Replanting Cherries in British Columbia

Establishment & Training Systems

Okanagan Valley Tree Fruit Authority

May 2002

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Note: When viewed on the web, photos and diagrams can be enlarged, copied or printed.

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Orchard Establishment

Site:

Site considerations should be the primary focus that will determine the direction of the decision-making process. Site as a title, has a number of subsets. These are soils, and their components of, depth, water and nutrient holding capacity, aspect and slope and drainage; as well as solar radiation, terrain, precipitation, wind susceptibility, hail susceptibility, and frost susceptibility. Site is also considered with reference to seasonal development, elevation and proximity to bodies of water. These aspects along with northern verses southern areas can dramatically influence maturity dates of any given variety. Any one or all of these components will impact on variety selection and system and density choices.
Site can also influence marketing decisions; good highway access or proximity to centres of population may mean direct marketing is a good choice. So marketing could profoundly influence site selection.

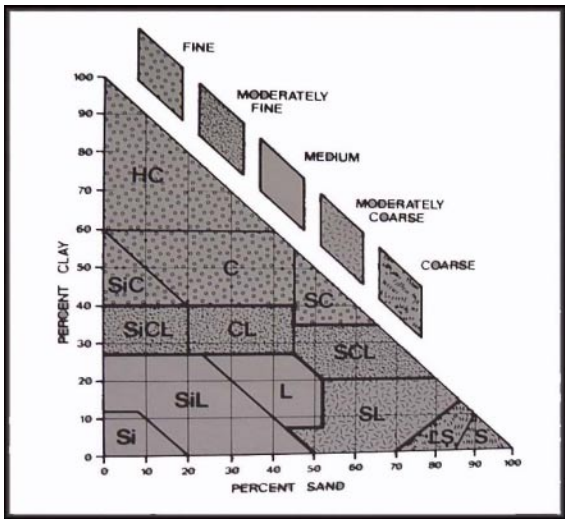
Initially a grower must understand the parameters that describe a good site and then make adjustments to maximize site potentials or minimize site difficulties.

A key concern of site or location is the influence of that location on variety maturity time. To have the earliest fruit on the market or to be in the early pools with the packinghouse system, choose an early location on the Canadian U.S. border at the southern end of the Okanagan Valley. Conversely a choice of a very late location means missing the large volumes in the middle of the season when prices can drop severely. Having fruit mature when large volumes come on is risky, high quality and large size will command higher prices but considerably lower than at the beginning or end of the marketing period. It should be noted that having early fruit in the Okanagan might not be good enough if high volumes out of California and Washington have already flooded the market.
The trend in British Columbia has been to move to the very late maturing varieties in later sites when prices are moving up and volumes have declined.

It is important to understand what is meant by high quality in order to make the best choices for site and other parameters associated with establishing a new planting. Currently a quality fruit is large- 11 to 13 grams (approximately 9 row), and firm around the stone. It has dense firm flesh that is sweet and flavourful. It also has eating crunch and is free from damage (insect and disease, wind whip, frost marks, pitting, rain splits and bird damage) and the fruit has fresh looking green stems.
Site choice can affect these aspects of marketability and ultimately return to the grower.

Soil:

Due to glaciations and subsequent glacier melting and glacier retreats we have various kinds of deposits, from sands and gravels to silt deposits. Cherries prefer a deep, well drained soil, preferably a gravely to sandy loam. Well to rapidly drained soils are best. Imperfectly and poorly drained soils usually have finer textures resulting in poor aeration. These factors lead to insufficient root development and poor nutrient uptake. Cherries will not tolerate a high water table or conditions that allow roots to be sitting in very wet conditions. Roots in the wet zone may die and trees will be shallow rooted. Trees in these conditions are usually short lived.



Sandy loams range from 50% to 80% sand and 0% to 20% clay. Loams range from 25 percent to 50% sand and 10% to close to 30% clay. The higher the clay fraction, the higher the cation exchange capacity, which is generally related to soil productivity. Sandy and gravely soils have moderate to low available water storage capacity. A moderate AWSC is 1.2 to 1.7 mm water per cm and low is 1.0 mm of water per cm of soil.

TEXTURE CLASS	AWSC* Mm/cm of soil	RELATIVE AWSC RATING
gravel	0.2 - 0.6	very low
sand	0.8	very low
loamy sand	1.0	low
sandy loam	1.2	moderate
loam	1.7	moderate
silt loam	2.1	high
clay loam	2.0	high
clay	2.0	high
organic	2.5	very high

(**AWSC** – amount of water held between field capacity and the permanent wilting point).

***AWSC** values are given for the less than 2 mm size fraction only. For gravely soils with coarse fragments, the AWSC values are correspondingly reduced.

The difficulty for a crop like cherries is the need to balance the vigour and productivity associated with heavier soils, with the need for a well-drained soil. Extremes can be compensated for with mulching, irrigation type and frequency on soils that are low in productivity and water-holding capacity. On very light soils there is a risk of inadequate vigour and fruit size and the ability to carry heavier yields of good- sized fruit. But light soils may be easier for the manager to manipulate than a very heavy soil with very poor drainage.

In the Okanagan and Similkameen Valleys you can generally pick out the more suitable areas. Examples are the benches and alluvial fans (sloping fans that are outwashes of streams from higher elevations) north and northeast of the Similkameen River in the Keremeos- Cawston area and some limited areas south of the river. The valley bottom soils are poorly drained and may also have frost problems. From south to north in the Okanagan, the bench soils are suitable but variable. In the Oliver/Osoyoos areas the soils tend to be very sandy to gravely. Throughout Penticton, Naramata, Summerland and continuing north there are great variations from silt benches to very sandy sites with considerable variation within sites. The silts can be very productive but strong and require lower density plantings.

Slope/Aspect and Solar Radiation:

Fruit maturity timing is influenced by another variant called site- slope, that is, steepness of the land, and aspect, the direction that the surface of the land faces. This information can influence which variety to plant and maturity time for a given variety.

The greatest amount of solar radiation is received on 20 percent to 40 percent slope on south facing sites. Steep north facing slopes receive an intermediate amount. For example a 10 percent south-facing slope will receive 15 percent more radiation than a 10 percent north-facing slope. A 20 percent south facing slope will receive over 25 percent more solar radiation than a 20 percent north facing slope. Also, westerly facing slopes will be warmer than easterly facing slopes. This is partially due to morning radiation being used to evaporate dew, instead of raising soil and air temperature. These facts have implications not only for maturity dates, but also for bud and flower strength, and how open the trees must be pruned, to maximize light. As a result, the crop volumes may be affected. As with most tree fruits light intensity and light distribution are important to bud quality and flower strength and set.

The Okanagan Similkameen has large areas of bench-land where slope and aspect are ideal for maximizing solar radiation. But there are many instances of minor variations within a geographic region that can influence maturities by three to seven days. These sorts of variations have implications for marketing and labour management. As tonnages

increase growers will have to co-ordinate activities to take advantage of relatively minor differences in maturities.
The factors of slope and aspect that influence varietal development, are further influenced by elevation changes and the proximity to bodies of water.

Winter damage and spring frost risk:

There are variations in chilling requirement that make cherries susceptible to winter cold. Cherries require 750 to 1400 hours between 0° and 7 °Celsius as a rest period, during which trees cannot break bud. When chilling requirements are met by each variety is critical in the Okanagan- Similkameen, due to the likelihood of a warm period that can frequently occur in January to February. If the variety has not met its chilling requirement it will not break dormancy and go into bud swell and it will not have dramatic losses in dormancy. Bud hardiness will decrease to minus 21° Celsius with warm spells but it will not go below minus 21 prior to breaking rest. Buds have the ability to be super cooled; that is, water remains liquid in the buds even though there are ice crystals in the woody tissue, so shoots may be killed but buds will survive.

The first level of hardiness of minus 21 is reached by early November. This level is quite constant if no cold weather (below –2.2° Celsius) occurs and hardiness will remain at –21° C, but continuous cold results in 0.5° to 2 ° of hardening per day at temperatures below –2.2°. Therefore hardiness can increase to approximately -28° C with this sort of cold preconditioning. Once chilling requirements have been met, mild temperatures can

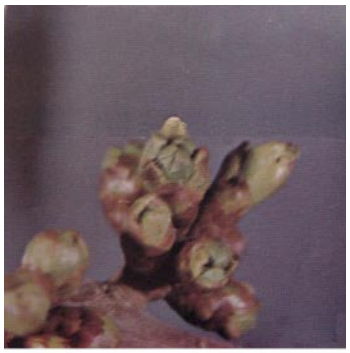

First Swelling


Side Green


Green Tip

reduce hardiness by as much as 0.5° to 2° per hour with a warm thaw in mid to late January through to late February. If this is followed by a sudden drop in temperature, buds are not necessarily killed but there may be substantial damage to the basal supporting tissue. Buds may develop normally and then dry up.

Cherries, due to time of bud swell (early April to full bloom in mid to late April in the Okanagan) are particularly susceptible to spring frost.
Leading up to full bloom, cherries are generally more susceptible than peach. The temperature that kills ten percent or more of the flower buds is a little warmer for cherry than for peach or apricot. The range of temperatures from first bud swell to full bloom



Tight Cluster

Open Cluster

First White

becomes narrower. There is ten percent kill at -8.3 °C; ninety percent kill at – 15°; compared to ten percent kill at –2.2 °C at full bloom, and –3.9°C for ninety percent kill. At each bud stage cherries are slightly more susceptible than peach.

The temperatures mentioned refer to Bing. Lambert and Ranier are one half to one degree hardier than Bing, and it is likely that Lapins is similar to Lambert and Rainier. Sweetheart appears to be no hardier than Bing.

First Bloom

Full Bloom

Post Bloom

Through the winter, after chilling has been met, buds can be cut to determine percentage damage. Twigs and supporting basal tissue as well as flower buds can be sectioned, looking for browning in the tissue. Similar examinations of buds can be made from bud swell to husk fall. Typically flower stigmas or ovules are browned or blackened.

Site with reference to severity from winter cold or spring frost can have considerable influence on success. Experience from temperature towers has shown that there are damaging frosts in some years, of eight to ten frosts between mid April and mid May in the South Okanagan from temperature inversions.

Sloping benches facing southwest or east to southeast are least susceptible to frost damage. On the frost risk maps the dangers from frost, range from zone 1 (0-2 percent risk* of frost) to zone 2 (2 to 8 percent risk* – once or twice per generation) to zone 3 – medium damaged (8 to 20 percent* damage – once or twice every ten years). Areas that are considered not suitable are in zone 4 (frost frequency of 20 percent to 50 percent*) and zone 5 (frost frequency of 50 percent to 100 percent* – strongly dangered- frost

nearly every year). For example in the Oliver- Osoyoos areas the lowland from the head of Osoyoos Lake along the river channel through to north of Oliver is all zone 4 and 5. There is also a fairly broad area extending from the Fairview area south-east to highway 97 that is zone 4. Similar comments can be made throughout the Okanagan, and frost risk maps must be examined carefully when locating a cherry planting.
(*This is the percentage of times when temperatures will drop to –2.2°C on or after full bloom.)

Frost damage, and other factors related to ovule longevity:

Frost damage prior to, during and post bloom may be complicated by other factors related to ovule longevity and later fruit drop. Tree to tree variability in fruit set, as well as reduced fruit set on low verses high branches on the same tree, was associated with variation in ovule longevity. These differences may relate to mineral nutrition or perhaps carbohydrate resources. Variation in nutritional status among trees in an orchard can occur due to site differences in soil composition or to differential distribution or uptake. Variations due to location within the canopy may be related to preferential allocation of nutrients to the upper part of the tree, but are more likely due to reduced carbohydrate reserves associated with excessive shading in the lower parts of the tree. These aspects may have implications with regard to system type and pruning within a system.

Therefore, there can be heavy loss of flowers and later fruit drop related to frost damage, carbohydrate reserves and their distribution, but other factors that cause drop are unknown. There are 3 stages of drop. The first, is two to two and half weeks after full bloom, the second about one week later and the third, the so called June drop, occurs about three weeks after the second. Although cause is unknown, a likely cause is competition for nutrients. When flowers are hand thinned or lost from frost, a larger percentage of the remaining flowers set fruit. Also the percentage of flowers lost in the first drop affects the percentage lost in the second, that is, a heavier first drop results in a lighter second drop. The annual variation of the three drops suggests an influence of weather indirectly on nutrient uptake or mobilization.

Soil Preparation:

Soil preparation prior to planting is critical for it is generally a one time chance to effect a major change in soil conditions that are likely to have a lasting affect on the health and productivity of the new trees. The ideal situation is to allow a full year between tree removal and replanting. Unfortunately most growers do not find this practical and remove old trees in the fall after harvest with the intent to replant the following spring.

Replant analysis:

It is accepted that cherries following cherries may be adversely affected and may benefit from the use of a soil fumigant such as Vapam. (See OVFTA replant bulletin). There is no specific test for replant disease in cherries.

Soil analysis and soil amendments:

Soil sampling should be performed 6 to 9 months ahead of planting. Sampling should reflect terrain and potential soil type differences. For example a gravely ridge should be sampled separately from heavy lowland soil. Request all major and minor nutrients as well as pH and cation exchange capacity in your soil analysis. A cation exchange capacity analysis (CEC) specifies the nutrient holding capacity of a given soil. The soil can be topped up with the major cations - magnesium, potassium and calcium and other nutrients such as boron (note stone fruits are particularly sensitive to excessive boron). Irrigation and fertilizer use acidify soils, leaching magnesium, boron, potassium and calcium to an area below the root zone of young trees. Where soil sampling indicates a need, liming may be required to raise the pH, or sulphur to lower the pH in addition to other amendments as listed above. Organic matter such as peat soil may be added to lighter soils prior to final rotovating. If added at this stage the amendments will be in the root zone for new trees.

Weed control:

A good start to preparation is a Round-up or Glyphosate application to the full field to be replanted or to the new proposed row strips. (see more information in the weed control section of this manual)

Tree removal:

Most growers remove all small branches, and pile this brush and then cut large branches down to the stump retaining this wood as firewood. Stumps are then removed with a large excavator, backhoe, or a caterpillar tractor, and the ground is smoothed.

Land levelling:

Slopes that are greater than 9 or 10 percent may need levelling, or if there are pockets or depressions they should be filled to reduce frost hazard. Topsoil needs to be retained. Where levelling is to take place, the topsoil should be removed and piled to one side and then replaced evenly over the newly levelled area. If this is not done, there will be great variation throughout the planting in growth and tree vigour.

Ripping and cultivating:

Most locations, especially those with heavier soils, will require ripping with deep chisels to break up a hardpan, or to deal with compaction as a result of equipment use in the previous planting. Rocky and gravely locations may not require ripping as the soil is well drained and often such activity only brings up a large number of rocks. Cultivating with a spring tooth cultivator or a spader works the soil to a depth of 25 to 40 cm (10 to 16 inches). Final smoothing can be done with a rotovator, but it should not be used instead of a spader or a cultivator as it only works the surface few inches and can leave a hard layer in the fine textured soils.

Cover crops:

When a full year is available prior to replanting, soil organic matter can be built up by seeding oats and field peas in April. Incorporation should take place before seed maturity. Oats can be seeded two or three times and turned under before seed maturity. It is very difficult to substantially change soil organic matter levels, but adding organic matter when possible helps soil moisture holding capacity and improves the soils ability to absorb and retain nutrients.

Fumigation:

Fumigation is advised if planting cherries following cherries or if a soil test indicates damaging levels of parasitic nematodes. This can be done in the fall prior to tree removal while soil temperatures are still above 7 ° C. The area can be treated successfully with the old trees in place. The ground should not be cultivated for three weeks to allow the fumigant action to take place. It may not be possible to work the soil in the fall, therefore rip, spade and rotovate in the spring. Whether the site was fumigated in the fall or after soil workup in the spring, it is wise to perform a germination test to determine the presence of the fumigant.

- Plant lettuce or cress seeds in a closed jar in soil from the fumigated area,
- Plant similar seeds in soil from and untreated area
- Compare the germination rates of the seeds from the two areas
- If the germination rate is poor in the treated soil, repeat the test at two to three day intervals until the germination percentage is similar

Tree spacing:

To gain maximum light penetration rows should run north and south. This will ensure balance of light for bud strength, evenness of bloom on all sides of the tree and a more even maturity and colouring of the fruit. Other considerations may take precedence, for example, reduction of frost risk, and the need to ensure good air movement to reduce the incidence of diseases such as brown rot and powdery mildew.

In the past spacings, for cherries have been 4.5m x 4.5 m (15 ft x 15 ft) to 4.5m to 6 m (15 ft x 20 ft). Now growers are successfully growing central leader type trees at densities as high as 1 m x 4m (3 ft x 12 or 13 ft) Regardless of the system each planting will need to be adjusted to match the rootstock used and the site limitations of soil and slope. Row spacing needs to be approximately 1.3 to 1.5 times the anticipated height of the trees to avoid shading of lower parts of the adjacent rows. The absolute minimum row spacing is a one to one ratio of tree height to row width.

Staking out the planting:

Tree rows must be straight and the same distance apart from end to end, particularly for the use of machinery such as double weed booms. A surveyor is strongly recommended for set-up, particularly where slope is a factor.

“In row spacing” needs to reflect a balance with the “between row spacing” to allow for balanced tree development. Depending on the density, growers may still use augers to dig holes for the trees, shovels may be more suitable or a plough, to create a deep furrow for planting. Where augers are used, growers may wish to use a planting board that is notched for stakes either side of the hole, with a notch in the centre for the tree. As densities have increased, this method has not been used, and growers prefer a centering string to follow. Exact tree locations are marked with lime or fertilizer.

Selection of nursery stock:

Good quality, strong, disease free stock is critical for cherries as they are prone to bacterial infections. Stock should be 1.6 cm to 2.2 cm caliper (5/8 to 7/8 inches) or greater in diameter, 5 cm to 7.6 cm (2 to 3 inches) above the bud union. Trees of 1.27 cm caliper (1.5 inch) may be available but are not really acceptable. A better caliper generally goes hand in hand with tree health and a strong fibrous root system. All other aspects being equal quality trees will bud out quickly and achieve good growth in the first season.

With cherries in particular, growers need to be watchful for gumming up and down the stem and shank of new trees that may indicate the beginnings of bacterial canker. This is especially true for trees grown under coastal conditions.

Branched or feathered trees may be advantageous if there are 3 to 5 branches spaced evenly around the trunk and they are of moderate strength and not set at too strong an angle. If this is not the case but branches are present, they should be removed. (See systems section)

Handling and receiving trees:

Check newly received trees carefully for dry roots, canker and galls as well as caliper. Take a knife and check the bark and tissue beneath the bark for dryness. When transporting or handling, trees must not be allowed to dry out. Roots should be covered in damp sawdust and both roots and tops covered with a tarp to protect them from drying in transport.

The roots of stored trees should be soaked in a clean barrel of fresh water for six to twelve hours prior to planting. It the trees cannot be planted for several days, store them in a location protected from sun, wind, and frost. Bundles should be broken up to remove air pockets and avoid root drying and planted in a trench or sawdust in bin and thoroughly wetted.

Note: do not store trees in a fruit storage room as ethylene gas released from fruit can injure trees.

Time of planting:

Trees can be planted in spring or fall, but in the Okanagan fall planting is extremely risky. Time of spring planting has come under some debate. If the soil has been fumigated, planting must wait until the soil has been aired out and checked with a germination test. In addition, planting will depend upon whether the trees have been dug and stored in the fall or have been retained in the nursery until spring. Trees held in the nursery will start to push bud and will require planting before bud push, likely by late March or early April. Trees that are held in storage can be held until it is convenient to plant, which may be as late as the end of April to early May. Research at the Pacific Agricultural Research Centre has shown that very early planting prior to adequate soil warming is not an advantage and that trees planted mid to late April depending on temperatures, will perform as well, and in many cases better than early planted trees. Trees sitting in cool wet soils are prone to root rots and trees tend to sit without signs of bud push.

Handling trees at planting:

Prune nursery tree roots back to six to eight inches, removing root ends by holding the tree horizontally, rotate the tree, cutting back droopy, floppy ends, to encourage new balanced root development. Remove any root galls that are present as well.

Planting hole preparation:

Whether you are using an auger, shovel, or tree planter, do not prepare too far in advance in order to avoid soil drying.

Augers can create a glazing on the walls of the hole creating a pot effect. This will affect water drainage and root penetration into surrounding soil. In addition there may be a shrinking of soil away from the hole perimeter. Augers with flanges welded on will rough up the sides of the hole and offset the tendency for glazing to take place.

Cherry Systems

Introduction:

In the Okanagan we are in the early stages of a major revolution in sweet cherry management. Fruit quality and labour demands are moving the industry towards higher density orchards, smaller, more labour friendly trees and trees that produce earlier in their lives.

In the past we have traditionally grown large modified central leader and vase style trees at spacings of 30 by 24 feet and 24 by 18 etc. These trees were large and required 10 to 16 foot ladders. Trees like this move their productive surface out and up; with the interior of the tree being shaded with the result being old weak spur systems and poorly sized fruit. In addition fruit maturity might be varied throughout the tree. Some growers have done well on these types of trees, renewing wood, removing large limbs that shade and have kept tree heights reasonable. The result was good quality fruit with good yields. Despite these results, trees took too long to get into production, and labour in terms of ease of picking and other practices was difficult and expensive.

Goals of new plantings:

Dr. Martin Balmer outlined these goals as follows:

"A modern planting system has to achieve certain necessary requirements. It should have a short juvenile stage (influenced by special growing measures, cultivar, rootstock, density, and a productive tree form), regular yields and high yields of good sized, good quality fruit that is easy to sort, from trees that are easy to pick." Weber puts it a little differently- " the requirements of a modern orchard are regular, high early yields, excellent quality fruit, low labour costs and high picking output as well as the ability to protect from rain and bird damage.

This aim requires efficient canopy management to achieve full canopy development at an early age.

To achieve these goals it is important to have a thorough knowledge of the fundamentals of the tree's fruiting habit, of pruning and training techniques to ensure a basic concept in all high-density systems, which is to promote light interception and distribution to generate high quality fruit.

Regardless of the training system, precise branch development is critical. With newer techniques and dwarfing roots and self-fertile varieties, vegetative growth can slow dramatically as cropping begins. Therefore it is important to fill the canopy space quickly and efficiently, with well-placed branches in the first two to four years of growth. New training techniques to maximize the right caliper branches for good fruiting potential and the use of precocious rootstocks can lead to excessive crop loads. Between years three and five this can cause severe runting out, especially on lighter soils. Early cropping competes with tree growth and with the building of storage reserves as young trees have limited roots and trunks for storage of nutrients and carbohydrates. This lack of storage will affect early season growth.

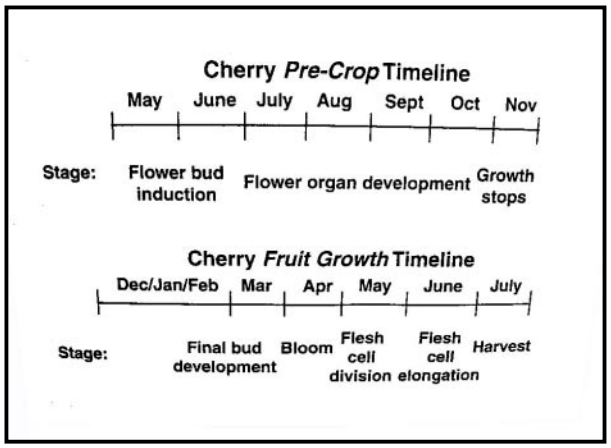
The grower must prune and train with the idea of promoting good balance between fruit and growth to ensure good fruit size two to three years ahead of fruiting a particular branch. Branches and trees can easily be over-cropped when they are trying to develop new growth and initiate fruit buds.

It is important to understand branch, leaf and fruit, and bud development and their relationship to each other.

For growers in the Okanagan this is especially critical as most growers are using Mazzard roots in fairly high-density systems. It is necessary to understand how to strive for weaker productive wood and softer balanced trees. Many growers are planting high-density

cherry orchards, but are not using dwarfing rootstock and are using techniques that encourage strong less productive growth in trees that may become unmanageable.

Regardless of the system selected, a grower must understand vigour management and the cyclical timeline of shoot growth, leaf and flower bud development. This is a major objective to promote annual cropping. It is a fifteen-month development process from fruit bud initiation to harvest. During spring and early summer photosynthesis and nutrient uptake drives growth. This establishes leaf area for current growth, leaves and fruit bud initiation on last year's growth, and fruit and leaves on the wood established the season before. As shoot growth slows down and ceases, formation of microscopic flower parts begins on last year's growth (the start of the fifteen month process to harvest). The continued production by leaves moves carbohydrate production into reserve storage, which will drive growth the next spring. The ability of the tree to store adequate reserves, ensures the critical final development of flower parts, set, and the necessary shoot growth in the early part of the spring, The ability to be able to store sufficient reserves drives spring cell division which will determine fruit size and leaf area. As in apples, numbers of cells are very critical for fruit size, but the achievement of good sized fruit and excellent sugar levels is not driven by reserves but by current photosynthetic activity of nearby leaves. The better the situation is for balanced growth the larger the leaves, which in turn will provide the resources for fruit growth and ripening. Pruning, training and a mix of other management factors influence final crop development.



No matter which system is used, precision is required in canopy development, cropping and in managing leaf population within the tree. As we shift to the use of a smaller tree structure in high density, each opportunity to develop fruiting branches must be optimized. This will assist greatly in achieving necessary crop volumes on trees sized for the space allocated.

The natural growth habit of sweet cherry develops a canopy that is high and wide with good fruit on the periphery of the tree. Heading of main leaders and scaffolds does not change this fact of life with a tree as apically dominant as sweet cherry. Therefore growers have to alter the structure at the bud or future growing point level. Selecting of individual buds will allow for more precise development of branches and crop.

Methods of Influencing Precision Branching

Scoring:

Scoring is a more certain technique to induce branching than Promalin, and it has a wider window of opportunity.

This window occurs from bud swell to bud break. The score or cut must be through the cambium and sufficiently wide and deep to maintain cambium interruption. It must not heal before shoot growth begins. If the scoring cut is too deep there is the risk of breakage from the wind, and there is potential for disease entry in the wound.

Removal of unwanted buds or debudding:

Removal of two thirds to three quarters of the buds along the leader has an even wider physiological window from dormant through post bud break. The easiest time is at bud swell. At this time the buds snap off readily (see more detail in systems section). Bud removal has two disadvantages: 1) there is the potential for bacterial infections of wounds where buds are broken off and 2) (but in addition to this) potential branching and crop is removed. This is on the one hand a disadvantage but it is really a major advantage in removing excess crop. Bud removal really results in more branch initiation than would otherwise happen.

With regards to these three methods of inducing buds to break into shoots, Robinson, Andersen and Hoying of Cornell did work to compare the three approaches. Working with Lapins, Sweetheart and Hedelfingen they examined all three techniques on the lower, mid and upper third of the leader. Generally bud removal was the most consistent, but promalin performed better on the top third of all three varieties, and Lapin was the most difficult to induce branching across all sections with all three approaches. Promalin was applied at 5000 ppm mixed with diluted white paint (a ratio of 1:1 paint to water was sprayed on the leader at bud swell). Notching or scoring was done above every third bud at bud swell, and bud removal, involved rubbing off two buds and leaving one at bud swell. Combinations or overlapping of these methods can also be done.

Precise cropping:

Once tree structure patterns have been established, the focus is on precise cropping. Within any cropping system there must be a good understanding of the relationship of shoot age and crop development.

Trees with good annual vigour should have no fruiting spurs formed on the previous seasons shoot growth although there are frequently solitary buds of non spur flowers on basal portions. Good annual vigour implies reasonably strong growth; stressed situations will have reduced shoot length with more flower buds. Most of the buds on one-year shoots will initiate the first microscopic beginnings of flower spurs in their second season and will fruit in the third season. For example there will be a new terminal shoot grown in 2002, there will be flower bud primordia formed on wood grown in 2001 and actual fruit will be present on wood that grew in 2000. As most growers have observed there is a tendency for the number of flower buds per spur to increase on the shoot growth that occurred late in the previous season. This is where the heavy clumps of fruit will develop. Therefore removing 10 to 25 percent of new shoot length with head pruning in dormant or late summer can remove as much as 25 to 50 percent of future crop load, allows better spray penetration and will reduce the potential for disease. This will also promote shoot growth behind the cut.

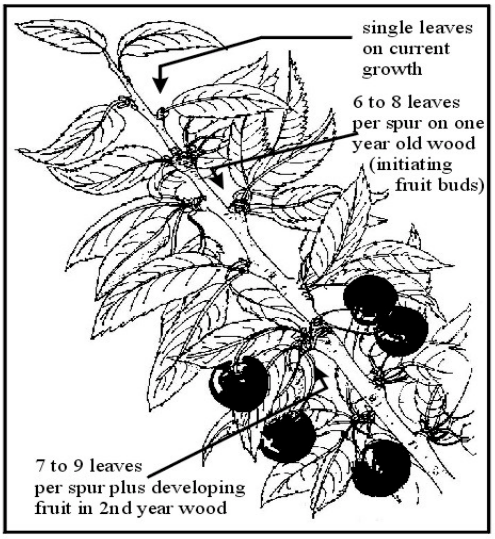
There will be variation in reactions depending on vigour, rootstock, variety, site, and climate. Dwarfing rootstock, light, soil types and moisture stress will promote more intense bud development requiring stronger measures to promote growth, and reduce crop load in order to gain tree structure fruit size and quality.

Please note that Promalin is not registered for cherries in Canada. Any references are research based and growers have no legal right to use the product commercially.

The relationship between shoot growth and age, and fruit bud development is important to understanding how to manage overall tree size and crop load. But leaf growth and understanding leaf populations on different ages of wood in the canopy is critical as they support shoot growth and generate reserve carbohydrates.

Leaves of current growth:

As a new shoot forms, single leaves develop at each node. They become sinks for carbohydrates from storage and then from more mature nearby leaves. As they mature they contribute to other newer leaves, shoot and fruit growth as well as storage. Lang indicates that removal of any portions of this leaf area to improve light conditions has only a minor impact on total leaf area.



Leaves on one year old wood:

These leaves develop on last years shoot growth and there are six to eight leaves per node. It must be kept in mind that these leaves are on the wood that is developing fruit buds that will have fruit the following year. The health and vigour and size of these leaves are important to the newly forming flower buds on this age of wood. These leaves are a major source of food for the newly developing fruit on two-year old wood and for new shoot growth. The leaves on the second season growth are a major source of photosynthetic production. Summer pruning of this age of wood should be minimized.

Leaves on two year old wood:

There are seven to nine leaves per node, which are mostly fruiting spurs on two year wood. Carbohydrate produced by these leaves supplies the immediate fruit and fruit on nearby spurs. If there are few fruit per spur these leaves are adequate to size and bring the fruit to maturity. If the fruit density is high, the leaf population on one-year old wood is very important to support the fruit on two-year wood. Therefore the loss of one-year wood or a portion of this wood means a major loss of supporting leaves. An imbalance occurs if longer sections of two-year wood are maintained followed by a sudden reduction in one-year wood through summer pruning. A balance should be maintained by annual summer pruning or pruning the next spring of one-year wood. Therefore as wood ages there are shorter fruiting lengths that will be matched with shorter one-year wood

that is created with summer pruning. It is important to understand these relationships as different types of pruning cuts are made.

Growth manipulations:

Any effort to influence growth or vigour, either to promote it or reduce it can be considered a growth manipulation technique. There are a number of different techniques:

pruning cuts, bud removals, bending techniques, spreading, scoring, and growth regulator use such as Promalin. The use of a particular rootstock, seedling verses dwarf and conditions of site: soil, slope and moisture and tree habit, can influence the kinds and combinations of techniques to promote or influence both growth, and amounts as well as fruiting intensity.

Growers in B.C. are largely using seedling roots and need to employ techniques and systems that don't trigger a vigorous or strong response. On gravely or sandy sites, techniques and systems that foster a stronger result may be required. Growers that do use dwarf rootstocks especially on light soils may require approaches that result in a stronger more vigorous tree. But in many of our soils, dwarf rootstocks may have a tendency to over-crop and runt out and never reach their cropping potential. Lang emphasizes that early cropping not only competes with tree structure growth but also with the building of storage reserves for initiating good vigour and set the following spring.

Young trees have limited storage tissues for spring growth. Too many shoots or too heavy a crop load can tip the balance and dramatically slow the growth. Harsh measures of heavy pruning even restarting young trees, plus extra fertilizer and mulching may be required. If some trees do runt out, the block becomes inconsistent and the planting can become very difficult to manage. A mixture of techniques may be required throughout the block making labour management difficult.

Once tree structure has been developed regardless of the system, detailed shoot pruning, and understanding of growth and leaf population relationships is essential to balance fruiting and shoot development to gain the result of large high quality fruit.

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Manipulation techniques and definitions

Summer pruning, dormant pruning and late spring pruning:

Pruning in late autumn through winter to early spring can result in an increase in disease especially under wet climate conditions. There is definitely concern with bacterial canker in the Okanagan despite the reputation of a dry climate. In late spring at bud swell there is a flush of sap flow in the shoot which blocks damaged conductive tissue and other wood cells with gums and phenolics within ten days. (Webster p 261) In favourable conditions this is followed by the formation of a corky callus tissue forming over the wound in four to five weeks. Shoots pruned earlier show no healing until late spring and are open to infection.

Summer pruning after harvest when there may be less chance of re-growth is a way of reducing overall tree size, promoting new shoots but with the result of less vigour than late spring pruning. As was mentioned earlier this is an effective way to help reduce future crop load.

Heading into one year wood:

This cut is used primarily in young trees to develop structure and is heavily used in the Spanish Bush system and the development of the steep leader system. This type of heading tends to invigorate the area around the cut and delay fruiting.

Heading into older wood:

As in heading into one-year wood, heading into older wood encourages lateral branching but is not as invigorating as the former and does not delay fruiting as much. It is another tool to influence overall vigour and is used in all systems. It also tends to reduce crop load, especially clumps of fruit at annual intersections of growth. This type of cut effectively stiffens branches and is also used to eliminate hanging wood. As was discussed earlier, the pruner must be aware of the crop load and the amount of one year, two, three year and older wood there is, in terms of leaf populations to support large fruit.

Renewal cuts:

There are basically three types of renewal cuts.

a) Bench cut: This cut is made horizontal to the leader or primary branch and leaves no upper latent buds. Depending on vigour, this type of cut or stub close to the leader usually generates a strong response from an underside latent bud and results in a strong generally undesirable shoot.

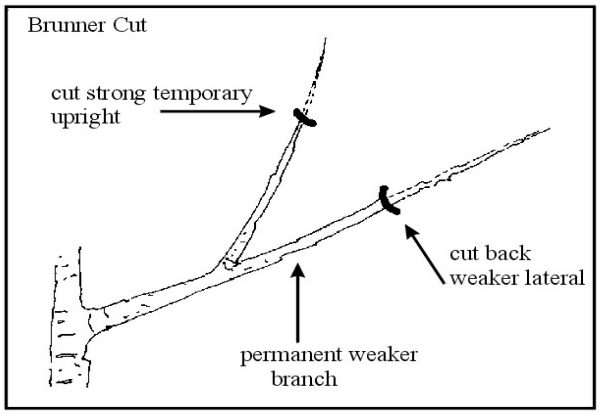
b) Stub cut: This cut into an existing branch can be fifteen centimetres to thirty or forty centimetres long. It is primarily used in the Zahn training system to protect the tree against entry of bacterial canker. When this cut is made in the spring, there is the chance of wet weather. If infection does take place it usually only goes into the wood a short distance. The stub is then cut off back to the leader in the dry weather of summer.

Under conditions in the Okanagan it is also used to generate weaker replacement wood. If canker is present in the orchard the stub could be cut out or cut back to one of the suitable shoots that may be present. This type of stub usually results in several buds growing with less vigour than the bench cut, one or two of these shoots may be suitable and one or both can be left to generate new fruiting wood. Any shoots that grow from the top of the stub will very likely have to be removed.

c) Double sectorial pruning or the Brunner cut:

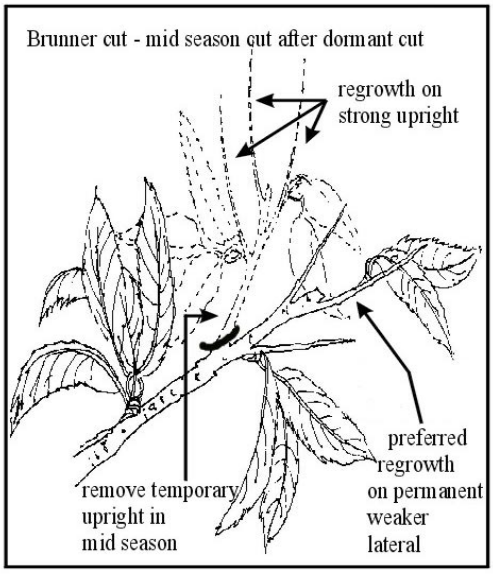
This cut is a combination of two cuts to control vigour in young trees while reducing the potential for delayed fruiting.

A heading cut is made into a vigorous temporary branch while at the same time a cut is made into a weaker adjacent branch. This diverts vigour away from the permanent weaker branch.



The strong vertical branch is removed at the junction to the weaker branch in mid season. Lynn Long of Oregon, state points out that this cut is particularly useful in the steepleader and Spanish bush systems.

Judicious use of this cut and the second type of longer stub cut mentioned will be particularly useful to Okanagan growers using Mazzard rootstock to assist in controlled renewal to de-emphasize the vigour of the Mazzard, particularly in strong soil types.



Thinning Cuts:

Thinning cuts can remove whole branches or part of a branch. It is a cut into older wood, or a cut back to the main leader. It is a primary cut that more than any other type of cut influences light penetration and distribution. Thinning cuts will have a major impact on extensive sections of the trees' canopy, affecting light, bud health, strength of flowers and evenness of maturity. Its affect on vigour response is displaced over a more extensive region of the canopy than the other cuts. It is used in all of the training systems discussed.

Shoot/Branch manipulation:

Although some varieties of cherries, such as sweetheart, tend to have fairly wide crotch angles naturally, most varieties do not. Lapin is an extreme example of this strong apical dominance with vertical wood and narrow crotch angles. If these shoots are not spread very early in their life the result will be a bark inclusion in the crotch which will leave the branch structurally weak, and prone to winter injury and disease such as bacterial canker. In addition the tree will develop an upside down profile with a wider more extensive top and narrow base with intense shading in the interior of the tree and heavily shaded basal area. Spreading shoots and branches reduces terminal dominance, reduces growth and extension and encourages early fruiting.

There are a number of methods of spreading, but timing is critical. A key local method is the use of tooth picks – these are the double- ended round toothpicks. They are placed when the shoots are five to ten centimetres long (two to three or four inches) while they are still green and flexible. Under the generally warm dry conditions in the Okanagan there has been no problem with creating a wound in both the new shoot and the leader, but it is always a high risk and if there is any canker in the orchard. In addition the toothpicks do not always stay in place.

A preferred method is to use clothespins. Clothespins are superior to toothpicks in that they tend to stay in place and it is easier to induce the preferred ninety- degree angle. The clothespin is clasped perpendicular to the leader when shoots are five to ten centimetres (two to four inches) long, about the length of the clothespin. Because of the size and thickness of the clothespin the new shoot is obstructed. If the operation is left until the shoots are twenty –five to thirty centimetres long (as it may be in apples) the crotch of cherry will be formed and lignified and will very likely break, if not right away possibly in the next twenty-four hours. Generally wooden clothespins have too narrow a jaw

opening and slip out of position on sweet cherry branches. The only product that works satisfactorily is one distributed by Brightland Distrubutors 3208 28th St. Vernon B.C. V1T 4Z8. (1-800-663-5416)

Pinching: hard, soft pinching:

Pinching is a technique that slows shoot extension and promotes lateral branching to reduce the flow of auxin and allows other shoots to push. Soft pinching is a tearing of the terminal green shoot tissue immediately above the meristem in the tip of the shoot without injuring the meristem. Soft pinching is generally used on the leader, and it will cause the leader to hesitate in its growth seven to twelve days. Hard pinching tears or injures the meristematic tissue or the shoot is cut below the tip and is more commonly done on laterals close to the leader to allow buds further down the leader to break and push. Pinching is initiated when shoots are five to ten centimetres as with toothpicks and clothespins. It can be performed several times in the first and second season. Hard or soft pinching is used to balance growth so some shoot tips may or may not be pinched depending on need to balance growth.

Spreaders:

Spreaders are used for longer branches to achieve better light distribution, and may be used even when clothespins were used earlier.

Growers have used wooden spreaders with nails sticking out of both ends. These are not acceptable for cherries, the wound is substantial and promotes gumming with a good possibility of entry by pathogens. Despite a relatively dry climate, bacterial canker is a considerable problem in the Okanagan. A substitute is a wooden spreader with a wide "V" cut in either end, they work fairly well but thin lathe types bend and break and can be blown out by the wind.

Debudding of Sweet Cherry Trees:

Debudding is a technique that originated with Tobias Vogel of Germany. It was developed for branching in the Vogel Spindle system, but is also used in the Zahn System and is useful in the steep leader system and the central leader. Any system that wishes to promote branching could use debudding to advantage. A number of researchers are using this approach to develop balanced branching.
The upper-most buds and newly developing leaves on the leader produce more auxin than buds lower down the leader. The auxin discourages or inhibits bud development further down the leader. Also as the upper-most buds have sharp angles and are vigorous, often buds further down the leader do not push out and become shoots. This results in blind wood that has fruit buds but no shoot development. Debudding is performed when the buds have pushed a little more than a centimetre, just past the green bud stage. If the upper buds are allowed to develop they will be a constant problem, requiring extra labour and the likelihood of less fruit on such vigour prone shoots.

Bending:

Limb bending and twisting is performed, late in the season on current growth or early in the second season of growth. The branch is grasped close to the leader to support it and held further out and twisted and bent down. The pressure and bending is done until superficial cracks appear in the bark. The branch growth is stalled and the branch will heal in the new position and tend to put on fruit buds more readily.

Crop regulation and summer pruning:

To date, growers in B.C. have largely used pruning to reduce crop load. But in most cases this has occurred as a natural result of thinning cuts to achieve better light distribution. Growers have been summer pruning current growth to control tree size as well as reducing length of wood available to carry crop two seasons later. In most cases growers are pruning for light and harvesting access and have incidentally done crop regulation.

Pruning can be more precise. Fruit size and number of fruits per foot of producing wood must be balanced against amounts on new wood left and the impact on fruit size, when cuts are made into two and three year and older wood. When cutting into older producing wood leaves on second season wood are eliminated and therefore are not there to contribute to fruit size and assist in new wood and leaf production. In fact buds near the cut are stimulated and will grow – requiring carbohydrates and nutrients to flow from leaves on third season wood that are having to size and mature fruit. Therefore this type of heading or thinning must be kept to twenty to twenty-five percent or less so as not to have to heavy an impact on fruit sizing. It may be especially necessary to couple pruning into fruit- wood with fruit thinning or fruit bud thinning.

Fruit thinning:

Fruit thinning is done at about pit hardening while fruitlets are still quite green and have not started the fruit swell to ripening. It involves removal of clusters and clumps of fruit from the undersides of branches, so fruit on the sides and tips of branches can fall into the open space created. This tends to bring fruit and leaf ratios into line so maximum sizing can occur. I t is a rough and quick pulling of fruits off the branch.

More detailed fruit or earlier bud thinning has not normally been done due to the need to "see" the crop before any removal. Research has shown that earlier bud thinning results in less drop due to less competitive action between fruits. Lang and Ophardt found that fruit quality improved significantly as yields were reduced through floral bud thinning.
Thinning fruit on spurs to three buds per spur did not improve quality – either fruit mass or fruit soluble solids. But thinning to two buds per spur increased fruit mass by thirty percent and soluble solids by six percent. Thinning to one bud per spur increased fruit mass by forty-three percent and sugars to thirteen percent. In both cases the relative increase in fruit size was greater than the relative decrease in total yield. As much as fifty-one percent of the un-thinned fruit was culled, as it was less than eleven row in size. When the spurs were thinned to two or one buds per spur only eighteen or thirteen

percent respectively would not have made it to the fresh market. Put in terms of total yield control trees would have produced only eight and half tonnes of marketable fruit per hectare, but by reducing crop load to two or one bud per spur fresh market yield increases to in excess of eleven tonnes per hectare.

In the Okanagan our export markets are even more demanding. Fruit smaller than ten and a half row or one inch fruit is culled. To date, pruning current shoot growth either pre or post harvest has adequately reduced fruit load, but fruit thinning and floral bud thinning may become necessary to ensure nine and eight row fruit. The bar for cullage may be moved to ten row fruit before long, or price reductions will be dramatic for small fruit.
Nine row fruit is 29.75 mm in diameter and weighs twelve to thirteen grams per fruit. There are approximately thirty seven to forty fruit per 0.45 kg (1 lb) and approximately 0.45 to 0.6 kg (one to one and a half pounds) per 30 cm (one foot) of fruiting wood. Estimates such as this assist the grower to determine how much fruiting wood to leave to reach specific tonnages. Most growers of large sized, high quality fruit agree that to produce large size, production should not be more than twelve to nineteen tonnes per hectare (five to eight tons per acre)

An example of this type of crop management could go as follows- a 4.5 meter by 1.8 meter (15 feet by 6 feet) planting has 1195 trees per hectare (484 trees per acre). With a production of 17 tonnes per hectare (7 tons per acre), and 0.45 kg per 30 cm (1.48 kg per meter) or 1 lb per foot of production wood. This results in 29 lbs per tree, therefore each tree would require 29 feet of production wood. This is two year and older wood with fruiting spurs. There should be an allowance for one-year wood of an additional 25 percent or 7 feet plus an allowance for poor set of another 25 percent. Each tree at this spacing would have just over 42 feet of wood. (Adding up all the length of all branches)

Systems development:

In the Okanagan/Similkameen and Kootenays there are a wide variety of reasons that will influence the decision of which system to choose. They range from soil, rootstock, variety, labour and personal preference.

Okanagan growers have used Mazzard as the rootstock, and generally it has been the only rootstock on which new varieties have been propagated. Also growers have not quickly moved to growth controlling rootstock because of the desire for strong vigour to produce larger fruit. Most growers are planting blocks at fairly high densities using Mazzard regardless of soil type with various central leader and spindle approaches. Growers are attempting to control trees with minimal heading, scoring above buds, spreading limbs, and bending and twisting and tying down limbs.

On new and relatively young plantings of mazzard, some of the techniques of the Zahn and Vogel systems could be applied to control vigour and increase light and productivity. For older plantings some techniques used in both systems mentioned, such as stubbing

for renewal and removal of strong laterals coupled with root pruning and perhaps a reduction in nitrogen fertilizer, may be very helpful.

At this time growers are trying to achieve fruit size largely through nitrogen application and heavy pruning. Understanding wood development, and fruit load must be more critical aspects of management to ensuring fruit size and vigour control.

The continued use of Mazzard in Okanagan plantings to date may have been a wise decision until a growth controlling rootstock that is a little less precocious is available. If the use of Mazzard is going to be the direction for now, then the Zahn system needs to be considered especially for strong soils and closer spacing. It is the most calming of the systems. The Vogel approach is more vigour stimulating and the central leader is even even more so. Dr. Ron Perry has suggested a blending of the two systems, and this may be the best approach for the Okanagan to control vigour and productivity.
For high vigour situations the use of dwarf roots just makes it easier to produce smaller, more labour friendly trees that are less likely to have row to row and tree to tree shading. But they will require more attention to crop load detail to ensure good fruit size.
The Spanish bush system allows for lower tree density and a fully pedestrian style planting. It must also be started properly and maintained to encourage good light conditions and fruitfulness throughout the tree. There a number of good reasons to choose Spanish bush other than its pedestrian nature, which primarily covers labour issues, but it also maintains multiple growing points that helps divide up the trees vigour resulting in wood development that tends to be of a more fruitful diameter.

Systems description:

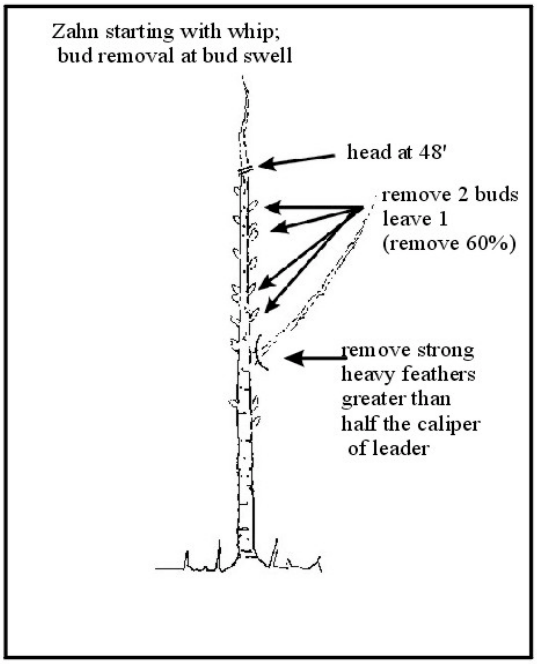
The systems will be dealt with as a progression from the most vigour controlling to the least vigour controlling followed by a separate description of the Spanish bush system.

Zahn system:

The Zahn spindle system for cherries is the least vigour promoting system of the spindle and central leader systems. The Zahn is the best choice for higher densities- 1m to 2.4 m by 3.6 to 4.5 m. There is a strict approach to each system including the Zahn for starting the tree and follow-up technique. But the Zahn techniques can be used at any stage on the other systems to generate a calming less vigorous response from the tree.

Year of planting:

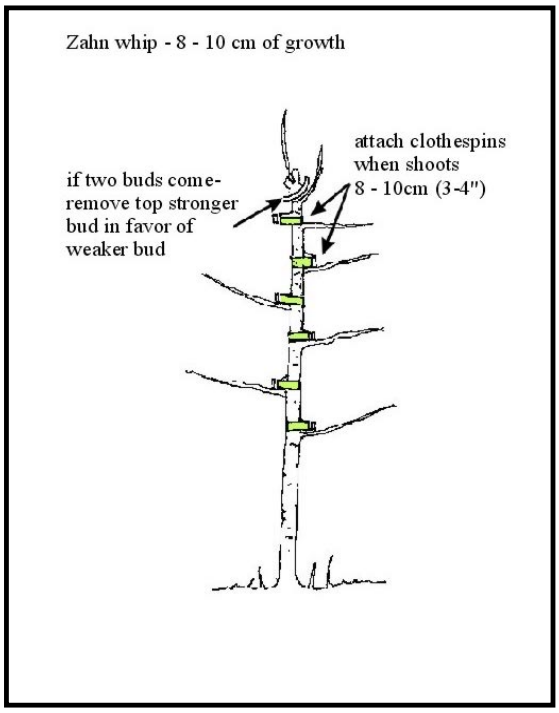
Head the trees at one hundred and twenty centimetres*
(48 inches). Feathers that are larger than fifty percent the diameter of the leader are removed. If there are three or four balanced feathers with branch angles close to the horizontal leave them in place. If not remove them all. These branches can be bench cut to leave a bud if the branch is situated where a branch is required.



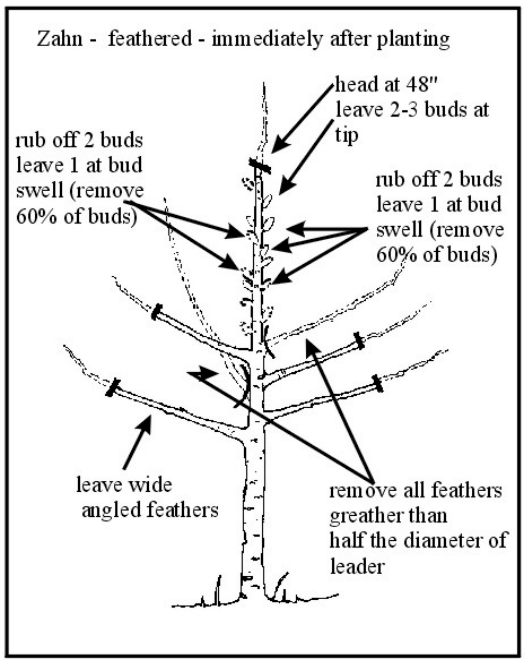
Bud swell:

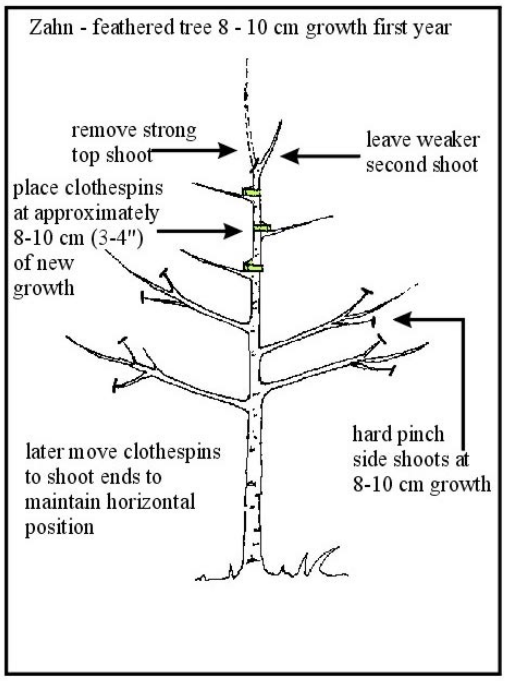
At bud swell leave two buds below the heading cut and remove two buds and leave one all the way down the leader. (Remove sixty percent to seventy-five percent of the buds)

Eight to ten centimetres of growth: *



Once the shoots have reached eight to ten centimetres of growth place the plastic clothespins on the leader to force the shoots to grow at ninety degrees. If two buds have pushed at the top of the leader remove the stronger shoot.

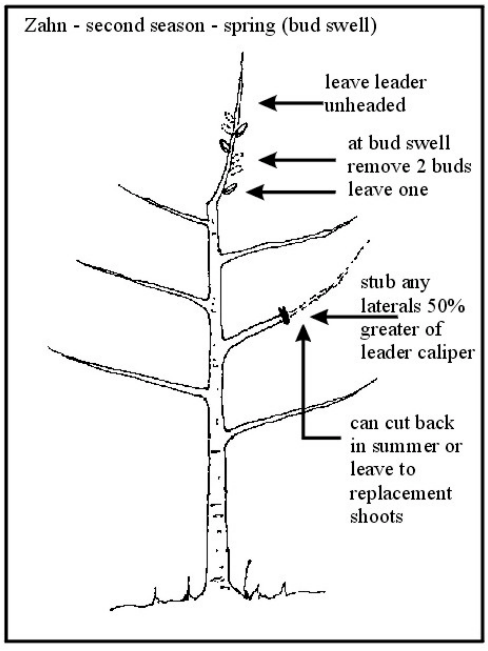




Pinch side shoots on feathers that were left at planting and were headed.

***Whips are also headed at 120 centimetres and buds are rubbed off at bud swell as described above.**

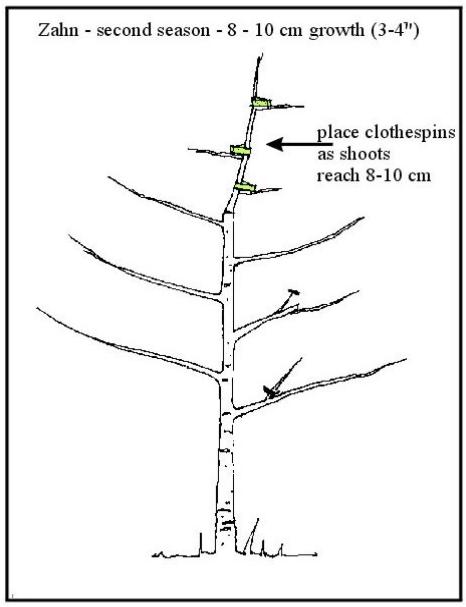
Zahn second season:



The Zahn approach is to control vigour, therefore the second year and thereafter until maturity the leader is not headed. Sixty percent of the buds along the leader are removed as in the first leaf. When shoots have reached eight to ten centimetres again place clothespins to force shoots to the horizontal position. (In apples this operation can be left until shoots are longer, but in cherry, the shoots will be brittle as they harden and mature and will break off very easily.) As the shoots grow longer they will grow upward, so to maintain the horizontal position move the clothespin to the end of the shoot or place a weight further out the shoot. Note that with the Zahn approach

every attempt is made to maintain a “quiet top” to avoid surges of vigour to the top, which creates strong branches that will compete with the leader and create shade and growth and will not be as productive as weaker more horizontal shoots.

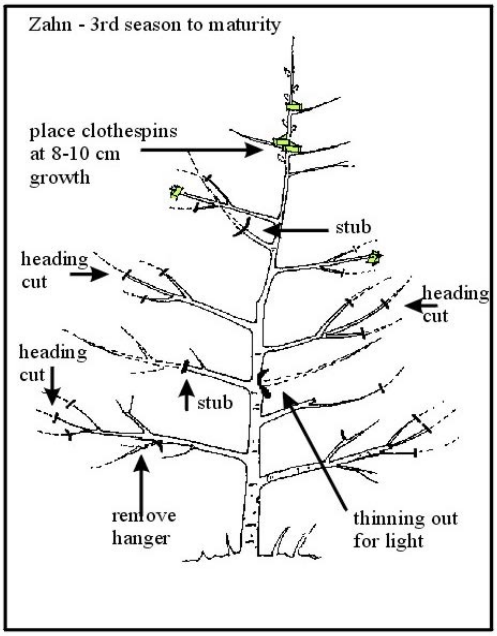
Any laterals that grow more strongly upright or are one-half or greater the diameter of the leader at their junction are stubbed back to 15 centimetres (six inches) to twenty-five centimetres (ten inches). Stubbing is a technique that was particularly recommended for areas that are prone to bacterial canker. The stubs are cut back in the summer when conditions are drier. Stubbing is also a renewal technique. Weaker replacement shoots have an opportunity to push along the length of the stub. A weak well positioned shoot is chosen the following spring. Any feathers that were retained and headed lightly should be left alone except for any shoots growing strongly upright which can be pinched back or removed. Shoots close to the terminal can be pinched back but maintain main branch dominance, and don’t head.



Zahn: third season to maturity

The leader must be treated the same as previously until maturity. Rub sixty percent of the buds at bud swell and place clothespins as shoots reach the length mentioned previously.

Thinning cuts must be made to promote light distribution throughout the canopy following harvest to maintain a good distribution of both flower buds and storage reserves. Again where bacterial canker* is a problem, use stub cuts. If renewal shoots are not needed these stubs can be cut back in the drier summer period. Heading cuts tend to reduce excessive spur formation and stimulate new shoots and a greater leaf area close to



existing spurs, helping to maintain the balance between fruiting and shoot growth and adjusting crop load to assist the tree in maintaining good fruit size. This is critical in B.C. as the market demands large sized fruit. In the Okanagan in the third season and beyond as the trees come into production make more heading cuts into current or past seasons wood in the bottom two-thirds of the tree the next spring to regulate crop load and maintain vigour in the lower parts of the tree. Thinning cuts and stub cuts are made as well for light and renewal. The focus in the top part of the tree at or close to maturity, should be thinning cuts, stub cuts, and removal of strong branches to avoid excessive shading.

*Bacterial canker is definitely a problem in B.C. cherry blocks.

Zahn at maturity:

Treat the canopy as described above, but the leader will need to be headed to a weak lateral to control ultimate tree height.

Vogel System:

The Vogel approach brings tree vigour control techniques into play but the leader treatment differs from the Zahn and as a result requires a wider spacing for the same variety, soil type and site considerations. Generally plantings should be 2.4 meters to 3.6 meters between trees in row and 4.5 to 5.4 meters between rows (8 to 12 feet in the row and 15 to 18 feet between rows) with adjustments made for variety, soil and terrain.
There is less pruning than with the standard central leader techniques and as a result there is earlier productivity and more tree control.

Planting and early in the first spring:

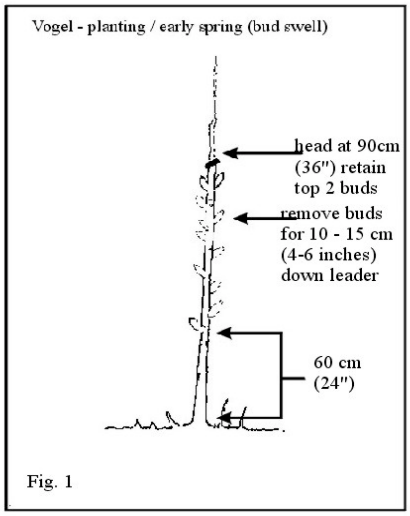
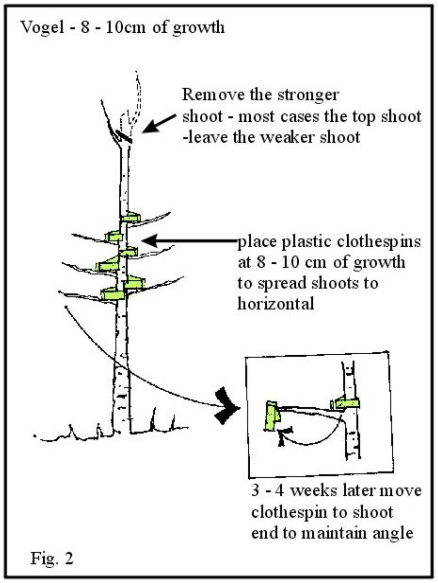


Fig. 1

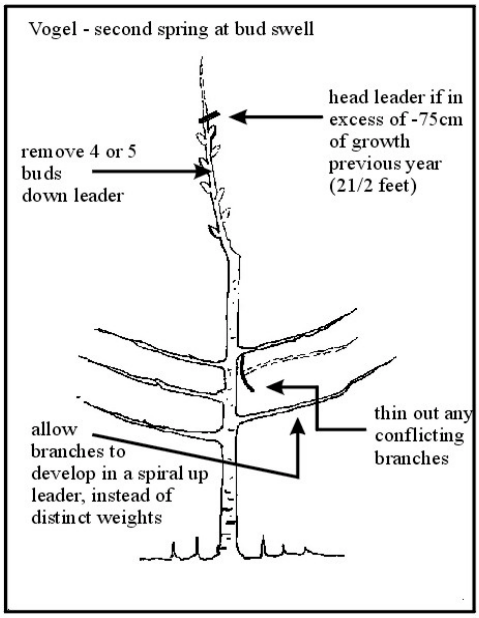
All feathers are removed and the tree is headed at 80 to 90 cm (32 to 36 inches). Below the top two leader buds, all buds are removed down 10 - 15 cm (4 - 6 inches) of the leader. No more buds are removed in the Vogel approach. By removing the buds in the first 10 - 15 cm below the top, two steep angled branches are avoided and strong auxin influence is removed in favour of inherently wider angled branches down the leader. (Fig.1) These buds would be strongly inhibited if all the buds pushed and remained in place on the leader.

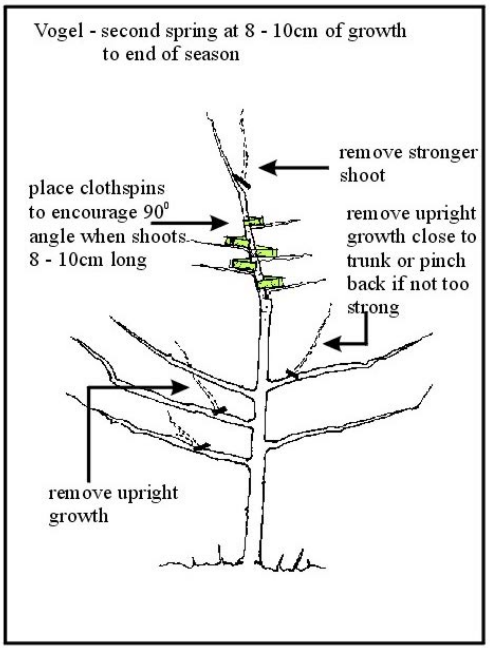


When the lateral shoots reach 8 to 10 cm in length attach clothespins to the leader and force the shoots into a 90 degree angle. (Fig.2) As shoots push, the clothespins can be moved out close to the tip of the shoot. On heavy productive soils fertilizer applications will have to be reduced from what growers are used to in order to help control vigour.

Second and third spring and summer:

Head the leader by one-third to one-half if there is in excess of 50 cm (20 inches) of growth from the previous year. At bud swell leave the top two buds and remove the next four or five. Perry suggests if last years growth is in excess of 90 cm it is advisable to remove all the buds for 30 cm to remove enough buds to reduce auxin influence sufficiently to induce the lower buds to push. At 8 to 10 cm of growth, place clothespins on the leader, and after four to five weeks as above move them out to help maintain a horizontal position.

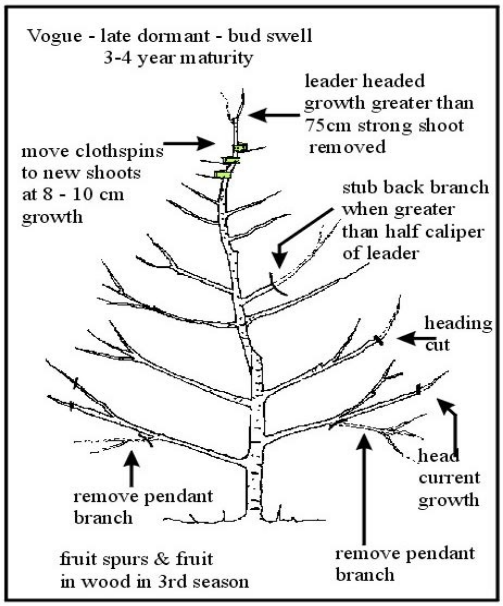




Thin out conflicting branches to allow for good light penetration. Side shoots can be left unless they are close to the trunk or too vertical to act as replacement branches for renewal. Other primary laterals that exceed fifty percent of the leader caliper at the junction, should be stubbed.

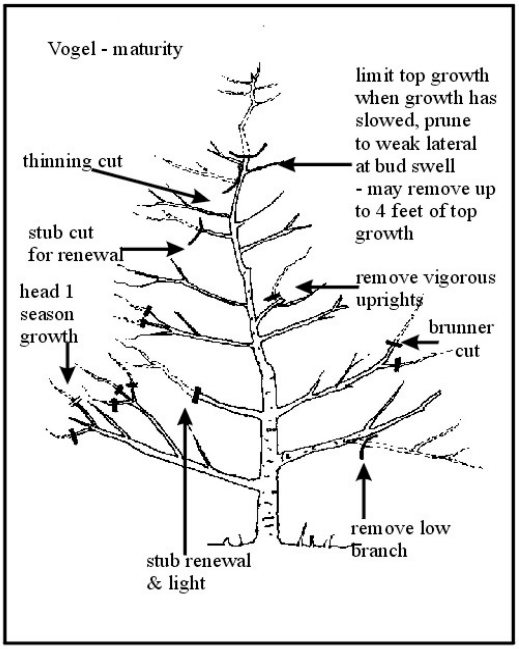
Third to fifth year to maturity:

Head the leader each year at late dormant to bud swell, removing one-half to one-third of last year's growth if the growth was in excess of 50 cm. Focus on thinning cuts and stubbing for renewal where necessary in the upper half of the tree. In the lower two-thirds of the tree thinning and stubbing is also done, but in addition, focus on heading into current seasons growth if done around harvest timing or last seasons growth if done at late spring to bud swell the next spring.



Maturity to post harvest:

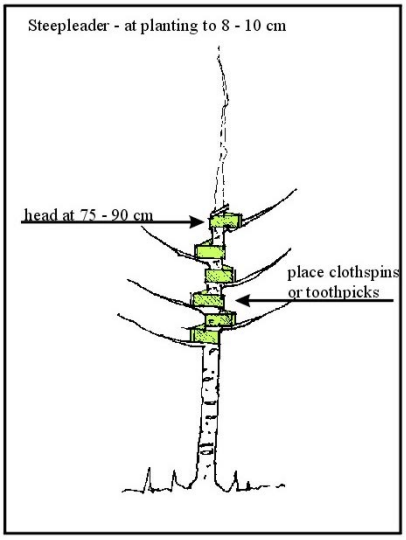
The trees may be topped to final height once growth has slowed. Tree height will have to be reduced to no more than a 1 to1 ratio of tree height to row width. Each tree must be an individual to allow good light penetration. If tree vigour is balanced, as much as four feet can be removed to a weaker lateral. Renewal stub pruning and thinning cuts in upper portions of the tree must be ongoing for good light distribution, to encourage young spurs for maximum fruit size and balanced fruit load. In the bottom two-thirds to one-half, couple these with heading cuts to invigorate the basal portions of the tree and regulate crop load.



Steep Leader System:

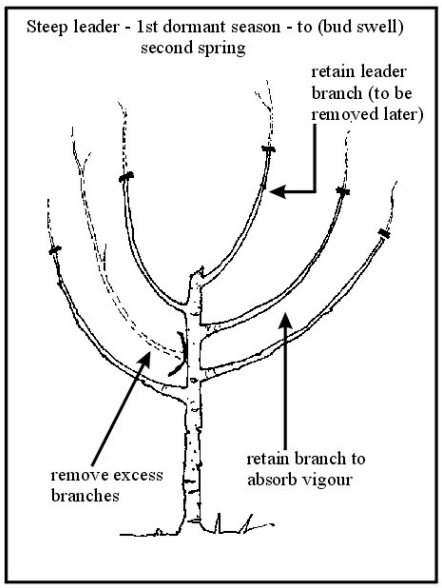
The steep leader system is designed to create a tree for wider spacings of 4.8 metres by 6 metres to 6.7 metres (16 by 20 to 22 feet) and as wide as 5.5 metres by 6.7 metres to 7.3 metres (18 by 22 to 24 feet). It is similar to the traditional open centre vase, but it has a wider base and triangle shape for good light penetration. Each leader is treated as a separate spindle.

Planting to bud swell to eight to ten cm of growth:



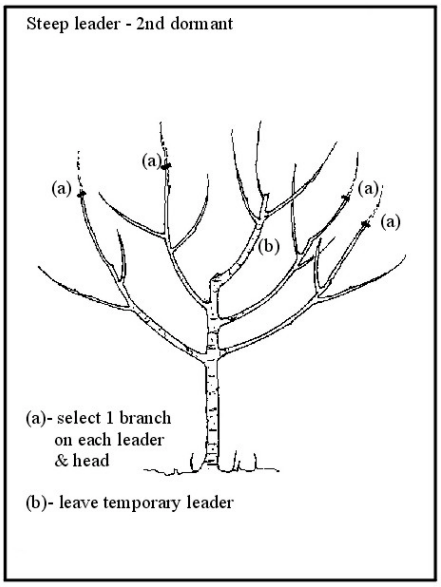
Head the leader at 75 to 90 cm (30 to 36 inches) depending on the strength of the whip and desired height of the first whorl. If three to five wide angled branches are present, spaced fairly evenly around the leader, retain them, if not, remove them all. If suitable buds at the right height are not present then bench cut the branches to initiate new growth. At bud swell leave the top two buds, remove buds for 20 cm down the leader and place clothespins on the leader to push developing shoots to horizontal as they reach 8 to 10 cm.

First dormant season:

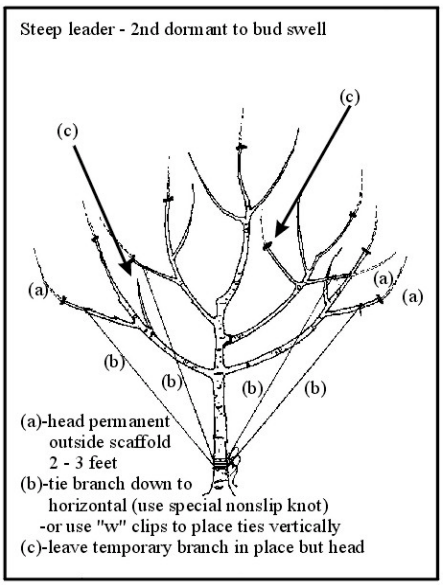


This is the point where leaders are selected from the previous year's growth. For row spacing of 6 metres or less, select three leaders due to shading potential, wider spacing may be able to accommodate four leaders. If the vigour potential is considerable due to soil type, additional temporary leaders or branches may be left to absorb vigour. These leaders are headed 60 to 90 centimetres (two to three feet) from the main leader. Remove any conflicting, or bad angled branches.

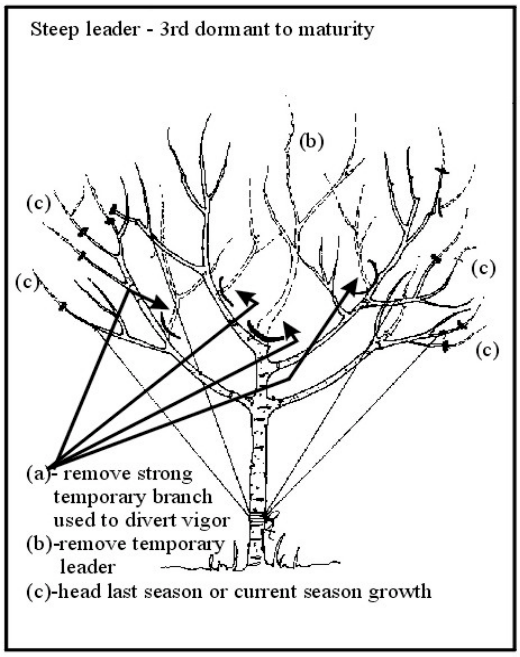
Second dormant season to bud swell:



Choose secondary branches on each of the main leaders that will continue to be the dominant leader and head them. Next choose a secondary outside branch on the main leader to spread to establish as the main bottom scaffold, and spread and head them 60 to 90 centimetres from their base. Also leave the temporary leaders in place and head them.

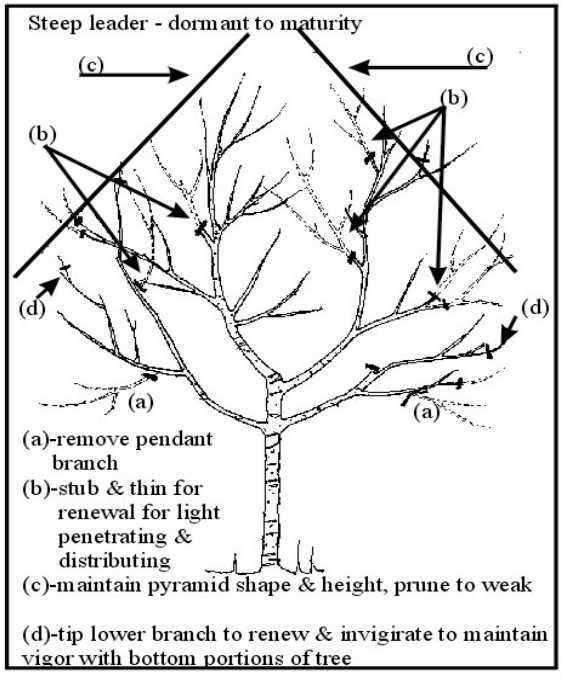


Third dormant season to maturity:



Thin out the strong temporary branches used to absorb vigour. Each year as the canopy fills in stub a few branches to ensure light penetration and renewal, remove pendant (hanging) wood. In the lower two-thirds of the tree head last season's growth, and/ or head current growth, pre or post harvest to maintain vigour and regulate cropping and promote good sized fruit.

Also, in the Okanagan-Similkameen growing conditions, especially in lighter soils vigour must be maintained through the combination of thinning cuts, stubbing cuts, removal of 25 to 50 % of current growth on a more general basis to ensure fruit size.



Central Leader System:

The central leader system is the system most growers have chosen in the Okanagan as they have moved from the old open vase style trees. In the Okanagan the system has involved heading every season, in some cases removal of the second and third buds and scoring above buds down the leader at half inch green to encourage new shoots. Some spreading has been done with toothpicks. Frequently the results have been strong branches near the cuts and variable results from scoring.

Central leader training is more invigorating with the intent of filling a larger tree space. The spacing required is 4.25 m by 5.4 m (14 by 18 feet) to 4.8 m by 6.0 m (16 by 20 feet) depending on soil type and variety growth habit. There are two major differences between apple and sweet cherry. Sweet cherry is much more apically dominant than apple, and cherry branch development is not as easily affected by fruit weight and gravity as apple.

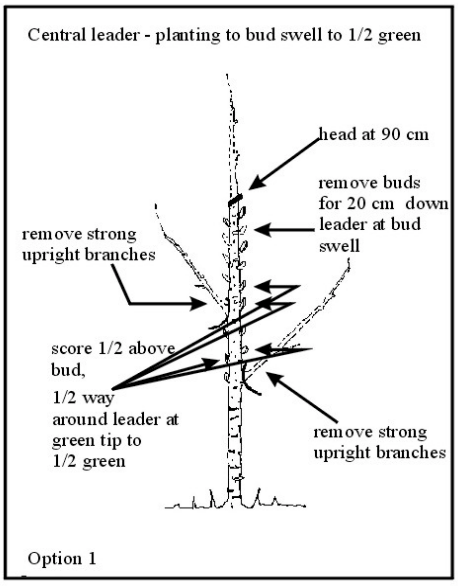
For true central leader where larger branches are developed to fill the space there are measures that can be used to confine the tree more successfully and control the tops and vigour and maintain productivity.

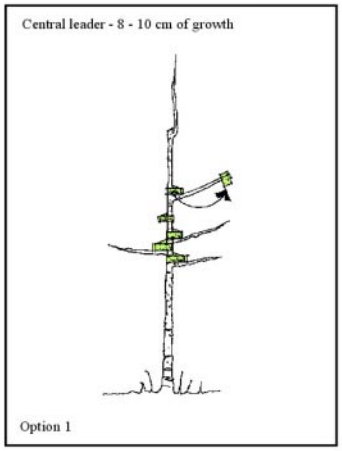
Planting- to bud swell to 8 to10 cm of growth:

The tree is headed at 90 cm (36 inches) and large strong and poorly angled feathers are removed. If three to five suitable branches are spaced evenly around the stem and have good angles to avoid bark inclusion and future breakage, they can be retained.

Bud treatment at bud swell:

i) Option one:

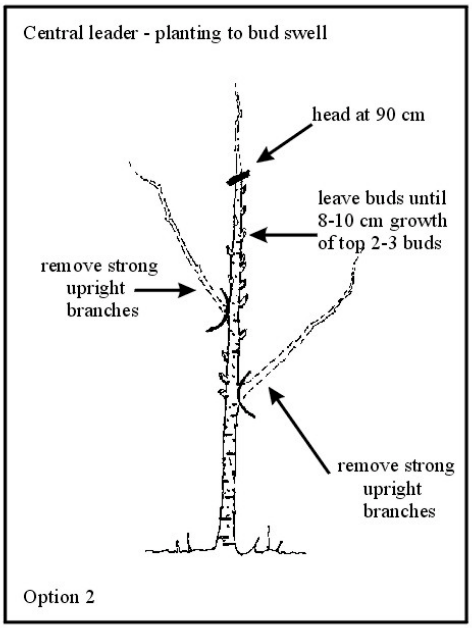




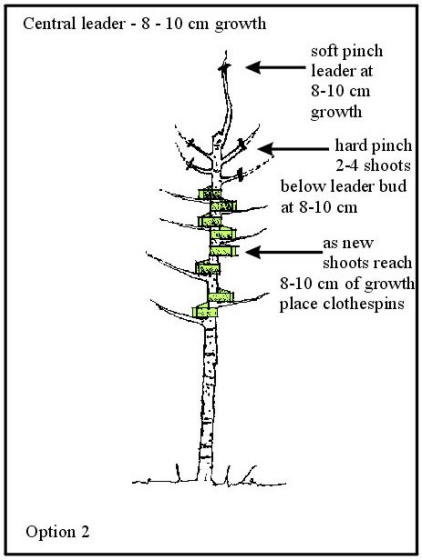
Remove the buds below the leader bud for 20 cm (8 inches) at bud swell. At half inch green score 1.25 cm above the buds down the leader to the lowest point where branches are desired When the buds push to 8 to 10 cm attach clothespins to the leader and force the shoot growth to 90 degrees. Later move the clothespins further out on the shoot or place weights as described earlier.

ii) Option two:

The leader buds and buds below the leader buds are left in place and as the top two or three buds push to 8 to 10 cm soft pinch the leader shoot and hard pinch the lateral shoots. The pinching removes the auxin flow that inhibits the pushing of the buds below so the lower buds will push. They will have wider angles than the top several buds. Growth of the shoots that are pinched is stalled for two or three weeks. The pinching may be required again three to four weeks later. By leaving the upper buds in place but removing the auxin flow, the lower buds will not assume a more upright stance as they might if the upper buds are removed completely.



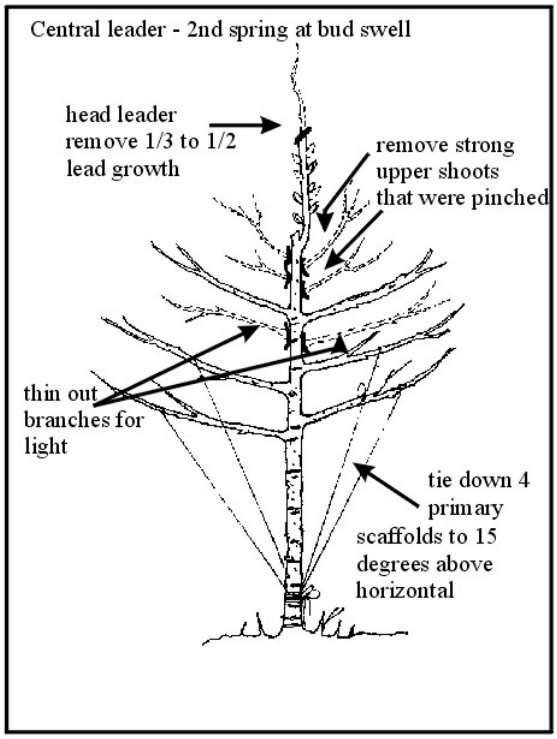
If the pinching is done at the correct time spreading may not be necessary, but the use of clothespins will ensure good crotch angles. As was mentioned earlier, toothpicks do a partial job but are subject to falling out and in cases where disease is a problem, can cause an entry point for disease.
In both scenarios the large branches (greater than fifty percent of the leader) must be removed or the vigour moves to them at the expense of buds that may be located in a preferred location.



Second year: bud swell to 8 to 10 centimetre growth:

Head last year's leader growth at bud swell removing one-third to one-half of the growth. Also the three to five main scaffold limbs can be tied down to about fifteen degrees above horizontal.

Option one can be repeated removing buds for 20 cm down the leader and spreading the new shoots to the horizontal when they are 8 to 10 cm in length. Option two can also be repeated, soft pinching the leader and hard pinching the several buds down the leader when they reach 8 to 10 cm in length. Further down the leader below the heading cut that was made at planting, remove the two or three steep angled shoots that were hard pinched the previous early summer.



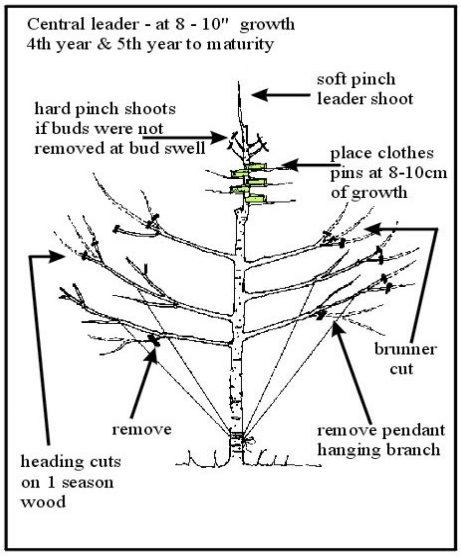
Branches that are crowding or conflicting must be thinned out in both options or stub a branch that is too strong encouraging renewal shoots, or remove the stub later in the summer.

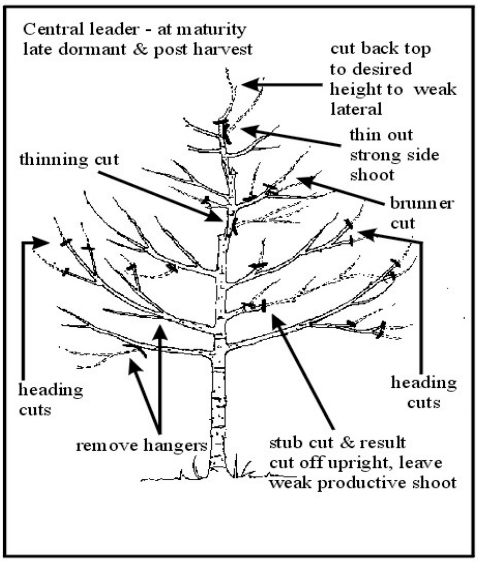
Summer pruning- pre-harvest or post harvest in third year and beyond:
Cut back current growth by one-third to one-half or more to induce shoots and to start to regulate cropping that will occur when shoot wood reaches its third season.

Heading current wood is invigorating near the cut and when done in the upper portions of the tree, results in excessive shading. The best suggestion for tree control and renewal is to carry it out on older wood in the lower portions of the tree and do more stubbing and thinning cuts in the upper one-half of the tree.

Fourth and fifth year to maturity:

At this point tree height makes it difficult to do too many manipulations on last years growth. Continue heading one-third to one-half of the new leader growth and remove steep angled shoots in the top of the tree. Remove hanging branches in the lower portions of the tree, remove excess branches, stub for renewal, and make use of the Brunner cut described earlier. (See Brunner cut and diagram in "Manipulation techniques and definitions") Repeat heading cuts in the lower two-thirds of the tree as described above.





Post harvest at maturity- top control:

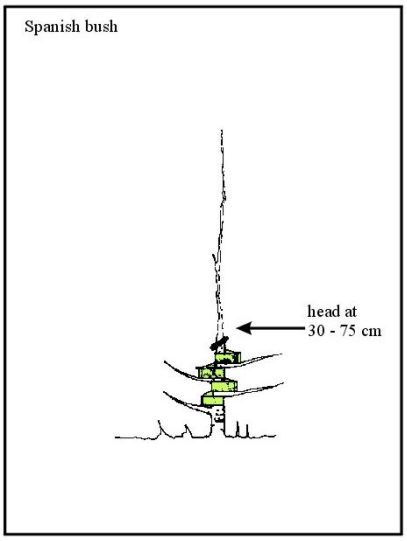
When the trees have reached maturity and desired height (also when production in the upper portion of the tree has slowed vigour in the top) cut the leader to a weaker side branch. If the vigour in the trees is strong, summer pruning instead of dormant pruning may be the best course of action. Weak trees should be dormant pruned, branches stubbed to renew, branches should be headed into older wood to remove crop load and invigorate the branch area, remove hanging wood.

Spanish Bush:

The Spanish Bush system is regarded as a high-density system, but pedestrian. Multiple leaders are maintained to force branches out to create a spreading habit. Experience to date has been reasonably successful. The resulting nature of the wood development tends to be less strong than other systems, with a thinner more productive caliper being the norm. Fruit spurs seem to be spread out well on the wood allowing for less competition and better fruit size.

Spanish Bush row spacings range from 2 m by 4 m to 4.25 m (7 feet by 13 feet to 14 feet) to 3 m by 4.8 m (10 feet by 16 feet). The spacing differences range because of varietal habit, soil type and equipment accessibility.

Planting year:

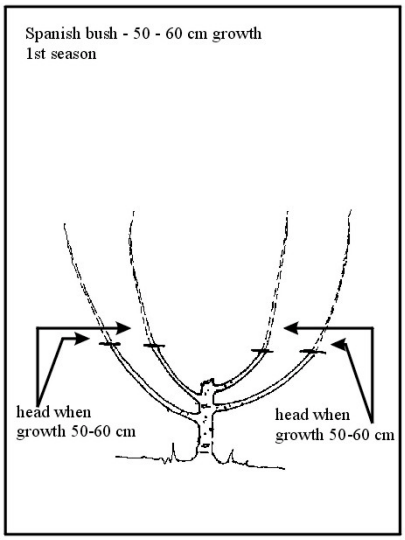


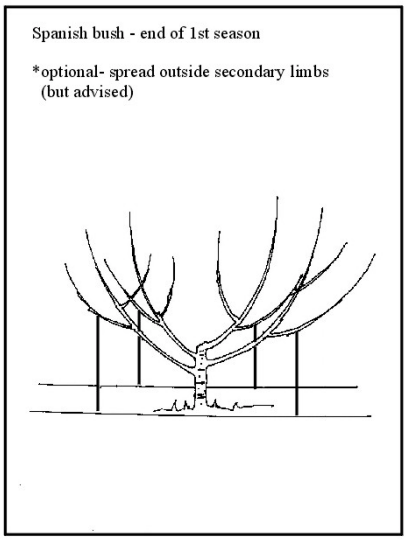
The whip is headed at thirty to seventy-five cm, much lower than in the other systems previously mentioned. It is essential that there are good healthy looking buds, sometimes they are rubbed off during handling or are damaged. Therefore check for suitable buds before heading. As shoots reach 8 to 10 centimetres spread them with clothespins to ensure a good wide strong crotch angle.

The Spanish Bush system depends on good vigour to establish enough growth to start the system. In other words there must be adequate fertilizer and water from the outset. It is important to encourage as much as fifty to sixty centimetres of growth by mid to late June. When the growth has reached this point the shoots are cut to within 15 cm of the leader. An

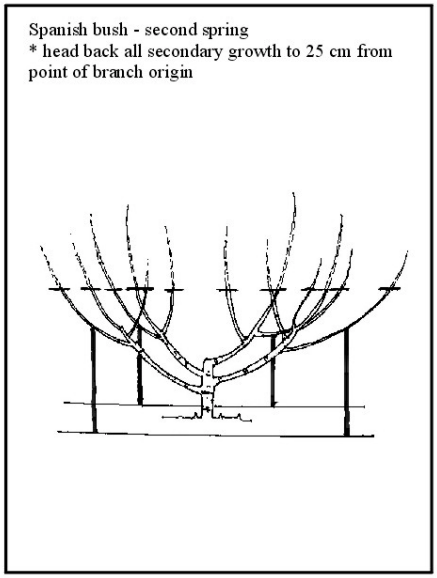
additional fifty to sixty centimetres of growth should be present by the end of the growing season.

A major consideration is the need to spread limbs to ensure a pedestrian style tree. A successful suggestion by extension agent Lynn Long of Oregon State is to place high tensile wires on the ground 45 to 60 centimetres from the base of the tree row and tie the outside limbs off the main scaffolds to the wire at the end of the first season.



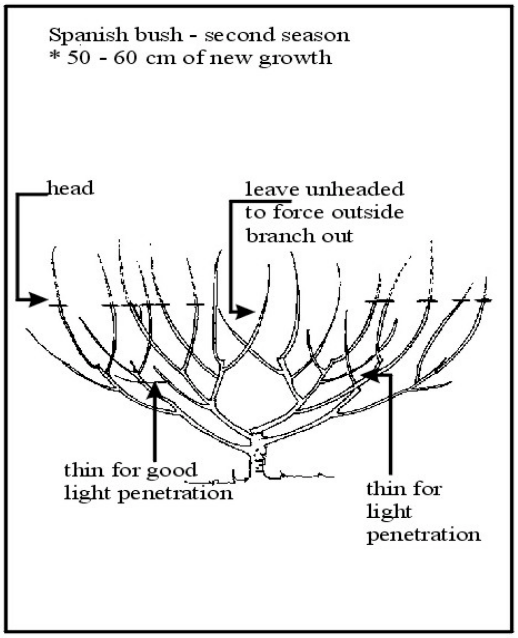


Second spring to mid season:

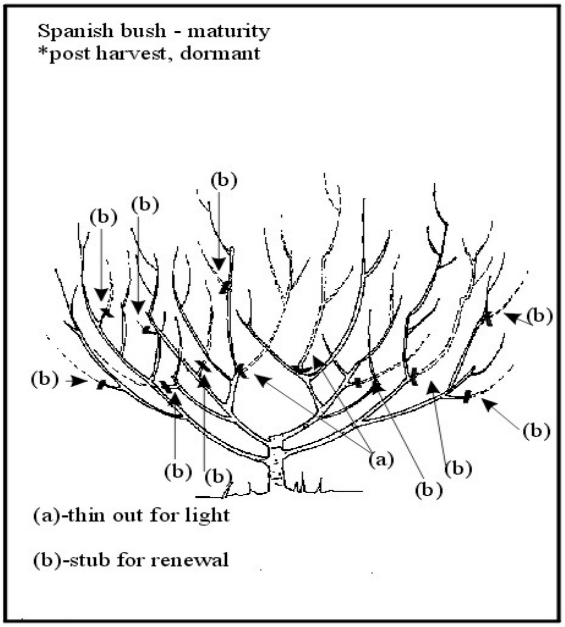


If secondary branches were able to make the necessary 50 to 60 cm of growth by the previous fall, they should be cut back to 25 cm from the point of origin. If not, let them grow and head them when they have reached this goal.

Later the second spring when the current growth (tertiary branches) has reached 50 to 60 cm head all uprights except several in the centre 25 cm above the last cut. The centre uprights are left to force the outer uprights to spread. Leave more horizontal laterals unheaded to encourage fruiting. These are the last cuts made in the basic training and formation of the tree. The style of the Spanish Bush creates a large number of shoots, and thinning cuts will be required to enhance light penetration and distribution



Third season to maturity- Post harvest or dormant pruning:



Post-harvest may be preferred as light conditions are enhanced which will assist in bud maturity and strength, and the timing tends to be less invigorating than full dormant pruning. As the trees age thinning cuts for light are required and renewal with stubbing needs to occur each year on 20 to 25 percent of the shoots and branches that come off the main scaffolds to create new fruiting wood and encourage good sized fruit.

The centre several main scaffolds that were left in will have to be removed, preferably one each year as is required to allow light penetration.

Conclusion:

The previous descriptions of systems are meant to be a guide, but may require adjustments for site, soil conditions, variety, tree spacing, as well as grower experience and preference.

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