Chemical Thinning of Stone Fruits Grown in the Sierra Foothill Region

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Abstract

During the second year of this project we continued to evaluate the effect of a chemical thinning agent on fruit set, size of fruit prior to thinning, number of fruit hand-thinned, and fruit size and weight at harvest. We used a commercial airblast sprayer to apply Entry™ (Wilbur-Ellis) at the full label rate of 3% in the equivalent of approx. 300 gal./acre during 60-95% bloom to commercial four-tree plots, three replicates of each in a randomized block design. Varieties treated included 'Rosemary' and 'Friar' plum, 'Arctic Rose' nectarine, and 'O'Henry' and 'Cal Red' peach. A second application was applied to trees in the 'Arctic Rose' block to compare the effect of one Entry spray vs. two. Due to spring frost, the bloom on the 'Rosemary' and 'Friar' plum varieties was injured and very little fruit was set; therefore, these varieties could not be evaluated. Measurements were taken from the middle two trees of each four-tree plot in the peach and nectarine varieties. Flowers and subsequent fruit on eight shoots of each tree were counted and the percent fruit set was calculated. The total number of fruit removed from each tree during hand thinning was recorded. The diameter of at least ten random fruit per tree was measured prior to hand thinning and at harvest. The number of fruit per box harvested from each tree was counted and the box was weighed and then all data was summed to determine average fruit weight/tree at harvest.

Results appeared promising for the peach and nectarine varieties. Mean percent fruit set and the mean number of fruit removed during hand-thinning was reduced ($p < 0.01$) in the 'Arctic Rose', 'O'Henry' and 'Cal Red' varieties, although the 'O'Henry' peaches appeared over-thinned by the chemical treatment, likely due somewhat to frost effects. At harvest, the mean fruit diameter and the mean fruit weight/tree was greater (at $p < 0.01$ and $p < 0.05$, respectively) in the chemically thinned 'Arctic Rose' and 'O'Henry' blocks as compared to the untreated controls.

Blocks sprayed with Ralex in June of 2001 were evaluated and the number of fruit removed during hand thinning was not reduced in either the 'O'Henry' or the 'Cal Reds', but was slightly reduced ($p=0.046$) in the 'Arctic Rose'. The mean fruit weight/tree at harvest was not different between the Ralex-treated trees and the untreated controls in the 'Arctic Rose' or 'O'Henrys' but was slightly different ($p=0.047$) in the 'Cal Reds'. The registration for Ralex™ (Abbott Labs.) was withdrawn in 2002, therefore, no further applications were made.

Introduction

The increasing cost of labor has become a major concern for tree-fruit growers. A recent cost of production study for foothill-grown peaches found hand thinning to be the single greatest cost of all cultural operations, accounting for 33% of the cost of all cultural practices. While chemical thinning has the potential to reduce the cost of hand thinning, growers interested in adopting this practice have few research guidelines to help them gain the confidence and results necessary for cost-saving success. This project sought to continue the field research on chemical thinning agents in fresh market peaches, nectarines, and plums that we began in 2001, in order to build our knowledge on the proper use and efficacy of these materials and with the goal to reduce grower hand-thinning costs without loss of fruit quality or yield.

Specific objectives were:

Objective 1: To continue to evaluate and compare the efficacy of Entry™ blossom thinner applied to peach and nectarine varieties in the following treatments:

Treatment 1: Single application at 3% rate at approximately 40% bloom.

Treatment 2: Single application at 3% rate at approximately 80% bloom.

Treatment 3: Two applications at the 3% rate applied both at the time of treatment 1 (approx. 40% bloom) and again at treatment 2 (approx. 80% bloom).

Objective 2: To evaluate the efficacy of Ralex™, applied in 2001, to several peach, nectarine and plum varieties, on reducing flower density, and to repeat promising results with an application in 2002.

Materials and Methods

Objective 1. Prior to flagging the plots, the decision was made to use the grower's airblast sprayer to apply the Entry™ treatments rather than a backpack sprayer, as in 2001. We felt that this application method would better reveal the results that a grower would experience using Entry™ in a commercial operation. Therefore, plots consisted of four trees that were randomly selected and flagged prior to bloom and treatment with Entry™. The two end trees of each plot acted as "guard" trees and measurements were only gathered from the middle two trees of each plot. Plots were selected so that sprayer "blow-through" would not effect trees included in the experiment. Three replicates of each four tree-plot per variety were flagged. Varieties included 'Rosemary' and 'Friar' plum, 'Arctic Rose' nectarine, and 'O'Henry' and 'Cal Red' peach. All orchards were located in the "Gold Hill" region of El Dorado County at an elevation of approx. 1800 ft. On all varieties except the 'Friar' plum, eight shoots on each of the two middle trees in each replicate plot were flagged, each shoot length was measured and the total number of flowers/shoot was counted prior to treatment.

Unusually severe cold temperatures in early March effected normal bloom, causing frost damage. Due to this frost, and our subsequent uncertainty regarding fruit set, we dropped treatments 2 and 3 in all varieties except the 'Arctic Rose'. In the 'Arctic Rose', two treatments were applied and compared to an untreated control: Treatment 1: one spray applied at approximately 70% bloom compared to Treatment 2: the first spray plus an additional spray to be applied at approximately 90% bloom.

A 3% concentration of Entry™ was applied using the grower's airblast sprayer at approximately 60-95% bloom, as the grower's schedule allowed (see Table 1). The grower supplied the tractor driver who drove at a speed typical for their dormant application, applying an estimated 300 gal/acre volume of the 3% Entry spray. A flagger stood at each plot to insure the driver sprayed only the appropriate trees. Temperatures were recorded and observations were made on phytotoxic effects post-treatment.

Variety	**Date Treated**	**Est. % bloom at treatment**
Rosemary plum	March 4	80%
Friar plum	March 4	95%
Arctic Rose nectarine	March 14 (spray #1) March 22 (spray #2)	70% 95%
O'Henry peach	March 14	60%
Cal Red peach	March 22	95%

Table 1. Varieties, date treated with Entry, and estimated percent bloom of each variety at time of treatment in 2002.

Treatment effects were evaluated at three stages: 1.) prior to hand thinning, at fruit set; 2.) during hand thinning, and 3.) at harvest.

1.) Prior to hand thinning, the number of fruit on each flagged shoot was recorded. Fruit set was then calculated as (the number of fruit/the number of flowers) for each shoot. The cross-suture diameter of ten randomly chosen fruit from each tree was measured.

2.) During hand thinning, workers placed fruit removed directly into picking bags and the total number of fruit removed from each tree was then counted. The same workers thinned each treatment within each replicate.

3.) At harvest, fruit size and weight data was gathered. Cross-suture diameter was measured on at least ten randomly selected fruit from each tree. The number of fruit in each box harvested was counted and the total weight of that box was recorded. Box tare weights were subtracted from the total fruit box weight. Fruit counts and box weights were summed to give average fruit weight/tree. Since the grower harvests only when fruit is tree-ripe, several pickings on different dates for each variety were conducted.

<u>Objective 2.</u> In spring of 2002 the chemical thinning label for Ralex™ was withdrawn, therefore we did not conduct any further experiments with Ralex in 2002. Data was gathered on trees treated with Ralex in the summer of 2001, however. The number of fruit hand thinned was recorded as described above. Harvest fruit diameter and weight data was also recorded, as described above.

All data was analyzed using either Statgraphics ANOVA or SAS GLM procedure. Since the second treatment was dropped for the 'O'Henry' peach, we combined data from those replicates (receiving only the first spray, exactly the same as the first treatment) with the other three replicates of treatment one for a total of six replicates in that variety.

Results: Entry™ experiments.

<u>Effect of frost.</u> Figure 1 illustrates the temperatures at bloom time. Temperatures reached a low of 28°F on the evening of March 8, four days after the Entry treatment was applied to the ‘Rosemary’ and ‘Friar’ plums. Temperatures dipped again on March 13 and 14, reaching lows of 30-31°F. Due to the bloom timing, the Entry application was made on March 14 to the ‘Arctic Rose’ (first spray) and the ‘O’Henry’ peach, however subsequent plans for a second treatment were dropped due to the severe frost, as noted above.

Temperatures during bloom-time in 2002.

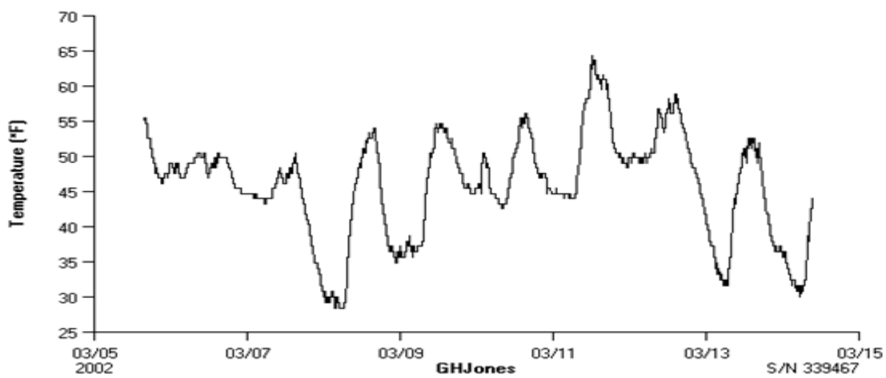

Figure 1. Temperatures (°F) recorded at the ‘Arctic Rose’ thinning plots during bloom time in 2002. Entry applications were made on March 4, 14, and 22.

The frost severely damaged bloom on both the ‘Rosemary’ and ‘Friar’ plums, so that virtually no fruit was set in the ‘Rosemary’ plums and very little in the ‘Friars’. Phytotoxic effects (“burn”) appeared severe in the ‘Rosemary’ plums, likely compounded by the cold temperatures. Therefore, the effect of our Entry spray on these varieties could not be evaluated in this year of the study. Although frost also appeared to damage some bloom in the peach and nectarine varieties, there was adequate fruit set to necessitate hand-thinning and to enable us to evaluate the effects of our thinning sprays. Of the three varieties, ‘O’Henry’ peach was the most effected by the frost, decreasing average fruit set by approximately 20% in 2002 as compared to 2001.

Mean percent fruit set from chemically-thinned and untreated trees in 2002.

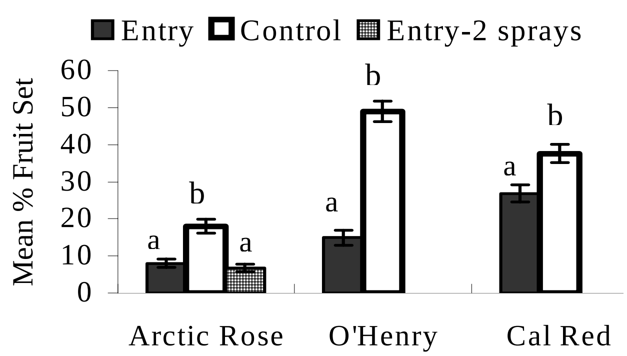

Figure 2. Mean percent fruit set in trees treated with Entry™ compared to untreated controls. n= 48 for all except O’Henry-Entry where n=96. Bars indicate standard error. Different letters for treatments within each variety indicate a significant difference ($p < 0.01$).

Fruit set. Figure 2 shows the mean percent fruit set comparing the Entry-treated plots to the unsprayed controls in the 'Arctic Rose', 'O'Henry' and 'Cal Red' blocks. Mean percent fruit set was reduced in all of the Entry-treated trees as compared to the untreated controls ($p < 0.01$). The percent fruit set in treatment 2 of the 'Arctic Rose' (receiving two Entry sprays) was not different than treatment 1 (receiving one Entry spray). The reduction in fruit set ranged from about 10% less in the 'Arctic Rose' and 'Cal Red' varieties to 34% less set in the 'O'Henry' peach.

Fruit diameter prior to thinning. Figure 3 illustrates the mean fruit diameters measured from randomly selected fruit from trees treated with Entry and untreated trees, prior to hand-thinning. The diameters are larger ($p < 0.01$) for the fruit from trees treated with Entry in each variety. There was no difference between fruit diameters from the two Entry treatments in the 'Arctic Rose'.

Mean cross-suture fruit diameter from chemically-thinned and untreated trees prior to hand-thinning.

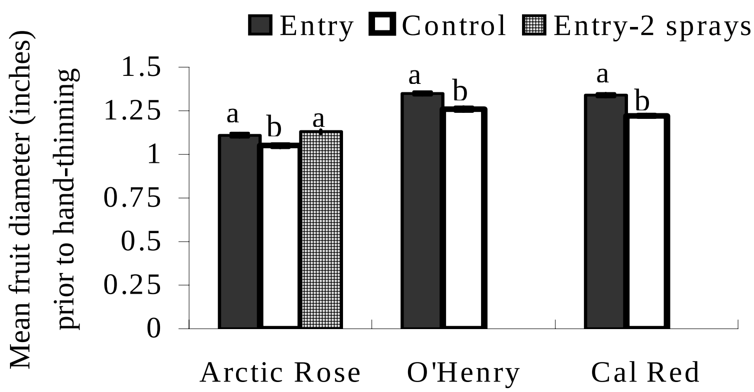

Figure 3. Mean cross-suture fruit-diameter, in inches, from Entry-treated and untreated trees measured prior to hand-thinning. n=60 for all except O'Henry-Entry where n=120. Bars indicate standard error. Different letters for treatments within each variety indicate a significant difference ($p < 0.01$).

Number of fruit removed during hand-thinning. Figure 4 shows the mean number of fruit removed by workers during hand-thinning of the Entry-treated trees compared to the untreated trees. In all varieties the number of fruit removed from the untreated trees was greater than the Entry-treated trees ($p \leq 0.01$). Differences in the mean number of fruit removed from untreated trees compared to treated trees ranged from 86 fruit in the 'Cal Red', to 114 fruit in the 'O'Henry' and 122 fruit in the 'Arctic Rose'.

Harvest fruit diameters and weight. Mean cross-suture fruit diameters and mean fruit weight per tree at harvest were higher in the chemically-thinned 'Arctic Rose' and 'O'Henry' trees, but not in the 'Cal Red', as compared to untreated controls. Figure 5 shows the mean fruit diameters measured at harvest. The mean fruit diameter was not statistically different for the 'Arctic Rose' Treatment 1 (1 Entry spray), 2.53 inches, compared to Treatment 2 (2 Entry sprays), 2.56 inches, but both were statistically different from the untreated control, 2.45 inches. Therefore, the thinning treatment increased size of the 'Arctic Rose' at harvest by 0.08-0.11 inch. In the

'O'Henry' block the size increase was greater. The mean fruit diameter at harvest from the Entry treated 'O'Henry' trees was 3.29 inches, 0.21 inch greater than the untreated fruit diameters, 3.08 inches.

Mean number of fruit removed during hand-thinning from chemically-thinned and untreated trees in 2002.

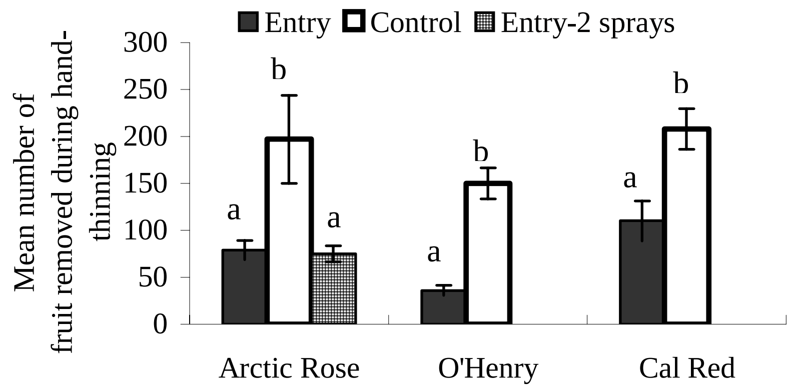

Figure 4. The number of fruit removed during hand thinning in Entry-treated and untreated (control) trees. n=6 for all except O'Henry where n=12. Bars indicate standard errors. Different letters for treatments within each variety indicate a significant difference ($p \leq 0.01$).

Mean cross-suture fruit diameter at harvest from chemically-thinned and untreated trees in 2002.

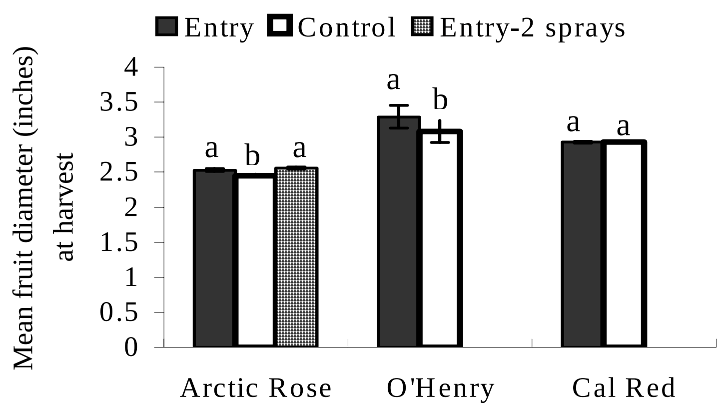

Figure 5. Mean cross-suture fruit diameter at harvest in Entry-treated and untreated (control) trees. n=60 for the Arctic Rose, n=120 for the Cal Red and n=240 for the O'Henry. Bars indicate standard errors. Different letters for treatments within each variety indicate a significant difference ($p < 0.01$).

Figure 6 shows the mean fruit weight/tree at harvest from the Entry-treated and untreated trees. Data was gathered on three different harvest dates from the 'O'Henry' block, however, the interaction between date harvested and treatment was not significant, therefore all harvest data was compiled for the mean fruit weight/tree. The gain in weight was greatest in the 'O'Henry', where fruit from Entry-treated trees had a mean weight of 10.3 ounces compared to a mean of 8.76 ounces from the untreated trees. The mean fruit weight from Entry-treated trees in the

'Arctic Rose' was 0.4 ounces greater than the controls. There were no differences in fruit weights in the 'Cal Reds'.

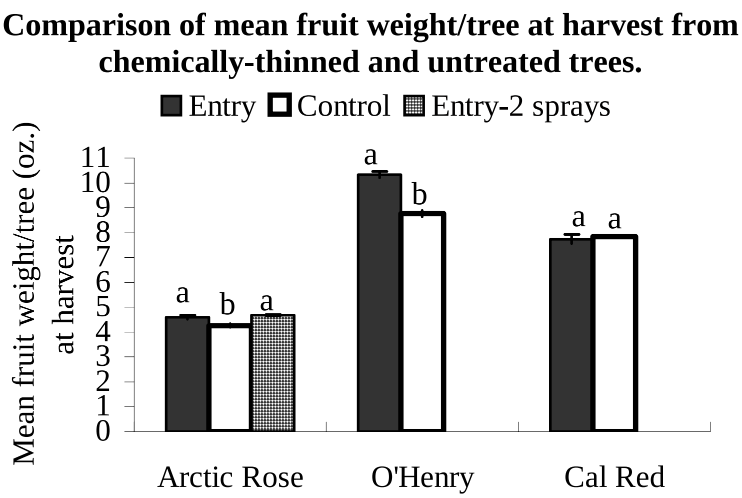

Figure 6. Mean fruit weights per tree in ounces taken at harvest from Entry-treated and untreated trees. Bars indicate standard errors. Different letters for treatments within each variety indicate a significant difference ($p < 0.05$).

Results: Ralex™ experiments.

Since Ralex is no longer registered for stone fruit thinning we will only briefly report here the results from our Ralex trial that was applied in June of 2001 and evaluated in 2002. There were no statistical differences in the number of fruit removed during hand-thinning from the Ralex-treated trees and the untreated trees in the 'O'Henry' and 'Cal Red' blocks. There was a slight difference ($p=0.046$) between the number of fruit hand-thinned in the 'Arctic Rose' Ralex-treated and control trees. There, the mean number of fruit removed during hand-thinning was 133 fruit in the Ralex-treated trees compared to 208 fruit in the untreated. At harvest, the mean fruit weight per tree from the Ralex-treated and untreated plots was not different in the 'Arctic Rose' or 'O'Henry' blocks, and slightly different ($p=0.047$) in the 'Cal Red'.

Discussion

The frost during bloom appeared to effect the 'O'Henry' block the greatest and we observed some over-thinning, likely due to the frost effects or possibly the volume of thinning spray or both. Therefore, although we saw the greatest differences in fruit size and weight in that block we cannot attribute those results to our thinning spray alone. It would be worthwhile to repeat this experiment in a frost-free year to insure that our spray volume was not the cause of the over-thinning observed. We were especially pleased to accomplish reduced fruit set in the 'Arctic Rose' block, since we did not see thinning effects in that variety in 2001. This variety appears to require the larger volume of thinning spray. We did not observe treatment effects on harvest fruit size and weight in the 'Cal Red', although we did see a reduction in fruit set and the number of fruit requiring hand-thinning. We applied our thinning treatment relatively late in that variety and suspect we may have seen greater results if we had been able to make the application earlier.