Effects of Simulated Rain Following ReTain Application on Preharvest Drop and Fruit Quality of McIntosh Apples

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All who manage orchards have experienced the indecision associated with having a weather forecast suggesting the possibility of a 30 to 50% possibility of thundershowers on a day when you would like to spray. It would help the decision-making process to know what the repercussions would be if heavy rain followed the application of a very important spray application. The purpose of this study was to evaluate the effects that a simulated heavy thundershower would have on preharvest drop and fruit quality following a ReTain application.

Materials & Methods

1992 Study. A block of 5-year-old Marshall McIntosh/Mark was selected at the University of Massachusetts Horticulture Research Center, Belchertown, MA. Sixty trees were selected and blocked into six groups (replications) of ten trees each based upon crop load and proximity. Trees in each block were paired, with one tree in each pair being designated as a sample tree, while the second tree was designated as a drop tree. On August 24, 1992, ten of the twelve trees in each replication received a dilute spray of 225 ppm AVG applied with a hand-gun, sprayed to drip. One hour after application, two trees that were previously sprayed with AVG were washed with 6 to 7 gallons of water using a hydraulic sprayer with a hand gun attached. Pairs of AVG-treated trees were similarly washed at 4 and 8 hours after application. Two trees in each block were not sprayed with AVG and served as the untreated control trees. On September 17, fifteen fruit were randomly harvested from the periphery of each of 30 trees designated as the sample trees. Fruit were weighed, and then the percent red color was estimated visually to the nearest 10%. Flesh firmness was measured using an Effegi penetrometer with two punctures per fruit. A composite juice sample collected during the pressure test was used to determine soluble solids using a hand-held refractometer. Fruit were then cut in half, dipped in starch iodine solution, and maturity then estimated using the McIntosh starch chart

Table 1. Effects of AVG and time of simulated rain (washoff) on fruit quality at harvest of Marshall McIntosh/Mark. 1992.

Treatment[1] (ppm)	Washoff time	Flesh firmness (lb)	Soluble solids (%)	Red color (%)	Starch[2] rating
Control	---	14.6 b	12.8 a	91 a	5.0 a
AVG 225	none	15.2 a	12.3 b	83 c	4.6 b
AVG 225	1 hr	15.0 ab	12.8 a	86 b	4.7 b
AVG 225	4 hr	14.7 b	12.7 a	87 b	4.6 b
AVG 225	8 hr	14.9 ab	12.8 a	89 b	4.7 b
Significance					
AVG		*	*	***	*
Harvest date(HD)		***	***	***	***
AVG x HD		NS	NS	**	NS
Washoff		NS	NS	NS	NS
AVG vs. Control		**	***	***	***
AVG vs. Washoff		NS	***	**	NS

[1]AVG applied August 24, 1992.
[2]Starch rating 1-3, immature; 4-6, mature; and 7-9, overmature.
Means within columns not followed by the same letter are significantly different at odds of 19 to 1.

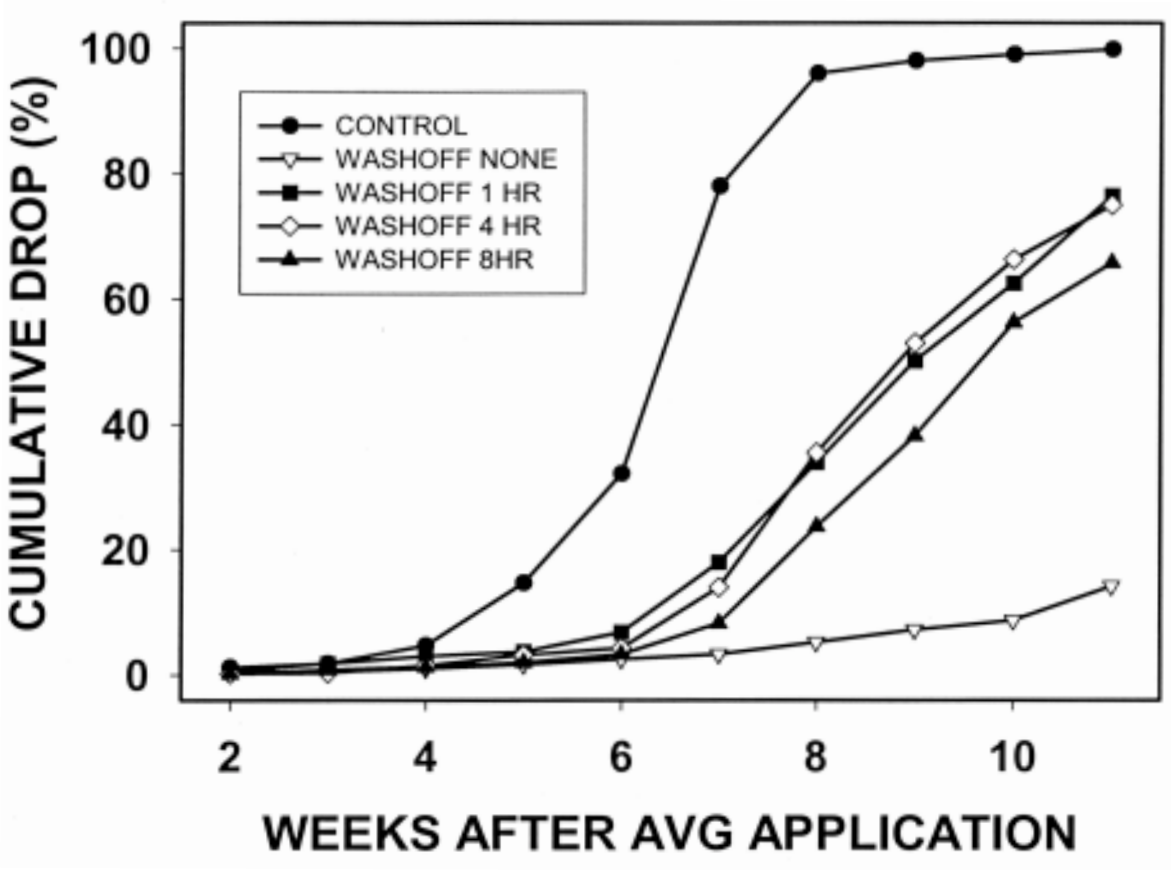

Figure 1. Effects of AVG and the and simulation of rain on AVG-treated trees on cumulative drop of Marshall McIntosh/Mark apples. 1992.

developed by Priest and Lougheed. Three additional harvests were made and fruit were similarly evaluated at weekly intervals on September 24, October 1, and October 8. All fruit were picked up under each tree designated as a drop tree on September 1 and then twice weekly until November 9. On each drop-pick-up day the number of fruit picked up under each tree was recorded. On November 9, all fruit remaining on the drop trees were harvested and counted. Cumulative drop per tree was then calculated.

2000 Study. A block of mature Marshall McIntosh/M.26 was selected at the University of Massachusetts, Horticultural Research Center, Belchertown, MA. Sixty trees were selected and blocked into six groups (replications) of 12 trees each based upon crop load and proximity. On August 17, ten of the twelve trees in each replication were sprayed with 50 g a.i./acre ReTain containing 0.1 % Silwet in 100 gallons per acre using a rear-mounted airblast sprayer. TRV assessment suggested that these trees would require 140 gallons per acre for a dilute application. One hour after ReTain application, two trees in each block that had received ReTain were washed with 10 to 12 gal of water for 3 to 4 minutes using an hydraulic sprayer with a hand gun attached. Particular effort was made to direct the wash water on the fruit and spur leaves. Pairs of ReTain-treated trees were similarly washed at 3 hours and 8 hours after application. Two trees in each block did not receive ReTain and served as the untreated control trees. On September 7, twenty fruit were harvested randomly from the periphery of each of the 30 trees designated as the sample trees. Fruit were weighed, and then the percent of the fruit surface that was red was estimated visually to the nearest 10%. Further, the red color was judged to determine if it was intense enough to meet US Extra Fancy standards. A representative 10-apple subsample was taken and flesh firmness and soluble solids determined as described in the 1992 investigation. Fruit were then cut in half, dipped in starch iodine solution, and maturity then estimated using the generic starch chart developed at Cornell University. Three additional harvests were made, and fruit were evaluated similarly at weekly intervals on September 14, September 21, and September 28. All dropped fruit were picked up under each tree designated as a drop tree on September 1 and then twice weekly until October 16. On each drop pick-up day the fruit picked up under each tree were recorded. On

Table 2. Effects of AVG (ReTain) and time of simulated rain (washoff) on fruit quality at harvest of Marshall McIntosh/M.26. 2000.

Treatment[1]	Washoff time	Flesh firmness (lb)	Soluble solids (%)	Red color (%)	US Extra fancy (%)	Starch[2] rating
		Mean of Harvests on 9/7, 9/14, 9/21, and 9/28				
Control		15.2 c	11.3 ab	72 a	70 a	5.7 a
AVG 50 gai	1 Hr.	15.8 ab	11.2 bc	69 ab	68 a	5.4 a
AVG 50 gai	3 Hr.	15.6 bc	10.9 c	70 ab	64 ab	5.4 a
AVG 50 gai	8 Hr.	16.1 a	11.6 a	67 b	61 ab	5.2 a
AVG 50 gai	None	15.7 ab	11.2 bc	66 b	53 b	5.2 a
Significance						
AVG		**	NS	*	***	*
Harvest date (HD)		***	***	***	***	***
AVG x (HD)		NS	NS	NS	NS	NS
AVG vs. Control		***	NS	**	NS	NS
AVG vs. Washoff		NS	NS	NS	NS	*

[1]AVG at 50 gai/acre was applied August 17, 2000 in 100 gal of spray containing 0.1% Silwet on 140 gal/acre TRV trees.
[2]Starch rating 1-3, immature; 4-6, mature; 7-8, overmature.
Means within columns not followed by the same letter are significantly different at odds of 19 to 1.

October 16, all fruit remaining on the drop trees were harvested and counted. Cumulative drop per tree was then calculated.

Results

AVG applied in 1992 significantly increased flesh firmness, and reduced soluble solids, red color development, and starch iodine rating (Table 1). Simulated rain following application modified the AVG effect. Soluble solids were restored to the levels of the control fruit and red color retardation was reduced, whereas flesh firmness and starch rating were not affected. AVG resulted in a greater reduction in red color development at the early harvest than at the later harvests (data not shown).

All AVG treatments applied in 1992 significantly and comparably retarded preharvest drop for the first 6 weeks after application (Figure 1). At 7 weeks after application and later, the effectiveness of AVG was significantly diminished on trees that were washed to simulate a soaking rain.

AVG applied in 2000 significantly increased fruit flesh firmness, while reducing red color, the percent of fruit that were judged to meet the US Extra Fancy grade, and starch rating (Table 2). The only effect simulated rain had on fruit quality parameters was that the percent of fruit in the US Extra Fancy category was slightly lowered when trees were washed one hour after ReTain application. As expected, the major AVG effect was a reduction in red color and an increase in fruit flesh firmness.

AVG significantly retarded preharvest drop compared with the control (Figure 2). This response was evident on the first date dropped fruit were collected, and it extended through the entire drop-evaluation period. Simulated rain did not reduce the effects of ReTain on preharvest drop, since at no time during the drop pickup period did any washed trees that received ReTain have more dropped fruit under them (percent of total) than unwashed trees that also received ReTain.

Discussion

The purpose of these experiments was to determine if the performance of ReTain would be altered by subjecting trees to simulated rain at intervals after application. The conditions of application and the contents of the spray used were quite different in the two years. The experiment done in 1992 used AVG technical powder formulated for testing AVG. It was applied to the drip point with a hand gun, and no surfactant was used. The experiment done in 2000 mimicked a commercial application of AVG as the commercial ReTain formulation was used, it was applied according to label directions, and the application was made using a commercial airblast sprayer. Further, the spray contained 0.1% Silwet surfactant, a label-recommended surfactant, at a recommended concentration. Clearly, there were differences in response to the simulated rain in the two years. In 1992, washing trees, even as much as 8 hours after

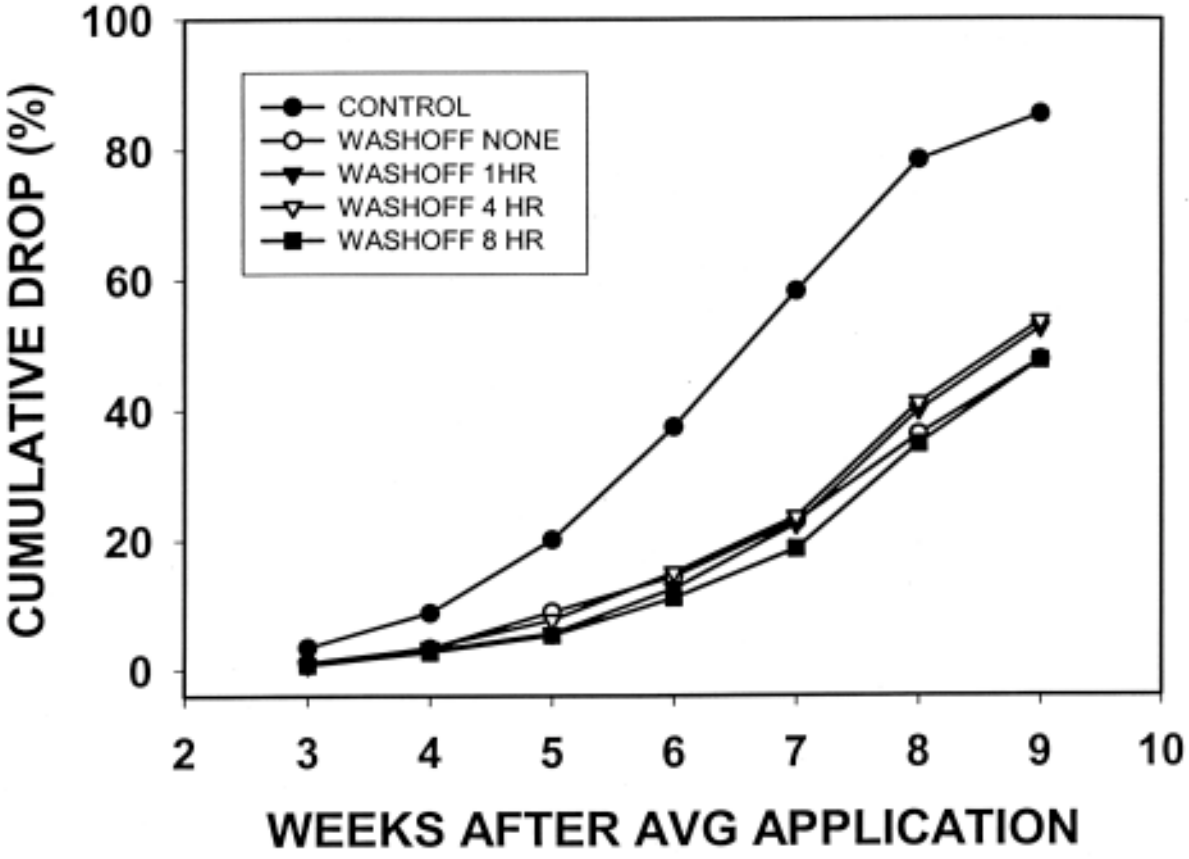

Figure 2. Effects of AVG as the ReTain formulation and simulated rain on ReTain-treated trees on cumulative drop of Marshall McIntosh/M.26 apples. 2000.

application resulted in reduced drop control and a modification of the reduction in red color and lowering of soluble solids normally associated with ReTain use. In 2000, washing trees even as soon as 1 hour after application resulted in no reduction in drop control and a minimal effect on the intensity of red color as indicated by a small reduction in the number of fruit that were judged to be US Extra Fancy. Different formulations of AVG were used in the two years may have been a contributing factor. However, we believe that the major factor responsible for the extreme rainfastness demonstrated in 2000 was the use of Silwet. There are a number of citations in the literature that demonstrate that the use of Silwet with other agricultural chemicals imparts rainfastness.

In a previous report we emphasized that the use of a recommended surfactant was important to achieve the maximum response from ReTain. The results from this investigation provide another convincing reason to use a recommended surfactant when applying ReTain.

Based upon previous experience, the window of opportunity to apply ReTain is reasonably wide. However, weather during August can be quite fickle and very unpredictable. It appears that the use of Silwet or possibly Sylgard 309 with ReTain provides a certain amount of insurance that if rain or a shower follows soon after application, one can expect nearly 100% response to ReTain.

The commercial application of ReTain in 2000 confirmed that ReTain is an effective drop-control compound and harvest-management tool. It effectively retarded preharvest drop for at least 7 weeks after application, into early October, and significantly retarded it well beyond that time. Further, it retarded the loss of flesh firmness and delayed ripening, which would allow scheduling of harvest or extending the harvest season in a pick-your-own operation.

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