Evaluation of the Use of Two Full Rates of ReTain on Preharvest Drop and Fruit Quality of Honeycrisp at Harvest and Following a Period of Cold Storage, 2017

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Three of the most popular apples grown in the New England are McIntosh, Honeycrisp, and Gala but unfortunately the time of ripening of these is nearly identical. Two other popular varieties Macoun and Cortland ripen very soon after. Delay in normal harvest of any of these varieties due to difficulties in harvest management can result in the harvest of poor quality fruit that have reduced storage potential. Based on recent experience and success using high rates of ReTain we have shown that we can use two full rates of ReTain (two 333 g pouches/acre) on McIntosh and Cortland to improve overall quality of late-harvested fruit, and in the case of McIntosh achieving effective control of preharvest drop.

Honeycrisp and Gala are two varieties that have national importance and consequently the demand for these varieties is increasing. These two varieties also are relatively low ethylene emitters and as a result lower rates of ReTain (1/3 to 1/2 of a pouch) are generally used to minimize the delay in red color development. ReTain is used primarily on Honeycrisp to delay preharvest drop whereas it is applied to Gala to slow ripening and reduce stem-end cracking.

Pick-your-own is a method of sales that is prominent in New England and is an important component in many growers' business plan. Sales on weekends in late September and in the first 2 weeks in October are extremely important, and success during these later weekends in the fall often makes the difference between a successful season and one far less profitable. Therefore, it would be very beneficial to have fruit of both varieties on the tree for pick-your-own late into the season.

Last year we did a nonreplicated experiment with both Gala and Honeycrisp where we treated with a split application of two full rates of ReTain in late August and early September. Fruit were harvested on Columbus Day, at the end of second weekend in October. The fruit quality was very good and we concluded based on the quality of fruit that this approach to handling these varieties was very positive and had potential. The

delay in red color development did not appear to be a problem at harvest and the high fruit quality of both varieties in late September and into October. Observations made over the past 5 to 6 years has been by using high rates of ReTain (one application of 2 pouches or two split applications of 1 pouch each time) slows down maturity and allows apples to ripen later in the season when the weather is invariably more favorable for red color development. The additional time on the tree also improves the eating quality of these later harvested fruit.

In 2017 we decided to do a full evaluation using two full rate application of ReTain (2 pouches/acre) on Honeycrisp and evaluate fruit quality periodically from the time Honeycrisp are normal harvested until Columbus Day. We were also concerned about the postharvest potential of fruit harvested at the end of the second week in October. Once harvested, how long would it be possible to store the fruit and still have high quality fruit to sell? Was the fruit still saleable? A concern was that late harvested Honeycrisp are more prone to develop soft scald in storage than fruit harvested early.

Therefore, harvested fruit were conditioned by keeping them at room temperature (60° F) for 5 days prior to placing them in air storage at 32° F. All remaining fruit on the treated trees and the control trees were harvested, placed in air storage and evaluated after 6 weeks and 13 weeks.

Materials & Methods

In a block of 8-year-old Honeycrisp/M.9, 10 groups of trees containing two to three contiguous trees were selected and marked. These groups were further paired by crop load and proximity in the row into 5 blocks (replications) containing 2 groups of trees. Within each replication one group was randomly chosen to serve as the untreated control where no ReTain spray was applied and the second group of trees was sprayed twice with ReTain, first on August 21 and again on September 7 with one pouch of ReTain (333g) per acre applied using a commercial airblast sprayer at the TRV volume of 100 gal/acre. Silwet L-77 was included in the tank at a rate of 0.05 % (v/v). One tree in each block was designated as the drop tree and no fruit were harvested from that tree during the experiment. One tree in each block was designated as the sample tree and all fruit were harvested from that tree. On September 5 all dropped fruit were picked up under the drop trees and then twice weekly, fruit were picked up, counted and recorded until the experiment was terminated in October. At the end of the experiment all fruit were harvested from the drop trees and counted to allow calculation of cumu-

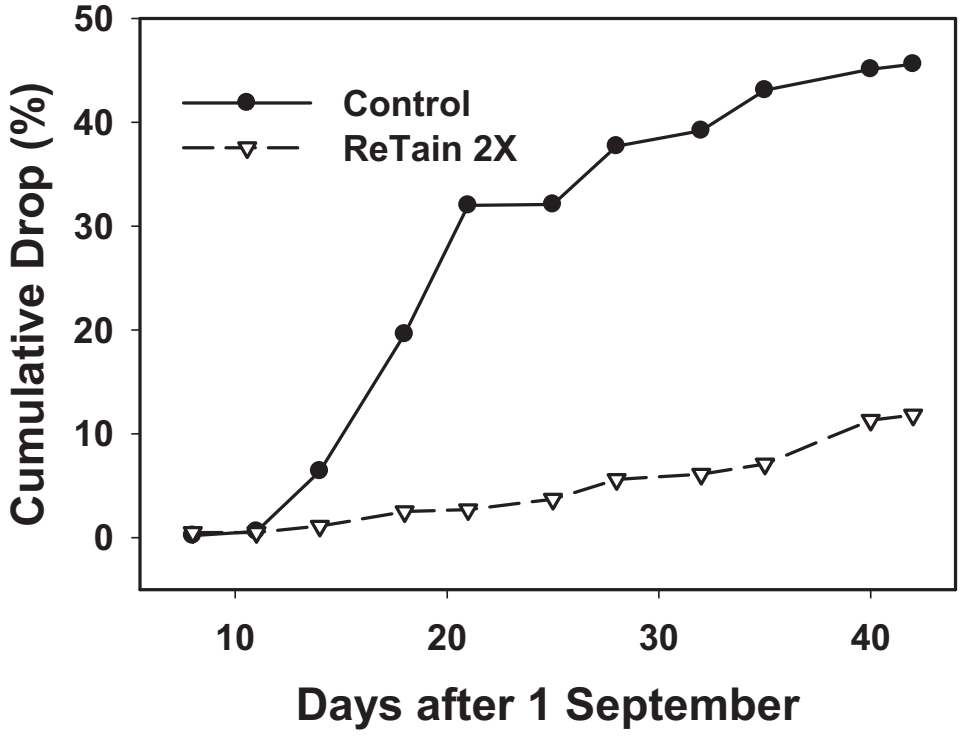

Figure 1. Influence of two full rates of ReTain (two 333g pouches/acre) on preharvest drop of Honeycrisp apples.

Table 1. Influence of two full rates (2 pouches/acre) ReTain on fruit quality of Honeycrisp at harvest, 2017.

Treatment[1]	Weight (g)	Red color (%)	Firmness (lb)	Soluble solids (%)	Starch rating (1-8)	Climacteric (%)
	---------- Mean 4 harvests (9/15, 9/25, 10/5, 10/12) ----------					
Control	224	77	12.5	12.1	7.4	88
ReTain	234	63	13.3	11.9	6.1	15
Significance[2]						
ReTain (R)	NS	*	**	NS	***	***
Harvest (H)	***	***	***	***	***	**
R x H	NS	NS	NS	NS	***	**

[1]One pouch (333g) ReTain was applied at a TRV dilute rate of 100 gal/acre on August 21 and September 7.
[2]***,**,*,NSSignificant at P = 0.001, 00.1, 0.05 or nonsignificant.

lative drop.

A 15 apple sample was harvested from each sample tree on Sept. 15, 25, Oct. 5 and 12. Fruit were taken to the lab where they were subjected to a standard fruit quality evaluation. They were weighed and the surface red color was estimated to the nearest 10%. The internal ethylene was determined on a 10 fruit subsample by extracting a 1 ml gas sample from the core of each apple and injecting it into a gas chromatograph. Internal ethylene was measured and recorded with the aid of a digital integrator. The percent climacteric fruit was determined by noting the number of fruit in the sample that had an internal ethylene content of 1 ppm or more. Flesh firmness was taken on these fruit by making 2 punctures on each apple with a pressure tester using an 11 mm head. Juice collected during the firmness test was measured for soluble solids contents using a digital refractometer. Fruit were then cut at the equator and dipped in an iodine solution and evaluated using the Cornell Generic Starch chart using a scale of 1 (immature) to 8 (over mature). One bushel of fruit was harvested from each block and placed at room temperature for 5 days. Following this conditioning period all fruit were placed in air storage at 32° F for later evaluation. On November 20, 6 weeks after fruit were placed in storage, fruit were evaluated for storage disorders and then returned to the storage. Fruit were again removed from storage on January 4, after 13 weeks after being placed in storage. At this

Table 2. Influence of two full rates (2 pouches/acre) ReTain on storage disorders following 6 or 13 weeks in regular air storage, 2017.

Treatment[1]	Firmness (lbs)	Soft scald (%)	Bitter pit (%)	Rot (%)	Cracking (%)	Lenticel breakdown
	---------- 6-weeks storage ----------					
Control	-----	0.3	0.3	4.9	26.9	1.4
ReTain	-----	6.0	0.0	1.4	7.5	1.1
Significance[2]		NS	NS	**	***	NS
	---------- 13 weeks storage ----------					
Control	10.3	2.1	0.6	13.6	31.8	3.8
ReTain	12.3	21.1	0.3	3.0	10.5	2.6
Significance[2]	*	**	NS	**	***	NS

[1]One pouch (333g) ReTain was applied at a TRV dilute rate of 100 gal/acre on August 21 and September 7.
[2]***, **, *, NSSignificant at P = 0.001, 0.01, 0.05 or nonsignificant.

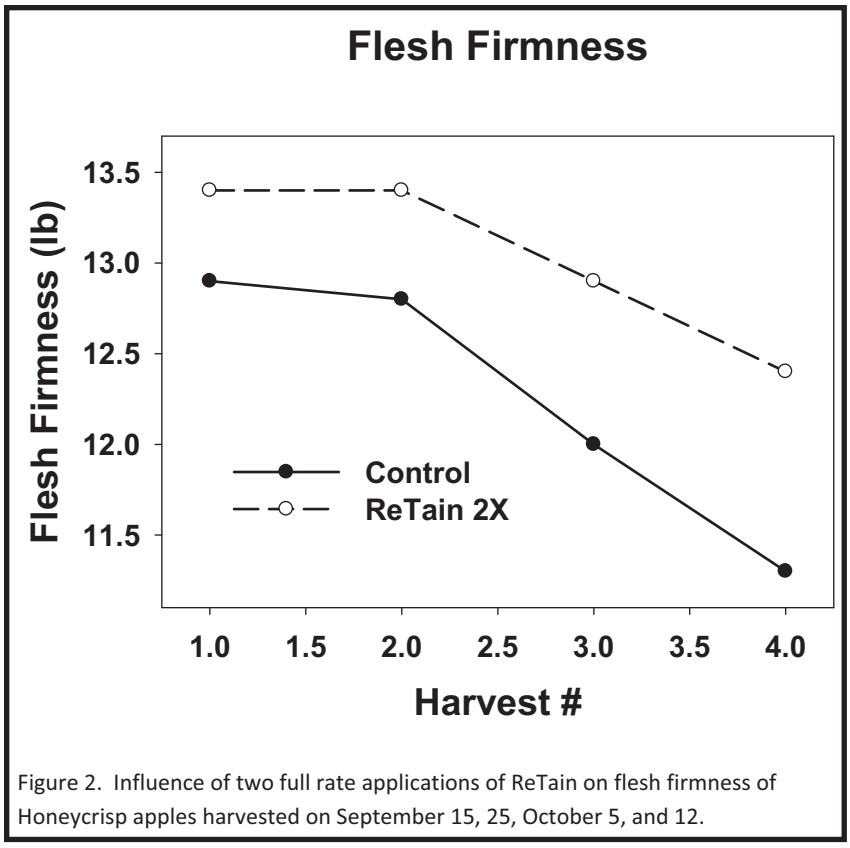

Figure 2. Influence of two full rate applications of ReTain on flesh firmness of Honeycrisp apples harvested on September 15, 25, October 5, and 12.

time fruit were pressure tested as previously described. The remaining fruit in each box were reevaluated for development of storage disorders.

Results & Discussion

Honeycrisp is a variety that can have severe preharvest drop problems in some years. Results in this experiment showed convincingly that preharvest drop can be controlled with the two applications of ReTain well into October (Figure 1). At the end of the experiment (October 12), cumulative drop on ReTain-treated trees was 11.8 percent whereas cumulative drop on the control trees it was 45.6%. The 2017 season was not a severe drop year for Honeycrisp. However, these data show that by using the high rates of ReTain, losses due to preharvest drop can be held to a minimum through periods where preharvest drop is often severe during the last half of September. These data also confirm observations made over many years and that is that if preharvest drop can be controlled until later in the fall, environmental factors change resulting in less drop. The ReTain certainly did control drop during the heavy drop period from Sept 15 to Sept 28, a period of time when preharvest drop can be substantial. Even though the check fruit were ripe, based upon the climacteric data, they did not drop in October at the rate they did earlier. The degree of drop control demonstrated in this experiment should provide growers with piece-of-mind during September when drop can be severe.

Fruit quality information collected over the course of the experiment is illustrated in Table 2. The data shown for each parameter represents the mean of the four harvest

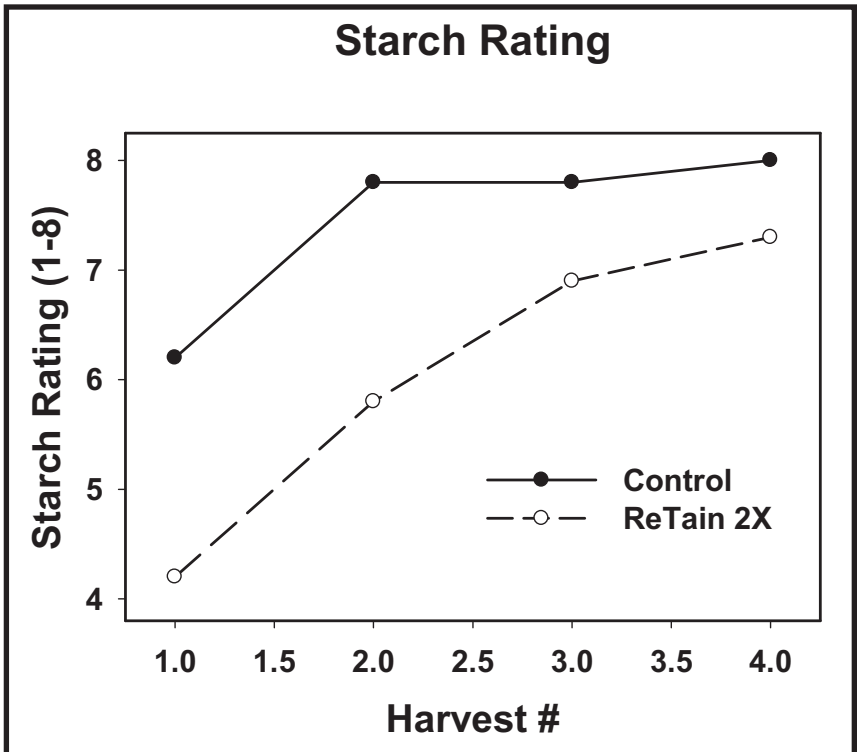

Figure 3. Influence two full rate appllications of ReTain on the starch content of apples using the the Cornelll Gebneric Satrch chart, 1=immature 8=over mature.

dates and the ANOVA includes all harvests dates. With the exception of fruit weight, ReTain significantly influenced all parameters evaluated.

Flesh firmness is significantly affected both by ReTain and harvest date. We have not evaluated Honeycrisp over such a long period and we are surprised at the seemingly fast rate of decline of firmness with time, especially in October (Figure 2). ReTain delayed the loss of firmness of Honeycrisp. If one compares the firmness of control fruit on Sept 15 and ReTain treated fruit in October, they are essentially identical.

The extent of starch degradation in the harvested fruit is a measure frequently used to assess the stage of ripening of fruit. If one compares the starch rating of control fruit on September15 with ReTain treated fruit in October the starch rating of treated fruit is lower, 7.8 vs 6.9 and 7.3 (Figure 3). An alternative method to assess the stage of ripening, and one that is often considered more definitive, is to measure internal ethylene. Fruit with 1 ppm internal ethylene are frequently considered climacteric (Figure 4). Fruit treated with ReTain have a similar percent of climacteric fruit on the last harvest date as control fruit had on the first harvest date. These data present a very compelling case to suggest that the stage of ripening of ReTain-treated fruit in October (Oct 12) is comparable to fruit quality of untreated Honeycrisp at the initial (normal) harvest time on Sept. 15.

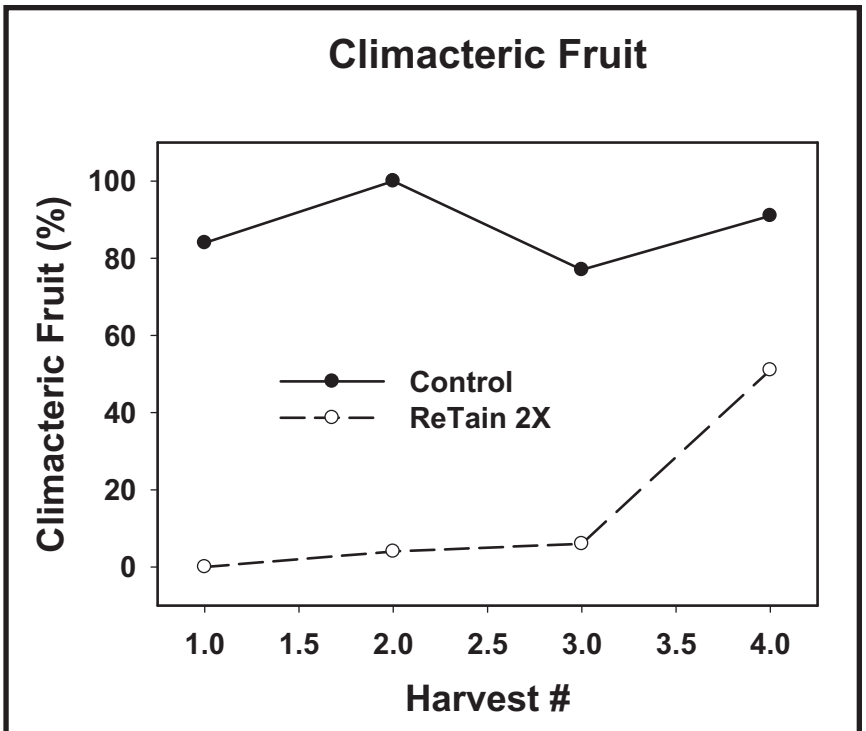

Figure 4. Influence of two full rate applications of ReTain on the percent of fruit that have 1 ppm ethylene internal ethylene (percent climacteric fruit) in Honeycrisp apples harvested on September 15, 25, October 5, and 12.

An objective of this experiment was to determine if quality Honeycrisp with acceptable red color could be harvested in October. If one compares the percent red color of the untreated fruit on September 15 with the color of treated fruit on October 5 and 12 the red color is similar if not identical (Figure 5). If one compares red color development of the ReTain treated fruit with control fruit at similar stage of maturity it clearly shows that ReTain does not decrease red color but rather these fruit have a very similar amount of red color when one compares red color at comparable stages of maturity. In October treated fruit did have very good color and thus we conclude that a reduction in red color development would not be a problem in October on Honeycrisp treated with high rates of ReTain.

Although no taste evaluation was done in this investigation, we did taste the fruit.
Honeycrisp harvested in October were different, both treated and untreated. Honeycrisp is normally characterized at harvest as having noticeable acidity. Although not measured late harvested Honeycrisp appeared to have a reduced acidity level compared with untreated fruit harvested on September 15. Several tasters commented on this. The treated Honeycrisp had excellent quality with good taste and attractive appearance. We considered these were the best Honeycrisp harvested on the farm in 2017. Initial observations were made after 6 weeks in storage (Table 2). Fruit quality of ReTain-treated fruit after 6 weeks in storage was considered acceptable (Table 3). There was a small but statistically nonsignificant amount of soft scald and fruit cracking on treated fruit. Treated fruit were of acceptable quality and we could say that the treated fruit could be kept safely in storage for 6 weeks (until

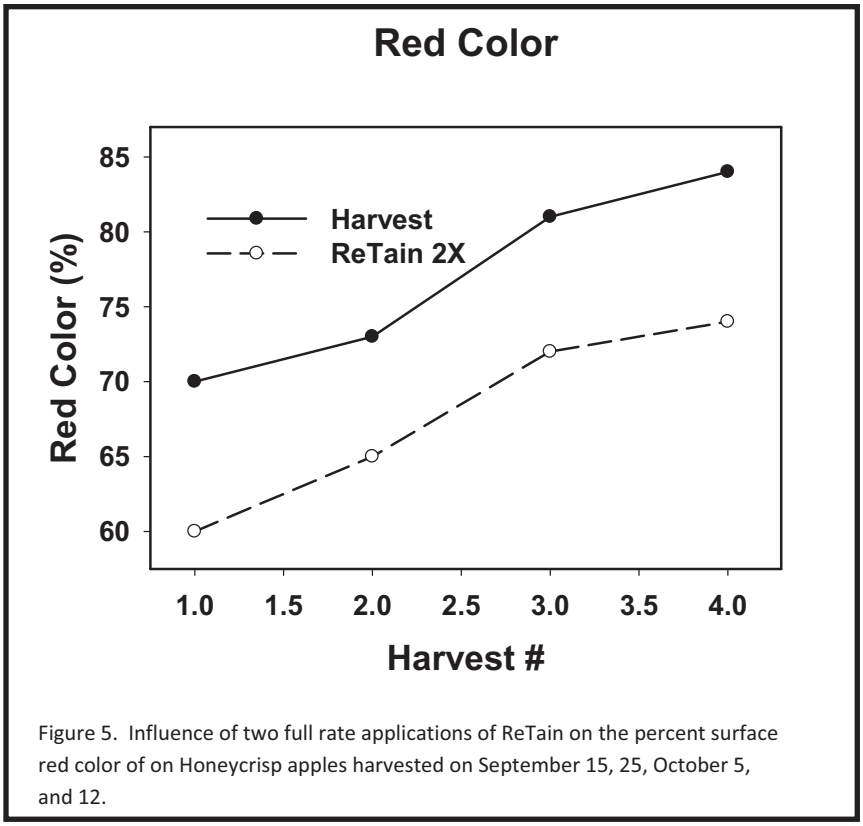

Figure 5. Influence of two full rate applications of ReTain on the percent surface red color of on Honeycrisp apples harvested on September 15, 25, October 5, and 12.

Thanksgiving). Untreated control fruit were starting to show rot and significant cracking and we considered the quality of these fruit to be marginal at best. A second evaluation of stored fruit was made after 13 weeks in storage. Flesh firmness of treated fruit was deemed unacceptable (10.3 lb). However, they showed a significant increase in soft scald, and an increasing amount of skin cracking. The increase in soft scald was not expected due to the fact that maturity was delayed relative to the untreated control. This observation must be checked in the future. As was observed in the earlier storage evaluation, control fruit control were not of acceptable quality at the time of evaluation with a large amount of skin cracking and increased fruit rot. Fruit look "old" and the fruit taste, firmness and texture were unacceptable.

Summary

The results of this investigation demonstrated quite clearly that the use 2 pouches of Retain per acre (666 g total) is a viable option for growers who wish to delay harvest of Honeycrisp until October. First, growers who wish to have quality Honeycrisp on the tree into October for the pick-your-own customers and second as a vehicle to manage harvest when too many fruit of different varieties ripen at the same time. ReTain-treated fruit in October had nearly identical quality if not identical quality as untreated Honeycrisp that were harvested during the normal harvest period on 15 September. If a grower wishes to manage harvest by deferring harvest of Honeycrisp until October then this option appears to be an attractive one as well. The drop control into October was excellent and fruit quality was comparable to fruit harvested on untreated trees earlier. If a grower chooses this option it is our suggestion that these fruit should not be put in long term storage.

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