COMPREHENSIVE EVALUATION OF CALCIUM AND POTASSIUM METALOSATE ON EASTERN SHIPPING (ATHENA) TYPE CANTALOUPE

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Introduction

Production of cantaloupe encompasses over 7,000 aces and is estimated at almost $38 million in Georgia (Boatright and McKissick, 2004). This fresh market vegetable is picked at full maturity and has a limited shelf life. Cantaloupe production in Georgia is dominated by the variety Athena or similar types. These are large unevenly netted cantaloupes often referred to as Eastern shipping types. They are distinguishable from Western shipping types which are smaller and more uniformly netted.

Calcium and potassium metalosate are chelated forms of these elements in which the elements of chelation are amino acids. They are available in a liquid form for easy application and the amino acid chelation makes them readily available for metabolism.

Work by Lester and Grusak (1999) had shown that calcium and potassium metalosate dips could extend the shelf life of honeydew melons, but did not have the same effect on Western shipping cantaloupes. Preliminary work with Athena type cantaloupes was encouraging particularly using a cold solution of calcium metalosate to extend shelf life (Boyhan et al., 2004).

Materials and Methods

Two experiments were conducted in 2004 at on-farm locations in Wheeler and Wilcox Counties, Georgia. In both experiments ten treatments were applied in a randomized complete block design to commercially planted cantaloupes with experimental units of approximately 20 ft (Table 1). Treatments 1-7 were applied with a pump-up sprayer to runoff. Cantaloupes were harvested on 11 June 2004 from the Wheeler Co. site and on 22 June 2004 from the Wilcox Co. site. Samples were transported to laboratory facilities in Tifton, Ga. for applications of treatments 8-10, further testing, and sample preparation for shipment to other laboratories. Samples were frozen for next day shipment to Albion Labs, Clearfield, UT and to the USDA Lab, Weslaco, TX.

Leaf tissue, mesocarp, and flesh tissue were analyzed by Albion Labs. These tissues were tested for N, P, K, Ca, Mg, S, Na, Fe, Al, Mn, B, Cu, Zn, and Mo in the case of mesocarp and flesh tissue. Leaf tissue was tested for all the previously mentioned elements except Mo, but was tested for nitrate-N. Gene Lester's lab at the USDA in Weslaco, TX evaluated samples for vitamin C, carotene, carbohydrates including sucrose, glucose, and fructose as well as percent dry matter. Intact fruit were stored at 37 deg. F and 95% humidity in Tifton for visual evaluations. Visual evaluations were made every three days for firmness and ripeness on a 1-5 scale. One indicated very firm fruit and 5 indicated soft unmarketable fruit. Ripeness used the same scale with 1 indicated unripe fruit and 5 indicating ripe fruit. In addition, intact fruit were evaluated for CO_2 and O_2 generation after 10 days in storage. And finally a non-destructive firmness measure using a laser puff instrument was employed (Hung et al., 1999).

All measurements were subjected to analyses of variance and where significant a Fisher's Protected Least Significant Difference was calculated at the 5% level. In addition, a coefficient of variation was determined.

Results and Discussion

There were no differences for firmness or ripeness for either the Wheeler or Wilcox Co. locations during visual evaluations over the course of storage (approximately 1 month) (data not shown). There were no differences between the treatments for the laser puff test (data not shown). Percent weight loss among the treatments differed with Ca & K metalosate (trt. 6) having significantly less weight loss than water (trt. 7) or Ca metalosate (trt. 2) if culled fruit are considered 100% weight loss (Table 2). These differences disappear when culled fruit are excluded. Results in Wilcox Co. were quite different with significant results if the culled fruit were excluded and no differences if the culled fruit were included (data not shown). Treatment ranking was also different for each location

Oxygen consumption and carbon dioxide generation are summarized in tables 3 and 4. Oxygen consumption was significantly different at both locations, but CO_2 generation was only significant at the Wilcox Co. experiment.

Flesh tissue analyses indicated signficant differences with S, P, Na, Al, Mn, Cu, Zn, and Mo in Wheeler Co. (Table 5). All other elements analyzed did not show any significant differences (data not shown). Only S showed differences among treatments for flesh tissue in Wilcox Co. (data not shown), but the differences or ranking among the treatments differed from Wheeler Co.

Differences among the elements analyzed in mesocarp tissue in Wheeler and Wilcox Cos. are summarized in tables 6 and 7. All other elements tested did not have significant differences. Between these two experiments only S and Zn showed significant differences at both locations, but the ranking of the treatments were completely different.

Leaf tissue anaylses with significant differences in Wheeler Co. are summarized in table 8. There were no differences among the treatments for any element tested at the Wilcox Co. location.

In the Wheeler Co. experiment there were differences for percent dry weight, sucrose, and vitamin C (Table 9), while at the Wilcox Co. experiment there were differences for sucrose, glucose, and vitamin C (Table 10). Only sucrose and vitamin C had significant differences at both locations, but the treatment rankings were quite different.

Although there were many differences noted between treatments the most important concerning extension of shelf life was not significant. Although work has shown that postharvest dips and field sprays can extend shelf life with honeydew melons, results for netted melons have not been demonstrated or are inconclusive (Boyhan et al., 2004, Lester and Grusak, 1999, 2004). For this to be practical whether applied in the field or packinghouse the results must be consistant from year to year and under different environmental or cultural practices.

Literature Cited

Boatright, S.R. and J.C. McKissick. 2004. 2003 Georgia Farm Gate Vegetable Survey Report. Univ. of Ga. Rep. SR 04-01.

Boyhan, G.E., M.D. Hayes, J.T. Paulk. 2004. Calcium metalosate maintains cantaloupe wieght and firmness while slowing ripening in postharvest cold storage. 2003 Ext-Res. Rep. Univ. of Ga.

Hung, Y.C., S.E. Prussia, and G.O.I. Ezeike. 1999. Nondestructive firmness sensing using a laser air-puff detector. Postharvest Biol. and Technology 16:15-25.

Lester, G.E. and M.A. Grusak. 1999. Postharvest application of calcium and magnesium to honeydew and netted muskmelons: effects on tissue ion concentration, quality, and senescence. J. Amer. Soc. Hort. Sci. 124:545-552.

Lester, G.E. and M.A. Grusak. 2004. Field application of chelated calcium: postharvest effects on cantaloupe and honeydew fruit quality. HortTechnology. 14:29-38.

Table 1. Ca & K metalosate treatments and controls.

Treatment Number	Material	Application Method
1	Ca metalosate	2x at flowering and 2 weeks later
2	Ca metalosate	4x at flowering and each week for 4 applications
3	K metalosate	2x at flowering and 2 weeks later
4	K metalosate	4x at flowering and each week for 4 applications
5	Ca & K metalosate	2x at flowering and 2 weeks later
6	Ca & K metalosate	4x at flowering and each week for 4 applications
7	Water	4x at flowering and each week for 4 applications
8	Ca metalosate	Postharvest cold dip 20 minutes
9	Ca metalosate	Postharvest ambient temp. dip 20 minutes
10	Water	Postharvest ambient temp. dip 20 minutes

Table 2. Percent weight loss after 38 days of refrigerated storage (Wheeler Co. cantaloupes).

Treatments	Weight Loss (%)[1]	Weight Loss (%)[2]
1	38.3	7.3
2	60.9	6.3
3	22.0	6.5
4	13.8	6.1
5	14.4	6.5
6	6.2	6.2
7	45.5	6.5
8	6.1	6.1
9	17.3	5.5
10	5.6	5.6
CV	99%	16%
LSD ($p \leq 0.05$)	32.9	NS

[1]Includes culls as 100% weight loss

[2]Does not include culls.

Table 3. Oxygen consumption and CO_2 generation after 10 days (Wheeler Co.).

Treatment	O_2 (umol/kg)	CO_2 (umol/kg)
1	15.91	6.57
2	14.53	6.46
3	15.87	7.37
4	17.64	8.08
5	17.42	7.30
6	18.70	8.08
7	18.60	8.64
8	18.09	7.75
9	20.55	9.49
10	18.89	8.78
CV	12%	18%
LSD ($p \leq 0.05$)	3.11	NS

Table 4. Oxygen Consumption and CO2 Generation after 10 days (Wilcox Co.)

Treatment	O_2 (umol/kg)	CO_2 (umol/kg)
1	9.16	5.59
2	8.91	5.23
3	9.30	5.72
4	9.75	5.85
5	8.90	5.20
6	9.51	6.07
7	11.23	7.34
8	13.37	7.40
9	12.08	6.64
10	12.23	7.22
CV	13%	16%
LSD ($p \leq 0.05$)	2.0	1.4

Table 5. Flesh tissue analyses (Wheeler Co.)

Treatments	Sulfur	Phosphorus	Sodium	Aluminum	Manganese	Copper	Zinc	Molybdenum
				ppm				
1	1188	1858	438	3.0	6.8	5.3	16.8	0.3
2	1070	2468	448	2.3	9.5	6.0	19.3	0.7
3	1096	1881	350	1.6	8.6	4.0	15.4	1.2
4	1175	2078	363	1.5	8.5	5.5	22.8	0.9
5	1035	1345	540	1.5	9.0	3.5	13.5	1.2
6	1076	2311	390	2.4	7.4	6.4	18.1	1.0
7	1223	2115	393	2.3	8.3	3.8	14.5	1.3
8	1905	1235	615	5.0	12.0	3.5	17.0	0.9
9	885	1625	320	2.0	10.5	3.5	17.0	0.9
10	1500	1485	585	2.5	14.0	3.5	20.0	0.9
CV	24%	27%	27%	40%	24%	27%	16%	36%
LSD ($p \leq 0.05$)	415	709	171	1.4	3.3	1.7	4.1	0.5

Table 6. Mesocarp tissue analyses (Wheeler Co.)

Treatments	Nitrogen	Sulfur	Phosphorus	Calcium	Manganese	Copper	Zinc	Molybdenum
	ppm							
1	10153	2365	3373	3703	12.8	5.5	31.3	0.5
2	10615	2655	3313	4418	15.8	6.8	31.8	0.7
3	8185	1724	2793	3985	13.4	4.8	24.9	1.3
4	8490	2035	3303	3648	19.5	5.0	31.5	1.0
5	6820	1850	2645	4055	8.5	3.0	20.5	1.5
6	8588	3086	3680	4555	15.1	6.5	34.4	1.0
7	7403	2063	2753	3805	13.8	4.8	25.5	1.5
8	9525	2930	2325	4345	14.5	6.5	28.0	0.9
9	7080	1670	2725	3395	15.0	3.0	21.5	1.4
10	9680	3145	2770	2440	16.0	3.0	26.5	1.0
CV	19%	26%	17%	21%	22%	36%	19%	34%
LSD (p≤0.05)	2338	903	717	1182	4.6	2.5	7.4	0.5

Table 7. Mesocarp tissue analyses (Wilcox Co.)

Treatments	Sulfur	Potassium	Magnesium	Zinc
	ppm			
1	2038	35068	1870	29.8
2	1778	29875	1500	28.3
3	2023	33803	1773	31.0
4	1635	29235	1580	24.3
5	1740	35900	1765	30.0
6	2265	35018	1823	27.8
7	2078	35625	1838	31.8
8	1585	29123	1610	24.0
9	1198	29070	1213	24.5
10	1640	37943	1728	28.0
CV	14%	13%	15%	13%
LSD (p≤0.05)	368.1	6054	353	5.3

Table 8. Leaf tissue analyses (Wheeler Co.)

Treatments	Nitrogen	Potassium	Sodium	Copper
		(%)		(ppm)
1	3.18	1.81	0.09	125
2	3.40	1.81	0.09	94
3	3.08	1.69	0.10	158
4	3.18	1.85	0.10	178
5	3.25	1.72	0.10	147
6	3.15	1.82	0.11	136
7	2.85	1.43	0.11	201
CV	6%	5%	7%	24%
LSD ($p \leq 0.05$)	0.29	0.13	0.01	52

Table 9. Dry Matter, Sugar, Carotene, and Vitamin C (Wheeler Co.)

Treatments	Dry Matter (%)	Sucrose (gFWT)	Glucose (gFWT)	Fructose (gFWT)	Carotene (ug/gFWT)	Vitamin C (mg/100g)
1	7.86	12.75	17.02	18.33	14.95	23.35
2	8.37	9.34	16.56	17.86	11.58	21.77
3	8.01	9.83	15.46	16.63	15.81	23.93
4	7.80	12.04	13.76	15.26	19.64	25.37
5	6.68	5.92	15.24	16.03	14.13	24.98
6	7.71	10.16	17.92	19.02	14.70	24.33
7	6.76	9.63	15.94	17.45	11.33	20.97
8	8.03	10.74	15.24	16.35	15.39	28.31
9	7.84	7.79	17.01	18.91	16.66	27.09
10	9.45	23.59	14.52	16.37	20.79	32.51
CV	12%	46%	18%	16%	28%	12%
LSD ($p \leq 0.05$)	1.39	7.42	NS	NS	NS	4.30

Table 10. Dry Matter, Sugar, Carotene, and Vitamin C (Wilcox Co.)

Treatments	Dry Matter (%)	Sucrose (gFWT)	Glucose (gFWT)	Fructose (gFWT)	Carotene (ug/gFWT)	Vitamin C (mg/100g)
1	10.14	19.09	16.33	17.89	21.33	24.82
2	10.44	25.62	14.75	16.35	20.56	21.60
3	8.56	17.02	16.89	17.96	15.22	19.06
4	9.84	24.38	16.22	17.22	14.94	25.07
5	8.03	13.71	17.82	18.52	13.67	20.12
6	7.10	7.84	16.39	16.93	11.28	16.32
7	7.94	10.85	15.34	16.21	14.37	21.08
8	9.77	18.58	14.07	15.48	18.18	23.56
9	10.47	31.89	8.08	11.41	17.33	13.12
10	10.77	32.74	12.80	14.62	20.84	23.53
CV	24%	56%	23%	22%	30%	19%
LSD ($p \leq 0.05$)	NS	16.38	4.91	NS	NS	5.73