

Improving Sweet Cherry Branching

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Recent introductions of dwarfing rootstocks for sweet cherries in the United States have stimulated a flurry of work on the intensive management of cherries. The apple-marketing dilemma has also promoted interest in sweet cherries for crop diversification. Early commercial experiences with the Gisela series of stocks have shown the promise of early production, improved fruit quality, and renewed profitability to the grower through the ability to optimize labor, production, and fruit quality. Three Gisela series rootstock varieties representing a range in size control from 50 percent to 90 percent of full vigor have emerged from research in North America and Europe. They are: 'Gi 5' (50%), 'Gi 12' (75%), and 'Gi 6' (90%). There may be even better rootstocks in the future. Many researchers around the world are now actively investigating additional new rootstocks such as Weiroot, Edabriz, DAN, M X M, PiKu, P-HL, and other *Prunus* hybrids and species (Perry et al., 1996 Wertheim, 1998, Eremin and Eremin, 2000).

The introduction of these dwarfing stocks has made possible new sweet cherry planting systems, improved tree training techniques, and new more effective methods for protection from weather and pests (Lang, 2001, Long, 1999, Weber, 2001). With dwarf sweet cherry trees, netting and/or rain protection covers are more likely to be practically and economically accomplished.

One of the management challenges with several of the new training systems is to develop a sufficient number of side branches in the proper location for optimum production. Traditionally, growers have headed leaders and scaffolds to encourage branching. Although heading is somewhat effective for particular planting

systems, results are rarely perfect and commonly unacceptable for the newer planting systems, especially those that feature unheaded leaders. Precise placement of scaffolds and fruiting shoots on young trees is essential for making high density planting systems a success.

A number of techniques have been tried around the world for promoting branching without heading the leader. We designed an experiment to compare the available techniques for promoting branching along 1 year-old leaders, which typically show poor distribution of shoots and areas of blind wood.

Materials and Methods

In 1999, we established a trial with six different planting systems (Modified Central Leader, Vogel Slender Spindle, Spanish Bush, Perpendicular Vee, Zahn Vertical Axis, and Marchant Trellis) at the New York State Agricultural Experiment Station. Each system was established using three sweet cherry varieties (Sweetheart, Lapins, and Hedelfingen). At the beginning of the second growing season, trees from the Central Leader, Perpendicular Vee, Vogel, and Zahn systems were treated with one of three branching treatments: (a) applying Promalin® in latex paint to the entire leader, (b) by cutting a notch above every third bud from top to bottom along the leader, or by (c) removing every second and third bud from top to bottom along the leader. All treatments were applied between April 5 and 10 when trees were at the swollen bud stage of development and immediately preceding bud burst. After shoot growth ceased, each treatment was analyzed for the number of side shoots produced in the bottom, middle, or top third of the leader.

One of the management challenges with sweet cherries is to develop a sufficient number of side branches in the proper location along the leader. A new technique which involves removing two-thirds of the buds along a shoot is a highly effective way to stimulate horizontal lateral branching in New York. However, this practice should only be used where the threat of bacterial canker infection is low or where copper sprays are applied immediately after the buds are removed.

Promalin® (P) (a proprietary mixture of 6-Benzyladenine and GA 4+7 from Valent USA) applications were made according to label instructions using 5,000 ppm Promalin® and applied in a small 1.5 gallon capacity all-purpose pneumatic hand sprayer. Shoots were sprayed to runoff with the Promalin® mixed into inexpensive latex paint and water carrier mixed 1:1. The paint was included to ensure adherence to the target site (the buds) and to mark the location of application (Fig. 1).

"Notching" (N) was accomplished by cutting through the bark and cambial layer with a hacksaw blade above the selected buds (Fig. 2). This could also have been done using a knife or fine pruning saw. Cuts were deep enough to disrupt



Figure 1. White latex paint applied to the bud and shoot marks the location of the Promalin® application.

hormone and nutrient flow but **not so deep as to endanger the structural integrity of the leader** (Fig. 2). Notching was timed to precede several days of expected dry weather, and trees were also immediately treated before the next rain with a copper bactericide/fungicide spray to protect from infections by bacterial canker (*Pseudomonas syringae*) and Cytospora canker (*Cytospora leucostoma* or *cincta*).

“Bud Removal” (BR) in this trial consisted of the removal of every second and third bud along the leader from top to bottom resulting in only one-third of the buds remaining after treatment. Buds were simply rubbed off by applying side pressure with the tree trainer’s thumb or forefinger. The remaining buds tended to be evenly spaced along and around the leader approximately 3 inches apart. Additionally, competitive buds within 3 inches of the terminal bud were removed in both headed and unheaded systems (Fig. 3). Bud removal was also timed to precede expected dry weather and trees were treated with a copper bactericide/fungicide after bud removal to lower the chance of canker infection.

Results

The number of shoots produced along the leader varied more by variety than by the treatment imposed (Table 1). Hedelfingen produced the most branches with Promalin (P), Notching (N), and Bud Removal (BR) treatments producing 13, 12.2, and 11.8 shoots respectively. Sweetheart produced an average of 10.4 shoots, while Lapins, a notoriously stingy brancher, produced the fewest side shoots with only 7.6 shoots per leader among all three treatments. The difference among treatments for each variety usually varied by less than one shoot per leader. The removal of two-thirds the number of buds in the BR had no influence on the final number of buds that elongated into shoots. In fact, BR produced more shoots on Lapins than N or P. Approximately the same number of shoots were produced by BR, N, and P on the other 2 varieties that are more prone to natural branching.

Although the total number of shoots produced along a growing leader is important, the distribution of those shoots is even more important. Typically, fruit trees have the majority of their shoots in the top portion of the leader. The middle section of the shoot or leader produces fewer branches while the basal section rarely produces shoots. Typically, many of the shoots in the top one-third of a leader need be pruned away in the late dormant season to reduce

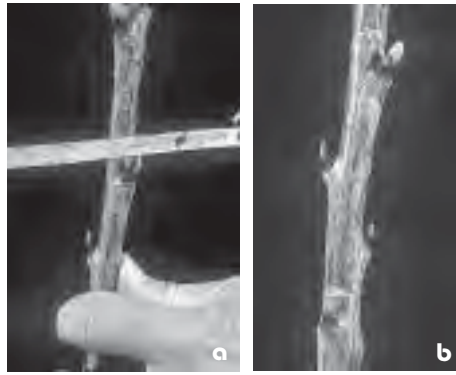


Figure 2a and 2b. A hacksaw blade (a) is used to make “Notching” cuts above the chosen fruit bud. This shallow cut (b) above every third bud disrupts hormone (auxin) and nutrient flow to the bud and stimulates branching.

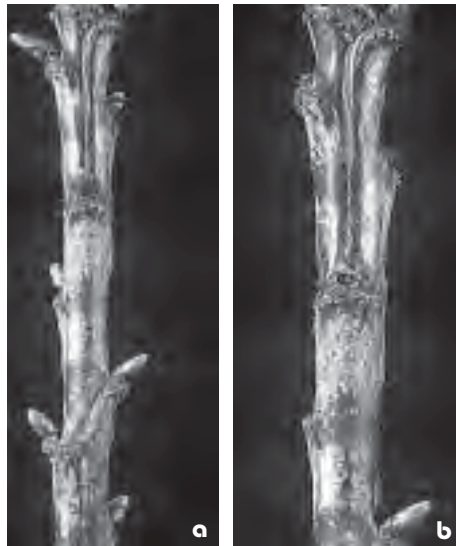


Figure 3a and 3b. Figure 3a shows typical bud distribution of the leader. Figure 3b shows the same leader after competitive buds have been removed.

leader competition and even out the distribution of shoots. Both the growing and pruning of this unneeded wood wastes energy that can be translated into lost yield.

In this experiment, bud removal was a very effective way of limiting shoot growth in the top one-third of the leader and encouraging shoots to grow in the middle and bottom one-third of the leader. In all three varieties, significantly fewer shoots were produced in the top one-third of the leader (Table 1). Significantly more shoots were produced in the middle and bottom thirds of the shoot compared to both the N and P treatments. Among the three varieties, BR produced the greatest number of shoots in the lower third of the leader on Hedelfingen and the least on Lapins reflecting each variety’s freeness to branch naturally (Fig. 4).

Training system also had some influence on branching within each sector of the leader (Table 2). This is probably because

the training plan for the Central Leader and Vogel Slender Spindle require leader heading whereas the Perpendicular Vee and Zahn Vertical Axis do not. Table 3 illustrates that heading in addition to BR produced better distributed shoots on Lapins and Sweetheart in all three sectors, but had little influence on the more freely branching Hedelfingen.

Discussion

Sweet cherry trees grow very vigorously. Vigorous growth on cherries also seems to inhibit side shoot formation. Buds in the second season that do not elongate into a shoot may produce a fruiting spur or may produce a leaf spur that usually dies out the following year. Fruit spur formation is variety dependant. Buds that die typically leave large areas of unproductive structural wood commonly known as “Blind Wood” (Fig. 5). Blind wood has been recognized as a problem in sweet cherry growing regions around the world, and a number of techniques are used to help reduce this blind wood. It has become especially important with the introduction of the more dwarfing trees to induce as much branching as possible so that there is a choice of scaffolds and fruiting limbs from which to choose.

Traditionally, the stimulation of lateral branches has been done in sweet cherries by heading candidate shoots. These cuts into 1 year-old wood remove suppressive hormones (auxins) and release subordinate buds from the control that upper-level buds exert. Heading is done in the dormant season, and typically, the leader or scaffolds branches which are headed are reduced to a functional length depending on the past years growth. A common rule of thumb is to remove one-third of the leader, removing more with weak growth or less with excessive growth. Heading is effective in producing abundant branching near the cut. It can be used to produce branching in the approximate location that you want although the distribution of the branches is far from satisfactory. Heading is simple to explain to workers and inexpensive to perform. Heading causes only the four or five buds just below the cut to grow into shoots. These shoots tend to be the strongest, most upright, most dominant, and if left on the tree are generally not suitable as fruiting branches. If they are not removed, they cause shading and prevent the development of productive fruiting wood. In sweet cherry, these branches usually have narrow angles, which result in bark inclusions that often are sites for winter injury and cankers.

The technique of "Notching" above buds removes temporarily the influence of auxins from the bud, which allows the bud to grow into a shoot. However, this technique has been variable in response on apples and even less responsive in this experiment. In apple, the accepted technique is to notch three buds for every one expected to respond. (Hoying 1993, Greene and Autio, 1992). The possibility of cutting too deep is real, and growers have occasionally lost leaders using this technique. Perhaps a greater threat is the introduction of canker forming bacteria or fungi into the cut.

The application of Promalin® to stimulate lateral branching has given variable and generally unreliable branching in the eastern United States with some of the variability attributed to the precise timing required for the material. Constante (1980) reported on the effect of Promalin on the stimulation of growth and branching of young Macspur apple trees. He was able to more than double the amount of branching and total shoot length when applied in a lanolin paste either to individual buds or to all the buds and bark in the desired region. He found the early season timing of the treatment important but difficult to achieve. He also concluded that the treatment method was costly and tedious. On sweet cherries, Dr. Tim Facticeau (personal communication) in Oregon has had better success using 150 mls Promalin® in 250 mls latex paint plus 3 mls of Buffer X. Promalin® is known to work better in warmer climates, which may be the reason why he has had better success than our tests.

The Bud Removal technique is a relatively new development first being used in Europe. Lang (2001) reported that this technique is valuable in reducing excessive early spur and fruit formation but the technique may produce more vigorous and upright shoots. Our results have shown that this technique is a highly effective way to stimulate horizontal lateral branching in New York without excessive vigor.

Conclusions

This research project along with other practical experiences of the authors suggests that Bud Removal technique coupled with weather monitoring and copper protectants is quite likely to become the standard practice of stimulating lateral branching in sweet cherry training in New York. It allows good lateral branch development without heading the leader. This should allow more rapid development of the canopy and earlier production. We

TABLE 1

Effect of branching treatments on side branching of the leader of 3 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	Total Number of Side Shoots Produced on the Leader	Average # of Shoots per Treatment
Hedelfingen	Promalin®	0.5 c	2.2 b	10.3 a	13.0	
Hedelfingen	Notching	1.2 b	1.7 b	9.3 a	12.2	
Hedelfingen	Bud Removal	2.9 a	4.2 a	4.7 b	11.8	
LSD $p \leq 0.05$		0.7	0.7	1.1		12.3
Lapins	Promalin®	0.2 b	0.2 b	7.5 a	7.9	
Lapins	Notching	0.1 b	0.1 b	6.4 b	6.6	
Lapins	Bud Removal	0.9 a	2.6 a	5.0 c	8.5	
LSD $p \leq 0.05$		0.4	0.4	0.7		7.7
Sweetheart	Promalin®	0.1 c	0.4 b	10.5 a	11	
Sweetheart	Notching	0.6 b	0.3 b	9.1 b	10	
Sweetheart	Bud Removal	1.5 a	3.3 a	5.3 c	10.1	
LSD $p \leq 0.05$		0.4	0.5	1.1		10.4

TABLE 2

Interaction of training system and branching treatment on side branching of the leader of 3 sweet cherry varieties.					
Variety	Training System	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	CL	Promalin	0.0 f	1.7 c	6.3 c
Hedelfingen	CL	Notching	1.7 cd	3.0 abc	5.0 cd
Hedelfingen	CL	Bud Removal	2.0 bc	2.6 bc	2.6 d
Hedelfingen	Vogel	Promalin	0.2 ef	2.2 bc	9.5 ab
Hedelfingen	Vogel	Notching	1.2 c	1.8 c	7.3 bc
Hedelfingen	Vogel	Bud Removal	2.9 ab	3.5 abc	4.8 cd
Hedelfingen	Zahn	Promalin	0.4 ef	2.7 abc	11.7 a
Hedelfingen	Zahn	Notching	1.6 cd	1.0 d	10.8 a
Hedelfingen	Zahn	Bud Removal	3.2 a	4.5 ab	4.7 cd
Hedelfingen	Vee	Promalin	1.1 cde	1.9 c	10.7 a
Hedelfingen	Vee	Notching	0.8 d	1.8 c	10.5 a
Hedelfingen	Vee	Bud Removal	3.0 ab	5.0 a	5.4 c
LSD $p \leq 0.05$			1.1	2.4	2.8
Lapins	CL	Promalin	0.3 cd	0.0 c	4.0 de
Lapins	CL	Notching	0.0 e	0.0 c	3.3 e
Lapins	CL	Bud Removal	1.2 ab	3.2 a	3.5 de
Lapins	Vogel	Promalin	0.2 de	0.2 c	4.8 cde
Lapins	Vogel	Notching	0.0 e	0.0 c	3.5 de
Lapins	Vogel	Bud Removal	1.4 a	2.8 a	4.1 de
Lapins	Zahn	Promalin	0.0 e	0.1 c	10.4 a
Lapins	Zahn	Notching	0.0 e	0.0 c	8.2 ab
Lapins	Zahn	Bud Removal	0.5 c	2.1 b	5.0 cde
Lapins	Vee	Promalin	0.3 cd	0.4 c	7.4 bc
Lapins	Vee	Notching	0.4 cd	0.4 c	7.6 abc
Lapins	Vee	Bud Removal	1.0 b	2.9 a	6.3 bcd
LSD $p \leq 0.05$			0.3	1.0	2.9
Sweetheart	CL	Promalin	0.3 c	0.3 b	6.0 de
Sweetheart	CL	Notching	0.3 c	0.3 b	4.0ef
Sweetheart	CL	Bud Removal	2.2 a	2.5 a	3.3 f
Sweetheart	Vogel	Promalin	0.0 c	0.3 b	8.0 cd
Sweetheart	Vogel	Notching	0.2 c	0.5 b	6.2 de
Sweetheart	Vogel	Bud Removal	1.4 ab	3.0 a	4.8 ef
Sweetheart	Zahn	Promalin	0.1 c	0.1 b	10.8 ab
Sweetheart	Zahn	Notching	0.7 bc	0.1 b	10.3 bc
Sweetheart	Zahn	Bud Removal	1.5 ab	3.5 a	6.0 de
Sweetheart	Vee	Promalin	0.2 c	0.7 b	13.3 a
Sweetheart	Vee	Notching	0.8 bc	0.4 b	11.6 ab
Sweetheart	Vee	Bud Removal	1.4 ab	3.7 a	6.0 de
LSD $p \leq 0.05$			0.9	1.3	2.7

have observed that bud removal can also stimulate branching on scaffold branches as well as on the leader as we have shown here. The development of secondary branching on scaffolds can be useful in the early tree training of high-density sweet cherry trees. We are recommending this practice only where the threat of bacterial canker infection is low or where copper sprays are applied immediately after the buds are removed.

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TABLE 3				
Effect of heading cuts in addition to bud removal on distribution of shoots along the leader.				
Variety	Systems*	% Shoots in Bottom 1/3	% Shoots in Middle 1/3	% Shoots in Top 1/3
Hedelfingen	Headed	26.8	33.7	39.5
Hedelfingen	Unheaded	24.1	36.8	39.1
Sweetheart	Headed	21.4	31.9	46.7
Sweetheart	Unheaded	13.1	32.6	54.3
Lapins	Headed	16.0	37.1	46.9
Lapins	Unheaded	8.2	28.0	63.8

* Headed systems were Central Leader (CL) and Vogel Slender Spindle (Vogel). Unheaded systems included Zahn Vertical Axis (Zahn), and Perpendicular Vee (Vee).



Figure 4. Bud Removal distributes side branching from top to bottom along the leader.



Figure 5. Blind wood in the lower portion of the leader was common in headed, Notched, and Promalin® treated leaders.