

Viticulture - Cultivation of the vine - Types and methods of pruning and training

DEFINITIONS

- Trellis Systems - support structures for the vine framework required for a given training system.
- Training Systems - methods of vine training, which vary considerably around the world.
- Trunk - The main stem of a tree, from the ground to the first branches or, in the case of a grapevine, to the cordons or head.
- Cordon -
 - Part of the vine's woody framework, arising from the top of the trunk and on which arms are born.
 - Cordons can be at any angle but are generally trained along horizontal wires or shallowly sloped wires as in come tendon trellises.
 - The most common arrangement is a bilateral cordon in which two horizontal cordons are arranged in opposite directions from the top of the trunk, but any number of arrangements are possible.
 - The unilateral cordon is common in some parts of Europe, and because of ease of training is being increasingly adopted in the New World.
 - Usually the cordon is trained to its permanent position and remains there.
- Cane -
 - The stem of a mature grapevine shoot after the bark becomes tan-colored at veraison and starts its overwintering form.
 - After leaves have fallen, the canes of a vine display the total vegetative growth it made during the previous season.
 - The canes are cut at winter pruning to reduce the number of buds and to select their position. The cutting may be to spurs or canes.
- Spur -
 - A viticultural term for a shortened grapevine cane.
 - A spur is a stub formed by pruning the cane to between one and four nodes, usually two.
 - Spurs are used to provide the next season's fruiting shoots.
 - Of all pruning systems, spur pruning is the most severe since over 90% of the previous year's cane growth is removed.
 - Spurs are also left on cane-pruned vines to augment replacement canes at next pruning.
- Confusion between the terms training systems, trellis systems, and pruning is widespread. In fact they are three distinct, if closely related, entities.
- A trellis is a man-made physical structure, consisting normally of wood and wires.
- The word training describes the actions of pruning in winter and summer, and shoot and cane placement, so that the vine's trunk, arms, and cordons and buds are appropriately located on the trellis system.
- Those training systems which involve trellises are often named after the trellis.
 - Nelson Shaulis

PRUNING

- Involves cutting off unwanted vegetative parts in the form of canes in winter.
- Winter pruning is a vineyard practice developed primarily to produce fewer but larger bunches of riper grapes and is particularly important in cooler climates.
- More than 85% of each year's shoot growth may be removed.
- There is an important relationship between vine pruning and vine training, as the pruning method used depends on the training system employed.
- Vines growing in their natural state are not pruned. At the top of such vines, many of which grow up trees, and on other parts of the vine exposed to the sun, are many small bunches of grapes. While the vine may have had thousands of buds present in winter which could have produced shoots and fruit, only a small proportion will burst in spring. This reduced budbreak is the principal means by which unpruned vines in their natural state avoid overcropping, which may weaken the vine and shorten its life.

AIMS OF PRUNING

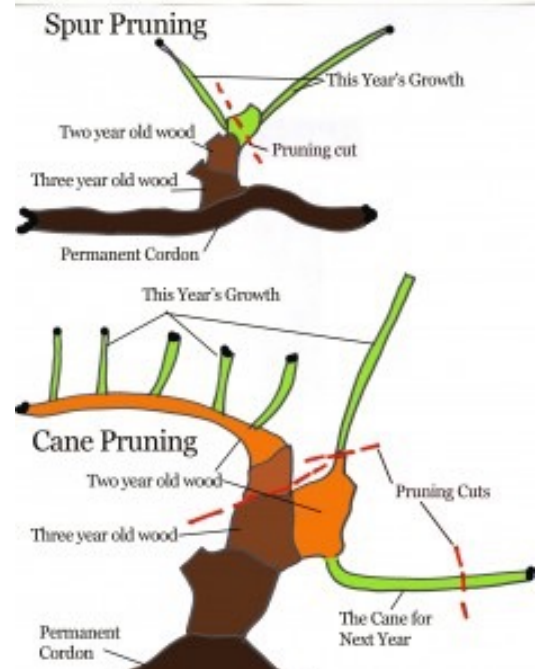
- Early aims of pruning by the Ancient Egyptians would have been to increase the size of individual berries and bunches.
- A vine which is lightly pruned has many buds and will produce numerous bunches with small berries.
- To establish or maintain a shape of vine, which makes all other vineyard operations easier.
- Most importantly it regulates the next season's yield by controlling the number of buds which can burst and produce bunches of grapes.

TIMING OF PRUNING

- Carried out in winter, normally once the first frost causes the leaves to fall, thereby exposing the woody canes, but the precise timing of winter pruning is not generally critical.
- Winter pruning should be completed by the time of bud break in spring, as the pruners can damage emerging shoots as they work.
- Some early-budding varieties may be pruned very late in an effort to delay bud break and minimize frost damage. Vines lose water from pruning wounds just prior to budbreak.
- In regions with warm winters, such as tropical and subtropical regions, the vines may not become completely dormant, and vines may have to be pruned when they are covered in leaves.

SPUR PRUNING

- Spurs are cut to retain only two buds, while canes are longer, typically with five to 15 buds,
- In the spring, each bud on the two-bud spur normally produces one shoot.
- In autumn, these shoots become woody.
- During winter pruning the cane growing from the uppermost bud on the spur is removed, and the cane from the bottom bud is cut back to two buds, creating the new spur.
- The vine's physiology determines that, when a cane is cut, the last two buds will burst. This is the reason for the common two-bud spur.
- If spurs are left with three buds, the bottom bud would often not produce a shoot, and so the spur position would move further and further from the cordon or head as the years passed.
- Spur pruning is commonly used with free-standing vines, such as are widely seen in Mediterranean wine regions. The goblet-trained vines in the south of France are typical. Goblet vines are free standing with short trunks rarely more than half a meter high. The spurs arise from the trunk or from short arms on the trunk. This is a very simple form of vine training, requiring no supporting posts or wire.
- Common in the Old World. Majority of the vines in the Languedoc and Roussillon. Common in lower rainfall areas of Spain, Italy, and Portugal, such vineyards being of lower vigor to which the system is best suited. Some of the older New World vineyards, for example in California, Australia, and South Africa, also have such vines, often described as head trained.
- Another spur-pruned form which is more common with higher-vigor vineyards is cordon training.
- Here the spurs arise from one or more horizontal arms or cordons. Known in France as Cordon de Royat, this pruning method has been used since the end of the 19th century.
- The cordons are trained along a wire, and this method is particularly common in New World vineyards.
- Of all pruning methods, this one lends itself more readily to mechanization since all of the canes to be pruned are more or less in the one plane.



CANE PRUNING

- Became common after the 1860 studies of the Frenchman Dr Guyot.
- In traditional French vineyards each vine is typically pruned to one cane with six to eight buds and one spur with two buds.
- During winter pruning the cane from the previous year is cut off and a new one laid down, using one of the canes arising from the spur.

- The number of buds on the cane depends on regional tradition and the small print of the AOC laws. For example, eight buds may be left on Syrah canes in the CdR; eight on all major varieties in Burgundy; in Bordeaux seven buds is the maximum for Semillon in Sauternes, six for Muscadelle, but eight for Merlot Blanc.
- These small bud numbers per cane (and hence cane length) contrast greatly with those used for wine grapes in other regions where vine vigor is higher. For example, in vigor irrigated vineyards in Australia it is not uncommon to see up to ten canes, each with up to 15 buds, left on a single vine after winter pruning. Of course, these vines are planted further apart.
- A common observation with cane pruning is that buds in the middle of the cane often do not burst. There are often a few shoots growing near the head of the vine (at the base of the cane), and the last two shoots at the cut end of the cane will invariably grow.
- Where the cane was growing in shade the previous year the bud burst is invariably poor.

TRELLIS SYSTEMS - DEFINITIONS

- Normally man made, although vines are still occasionally trained to trees.
- In its simplest form consists of a stake driven beside a vine to which the vine trunk or shoots are tied.
- Nowadays wires are used to support vines and foliage, as posts as installed at intervals along the row.

TRELLIS SYSTEMS - DESIGN (Basic)

- There are several designs of end assemblies but they are all firmly anchored in the ground so as to support the strain in the wire due to the weight of the crop, the vines, and any wind stresses.
- At intervals along the row are intermediate posts, which help carry the vine weight.
- In a well-constructed trellis system, the wires should be strained so tight that the wire does not sag, and this in turn facilitates mechanization.
- Vineyard posts are made from wood, concrete, plastic, steel, stone, or even cane.
 - If made from softwood, vineyard posts must be chemically treated to stop wood-rotting fungi.
- The majority of the world's vineyards have very simple trellis systems.
 - For many, the vines are free standing (gobelet), or have loose wires running from vine to vine supported by occasional stakes.
 - The major support for the weight of the vine and crop is from the vine trunk.

TRAINING SYSTEMS

- The grapevine is a true vine, and it not self-supporting like a tree, innumerable training systems for vines have been devised over the millennia of cultivation.
- The vine is pruned in winter as a means of training the framework and buds into an appropriate position to be supported by the trellis system.
- Until the 1960s, it was extremely rare for any training system other than that traditional in a given region to be considered.
- In many parts of the world, little has changed, although the recently developed vineyards of some New World regions have evaluated the various systems and adopted those best suited to their requirements.
- There is an almost infinite variety of vine-training systems; there are few plants whose cultivation can vary as much as between the densely planted (10,000 vines per ha or 4,000 per acre), neatly trimmed vertical hedges of the vineyards of the Medoc and the vineyards of a few hundred vines per hectare trained up trees around agricultural fields in the Vinho Verde region of Portugal.

TRAINING SYSTEMS - DECISIONS

- The viticulturist's choice of training system will be affected by the cost of the system, the availability of any materials required, the availability of the skilled labor required to install and management it, climate, topography, vine vigor, vine variety, mechanization requirements, and, in many instances, knowledge of alternative systems.
- In many places in the world, especially the old world, little thought is given to using any but the region's traditional system.
- In the New World, much consideration is given to the choice of training system, because of recent research into canopy management which has shown substantial benefits in terms of yield, wine quality, and disease reduction by adopting new designs.
- Training systems may be dictated by requirements for mechanical harvesting and mechanical pruning.

- A basic difference in training systems is why some vineyards have trellis systems with wires, and other not.
- While self-supporting goblet vines are common in southern Europe, in many countries such vineyards are considered old-fashioned, and wires to suspend foliage are used instead.
 - If vines were planted to goblet system in an area of summer rainfall such as northern France, the vines could be very prone to fungal diseases because the leaves and fruit would be in a shaded, humid environment.
 - Lifting the foliage up and containing it between wires allows trimming of the ends and leaf removal for better fruit exposure.
 - Both tractor access to the vineyard and airflow within it are also improved.
- The control of vine vigor and vine diseases are the principal reasons for adopting more elaborate systems.
- A vine-training system should aim to maximize yield and quality, and to facilitate cultural operations such as spraying, cultivation, harvesting, and pruning.
- As the degree of mechanization increases, so does the need for the vineyard to be uniform and orderly.
 - For example, mechanical leaf removal and harvesting are made easier by locating the bunches of grapes in a single zone.
 - Similarly, mechanization of summer and winter pruning is made easier if the vine shoots and canes all point in the same direction, vertically upwards, for example.
- The vine framework should ideally be at a convenient height for any hand operations, neither too high nor too low.
- Some would argue that the fruit should be near the ground to absorb reflected heat, although this can involve back-breaking labor at harvest and pruning, and is extremely difficult to mechanize.

TRAINING SYSTEMS - CLASSIFICATIONS

- Vine-training systems can be classified in a number of ways.
- In France, it is common to classify vines as low-trained (*vignes basses*) or high-trained (*vignes hautes*).
- For low vines, the trunk is up to 50 cm/ 20 in high, but usually shorter.
 - Such training systems are more economical, and are suited to lower-vigor vineyards.
 - Grape ripening may benefit from the fruit being closer to the ground, but both harvest and pruning are much less comfortable manual operations, and vines may also be more disease prone.
 - The many examples of low-trained vines in France include the extensive southern area of gobelet, the cordon de royale vines of Burgundy and Champagne, and the double guyot of Bordeaux.
- High Vines
 - Less common in modern France but were certainly known by Roman authors.
 - Interest in high vines was more recently rekindled by the 1950 publication of the Austrian Lenz Moser.
 - He recommended low-density vineyards with wide rows of trunks about 1.25 m/ 4 ft high.
 - Higher training does reduce frost risk, but required thicker and more expensive supports, although vineyard work is made easier.
 - 'High-culture' vines can be trained either cordon or Guyot.
 - Vineyards of the New World have typically used high vine-training systems.
 - Overhead trellises such as Italy's tendon are special examples of high vines.
- Other possible ways of classifying vine-training systems:
 - The cordons may be classed as short, as in 0.5 m in a closely spaced cordon de Royat, or many metres in length as for the Portuguese cruzeta.
 - An alternative classification takes account of whether the foliage is free, as for example in the gobelet vines of the Midi, or shoot positioned or constrained into a plane, such as the vertical systems common in Alsace and Germany in which the foliage is held in place by wires and maintained by trimming.
 - The vine canopies can also be classified by their plane: arbors or tendons-trained vines have horizontal canopies about 2 m above the ground, while the Tatura trellis developed in Australia is inclined at 60 degrees to the ground, and most shoot-positioned canopies are vertical. Some canopies have shoots all growing upwards, as in the lyre trellis, while the Geneva Double Curtain (GDC) has shoots trained both upwards and downwards. Vines may have a divided canopy in either the horizontal plane such as the GDC or Lyre trellis, or vertically as in the Scott Henry.
 - Training systems can be simple, like the free-standing gobelet vines of the Rioja, or elaborate, like the Ruakura twin two tier (RT2T) developed in New Zealand, which is both horizontally and vertically divided, and requires 20 wires per row to support fruit and foliage.

TYPES OF TRAINING SYSTEMS

- **Alberate**
 - An old form of vine-training system used in parts of Italy where the vines are trained on or between trees.
 - There are local variations, such as those in Bologna, Toscana, Venetp, and Romagna, with the common feature being that trees are used for support.
- **Arched Cane**
 - A variation on many different forms of training systems where canes are arched rather than being tied horizontally.
 - Alternative names include bow trained, *arcure* in French, *Capovolto* or *Guyot ad archetto* in Italy.
 - This practice is claimed to lead to better bud break in the center of the canes, where buds do not normally burst well.
 - It can be considered a variation of Guyot training.
- **Ballerina**
 - A form of Smart-Dyson developed in King Valley, Victoria, Australia.
 - One vertical and two transverse curtains are created from on or two cordons trained to spurs pointing upwards.
 - Many bilateral cordon training systems can easily be converted to Ballerina.
- **Barra**
 - Used for monoculture in Vinho Verde whereby vines are trained in one direction along a single wire at shoulder height.
- **Basket Training**



- Often used for free-standing vines where canes are wound one around the other for mutual support. Common for some bush vine systems which are pruned. Typically they are of low vigor.
- **Casarsa, or Casarsa Friuli**



- An Italian training system like the Sylvoz, except the canes are not tied down after pruning.
- **Cazenave**

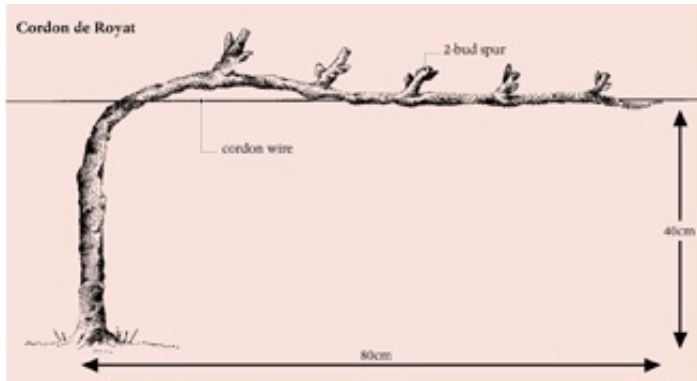
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- An Italian vine-training system which uses a modified form of Guyot pruning where short arms containing spurs and canes (five to six buds) are arranged along a horizontal cordon.
- The canes are tied about vertically to a wire above.
- Because the pruner is able to leave so many buds per vine, this system is suited to fertile soils.
- Château Thierry
 - A form of Guyot training where the cane is tied in an arch to a stake beside the free-standing vine.
- Cordon de Cazenave
 - An Italian and French system used for fertile soils, with one or more canes left on a Cordon de Royat.
- Cordon de Royat



- An old forms of cordon training used in France for wine grapes since the end of the 19th century.
- The system was proposed by Lefebvre, director of the French agricultural school of Royat.
- The classic form is a unilateral cordon on a short trunk (about 30 to 50 cm (12-20 in)), the term unilateral meaning that the cordon is trained only to one side of the trunk.
- The cordon extends mostly from one vine to another.
- The vines are normally spur pruned to two bud spurs.
- The number of spurs is limited for each variety under appellation laws: in Burgundy, for example, to four spurs each for pinot noir and chardonnay vines, to eight for gamay.
- Cordon Trained
 - American term to distinguish a training system using cordons as opposed to canes.
 - These are typically horizontal and bilateral but in the late 1990s, in California as in Europe, unilateral cordons were in vogue.
- Cordon Vertical
 - A vertical cordon with alternation spurs to either side.
 - Not used very commonly as growth tends to be mainly from the top buds.

- Cruzeta



- A system used in the Vinho Verde area of Portugal where vines are trained to a wide cross arm about 2 m off the ground.
- More sophisticated than *latada* but less so than *barra*.
- Duplex
 - A system developed in California in the 1960s with flexible cross arms to allow for machine harvesting.
 - While the fruiting wires are horizontally divided by 1 m / 3 ft, the foliage was not shoot positioned to create two separate curtains as for the Geneva Double Curtain. As a consequence, it is not nearly as beneficial in terms of yield, quality, and disease resistance.
- Éventail

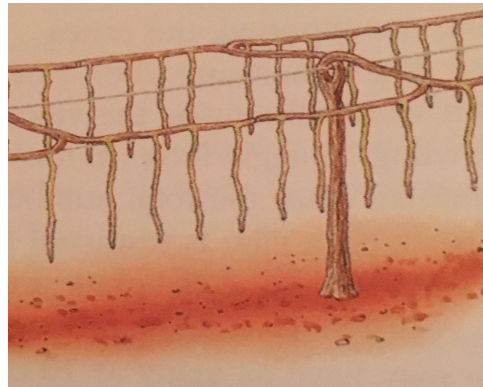


- Meaning 'fan', a French system with multiple arms, each giving rise to a spur or short cane. Originally the form used in Chablis, with the arms lying on the ground, this has been modified to the *taille de Semur* system, where each arm is tied to a lower wire in the one plane.
- Factory Roof System
 - Commonly used for table grapes in South Africa and Israel where the canopy is trained up at an angle to meet in a gable near the row centre.
 - This may also be called a closed, one-arm Pergola, and provides excellent access to the fruit for any hand work required.
- Fan Shaped
 - A training system distantly related to *éventail* that is used in central Europe, particularly Russia, where the vine trunks are spread out in a shape of a fan, which makes it easier to bury vines for winter protection.
 - The Italian version is called *Ventagli*.

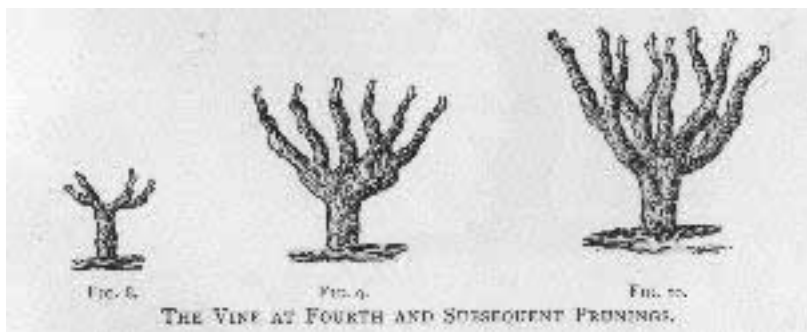
- Flachbogen (vertical trellis)



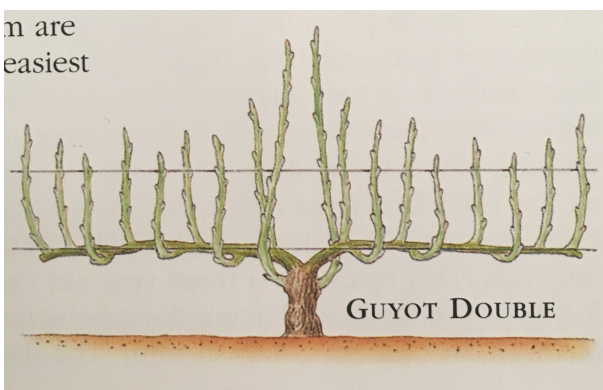
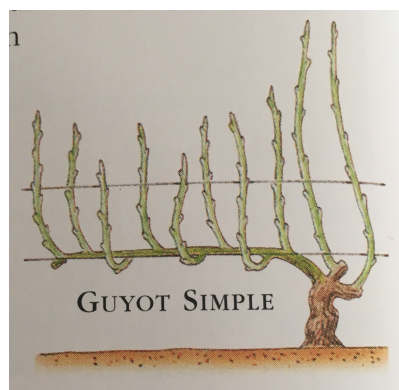
- The German name for a training system like the Guyot whereby one cane is laid horizontally either side of the head, and shoots training vertically between foliage wires.
 - The shoots are trimmed at the top.
- Geneva Double Curtain



- Abbreviated to GDC, whereby the canopy is divided into two pendent curtains, trained downwards from high cordons or canes.
 - The system was developed by Professor Nelson Shaulis of Geneva Experiment Station in upstate New York in the early 1960s.
 - The vines are planted in about 3-m/10-ft rows and the trunk divided at about 1.5 m height to form two parallel cordons about 1.3 m / 4 ft apart.
 - The foliage is trained downwards from these cordons, forming the so-called double curtains.
 - This training system was one of the first examples of a divided canopy developed in the New World and, by reducing shade, it increases both yield and grape quality.
 - While initially developed for the American variety Concord, the system has been applied to Vinifera wine grapes, especially in Italy.
 - It is one of a number of trellis systems advocated as part of canopy management in the 1990s.
 - The GDC system is particularly useful for wide row spacing vineyards of high vigor.
 - While most wine grape varieties have more erect shoots than the American vines it was developed with, it has been found suitable for use in many vineyards, and some notable increases in yield and wine quality have resulted from use of the system.
- Gobelet



- A form of vine-training system, used since Roman times, whereby the spurs are arranged on short arms in an approximate circle at the top of a short trunk, making the vine look something like a goblet drinking vessel.
- The vines are free standing (apart from a small supporting stake when young) and the system is best suited to low-vigor vineyards in drier climates.
- This is a form of head training and is generally subject to spur pruning.
- The trunk is short, typically 30 to 50 cm (12-19 in) and the foliage is unsupported by wires.
- The goblet is widespread in France, from Beaujolais southwards, although it is now less common than it was because it is generally more economical to train vines on trellis systems rather than have them free standing.
- The traditional spacing was 1.5 by 1.5 m (5 ft), but the distance has been increased to allow tractor access and the vineyards are typically cultivated in both directions.
- Sometimes the vines are trained with several trunks.
- With low-vigor vineyards the foliage can be relatively erect, but shoots may trail on the ground in high-vigor vineyards, and there can be substantial shade. Grape yield and quality may suffer as a result.
- The system is used widely in many Mediterranean countries and is most suited to low-vigor vineyards.
- In Italy, the system is called *alberelli a vaso*, and in Portugal *en taça*.
- In many New World countries such as Australia, South Africa, and California, the traditional and low-vigor goblet-trained vineyards were often called bush vines; they have increasingly been replaced by vines with some form of trellising to accommodate the improved vigor of newer vineyards.
- Guyot - *cane-training*



- Jules Guyot
 - Respected 19th-century French scientist with a particular interest in viticulture and wine-making whose name lives on in the system of cane pruning which he promulgated.
 - His practical treatises on growing vines and making wine were translated into English in the second half of the 19th century and are enthusiastically followed by New World vignerons.
 - Although cane pruning had been used in France for a very long period, it was promoted by Dr Guyot in 1860.
- The basic principle of Guyot pruning is to leave six to ten-bud canes and for each a single two-bud spur at the base; shoots from this spur form the cane the following year.
- The Guyot simple form, also known as single Guyot, has one cane and one spur.
- The length of the cane (in French *long bois* or *aste*), or at least the number of buds thereon, may be fixed by appellation laws.
- Guyot double, or double Guyot, the most common vine-training system in Bordeaux, has two canes and two spurs, and the canes are trained to each side.
- Sometime the canes are arched, as in the Jura.
- It is the least complicated concept for growers to learn and, providing the number of fruiting canes and the number of buds on them are restricted, Guyot is the easiest means of retraining yields.
- Even when growers abuse the system, it is still the most difficult vine-training method with which to pump up production.

- Halbbogen



- A German training system whereby the vine is pruned to one cane of about 15 buds' length and is arched in the middle over a wire about 25 cm / 10 in above the base and end of the cane.
- Shoots are trained each year vertically between foliage wires, and are trimmed at the top.
- Head Trained
 - Common American term for a vine trained so that a group of spurs arise in one zone, called the head.
 - Such vines are normally cane pruned, but may also be spur pruned.
 - Here the spurs elongate into arms and the resulting structure is something of a hybrid between a vertical cordon and a gobelet.
- Hudson River Umbrella

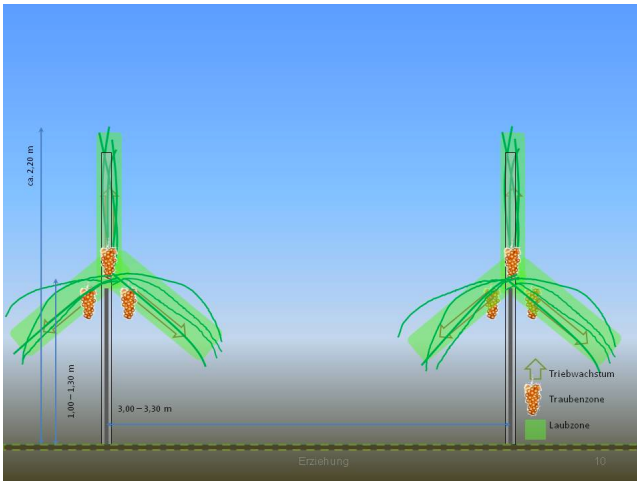


- A system used in the eastern US where canes are arched downwards from a high head.
- Isère
 - A training system much like Ch Thierry, where the cane is trained in a bow to a stake beside the vine.
- Latada (Ramada)

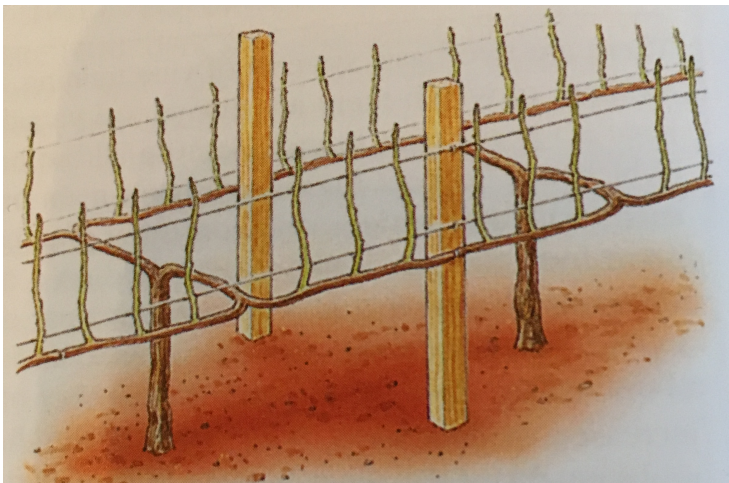


- Traditional 3-m high trellis used in the Vinho Verde region for vines grown around fields of other crops.

- Lenz Moser

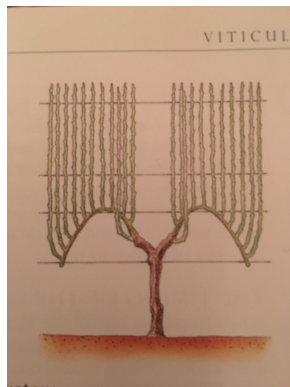
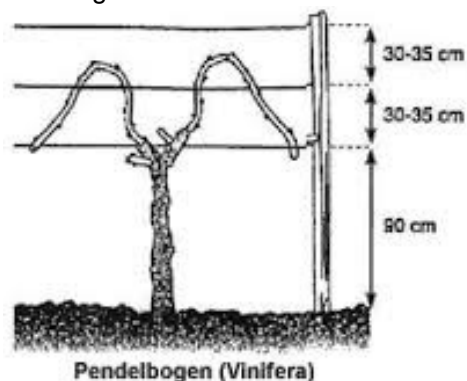


- In the 1920s, Dr Lenz Moser III developed a new training system employing wider rows (about 3.5 m / 11.5 ft) and higher trunks (1.3 m) than had previously been the norm, thereby reducing vine density.
- Lenz Moser's ideas influenced Professor Nelson Shaulis, who developed the Geneva Double Curtain.
- The Lenz Moser system found favor in parts of Europe in the mid 20th century because it deserves labor and therefore production costs, without any need for special machinery.
- French and German studies found reductions in fruit quality, however, probably because of shade in the fruit zone and it is now much less common even in Austria.
- It is also known as high culture, or *Hochkultur* in German.
- Lincoln Canopy
 - A horizontal canopy developed at Lincoln University in New Zealand.
 - It is like the arbour, but is at waist height and allows tractor access between rows.
- Lyre

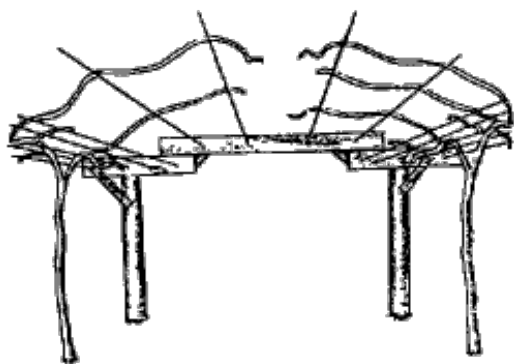


- Also known as the "U" system, the canopy is divided horizontally into two curtains of upward-pointing shoots and which resembles a lyre in shape.
- The system was developed in Bordeaux in the early 1980s by Dr Alain Carbonneau, now Professor of Viticulture at Montpellier.
- Carbonneau was much influenced by the pioneering studies of Nelson Shaulis in canopy management.
- The lyre system improves the canopy microclimate and leads to improvement in yield and wine quality because of better leaf and fruit exposure to sunlight.
- Either spur pruning or cane pruning can be used.
- Further use of this system has been delayed by the unavailability of mechanical harvesters.
- The system is being adopted in New World vineyards in particular, especially in California, and to a lesser extent in Australia, New Zealand, Chile, and Uruguay.
- The lyre system is essentially an inverted Geneva Double Curtain, with the two adjacent curtains of foliage trained upwards rather than downwards.

- Both systems are used to reduce the shading of dense canopies.
- The lyre system is typically recommended for medium-vigor vines, whereas GDC can harvest higher vine vigor.
- The lyre system has shown substantial improvements in wine quality where it has been evaluated in Europe.
- MPCT (Minimal pruned cordon trained)
 - Describes the system developed and extensively used in Australia, mainly for bulk wine production.
 - Young vines are trained to a form of cordon at about 1.5 m height and, apart from wrapping early can growth on the wire, receive minimal hand work, including pruning.
- Palmette
 - An Italian training system, with one vine trained to four horizontal canes, one pair above the other.
- Pendelbogen

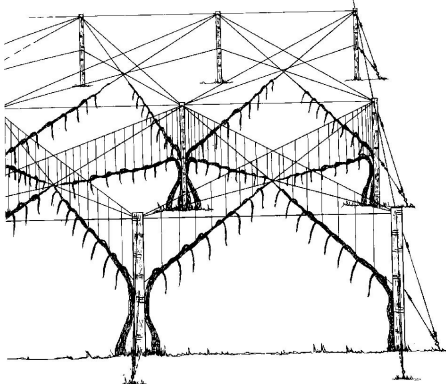


- The German name for the arched cane training system.
- There is a 50-cm height difference between the end of the cane and the highest point, which is thought to improve bud break in the middle of the cane.
- Most of the shoots are trained vertically upright between foliage wires, and normally require trimming at the top.
- Pendelbogen means 'pendulum bow', and there are related training forms called not just Halbbogen ('half bow'), but also Rundbogen ('round bow') and Doppelbogen ('double bow').
- The name has also been applied to a mid-height Sylvos system in New Zealand.
- Pergola

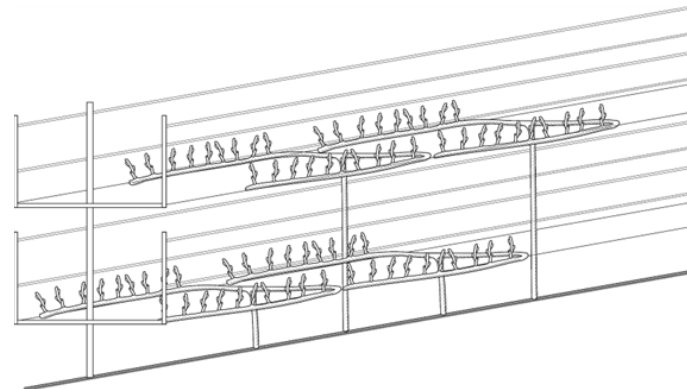
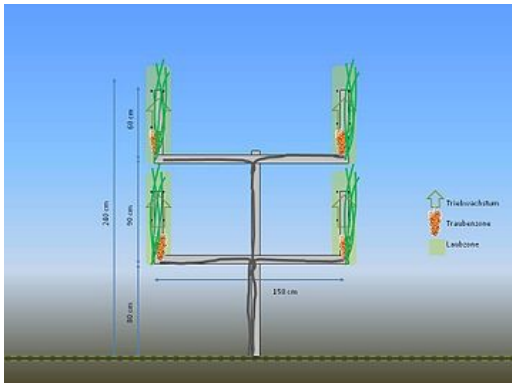


- A form of overhead vine training.
- Where the canopy is horizontal, the pergola can alternatively be called Tendone.
- Pergola trellises can be either one or two armed, depending on whether the vines are trained on one or both sides of the row.
- If the trellis is joined overhead it is called a closed pergola.
- The pergola is widely used in Italy, where the canopies vary but are often inclined rather than horizontal (in Trentino, for example, the slope is 20 to 30 degrees).
- In Emilia-Romagna the pergola system is used, while the pergola Capucci was developed by the eponymous Bologna professor. The pergola a Valentano is very similar to GDC. Where the vines have marked vigor, the bunches which hang below the leaf canopy are in shade, with predictable negative effects on wine quality.
- Perold
 - Form of vertical trellis used in South Africa.

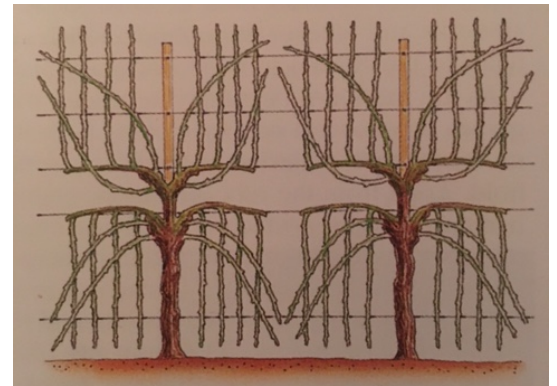
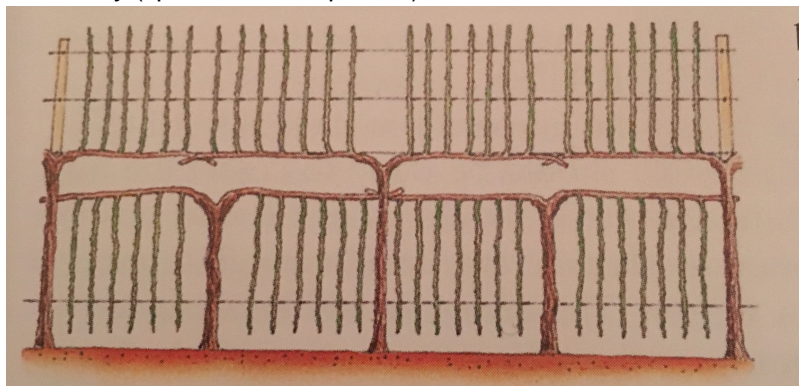
- Pyramid
 - An Italian training system where vine shoots are trained over a group of stakes tied together at the top, forming a pyramid.
- Raggi Bellussi



- An Italian overhead training system suspended from above and with two vines planted together and trained in four directions.
- Pruned like the Sylvoz.
- Raggiera or raggi
 - An Italian training system where vines are trained overhead on wires like the spokes of a wheel.
 - Either one vine may be trained up a central stake or tree and divided into cordons, or several vines may be at the one position which each trained along a different radius.
- Ruakura twin two-tier (RT2T)

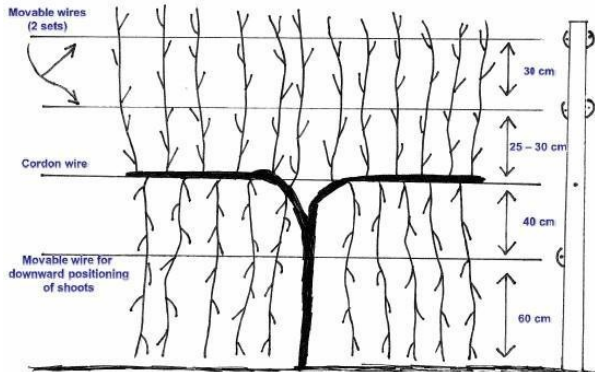


- Developed at the Ruakura Research Centre in New Zealand with the canopy divided into four curtains, two above two.
- Well suited for high-vigor vineyards, but no mechanical harvester had been developed for it by the 1990s.
- Scott Henry (spur then cane-pruned)

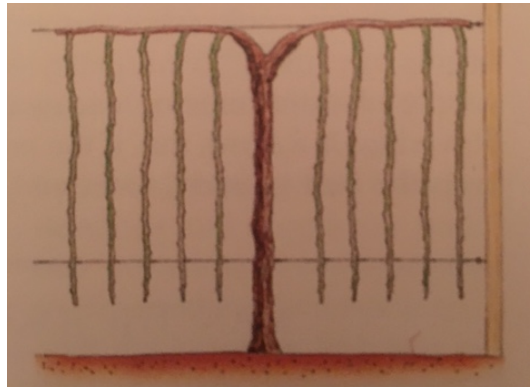


- The canopy is divided vertically and the shoots are separated and trained in two curtains, upwards and downwards.
- The canopy is about 2 m / 6.5 ft tall, and the leaves are held in place by foliage wires.
- The system was developed by an Oregon vine-growers of the same name in the early 1980s when his vines were so vigorous that both yield and quality were reduced.

- The system was originally developed for cane pruning; a later spur-pruned version has now generally been superseded by the Smart-Dyson system.
- The system is suited to moderate-vigor vineyards with row spacing of about 2 m or more.
- It became widely used in many New World countries in the 1990s because of its suitability for mechanical harvesting and potential for improving wine quality.
- Shelf, or Tana
- Local name for overhead trellis in Japan.
- Smart-Dyson

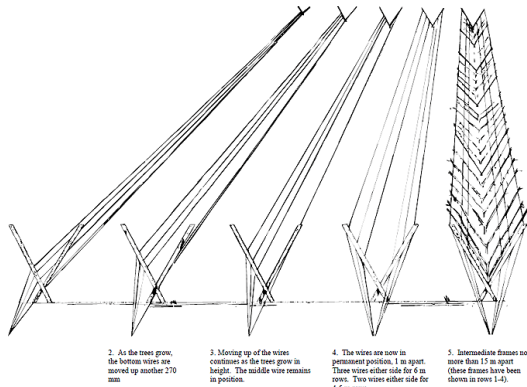


- Developed in the early 1980s in California and by the late 1990s adopted in new plantings in Argentina, the United States, Australia, Chile, Portugal, and Spain.
- Towards the end of the 20th century, the use of the trellis increased, especially in California and Spain.
- Some growers have used it in conjunction with organic viticulture because the open canopy discourages disease.
- Devised by Richard Smart of Australia and John Dyson of New York, and initially trailed on Dyson's ranch in Gilroy, California, in 1992 with Merlot vines.
- It is a vertically divided training system like Scott Henry, but the vine is cordon training and there are upwards- and downwards-pointing spurs giving rise to the two canopies.
- It is compatible with mechanical pruning, unlike the Scott Henry system, and it can be mechanically harvested as readily.
- Sylvoz

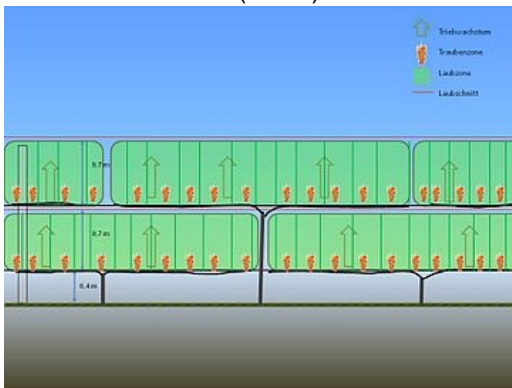


- Developed by the Italian grower Carlo Sylvoz in which canes of up to ten buds in length are tied to a wire below a high cordon.
- The vines can be trained with a high cordon, about 2 m / 6.5 ft, or a mid height cordon at about 1 m.
- Depending on the number of buds retained, the system can be very high yielding.
- A variation of the Sylvoz is the Casarsa system common in northern Italy, where the canes are not tied below the cordon, but fall downward as a result of their own weight.
- The Sylvoz system is suited to vines of high vigor where it is necessary to minimize pruning labor.

- Tatura trellis



- Developed at the Tatura Research Station in Australia and consisting of two inclined canopies at 60 degrees meeting in the middle of the row.
- Early studies indicated high productivity, but the system has not been used commercially for wine grapes, probably because of mechanization difficulties.
- Te Kauwhata two tier (TK2T)



- Developed at the Te Kauwhata Research Station in New Zealand, the system is vertically divided, with shoots trained vertically upwards.
- Limited commercial use in California and New Zealand.
- Tendone
 - The Italian name for the overhead system widely used in southern Italy.
 - It is also common in South America, where it is used for both table grapes and wine grapes, and is called parral (Argentina) or parron (Chile).
 - English terms used include both arbour and pergola, although the system is little used in English-speaking countries.
 - The vines are normally trained with trunks about 2 m / 6.5 ft high and a system of wooden frames and cross wires supports the foliage and fruit.
 - Arbours are normally high enough from the ground to allow tractors and implements to pass underneath, but not so high as to make hard work difficult.
 - The vines are pruned to either canes or spurs.
 - Because all of the sunlight is captured, the system can be very productive: 30 to 70 tonnes of grapes per hectare when water supply is plentiful.
 - Such training systems are limited in use because of the expense of their construction and the high cost of labor required to manage them.
 - Worker productivity is lower because of fatigue, and, where the vines are vigorous, the leaves form a very dense canopy on top and so the fruit and lower leaves are heavily shaded.
 - This reduces both yield and quality, and increases the risk of powdery mildew.
 - Ventilation under such canopies is very restricted and the build-up of humidity favors botrytis bunch rot.
 - The arbour system is used for table grapes in many parts of the world, and has advantage that the fruit hangs freely and makes access easy.
 - Included overhead trellis systems which do not completely cover the ground are often used for table grapes, as in South Africa (where it may be called the verandah system), and for wine grapes around the borders of fields in the Vinho Verde region of Portugal.

- Three-Wire Trellis
 - Another California trellis system with a pair of fixed foliage wires above the cordon.
 - Shoots are not positioned, and fall across these wires under their own weight.
- T Trellis
 - Common in Australia, where the vine is trained to two horizontal cordons about 0.5 m apart.
 - It takes its name from the appearance of the vine truck and cordons.
 - Shoots are not positioned, and so the canopy is not divided.
 - Can be machine pruned and harvested, and is widely used in bulk wine-producing areas.
- Tunnel
 - An alternative name for a form of overhead vine training where the vines are planted in two rows and trained overhead.
- Two-Wire Vertical Trellis
 - Common terminology in California, where one wire is occupied by the cordon and the second is a fixed foliage wire.
 - Shoots grow up and over this wire and fall under their own weight to form a bell-shaped canopy.
 - When the vines are vigorous, the canopy is very shaded.
- Umbrella Kniffin
 - A system used in eastern America where canes from a mid-height head are trained over a top wire and tied below.
- V
 - The shape of the letter where shoots are trained upwards into two curtains.
 - This form does not work as well as the Lyre or U system, where the cordons are separated at the base.
- Vertical Cordon
 - A rare training system as top buds tend to burst first, making it difficult to manage.
- Vertical Trellis
 - Widely used throughout the world, in which shoots are trained vertically upwards in summer.
 - The system is commonly called vertical shoot positioning, or VSP, in the New World.
 - The shoots are held in place by foliage wires which, in turn, are attached to vineyard posts.
 - In many vineyards there are two pairs of foliage wires, and commonly the vines are subjected to trimming at the top and sides to maintain a neat, hedge-like appearance.
 - Both spur pruning and cane pruning are possible.
 - This trellis system is widely used in Alsace, Germany, eastern Europe, the United States, and New Zealand, with high vines (trunks of about 1 m / 3 ft) and relatively low-density plantings.
 - The vineyards of Bordeaux, Burgundy, and Champagne are also vertically shoot positioned, although the vines are planted closer together and the trucks are much shorter.
- VSP



- Vertical shoot positioning, which describes a system used throughout the world where annual shoot growth is trained vertically and held in place by foliage wires.
- Y
 - In the shape of the letter and equivalent to the V system except that the trunk of the vine forms the vertical part of the letter.

The above cannot pretend to be a comprehensive list of the multitude of training systems used worldwide, nor of all their local names, and how patterns of usage are changing, especially in the New World, but it does give some

indication of the extraordinary variation in vine-training systems. The greatest complexity of training systems in the world is to be found in Italy, while those used in France tend to be determinedly regional.