
NAA: Understanding an 80 year-old product using genetic science

GS Long Company, 2009

**Kyle Coleman
Amvac Chemical**

How is NAA used in tree fruit?

- Fruit thinning
 - Return bloom
 - Early harvest management:
 - Pre-harvest drop: While an effective product:
 - NAA has been known to reduce fruit firmness
 - Timing/hot weather
 - Rate
 - Number of applications
 - Variety
 - *This reduction in fruit firmness may be slowed or even reversed when used in combination with other products.*
-

1-MCP, AVG and NAA on 'Delicious' fruit firmness (Yuan, 2007)

TRT	Appl. time (WBH*)	Conc. (ppm)	Fruit firmness (lb)			
			Sept 5	Sept 13	Sep 19	Oct 3
Control	-		18.1	16.3	16.1 c	14.5 b
1-MCP	1	80			16.4 c	15.5 a
1-MCP	1	160			17.2 a	15.8 a
1-MCP	2	80			16.5 bc	15.9 a
1-MCP	2	160			16.7 abc	15.5 a
AVG	4	125			16.9 ab	15.4 a
NAA	2	10			16.2 c	14.0 c
AVG + NAA	2	125			16.7 abc	15.5 a
	2	10				

1-MCP, AVG and NAA on 'Delicious' fruit water core (Yuan, 2007)

TRT	Appl. time (WBH*)	Conc. (ppm)	Fruit water core (%)			
			Sept 5	Sept 13	Sep 19	Oct 3
Control	-		0.0	0.0	2.0 a	70.0 a
1-MCP	1	80			2.0 a	32.0 b
1-MCP	1	160			0.0 a	6.0 d
1-MCP	2	80			0.0 a	28.0 bc
1-MCP	2	160			2.0 a	6.0 d
AVG	4	125			4.0 a	26.0 bc
NAA	2	10			0.0 a	66.0 a
AVG + NAA	2	125			0.0 a	10.0 cd
	2	10				

1-MCP, AVG and NAA on 'Rome' fruit firmness (Yuan, 2007)

TRT	Appl. time (WBH*)	Conc. (ppm)	Fruit firmness (lb)				
			Oct. 5	Oct. 11	Oct. 19	Oct. 26	Nov. 2
Control	-		20.2 bc	18.4 c	18.6 c	17.1 b	15.9 c
1-MCP	2	160	21.2 ab	20.7 ab	19.7 ab	18.7 a	17.0 bc
1-MCP	1	160	21.4 a	21.1 a	19.7 ab	19.1 a	17.8 ab
AVG	4	125	21.4 a	20.5 ab	20.4 a	19.5 a	19.0 a
NAA	2	10	19.9 c	18.8 c	18.9 c	16.9 b	14.1 d
1-MCP + NAA	2	80	20.9 abc	20.1 b	19.7 ab	19.2 a	17.7 ab
AVG + NAA	4	125	20.5 abc	20.4 ab	19.7 ab	19.5 a	18.5 ab
	2	10					

ReTain and NAA Combinations:

fruit firmness 4 weeks after normal harvest

Treatment (ppm)		Firmness (lb)
-4 Weeks	-2 Weeks	
Control	-	12.7 a
AVG (125)	-	13.7 b
-	NAA (20)	13.6 b
AVG (125)	NAA (20)	13.7 b
-	AVG (125) + NAA (20)	14.5 c
-	AVG (62.5) + NAA (20)	13.5 b



McCartney, NC State 2008

Now a Look at Pre-Harvest Drop...

Table 1. Effect of stop drop on preharvest drop of ‘Delicious’ apples, PA 2005 (Schupp).

Treatment	% Fruit drop by date			
	19 Sep	23 Sep	26 Sep	28 Sep
Control	12	15	17	24
AVG ^x	5	8	10	12
NAA ^w	5	10	10	10
NAA pre-load ^v	3	8	13	15
AVG + NAA pre-load ^u	4	5	5	8

Table 2. Effect of stop drop on fruit maturity and firmness of ‘Delicious’ apples at harvest, PA 2005.

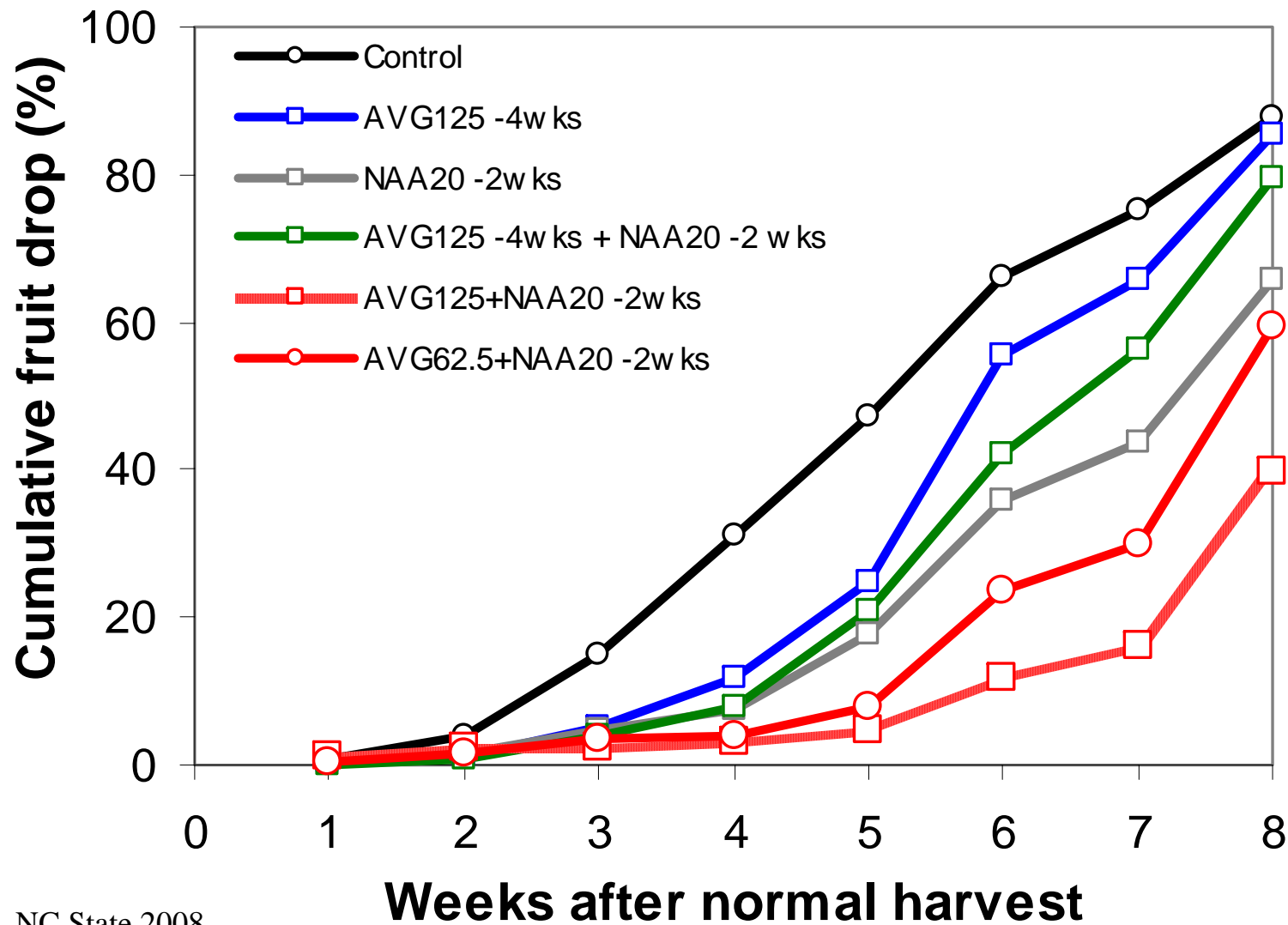
Treatment	Internal ethylene conc. (PPM)	Starch index	Firmness (kg)	Soluble solids (%)
Control	26.5 ab ^t	5.3 ab	6.9	13.6 ab
AVG ^x	11.0 bc	4.7 ab	7.2	13.1 bc
NAA ^w	11.4 bc	5.4 ab	7.1	13.7 ab
NAA pre-load ^v	39.7 a	5.7 a	7.0	14.2 a
AVG + NAA pre-load ^u	1.6 c	3.3 bc	7.3	12.5 c

10 weeks later...

Table 4. Effect of stop drops and post-harvest 1-MCP on internal ethylene concentration and fruit firmness of 'Delicious' apples after 10 weeks of refrigerated storage.

Treatment		Internal ethylene concentration (ppm)	Firmness (lb)
<u>Pre-harvest</u>			
	<u>Timing</u>		
Control	--	151 a	9.5 cd
Retain	H-28	130 a	10.2 bc
NAA	H-7	126 a	9.4 d
NAA Pre-load	H-28, H-21, H-14, H-7	142 a	9.3 d
Retain + NAA Pre-load		60 b	12.0 a
<u>Post-harvest</u>			
No 1-MCP		136 a	10.2 b
1-MCP		92 b	11.0 a

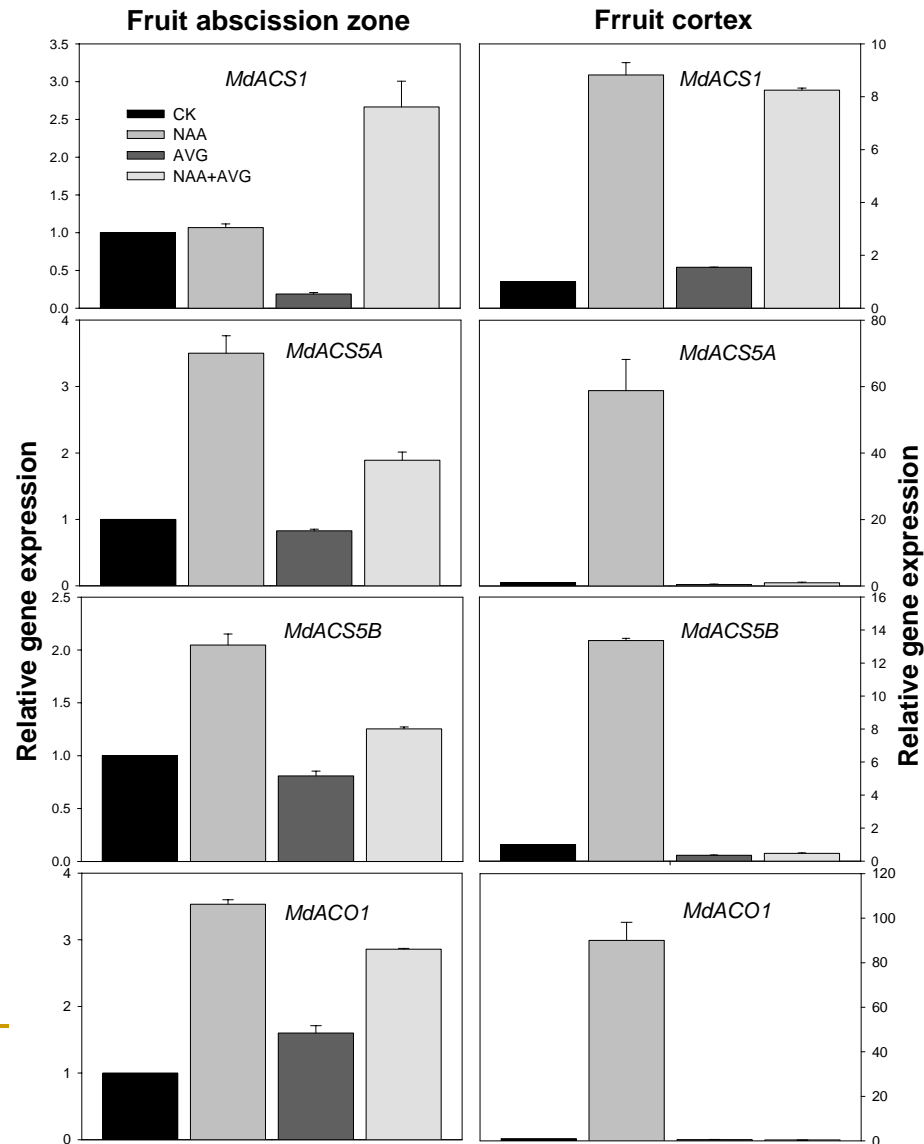
ReTain and NAA Combinations: fruit drop



How Does This Happen?

- According to Yuan (VA Tech), Gene “MdPG2a” is responsible for fruit abscission
 - NAA and ReTain BOTH increase the expression of this gene
 - Together, NAA + ReTain improve preharvest drop control.
-

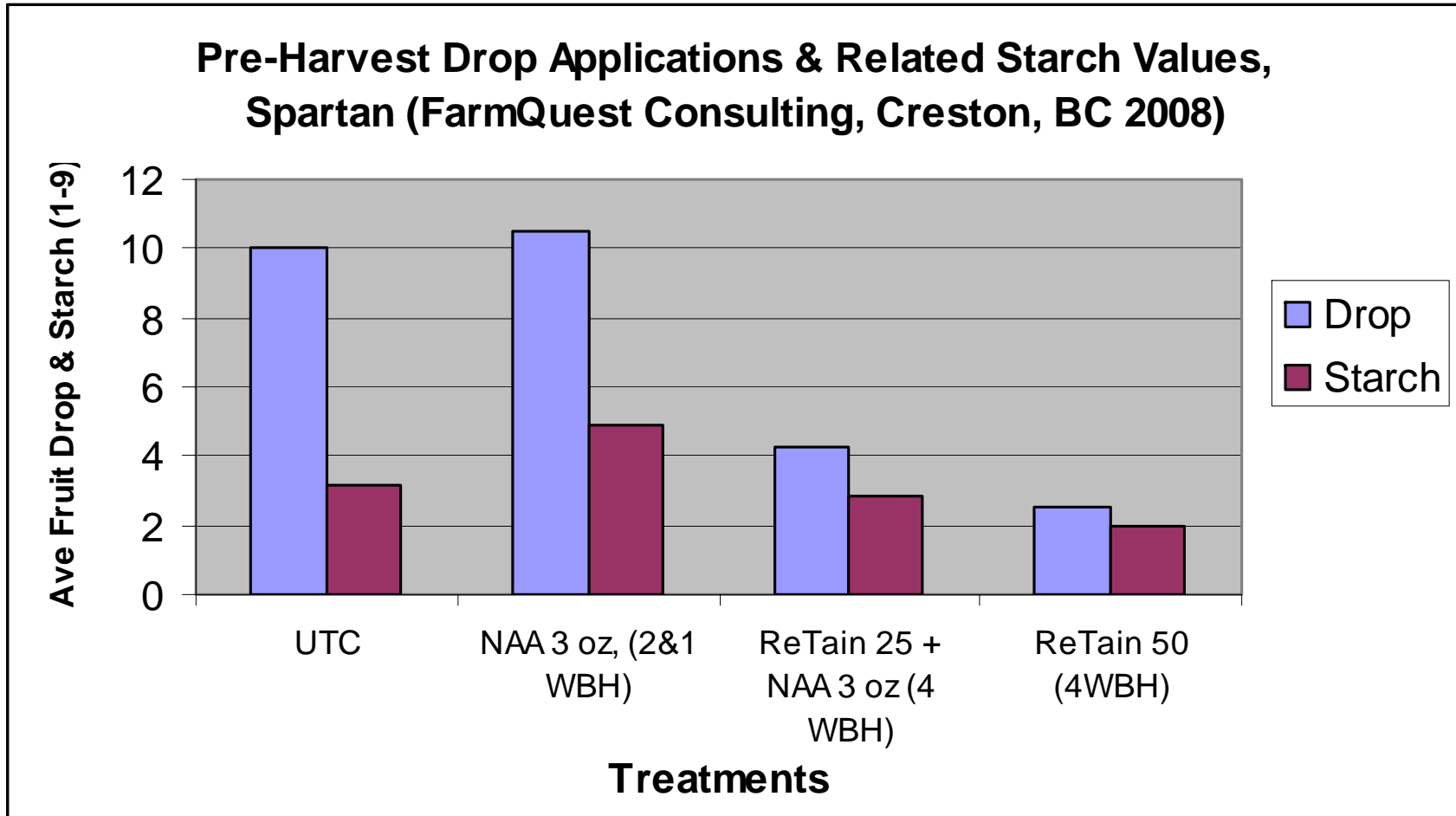
NAA and AVG on expression of genes related to ethylene biosynthesis in Delicious apples



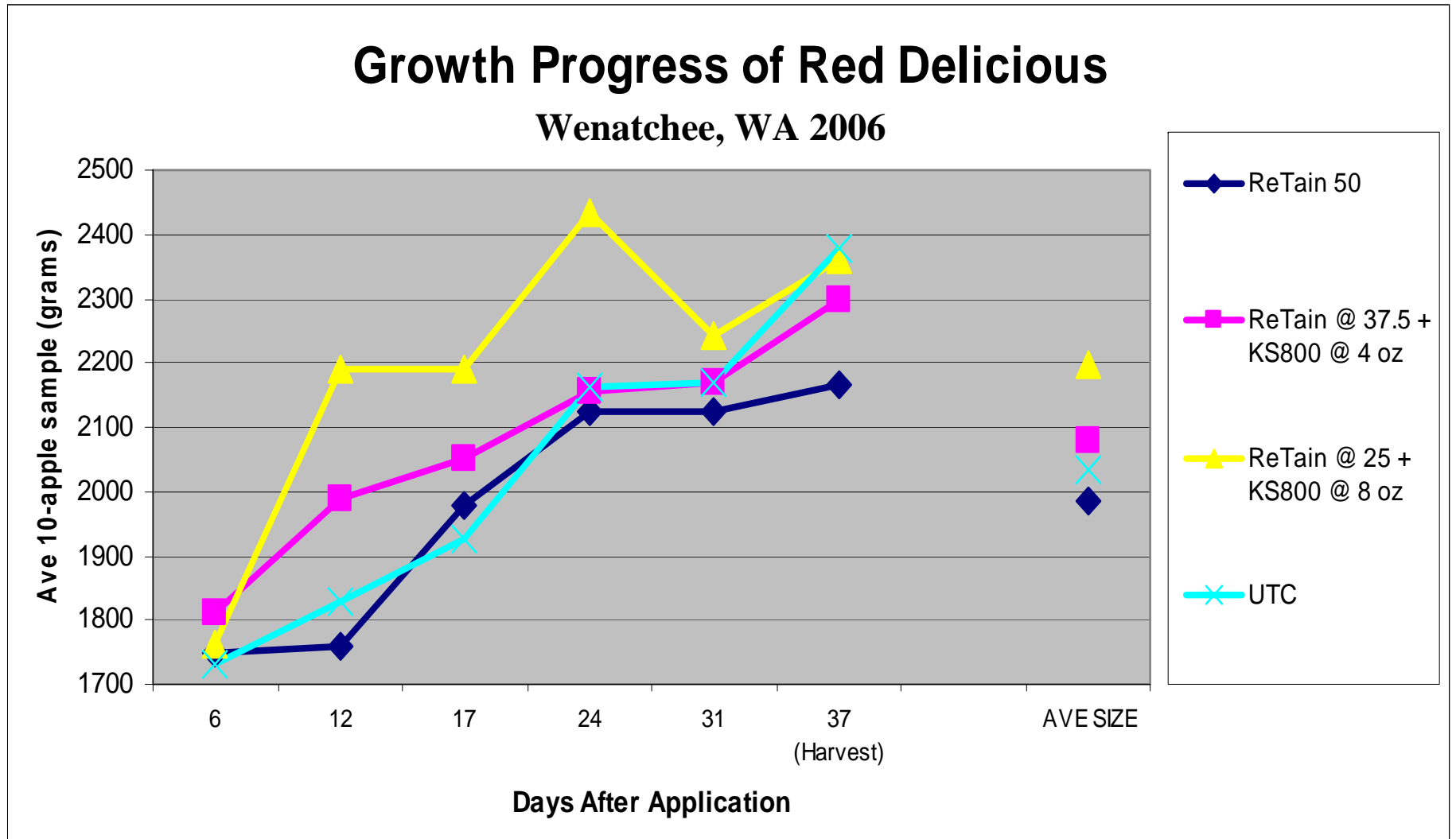
As for Firmness...

- Gene “MdCel1” is responsible for ethylene production and fruit ripening
 - NAA increases the expression of this gene on ethylene sensitive varieties, making fruit less firm over time.
 - ReTain decreases the gene expression.
 - So, ReTain overpowers NAA when it comes to the expression of fruit ripening, meaning ReTain’s influence on Gene 1 is generally stronger than NAA’s influence.
 - Exceptions? Yes! Ethylene-sensitive varieties would be less likely to ignore NAA completely.
-

An Example of an Ethylene Sensitive Variety (Spartan)



Other potential benefits? Fruit size



Summary

- NAA + ReTain work together for pre-harvest drop control
 - NAA + ReTain together may be better than either alone
 - The exception would most likely be ethylene-sensitive varieties
 - Rates, varieties and timing should be further explored
 - There may be more benefits to this work, such as increased fruit size.
-

Thank You and Good Luck!
