

System-Cal® and PGRs University Apple Research and Technical Data

Perhaps the busiest and most stressful time for a horticulturist and apple grower is the bloom and early post bloom period. Fruit thinning applications, plant growth regulator sprays like MaxCel®, Promalin®, Apogee® are being applied. All with the intent to improve fruit size, fruit quality, return bloom, reduce hand thinning expenses and pruning expenses. All of these applications are taking place during peak fruit cell division. This is the most critical time for foliar calcium applications as calcium can only enter the fruit cell wall during cell division. Being able to add foliar calcium to these sprays in a form that goes into the cell walls quickly and thoroughly, while at the same time making these sprays more consistent and effective is a very significant benefit. System Cal (Calcium Phosphite) has been shown in numerous trials for the past several years to have positive impact on all of these sprays while providing a significant amount of a very beneficial form of Calcium at the same time. In addition, the pH of System Cal contributes to the stability and performance of these products and to tank mix companions like Sevin® (carbaryl).

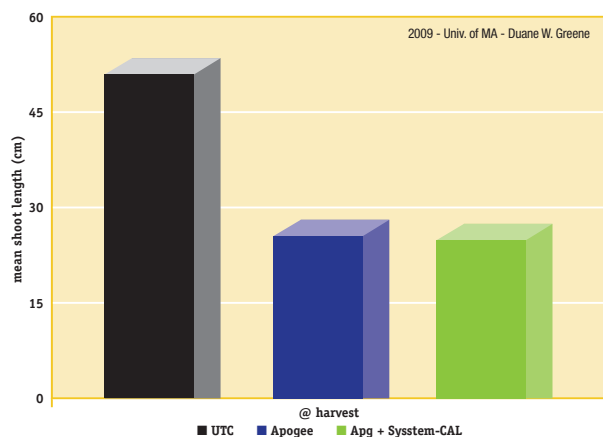
The Apogee Studies Data

University of Massachusetts

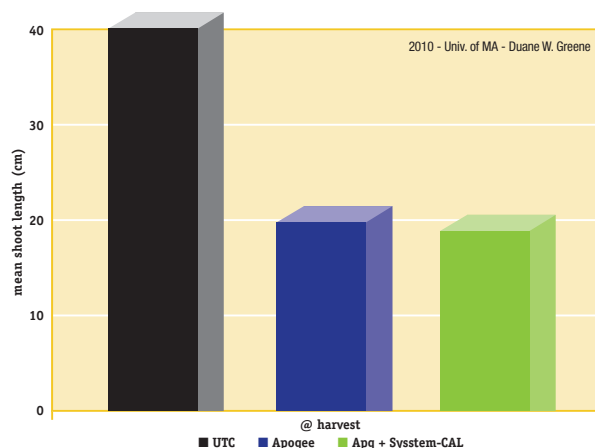
In replicated field research with Cortland/M.26 apple trees, Dr. Duane Greene, University of Massachusetts, found that Apogee plus a 64-ounce rate of System-CAL reduced terminal growth the same as Apogee alone, but also increased fruit weight and numerically reduced bitter pit.

“The weight of the fruit from trees treated with Apogee plus System-CAL were significantly larger than control fruit,” noted Dr. Greene. “Fruit on trees that received the higher rate of calcium sprays displayed numerically less bitter pit. But the key finding is that 64 oz/100 gallons of System-CAL in an Apogee tank mix does not reduce efficacy of the Apogee.”

System-CAL Effect on Apogee and Shoot Growth in Cortland



System-CAL Effect on Apogee and Shoot Growth in Cortland



Trees in the trial block at the U. Mass. Horticulture Research Center in Belchertown were quite vigorous, with terminal growth of 50.5 cm. The application of Apogee (3 oz/100 gal) successfully reduced the final terminal growth by 50 percent to an average length of 25.2 cm. When System-CAL (64 oz/100 gal) was included in the spray with Apogee there was no reduction in the efficacy of the Apogee, and the reduction was to 24.2 cm.

University of Massachusetts 2009.

Effect of Apogee and Apogee + Calcium-containing products on terminal growth, fruit weight and the incidence of bitter pit in Cortland/M.26 apples.

Treatment ¹	Terminal growth ² (cm)	Fruit weight (g)	Bitter pit (%)
Untreated control	50.5 a	277 b	11.8 a
Apogee alone 3 oz/100 gal	25.2 c	288 ab	10.5 a
Apogee + System Cal 64 oz.	24.2 c	305 a	7.4 a

¹Treatments applied May 5, June 2, and June 25, 2009 and applied in 100 gal/acre.

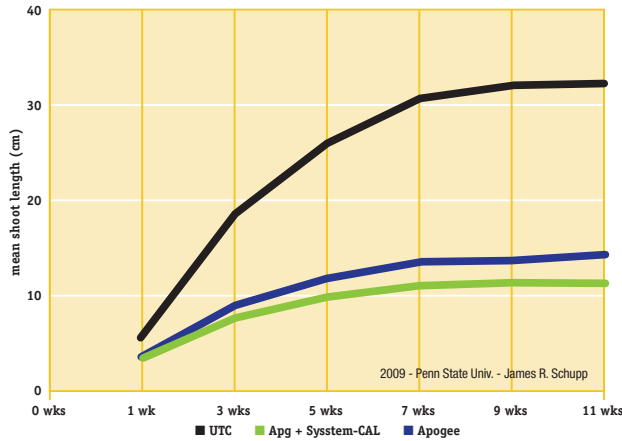
²Mean separation, Duncan multiple range test P = 0.05.

Similar research at The Pennsylvania State University Fruit Research and Extension Center by Dr. James R. Schupp, Associate Professor of Pomology, also found that Apogee plus System-CAL produced equal or better shoot reduction than Apogee alone.

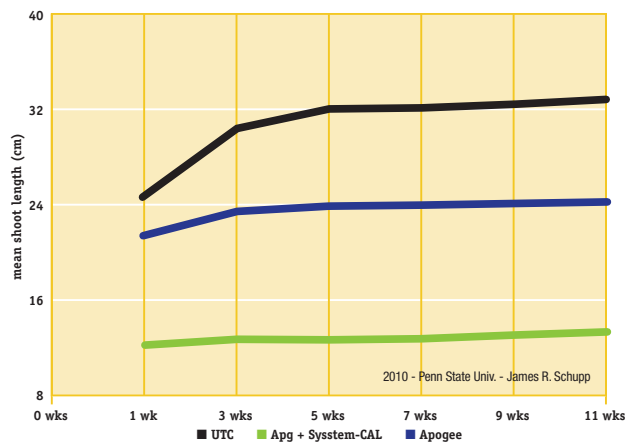
Penn State University

Similar research at The Pennsylvania State University Fruit Research and Extension Center by Dr. James R. Schupp, Associate Professor of Pomology, also found that Apogee plus Sysstem-CAL produced equal or better shoot reduction than Apogee alone.

System-CAL Effect on Apogee and Shoot Growth in York



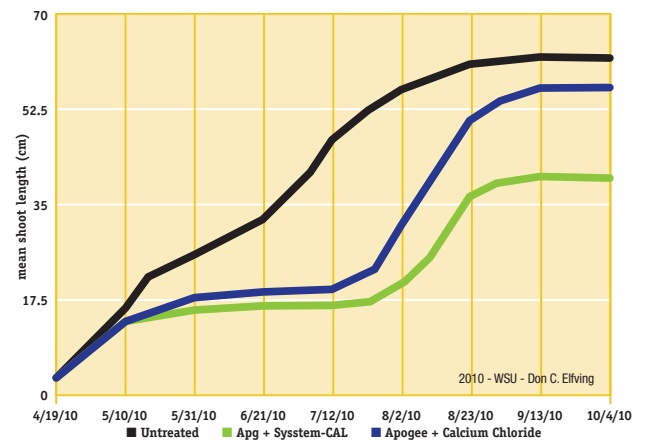
System-CAL Effect on Apogee and Shoot Growth



Washington State University

The work of Dr. Don C. Elfving, Horticulturist and Professor of Tree Fruit Research at Washington State University focused on a vigorous orchard of mature BC2 Fuji/M.7 apple trees planted in 1990. The research included comparisons of tank mixes of Apogee with System-Cal and Apogee with calcium chloride.

System-CAL Effect on Apogee and Shoot Growth in Fuji



“Apogee reduced shoot extension for about two months, after which a second growth flush began. When tank-mixed, the proprietary calcium (System-CAL) did not negate the growth control activity of Apogee, but it appeared as if the tank-mixed calcium chloride did reduce Apogee efficacy,” Dr. Elfving reported.

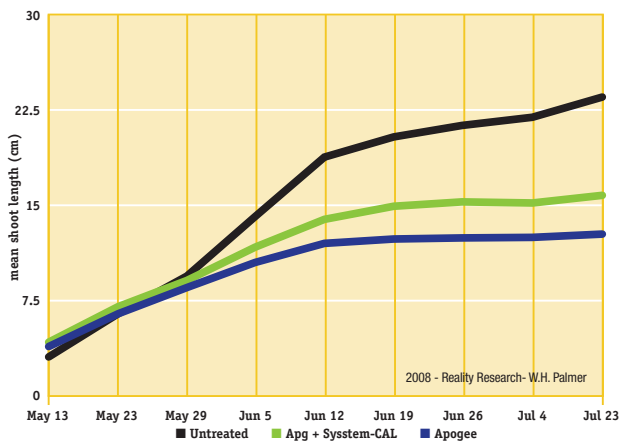
New York/Reality Research

Orchard trials by Reality Research found that System-CAL improved the thinning programs using Sevin XLR Plus, MaxCel®, and Fruitone® N as well as the growth control of Apogee. System-CAL had no phytotoxicity or handling issues and “definitely improved fruit thinning” of Gala, Fuji and Red Delicious varieties, said W.H. “Butch” Palmer, who managed the trials.

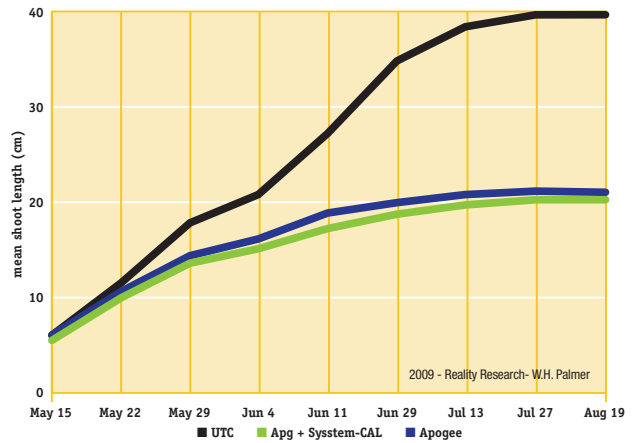
“Traditionally we do not apply calcium until summer, but now we are learning about the importance of providing calcium to apple crops early in the season, at the same timing when we use Apogee,” said Palmer. “The most widely used and least expensive source has been calcium chloride. But if you mix that with Apogee, you lose the effectiveness of Apogee.”

“With System-CAL we do not get that antagonism, and in one variety, Red Delicious, it clearly improved the performance of Apogee. And we used low 4 oz/acre rates of Apogee because a higher rate might have overcome any negative effect of the calcium. Growers are changing how they use Apogee, with lower rates in more split applications. So System-Cal is going to work perfectly for growers.”

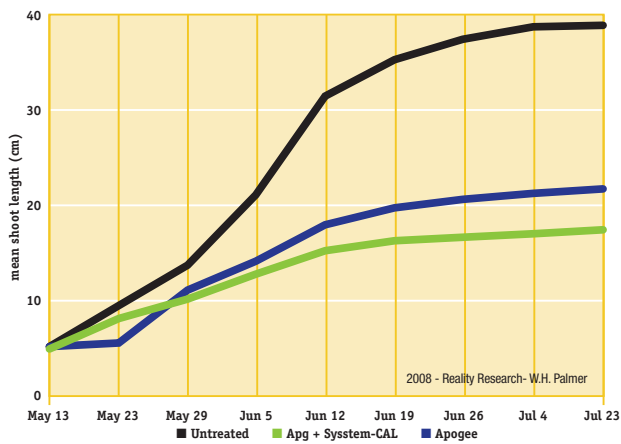
System-CAL Effect on Apogee and Shoot Growth in Cortland



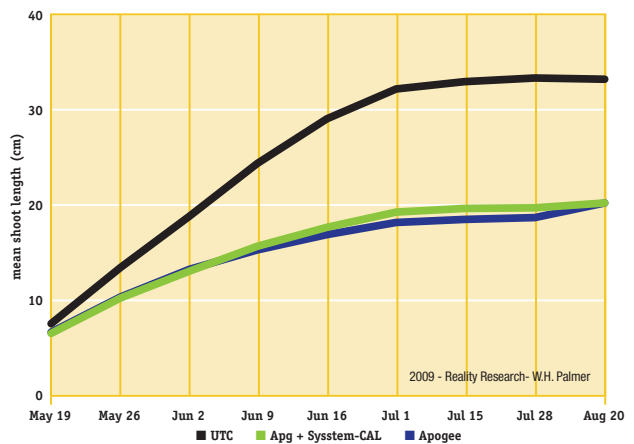
System-CAL Effect on Apogee and Shoot Growth in Macintosh



System-CAL Effect on Apogee and Shoot Growth in Red Delicious



System-CAL Effect on Apogee and Shoot Growth in Rome

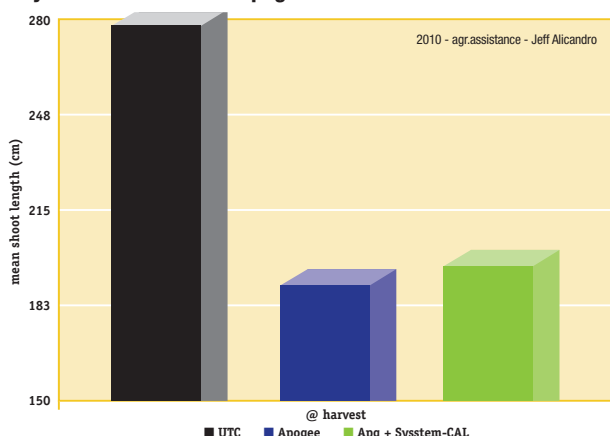


“Plus, the System-CAL formulation is easier to work with. Calcium chloride is a dry, bulky material that plugs nozzles, can cause phytotoxicity, and is highly corrosive to equipment. There is none of that with System-CAL. System-CAL stood out even among the newer calcium formulations, and there are a lot of them out there.”

While System-CAL can be used early in the season at timings where calcium chloride cannot, Palmer also noted that System-CAL would be a good option to replace calcium chloride in cover sprays.

Research by Jeff Alicandro of agr.assistance in North Rose, New York showed both the Apogee alone and Apogee + Sysstem-CAL tank mix programs provided good vegetative growth control in a vigorous block of Macintosh trees more than 25 years old. There was a 30% reduction in total vegetative tree growth vs. the untreated check during that unusually warm and wet 2010 growing season.

Sysstem-CAL Effect on Apogee and Shoot Growth in Macintosh



“The addition of Sysstem-CAL to Apogee sprays did not reduce the efficacy of Apogee in reducing terminal growth,” Alicandro reported.

Fire Blight and Apogee

Plant physiology studies show that disease tolerance is a key aspect of delivering calcium to the tree when it is most needed. By strengthening the integrity of cell walls in branches as well as the fruit, calcium helps apple trees to better tolerate disease. Because Sysstem-CAL does not interfere with the efficacy of Apogee, the PGR is able to continue its role in helping growers manage fire blight in high infection areas such as the Northeast, Michigan, and elsewhere. Apogee inhibits gibberellin biosynthesis, which results in an early cessation of terminal growth. As Michigan State University Extension noted in a bulletin updated in 2009, “Shoots with inhibited growth are less susceptible to fire blight; therefore, the potential for the build up of fire blight during the summer is reduced significantly. Apogee only decreases host susceptibility; it does not affect the pathogen directly. Apogee is not a substitute for streptomycin during bloom for blossom blight control.” Growers should consult their state’s Extension pomologists for Apogee rates and timings if used for fire blight.

Fruit Sizing Performance Data

There are a number of early season tasks for apple growers to focus on at the same time to ensure maximum fruit quality at harvest. Among the most important are managing the fruit load and maximizing calcium uptake into the developing fruit. Trial work shown in the charts below conducted in New York and Massachusetts demonstrated that Sysstem-Cal, a foliar calcium, can improve the performance of thinning materials that are critical to maximizing fruit load and quality.

Dr. D. Greene, from UMass, in his trial on McIntosh apples noted that “clearly Sysstem-Cal when combined with MaxCel had a profound effect on increasing fruit size.”

Effects of Sysstem-Cal & Maxcel on Size of McIntosh Apples

Treatments		
Petal fall	10 mm	fruit wgt (gr)
Untreated Control	Control	156 c
Carbaryl 1 lb/100 gal + NAA 7.5 ppm	Carbaryl 1 lb/100 gal + MaxCel 100 ppm	191 b
Carbaryl 1 lb/100 gal + NAA 7.5 ppm + Sysstem- CAL 2 qts/100 gal	Carbaryl 1 lb/100 gal + MaxCel 100 ppm + Sysstem-CAL 2 qts/100 gal	255 a

Trial conducted by Duane Greene, University of Massachusetts 2010

Effects of Sysstem-Cal on Size of Gala Apples

Treatments		Fruit Size		
Petal fall	10-13 mm	<2.75"	2.75" -3"	>3"
Carbaryl 24 oz	Carbaryl 24 oz + Maxcel 2qts	46.0	41.0	13.0
Carbaryl 24 oz + Sysstem-Cal 2qts	Carbaryl 24 oz + Maxcel 2qts + Sysstem-Cal 2qts	39.0	37.0	24.0

Trial Conducted by Reality Research, Wayne Cty, NY - 2010

Effect of Sysstem-Cal on the Effect of Promalin to increase the L/D Ratio of Delicious Apples

University of Massachusetts

In a block of mature Early Red One Delicious/Mark 63 uniformly blooming trees were selected that were growing at the University of Massachusetts Horticulture Research Center in Belchertown, MA. Trees were organized into 9 groups (replications) of 7 trees each. A buffer tree separated the selected treatment trees. Treatments were applied when most of the king flowers were open on 15 May using a commercial airblast sprayer delivering a tree row volume dilute amount of 100 gal/acre. The high temperature on the day of application was 77° F and for the next few days it was 77°, 62°, 55°, 71°, and 82° F. The day after application trees were inspected and evaluated for any sign of phytotoxicity that could be attributed to the spray. On October 2, at the normal harvest time a 25 apple sample was randomly harvested from the periphery of each tree. Samples were taken to the laboratory where fruit weight and the L/D ratio were determined for the fruit harvested from each tree.

There were both favorable and unfavorable temperatures following application, depending on the day, which may explain why the Promalin response on the L/D ratio was not great. However, given the weather forecast at the time of application, it was deemed appropriate to make the application on May 15, which was the correct physiological stage indicated on the label. *“While these data do not conclusively show that Sysstem Cal does enhance the response of Delicious apples to Promalin, the numbers are suggestive of this.”*

Effect of Promalin and Promalin and Sysstem Cal on fruit weight and fruit L/D ratio of Early Red One Delicious/Mark

Treatment	L/D ratio'	Fruit weight (g)
Untreated control	0.99	152
Promalin 1 pt/acre (25 ppm)	1.00	153
Promalin 1 pt/acre + 2 qt Sysstem Cal	1.00	163
Promalin 1 pt/acre + 4 qt Sysstem Cal	1.01	157

Duane Greene, UMass, 2009

Effects of Sysstem-Cal™ (Sys) and MaxCel® (Max) Yield and Fruit Quality

Treatment	Avg. Weight (g)	Firm (kg)	Yield Kg/Tree	Stem Crack %	Sunburn %	Firmness 2.5mths Storage	Stem Rot %	Rotten %	Ca (ppm)
Control	188.2	8.98	29.77	0.5	8.2	6.950	2.04	5.82	5.45
Maxcel 128oz PF	217.7	8.78	29.67	2.8	11.1	6.953	2.50	8.04	6.02
Sysstem-Cal + Maxcel 128oz 5-10mm	227.1	8.44	46.17	1.7	6.7	6.699	3.24	5.56	6.25
Grower Std.(Sevin & NAA)	221.6	7.99	36.78	14.6	8.4	6.146	8.73	10.71	6.05

Dr. Essie Fallahi, Univ. of Idaho, 2011

The experimental orchard was a 'Buckeye Gala' on RN 29 that was located in Fruitland Idaho. Trees were planted in 2006 and had full crop in 2011. Over 220 trees were designated for this experiment. The experimental design was completely randomized block design with 9 treatments and 3 blocks. Each block consisted of 10 uniform trees per treatment. The orchard soil was sandy loam with a pH of about 7.2. Trees were trained into a vertical axis. Trees were irrigated with a micro -jet system and all cultural practices were made according to the local recommendation.

“Un-treated controlled had smallest fruits. But those with Sysstem-Cal™ 2Qts + MaxCel® 128oz at 5-10mm@200G/A had the largest fruit of any of the treatments. Fruit from trees receiving Grower's Treatment (Sevin and NAA) had lower firmness at harvest as compared to control and the Sysstem-Cal™ and MaxCel® treatments. Enrichment with Ca from Sysstem-Cal™ could have also contributed to higher firmness in Sysstem-Cal™-treated fruits.”

The Findings Show a Fit for System-CAL

In apples, growers no longer have to choose between the benefits of plant growth regulators and addressing the fruit's peak demand for calcium between bloom and the end of cell division. Sysstem-CAL doesn't just deliver the calcium when and where it is most needed within the tree and developing crop. Sysstem-CAL also provides buffering and improved PGR uptake.

Sysstem-CAL isn't just for early season crop development. Applications of Sysstem-CAL after cell division is complete will continue to support the tree's needs so calcium is not pulled from the fruit, thereby maximizing fruit calcium levels. Extensive research over many years has shown that high levels of calcium in the fruit will reduce bitter pit and improve storability of the fruit. Sysstem-Cal (calcium phosphite technology) does not contain potassium which can antagonize calcium uptake into the fruit during cell division, (a common problem with early season foliar potassium products like potassium phosphite).

Growers of other crops also are using Sysstem-CAL to maximize fruit quality and minimize calcium deficiency problems such as blossom end rot in tomatoes and internal cell breakdown in stone fruit, and increase nut weight in almonds, walnuts and filberts.