

Influence of Surfactants on the Performance of ReTain as a Harvest-management Tool on Marshall McIntosh Apples

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McIntosh is the most widely planted and most important apple variety grown in New England. Our unique set of environmental conditions allow McIntosh to be grown here better than almost anywhere in the world. One of the shortcomings of this variety is that it can, and usually does, display excessive preharvest drop. In an average year up to 25% of the fruit can be lost due to drop, while in severe years, where above average temperatures are experienced during the harvest season, over 50% of the fruit can fall before they can be harvested.

Various strategies have been employed to overcome some of the deficiencies of McIntosh. In the 1940's it was found that the chemical thinner naphthaleneacetic acid (NAA) could also retard preharvest drop. One application was effective for 7 to 10 days and a second application gave an additional 7 days of drop control. This compound is currently registered for controlling drop of apples. While it is sometimes effective at controlling drop, proper timing is important, ripening may be advanced, and the storage potential may be reduced. The discovery and ultimate registration of

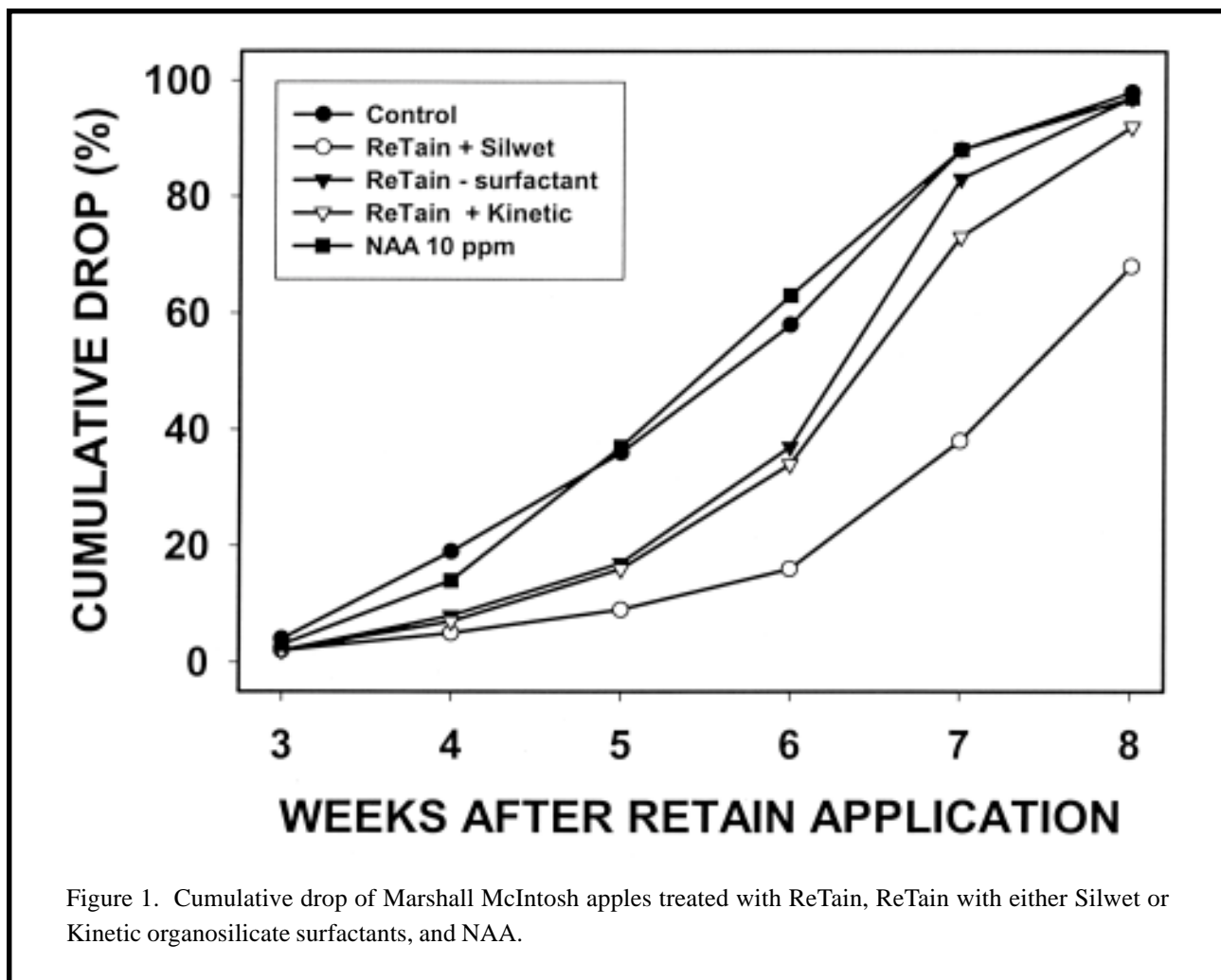
Alar for control of preharvest drop on apples was an enormous benefit to McIntosh growers in New England. However, the registration of Alar for use on apples was withdrawn in the late 1980's leaving growers only with the somewhat inadequate NAA for drop control.

Aminoethoxyvinylglycine (AVG) was developed as the ReTain formulation following the loss of Alar as a harvest-management compound on apples. In general, it has been a very effective compound. However, relative to other agrochemicals it is considered to be very expensive. Label directions for ReTain contain the suggestion that specific

Table 1. Effects of Retain, surfactants used with Retain, and NAA on quality of Marshall McIntosh apples.

Treatment	Red ¹ color (%)	US Extra fancy (%)	Flesh firmness (lb)	Soluble solids (%)	Starch rating (1-8)
<i>Mean of harvest on 9/11, 9/18, 9/25 and 10/2</i>					
Control	75 ab	78 a	14.9 c	12.0 a	5.0 b
Retain + Silwet (8/15)	72 b	74 ab	15.5 a	11.9 a	4.5 c
Retain - No surfactant (8/15)	72 b	67 b	15.3 ab	11.8 a	5.1 b
Retain + 0.1% Kinetic (8/15)	72 b	73 ab	15.4 ab	11.8 a	5.0 b
NAA 10 ppm (9/5)	77 a	81 a	15.0 bc	11.9 a	5.5 a
Significance					
Retain	*	*	**	NS	***
Harvest date	***	***	***	***	***
Retain x harvest date	**	**	NS	NS	*

¹Means within columns not followed by the same letter are significantly different at odds of 19 to 1.



surfactants should be used to enhance uptake and improve the performance of ReTain. The purpose of this communication is to confirm the importance of including a recommended surfactant when ReTain is applied as a preharvest-drop-control compound. Since NAA is the only other compound registered to control drop on apples, it was included to allow comparison with ReTain.

Materials & Methods

A block of mature Marshall McIntosh/Mark was selected at the University of Massachusetts Horticultural Research Center in Belchertown, MA. Sixty trees were blocked into six groups (replications) of 12 trees each based upon crop load and proximity. Trees in each replication 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 15, two trees in each block were sprayed with 90 ppm ReTain only, ReTain with 0.1% Silwet, or ReTain with 0.1% Kinetic, respectively, at a dilute gallonage of 125 gallons per acre. One pair of trees in each

block received a 10 ppm spray of NAA on September 5, and the last pair of trees in each replication received no spray and served as a control. Twenty five fruit were harvested from the perimeter of each sample on September 11, 18, 25, and October 2. The percent of the surface with red color was estimated to the nearest 10% as well as determining if the red color was intense enough to meet US Extra Fancy red color standards. A subsample of 10 fruit, representative of the sample was selected and flesh firmness determined on two sides of each fruit using an Effegi penetrometer. Fruit soluble solids were determined on a composite sample of juice collected while doing the flesh firmness, using a hand refractometer. Fruit from the firmness test were cut in half, dipped in a starch-iodine solution, and the starch pattern then rated using the Cornell generic starch chart. On August 29, all fruit were picked up under drop-designated trees and discarded. Twice weekly all fruit under drop trees were picked up and counted. On October 20, all fruit remaining on the drop trees were harvested and counted and the cumulative drop calculated.

Results

In general, ReTain affected fruit quality at harvest predictably (Table 1). ReTain retarded red color development but this reduction in red color was not sufficiently great to consistently reduce the number of fruit classified as US Extra Fancy. All ReTain treatments retarded the loss of flesh firmness. No treatment influenced fruit soluble solids. Fruit maturity, as determined by starch index, was retarded only when Silwet was included with the ReTain. NAA advanced fruit maturity but otherwise had little influence on other fruit quality.

ReTain had little influence on red color development on the first two harvests but at the later harvests red color development was delayed (data not shown). Conversely, ReTain retarded starch degradation at the early harvest dates, but at later harvests the differences were less.

All ReTain treatments retarded preharvest drop on Marshall McIntosh (Figure 1). However, during the last week in September, the ReTain treatments containing Kinetic or having no surfactant became clearly less effective at controlling preharvest drop than the ReTain treatment containing Silwet. The ReTain treatment containing Silwet continued to be better than the other two ReTain treatments for the duration of the experiment. NAA in general was ineffective as a preharvest drop compound. Only once, on September 15 (10 days after application), did NAA significantly retard drop, and the reduction at this time was only 4% better than the untreated control.

Discussion

The commercial harvest window of the fruit based upon

starch-iodine index was from mid to late-September (4.5 to 6 weeks after ReTain application). Application of ReTain following label directions using 0.1% Silwet, a recommended surfactant, effectively controlled preharvest drop. Drop control of ReTain-treated fruit without a surfactant or when applied with Kinetic was not as effective as when Silwet was used. However, the differences in drop control between these two treatments did not become apparent until after most of the harvest would have been completed (5 weeks after ReTain application).

Currently, there are four surfactants recommended for use with ReTain: Silgard 309, Silwet L-77, Break-Thru, and RNA Si 100. The latter two are only available through suppliers located on the west coast. We suggest using only the recommended surfactants, thus for growers on the east coast the choice is limited to either Silwet L-77 or Silgard 309.

ReTain had a small but significant effect on red color development. We do not look at this as a reduction in red color development *per se*, but rather a delay in development that is associated with consequence of delayed ripening. Fruit would have had similar if not greater red color if one compared red color on fruit of a comparable starch rating.

NAA has been registered as a stop-drop compound for many years. However, its use on McIntosh is not widespread. Many years it is not effective or at best it is marginally effective. In this investigation NAA had little effect on drop control. Unless it can be made to work more consistently, its use on McIntosh is likely to be very limited. NAA can advance ripening especially if warm weather follows application. In this investigation weather was seasonable, so advanced ripening effects were limited to a small increase in the starch index.

