APPLICATION OF BLOSSOM THINNERS FOR CROP LOAD MANAGEMENT IN APPLE, PEACH, AND NECTARINE

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ABSTRACT

Effects of ammonium thiosulfate (ATS) on fruit set, fruit quality, and yield of 'Fuji' apple (*Malus domestica* Bork.) were studied in 2000. Double application of ATS at a rate of 15 $mL \cdot L^{-1}$ or a single application of this chemical at a rate of 25 $mL \cdot L^{-1}$ resulted in satisfactory levels of thinning in 'Fuji' apple. Double application of ATS at a rate of 25 $mL \cdot L^{-1}$ resulted in excessive thinning. Also, effects of Tergitol-TMN-6 on fruit set, quality, and yield in 'August Lady' and 'Zee Lady' peaches [(*Prunus persica* (L.) Batsch] in two orchards in 2004 and 2006 and in 'July Red' nectarine in one orchard in 2005 were studied. In addition to Tergitol-TMN-6, effect of Crocker's Fish Oil (CFO) in combination with lime sulfur on fruit set, quality, and yield in 'July Red' nectarine in 2005 was studied. Tergitol-TMN-6 at 5 $mL \cdot L^{-1}$ or higher rates and applied at about 75%-80% bloom reduced fruit set without russeting peach fruit. Peach fruit size was often increased by Tergitol-TMN-6 treatment. Tergitol-TMN-6 at 7.5 $mL \cdot L^{-1}$ or 10 $mL \cdot L^{-1}$ and applied either once at 75%-80% bloom or twice at 35% bloom and again at 75%-80% bloom, reduced fruit set without any fruit russeting in nectarine. Results from several orchards in different locations in the Pacific Northwest showed that Tergitol-TMN-6 is an excellent blossom thinner for peach and nectarine at rates of 7.5 to 12.5 $mL \cdot L^{-1}$ and sprayed at a liquid volume of 1870.8 $L.ha^{-1}$ when about 75% to 80% blooms are open.

INTRODUCTION

Flower and fruit thinning of apples (*Malus domestica* Borkh.) is an important cultural practice due to the effect on fruit size and next season's flower bud initiation. Since 1989, several new materials, including ammonium thiosulfate (ATS), hydrogen cyanamide (Dormex™), endothalic acid (Endothal), perlargonic acid (Thinex®), and sulfcarbamide (Wilthin®) have been tested for replacements of Elgetol (Fallahi et al., 1990; Fallahi, 1997; Fallahi, et al., 1998; Fallahi and Williemsen, 2002).). Sanderson (1998) compared ammonium thiosulfate (ATS), Wilthin, and Endothall on stone fruits and reported that ATS was the best blossom thinner under Washington conditions. (Tergitol) TMN-6 (90% aq.) is at least one of the putative active ingredients of Surfactant WK, a surfactant that was labeled by DOW Chemical Company.

The objective of this study was to examine the effects varied rates of ATS on 'Fuji' apple, and effects of Tergitol TMN-6 or Crocker Fish Oil (CFO) plus lime sulfur on fruit set, fruit quality, and yield of peaches and nectarine.

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MATERIALS AND METHODS

General description for experimental orchards. Soil in all orchards was sandy loam with pH of approximately 7.3. Other than blossom and post-bloom thinning treatments, all cultural practices were performed according to the commercial orchard standards. Air blast sprayers were used in all experiments throughout this study. After June drop, fruits in all treatment were counted for fruit set calculation and then hand thinned to maintain 13 to 15 cm spacing between fruits. Fruit set was calculated as the number of fruit after June drop divided by number of mixed buds x 100 in 'Fuji' apple and as the number of fruit divided by flower number or branch cross sectional area in peaches and nectarine. Yield and fruit quality were measured at harvest.

The experimental design in all experiments was randomized complete block design with 3 blocks. Each block consisted of two adjacent rows with 6 trees each per treatment and thus a total of 36 data trees per experiment. Buffer rows were used between experimental rows.

Descriptions of apples experiment. A 7-year-old 'BC-2 Fuji' orchard was selected near Wilder, Idaho. Treatments on 'Fuji' trees are described in Table 1. Thirty fruits were randomly sampled from each tree at harvest, and average fruit weight was calculated. Fruit russeting (marking) status was visually assessed, and the percentage of russeting was calculated. The amount of fruit surface covered with red was rated visually on a scale of 1 (least color) to 5 (most color).

Peach experiments. In 2004, two peach cultivars (in two different orchards) were selected in Sunny Slope area. These orchards were: 1) a 6-year- old 'August Lady'; 2) a 7-year-old 'Zee Lady'. The treatments for both peach orchards in 2004 are described in Table 2. In 2006, many of the same treatment at 1870.8 $L \cdot ha^{-1}$ were repeated in different peach orchards. At the time of application, trees of 'August Lady' were in about 85% and those of 'Zee Lady' were in about 75% bloom in 2004 and 2006.

Nectarine Experiment in 2005. In 2005, a 10-years old 'July Red' nectarine was selected at Sunny Slope, Idaho. Treatments for this orchard are reported in Table 3. Tergitol TMN-6 at 7.5 or 10 $mL \cdot L^{-1}$, each rate applied once or twice. Trees that received any blossom thinner treatment twice were sprayed once at 35% bloom and again at 85% blooms. Trees receiving one time of blossom thinning were sprayed only when 85% of blooms were open.

Peach and Nectarine Yield and Quality: Yield per tree for all peaches and nectarine were recorded. Approximately 40 fruit per tree were sampled, cleaned, and evaluated for russeting (fruit marks). Thirty of these fruit were used for weight and color measurements. Fruit color was measured by giving a continuous ranking from 1 (green) progressively to 5 (fully developed color).

RESULTS AND DISCUSSION

'Fuji' Apple. In 'Fuji' apples, all treatments, except ATS at 15 $mL \cdot L^{-1}$ and post-bloom treatment, reduced fruit set as compared to control in 2000 (Table 1). Compared with control, fruit weight of 'Fuji' apples was not affected by ATS treatments, because fruits of all treatments were hand thinned in June, providing sufficient leaf/fruit ratio in most treatments. Trees

receiving a double application of ATS at 25 $mL \cdot L^{-1}$ had smaller fruits than those receiving one application of this chemical at 15 $mL \cdot L^{-1}$. Also, trees receiving ATS at a single application of 30 $mL \cdot L^{-1}$ or a double application at 15 or 25 $mL \cdot L^{-1}$ had lower fruit color than control. Trees that received double applications of ATS showed severe foliage burning that could have resulted in smaller fruit size and poorer color due to reduction of leaf surface/fruit ratio in some of these treatments.

Peach Experiments in 2004 and 2006. Tergitol TMN-6 at 5 $mL \cdot L^{-1}$ or higher, applied at either 935.4 or 1870.8 $L \cdot ha^{-1}$, significantly reduced fruit set in 'August Lady' peach (Table 2). With all Tergitol TMN-6 concentrations, application at the rate of 1870.8 $L \cdot ha^{-1}$ was more effective in fruit set reduction and fruit size increase in 'August Lady' peach than at 935.4 $L \cdot ha^{-1}$, although differences were not always significant (Table 2). 'August Lady' peach trees treated with Tergitol TMN-6 at 5 $mL \cdot L^{-1}$ applied at a rate of 935.4 $L \cdot ha^{-1}$ had lower yield as compared to control trees. Because, although fruit set was reduced with application of 5 $mL \cdot L^{-1}$ at 935.4 $L \cdot ha^{-1}$, fruit size was not increase to compensate for the reduced fruit numbers. Tergitol-TMN-6 at 7.5 or 10 $mL \cdot L^{-1}$ reduced fruit set in 'Zee Lady' peach in 2004 (Table 2). Results in 2006 were almost similar to those of 2004 (data not shown).

Nectarine Experiment in 2005. Tergitol TMN-6 at 7.5 or 10 $mL \cdot L^{-1}$, applied either once at 80% bloom or twice, once at 35% bloom and again at 80% bloom, significantly reduced fruit set in 'July Red' nectarine in 2005 (Table 3). However, double applications of Tergitol TMN-6 at either 7.5 or 10 $mL \cdot L^{-1}$ resulted in significantly lower fruit set than a single application in 'July Red' nectarine. In this nectarine, fruit size increased proportional to the rate and frequency of Tergitol TMN-6 applications (Table 3). Yield and fruit color were not affected by any of the blossom thinning treatments in 'July Red' nectarine, because all trees were hand thinned before pit hardening. Blossom thinner treatments did not increase severity of nectarine fruit russeting. Tergitol TMN-6 treatments reduced fruit set, and thus needs for hand thinning and labor cost (data not shown), while not affecting fruit russeting, and this is economically important for nectarine industry. A double application of CFO and lime sulfur did affect fruit set, yield or fruit quality in 'July Red' nectarine (Table 3).

General comments and over-all conclusions. This study demonstrated that ATS and Tergitol TMN-6 effective blossom thinners for 'Fuji' apple and stone fruits, respectively. A double application of each of these chemical was more effective than a single application.

LITERATURE CITED

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Table 1. Effect of blossom thinning treatments on 'Fuji' apple fruit, Wilder, ID, 2000[z].

Treatment	Fruit set (%)[y]	Fruit wt (g)	Russeting (%)	Fruit color (1-5)
Control + Hand	133.2 a	206.0 ab	23.3 a	3.39 a
ATS 15 mL·L^{-1} once+PB+Hand	114.4 ab	229.0 a	8.3 b	2.91 ab
ATS 15 mL·L^{-1} twice+PB+Hand	95.3 bc	198.4 ab	15.0 ab	2.42 b
ATS 25 mL·L^{-1} once+PB+Hand	77.0 cd	215.2 ab	18.3 ab	3.08 ab
ATS 25 mL·L^{-1} twice+PB+Hand	56.3 d	191.1 b	18.3 ab	2.58 b
ATS 30 mL·L^{-1} once+PB+Hand	97.0 bc	220.6 ab	12.9 ab	2.59 b
PB+Hand	122.2 ab	204.0 ab	15.0 ab	2.78 ab

[z] Mean separation within columns of each year by LSD at $\alpha \leq 0.05$. [y] Fruit set = Number of fruit / 100 clusters.

Table 2. Effects of Tergitol TMN-6 on fruit set, weight, and yield of 'August Lady' and 'Zee Lady' peaches in 2004[zy].

	Fruit set (fruit/cm^2)		Fruit wt (g)		Yield (kg/tree)	
Treatment	August Lady	Zee Lady	August Lady	Zee Lady	August Lady	Zee Lady
Control	54.33 a	43.60 a	146.2 ab	142.9 a	74.2 a	63.7 ab
Tergitol 5 mL·L^{-1} at 1870.8 L·ha^{-1}	40.40 bc	37.02 ab	159.2 a	152.9 a	72.1 a	80.8 a
Tergitol 7.5 mL·L^{-1} at 1870.8 L·ha^{-1}	24.68 e	31.13 b	163.5 a	156.9 a	64.4 ab	63.5 ab
Tergitol 10 mL·L^{-1} at 1870.8 L·ha^{-1}	25.36 e	23.24 b	155.7 a	144.3 a	52.8 b	48.4 b
Tergitol 5 mL·L^{-1} at 935.4 L·ha^{-1}	42.70 b	-	119.4 b	-	28.9 c	-
Tergitol 7.5 mL·L^{-1} at 935.4 L·ha^{-1}	33.22 cd	-	150.1 a	-	66.2 ab	-
Tergitol 10 mL·L^{-1} at 935.4 L·ha^{-1}	29.44 de	-	139.4 ab	-	64.8 ab	-

[z] Mean separation within columns by LSD at 0.05 level. [y] Trees were at 85% bloom in 'August Lady' and in 0.75% bloom in 'Zee Lady'

Table 3. Effects of Tergitol on 'July Red Nectarine' Fruit Set, weight, color, russeting, and yield in 2005 [zyx].

Treatment	Fruit Set (%)	Fruit wt (g)	Color (1-5)	Russeting (%)	Yield (kg/tree)
Control	45.55 a	147.5 c	1.27 a	10.11 b	99.9 a
20 mL·L^{-1} Lime Sulfur and 20 mL·L^{-1} Fish Oil at 35% and 85% bloom	50.42 a	174.0 b	1.32 a	9.6 b	98.4 a
Tergitol 7.5 mL·L^{-1} once at 85% bloom	29.76 b	195.7 ab	1.29 a	14.76 ab	75.7 a
Tergitol 10 mL·L^{-1} once at 85% bloom	30.89 b	173.5 b	1.30 a	9.70 b	82.4 a
Tergitol 7.5 mL·L^{-1} at 35% and 85% bloom	15.510 c	206.9 a	1.25 a	17.35 a	72.4 a
Tergitol 10 mL·L^{-1} at 35% and 85% bloom	12.310 c	206.1 a	1.29 a	14.63 ab	91.3 a

[z] Mean separation within columns by LSD at 0.05 levels. [y] All applications were made at a rate of 1870.8 L·ha^{-1}. [x] Fruit color: 1= Green, progressively to 5= red.