Managing Crop Load on Productive/Size Controlling Rootstocks to Insure Premium Quality Cherries

Lynn E. Long
Oregon State University

With the commercial acceptance of precocious, size controlling rootstocks and productive self-fertile varieties, cherry production took a giant step forward. Rootstocks such as Gisela 5, 6, 12, Weiroot 158, Maxma 14 and most recently LC52 and VSL-2 from Russia allow for the creation of pedestrian orchards. Self-fertile varieties such as 'Lapins', 'Skeena' and 'Sweetheart' enable the production of large fruit while extending the harvest.

These new innovations, however, are not without difficulties. Both the precocious rootstocks and many of the self-fertile varieties tend to cause heavy fruit set leading to a high fruit-to-leaf area ratio (F:LA) that limits the amount of carbohydrate movement into the fruit, detrimentally affecting fruit size.

Ayala and Lang (personal communication) found that when the F:LA was balanced the carbohydrates produced by non-fruiting spurs, which were located on two year old wood, was exported nearly equally throughout the fruit whether produced at the base of the branch or near the terminal. However, when there is a high crop load, very few carbohydrates from the non-fruiting spurs were exported to the fruit at the base, causing this fruit to be smaller and have less sugar.

Most North American cherry growers manage crop load exclusively through pruning. When pruning concepts of current and future crop reduction and light management are understood, this can be an effective way of managing crop load. However, successful crop load management through pruning alone becomes more difficult when less vigorous rootstocks, such as Gisela 5 are used, or when highly productive self-fertile varieties such as 'Sweetheart' are combined with productive rootstocks.

Comparing Blossom Hand Thinning and Spur Thinning

Reducing crop load through spur thinning has been adopted on a limited basis in the PNW. Due to the high cost of labor, however, most growers who implement this technique merely run their loppers on the underside of a branch and eliminate spurs. Fewer take the time to actually remove spurs by hand and fewer still can afford to hand thin blossoms. Nevertheless, Whiting and Ophardt (2005) studied the effect of hand thinning blossoms and spurs. Fifty percent of the spurs or blossoms were removed throughout the canopy on Bing trees grown on Gisela 5 and 6 rootstocks. Prior to this work Whiting and Lang hypothesized that optimum crop load is about 2000 fruit per tree with trees of this size.

Both blossom thinning and spur thinning reduced the fruit/tree by just under half and close to the hypothesized ideal fruiting level of 2000 fruit per tree (Table 2). Blossom thinned trees produced larger fruit than spur thinned trees. On Gisela 5 trees there was 5-fold and 11-fold more premium size fruit (26.6 mm and larger) as a result of spur and blossom thinning respectively.

In addition both treatments nearly eliminated small cull fruit of less than 20.5 mm, a serious problem in the untreated control where over 40% of the fruit were in this category.

The authors hypothesized that the greater improvement in fruit size seen in the blossom thinning treatment (a 25% increase in fruit weight) compared to the spur thinning treatment (a 19% increase in fruit weight) was due to the more positive F:LA. Removing blossoms on individual spurs balances the F:LA of that spur, whereas removing entire spurs improves F:LA on a scaffold or whole canopy basis but leaves F:LA of individual spurs unchanged.

Table 2. Effect of spur and blossom thinning on various fruit quality parameters. Treatments were applied in 2002 but not 2003. (Whiting, et al, 2005)

	2002			2003		
Parameter	Control	Spur-thinned	Blossom-thinned	Control	Spur-thinned	Blossom-thinned
Fruit/tree	3827 a	2053 b	2250 b	3581 a	2684 b	3944 a
Yield (kg)	22.8	13.4	16.6	24.2 a	19.6 b	22.6 a
Weight (g)	5.9 c	6.6 b	7.4 a	6.6	6.9	6.5

Chemical Blossom Thinning

Most of the work on chemical blossom thinning in the United States has been done by Dr. Matthew Whiting of Washington State University. Whiting, et al (2006), applied 2% ammonium thiosulfate (ATS), 2% fish oil + 2.5% lime sulfur (FOLS), and 3% vegetable oil emulsion (VOE) by air-blast sprayer at 1871 l/ha to heavily cropped 8 and 9 year old Bing on Gisela 5. Applications were made at 10% and 90% full bloom.

ATS and FOLS consistently reduced fruit set, whereas VOE did not. In 2002 all products over-thinned the crop, which of course is a potential problem with any blossom thinner. In 2002 ATS caused an 80% reduction and FOLS and VOE caused a 60% reduction in fruit set. In 2003, ATS and FOLS reduced fruit set by about 33% and VOE was ineffective.

In 2002 not only was fruit set reduced, but yield was also reduced with all three treatments, although not as much as fruit set, due to an increase in individual fruit weight. In this year yield was reduced by 60% by ATS, 50% by FOLS, and 30% by VOE. Fruit weight was only improved by 41%, 33% and 30%, respectively, not enough to offset the lower yields.

In 2003, fruit yield was unaffected by the thinning treatments even though fruit set was reduced with both ATS and FOLS. This was due to an increase in fruit size of treated fruit. In this trial a 33% decline in yield seemed to provide the right fruit set since fruit size fully compensated for the reduction in fruit set.

The real issue to growers, however, is not yield or fruit size but crop value. In 2002 the highest crop value was obtained on the unthinned control trees. This highlights one of the pitfalls to any treatment that reduces yield before fruit set levels are known. In 2003, the highest crop values were achieved with ATS and FOLS on both a tree (ca. $34/tree) and weight basis (ca. $3.10/kg) compared to the control of $29.60/tree and $2.63/kg, respectively (Table 3).

Table 3. Estimated effect of chemical thinning program on gross value ($/tree and $/kg) of Bing sweet cherries. Assumptions: 100% packout, 25.4 mm and larger ($3.39/kg), 22.6 mm and 21.43 mm ($1.85/kg), and smaller than 21.43 mm ($0.44/kg). Whiting, et al (2006).

Year	Treatment	Crop value ($/tree)	Crop value ($/kg)
2002	Control	26.0	1.50
	ATS	17.5	2.62
	FOLS	20.3	2.36
	VOE	24.7	2.21
2003	Control	29.6	2.63
	ATS	35.6	3.07
	FOLS	33.5	3.14
	VOE	23.9	1.78

Fruit thinning

Determining crop load before a thinning agent is applied has the advantage of allowing the grower to evaluate the need for thinning after the crop has set. This reduces the chances that over-thinning will occur causing a loss in crop value. Lenahan and Whiting (2006) evaluated the use of 2% fish oil + 2.5% lime sulfur (FOLS) applied 14 days after full bloom. Applications were made with an airblast sprayer at 1871 l/ha to 12-year-old Bing/Gisela 5.

Fruit set was reduced by 29% compared to the control (Table 4). However, fruit yield was statistically similar to the untreated control and fruit quality was not affected. When the fruit weight of the control is evaluated, however, it is evident that at 9.2 g the control trees were not overset to begin with. Theoretically this could explain the lack of fruit size response to the thinning process as well as the lower crop value per tree of the thinned trees.

Table 4. Effect of FOLS as a post-bloom thinner on several fruit quality parameters and crop value of 12-year-old Bing/Gisela 5. Lenahan and Whiting (2006).

Treatment	Fruit set (%)	Yield (kg)	Soluble solids (%)	Wt (g)	Firmness (g/mm)	Crop value ($/tree)
Control	38.3 a	11.2 ^{NS}	23.8 ^{NS}	9.2 ^{NS}	343 ^{NS}	35.31
FOLS	27.3 b	9.6	22.6	9.2	365	30.29

Although, this particular experiment failed to show either an increase in fruit size or dollar value per tree, it is clear that using FOLS as a post-bloom thinner has the potential to reduce crop levels, potentially, an invaluable tool in an overset situation.

Unlike chemical thinning, hand thinning of fruit can be more exact. This technique is used successfully on high value cherries such as Rainier in the United States. Although not evaluated experimentally, growers that have implemented this practice believe that it increases fruit size and crop value.

Hand thinning becomes economically feasible in the case of high value crops such as Rainer cherries in the United States or early market cherries in Spain. Most growers in Spain maintain fruit size solely through the use of pruning. However, one large grower, hand thins his cherries for maximum fruit size. Through close observation and experience the owner has estimated the maximum yield potential of each variety. For example, he believes that Newstar can carry a maximum crop load of 18 t/ha before size and firmness are affected. By knowing tree density in each block and desired fruit weight it is easy to calculate the target fruit load per hectare and per tree. He would like to grow a little over 1000 cherries per tree or 1.5 million cherries per hectare for Newstar.

To achieve this crop load he begins the thinning process each year while pruning. For Newstar, trees were thinned to 350 bud clusters per tree by making heading cuts into bearing wood. Shortly after the first natural drop of cherries in the spring the thinning crews start to work. The desired fruit load per tree is given to each crew and is different for each variety. The crew boss thins and counts one tree as an example for the crew. Armed with hand pruners the crews rapidly move through clusters, branches and trees. The crew boss follows behind counting and recording the results. Three to four trees per hectare are checked for quality control purposes. These trees are marked and a second man comes through and recounts the same trees. The grower maintains that that they never over thin, so if crop load is still too heavy the crew is sent through again.

Through thinning, the grower believes that it is possible to increase the average size of Newstar fruit by four millimeters. It costs him $2,000 per hectare to thin the fruit but the value of his crop is increased by $1.50 per kilogram, an average increase of 4 times his investment. Of course, none of this would be possible if it weren't for the fact that trees are small, with a maximum height of 2 ½ meters. All productive varieties, especially the self-fertile varieties from Canada, are candidates for thinning.

Summary

The future success of productive rootstocks depends on the ability of growers to properly manage crop load so that high quality fruit is produced on a regular basis. At this time, pruning is the most common tool used to manage crop load, and it will likely continue to be an integral part of any crop management program. However, other tools such as pre-bloom and post-bloom chemical thinners may soon be available to growers to aid in the production of the highest quality fruit possible.

Literature cited

Lenahan, O.M. and M.D. Whiting. 2006. Fish oil plus lime sulfur shows potential as a sweet cherry postbloom thinning agent. Hort. Sci 41 (3): 860-861.

Whiting, M.D. and G.A. Lang. 2004. ‘Bing’ sweet cherry on the dwarfing rootstock ‘Gisela 5’: Thinning affects fruit quality and vegetative growth but not net CO_2 exchange. J. Amer. Soc. Hort. Sci. 129 (3): 407-415.

Whiting, M.D., D. Ophardt, O.M. Lenahan, and D. Elfving. 2005. Managing sweet cherry crop load: New strategies for a new problem. The Compact Fruit Tree (38): 52-58.

Whiting , M.D., D. Ophardt. 2005. Comparing novel sweet cherry crop load management strategies. HortScience. 40(5):1271-1275.

Whiting, M.D., D. Ophardt and J.R. McFerson. 2006. Chemical blossom thinners vary in their effect on sweet cherry fruit, set, yield, fruit quality, and crop value. HortTechnology January-March 16 (1): 66-70.