RESEARCH REPORT

SUWANNEE VALLEY REC 95-07
EFFECTS OF K RATE AND PROPORTION OF K SUPPLIED FROM CONTROLLED-RELEASE K ON MUSKMELON

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ABSTRACT

Muskmelon was grown with various K fertilization programs involving K rate and proportion of K from controlled-release K (coated KNO_3, 'Multicoat' from Vicksburg Chem. Co., Vicksburg, MS). Whole-leaf K concentrations at early runner formation (first flowers open) were slightly below sufficiency levels for all K treatments. Leaf K was 3.8% or higher for the 150-lb K treatment, 3.2 to 3.8% for the 100-lb K treatment, and 3.1 to 3.3% for the 50-lb K treatment. Leaves contained only 1.7% K with the zero-K treatment. Leaf K was extremely low (0.5 to 1.0%) with all treatments one week before last harvest. Leaf K concentration increased linearly with increase in proportion of controlled-release K over the range of 0 to 50%. Yields of U.S. No. 1 medium and yields of total U.S. No. 1 grade fruits were increased in linear fashion by increases in K over the range of 50 to 150 lb K_2O/acre. Likewise, increases in proportion of controlled-release K from zero to 50% resulted in linear increases in yields of U.S. No. 1 medium and total yields of all U.S. No. 1 fruits.

INTRODUCTION

Muskmelon (*Cucumis melo* var. reticulatus) has been grown in Florida commercially since the early 1900s (Whitner et al., 1953). Today, muskmelon is a relatively minor crop, being grown on about 3,000 acres. Most of the muskmelons are grown with transplants and polyethylene mulch, a system with about $1,300 preharvest costs (Meline and Hochmuth, 1988). Approximately 10% of the preharvest costs are for fertilization costs.

No exact estimates of statewide fertilizer use on muskmelon are available, however it is estimated that 160, 136, and 209 lb/acre of N, P_2O_5, and K_2O, respectively, are applied for watermelons and melons (U.S.D.A., 1991). The recommendations for muskmelons currently are for a maximum of 150 lb/acre of N, P_2O_5, and K_2O, respectively (Hochmuth and Hanlon, 1995 a,b). Recent

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research in Florida supports these N recommendations (Csizinszky et al., 1985; Hochmuth et al., 1991a). These results are similar to elsewhere in the United States (DeBuchananne and Taber, 1985; Flocker et al., 1965). Negligible research results on potassium requirements of muskmelon could be found.

Controlled-release N fertilizers have been investigated for muskmelon with limited success (Lorenz et al., 1972; Wiedenfeld, 1986). In a recent study with a controlled-release potassium nitrate, K rate and source interacted in their effects on yield of muskmelon (Hochmuth and Hochmuth, 1994). Improved yields were realized with 100 lb K_2O/acre and with 25% of K_2O from controlled-release potassium nitrate.

Our study was conducted to evaluate the effects of controlled-release potassium nitrate on muskmelon growth and yield.

MATERIALS AND METHODS

Potassium fertilization studies were conducted during the spring of 1994 on a Lakeland fine sandy soil at the Suwannee Valley Research and Education Center near Live Oak, FL. Soil was disced and unfertilized soil was sampled to 6-inch depth, extracted with Mehlich-1 solution, and analyzed for P, K, Ca, Mg, Cu, Mn, and Zn (Hanlon et al, 1994).

Potassium fertilization treatments (Table 1) included rates of K (0, 50, 100, and 150 lb K_2O/acre) and proportion of K (0, 25, and 50%) supplied from controlled-release ('Multicoat') potassium nitrate (Vicksburg Chemical Co., Vicksburg, MS). Fertilizer mixtures were formulated from ammonium nitrate, magnesium sulfate, a micronutrient mix, soluble potassium nitrate, polymer coated potassium nitrate, and polymer coated urea.

Nitrogen was supplied at 150 lb N/acre and formulated from a mixture of soluble and coated N so all K treatments had equal proportions of the N supplied from coated, controlled-release N. Coated urea was used to equilibrate the controlled-release N for all treatments since controlled-release potassium nitrate supplied both controlled-release N and K. The soil tested high in P, therefore no P fertilizer was applied. Magnesium was supplied at 20 lb/acre.

On 16 Mar. 1994, fertilizer was blended, applied in a 30-inch swath in the future bed area, and rototilled to incorporate fertilizer into soil uniformly. Plots consisted of a single bed 30 ft in length with 5 ft between bed centers. Fertilizer rates were calculated on the basis of 5-ft centers to conform to standardized fertilization practices (Hanlon and Hochmuth, 1989). The 12 fertilization treatments were arranged in four randomized complete-blocks.

Fertilized soil was bedded, fumigated with a mixture of methyl bromide and chloropicrin (98:2) (400 lb/acre broadcast rate), pressed, and covered with black polyethylene mulch (Sonoco, Hartsville, SC). Drip irrigation tubing (Roberts Ro-Drip) was placed in the center of the bed and buried 1 inch deep in soil. Beds were 24 inches wide and 6 inches tall. The tubing had 8-mil thick walls with emitters on 12-inch spacing with a flow rate of 0.4 gal per minute per 100 ft at 10 PSI pressure.

On 25 Mar., 'Hymark' muskmelon transplants were placed in a single row on each bed at an 18-inch spacing. Drip irrigation was operated as needed to maintain a tensiometer gauge at -8 to -12 centibars at the 12-inch depth between two plants in a row, three inches from the drip tubing. Diseases and insect pests were controlled by timely applications of labeled pesticides based on pest

scouting of the crop. All crop cultural practices were according to University of Florida recommendations (Hochmuth, 1988).

On two occasions (29 Apr., vines 8 inches in length with first flowers open, and 7 June, one week before last harvest) whole leaves were collected for N and K analyses. Leaves were dried, ground, and wet-ashed in sulfuric acid and hydrogen peroxide. Leaf N was determined by rapid-flow colorimetry and leaf K was determined by plasma emission spectroscopy (Hanlon et al., 1994).

Muskmelon fruits were harvested two times on 13 and 16 June. Fruits were graded into U.S. No. 1 and U.S. No. 2 fruits of small, medium, and large size, counted and weighed. All data were analyzed by analysis of variance and regression techniques (SAS, 1985).

RESULTS

Fertilization treatment significantly affected whole leaf K but not N concentrations (Table 2). Leaf N concentration was very high for the first sampling date at early runner formation (Hochmuth et al., 1991b). There was no difference in leaf N concentrations for 120 or 150 lb N/acre (Table 2) for either sampling date. Leaf N concentrations were near or within sufficiency ranges for the second sampling date near the end of the season. Published leaf K sufficiency values are 5.0 to 7.0% K for early in the season. Leaf K concentration for young plants with K fertilization ranged from 3.1 to 4.2% and was 1.7 for plants with no K fertilizer (Table 2). These values are below published sufficiency ranges but, no K deficiency symptoms were observed, except for plants with no K fertilizer. Sufficiency ranges published for young muskmelon plants could be too high.

Main effects of K rate were not significant for leaf N (Table 3). K fertilization resulted in a linear increase in leaf K concentrations on both early and late sampling dates. Proportion of K from controlled-release K did not affect leaf N concentration (Table 3). Whole-leaf K for the first sample was increased in linear fashion by proportion of K from controlled-release K over the range of 0 to 50%. Leaf K for plants with early runners was near published sufficiency ranges with the 50% controlled-release K treatment and below sufficiency ranges for zero controlled-release K.

Fertilization program did not affect yields of early matured fruit (first harvest) but did affect total season yields (Tables 4,5). Fertilization effects were mostly on yields of medium and large U.S. No. 1 fruits and on seasonal yields of U.S. No. 1 fruits and on total season marketable fruit yields. Yields with 120 lb N/acre were the same compared to plants receiving 150 lb N/acre, treatment 1 versus 2 (Tables 4,5). Yields of lower quality U.S. No. 2 fruits and cull fruits were not affected by fertilization treatment. Total marketable yields were highest with 150 lb K_2O/acre and 25% K from controlled-release K and yields were lowest with no K fertilizer (Tables 4,5). Average fruit weight was not affected by fertilization treatment.

Proportion of K from controlled-release K and K rate did not interact for their effects on yield characteristics for either early or total season and main effects for proportion CRK and K rate are presented in Tables 6 and 7.

Early fruit yields were not affected by main effects of proportion of K from CRK or K rate (Tables 6,7). K rate and proportion CRK affected total season yields of U.S. No. 1 medium fruits (Tables 6,7). Yields were increased linearly as K rate increased from 50 to 150 lb K_2O/acre and as proportion K from CRK increased from zero to 50% (Tables 6,7). Yields of U.S. No. 1 large fruits

were not affected by K rate but yields of U.S. No. 1 large fruits were increased linearly by proportion K from CRK over range of zero to 50%.

Yields of seasonal U.S. No. 1 fruits were increased by K fertilization and proportion of K from CRK (Tables 6,7). Total marketable yield was increased linearly by K fertilization and by proportion of CRK (Tables 6,7).

Results of this study showed that muskmelons responded to up to 150 lb K_2O/acre on this soil that tested 28 ppm Mehlich-1 K which was low (Hochmuth and Hanlon, 1995), and for which 150 lb K_2O were recommended. Best muskmelon yields were with 25% to 50% K from controlled-release K.

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Table 1. Treatments used in potassium fertilization research with muskmelon at Live Oak, FL, 1994.

	N	K_2O	Soluble (%)		Controlled-release (%)	
Treatment[z]	(lb/A)	(lb/A)	N	K	N	K
1	120	100	100	100	0	0
2	150	100	100	100	0	0
3	150	0	100	0	0	0
4	150	50	50	100	50	0
5	150	50	50	75	50	25
6	150	50	50	50	50	50
7	150	100	50	100	50	0
8	150	100	50	75	50	25
9	150	100	50	50	50	50
10	150	150	50	100	50	50
11	150	150	50	75	50	25
12	150	150	50	50	50	50

[z]Other fertilizers were 20 lb Mg/A from $MgSO_4$ and zero P_2O_5/A.

Table 2. Effect of fertilization on muskmelon whole leaf N and K concentrations, Live Oak, FL, 1994.

					Controlled-		Sampling date			
	N	K_2O	Soluble		release		29 April		7 June	
Treatment	(lb/A)	(lb/A)	N	K	N	K	N	K	N	K
			----------%				-------leaf conc. (% dry wt).-------			
1	120	100	100	100	0	0	5.7	4.0a[z]	3.1	0.8abc
2	150	100	100	100	0	0	5.8	3.8ab	2.7	0.7bc
3	150	0	100	0	0	0	6.1	1.7d	3.8	0.5c
4	150	50	50	100	50	0	6.0	3.1c	3.0	0.5c
5	150	50	50	75	50	25	6.0	3.2c	3.5	0.7bc
6	150	50	50	50	50	50	6.3	3.3bc	2.9	0.6c
7	150	100	50	100	50	0	6.0	3.2c	3.4	0.8bc
8	150	100	50	75	50	25	6.0	3.4bc	3.1	0.7bc
9	150	100	50	50	50	50	5.9	3.8ab	2.9	0.7bc
10	150	150	50	100	50	0	5.9	3.8ab	3.1	1.2a
11	150	150	50	75	50	25	5.9	4.2a	3.2	1.1ab
12	150	150	50	50	50	50	5.8	4.0a	3.0	1.2a
Signif.[y]							NS	**	NS	**

[z]Means separated by Duncan's multiple range test (P = 0.05).

[y]Treatment effects significant at 1% (**) probability level or not significant (NS).

Table 3. Effects of K fertilization and proportion of K supplied from controlled-release K on muskmelon whole-leaf N and K concentrations, Live Oak, FL, spring 1994.

	Sampling date			
	29 April		7 June	
	N	K	N	K
K_2O rate (lb/A):	---------- Leaf conc. (% dry wt.) ----------			
50	6.08	3.22	3.14	0.57
100	5.96	3.47	3.15	0.71
150	5.88	4.01	3.08	1.16
Signif.[y]	NS	L**	NS	L**
Proportion CRK[z] (%):				
0	5.97	3.37	3.18	0.82
25	5.98	3.63	3.26	0.80
50	5.98	3.70	2.94	0.82
Signif.[y]	NS	L*	NS	NS

[z]CRK = controlled-release potassium (coated potassium nitrate, 'Multicoat').
[y]Treatment effects linear (L) at 5% (*) or 1% (**) probability level or not significant (NS).

Table 4. Effects of K fertilization programs on fruit yield and quality of muskmelon, Live Oak, FL, spring 1994.

	U.S. No. 1			U.S. No. 2			Total			
Treatment	Small	Medium	Large	Small	Medium	Large	U.S. No. 1	U.S. No. 2	Total Mkt.	Cull
	Numbers of fruits per acre (early)[z]									
1	0	220	435	0	0	0	655	0	655	0
2	0	145	220	0	70	0	365	70	435	220
3	0	0	0	0	70	0	0	70	70	290
4	0	365	510	145	145	0	870	290	1160	360
5	0	73	290	73	220	70	365	360	730	360
6	73	290	145	0	0	0	510	0	510	70
7	0	73	73	0	145	70	145	220	360	290
8	0	220	290	0	0	70	510	70	580	0
9	0	145	220	73	70	0	365	145	510	70
10	0	0	73	0	70	0	70	70	145	0
11	73	145	145	0	0	0	360	0	360	145
12	0	145	73	0	0	70	220	70	290	0
Signif.[y]	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Treatment	U.S. No. 1			U.S. No. 2			Total			
	Small	Medium	Large	Small	Medium	Large	U.S. No. 1	U.S. No. 2	Total Mkt.	Cull
	Numbers of fruits per acre (season)[z]									
1	1310	2690ab	4500ab	650	360	0	8490abc	1015	9510abc	290
2	1160	2830ab	4750ab	360	220	0	8570abc	580	9150abc	730
3	145	360d	800c	580	580	0	1310d	1160	2470d	1160
4	1670	1160cd	2395bc	725	510	70	5230c	1310	6530c	870
5	1015	2250bc	3850ab	145	650	70	7120bc	870	7990bc	940
6	1450	3270ab	2980b	360	145	220	7700abc	725	8420abc	360
7	1090	2690ab	3270b	290	290	70	7040bc	650	7700bc	800
8	1160	3410ab	3480ab	1015	360	70	8060abc	1450	9510abc	430
9	1740	2610ab	4070ab	650	870	0	8420abc	1525	9950abc	70
10	2325	2900ab	3270b	0	435	0	8495abc	435	8930abc	430
11	1670	3700ab	5735a	510	510	0	11110a	1015	12125a	220
12	2685	3920a	3560ab	650	70	70	10165ab	800	10960ab	360
Signif.[y]	NS	**	**	NS	NS	NS	**	NS	**	NS

[z]Early yield is first harvest; total season is sum of two harvests.

[y]Treatment effects significant at 5% (*) or 1% (**) probability or not significant (NS). Means separated by Duncan's multiple range test.

Table 5. Effects of K fertilization programs on fruit yield and quality of muskmelon, Live Oak, FL, spring 1994.

	U.S. No. 1			U.S. No. 2			Total				Avg. fr.
Treatment	Small	Medium	Large	Small	Medium	Large	U.S. No. 1	U.S. No. 2	Total Mkt.	Cull	wt. (lb)
	Early yield (cwt/acre)[z]										
1	0	4.9	11.1	0	0	0	16.0	0	16.0	0	1.8
2	0	3.3	5.7	0	1.4	0	9.0	1.4	10.4	3.8	1.2
3	0	0	0	0	1.4	0	0	1.4	1.4	3.2	0.5
4	0	7.8	15.0	2.2	3.0	0	22.9	5.2	28.1	5.1	2.1
5	0	1.7	5.4	0.9	3.7	1.5	9.1	6.2	15.2	4.3	1.8
6	1.1	6.2	4.4	0	0	0	11.7	0	11.7	1.6	1.3
7	0	1.7	1.7	0	3.0	1.7	3.3	4.8	8.1	3.6	1.1
8	0	4.6	8.1	0	0	1.7	12.6	1.7	14.4	0	1.9
9	0	3.0	5.9	1.3	1.2	0	8.9	2.5	11.4	0.9	2.3
10	0	0	1.7	0	1.1	0	1.7	1.1	2.8	0	1.0
11	1.1	3.4	3.8	0	0	0	8.3	0	8.3	3.6	1.2
12	0	3.0	2.0	0	0	1.8	5.1	1.8	6.9	0	1.3
Signif.[y]	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Treatment	U.S. No. 1			U.S. No. 2			Total			Cull	Avg. fr. wt. (lb)
	Small	Medium	Large	Small	Medium	Large	U.S. No. 1	U.S. No. 2	Total Mkt.		
	Season yield (cwt/acre)[z]										
1	22.0	59.0ab	120.5abc	9.5	8.1	0	201.4abc	17.6	219.0abc	4.8	2.1
2	18.7	59.8ab	134.0ab	0.7	4.4	0	212.5ab	5.2	217.7abc	13.8	1.8
3	2.2	7.5d	22.1d	8.7	11.3	0	31.7d	20.0	51.7d	17.5	1.3
4	24.8	24.6cd	67.3cd	10.5	9.6	1.7	116.7c	21.8	138.5c	16.0	2.7
5	16.2	49.2bc	108.5abc	1.7	12.0	1.5	173.8abc	15.2	189.0abc	14.0	2.7
6	23.0	67.7ab	82.2bcd	5.7	2.9	5.9	172.9abc	14.4	187.3abc	7.0	1.7
7	16.8	57.4abc	88.6bc	3.9	5.7	1.7	162.8bc	11.3	174.1bc	9.7	1.6
8	18.3	73.4ab	97.1abc	16.0	7.6	1.7	188.8abc	25.3	214.1abc	9.6	2.1
9	27.9	56.0abc	110.8abc	.1	16.2	0	194.7abc	25.3	220.1abc	0.9	2.2
10	34.9	56.3abc	56.8cd	0	8.3	0	148.0bc	8.3	156.3bc	6.2	1.4
11	28.4	72.5ab	156.6a	6.7	9.7	0	257.4a	16.4	273.9a	5.0	1.7
12	41.3	84.5a	97.2abc	10.5	1.6	1.8	223.0ab	13.9	236.9ab	8.7	1.7
Signif.[y]	NS	**	**	NS	NS	NS	**	NS	**	NS	NS

[z]Early yield is first harvest; total season is sum of two harvests.

[y]Treatment effects significant at 5% (*) or 1% (**) probability or not significant (NS). Means separated by Duncan's multiple range test.

Table 6. Main effects of K fertilization and proportion of K supplied from controlled-release K on muskmelon fruit yield and quality at Live Oak, FL, spring 1994.

	U.S. No. 1			U.S. No. 2			Total			
Treatment	Small	Medium	Large	Small	Medium	Large	U.S. No. 1	U.S. No. 2	Total Mkt.	Cull
	Numbers of fruits per acre (early)[z]									
K_2O rate (lb/A):										
50	24	242	315	73	121	24	580	220	800	266
100	0	145	194	24	73	48	340	145	485	121
150	24	97	97	0	24	24	220	48	265	48
Signif.[y]	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Proportion CRK (%):										
0	0	145	218	48	121	24	363	194	555	220
25	24	145	242	24	73	48	410	145	555	170
50	24	193	145	24	24	24	363	73	435	48
Signif.[y]	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Treatment	U.S. No. 1			U.S. No. 2			Total			
	Small	Medium	Large	Small	Medium	Large	U.S. No. 1	U.S. No. 2	Total Mkt.	Cull
	Numbers of fruits per acre (season)[z]									
K_2O rate (lb/A):										
50	1380	2226	3073	411	435	121	6679	968	7647	725
100	1330	2904	3605	653	508	48	7840	1210	9050	435
150	2226	3509	4186	387	338	24	9922	750	10672	338
Signif.[y]	NS	L**	NS	NS	NS	NS	L**	NS	L**	NS
Proportion CRK (%):										
0	1694	2250	2976	338	411	48	6921	799	7719	700
25	1282	3121	4256	556	508	48	8760	1113	9873	532
50	1960	3267	3533	556	363	97	8760	1016	9773	266
Signif.[y]	NS	L**	NS	NS	NS	NS	NS	NS	L*	NS

[z]Early yield is first harvest; total season is sum of two harvests.

[y]Treatment effects significant and linear (L) at 5% (*) or 1% (**) probability or not significant (NS). Means separated by Duncan's multiple range test.

Table 7. Main effects of K fertilization and proportion of K supplied from controlled-release K on muskmelon fruit yield and quality at Live Oak, FL, spring 1994.

	U.S. No. 1			U.S. No. 2			Total				Avg. fr.
Treatment	Small	Medium	Large	Small	Medium	Large	U.S. No. 1	U.S. No. 2	Total Mkt.	Cull	wt. (lb)
	Early yield (cwt/acre)[z]										
K_2O rate (lb/A):											
50	0.4	5.3	8.9	1.0	2.3	0.5	14.5	3.8	18.3	3.7	1.7
100	0	3.1	5.2	0.4	1.4	1.2	8.3	3.0	11.3	1.5	1.8
150	0.4	2.2	2.5	0	0.4	0.6	5.0	1.0	6.0	1.2	1.1
Signif.[y]	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Proportion CRK (%):											
0	0	3.2	6.1	0.7	2.4	0.6	9.3	3.7	13.0	2.9	1.4
25	0.4	3.2	6.4	0.3	1.2	1.1	10.0	2.6	12.7	2.6	1.6
50	0.4	4.1	4.1	0.4	0.4	0.6	8.6	1.4	10.0	0.8	1.6
Signif.[y]	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Treatment	U.S. No. 1			U.S. No. 2			Total			Cull	Avg. fr. wt. (lb)
	Small	Medium	Large	Small	Medium	Large	U.S. No. 1	U.S. No. 2	Total Mkt.		
	Season yield (cwt/acre)[z]										
K_2O rate (lb/A):											
50	21.3	47.1	86.0	5.9	8.2	3.0	154.5	17.2	171.6	12.3	1.9
100	21.0	62.2	98.8	9.7	9.8	1.2	182.1	20.6	202.7	6.7	2.0
150	34.9	71.1	103.5	5.7	6.5	0.6	209.5	12.9	222.3	6.7	1.6
Signif.[y]	NS	L*	NS	NS	NS	NS	L*	NS	L*	NS	NS
Proportion CRK (%):											
0	25.5	46.1	70.9	4.8	7.8	1.1	142.5	13.8	156.3	10.6	1.7
25	20.9	65.0	120.9	8.1	9.8	1.1	206.7	18.9	225.6	9.5	1.9
50	30.8	69.4	96.7	8.4	6.9	2.6	196.9	17.9	214.8	5.5	1.9
Signif.[y]	NS	L*	L*	NS	NS	NS	L*	NS	L*	NS	NS

[z]Early yield is first harvest; total season is sum of two harvests.

[y]Treatment effects significant at and linear (L) 5% (*) or 1% (**) probability or not significant (NS). Means separated by Duncan's multiple range test.