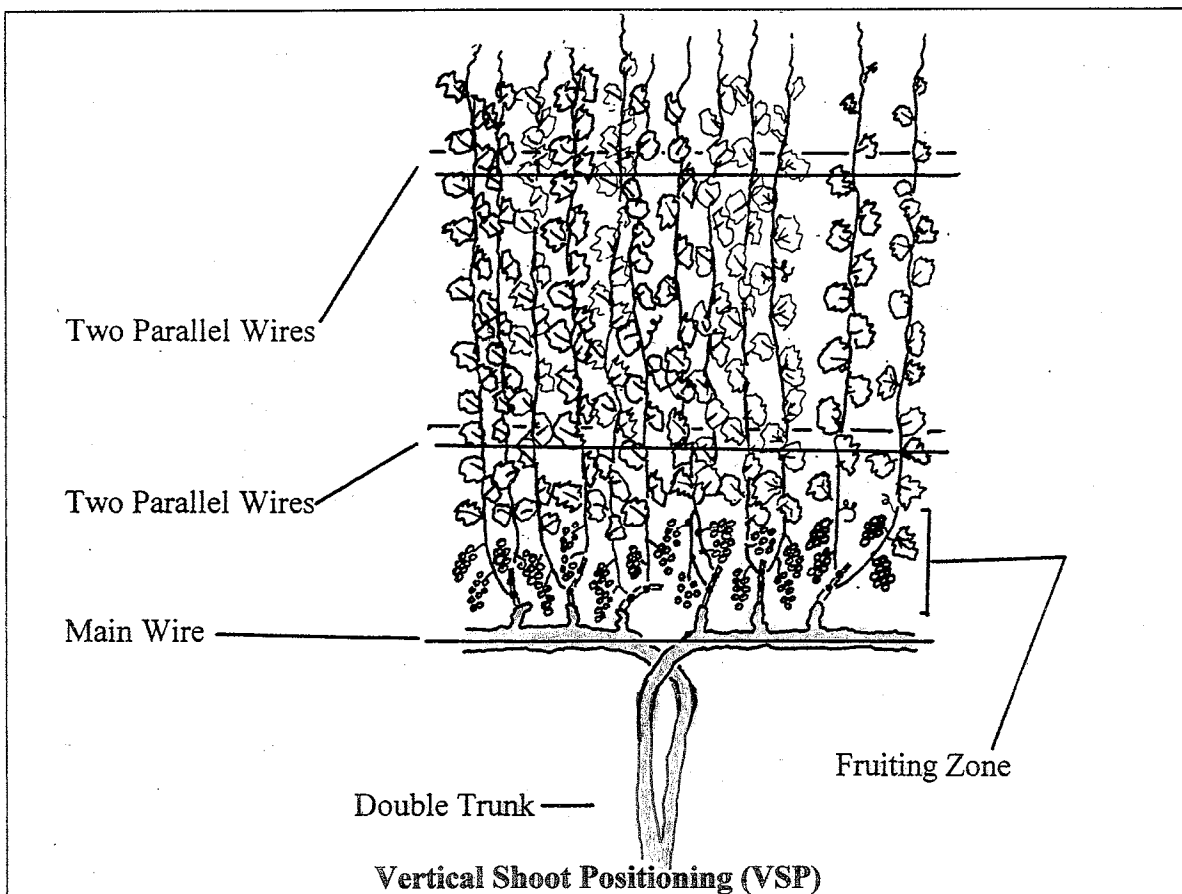


A **Cane** can have as few as six and as many as 12 buds, and in cool climates more. The cane system is ideal for climates which do not have spring freeze or hail problems to destroy the only bearing buds. In climates with maximum photosynthesis efficiency with cool temperatures and long growing season day lengths such as Germany and much of France, the cane pruning system is ideal. Shoots which grow from buds 4,5, and 6 on a cane are very fruitful, producing more and larger clusters. Very high yields are possible from cane pruning. However, in warm climates such as Texas it has been very difficult to train vineyard works how to cane prune.



Shoot Positioning As a grape shoot begins to grow, it can be **positioned** or **non positioned**, thus two different canopy concepts result. In Bordeaux and Burgundy with the Guyot canopy, shoots are positioned between one or two sets of parallel wires as they grow, remaining in an upright position. In Alsace and Germany where vines are larger, shoot positioning can be between two sets of parallel wires and the shoots can be placed between the wires by hand labor or machine. In cool or moderate climates, in addition to upright shoot placement, the leaves adjacent to the clusters are removed after berry set to allow good light contact with the fruit.

Vertical Shoot Positioning (VSP) is used widely in California on larger vines with either cane or spur pruning. It is assumed that VSP improves fruit and wine quality by increasing light contact. Most California fruit is produced using the bilateral cordon with no shoot positioning, which dates back to the late 1800's. It was proven to be the best system for California by A.J. Winkler and A. Mannine from 1935 to 1960 with extensive varietal pruning trials. Today the advocates of the VSP and the quality movement sarcastically call the old system the California Sprawl or Napa Flop with the bilateral cordon. Shoot positioning can be used on spur or cane pruned vines. In Texas the VSP has the added advantage of **good air movement** into the canopy and fruiting zone to reduce Black Rot. VSP fruit are also much easier to harvest, however, the system is very expensive to establish and manage.



Leaf Pruning in May in warm climates such as Texas the VSP improves light in the fruiting zone for better fruit bud initiation. It also allows better light contact with the fruit following veraison for better skin color and fruit ripening. If the leaves are removed after mid May there will not be sufficient protective wax on the berries and sun burn will develop on the skin of the berries. One or two leaves are removed per cluster. Good shoot length and 15 to 22 mature leaves will need to remain on the shoot to insure a good food supply to the clusters. The leaf pruning gives better air movement and fungicide contact with the clusters for better Black Rot control.

Excess sunlight on ripening berries in warm climates such as Texas can damage the berry skin and reduce wine quality. For this reason, only leaves on the east or north side of the vine are removed. South or west side leaves are not pruned as to provide shade and guard against sun burn.

Only time will tell if wine quality justifies the VSP cost of establishment and management. In climates with growing season rainfall growers will definitely profit with VSP for improved Black Rot and other disease management on *Vitis Vinifera* varieties.

Leaf pruning allows bird feeding much faster and severe on small vineyards

Leaf pruning allows much easier and faster hand harvest. The fruit is easy to see and cut.

Shoot Thinning or Green Pruning as it is called in France is practiced when using VSP on mature vines. Non count shoots, small shoots, weak shoots, shoots from basal buds, or any shoot not wanted are rubbed off before the xylem tissue or wood becomes hard. Mid or late season shoot thinning will require cutting the shoots out with shears. Removing unwanted shoots forces growth into the high quality count buds and shoots.

Shoot thinning is second only to bud count pruning for reducing crop size in premium wine regions.

With the combination of bud count pruning and shoot thinning a specific known number of clusters will be produced per vine, row, or vineyard. By reducing the crop size in cool or moderate climates, growers and winemakers feel overcropping is avoided, ripening is improved, and maximum fruit and wine quality is obtained.

In low light intensity wine regions, maximum sunlight is needed on the lower shoot to stimulate the production of fruit buds in the leaf axils for next years crop. Shoot thinning reduces shade, thus improving fruiting for next year.

In warm climates there are advantages to shoot thinning, but crop size reduction is not the main objective. As previously stated, it can improve air movement, sun drying, and fungicide contact for better disease prevention. Shoot thinning can improve the ease of hand harvesting.

Mechanization and Shoot Positioning Regardless of the canopy which is used in a vineyard, it is important to consider hand vs mechanical pruning and harvesting. Vineyards which are hand pruned and hand harvested will require different canopy considerations.

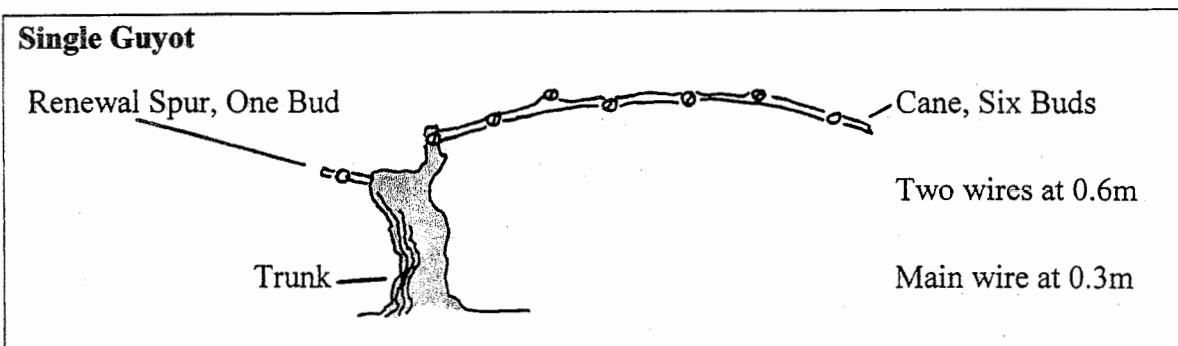
Classic Canopy Systems

There are over 30 different and established canopy systems used throughout the wine world. In France the AOC classification committee for each village uses decades of experience to determine the canopy system best suited for their specific site, grape, climate, management, and wine style.

New wine regions need to conduct pruning research to determine which canopy system and pruning level is best.

The French Guyot Canopy This is the most common pruning system of France. The **Guyot** is a small vine with one six bud cane and a one bud renewal spur. The head of the vine is only 12 inches from the ground. In much of France with warmer growing conditions and slightly higher vine vigor, the number of buds per vine are double in what is called a **Double Guyot**.

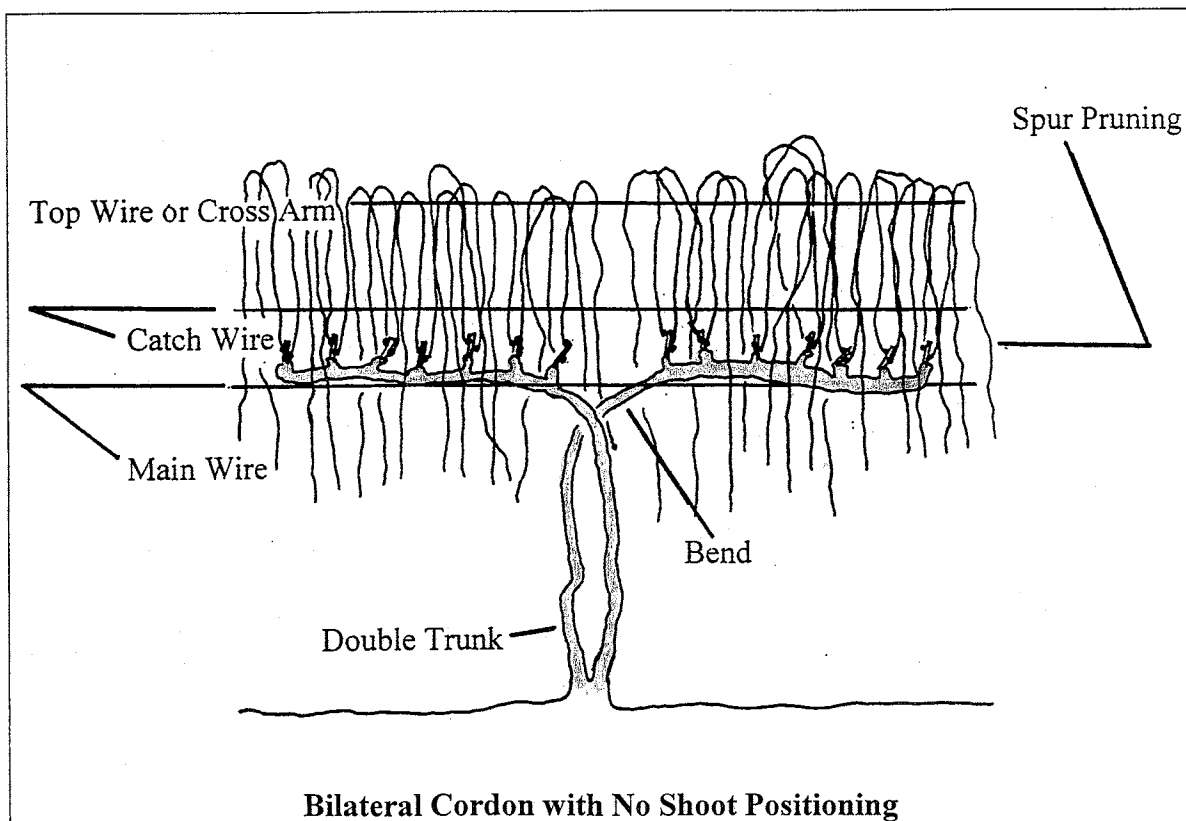
With the Guyot system, the cane is tied to a wire at 12 inches. The shoot produced from the one bud renewal spur will become the six bud cane the next pruning season. The vines are very small, but the 7 shoots per vine are strong, 3/8 inch in diameter, 1m in length with 12 to 15 mature leaves at harvest. Shoots are positioned upward via VSP on one or two sets of wires. Rows are 1m apart and vines spaced 1m in the row. The buds and shoots are not crowded, seven shoots on the vine are spaced over 39 inches or 5.5 inches per shoot.



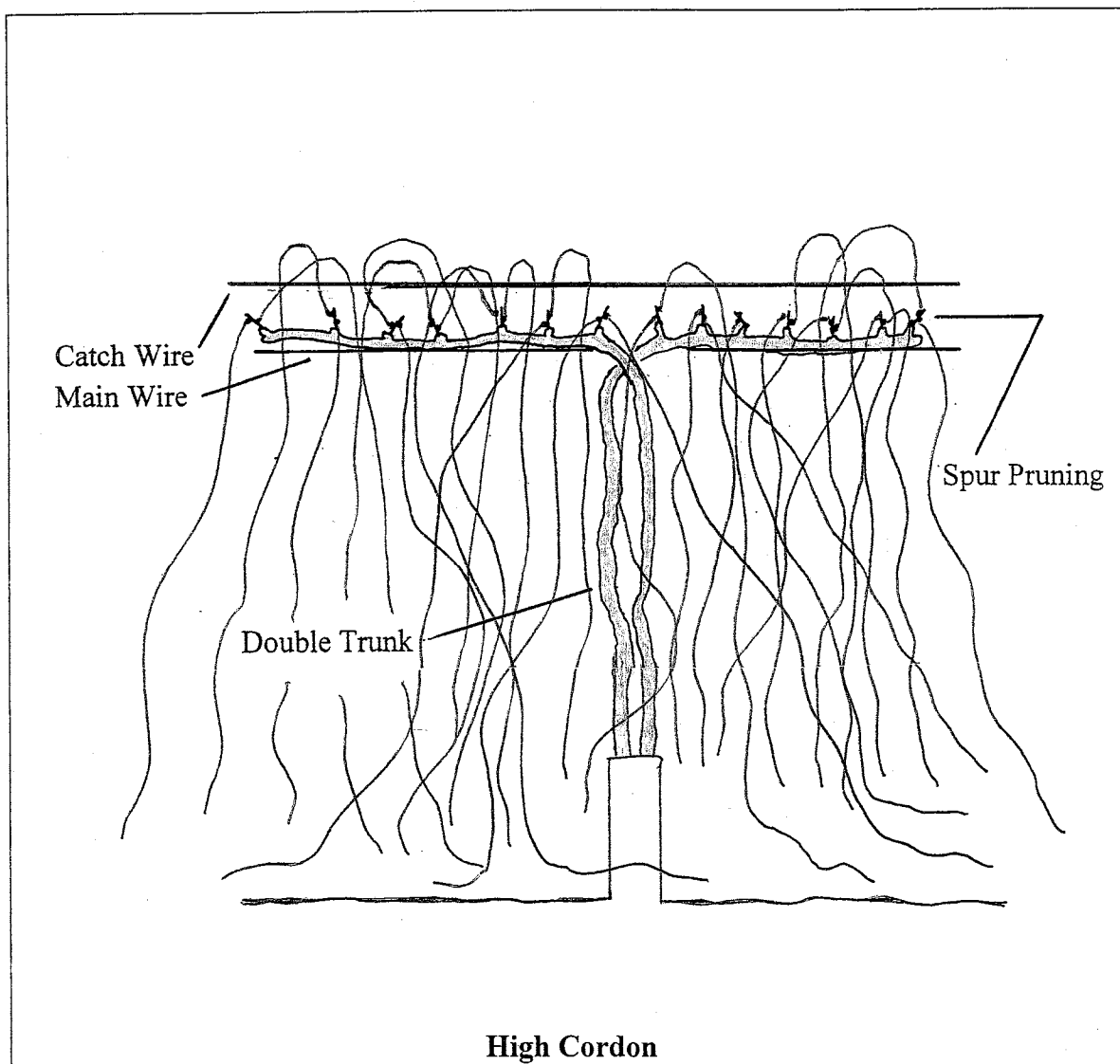
The reason we discuss the Guyot is that most canopy systems are similar to it. Warm climates such as Texas with good soils produce too much vigor for only 7 or 14 buds per vine; however, in France with a cool climate the Guyot systems produce 7 or 14 perfect VSP shoots. Furthermore, with late season ripening, the fruit hang time can be up to 9 weeks for maximum quality and concentration.

The US government brought Professor Guyot to America in the early 1800's to study the cause of poor *Vitis Vinifera* growth and survival in the eastern states. On this trip, Guyot illustrated his pruning system, and it is the same used in Burgundy today.

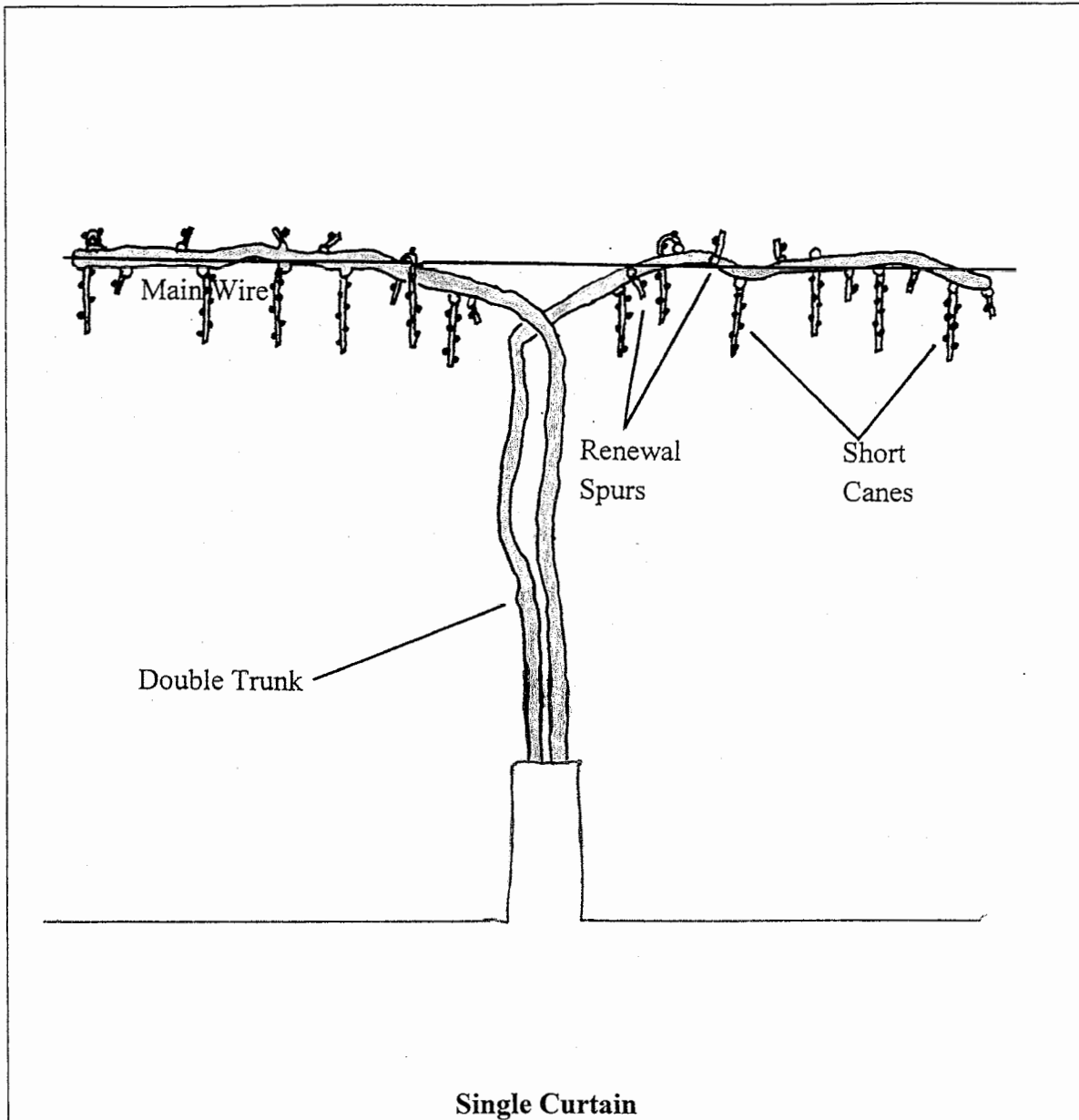
The **Bilateral Cordon** pruning system was proven to be the very best for California by A.J. Winkler from 1930 through 1935 and the system remains the most commonly used today. The vine has one trunk, a left and right cordon at 42 inches from a divide 6 to 12 inches below the cordons. Seven vertical positions are on each cordon with one spur of 2 buds. The vine has 14 spurs, 7 on each side, with 2 buds each and a total of 28 buds. The best vine spacing is 8 feet or 96 inches which yields 3.4 inches per shoot. The shoots are trained upward on a catch wire at 52 inches and shoots flop or hang over two top wires at 66 inches and 18 inches apart. The unpositioned shoots can be hand or mechanically pruned and harvested. If the bilateral cordon system produces the perfect size shoot, it is an excellent system. However, if shoots are too long more buds will be needed, thus a different system. Successful wine makers ask for what they feel is better quality from a VSP, rather than bilateral cordon. So vineyards in optimum California sites are shifting to VSP. Time will tell if the quality is in fact better.



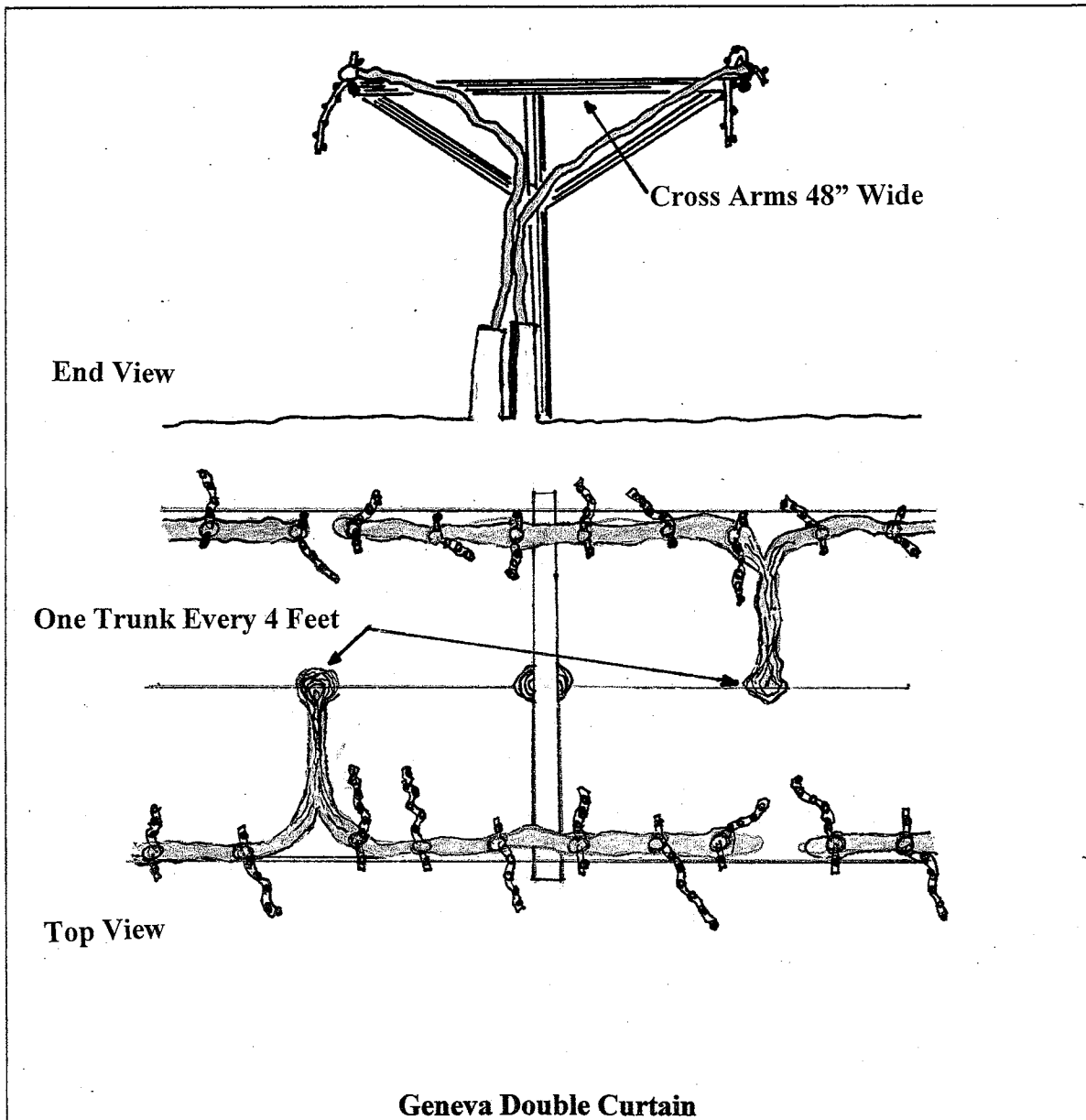
High Cordon at 66 inches above the ground with two rather than one trunk has become popular in Texas, New York, and Italy where vines have high vigor. The system trellis is two wires at 60 and 66 inches above the ground. It is easy to hand prune and harvest without having to bend. It is well suited for mechanical pruning and harvest. The catch wire above the main wire is for training spurs upward. Shoots are not positioned upward, they sprawl downward. In high sunlight climates shade is not a problem as sufficient enters the fruit zone for full ripening and fruit bud initiation.



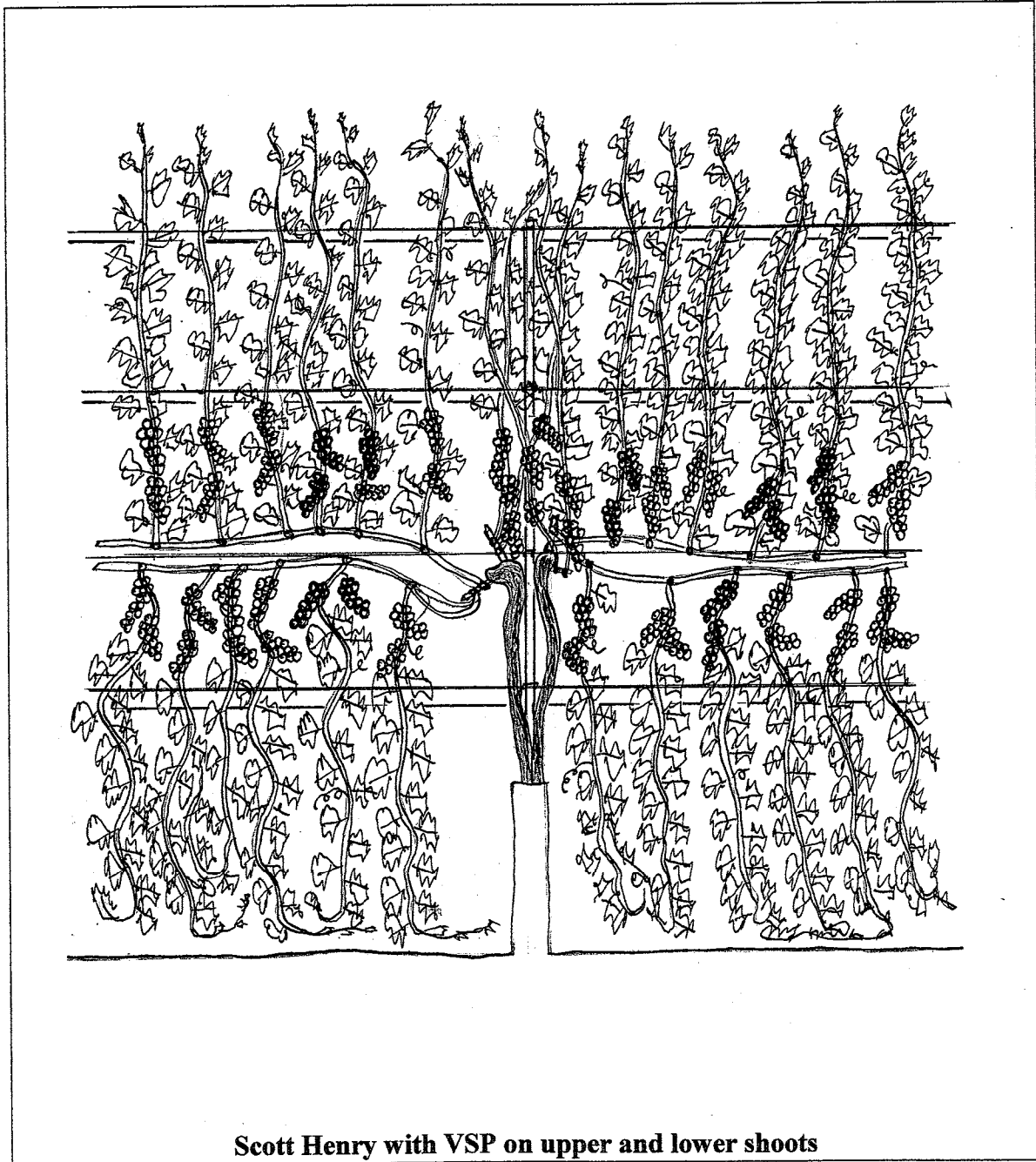
Curtain If a site produces excess vigor with the High Cordon, extra spurs can be left after pruning to reduce vigor. This can be continued until a one bud spur and one 6 bud cane remains every six inches, producing what is called a curtain system. With an 8 foot spacing, with a 6 bud cane and a one bud spur every 12 inches, the Curtain vine would have 56 buds and a shoot every 1.7 inches. This large number of buds per vine should reduce vigor to the perfect shoot size in most warm season vigorous sites.



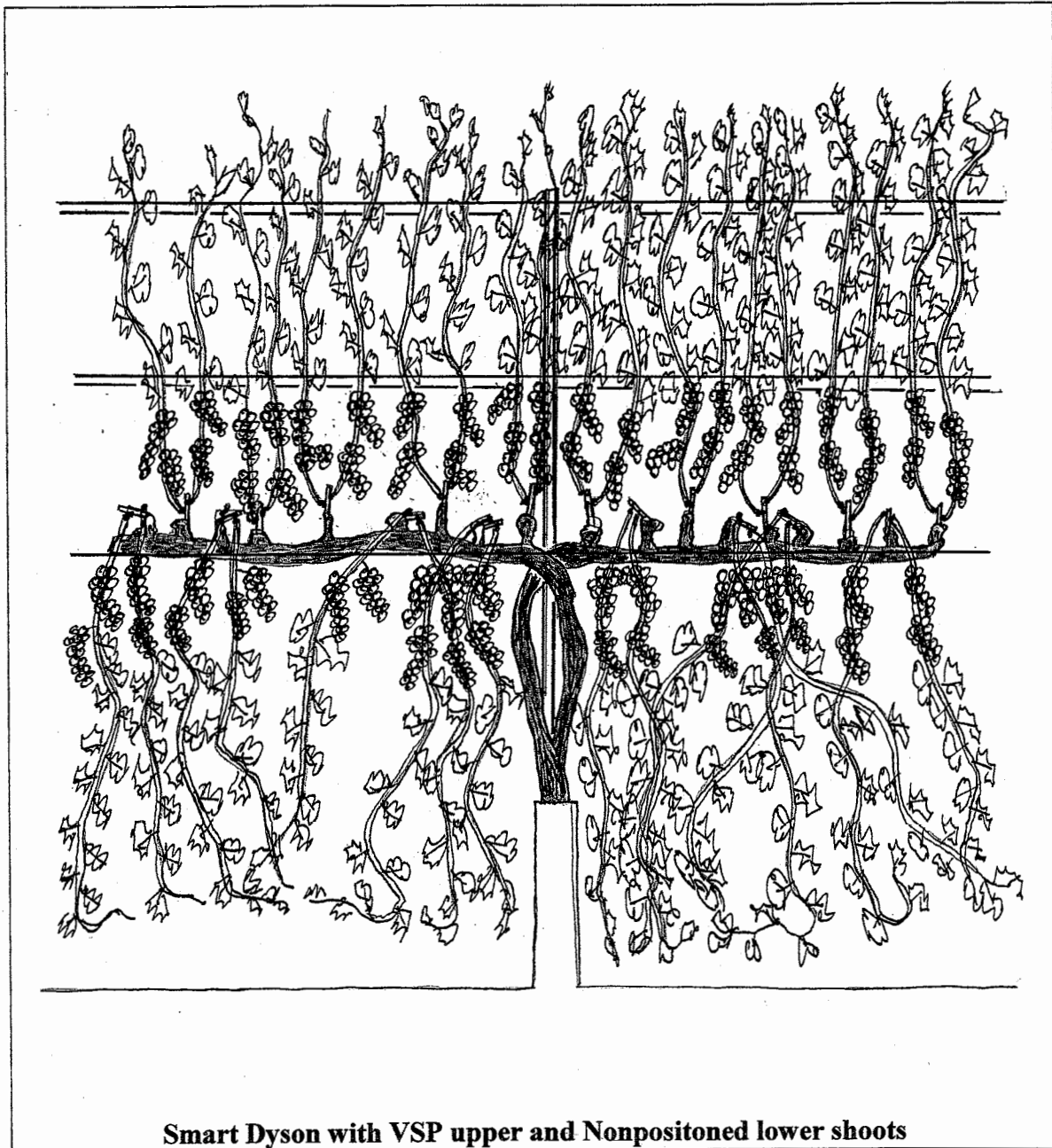
Geneva Double Curtain (GDC) was developed in New York in the 1950's by Nelson Shaulis for vines on extremely vigorous sites, even for a cool climate. Vines are spaced four feet apart in the middle of the row with double trunks leading to parallel wires 48 inches apart. These parallel cordons are 66 inches above the ground. There are two curtains of shoots growing from six bud canes and one bud canes. The system has doubled the number of vines per acre, while the distance between shoots remains 1.7 inches. Only the most vigorous sites can produce the perfect size shoot with the GDC. However, if needed, the GDC can produce very high yields with good fruit quality.



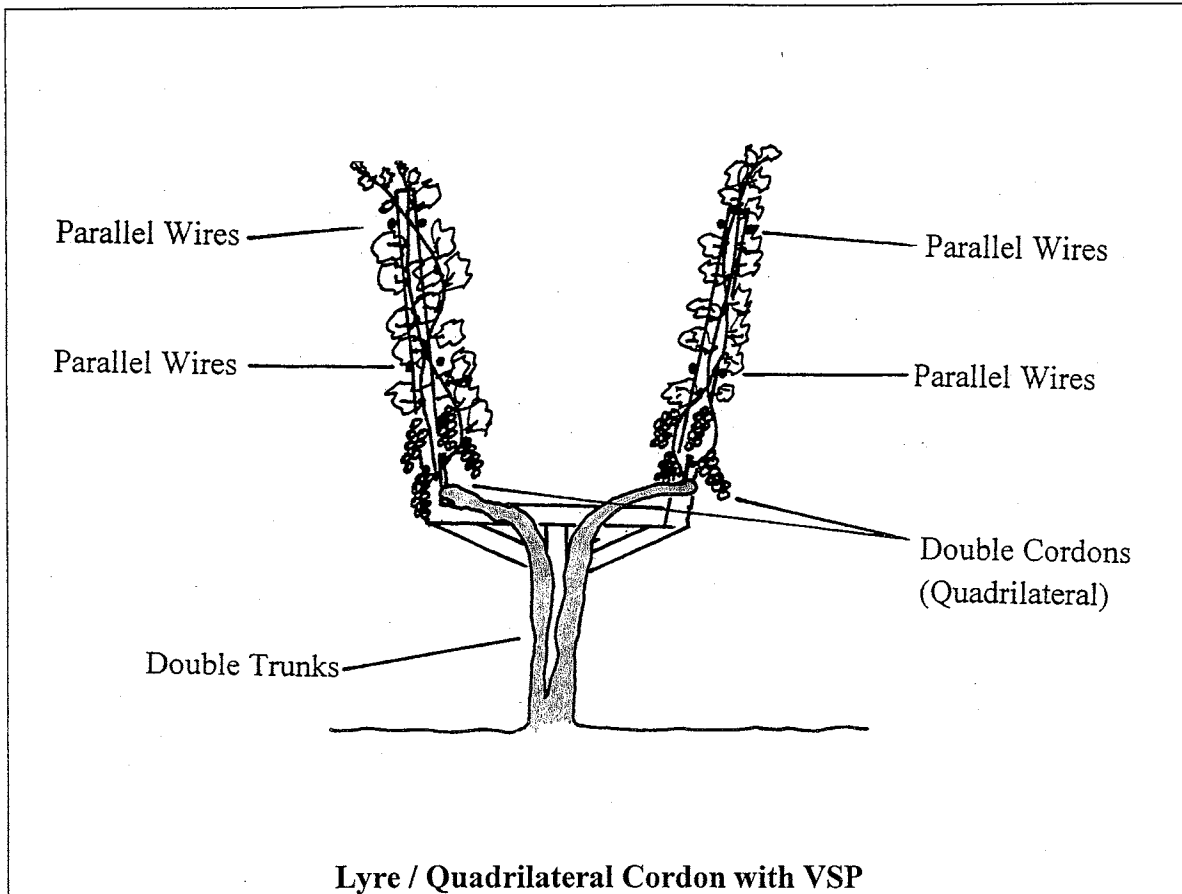
Scott Henry of Oregon developed a unique vertically divided canopy for high vigor sites. Two canes were selected right and left 44 inches above the ground. As the fruit begins to size, shoots from one cane on each side of the trunk is combed downward and shoots of two canes are positioned vertically via VSP. The Scott Henry system can give double the production and reduce vigor to obtain perfect size shoots. The Scott Henry system has been used to perfection in New Zealand with Sauvignon Blanc of vigorous volcanic soils and excellent growing conditions.



Smart Dyson was developed by Richard Smart and John Dyson which is very similar to the Scott Henry. Rather than having four canes, it has a standard bilateral cordon at 44 inches with 50% of the shoots positioned upward via VSP and 50% are allowed to sprawl down and out. The end view of the Smart Dyson canopy looks similar to a Ballerina, which has become the common name for the system. It is highly functional with mechanical pruning, mechanical shoot positioning, and mechanical harvesting. It is now in wide use in the California Central Coast and being tested the United States and the world. High yield with high fruit quality from this mechanically functional system is producing some of the highest quality wine in the world.

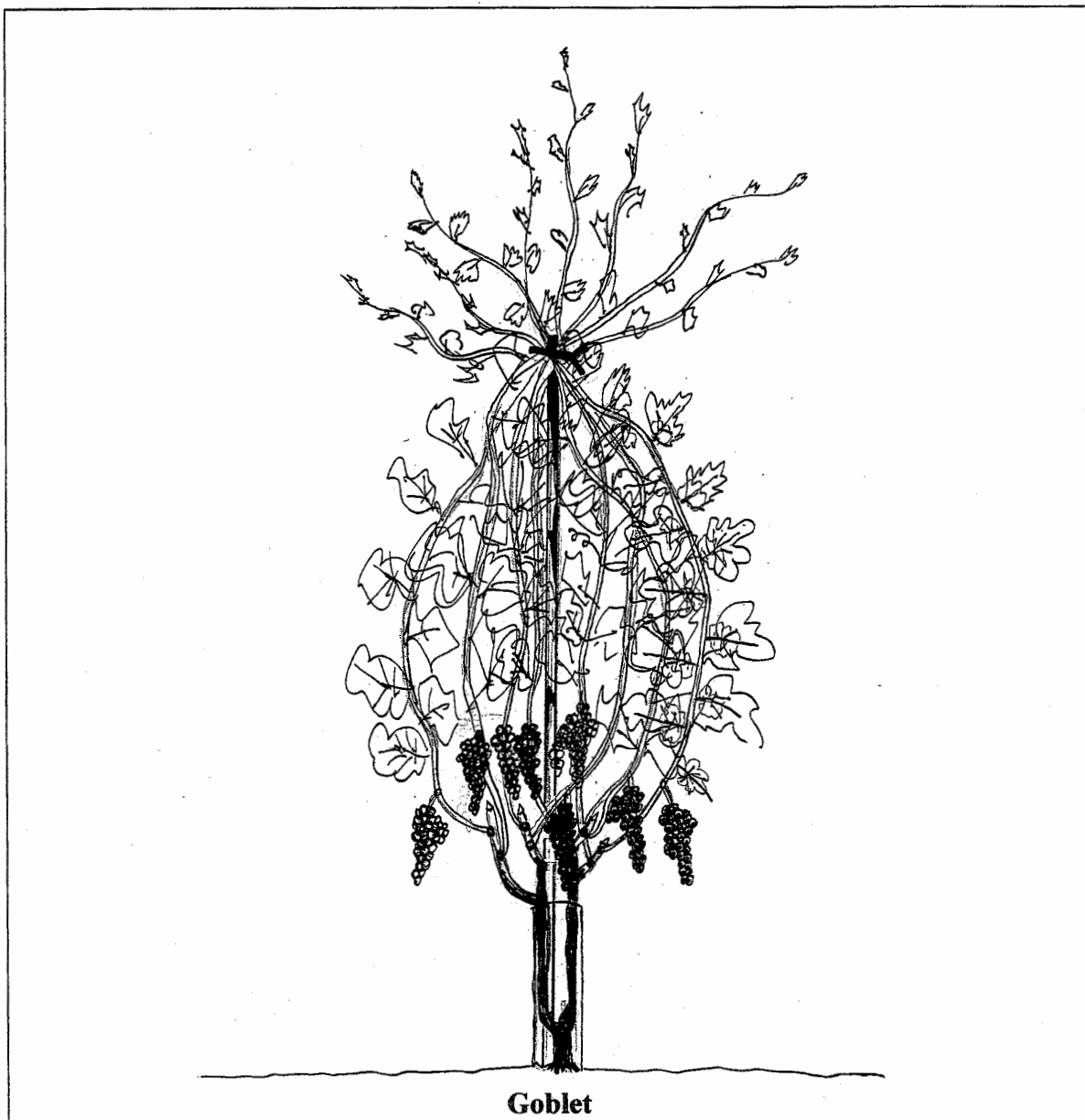


Lyre system was developed by Alain Carbonneau of France which is also a double canopy, however, it is two bilateral cordons on a single row with the shoots positioned upward via VSP. The most commonly used name is the **quadrilateral cordon**. As with the GDC there are two canopies, thus doubling the number of buds per acre, but not increasing the number of buds on the cordon.



Goblet system is used in many wine regions of Europe and could be the original canopy system prior to wire use. A stake is used at each vine and shoots are pulled upward and tied to the top of the stake. As the vine develops a strong root system, shoots grow very fast when low bud count is used. The shoots are tied together above the trunk, forming a basket like shape.

Today a permanent stake is used at each vine. The Goblet system works well for vigorous large cluster varieties, which are cluster thinned to one cluster per shoot. Green pruning is also important in keeping the count shoot vigorous. The system is also well suited for triangle vineyard design, thus allowing workers or visitors to walk within the vines in every direction.



Canopy Bud and Shoot Distance Estimates

One must imagine vines 5000 BC simply grew on the ground. Later they grew in trees or were placed in trees. At some point in time, or at least 56 AD when John wrote John 15, pruning was a cultural practice in canopy management. It must have been lost in the Dark Ages then redeveloped supposedly at Clos duVogue in Burgundy 1,000 years ago.

The following summary of canopy options gives an estimate of the number of buds per cane or cordon and distance between shoots.

Canopy	Pruning	Spacing	Bud Count & Pruning & Shoot Positioning	Shoot Distance
Single Guyot	cane	1x1m	one 6 bud cane & 1 one bud spur with VSP	14 cm
Double Guyot	cane	2x2m	two 6 bud canes & 2 one bud spurs with VSP	14 cm
Chablis Guyot	s & c	1x2 m	4 two bud spurs & two 6 bud canes with VSP	13 cm
Sauterns Guyot	spur	1x1 m	3 or 4 two bud spurs with VSP	14 cm
Goblet	spur	1x1 m	6 spurs & 12 buds & shoots tied vertically at top	12 cm
Head	cane	3x2 m	2 canes with 10 buds each with VSP or sprawl	10 cm
Bilateral Cordon	spur	3x2 m	5 two bud spurs left & 5 two bud spurs right with VSP	10 cm
Heart	cane	1x1 m	2 canes 14 buds each with lower 7 buds thinned canes pulled from top downward and tied	7 cm
Arched	cane	3x2 m	2 canes 10 buds each arched 30 cm above main wire with VSP	10 cm
High Cordon	spur	3x2 m	5 two bud spurs left & 5 two bud spurs right with shoots combed downward or sprawl	10 cm
Single Curtain	cane	3x2 m	5 six bud canes left & right & 10 one bud spurs with shoots combed downward or sprawl	4 cm
GDC	cane	3x2 m	two parallel cordons 120 cm apart with 5 six bud canes left & right & 10 one bud spurs with shoots combed downward or sprawl	4 cm
Scott Henry	cane	3x2 m	4 six bud canes left & right & 4 one bud spurs with shoots combed down from 2 lower canes shoots are positioned upward via VSP from 2 upper canes	10cm
Smart Dyson	spur	3x2 m	10 two bud spurs left and 10 two bud spurs right with 20 shoots sprawl downward with no positioning with 20 shoots positioned upward via VSP	10 cm
Lyre	spur	3x2 m	two parallel cordons 120 cm apart with 5 two bud spurs left and right on each cordon with VSP	10 cm
Two Tier Lyre	spur	3x2 m	two parallel cordons 120 cm apart with two tiers one above the other with 5 two bud spurs left and right on each cordon tier with VSP	10 cm
Cordon Sprawl	spur	4x2 m	bilateral cordon with unlimited spurs left & right with no shoot positioning	5 cm
Minimum Prune	xxxx	3x2 m	1 st established as bilateral cordon then cordon sprawl then minimum pruning only to shape canopy as a hedge	1 cms

Pruning Date should be as late as possible to avoid stimulating frost damage to new shoots. Rough prune at a date that allows one to finish before bud break. Final prune to ideal bud count when small leaves are developing on the end of canes before beginning pruning. **Destroy** pruning wood by shredding or plow into the soil.