Management of High-Density Sweet-Cherry Orchards

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High-density sweet cherry orchards have unique management challenges that include avoiding tree death due to bacterial canker or root rot, limited lateral branching without pruning, small fruit size on dwarfing rootstocks and rain induced fruit cracking. Through our experiments over the last 10 years we have learned several management techniques to overcome these issues. Taken together these management strategies can form a system of producing sweet cherries in NY that will result in consistent production of high quality cherries. We call this the integrated system of sweet cherry production.

High-density sweet cherry orchards have some of the same challenges as high-density apple orchards. These include limiting tree size as the orchard matures and managing light distribution in the canopy to maintain fruit quality and good fruiting wood in the bottom of the tree. However, sweet cherries present additional challenges that are unique. These include tree death due to bacterial canker or root rot, limited lateral branching without pruning, small fruit size on dwarfing rootstocks, soft fruit and rain-induced fruit cracking. Over the last six years as we have managed our high-density cherry systems trial, we have learned numerous techniques for successful management of high-density sweet cherry orchards; perhaps they will be of use to cherry growers in the Northeastern US.

Keeping Trees Alive

The saying goes that "Cherry trees love to die". With the heavier soils in New York, cherry tree survival is often poor. There are four important management approaches to limiting tree mortality.

1. Plant trees on broad 12" high berms. Tree death in sweet cherries is often associated with winter damage and excessive soil moisture. In some cases, death is caused by phytophthora and in other cases it is caused by winter injury. We have found that planting trees on broad 12" high berms results in significantly better tree growth and survival than without berms. This is likely due to better soil oxygen levels and to reduced water logging in the fall and in the spring. An important note is that trees planted on berms must be irrigated. The berms can dry out much quicker during hot weather in the summer. In our plots a single trickle line down the tree row has allowed excellent soil moisture management.

2. Use intensive soil tiling. Research on vinifera grapes in Ontario Canada has shown that much of the winter damage is associated with wet areas in a field. Intensive tiling down every row middle has resulted in much less winter damage and vine death. The same is true for cherries. We installed a subsurface tile line in the center of each tractor alley in our plots to remove excess moisture in the spring and to quickly remove excess water following heavy rainfall before harvest. The tile system down every drive row helps keep trees alive since they are never subjected to excessive moisture. The rapid removal of excess water close to harvest also helps limit fruit cracking.

3. Use resistant rootstocks. None of the currently available cherry rootstocks is resistant to phytophthora root rot; however, the Gisela rootstocks show greater tolerance than do Maheleb or Mazzard. In our two cherry systems plots we have lost 15% of the trees on Mazzard and 11% of the trees on Mahaleb but only 2% and 3% of the trees on Gi.5 and Gi.6, respectively. The losses with Mazzard and Mahaleb occurred despite planting the trees on berms and using intensive subsurface tiling. Without these precautions much higher percentages of trees on Mahaleb and Mazzard would have been lost. In addition to greater tree survival, the Gisela stocks also have much higher precocity and production than Mazzard and Mahaleb. Trees on Gisela 5 are about five times as productive over the first six years as trees on seedling rootstocks while trees on Gisela 5 are about three times as productive as trees on seedling rootstocks. Trees on Gisela five are about 65% the size of trees on seedling rootstocks and should be planted at densities from 400-800 trees/acre. Trees on Gisela 6 are about 80% the size of trees on seedling rootstocks and should be planted at densities from 300-500 trees/acre.

4. Control bacterial canker. In the humid climate of NY State it is important to plant varieties that are less susceptible to bacterial canker. In addition, three management practice are important to avoiding tree death due to canker. (a) Pruning should be delayed until growth starts or do all the pruning postharvest in late July. (b) Use a rigorous copper spray program that includes two sprays in the fall near leaf drop (20% leaf drop and 90% leaf drop) and two sprays in the spring at bud break and immediately following pruning if pruning is done in the spring. (c) Never make flush cuts on

the leader. Always leave a 6-8" stub. If canker gets in this stub it will progress slowly toward the trunk but will not girdle the trunk. The concept of leaving a stub when removing limbs was developed by Mr. Zahn in Northern Germany. He found that in a humid climate flush cuts led to serious canker infections on the trunk, while leaving a stub prevented infections on the trunk. We have made it a strict rule to always leave a 6" stub when cutting on the main trunk of the tree and to never allow flush cuts. The combination of tolerant varieties, intensive copper sprays and stub cuts has worked wonderfully at Geneva.

TABLE 1

Effect of Branching Treatments on Side Branching of the Leader of Three Sweet Cherry Varieties.

Variety	Branching Treatment	Number of Side Shoots Produced on Bottom Third of Leader	Number of Side Shoots Produced on Middle Third of Leader	Number of Side Shoots Produced on Top Third of Leader
Hedelfingen	Promalin	0.5 c[z]	2.2 b	10.3 a
	Notching	1.2 b	1.7 b	9.3 a
	Bud Removal	2.9 a	4.2 a	4.7 b
	LSD ρ≤0.05	**0.7**	**0.7**	**1.1**
Lapins	Promalin	0.2 b	0.2 b	7.5 a
	Notching	0.1 b	0.1 b	6.4 b
	Bud Removal	0.9 a	2.6 a	5.0 c
	LSD ρ≤0.05	**0.4**	**0.4**	**0.7**
Sweetheart	Promalin	0.1 c	0.4 b	10.5 a
	Notching	0.6 b	0.3 b	9.1 b
	Bud Removal	1.5 a	3.3 a	5.3 c
	LSD ρ≤0.05	**0.4**	**0.5**	**1.1**

[z] Mean separation by LSD. Means within each variety followed by the same letter are not significantly different (ρ≤0.05)

Training And Pruning Young Sweet Cherries

Traditionally sweet cherries receive little training and pruning for the first five years. However, with high-density orchards, investments in proper tree training pay dividends. In addition starting with the right tree will result in higher early production. As a result of our trials with sweet cherries we recommend:

1. Plant a high quality tree. The optimum tree to plant differs by system. For the Vertical-Axis, Slender-Spindle and Central-Leader systems, a large-caliper, highly feathered tree is the best and requires little pruning and training during the first few years. The larger caliper feathered tree used in the Vertical-Axis and Slender-Spindle systems have much greater production in the third – fifth years than a small caliper tree. For the Spanish Bush, Perpendicular V and the Steep-Leader systems, smaller caliper whips are better since these three systems employ severe heading of the leader at planting.

2. Minimize heading cuts for the first few years. Our results show that repeated pruning cuts in the first three years results in reduced yield whereas minimal pruning during the first three years results in high early yield. Systems that require significant pruning to form the tree will have much lower cumulative yield over the first five years. The Spanish Bush requires heading cuts two times per year for three years to form the bush and as a consequence it has lower early yield. The Perpendicular V and the Marchant trellis also employ significant early pruning. In contrast the Vertical Axis utilizes almost no pruning for three years. This has resulted in significant yield in the third year and mature yield in the fifth year when using Gisela rootstocks. If minimal pruning is combined with large caliper feathered trees, then very high early yields are possible. The Vogel Slender-Spindle system gives intermediate yields since it requires annual heading of the leader to develop side branches and limit tree height.

3. Develop side branches without heading. Results from our systems trials show that repeated heading of the leader in the first three years results in reduced yield whereas leaving the leader unheaded during the first three years as with the vertical axis system results in high early yield. However, the lack of heading the leader often results in blind wood and limited lateral branching on the leader. This led us to experiment in 2000 (the second year) with methods to induce lateral branching that do not involve heading cuts. We compared three methods of stimulating lateral branching along the leader; these were:

1) Promalin (5,000ppm) mixed with diluted white paint (1:1 ratio of paint and water) sprayed on the leader at bud swell.
2) Notching above every 3rd bud along the leader with a saw blade at bud swell.
3) Bud Removal of 2/3 of the buds along the leader (every third bud was left and the others were rubbed out at bud swell).

Promalin and notching were not very effective in stimulating lateral branching in the lower and middle sections of the leader. However, bud removal was very effective and resulted in significantly more side shoots in the lower and middle sections of the leader (Table 1). The bud removal treatment also gave a relatively uniform distribution of lateral branches along the shoot. Hedelfingen had the greatest number of lateral branches. Sweetheart had an intermediate number and Lapins the least.

The bud removal treatment should prove to be very useful for sweet cherry growers in the northeast, allowing more rapid development of the canopy and earlier production without heading cuts. To reduce the risk of bacterial canker infection from the wounds left by the bud removal technique, we recommend the application of a copper spray immediately before and after the buds are removed. A more complete description of these results can be found in Hoying et al., 2001.

4. Bend branches flat. Cherry trees are very apically dominant which results in upright branch angles. If the branches are spread flat the tips turn up and resume vertical growth. With the Slender-Spindle, the Vertical-Axis, the Perpendicular-V and the Central-Leader systems, horizontal branches are critical to producing a conic-shaped tree that has good light distribution at maturity. This requires training lateral branches horizontal. Training branches one time as with apple has not been successful with cherry since the lateral branches turn up after they have been trained down. A more successful system has been to use clothespins when the shoot is first developing. As with apple, we recommend installing clothespins when the young lateral shoot is 3-5" long. With the mouth of the clothespin around the leader, the tail of the clothespin can be adjusted to where it pushes the young shoot down to the

horizontal. The clothespins are left in this initial position for about two weeks, after which they are hung from the young leaves of the developing shoot near the tip. The weight of the clothespin on a young growing shoot keeps it in the horizontal position. The clothespins must be moved further out on the shoot near the tip every 7-10 days for the months of May, June and July. The process of moving the clothespins can done quickly on a young tree but it does require a significant labor commitment to accomplish the job. If the job is done in each of the first three years, one-three a conic-shaped tree can be developed which does not require large bench cuts on scaffold limbs to get horizontal limbs. The large bench cuts reduce yield and are undesirable. If additional follow-up limb spreading is necessary, limb tying to an anchor is the best method. We suggest using short pieces of conduit pipe pounded into the ground between each tree and then tying the branches down using avis strap.

Mature Management of Sweet Cherries

Mature high-density sweet cherry trees on dwarfing rootstocks have three major problems: small fruit size, dense canopies with too little light in the lower canopy and soft cherries. Our experience has taught us a few management strategies to overcome these problems.

1. Pruning to obtain large fruit size. The Gisela rootstocks can seem like a 'dream come true' in year's two through four. They fill the orchard space quickly and have lots of fruit below 10 feet high. However in subsequent years they tend to over-crop and produce smaller fruit size due to low leaf to fruit ratios. This requires an intensive management program that includes more aggressive pruning than is currently used with the standard cherry stocks, additional fertilizers, irrigation, and even fruit thinning. We suggest that mature trees on Gisela stocks be pruned more aggressively that trees on Mazzard. The pruning must include the removal of most of the fine and shaded wood each year. This wood tends to set very heavily, especially on less vigorous, precocious scion cultivars like Sweetheart and Somerset and on smaller fruited varieties like Kristin and Ulster. In addition, medium-vigor shoots should be headed by one-third to one-half their length. This reduces the amount of crop they will set two years later and stimulates additional leaf area to support the crop. This type of stubbing back pruning has been successfully used with Gala apples to increase fruit size and with cherries our experience has shown that this type of pruning will increase fruit size by over one gram per fruit. However, it always reduces total yield by approximately 25%. In addition, this style of pruning results in more slender conic- shaped trees which helps maintain high-density cherry trees in their allotted space.

2. Irrigation to obtain large fruit size. In addition to pruning, irrigation is essential for trees on Gisela rootstocks. With young trees, dry periods in late May and early June can cause the trees to stop growing and exacerbate the precocious fruiting character of these stocks. Consistent water supplies can ensure that adequate shoot growth is obtained. As cherries turn from green to straw color they enter the final stage of growth. During this time, large amounts of water are needed to increase fruit size. Daily trickle irrigation has been very beneficial. If trees are planted on berms, there is little risk of over-irrigation but when trees are planted on flat ground care should be taken to not over-irrigate them. When significant irrigation water is combined with aggressive pruning the vigor level of the Gisela trees should remain moderate to high, which will ensure good fruit size the next year.

3. Maintain light exposure of the lower part of the tree. In high-density plantings it is very easy to allow thick orchards and trees to develop. Cherries, like apples, need good light distribution in the lower part of the canopy to produce good fruit quality and healthy buds for next year's crop. Good light exposure of the lower canopy is best achieved with renewal pruning. Removal of one to two large limbs in the top or midsection of the tree each year either at bud swell or post harvest will limit the spread of the top of the tree and create light channels down into the canopy. Remember to leave a 6" stub when removing these limbs to prevent bacterial canker on the leader. If limb renewal is practiced annually a conic shaped tree can be developed which has no large limbs in the top. This also results in new fruiting limbs developing from the 6" long stubs left where a branch was cut out. This new fruiting wood produces large size fruit and can be managed as described above using heading cuts each year.

4. Obtaining firm fruits. One of the challenges for all cherry growers is soft fruit at harvest. Consumers prefer firm, crunchy cherries and the market pays a premium for firm fruit. Gibberrelic acid has been shown to give firm cherries and to delay harvest. We have experimented with GA sprays for several years and have found that harvest is delayed by 5-10 days and that fruit firmness is increased. The delay in harvest results in larger fruit size since cherry fruits grow about 1% per day so a 10-day delay in harvest results in 10% larger cherries. We suggest applying GA (Pro-Gibb) at straw color using 8-12 fluid ounces/100 gallons. Us the lower rate on a cool year and the higher rate on a hot year.

Protecting Sweet Cherries from Rain Cracking

One of the biggest obstacles to growing consistent high quality sweet cherries in NY state is rain-induced cracking. Major chain stores view NY producers as inconsistent suppliers delivering cherries of varying quality. This puts NY producers at a serious marketing disadvantage. If we could solve the rain-cracking problem, NY growers could become consistent suppliers of high-quality cherries and develop higher paying markets with local and regional chain stores. This would allow NY growers to expand acreage of this crop. In 2002 we installed a rain shield over one third of our high-density block to evaluate rain-cracking control methods. In 2003 we had significant rainfall events that preceded Lapins harvest by eight days. There was no significant cracking in either the rain protected plot or the unprotected plot. However, a few days later when Hedelfingen and Regina were close to harvest we had three days of rain just before harvest that resulted in 20-40% cracking in the unprotected plot (Figure 1). In the rain- protected plot we had only 5-15% cracking on Hedelfingen and Regina respectively. Sprays of dilute solutions of $CaCl_2$ have also been used for rain-crack prevention. When we applied the sprays by speed sprayer we were unable to prevent cracking. Apparently we needed to apply Ca more often than we could with a speed sprayer. In 2005 we evaluated an automatic sprinkler system of $CaCl_2$ sprays, which worked much better. Thus, it appears that either rain nets or automatic $CaCl_2$ applications can work to limit rain-induced fruit cracking. The economics of covering acres of cherry orchards with

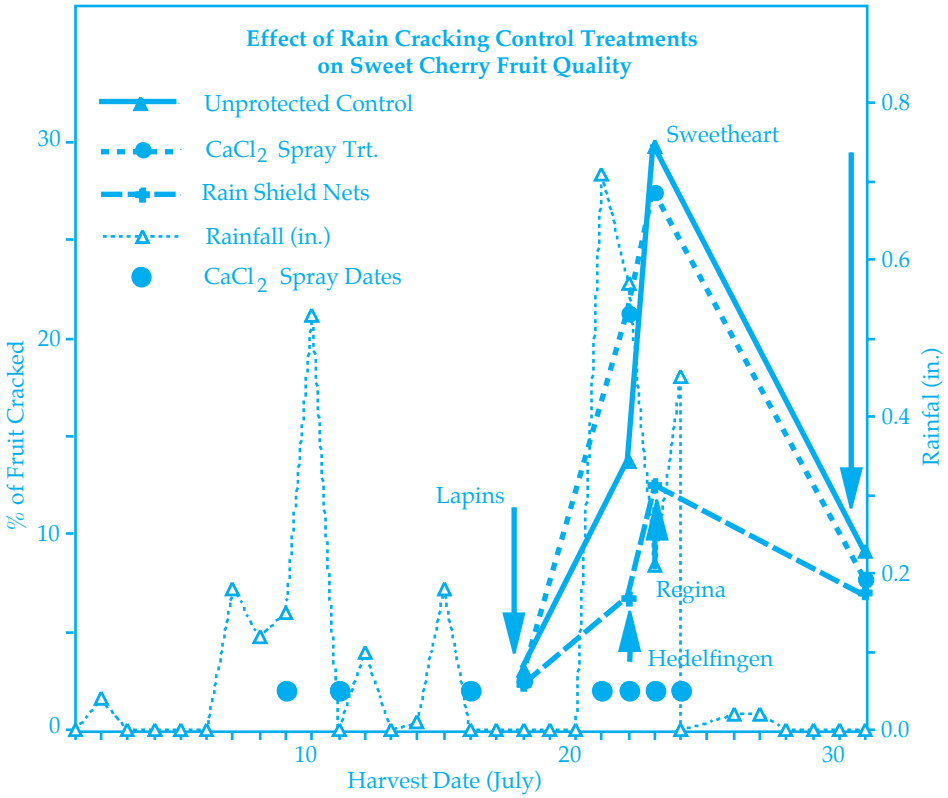

Figure 1. Rain cracking in 2003 with four sweet cherry varieties at the Geneva Sweet-Cherry Systems Trial.

expensive rain shields has not been evaluated, however, it appears to be an effective method for limiting rain-induced cracking and producing high-quality cherries.

Conclusions

Taken together these management strategies can form a system of producing sweet cherries in NY that will result in consistent production of high quality cherries.

We call this the integrated system of sweet cherry production. The essential points of the integrated system are to utilize:

- Berms and Tiling
- Copper spray programs
- Dwarfing Rootstocks
- High Tree Densities (>300 trees / acre)
- Minimal pruning during first four years and bud removal to obtain branching
- New varieties (e.g. Regina and Sweetheart)
- Irrigation
- GA sprays
- Rain Protection Nets or Ca sprays
- Bird Protection - Bird Nets
- Hydrocooling and
- MAP bags

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