CHEMICAL AND MECHANICAL THINNING OF PEACHES

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Abstract. **Horticultural and economic evaluations of chemical blossom thinners were conducted in 16 commercial orchard trials during 2005 to 2007. The treatments were applied at 80 percent full bloom and compared to hand thinning post-bloom. Chemical efficacy was variable among years and blocks. Chemical thinners decreased follow-up hand thinning time in 33 percent of the trials and increased fruit diameter in 55 percent of the trials, resulting in net impacts of $14 to $983 per acre in 78 percent of the trials.**

Similar evaluations of mechanical peach thinners were conducted in four commercial orchard blocks in 2007. A mechanical blossom thinner designed by a German grower for thinning apple trees in organic orchards was tested on peach trees trained to either a perpendicular V or quad V system. Thinning was conducted at 20 or 80 percent full bloom. A USDA spiked-drum shaker, originally designed for harvesting citrus, was tested at 45 days after full bloom in two of the same blocks that were mechanically blossom thinned. Mechanical thinners reduced fruit set, decreased follow-up hand thinning time, and increased the number of fruit in the 3-inch or greater size distribution in 100 percent of the trials. Net profits ranged from $71 to $796 per acre. Bloom thinning at 20 percent full bloom was similar to thinning at 80 percent full bloom. Detailed counts of flowers on branches with different orientations indicated that pruning can be adjusted to improve thinner performance.

Interest in chemical bloom thinning of peach trees has increased in recent years due to the premium price received for large sized fruit and the inability of costly post-bloom hand thinning to produce adequate fruit size. The goal of a thinning program for peach trees is to remove 50 to 75 percent of the excess fruit before petal fall, making final adjustments to crop load by hand once the final crop can be assessed. Interest in mechanical bloom and/or fruit thinning was renewed in 2007 as the supply of skilled workers continued to decline and labor costs increased.

Research trials in several regions indicate that fertilizer salts and surfactants are more reliable and less phytotoxic than chemicals originally tested for thinning peach blossoms (Osborne et al., 2005; Fallahi, 2006). Byers (1999) tested a number of caustic materials and reported that ammonium thiosulfate (ATS) was the most consistent treatment for increasing fruit size. Klein and Cohen (2000) demonstrated that Silwet 408, a surfactant, was an effective stone fruit thinner, and Wilkins et al. (2004) found another surfactant, Tergitol TMN-6, to be an effective peach thinner at full bloom through petal fall. Various mechanical thinners have been tested over the years, including trunk shakers (Berlage and Langmo, 1982), low frequency electro-dynamic limb shakers (Diezma and Rosa, 2005), high pressure water streams (Byers, 1990) and tree-width and rotating rope curtains (Baugher et al., 1991). As growers modify training systems for automation by maintaining narrow canopy widths, mechanical thinning options are more attainable (Glenn et al., 1994; Miller, 2006.).

A chemical blossom thinning project was conducted during the 2005 to 2007 growing seasons and a mechanical thinning project was added in 2007 to identify one or more promising thinner programs for the Mid-Atlantic peach and nectarine industry. The objectives were: 1) to provide peach and nectarine growers with local, science-based information about the optimal use patterns of chemical and mechanical thinners and 2) to help orchardists make informed decisions about how best to use peach thinners to reduce costly follow-up hand thinning and to increase crop value, through increased fruit size.

ATS, Tergitol TMN-6, and/or Silwet 408 were tested in commercial 'Redhaven' and 'Loring' peach blocks in three years and in commercial 'Glenglo,' 'John Boy,' 'Bounty,' and 'Babygold 5' blocks in two years. Grower cooperators applied the spray treatments at 80 percent full bloom to whole trees using an airblast sprayer calibrated to apply 100 gallons of spray per acre. Three growers also tested rope curtain and/or hand blossom thinning treatments.

At the beginning of the third year of the chemical thinning study, it appeared that manufacturers had decided against pursuing registration for surfactants for use as peach thinners. Also, growers were finding it increasingly difficult to find a workforce to manually thin peaches. Our research team decided to test a mechanical blossom thinner (Darwin) designed by a German grower for thinning apple trees in organic orchards and also a spiked-drum shaker,designed by USDA engineers for harvesting citrus. Thinning with the Darwin thinner was conducted at either 20 or 80 percent full bloom, and thinning with the spiked-drum shaker was conducted at 45 days after full bloom. Trials were conducted on 'Redhaven,' 'John Boy,' 'White Lady,' and 'Babygold 5' peach trees and 'Arctic Sweet' nectarine trees trained to either perpendicular V or quad V systems.

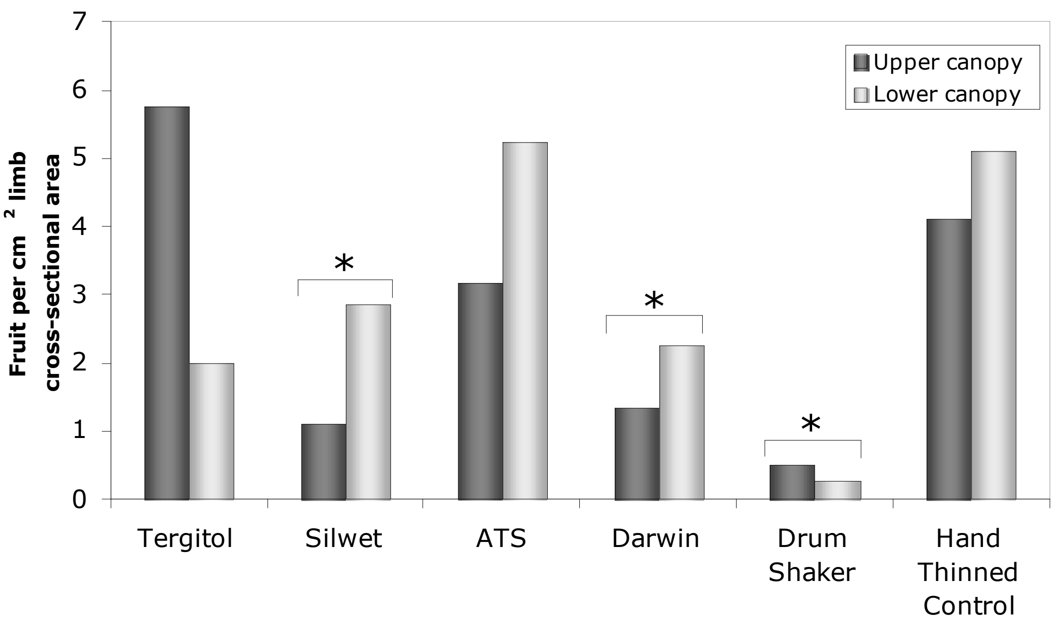
Table 1. Percentage of commercial trials, by treatment, with statistically significant improvement in measured/calculated parameters (*P=0.05*).

Measurement Influenced	*Tergitol*	*Silwet*	*ATS*	*Rope Curtain*	*German Thinner*	*Drum Shaker*	*Bloom HT*
Fruit set	73	89	63	100	100	100	100
Thinning time	25	63	25	80	100	100	80
Fruit diameter	38	88	56	80	100	50	40
Fruit ≥ 3-inches	44	88	50	80	100	100	60
Net profit	63	100	81	100	100	100	60
(n)	(16)	(8)	(16)	(5)	(4)	(2)	(5)

The experimental designs in all trials were randomized block, with multiple tree replicates. In chemical trials, there were buffer trees between treatments and replicates. Mechanical and chemical treatments were compared to hand thinning at 40 to 50 days after full bloom. Blossom removal and reductions in fruit set were evaluated, and following physiological drop all trees were hand thinned to a uniform crop load. Hand thinning time per plot was recorded to determine potential reductions in labor inputs. At harvest, yield per tree was assessed, and a sample of fruit was evaluated for mean fruit diameter and fruit size distribution. Economic cost/benefit analyses were performed to evaluate the impact of each thinning regime on fruit returns.

No phytotoxicity was observed in chemical thinning trials, and mechanical thinners caused little or no branch or bark damage except where excessively large branches (referred to as "hat racks" by growers) projected into the row. Table 1 provides a comparison of statistically significant results for the various chemical and mechanical thinning strategies for fruit set, follow-up hand thinning time, fruit diameter, number of fruit three inches or greater, and net economic impact. Although mechanical thinners were only tested one year, the results were more consistent than for chemical thinning.

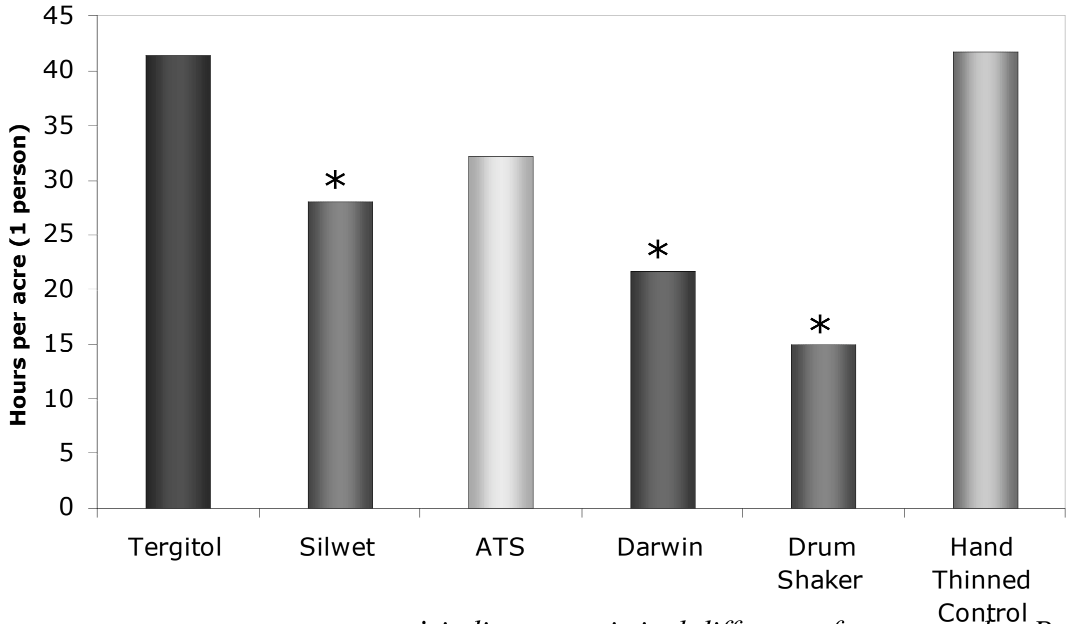
Figure 1. Fruit set comparisons across chemical, mechanical, and hand thinned treatments **(Babygold 5, 2007).**



* *indicates statistical difference from control at P*=0.05

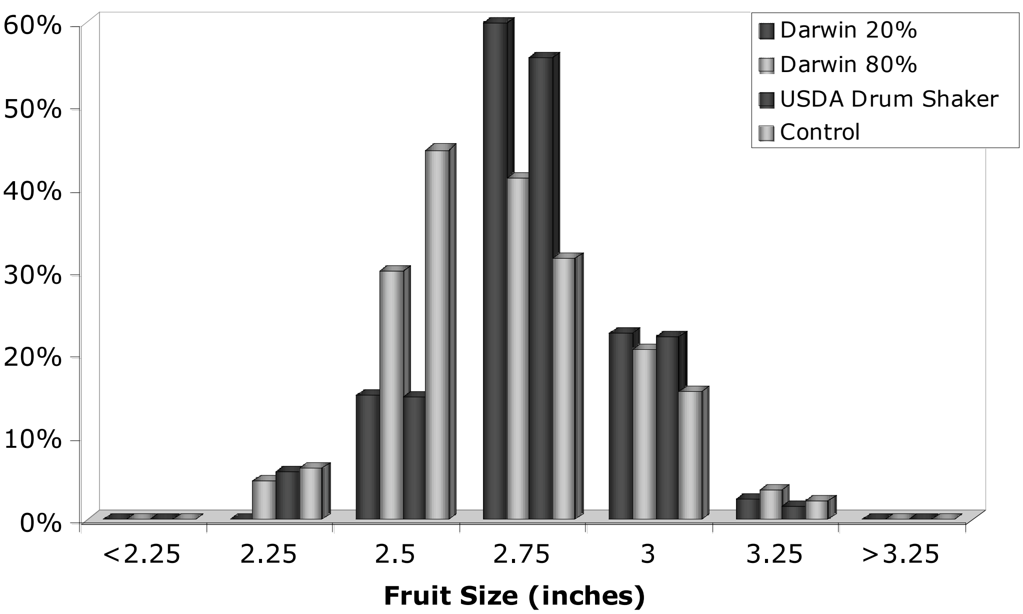
Chemical blossom thinners reduced fruit set in 63 to 89 percent of the trials, but only reduced follow-up hand thinning time in 25 to 63 percent of the trials, whereas the Darwin and USDA thinners reduced fruit set and follow-up hand thinning in 100 percent of the studies. Fruit diameter increases and the distribution of fruit in the three-inch or greater size categories were also more consistent in the mechanically thinned trials. Net profits increased in 100 percent of mechanically thinned trials, in 63 to 100 percent of chemically thinned trials, and in 60 percent of hand blossom thinned trials. Cost-benefit analyses varied considerably across orchard blocks, but when either fruit size or follow-up hand thinning time was impacted, an economical benefit was demonstrated. Net profits in chemically thinned plots increased by \$14 to \$983 per acre in 78 percent of the trials and in mechanically thinned plots increased by \$71 to \$796 per acre in 100 percent of the trials.

Figure 2. Follow-up hand thinning times (Babygold 5, 2007).



* *indicates statistical difference from control at P*=0.05

Figure 3. Effects of thinning treatments on Redhaven fruit size distribution.



The preliminary research with the Darwin and USDA thinners indicates that more work is needed on optimum timing for thinning and on possible adjustments in pruning strategies. Thinning at 20 percent full bloom was similar to thinning at 80 percent full bloom, with the exception that the 20 percent timing had a greater influence on fruit size distribution. In future studies, thinning at various bud stages will be more carefully investigated. Detailed counts of flowers on branches with different orientations indicated that adjustments in pruning practices would likely improve thinner performance, and this is another area that requires more research. Other important considerations as we continue our investigations with mechanical thinning include uniformity of thinning, effects on yield, and frost risk management. Mechanical thinners may allow growers to more precisely adjust crop load to fit individual tree sizes and shapes. Additional research is needed on targeted fruit loads in various canopy architectures.

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