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Effect of Aminoethoxyvinylglycine and Surfactants on Preharvest Drop, Maturity, and Fruit Quality of Two Processing Peach Cultivars

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Abstract. The effect of aminoethoxyvinylglycine (AVG), commercially available as ReTain, and three organo-silicone surfactants were evaluated in a series of four experiments over a 2-year period in two commercial peach orchards. Four rates of AVG (0, 66, 132, and 264 mg·L^{-1} AVG; all applied with 0.05% Sylgard 309) and three surfactants (0.05% Sylgard 309; 0.05% Regulaid; and 0.50% LI-700; all applied with 132 mg·L^{-1} AVG) were applied to 'Venture' and 'Babygold 7' peach trees 10 days before first harvest. Fruit were harvested according to commercial standard maturation criteria of background color, suture filling, and fruit size. Treatments were assessed in relation to fruit maturity, delay in harvest, fruit size and yield, fruit quality (flesh firmness and brix), as well as fruit quality following 2 weeks of cold storage. Based on sequential harvest data, the maturation of the AVG treated trees was delayed by about 3 to 4 days. Fruit from AVG treated trees were firmer at harvest and 2 weeks following cold storage at 2°C. However, no additional increase in fruit size or yield was detected. In addition, the addition of a surfactant was not necessary for AVG to be efficacious for delaying maturity and enhancing firmness when applied at 132 mg·L^{-1} AVG. However, when the three surfactants were compared, Regulaid and Li 700 advanced color development in one experiment and Li-700 resulted in firmer fruit in another. Aminoethoxyvinylglycine applications to the clingstone cultivars 'Venture' and 'Babygold 7' can be used successfully to manage harvest activities by delaying the onset of picking and improving fruit firmness.

Fruit softening and other ethylene-mediated processes in peach are correlated with an increase in 1-amino-cyclopropane-carboxylate (ACC) synthase (Tonutti et al., 1977). Aminoethoxyvinylglycine (AVG) is a plant growth bio-substance known to competitively inhibit ACC synthase, a rate limiting enzyme in the ethylene biosynthesis pathway. Research on ReTain (Valent BioSciences, Chicago, Ill.), a commercial formulation of AVG (15 % w/w), was developed and first registered for use on apples (Autio and Bramlage, 1982; Bangerth, 1978; Greene, 2002; Greene and Schupp, 2004; Schupp and Greene, 2004). The merits of using AVG on other climacteric fruit, such as peaches, is not well understood. Nonmelting processing peach cultivars, grown principally for the processing industry, would benefit from the same advantages that AVG offers for apples—a compressed harvest window for multiple-pick cultivars, improved firmness, storage potential, fruit size, fruit removal force, and reduced preharvest fruit drop. In addition, if preharvest softening of peaches could be delayed, it not only could provide growers more time to harvest but also might allow additional fruit growth and reduced physical damage.

In previous research on 'Redhaven' peach trees, AVG applied at 500 mg·L^{-1} at the end of stage I to midstage III of fruit growth had little effect on fruit maturity and fruit quality (Byers, 1997). However, in another study on 'Mibaekdo' peach (Kim et al., 2004), AVG applied at rates ranging from 100 to 200 mg·L^{-1}, 21 to 28 d before first harvest delayed fruit maturity by about 3 d and reduced preharvest fruit drop. In addition, Vizzotto et al. (2002) found that AVG, applied at rates ranging from 62.5 to 250 mg·L^{-1} 10 d before harvest to 'Redhaven' peach trees, delayed the onset of fruit ethylene evolution, reduced fruit drop, delayed fruit softening, and slightly increased soluble solids. Furthermore, Singh et al (2003) found that when AVG, applied at 125 mg·L^{-1}, 5 to 15 d before harvest to several fresh market cultivars, extended the harvest period, delayed fruit maturity, increased fruit firmness, and total soluble solids and in several, but not all cultivars. AVG has also been used successfully as a postharvest dip to delay softening and enhance the shelf-life of peaches (Byers, 1997; Garner et al., 2001). The literature overall indicates that for both apple and peach, the effects of AVG are influenced by concentration, time application with respect to harvest, and with cultivar (Autio and Bramlage, 1982).

The objectives of this study were to measure the fruit quality and yield benefits of AVG applied at various rates (0, 66, 132, and 264 mg·L^{-1}), and to compare three organo-silicone based surfactants (Sylgard 309; Regulaid; and LI-700) at a single rate of AVG, on 'Venture' and 'Babygold 7' peaches, two processing cultivars grown commercially in the Niagara Peninsula. Information on the benefits of AVG on these two processing cultivars is lacking, as is efficacy data on surfactants that are registered in Canada and that could be potentially be used with the commercial formulation, ReTain.

Materials and Methods

Experiment 1. A commercial block of 4-yr-old 'Venture' peach trees grafted on 'Bailey' rootstock and located in St. David's, Ont., was used for this study. Trees were spaced at 3.7 × 4.5 m (500 trees/ha) and trained to a free-standing central leader, without irrigation. Standard commercial orchard management practices for the region were used (OMAF, 2004). Four rates of AVG were applied by handgun to single trees using a research sprayer set at 1379 kPa. To minimize spray drift, experimental units were separated by at least one guard tree. Treatments consisted of a) water, no AVG; b) 66 mg·L^{-1} AVG; c)132 mg·L^{-1} AVG, 264 mg·L^{-1} AVG. All treatments including the control, contained 0.05% Sylgard 309 nonionic organo-silicone surfactant (Dow Corning Canada Inc, Toronto) and were applied on 31 Aug. 2002, 10 d before the anticipated first harvest date.

For Expts. 1 and 2, the number of dropped fruit were counted on 4, 6, 9, 12, and 16 Sept. 2002. Fruit were harvested, weighed and counted on 6, 9, 12, and 16 Sept. based on similar visual background color. On each harvest date, fruit quality (fruit weight, firmness, soluble solids, percent surface red color, ground and blush color) was measured on 10 unblemished, sound fruit. On 9 and 12 Sept., 10 unblemished, sound fruit were also randomly collected and stored at 2 °C for 2 weeks to determine treatments effects on fruit storage potential. At the end of the growing season, trunk circumference was measured and trunk cross sectional area and crop load calculated.

Experiment 2. In the same commercial block as Expt. 1 (same cultivar, spacing, tree age) three spray surfactants were compared at the common rate of 132 mg·L^{-1} AVG. The surfactant treatments were applied by handgun using the same methods as Experiment 1. Treatments consisted of a) 132 mg·L^{-1} AVG, no surfactant; b) 132 mg·L^{-1} AVG plus 0.05% Sylgard 309; c) 132 mg·L^{-1} AVG plus 0.05% Regulaid (Kalo Inc, Overland Park, KS), and; 4) 132 mg·L^{-1} AVG. and 0.50% LI-700 (Loveland Industries, Greeley, Colo.), were replicated five times, and were applied on 31 Aug. 2002. Fruit drop, yield, and quality data recorded were identical to Expt. 1.

Experiment 3. In 2003, a commercial block of 7-year-old 'Venture' peach trees grafted on 'Bailey' rootstock located in Vineland was used for this study. Trees were spaced 3.4 × 5.5 m, were not trickle irrigated and trained to a free-standing central leader.

A randomized complete block design was used with seven treatments and four single-tree replications. Experimental units were separated

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by a guard tree on each side to minimize spray drift. Treatments consisted of 1) surfactant only; 2) 66 mg·L^{-1} + 0.05% Sylgard 309; 3) 132 mg·L^{-1} + 0.05% Sylgard 309; 4) 264 mg·L^{-1} + 0.05% Sylgard 309; 5) 132 mg·L^{-1} + no surfactant; 6) mg·L^{-1} + 0.05% Regulaid; and 7) 132 mg·L^{-1} + 0.5% Li-700. Spray treatments were applied 3 Sept. using the same methods described in Expt. 1. At each of five successive dates (10, 15, 18, 22, and 24 Sept.) naturally abscised fruit were weighed and counted (and discarded). At each of four dates (15, 18, 22, and 24 Sept.), mature fruit were harvested on a uniform background color and their weight and number recorded. On each of the harvest dates, a random subsample of 10 fruit (free on split pits, insect damage, bruising, etc) were collected for fruit quality determination. On 18 and 22 Sept., 10 unblemished, sound fruit were also collected for their storage quality potential after 2 weeks in regular air storage (2 °C).

Experiment 4. In the same commercial orchard described in Expt. 3, a block of 6-yr-old 'Babygold 7' peaches on Bailey seedling rootstock planted at a spacing of 2.7 × 5.5 m was also used in this experiment. Cultural techniques, experimental design, and treatments were the same as those used in Expt. 3, with the exception that treatments were replicated five times. The first commercial harvest dates of 'Babygold 7' was 18 Sept.

Fruit quality. Surface blush color and ground color were measured on each 10 (Expts. 1 and 2) or 15 fruit (Expts. 3 and 4) sample using a tristimulus colorimeter (model CR-300; Minolta, Toronto). Fruit chromaticity was recorded in the L*, a*, b* space coordinates and the Chroma C* and hue angle (h°) were calculated (McGuire, 1992). Flesh firmness was evaluated on each fruit using an electronic

Table 1. Effect of AVG rate and various surfactants on yield components and trunk cross-sectional area of 'Venture' peaches in 2002.

Treatment	Total harvested fruit/tree (no.)	Total yield (kg/tree)	Crop load (no. fruit/cm^2)	Trunk cross-sectional area (cm^2)
Experiment 1—Rate of ReTain[z]				
0 mg.L-1	59.4	9.3	2.3	30.9
66 mg.L-1	61.0	10.3	2.6	28.6
132 mg.L-1	54.8	9.1	2.3	27.8
264 mg.L-1	51.6	8.4	2.2	26.7
Signifigancez	NS	NS	NS	NS
LSD (p = 0.05)	33.17	5.58	1.1	5.10
P	0.908	0.903	0.9	0.368
Experiment 2—Surfactant[y]				
None	57.8	10.0	2.3	30.5
0.05% Sylgard 309	65.8	11.4	2.8	29.4
0.05 % Regulaid	63.5	10.7	2.5	31.2
0.50% LI 700	64.8	11.6	2.3	33.4
Signifigancez	NS	NS	NS	NS
LSD (p = 0.05)	39.1	6.3	1.5	10.1
P	0.966	0.932	0.868	0.831

[z]All treatments in Expt. 1 include 0.05 % Sylgard 309 surfactant.
[y]All treatments in Expt. 2 include 132 mg·L^{-1} of Retain.
[NS,*,**,***]Nonsignificant or signifigant differences at P = 0.05, 0.01, or 0.001 respectively. Mean separation within columns by LSD at P = 0.05.

Table 2. Effect of AVG rate and various surfactants on the percent of harvested fruit by date, mean fruit weight, and preharvest fruit drop of 'Venture' peaches in 2002.

	Fruit harvested (% of total harvested by no.)			Cumulative fruit harvest (% of total harvested by no.)			Mean fruit wt (g/fruit)			Cumulative fruit drop [% dropped of total fruit no. (harvested+dropped)]				
Treatment	9 Sept.	12 Sept.	16 Sept.	9 Sept.	12 Sept.	16 Sept.	9 Sept.	12 Sept.	16 Sept.	4 Sept.	6 Sept.	9 Sept.	12 Sept.	16 Sept.
Experiment 1—Rate of ReTain[z]														
0 mg·L^{-1}	72	28	0	72	100	100	160.9	154.3	---	6	9	14	19	18
66 mg·L^{-1}	43	40	17	43	83	100	166.6	176.2	155.6	5	6	10	13	16
132 mg·L^{-1}	49	32	19	49	81	100	157.8	178.8	158.1	5	7	11	14	16
264 mg·L^{-1}	47	25	28	47	72	100	160.6	174.1	170.5	5	7	9	11	15
Signifigance	*	NS	*	*	*	---	NS	NS	NS	NS	NS	NS	NS	NS
LSD (p = 0.05)	19	15	17	19	17	---	25.9	27.8	22.7	7.2	8.8	11.4	11.8	11.8
P	0	0	0	0	0	---	0.9	0.3	0.3	1.0	0.9	0.8	0.5	0.9
Experiment 2—Surfactant[y]														
None	42	27	31	42	69	100	174.6	167.0	174.0	6	6	7	10	14
0.05% Sylgard 309	44	24	32	44	68	100	167.6	189.3	176.5	6	7	12	16	21
0.05 % Regulaid	42	29	30	42	70	100	173.8	188.4	156.7	4	4	7	11	18
0.50% LI 700	42	48	9	42	91	100	175.1	177.6	187.7	4	4	8	12	13
Signifigancez	NS	**	NS	NS	NS	---	NS	NS	NS	NS	NS	NS	NS	NS
LSD (p = 0.05)	22	13	26	22	26	---	35.4	35.6	45.9	7.6	8.3	10.8	9.8	10.8
P	0.996	0.007	0.23	0.996	0.23	---	0.959	0.482	0.521	0.92	0.885	0.677	0.589	0.36

[z]All treatments in Experiment 1 include 0.05 % Sylgard 309 surfactant.
[y]All treatments in Experiment 2 include 132 mg·L^{-1} of Retain.
[NS,*,**,***]Nonsignificant or signifigant differences at P = 0.05, 0.01, or 0.001 respectively. Mean separation within columns by LSD at P = 0.05.

Table 3. Effect of AVG rate and various surfactants on fruit firmness, soluble solids, and percent surface red colour of 'Venture' peaches in 2002.

	Fruit firmness (N)					Soluble solids (°Brix)					Fruit surface with blush (red) (%)				
Treatment	9 Sept.	12 Sept.	16 Sept.	24 Sept.[z]	26 Sept.[z]	9 Sept.	12 Sept.	16 Sept.	24 Sept.	26 Sept.	9 Sept.	12 Sept.	16 Sept.	24 Sept.	26 Sept.
Experiment 1—Rate of ReTain[y]															
0 mg·L^{-1}	59.7	63.9	---	68.5	70.8	15.2	15.1	----	12.4	14.5	46	35	----	27	22
66 mg·L^{-1}	75.0	74.5	64.3	86.7	79.0	13.4	14.6	15.6	12.5	14.1	53	46	40	36	36
132 mg·L^{-1}	81.0	76.3	74.1	88.5	86.6	14.5	14.7	14.0	14.0	15.2	58	59	45	44	48
264 mg·L^{-1}	86.5	94.5	73.8	94.0	94.2	15.1	15.1	16.2	12.7	16.0	57	54	57	46	49
Signifigance	***	***	**	***	***	NS	NS	NS	NS	NS	**	***	**	***	***
LSD (p = 0.05)	5.9	6.0	6.1	7.4	7.1	2.46	3.72	4.40	2.52	4.71	6	8	8	7	9
P value	0.000	0.000	0.001	0.000	0.000	0.404	0.989	0.681	0.526	0.456	0.001	0.000	0.001	0.000	0.000
Experiment 2—Surfactant[x]															
None	91.8	89.2	74.3	99.0	82.1	13.8	14.5	14.7	14.0	13.5	50	43	49	36	45
0.05% Sylgard 309	94.8	87.6	74.2	95.2	82.8	10.0	13.7	13.3	13.6	14.5	49	46	43	38	44
0.05 % Regulaid	88.0	81.2	69.4	92.0	82.6	12.7	14.2	14.3	13.2	13.1	37	41	32	35	33
0.50% LI 700	86.5	79.5	61.4	89.6	75.5	13.4	14.5	13.6	14.0	14.7	36	37	39	32	34
Signifigance	*	*	*	*	NS	NS	NS	NS	NS	NS	***	***	*	*	**
LSD (p = 0.05)	6.3	7.6	8.9	7.2	7.0	3.78	3.29	5.22	4.03	4.20	6	8	8	7	8
P	0.044	0.019	0.011	0.047	0.052	0.248	0.939	0.910	0.960	0.796	0.000	0.000	0.010	0.030	0.001

[z]Two weeks after cold storage.
[y]All treatments in Expt. 1 include 0.05 % Sylgard 309 surfactant.
[x]All treatments in Expt. 2 include 132 mg·L^{-1} of Retain.
[NS,*,**,***]Nonsignificant or signifigant differences at P = 0.05, 0.01, or 0.001 respectively. Mean separation within columns by LSD at P = 0.05.

penetrometer (fruit texture analyzer model GS-14; GÜSS, South Africa) equipped with a 11 mm probe. Two measurements were made on opposite sides after a about 2 mm tangential section of skin was peeled from the equator of the fruit. Fruit removed from cold storage were first warmed to 20 °C before measuring fruit firmness. A composite juice sample from each of the fruit was then collected using a hand juicer and analyzed for percent Brix using a temperature compensating digital refractometer (Atago, Japan).

Table 4. Effect of AVG rate and various surfactants on fruit blush color of 'Venture' peaches in 2002.

	Blush color L*					Blush color chroma (C*)					Blush color hue angle (Ho)				
Treatment	9 Sept.	12 Sept.	16 Sept.	24 Sept.	26 Sept.	9 Sept.	12 Sept.	16 Sept.	24 Sept.	26 Sept.	9 Sept.	12 Sept.	16 Sept.	24 Sept.	26 Sept.
Experiment 1—Rate of ReTain[z]															
0 mg·L^{-1}	43.0	45.5	----	47.3	47.5	29.7	30.5	----	28.1	29.7	35.7	38.9	----	39.6	44.0
66 mg·L^{-1}	42.0	41.5	43.9	44.2	43.8	26.4	28.4	27.8	25.7	25.8	31.7	30.9	34.4	34.9	33.3
132 mg·L^{-1}	42.2	41.3	46.0	44.0	44.5	27.5	27.0	27.5	21.9	25.0	35.9	30.9	39.6	33.8	34.4
264 mg·L^{-1}	42.0	43.7	43.2	43.9	46.0	25.7	27.9	25.8	25.4	23.3	32.4	36.6	32.9	35.7	38.4
Signifigance	NS	***	**	***	*	**	NS	NS	***	*	NS	**	**	NS	*
LSD (p = 0.05)	1.6	1.9	1.5	1.7	2.3	2.1	2.6	2.2	2.5	2.9	4.0	4.1	3.6	4.5	5.9
P	0.541	0.000	0.001	0.000	0.048	0.002	0.127	0.108	0.000	0.010	0.074	0.000	0.001	0.056	0.017
Experiment 2—Surfactant[y]															
None	39.8	43.6	44.1	45.8	43.2	31.4	29.9	27.2	26.8	26.6	36.1	37.1	32.9	37.7	33.2
0.05% Sylgard 309	39.4	44.7	47.2	46.3	44.1	27.7	30.2	32.1	26.5	27.0	33.3	41.0	42.5	40.6	36.6
0.05 % Regulaid	42.7	43.2	45.6	46.8	47.2	31.2	30.9	32.4	26.7	27.4	42.6	37.5	38.4	39.4	40.6
0.50% LI 700	44.6	45.5	48.0	47.4	47.0	32.5	34.3	33.0	28.7	31.8	45.0	41.4	43.7	42.5	41.9
Signifigance	***	NS	**	NS	**	**	*	***	NS	NS	**	NS	***	NS	***
LSD (p = 0.05)	2.30	2.72	2.17	1.79	2.17	2.92	2.95	2.77	2.73	3.17	5.99	6.88	5.11	5.15	5.48
P	0.000	0.396	0.001	0.286	0.000	0.001	0.013	0.000	0.348	0.241	0.000	0.630	0.000	0.310	0.000

[z]All treatments in Expt. 1 include 0.05 % Sylgard 309 surfactant.
[y]All treatments in Expt. 2 include 132 mg·L^{-1} of Retain.
[NS,*,**,***]Nonsignificant or signifigant differences at P = 0.05, 0.01, or 0.001 respectively. Mean separation within columns by LSD at P = 0.05.

Table 5. Effect of AVG rate and various surfactants on fruit ground color of 'Venture' peaches in 2002.

	Ground color L*					Ground color chroma (C*)					Ground color hue angle (Ho)				
Treatment	9 Sept.	12 Sept.	16 Sept.	24 Sept.	26 Sept.	9 Sept.	12 Sept.	16 Sept.	24 Sept.	26 Sept.	9 Sept.	12 Sept.	16 Sept.	24 Sept.	26 Sept.
Experiment 1 - Rate of ReTain[z]															
0 mg·L^{-1}	68.3	67.2	----	69.1	67.8	48.8	47.4	----	46.7	47.0	225.5	167.1	----	174.2	161.5
66 mg·L^{-1}	68.8	69.2	70.5	68.5	69.4	47.4	49.0	49.7	45.0	47.3	210.8	212.4	250.7	209.2	196.3
132 mg·L^{-1}	67.7	68.7	69.7	68.3	69.1	46.4	47.8	47.6	42.3	44.1	209.2	252.0	228.3	234.6	214.6
264 mg·L^{-1}	68.1	67.8	67.7	66.7	68.5	46.4	47.0	46.6	42.2	43.8	270.4	313.7	267.5	241.7	241.5
Signifigance	ns	**	**	***	**	*	ns	*	***	**	ns	***	ns	ns	***
LSD (p = 0.05)	0.8	1.2	1.3	1.0	1.2	1.7	1.9	1.6	1.8	1.9	58.0	36.7	40.4	65.3	29.5
P	0.063	0.008	0.003	0.000	0.005	0.013	0.098	0.042	0.000	0.000	0.133	0.000	0.122	0.169	0.000
Experiment 2 - Surfactant[y]															
None	67.1	67.7	69.7	68.8	68.6	46.4	47.5	47.5	45.0	46.2	204.1	258.0	209.5	195.9	211.8
0.05% Sylgard 309	66.5	67.6	70.1	68.8	68.9	45.1	46.7	48.5	42.5	46.4	317.7	246.4	240.1	219.2	280.0
0.05 % Regulaid	67.3	68.1	69.6	69.0	69.5	45.7	47.7	49.1	43.6	46.4	269.8	252.4	203.5	249.3	210.9
0.50% LI 700	67.7	68.3	69.9	69.9	69.5	46.7	48.4	49.3	45.0	47.9	232.0	221.8	193.4	230.7	199.9
Signifigancez	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	**	ns	ns	ns	***
LSD (p = 0.05)	0.9	1.1	1.2	1.1	1.0	2.2	2.1	2.3	1.9	2.1	65.4	49.2	47.9	89.0	34.8
P	0.089	0.442	0.728	0.113	0.213	0.467	0.313	0.721	0.014	0.241	0.005	0.390	0.115	0.719	0.000

[z]All treatments in Expt. 1 include 0.05 % Sylgard 309 surfactant.
[y]All treatments in Expt. 2 include 132 mg·L^{-1} of Retain.
[NS,*,**,***]Nonsignificant or signifigant differences at P = 0.05, 0.01, or 0.001 respectively. Mean separation within columns by LSD at P = 0.05.

Table 6. Effect of AVG rate and surfactants on yield components and trunk cross-sectional area of 'Babygold 7'and 'Venture' in 2003.

Treatment	Surfactant (%)	Total fruit harvested per tree (no.)	Total yield/tree (dropped and harvested fruit) (kg/tree)	Total yield of harvested fruit (kg/tree)	Crop load (no. fruit/cm^2)	Mean fruit wt of harvest fruit (g)	Trunk cross-sectional area (cm^2)
Babygold 7							
0 mg·L^{-1}	0.05 Sylgard 309	169	28.6	23.7	6.6	140	31.4
66 mg·L^{-1}	0.05 Sylgard 309	169	33.2	27.3	5.9	161	36.5
132 mg·L^{-1}	0.05 Sylgard 309	157	26.9	23.0	6.3	150	28.8
264 mg·L^{-1}	0.05 Sylgard 309	180	31.7	29.1	6.1	164	32.8
132 mg·L^{-1}	None	186	34.7	31.4	7.1	174	31.0
132 mg·L^{-1}	0.05 Regulaid	181	34.5	31.1	5.5	175	37.6
132 mg·L^{-1}	0.5 Li-700	146	31.3	28.0	5.2	195	32.9
Signifigance		NS	NS	NS	NS	*	NS
LSD (p = 0.05)		61	11.0	9.9	2.30	31	9.4
P		0.825	0.725	0.489	0.656	0.028	0.490
Venture							
0 mg·L^{-1}	0.05 Sylgard 309	245	46.7	40.5	5.5	166	52.3
66 mg·L^{-1}	0.05 Sylgard 309	204	41.4	35.6	4.3	174	57.3
132 mg·L^{-1}	0.05 Sylgard 309	223	41.4	35.8	5.1	161	51.9
264 mg·L^{-1}	0.05 Sylgard 309	244	49.2	42.8	5.0	176	58.0
132 mg·L^{-1}	None	257	45.8	41.5	5.4	163	54.4
132 mg·L^{-1}	0.05 Regulaid	227	43.0	37.7	5.8	168	46.4
132 mg·L^{-1}	0.5 Li-700	195	41.1	34.9	4.5	182	53.1
Signifigance		NS	NS	NS	NS	NS	NS
LSD (p = 0.05)		74	11.4	10.6	1.4	34	9.2
P		0.569	0.662	0.590	0.277	0.856	0.217

[NS,*,**,***]Nonsignificant or signifigant differences at P = 0.05, 0.01, or 0.001 respectively. Mean separation within columns by LSD at P = 0.05.

All data were subjected to analysis of variance using SAS PROC GLM procedure (Cary, NC). Mean separation using Protected Fishers Least Significance Difference was used to separate treatment means.

Results and Discussion

In Expts. 1 and 2, the rate of AVG and type of surfactant had no effect on the total number of fruit harvested per tree, total yield per tree, crop load, or trunk cross-sectional area (Table 1). However, AVG did delay the onset of fruit maturity by about 4 d (Table 2). This response was similar at all rates of AVG (66 to 246 mg·L^{-1}) and independent of the presence of surfactants when AVG was sprayed at a concentration of 132 mg·L^{-1} (Table 2). For instance, on 12 Sept. all fruit had been harvested from the untreated control trees, while 72% to 83% had been harvested from trees treated with AVG and Sylgard 309 surfactant. Furthermore, the rate of AVG or type of surfactant had no effect on fruit drop either preharvest (4 and 6 Sept.) or during the harvest period (Table 2).

AVG had a very positive influence on fruit firmness on 9 Sept. (P = 0.001), 12 Sept. (P = 0.001), 16 Sept. (P = 0.01), and 2 weeks after air storage at 2 °C (P = 0.001), even though fruit were harvested with similar background colors (Table 3). In general, the firmness response was rate dependent and increased in a curvilinear fashion with increasing rates of AVG. On the first harvest date, there was a 26 N difference in firmness between fruit treated with 0 and 246 mg·L^{-1} AVG, and this difference was maintained after 2 weeks in cold storage. Interestingly, fruit firmness appeared to increase after cold storage, perhaps due to slight dehydration during storage. The type of surfactant also had a significant effect on fruit firmness (P = 0.05). Trees receiving AVG with either no surfactant or 0.05% Sylgard 309 had the firmest fruit, while trees receiving AVG with 0.05% Regulaid or 0.50% Li 700 had consistently less firm fruit at the three harvest dates and in fruit which were harvested on 12 Sept. and stored for 2 weeks.

Neither rate of AVG nor type of surfactant significantly affected fruit soluble solids at any of the harvest dates or on fruit after cold storage (Table 3).

The percentage of surface red color on 9 Sept. (P = 0.01), 12 Sept. (P = 0.001), 16 Sept. (P = 0.01), and 2 weeks after air storage at 2 °C was influenced by the rate of AVG (P = 0.001)

Table 7. Effect of AVG rate and various surfactants on percent fruit harvested, cumulative fruit harvested, mean fruit weight of 'Venture' and 'Babygold 7' in 2003.

		Fruit harvested (% of total by number)			Cumulative fruit harvested (% of total harvested by no.)					Mean fruit wt of harvested fruit (g/fruit)			Cumulative fruit drop [% dropped of total fruit no. (harvested+dropped)]					
ReTain	Surfactant (%)	15 Sept.	18 Sept.	22 Sept	25 Sept.	15 Sept.	18 Sept.	22 Sept.	25 Sept.	15 Sept.	18 Sept.	22 Sept	25 Sept.	10 Sept.	15 Sept.	18 Sept.	22 Sept.	25 Sept.
Babygold 7																		
0 mg·L^{-1}	0.05 Sylgard 309	---	36	55	9	0	36	91	100	---	141	148	115	1.6	4.2	7.6	14.6	15.9
66 mg·L^{-1}	0.05 Sylgard 309	-	21	43	36	0	21	64	100	---	182	163	147	2.3	4.3	6.7	12.1	18.1
132 mg·L^{-1}	0.05 Sylgard 309	-	25	32	43	0	25	57	100	---	160	155	143	2.1	2.5	3.7	10.2	16.3
264 mg·L^{-1}	0.05 Sylgard 309	---	20	31	49	0	20	51	100	---	177	178	155	1.2	2.1	4.6	6.5	8.5
132 mg·L^{-1}	None	-	19	34	47	0	19	53	100	---	180	183	161	1.6	3.0	5.3	8.1	11.5
132 mg·L^{-1}	0.05 Regulaid	---	19	34	47	0	19	53	100	---	189	199	160	1.3	2.3	4.2	6.3	10.8
132 mg·L^{-1}	0.5 Li-700	---	26	34	40	0	26	60	100	---	174	279	162	2.2	3.9	7.6	10.7	15.4
Signifigance		---	NS	**	**	NS	NS	**	---	---	NS	NS	NS	NS	NS	NS	NS	NS
LSD (p = 0.05)		---	15.7	20.6	20.6	---	15.7	20.6	---	---	37.03	85.63	26.16	1.92	2.82	4.00	6.03	7.89
P		---	0.263	0.007	0.007	---	0.263	0.007	---	---	0.179	0.068	0.088	0.823	0.479	0.250	0.081	0.161
Venture																		
0 mg·L^{-1}	0.05 Sylgard 309	33	15	33	19	33	48	82	100	180	180	157	133	2.0	4.9	6.5	12.7	16.3
66 mg·L^{-1}	0.05 Sylgard 309	17	12	25	46	17	29	54	100	187	182	181	163	2.2	3.0	4.3	6.9	16.2
132 mg·L^{-1}	0.05 Sylgard 309	12	9	38	41	12	21	59	100	182	171	165	151	1.5	2.2	3.0	8.2	15.3
264 mg·L^{-1}	0.05 Sylgard 309	11	6	18	65	11	17	35	100	191	187	204	166	2.5	4.3	4.8	7.0	15.2
132 mg·L^{-1}	None	15	9	34	43	15	24	57	100	181	169	173	150	2.7	3.8	4.3	6.7	11.8
132 mg·L^{-1}	0.05 Regulaid	21	10	39	30	21	32	71	100	175	170	171	159	2.4	2.7	3.3	7.7	15.5
132 mg·L^{-1}	0.5 Li-700	19	12	27	42	19	31	58	100	196	184	197	164	3.1	4.9	6.0	10.3	17.2
Signifigance		NS	NS	NS	NS	NS	NS	*	---	NS	NS	NS	NS	NS	NS	NS	NS	NS
LSD (p = 0.05)		13.9	19.3	25.9	25.9	13.9	19.3	25.5	---	38.42	33.73	34.99	34.01	2.97	4.12	4.96	5.46	7.99
P		0.054	0.407	0.107	0.107	0.054	0.065	0.042	---	0.925	0.845	0.104	0.546	0.950	0.709	0.742	0.248	0.870

NS,*,**,***Nonsignificant or signifigant differences at P = 0.05, 0.01, or 0.001 respectively. Mean separation within columns by LSD at P = 0.05.

Table 8. Effect of AVG rate and various surfactants on fruit firmness of 'Venture' and 'Babygold 7' in 2003.

		Firmness (N)					
						After storage	
Treatment	Surfactant (%)	15 Sept.	19 Sept.	22 Sept.	25 Sept.	6 Oct.	10 Oct.
Babygold 7							
0 mg·L^{-1}	0.05 Sylgard 309	---	56.1	46.7	40.2	52.3	38.8
66 mg·L^{-1}	0.05 Sylgard 309	---	65.0	58.2	47.5	61.1	46.7
132 mg·L^{-1}	0.05 Sylgard 309	---	69.3	60.4	52.8	69.3	51.9
264 mg·L^{-1}	0.05 Sylgard 309	---	78.7	65.0	64.8	74.9	61.0
132 mg·L^{-1}	None	---	72.1	61.2	54.2	69.5	51.0
132 mg·L^{-1}	0.05 Regulaid	---	73.7	61.5	51.4	70.9	51.1
132 mg·L^{-1}	0.5 Li-700	-	77.5	63.6	57.3	75.1	52.6
Signifigance		---	***	***	***	***	***
LSD (p = 0.05)		---	3.5	3.0	3.6	3.6	3.3
P		---	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Venture							
0 mg·L^{-1}	0.05 Sylgard 309	58.1	57.7	48.7	46.2	56.2	48.8
66 mg·L^{-1}	0.05 Sylgard 309	70.3	70.7	63.7	58.0	73.9	58.5
132 mg·L^{-1}	0.05 Sylgard 309	70.7	69.1	64.0	56.3	72.1	59.8
264 mg·L^{-1}	0.05 Sylgard 309	83.0	82.3	73.3	65.0	80.6	62.7
132 mg·L^{-1}	None	64.9	67.6	55.5	49.4	56.6	49.1
132 mg·L^{-1}	0.05 Regulaid	66.5	68.5	56.8	48.6	68.4	50.5
132 mg·L^{-1}	0.5 Li-700	67.6	72.7	62.5	51.7	68.0	51.0
Signifigance		***	***	***	***	***	***
LSD (p = 0.05)		4.7	4.0	3.6	3.9	5.2	4.2
P		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

NS,*,**,***Nonsignificant or signifigant differences at P = 0.05, 0.01, or 0.001 respectively. Mean separation within columns by LSD at P = 0.05.

(Table 3). Percentage of surface red increased with increasing rates of AVG. Trees receiving AVG with either no surfactant or 0.05% Sylgard 309 had more surface red color than fruit from trees receiving AVG with 0.05% Regulaid or 0.50% Li 700.

Fruit blush color L*, chroma and hue angle values were generally lower on fruit treated with AVG, regardless of the rate of AVG applied (Table 4). Also, trees treated with Regulaid and Li 700 had higher blush L*, chroma and hue angle values. Likewise, there was a significant rate effect on fruit ground color L*, chroma and hue angle values; when this effect was significant at a particular harvest date, the L* and chroma values were lower, and hue angle values were higher, at higher rates of AVG.

The influence of surfactants on fruit ground color L*, chroma and hue angle values were inconsistent (Table 5).

In Expts. 3 and 4, the rate of AVG and type surfactant had no significant effect on the total number of fruit harvested per tree, total yield per tree, crop load, or trunk cross-sectional area for both 'Babygold 7' and 'Venture' (Table 6). 'Babygold 7' fruit treated with AVG appeared to have greater mean fruit weight, however, when fruit weight was analysed with crop load as a co-variate, this effect was not significant, indicating that fruit size was influenced more by crop load than AVG treatment. AVG did however significantly delay the fruit maturity for 'Babygold 7' and 'Venture' by about 3 and 4 d, respectively (Table 7). There was no significant AVG or surfactant effect on mean fruit weight or fruit drop at any of the harvest dates for either cultivar (Table 7).

As was found in Expts. 1 and 2, AVG had a significant effect on fruit firmness during harvest (Fig. 1) and after storage (Table 8) for both 'Venture' and 'Babygold 7'. Firmness increased in a quadratic fashion with increasing rates of AVG at all harvest dates, with the exception of 'Babygold 7' harvest on 25 Sept., which increased in a linear fashion (Fig 1a). The effect of surfactants was inconsistent and much less dramatic than the rate effect of AVG (Table 8). 'Babygold 7' and 'Venture' trees treated with 0.05% Li-700, generally had fruit with greater firmness than trees treated with either 0.05% Regulaid or no surfactant, when compared at

Table 9. Effect of AVG rate and various surfactants on fruit blush color of 'Babygold 7' and 'Venture' peaches in 2003.

		Blush color																		
		L*						Chroma (C*)							Hue angle (Ho)						
		After storage						After storage							After storage						
Treatment	Surfactant (%)	15 Sept.	19 Sept.	22 Sept.	25 Sept.	6 Oct.	10 Oct.	15 Sept.	19 Sept.	22 Sept.	25 Sept.	6 Oct.	10 Oct.	14 Oct.	15 Sept.	19 Sept.	22 Sept.	25 Sept.	6 Oct.	10 Oct.	14 Oct.
Babygold 7																					
0 mg·L^{-1}	0.05 Sylgard 309	---	48.2	50.3	51.7	47.6	49.9	---	28.8	31.2	35.5	28.4	30.3	35.8	---	35.1	41.8	45.4	34.4	38.9	47.9
66 mg·L^{-1}	0.05 Sylgard 309	---	48.6	49.7	50.2	48.0	47.8	---	29.7	32.8	33.1	29.4	29.8	33.9	---	36.7	41.7	43.2	35.9	35.7	46.2
132 mg·L^{-1}	0.05 Sylgard 309	---	45.3	46.5	46.7	46.6	47.4	---	26.7	29.6	30.4	28.6	28.1	33.2	---	29.5	34.0	36.5	32.9	34.2	44.2
264 mg·L^{-1}	0.05 Sylgard 309	---	45.0	45.6	43.3	44.6	43.5	---	25.1	26.7	26.3	25.7	25.6	28.9	---	29.8	30.9	28.1	28.5	28.3	36.3
132 mg·L^{-1}	None	---	45.3	44.1	45.1	46.0	45.5	---	26.8	26.4	29.1	27.7	26.6	28.0	---	29.8	29.0	31.6	31.5	31.5	31.9
132 mg·L^{-1}	0.05 Regulaid	---	47.8	47.9	48.6	45.6	47.1	---	28.2	30.5	31.1	27.3	28.3	32.7	---	35.0	35.3	37.5	31.5	34.0	42.9
132 mg·L^{-1}	0.5 Li-700	---	46.6	46.0	45.7	46.4	45.9	---	28.1	28.1	28.7	27.7	26.5	30.4	---	31.8	32.3	32.4	31.8	31.5	39.8
Signifigance		---	***	***	***	*	***	---	*	***	***	NS	***	***	---	***	***	***	*	***	***
LSD (p = 0.05)		---	1.83	1.88	1.95	1.80	1.81	---	2.23	1.86	2.05	1.96	2.08	2.86	---	3.56	3.67	3.74	3.29	3.24	5.23
P		---	0.000	<0.0001	<0.0001	0.017	<0.0001	---	0.018	<0.0001	<0.0001	0.067	<0.0001	<0.0001	---	<0.0001	<0.0001	<0.0001	0.004	<0.0001	<0.0001
Venture																					
0 mg·L^{-1}	0.05 Sylgard 309	43.0	49.5	48.1	52.6	46.9	46.3	27.6	29.3	30.8	35.8	29.4	27.0	---	29.5	39.3	38.1	47.5	33.5	32.8	---
66 mg·L^{-1}	0.05 Sylgard 309	43.0	52.3	47.4	49.6	45.2	48.6	25.5	30.8	29.5	32.5	25.8	29.3	---	29.7	48.0	35.8	42.9	31.3	37.5	---
132mg·L^{-1}	0.05 Sylgard 309	42.4	48.7	50.1	51.8	46.8	46.4	27.3	29.7	32.9	35.3	29.2	30.8	---	28.8	36.3	41.2	48.6	34.8	35.1	---
264 mg·L^{-1}	0.05 Sylgard 309	43.4	45.2	49.8	50.3	45.5	46.1	26.1	23.5	29.7	30.8	26.1	25.6	-	30.1	30.6	40.0	44.2	31.5	33.4	---
132 mg·L^{-1}	None	42.9	47.6	50.4	52.9	45.8	45.6	25.6	26.3	32.2	35.8	25.3	27.8	---	29.6	34.8	41.7	49.2	32.3	32.1	---
132 mg·L^{-1}	0.05 Regulaid	43.3	45.8	53.4	54.5	45.2	48.3	26.0	26.2	35.6	37.7	28.2	31.1	---	28.5	31.4	47.8	51.6	30.7	36.9	---
132 mg·L^{-1}	0.5 Li-700	42.6	46.9	50.1	49.2	45.1	45.8	25.7	25.9	31.3	32.2	25.9	28.2	---	28.6	33.7	41.3	42.3	31.0	32.2	---
Signifigance		NS	***	*	NS	NS	*	NS	***	**	**	NS	***	---	NS	***	*	NS	NS	*	---
LSD (p = 0.05)		1.65	2.50	3.27	3.88	2.63	2.11	2.30	3.22	3.07	3.62	3.17	2.79	---	3.04	5.11	6.66	7.54	4.53	3.70	---
P		0.902	<0.0001	0.014	0.124	0.690	0.021	0.428	<0.0001	0.002	0.006	0.183	0.001	---	0.916	<0.0001	0.026	0.153	0.581	0.011	---

^{NS,*,**,***}Nonsignificant or signifigant differences at P = 0.05, 0.01, or 0.001 respectively. Mean separation within columns by LSD at P = 0.05.

Table 10. Effect of AVG rate and various surfactants on fruit ground color of 'Babygold 7' and 'Venture' peaches in 2003

		Blush color																		
		L*						Chroma (C*)							Hue angle (Ho)						
		After storage						After storage							After storage						
Treatment	Surfactant (%)	15 Sept.	19 Sept.	22 Sept.	25 Sept.	6 Oct.	10 Oct.	15 Sept.	19 Sept.	22 Sept.	25 Sept.	6 Oct.	10 Oct.	14 Oct.	15 Sept.	19 Sept.	22 Sept.	25 Sept.	6 Oct.	10 Oct.	14 Oct.
Babygold 7																					
0 mg·L^{-1}	0.05 Sylgard 309	---	71.3	67.8	70.6	70.7	71.6	---	45.8	42.2	46.4	43.1	42.9	44.1	---	84.4	76.9	85.2	79.9	80.4	79.8
66 mg·L^{-1}	0.05 Sylgard 309	---	71.2	69.9	70.5	72.3	71.5	---	44.2	45.1	45.5	43.8	44.7	44.8	---	86.8	86.2	85.8	83.9	82.5	83.5
132 mg·L^{-1}	0.05 Sylgard 309	---	71.0	70.6	69.2	71.3	71.3	---	45.8	45.0	44.7	44.1	43.9	43.7	---	84.6	84.6	84.4	84.3	84.2	79.7
264 mg·L^{-1}	0.05 Sylgard 309	---	70.7	70.0	69.8	70.8	71.1	---	44.0	42.6	43.4	42.8	43.1	42.7	---	87.2	84.0	87.6	83.6	84.8	83.3
132 mg·L^{-1}	None	---	70.6	68.6	68.6	70.5	70.0	---	42.4	42.5	43.1	42.1	42.2	41.5	---	87.5	81.5	83.3	83.5	81.8	77.9
132 mg·L^{-1}	0.05 Regulaid	---	71.0	70.9	70.1	70.8	70.7	---	43.8	43.4	44.9	42.2	43.0	42.6	---	87.4	85.0	85.3	83.0	82.2	80.6
132 mg·L^{-1}	0.5 Li-700	---	70.8	70.5	70.5	71.4	71.4	---	43.4	43.8	44.2	42.4	42.5	41.4	---	90.3	85.9	87.7	84.8	84.4	80.8
Signifigance		---	NS	NS	*	NS	*	---	***	***	***	**	***	***	---	**	***	***	*	***	***
LSD (p = 0.05)		---	1.04	1.82	1.16	1.28	0.92	---	1.62	1.57	1.44	1.24	1.19	1.62	---	2.77	3.27	2.36	2.90	2.08	3.30
P		---	0.882	0.005	0.002	0.078	0.012	---	0.000	<0.0001	0.000	0.003	0.000	<0.0001	---	0.001	<0.0001	0.001	0.020	<0.0001	0.000
Venture																					
0 mg·L^{-1}	0.05 Sylgard 309	70.4	69.6	70.4	69.8	71.5	70.4	47.1	44.8	46.7	49.0	45.6	46.3	---	81.8	80.1	81.9	80.8	80.6	78.2	---
66 mg·L^{-1}	0.05 Sylgard 309	70.2	70.1	71.6	69.7	71.6	70.8	45.8	44.5	46.1	47.3	44.7	45.7	---	85.3	84.7	85.9	83.3	83.6	81.3	---
132 mg·L^{-1}	0.05 Sylgard 309	70.4	71.3	70.9	69.6	77.2	70.6	46.3	45.2	51.3	47.2	46.9	47.0	---	85.3	85.0	85.2	84.8	81.1	79.8	---
264 mg·L^{-1}	0.05 Sylgard 309	70.5	71.0	70.6	68.1	71.9	71.2	43.5	42.9	44.1	44.0	44.4	43.8	---	86.7	88.8	87.5	84.4	86.6	84.7	---
132 mg·L^{-1}	None	68.2	70.7	70.8	68.5	71.0	70.8	42.1	43.0	45.6	46.3	43.2	44.0	---	82.2	86.4	84.4	81.6	83.1	79.7	---
132 mg·L^{-1}	0.05 Regulaid	70.7	71.5	70.3	67.8	71.2	71.0	45.2	45.3	45.6	46.9	45.2	45.6	---	83.9	84.6	81.4	78.7	81.5	80.4	---
132 mg·L^{-1}	0.5 Li-700	69.2	70.5	70.5	69.2	70.5	71.2	43.9	43.2	45.3	47.6	42.9	44.8	---	82.8	88.1	83.7	83.3	82.8	80.6	---
Signifigance		***	*	NS	NS	NS	NS	***	*	*	***	**	***	---	**	***	**	**	NS	***	---
LSD (p = 0.05)		1.19	1.18	1.26	1.48	6.56	0.92	1.44	1.76	4.31	1.57	1.78	1.35	---	2.64	2.63	3.49	3.36	3.78	1.99	---
P		0.000	0.015	0.421	0.062	0.509	0.468	<0.0001	0.014	0.043	<0.0001	0.009	<0.0001	---	0.001	<0.0001	0.008	0.006	0.271	<0.0001	---

^{NS,*,**,***}Nonsignificant or signifigant differences at P = 0.05, 0.01, or 0.001 respectively. Mean separation within columns by LSD at P = 0.05.

the same rate of 132 mg·L^{-1} AVG. This effect was observed for all the harvest dates, although not always statistically significant.

AVG reduced while surfactants generally increased blush L*, chroma and hue angle values (Tables 9). For AVG, this effect was rate dependent and inversely related to concentration; fruit treated with the highest rates of AVG had the lowest L*, chroma and hue angle values. The effect of surfactants was less dramatic and less consistent.

AVG and the surfactants had a more variable effect on fruit ground color (Table 10). Their effects on L* values, while at times significant, were inconsistent between harvest dates and cultivars. AVG and surfactant treatments had a more measurable effect on ground color chroma and hue angle values. In particular, surfactants increased the chroma values of 'Venture' fruit in contrast to trees which did not receive a surfactant when both were sprayed with 132 mg·L^{-1} AVG. Aminoethoxyvinylglycine, particularly at the highest rate of 264 mg·L^{-1}, impeded color development resulting in lower chroma values and higher hue angle values on most harvest dates and for both cultivars.

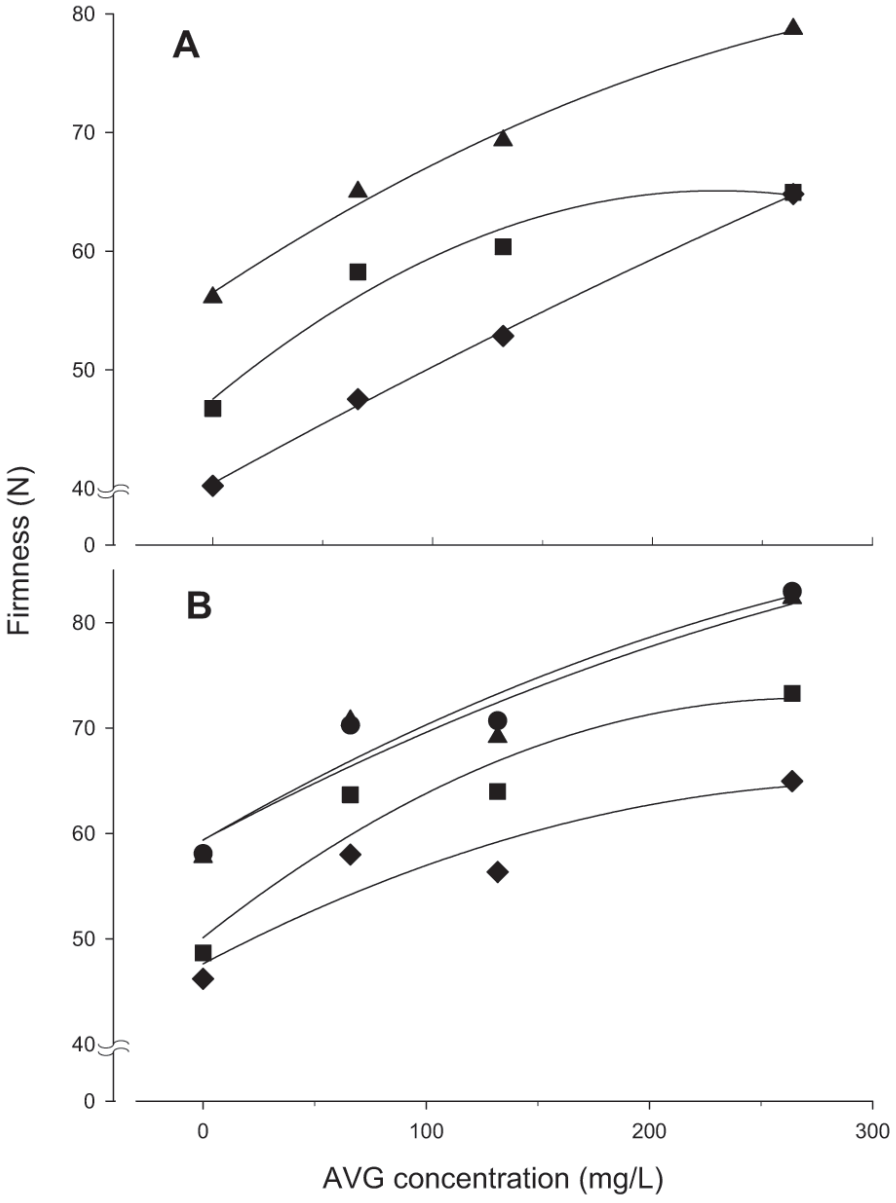

Fig. 1. Relationship between AVG concentration and fruit firmness for 'Babygold 7' (**A**) and 'Venture' (**B**) peaches at four harvest dates: 15 Sept. (●), 19 Sept. (❖), 22 Sept. (■), and 25 Sept. (▲) 2003. Points represent means for each AVG concentration. Lines represent linear ($y = b\,x + c$) or quadratic ($y = ax^2 + bx + c$) regression equations, where x = AVG concentration. Specific coefficients are:

Cultivar	Harvest date	a	b	c	*r*
Babygold 7	19 Sept.	---	0.10	40.42	0.999
	22 Sept.	–0.0003	0.15	47.52	0.979
	25 Sept	–0.0001	0.12	56.49	0.996
Venture	15 Sept.	–0.0001	0.12	59.36	0.967
	19 Sept.	–0.0001	0.11	59.38	0.944
	22 Sept.	–0.0003	0.17	50.11	0.959
	25 Sept	–0.0002	0.11	47.62	0.928

Summary

A summary of these four experiments indicates that ReTain consistently and effectively delayed fruit harvest by about 3 to 4 d. This response was rate dependent and increased in a linear fashion with increasing rates of AVG.

These data are in agreement with the results of others on peaches (Belding and Lokaj, 2002; Dekazos, 1981; Jobling et al., 2003; Kim et al., 2004; Legendre et al., 2003, Vizzotto et al., 2002) and nectarines (Rath and Prentice, 2004). AVG also increased fruit firmness in a rate dependent fashion even though fruit were harvested at similar visual stages of maturity (based on uniform background color). The positive influence of increasing concentrations of AVG on firmness has not been observed in previous studies (Kim, et al., 2004; Vizzotto et al., 2002), although when compared with untreated trees, AVG has been reported elsewhere to either improve peach fruit firmness or delay softening (Bregoli etal, 2001, 2002; Rath and Prentice, Singh et al., 2003a, 2003b; Vizzotto et al., 2002).

In contrast to previous studies on peaches (Kim et al., 2004; Vizzotto et al., 2002) the present study failed to show that AVG will delay or reduce preharvest fruit drop even though accumulated fruit drop by the last harvest date from untreated control trees ranged from 16% to 18% for 'Venture' and 'Babygold 7'. In 2003, trees were exposed to wind gust up to 55 km·h^{-1} (from the tail end of a tropical low pressure system) for the period 72 h before and including the last harvest date on 25 Sept., and although anticipated, no statistical differences in fruit drop between AVG or surfactant treatments was detected, even for the preharvest drop susceptible cultivar 'Babygold 7'. One explanation for this may be because 80 and 90% of untreated fruit from the 'Babygold 7' and 'Venture' trees, respectively, had already been harvested before this event. Where preharvest drop is a concern commercially, the cling processing cultivars are generally harvested over two picking dates and greater differences in fruit drop between untreated and AVG treated trees might occur if a greater percentage of fruit remains unharvested before the final harvest date. Greater fruit retention on AVG treated peaches has been observed in other studies (Kim et al., 2004; Vizzotto et al., 2002)

In contrast to a study on 'Feichen' peaches by Ju et al (1999), this study failed to demonstrate any measurable effect on increased yield in either of the four experiments. The delay in harvest was perhaps insufficient for fruit to accumulate additional assimilates which could conceivably translate into greater yields and mean fruit size. Only in one instance in 2003, was the mean fruit size of 'Babygold 7' increased, however this response, was more likely an indirect effect of crop load. In a larger scale experiment in Australia on 'Arctic Snow' nectarine, a 12% increase in yield and greater fruit size was realized from AVG-treated trees, primarily a result of a reported 2.75 day delay

in maturity (Rath and Prentice, 2004).

The surfactants used in these experiments had little to no effect on the efficacy of AVG. AVG applied with or without a surfactant equally and effectively both delayed maturity and increased fruit firmness. Initially it was anticipated that surfactants might aid in surface wetting of the fruit, but visual observations at the time of spraying indicated that spray mixtures in the absence of surfactants easily penetrated, and perhaps were aided by, the extensive hairy surface of the peach fruit. In fact peach fuzz may help AVG and other growth regulator sprays persist longer on the fruit surface had they otherwise not been present.

The most notable influence of surfactants was that, in one instance, Regulaid and Li 700 advanced color development and in another, fruit treated with Li-700 and AVG were firmer in comparison with fruit treated with Regulaid and AVG.

In summary, these data indicate the advantage in AVG-treated fruit on fruit quality, however, because of relatively small sample sizes, and inherent fruit variation on the tree on in the orchard, larger orchard studies are required to fully evaluate the benefits of AVG on improved yield and fruit size. Furthermore, the benefits of AVG on local fresh-market cultivars grown in Canadian production regions requires evaluation.

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