

Drs. Gene E. Lester and Michael A. Grunsak

Cantaloupe, Honeydew Fruit Respond Differently To Chelated Calcium

Two-year study assesses benefits of pre-harvest plant applications during fruit growth and maturation.



Post-harvest dipping fully ripened honeydew melons in organic chelated Ca versus EDTA-chelated Ca or Ca chloride (CaCl_2) solutions has been shown to maintain stored honeydew fruit Ca concentration at levels found in recently abscised fruit, thus maintaining fruit tissue firmness, plasma membrane integrity, and extending storage life. However, applying Ca to commercially grown melons as a post-harvest dip is not suitable for melon growers in the desert southwestern U.S. or other low-humidity melon growing regions of the U.S. These growers box melons for shipment in the field at harvest, making a post harvest dip impractical.

Although application of Ca to melon fruit tissue disks, greenhouse grown melons, or commercially harvested melons has been reported, no

Summary: Cantaloupe fruit at both locations did not appear to benefit from pre-harvest plant applications of calcium (Ca) when compared to fruit from plants treated with water. Honeydew fruit did, however, and the benefit was both years. Honeydew fruit that received four pre-harvest plant applications of Ca, regardless of source, were generally superior in firmness, marketability, and had a higher Ca concentration than fruit from plants receiving water or one or two applications of Ca. Fruit sugars and taste were not affected by pre-harvest plant applications of Ca.

studies have been reported during fruit production for pre-harvest plant application of organic-chelated Ca sources to commercial fields of either honeydew or netted cantaloupe.

Therefore, the objective of this study was to assess the benefits of pre-harvest plant-applied applications of two commercial organic chelated (amino acid or mannitol) Ca formulations at different times during fruit growth and maturation. Following harvest and storage for up to 22 days, fruit were evaluated for firmness, marketability, Ca concentration, interior soluble solids concentration (sugars), and consumer preference (taste).

Honeydew melons

Firmness. In 2001 and 2002, four applications of amino acid chelated Ca (AA-Ca) or mannitol-complexed Ca (MC-Ca), versus control applications of water, resulted in significantly firmer readings of the fruit exterior tissues under the peel at harvest (Table 1). Fruit interior (edible tissue) firmness readings in 2001 from four applications of AA-Ca or MC-Ca and only AA-Ca in 2002, versus water, resulted in significantly firmer edible tissue. One or two applications of either Ca compound, applied at female

flowering and/or within 20 days after flowering (early applications) or within 40 days after female flowering and/or within 3 to 5 days before abscission (late applications), were not always significantly better than water in affecting exterior or interior fruit firmness. Following storage of melons for 2 or 3 weeks, exterior and interior firmness were generally significantly firmer with four applications of either plant-applied Ca compound, than those receiving one or two early or late Ca applications of water.

Ca. In 2001 and 2002 four applications of AA-Ca or MC-Ca (versus water) resulted in significantly higher Ca concentrations in fruit exterior and interior tissues at harvest (Table 2). One or two early or late applications of either Ca compound were not always significantly higher in Ca than water. In both years, fruit from four applications of Ca stored for two weeks had higher exterior and interior Ca concentrations than water. After three weeks, for both years, fruit from four applications of Ca were significantly higher in tissue (exterior and interior) Ca concentrations than those treated with water.

Marketability. Following two or

		Firmness (N)			
		Exterior		Interior	
Treatment	Application ^y	2001	2002	2001	2002
At harvest					
Water	-	9.1 b	17.4 c	6.2 c	7.7 c
AA-Ca	2 early + 2 late	16.0 a	23.5 a	12.1 a	12.3 a
MC-Ca	2 early + 2 late	16.5 a	20.9 ab	13.0 a	9.3 bc
AA-Ca	1 early	-	18.4 b	-	8.3 bc
AA-Ca	2 early	-	18.4 b	-	8.0 bc
MC-Ca	1 early	-	20.4 bc	-	10.4 ab
MC-Ca	2 early	-	19.2 bc	-	9.8 bc
AA-Ca	1 late	8.7 b	-	13.0 a	-
AA-Ca	2 late	12.5 ab	-	10.7 ab	-
MC-Ca	1 late	12.1 a	-	9.6 b	-
MC-Ca	2 late	11.5 b	-	11.9 ab	-
P≤0.05					
After 2 weeks storage					
Water	-	8.2 c	15.7 c	4.2 b	7.2 d
AA-Ca	2 early + 2 late	11.5 ab	23.5 a	7.5 a	12.3 a
MC-Ca	2 early + 2 late	14.5 a	20.7 ab	8.6 a	9.6 bc
AA-Ca	1 early	-	19.7 ab	-	10.1 ab
AA-Ca	2 early	-	16.6 bc	-	7.9 cd
MC-Ca	1 early	-	17.9 bc	-	11.4 ab
MC-Ca	2 early	-	19.1 bc	-	9.1 bcd
AA-Ca	1 late	8.5 c	-	3.6 b	-
AA-Ca	2 late	8.2 c	-	4.9 b	-
MC-Ca	1 late	8.5 c	-	3.9 b	-
MC-Ca	2 late	9.7 bc	-	3.0 b	-
P≤0.05					
After 3 weeks storage					
Water	-	7.2 c	14.3 c	3.3 c	6.9 b
AA-Ca	2 early + 2 late	10.1 ab	20.9 a	5.0 ab	11.7 a
MC-Ca	2 early + 2 late	12.3 a	17.2 bc	6.4 a	9.0 ab
AA-Ca	1 early	-	15.3 bc	-	9.1 ab
AA-Ca	2 early	-	15.6 bc	-	8.9 ab
MC-Ca	1 early	-	19.1 ab	-	11.8 a
MC-Ca	2 early	-	14.3 c	-	6.9 b
AA-Ca	1 late	7.5 c	-	2.9 c	-
AA-Ca	2 late	8.1 b	-	4.0 bc	-
MC-Ca	1 late	8.2 bc	-	3.9 bc	-
MC-Ca	2 late	8.1 bc	-	3.5 c	-
P≤0.05					
y Applications: 1 early = at female flowering, 2 early = 1 early + 20 d later, 1 late = 3 to 5 d prior to full-slip, 2 late = 40 d after female flowering + 1 late. (-) = no treatment application conducted that year.					

Table 1. Firmness of 'Orange Dew' orange-flesh honeydew melon exterior with peel removed (exterior) and edible-flesh (interior) at harvest and following commercial storage, Sacramento Valley, CA. Fruit harvested at abscission in Sept. 2001 and 2002.

three weeks of storage, exterior and interior percent marketability of fruit from plants receiving four applications of AA-Ca or MC-Ca, versus water, were for most comparisons significantly greater. Also, one or two applications of Ca applied early or late, when compared to water, were significantly greater in exterior and interior marketability for most comparisons.

Sugars and taste. Percent soluble solids concentration for all fruit was similar within each production year, regardless of Ca source or number of applications. Sugars were lower by about 2.8 percent in 2002 versus 2001. With few exceptions, consumer preference for all fruit ranged from like to like extremely. Consumers usually gave fruit from water-treated plants the best taste ratings, but fruit from the water treatments generally were not significantly better than fruit from plants receiving Ca treatments. Only a few of the Ca treatments resulted in fruit with significantly lower ratings, relative to water-treated controls

Cantaloupe melons

Firmness. At harvest, whether grown in California or Texas or having received pre-harvest plant-applied Ca treatments or water, exterior or interior firmness readings were not consistently, significantly different. Following one or two weeks storage, fruit exterior or interior tissues from plants receiving applications of Ca were usually not significantly firmer than those from the water treatment

Ca. At harvest, whether grown in California or Texas, Ca concentration was usually numerically the highest in both exterior and interior fruit tissues from plants having received four applications of AA-Ca (Table 3), but the concentrations were not significantly higher in fruit from the water treatment. Following one or two weeks storage, fruit exterior and interior tissues from plants having received four applications of AA-Ca remained numerically the highest in Ca and generally were significantly higher than water. However, all other Ca treatments usually were not

		Exterior Calcium (ppm)		Interior Calcium (ppm)	
Treatment	Applications ^z	2001	2002	2001	2002
At harvest					
Water	-	2974 b	3756 c	505 b	417 d
AA-Ca	2 early + 2 late	3748 a	4872 a	654 a	667 a
MC-Ca	2 early + 2 late	3748 a	4443 b	638 a	578 ab
AA-Ca	1 early	-	4431 b	-	470 d
AA-Ca	2 early	-	4374 b	-	507 c
MC-Ca	1 early	-	4482 b	-	572 abc
MC-Ca	2 early	-	4387 b	-	473 cd
AA-Ca	1 late	3377 ab	-	513 b	-
AA-Ca	2 late	3373 ab	-	634 ab	-
MC-Ca	1 late	3298 a	-	521 b	-
MC-Ca	2 late	2721 b	-	618 ab	-
P≤0.05					
After 2 weeks storage					
Water	-	2677 bc	3175 c	502 b	548 cd
AA-Ca	2 early + 2 late	3342 ab	4429 a	642 a	671 a
MC-Ca	2 early + 2 late	3565 a	4119 ab	620 ab	627 a
AA-Ca	1 early	-	3858 b	-	502 d
AA-Ca	2 early	-	3830 b	-	537 b
MC-Ca	1 early	-	4087 b	-	601 ab
MC-Ca	2 early	-	3991 b	-	560 bc
AA-Ca	1 late	2262 c	-	457 c	-
AA-Ca	2 late	2672 bc	-	620 ab	-
MC-Ca	1 late	3020 abc	-	480 c	-
MC-Ca	2 late	2357 c	-	480 c	-
P≤0.05					
After 3 weeks storage					
Water	-	2114 c	3078 c	344 c	447 b
AA-Ca	2 early + 2 late	2974 ab	4233 a	530 ab	522 a
MC-Ca	2 early + 2 late	3351 a	3960 a	574 a	505 a
AA-Ca	1 early	-	3380 b	-	472 ab
AA-Ca	2 early	-	3241 bc	-	409 b
MC-Ca	1 early	-	3351 bc	-	465 ab
MC-Ca	2 early	-	3405 b	-	465 ab
AA-Ca	1 late	1515 d	-	355 c	-
AA-Ca	2 late	2138 c	-	485 b	-
MC-Ca	1 late	2748 b	-	400 c	-
MC-Ca	2 late	2357 c	-	334 c	-
P≤0.05					

^z Applications: 1 early = at female flowering, 2 early = 1 early plus 20 d later, 1 late = 3 to 5 d prior to full-slip, 2 late = 40 d after female flowering plus 1 late. (-) = no treatment application conducted that year.

Table 2. Calcium concentration of 'Orange Dew' orange-flesh honey dew melon exterior with peel removed and edible-flesh (interior) at harvest and following commercial storage, Sacramento Valley, Calif.

Fruit were harvested at abscission in Sept. 2001 and 2002.

significantly higher than water.

Marketability. Following one week of storage, exterior and interior percent marketability of fruit from plants receiving Ca versus water was not significantly different. Following two weeks storage, Texas-grown fruit exterior and interior marketability from plants receiving Ca applications was significantly better than water (Table 4). But in California-grown fruit, Ca treatments (versus water) were not statistically different for either exterior or interior percent marketability.

Sugars and taste. Percent soluble solids concentration, within each growing location for all fruit was similar. Between locations the concentration of sugars was lower in Texas than California-grown fruit. With few exceptions, consumer preference for all fruit, regardless of location, ranged from like to like extremely. Statistically, significant differences were observed between certain treatments, but across all locations or storage times, no treatments were consistently different. Consumers usually gave fruit from Ca-treated plants the best rating, but it was never always significantly better than fruit from plants receiving water.

		Exterior Calcium (ppm)				Interior Calcium (ppm)			
		Calif.		Texas		Calif.		Texas	
Treatment	Applications ^z	Calif.	Texas	Calif.	Texas	Calif.	Texas	Calif.	Texas
At harvest									
Water	-	7743 ab	9076 abc	628 abc	1501 abc				
AA-Ca	2 early + 2 late	8172 a	9846 a	747 a	1750 a				
MC-Ca	2 early + 2 late	7109 bc	9706 ab	735 ab	1635 a				
AA-Ca	1 early	6475 cd	9143 ab	559 c	1319 bcd				
AA-Ca	2 early	6912 bc	9636 ab	629 abc	1482 abc				
MC-Ca	1 early	5808 d	8663 ab	630 abc	1276 bcd				
MC-Ca	2 early	6148 cd	8908 abc	718 a	1291 bcd				
AA-Ca	1 late	6407 cd	9287 abc	671 abc	1059 d				
AA-Ca	2 late	6971 bc	9308 abc	679 ab	1130 d				
MC-Ca	1 late	6871 bc	8267 bc	665 abc	1232 cd				
MC-Ca	2 late	6254 c	8310 bc	725 ab	1299 bcd				
P≤0.05									
After 1 weeks storage									
Water	-	5724 c	8888 ab	625 b	1323 a				
AA-Ca	2 early + 2 late	7573 a	9511 ab	882 a	1557 a				
MC-Ca	2 early + 2 late	5949 bc	9580 a	814 a	1424 a				
AA-Ca	1 early	5542 c	8719 ab	617 b	1375 a				
AA-Ca	2 early	5623 c	8748 ab	713 ab	1299 a				
MC-Ca	1 early	5803 bc	8552 ab	752 ab	1209 a				
MC-Ca	2 early	7508 a	8452 ab	847 a	1289 a				
AA-Ca	1 late	6448 abc	9206 ab	742 ab	1396 a				
AA-Ca	2 late	7001 ab	8467 ab	716 ab	1207 a				
MC-Ca	1 late	5703 c	8722 ab	770 ab	1323 a				
MC-Ca	2 late	5966 bc	8285 b	614 b	1262 a				
P≤0.05									
After 2 weeks storage									
Water	-	5284 c	6685 b	689 a	1268 c				
AA-Ca	2 early + 2 late	6769 a	8817 a	764 a	1775 a				
MC-Ca	2 early + 2 late	5099 c	8818 a	655 a	1363 bc				
AA-Ca	1 early	5088 c	8697 a	664 a	1663 ab				
AA-Ca	2 early	5644 bc	8747 a	667 a	1276 c				
MC-Ca	1 early	4580 cd	7714 ab	600 a	1622 ab				
MC-Ca	2 early	4485 cd	7913 ab	632 a	1373 bc				
AA-Ca	1 late	4965 c	7310 b	641 a	1502 abc				
AA-Ca	2 late	6415 ab	8553 a	631 a	1407 bc				
MC-Ca	1 late	3717 d	7693 ab	611 a	1400 bc				
MC-Ca	2 late	4078 d	6883 b	634 a	1363 bc				
P≤0.05									
^z Applications: 1 early = at female flowering, 2 early = 1 early plus 15 d later, 1 late = 3 to 5 d prior to full-slip, 2 late = 30 d after female flowering plus 1 late.									

Table 3. Calcium concentration of 'Sol Real' (Calif.) and 'Primo' (Texas) orange-fleshed netted cantaloupe, with peel removed (exterior) and edible-flesh (interior) at harvest and following commercial storage. Imperial Valley, CA, and the Rio Grande Valley, TX, 2002.

		Marketability (%)			
		Exterior		Interior	
Treatment	Applications ^z	Calif.	Texas	Calif.	Texas
After 1 week of storage					
Water	-	88 a	100 a	84 b	100 a
AA-Ca	2 early + 2 late	87 a	100 a	100 a	100 a
MC-Ca	2 early + 2 late	87 a	100a	100 a	100 a
AA-Ca	1 early	71 bc	100 a	100 a	100 a
AA-Ca	2 early	76 b	100 a	100 a	100 a
MC-Ca	1 early	79 ab	100 a	100 a	100 a
MC-Ca	2 early	77 b	100 a	97 a	100 a
AA-Ca	1 late	62 c	100 a	100 a	100 a
AA-Ca	2 late	79 ab	100 a	100 a	100 a
MC-Ca	1 late	72 bc	100 a	100 a	100 a
MC-Ca	2 late	79 ab	100 a	100 a	100 a
P≤0.05					
After 2 weeks storage					
Water	-	59 a	20 c	100 a	85 b
AA-Ca	2 early + 2 late	55 a	85 a	100 a	100 a
MC-Ca	2 early + 2 late	56 a	85 a	88 a	100 a
AA-Ca	1 early	36 cd	85 a	94 a	100 a
AA-Ca	2 early	43 bc	85 a	100 a	100 a
MC-Ca	1 early	36 cd	50 b	100 a	100 a
MC-Ca	2 early	50 ab	50 b	100 a	100 a
AA-Ca	1 late	30 d	85 a	100 a	100 a
AA-Ca	2 late	30 d	85 a	100 a	100 a
MC-Ca	1 late	45 ab	85 a	94 a	100 a
MC-Ca	2 late	36 cd	85 a	97 a	100 a
P≤0.05					

^z Applications: 1 early = at female flowering, 2 early = 1 early plus 25 d later, 1 late = 3 to 5 d prior to full-slip, 2 late = 30 d after female flowering plus 1 late.

Table 4. Marketability of 'Sol Real' (Calif.) and 'Primo' (Texas) orange-fleshed netted cantaloupe, with peel removed (exterior) and edible-flesh (interior) at harvest and following commercial storage, Imperial Valley, Calif., and the Rio Grande Valley, Texas, 2002.

Dr. Lester is research plant physiologist, USDA-ARS, Kika de la Garza Subtropical Agricultural Research Center in Weslaco, TX, and Dr. Grusak is research plant physiologist, USDA-ARS, Children's Nutrition Research Center, Houston, TX.