Quote: The earliest and cheapest fruit thinning is done with a pruning shear. . . . Crop load adjustment is the most reliable way to increase fruit soluble solids content.

IMPROVING FRUIT SIZE: THINNING AND GIRDLING NECTARINES, PEACHES, AND PLUMS

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INTRODUCTION

It is essential to achieve adequate fruit size in order to satisfy consumers. This improvement is generally achieved by one method—regulation of crop load. While proper cultural practices such as correct plant nutrition and adequate irrigation are essential, these do not affect final fruit size to the same degree as crop load adjustment.

Proper pruning is essential in achieving good fruit size. A mature, open-center trained peach or nectarine tree may have 3000 to more than 8000 flowers—even after pruning. In a “normal” year, approximately 50% (or more) of these flowers will set fruit. This leaves 1500 to 4000 or more fruit on a tree that can properly size less than half that amount. For this reason it is important to figure out proper dormant pruning levels that leave only as much fruitwood as is necessary. Remember that the earliest and cheapest fruit thinning is done with a pruning shear.

FRUIT GROWTH DYNAMICS

Stone fruits grow according to what is called a double sigmoid growth curve. In general, fruit grow very fast for several weeks after bloom in a period called stage I. Fruits then begin to slow down for a varietal specific period of time called the “lag phase,” or stage II. Fruits once again begin growing rapidly about 4 to 6 weeks before harvest in what is called stage III, or “final swell.”

Research by Grossman and DeJong (1995) has shown that fruit growth during stage I is extremely important in relationship to final fruit size. Since fruit are growing at a logarithmic rate during stage I, it is essential to optimize fruit growth during that period; otherwise potential size can be lost. In other words, any size that is lost early in the development of a fruit can never be regained. This is very much like the law of compound interest in that small investments over a long period of time yield much more than large investments over a short period.

FRUIT THINNING

Date of Thinning

For the above reasons, fruit should be thinned as early as reasonably possible. Numerous studies have been performed that illustrate this concept. One of the more recent studies and one of few performed on plums (DeJong et al., 1990) demonstrated how late thinning could greatly harm fruit size (Table 1). In that study, unthinned trees actually had more marketable fruit per acre

than trees thinned during the later parts of stage II of fruit growth. Such studies emphasize the need to thin fruit as early as is economically possible.

Table 1. Royal Diamond plum thinning study with trees thinned on varying dates (after DeJong et al., 1990).

	Thinning Date				
	19 April	30 April	16 May	1 June	Unthinned
Total kg/tree	22.1a[z]	20.3ab	19.3b	18.9b	75.8c
Fruit/tree	268.0a	284.0a	272.0a	254.0a	1748.0b
Fruit wt. (g)	82.5a	71.5b	71.0b	74.4b	43.4c
% Undersize	7.7a	12.6b	12.1b	16.7c	80.2d
Total fruit (tons/acre)	9.8a	9.0ab	8.6b	7.6c	33.6d
Marketable fruit (tons/acre)	9.0a	7.9ab	7.5b	5.5b	6.6c

[z]For each line, values followed by the same letter are not significantly different.

Severity of Thinning

This concept states that crop load is inversely proportional to fruit size. In other words, the more fruit removed from the tree, the larger the remaining fruit will grow. Of course, the more fruit removed, the less total production the tree will have—note in Table 1 how the unthinned treatment had 33.6 tons of fruit per acre, while the others were vastly lower. However, the three earliest thinning treatments had more marketable fruit yield than the other treatments.

Crop load is also inversely proportional to fruit color and soluble solids content. Research has shown that crop load adjustment is the most reliable way to increase fruit soluble solids content, more so even than delaying harvest by a few days (Crisosto et al., 1997; Day et al., 1994).

Growers need to consider these concepts but remember that ultimately market forces determine what size fruit is required. After that, total crop load must be adjusted annually to produce fruit that meet that market demand. There is no practical way to do this other than by trial and error, estimates, experience, and fruit counting.

Hand Thinning

Virtually all thinning done on stone fruits in California is done by hand. Numerous attempts have been made to develop mechanical or chemical thinning methods. To date, neither has proven successful for commercial production. Table 2 presents data on a thinning trial for Loadel canning cling peaches (DeJong et al., 1991). The results show that the early thinning

took the greatest amount of time but also yielded the most and the largest fruit. Also note the differences in the amount of fruit removed at thinning (2.36 vs. 40.18 kg/tree) between the extreme treatments. As mentioned above, these fruits which are thinned off represent a great deal of photosynthate energy that could have been diverted into crop had the trees been thinned earlier.

There are two primary reasons growers often wait to thin—one is to save money on labor, the other to better identify which fruits will be the largest on a particular fruiting shoot. The first reason is nearly always a mistake unless the variety is obsolete or the market is very bad (and under those conditions growing no fruit loses less money than growing much fruit). Those who consider trying to save money by waiting should take a close look at Table 2. The second reason makes sense with some very early-season varieties that often have erratic size ranges. However, it is best to wait no longer than necessary to thin.

Table 2. Summary of fruit thinning trial of Loadel canning cling peaches thinned on three different dates in 1991 (after DeJong et al., 1991).

Measurement	Thinning Date		
	10 April	30 April	23 May
Thinning time (hr/tree)	1.12	0.52	0.37
Fruit removed (kg/tree)	2.36	20.73	40.18
Fruit removed (number/tree)	5383	2961	2051
Fruit size at thinning (g/fruit)	0.44	7.00	19.59
Fruit size at harvest (g/fruit)	149.8	137.6	134.6
Crop load at harvest (number fruit/tree)	1201	1248	969
Fruit yield (tons/acre)	23.8	22.8	17.3
% split pits	0.01	0.61	0.90
% undersize fruit	0.01	2.08	2.61

One of the most important things to do when thinning is to have proper records of crop load and thinning date. It is necessary to count fruit remaining on trees after thinning for each variety and for every orchard. This is more difficult in plums and some growers thin trees to what they consider appropriate levels and then strip the remaining fruit to get a totally accurate fruit count. Over a number of years, such records become very important in helping to identify correct thinning levels and problem sites.

Chemical Thinning

For years, researchers have looked for some type of chemical thinner appropriate for stone fruits. This is made more frustrating because of the great success of chemical thinners for apples. It is important to remember that apples have a separate "king" bloom that opens earlier than the other flowers on the tree. Stone fruits have no such type of bloom and this makes finding materials and application timing that much more difficult.

Many types of thinners have been investigated, but current research efforts focus on two types: 1) flower thinners (which generally act by burning or drying out flowers) and 2) flower inhibitors. Research with products of the first type shows that both Wilthin® and Armothin® have promise. These products "burn" flowers. The more product applied, the more flowers removed. Current research is focusing on determining the best rate and best timing for each. Small commercial plots have been applied, but results have been erratic (Johnson et al., 1997).

The product Release® or, as it is now known, Ralex® is a gibberellic acid compound that is applied during the summer to prevent flower initiation and thus reduce bloom the following spring. Again, results have been promising, but erratic. Research is ongoing to develop better information regarding rates and timings for this product.

It is also important to keep in mind that all chemical thinners are intended to supplement—not replace—hand thinning. Any use of these products must be based on that premise.

GIRDLING

Purpose

Girdling involves removing a thin strip of bark containing the cambium and phloem from around the stem, branch, limb, or scaffold of a plant. Doing so is thought to prevent the downward flow to the roots of sugars and other organic compounds, thereby making them available to support and augment fruit growth.

There are three primary reasons to girdle fruit trees: 1) advance fruit maturity, 2) increase fruit size, and 3) reduce the number of harvests necessary. Girdling is usually practiced only on early-season peaches and nectarines. This is because they are usually quite small and difficult to size and because prices for early fruit are more volatile and earlier harvest usually means greater profit. Varieties of peaches and nectarines that ripen after about the first three to five weeks of the season usually are not girdled.

Drawbacks

There are a number of problems associated with girding. The greatest potential problem is tree death. Girdles that are too deep, wide, or heal too slowly can severely damage or kill trees. Extreme care should be taken to ensure that the xylem of the tree is not damaged when girdling, otherwise tree health may suffer.

Another major problem associated with girdling is split-pit fruits. These occur when fruits grow too quickly just as the pits are hardening. Proper timing of girdling can reduce this problem, but varieties prone to split-pits often cannot tolerate girdling. Associated with this are internal split-pits. These cannot be seen from the outside of the fruit but still adversely affect fruit quality. Fruits with internal split-pits often ripen erratically and/or quickly, making harvest and packing very difficult.

Date of Girding

Peaches and Nectarines

Proper timing of girdling is essential to maximize advantages and minimize difficulties. An understanding of the growth curve is again essential to understanding how girdling works. Just as with thinning, girdling provides a "boost" in fruit growth rate. However, with thinning the boost is permanent, but with girdling it is temporary and lasts only until the girdle heals. For this reason, fruit should be girdled just prior to the beginning of stage II of fruit growth. Girdling at this period reduces the amount and duration of the lag phase in stage II and allows for increased fruit size.

Many methods have been proposed for predicting this period, days after bloom, degree-day or heat unit accumulation after bloom, and onset of pit hardening. The best way to predict optimum timing is by using seed length. Seeds grow at a rate dependent upon heat accumulation and act as plant-based integrators of degree-days. Additionally, seed length is independent of fruit size and is not affected by annual crop load variations.

Table 3 shows the results from a girdling trial that investigated using seed length as a marker for determining girdling date. In this trial, girdling effect was optimal when performed when seeds were 9 to 12 mm long. Subsequent studies have verified this 10 ±2 mm seed length timing as being optimum for other varieties as well.

Table 3. The effect of date of girdling on tree and fruit performance of Mayfire nectarine (after Day and DeJong, 1990).

Treatment	Seed length (mm)	(Yield (kg/tree)	Fruit count (#/tree)	Fruit size (g/fruit)	Soluble solids concentra-tion (%)	Split-pit fruits (%)	Fruits harvested in first pick (%)
24 March	7.1	12.31	136.7	91.5	14.1	4.8	79.8
31 March	9.6	12.94	132.7	97.8	14.2	4.7	89.6
7 April	13.9	14.22	156.6	94.2	13.7	6.6	79.0
18 April	17.6	13.25	158.0	84.3	12.2	8.2	75.6
Ungirdled	-	11.67	146	79.5	10.0	5.7	67.9

Timing of Girding

Plums

Girdling of plums is less risky than peaches and nectarines if only because plum fruits do not generally have split-pits. Also, most plum varieties are firm and are not as likely as peaches and nectarines to soften rapidly on the tree. However, we have observed that the results are often very erratic. In some years there is little to no effect on the fruit, and in some years the effect is very dramatic (Day, unpublished data).

The key to girdling plums is to apply the girdles early. Many early trials showed girdling to be ineffective on plums because girdles were applied too late after bloom. The best time to girdle plums is during or just after petal-fall. Girdling should never be done later than three weeks after bloom. The problem with such timings is that it is impossible to tell that early in the season if the trees will have a normal crop. If so, girdling will be helpful but, if the crop is very light, girdling will have no effect on fruit size or maturity.

Plum trees seem to be more affected than peach or nectarine by improperly applied girdles. Tree death can occur if plums are girdled too deeply or a wide knife is used that causes slow wound healing. Also, weak trees should never be girdled; it is too debilitating. Care should be taken when girdling plum varieties that sometimes soften rapidly, such as Santa Rosa. The presence of a girdle can cause fruit to ripen very quickly.

CONCLUSION

Improving fruit size is best achieved through proper crop load adjustment. Pruning is the quickest, easiest, and least expensive method available for so doing. Hand thinning is essential and is most effective when performed as early as reasonably possible. Chemical thinning has potential but only as a supplement to hand thinning. Girdling can improve fruit size and advance maturity of fresh market stone fruits but can permanently harm trees. Peaches and nectarines are best girdled when seed length is 10 ±2 mm. Plums are best girdled during or just after petal-fall.

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