RESEARCH REPORT
SUWANNEE VALLEY REC 95-6

EFFECTS OF K AMOUNTS AND PROPORTIONS OF K SUPPLIED FROM CONTROLLED-RELEASE POTASSIUM NITRATE ON EGGPLANT YIELD

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ABSTRACT

Potassium fertilization affected eggplant yield, however, yield was only reduced with the zero-K treatment. Eggplant yield was similar with 100 or 150 lb K_2O per acre. Proportion of K from controlled-release potassium nitrate did not influence eggplant yields or fruit size. Leaf tissue K concentrations were affected by K fertilization but not by proportion of K from controlled-release K. Leaf K concentration fell to 1.2% at the end of the season with no K fertilizer and was 2.5% with 100 lb K_2O per acre.

INTRODUCTION

Eggplant (Solanum melongena L.) was produced on 2,400 acres in Florida in the 1993-94 production season (Freie and Pugh, 1995). The average statewide yield was 830 cartons (33-lb) per acre, and the total crop value was $18.7 million. The estimated production costs for eggplant in the Palm Beach area are $9200 per acre of which $380 are due to fertilizer (Smith and Taylor, 1995). Typical fertilizer use for eggplant was estimated to be 580 N, 240 P_2O_5, and 750 lb K_2O/acre (USDA, 1991).

Since eggplant is a relatively minor crop in Florida, there has been little research conducted on fertilizer requirements. This lack of information on nutrient requirements of eggplant has, in part, been responsible for what appears to be very high fertilization rates used by commercial eggplant growers

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In a two-year study at Dover, FL, eggplant yield leveled off with 100 lb N/acre in one season and 130 lb N/acre in the second season (Sutton and Albregts, 1970). Eggplant responded to up to 270 lb K_2O/acre. These studies were conducted with unmulched eggplant using split-applications of nutrients.

More recent work in northern Florida showed eggplant yield responses to N were maximized with about 120 lb N/acre (Hochmuth et al., 1991a) and responses to K were maximized with 100 lb K_2O/acre (spring) and 65 lb K_2O/acre in the fall (Hochmuth et al., 1992). The latter studies were conducted with eggplant mulched with polyethylene and irrigated with drip irrigation with all fertilizer applied before mulching and planting. With large amounts of fertilizer used on eggplant there exists a chance for soluble salt injury or nutrient losses due to leaching. Controlled-release N and K sources might provide a chance to reduce fertilizer applications to eggplant and still maintain a favorable amount of nutrients available to the plant. Controlled-release N sources have been studied for pepper and tomato, but little work has been done for eggplant. In one recent study, controlled-release potassium nitrate improved yields of U.S. No. 1 eggplant fruits over those with soluble potassium nitrate (Hochmuth and Hochmuth, 1994). With 100 lb K_2O/acre, yields were best when 50% of the K was supplied from controlled-release K, and with 150 lb K_2O/acre, yield was best with 25 or 50% controlled-release K.

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 disked and soil samples of unfertilized soil were taken to 6-inch depth, extracted with the Mehlich-1 solution, and analyzed for P, K, Ca, Mg, Cu, Mn, and Zn.

Potassium fertilization treatments (Table 1) included rates of K (0, 100, and 150 lb K_2O/acre) and proportions (0, 25, and 50%) of K supplied from controlled-released (coated) (Vicksburg Chemical Co., Mississippi) potassium nitrate. 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 175 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 Mg/acre.

Fertilizer was blended, applied in a 30-inch swath in the future bed area, and rototilled to uniformly incorporate fertilizer into soil. Plots consisted of a single bed 25 ft in length with 5 ft between bed centers. Fertilizer rates were calculated on the basis of 6-ft centers to conform to standardized fertilization practices (Hanlon and Hochmuth, 1990). The seven fertilization treatments were arranged in four randomized complete-blocks. On 16 Mar, 1994, fertilized soil was bedded,

fumigated with methyl bromide (400 lb/acre broadcast rate), pressed, and covered with black polyethylene mulch (Sonoco, South Carolina). Beds were 24 inches wide and 6 inches tall. Drip irrigation tubing (Roberts Ro-drip) was placed in the center of the bed in a one-inch groove in the soil. 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., 'Classic' eggplant 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 (Maynard and Hochmuth, 1995).

On two occasions (29 Apr; plants 8 inches tall with no open flowers and 7 June; second 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 spectrometry (Hanlon et al., 1994).

Eggplant fruits were harvested five times on 3, 6, 13, 20 and 27 June, 1994. Fruits were graded by size into U.S. No. 1 and U.S. No. 2 small, medium, and large fruits or cull fruits. Numbers and weight of fruits in each grade category were recorded. Data were analyzed by analysis of variance and regression techniques (SAS, 1985).

RESULTS

Results of the Mehlich-1 soil test showed the following (ppm soil): P (93), K (28), Mg (24), and Ca (312) with a soil pH (1soil:2water) of 5.6. The K index was interpreted as low and 130 lb K_2O were recommended (Hochmuth and Hanlon, 1995a, b; Hochmuth et al., 1991).

Eggplant early yields were not affected by K fertilization program (Table 2). Total-season yields were reduced with no K fertilizer. The effects of fertilization were mostly on reductions in yields of U.S. No. 1 large fruits. In addition, yields of U.S. No. 2 small fruits (low-value fruits) were increased with no K fertilization. Total early season yields of U.S. No. 1 total marketable fruits, and average fruit weight were not affected by K treatment (Table 3). Yields of total-season U.S. No. 1 fruits and total marketable fruits were reduced with the zero-K treatment. Total marketable fruit yields were 1127 bu/acre with no K and averaged 1443 with the other six treatments. Average fruit weight for the season was not affected by K treatment.

Yields of early eggplant were similar with 100 or 150 lb K_2O/acre (Tables 4,5) indicating that the K recommendation of 130 lb K_2O/acre was adequate for this site. Likewise, total season eggplant yields were similar with 100 or 150 lb K_2O/acre.

Early or total-season eggplant yields or fruit size were not influenced by proportion of K from controlled-release K (Tables 4,5). These results are slightly different from a previous study where

K rate and proportion of K from controlled-release K interacted in their effects on total season yield of U.S. No.1 fruits (Hochmuth and Hochmuth, 1994). With 100 lb K_2O per acre in that study, yields were best with 50% of K from controlled-release K and yields were better with 25% controlled-release K when K rate was 150 lb/acre.

Eggplant leaf tissue K concentration was reduced at two sampling dates with no K fertilizer (Table 6). Leaf K was similar with all other K fertilization programs. Leaf K was similar with 100 or 150 lb K_2O/acre and was not influenced by proportion of K from controlled-release K. Leaf K with 100 or 150 lb K_2O was within adequate ranges for eggplant (Hochmuth et al., 1991b; Hochmuth, 1995).

LITERATURE CITED

Freie, R.L., and N.L. Pugh. 1995. Florida Agric. Statistics, Vegetable Summary 1993-1994. Fla. Agric. Stat. Serv. Orlando, FL.

Hanlon, E.A., and G.J. Hochmuth. 1989. Calculating fertilizer rates for vegetable crops grown in raised-bed cultural systems in Florida. Fla. Coop. Ext. Serv. Special Series SS-SOS-901.

Hanlon, E.A., J.G. Gonzales, and J.M. Bartos. 1994. IFAS Extension soil testing laboratory chemical procedures and training manual. Fla. Coop. Ext. Serv. Circ. 812.

Hochmuth, G. 1995. Plant petiole sap-testing guide for vegetable crops. Fla. Coop. Ext. Serv. Circ. 1144.

Hochmuth, G.J., and E.A. Hanlon. 1995a. IFAS standardized fertilization recommendations for vegetable crops. Fla. Coop. Ext. Serv. Circ. 1152.

Hochmuth, G.J., and E.A. Hanlon. 1995b. Commercial vegetable crop nutrient requirements in Florida. Fla. Coop. Ext. Serv. SP 177.

Hochmuth, G., and B. Hochmuth. 1994. Response of eggplant to controlled-release potassium fertilization. Univ. Fla. Suwannee Valley AREC. Research Report 94-02.

Hochmuth, G., B. Hochmuth, E. Hanlon, and M. Donley. 1991a. Nitrogen requirements of mulched eggplant in northern Florida. Univ. Fla. Suwannee Valley AREC Research Report 91-14.

Hochmuth, G., D. Maynard, C. Vavrina, and E. Hanlon. 1991b. Plant tissue analysis and interpretation for vegetable crops in Florida. Fla. Coop. Ext. Serv. Special Series SS-VEC-42.

Hochmuth, G.J., R.C. Hochmuth, E.A. Hanlon, and M.E. Donley. 1992. Effect of potassium on yield and leaf-N and K concentrations of eggplant. Univ. Fla. Suwannee Valley AREC Research Report 92-02.

Maynard, D.N., and G.J. Hochmuth (eds.). 1995. Vegetable Production Guide for Florida. Fla. Coop. Ext. Serv. SP 170.

S.A.S. 1985. SAS Users Guide:Statistics Version 5th Edition. Cary, NC.

Smith, S.A., and T.G. Taylor. 1994. Production cost for selected vegetables in Florida, 1994-95. Fla. Coop. Ext. Serv. Economic Information Report E I95-1.

Sutton, P. and E.E. Albregts. 1970. Response of eggplant to nitrogen, phosphorus, and potassium fertilization. Soil Crop Sci. Soc. Fla. Proc. 30: 1-5.

United States Dept. Agric. 1991. Agricultural chemical usage. 1990 Vegetable Summary. Nat'l. Agric. Stat. Serv. Econ. Research Serv. Wash, D.C.

Table 1. Fertilization treatments used in eggplant potassium study at Live Oak, FL, 1994.

Treatment	K_2O rate (lb/acre)[z]	Soluble (%)		Controlled-release (%)	
		N	K	N	K
1	0	50	0	50	0
2	100	50	100	50	0
3	100	50	75	50	25
4	100	50	50	50	50
5	150	50	100	50	0
6	150	50	75	50	25
7	150	50	50	50	50

[z]Recommended K rate was 130 lb K_2O/acre.

Table 2. Response of eggplant to potassium fertilization with controlled-release potassium nitrate, Live Oak, Spring, 1994.

	No. 1 Small		No. 1 Medium		No. 1 Large		No. 2 Small		No.2 Medium		No. 2 Large		Cull	
Treatment	**No.**	**bu.[y]**	**No.**	**bu.**	**No.**	**bu.**	**No.**	**bu.**	**No.**	**bu.**	**No.**	**bu.**	**No.**	**bu.**
	----------Early yield per acre (first 2 harvests)----------													
1	0	0	780	34	3570	145	0	0	0	0	700	23	0	0
2	0	0	90	2	4530	197	0	0	0	0	260	9	0	0
3	0	0	0	0	4440	180	0	0	0	0	780	33	0	0
4	0	0	170	4	5580	246	0	0	0	0	960	40	0	0
5	0	0	90	2	4700	200	0	0	0	0	520	23	0	0
6	0	0	0	0	4880	189	0	0	0	0	350	16	0	0
7	0	0	260	6	4360	178	0	0	0	0	870	35	0	0
Signif.[z]	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	----------Total season yield per acre (5 harvests)----------													
1	9760	220	10280	333	8450b	355b	4440a	89a	2610	77	1390bc	50bc	520	13
2	7930	186	13160	415	16120a	680a	1920b	39b	1740	56	700c	24c	260	8
3	6620	154	10980	402	15330a	637a	2790b	58b	3490	109	3400a	134a	1130	26
4	5660	130	11940	400	17420a	754a	2790b	55b	2700	88	2530ab	105ab	440	18
5	7140	163	12280	394	17770a	750a	1830b	34b	1740	46	1570bc	60bc	610	17
6	7930	170	11940	363	17080a	663a	1480b	27b	2000	66	1570bc	61bc	170	6
7	6970	153	12200	378	17080a	700a	2790b	59b	2530	80	1570bc	65bc	700	18
Signif.[z]	NS	NS	NS	NS	**	**	**	**	NS	NS	*	*	NS	NS

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

[y]Bushel=33lb.

Table 3. Response of eggplant total yields to potassium fertilization with controlled-release potassium nitrate, Live Oak, FL, Spring, 1994.

	Total yields per acre				
	U.S. No.1		Total Market.		Avg. fruit wt.
Treatment	No.	bu.[y]	No.	bu.	(lb.)
	----------Early yield (first 2 harvests)----------				
1	4360	180	5050	202	1.11
2	4620	199	4880	209	1.06
3	4440	180	5230	213	1.27
4	5750	250	6710	290	1.40
5	4792	202	5310	224	1.30
6	4880	189	5230	205	1.24
7	4620	184	5490	219	1.13
Signif.[z]	NS	NS	NS	NS	NS
	----------Total season (5 harvests)----------				
1	28490b	910b	36940	1127b	1.02
2	37200a	1282a	41560	1401a	1.05
3	32930ab	1194a	42600	1494a	1.16
4	35020a	1283a	43040	1530a	1.21
5	37200a	1305a	42340	1447a	1.15
6	36940a	1195a	41990	1350a	1.10
7	36240a	1230a	43120	1435a	1.08
Signif.[z]	*	**	NS	**	NS

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

[y]Bushel=33lb.

Table 4. Main effects of potassium rate and proportion of K as controlled-release K (CRK) for eggplant, Live Oak, Spring, 1994.

	No. 1 Small		No. 1 Medium		No. 1 Large		No. 2 Small		No.2 Medium		No. 2 Large		Cull	
Treatment	**No.**	**bu.**	**No.**	**bu.**	**No.**	**bu.**	**No.**	**bu.**	**No.**	**bu.**	**No.**	**bu.**	**No.**	**bu.**
	----------Early yield per acre (first 2 harvests)----------													
K_2O rate (lb/A):														
100	0	0	87	2	4850	208	0	0	0	0	670	27	0	0
150	0	0	116	3	4650	190	0	0	0	0	580	25	0	0
Signif.[z]	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CRK(%):														
0	0	0	87	2	4620	199	0	0	0	0	392	16	0	0
25	0	0	0	0	4660	185	0	0	0	0	566	25	0	0
50	0	0	217	6	4970	212	0	0	0	0	915	37	0	0
Signif.[z]	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	----------Total season yield per acre (5 harvests)----------													
K_2O rate(lb/A):														
100	6740	156	12020	406	16290	690	2500	50	2640	84	2210	88	610	17
150	7350	161	12140	378	17310	704	2030	40	2090	64	1570	62	490	14
Signif.[z]	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CRK(%):														
0	7535	170	12720	400	16940	710	1870	36	1740	51	1130	42	435	12
25	7270	160	11460	380	16200	650	2130	42	2740	87	2480	98	650	16
50	6315	140	12070	390	17250	730	2790	57	2610	84	2050	85	570	18
Signif.[z]	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[z]Treatment effects significant at 5% (*) or 1% (**) probability levels or not significant (NS).

Table 5. Main effects of potassium rate and proportion of K as controlled-release K (CRK) for eggplant, Live Oak, Spring, 1994.

Treatment	Total yields per acre				Avg. fruit
	U.S. No. 1		Total Market		
	No.	bu.	No.	bu.	wt. (lb.)
	----------Early yield (first 2 harvests)----------				
K_2O rate (lb/A):					
100	4936	210	5604	237	1.24
150	4762	192	5340	216	1.22
Signif.[z]	NS	NS	NS	NS	NS
CRK(%):					
0	4700	200	5096	216	1.18
25	4660	184	5227	209	1.25
50	5180	217	6098	254	1.26
Signif.[z]	NS	NS	NS	NS	NS
Interaction	NS	NS	NS	NS	NS
	----------Total season yield (5 harvests)----------				
K_2O rate(lb/A):					
100	35053	1253	42400	1475	1.14
150	36800	1244	42485	1410	1.11
Signif.[z]	NS	NS	NS	NS	NS
CRK(%):					
0	37200	1294	41950	1425	1.10
25	34940	1194	42296	1422	1.13
50	35630	1256	43080	1483	1.15
Signif.[z]	NS	NS	NS	NS	NS
Interaction	NS	NS	NS	NS	NS

[z]Treatment effects significant at 5% (*) or 1% (**) probability levels or not significant (NS).

Table 6. Effects of potassium fertilization and proportion of K from controlled-release K (CRK) on eggplant leaf N and K concentration, Live Oak, Spring, 1994.

Treatment	K_2O (lb/acre)	CRK[y] (%)	29 Apr		7 June	
			N	K	N	K
			----------%----------			
1	0	0	5.7	4.8	4.7	1.2
2	100	0	5.4	5.5	4.9	2.5
3	100	25	5.6	5.8	5.1	2.4
4	100	50	5.4	6.0	5.1	2.6
5	150	0	5.5	6.0	4.9	2.8
6	150	25	5.4	6.2	5.1	2.8
7	150	50	5.4	6.2	4.8	2.9
Prob.>F			0.4966	0.0274*	0.6054	0.0004**
LSD (0.05)[z]			NS	1.0	NS	0.6
Main effects:						
	K_2O rate	100	5.5	5.8	5.0	2.5
		150	5.4	6.2	4.9	2.8
		Signif.[z]	NS	NS	NS	NS
	CRK	0	5.4	5.8	4.9	2.6
		25	5.5	6.0	5.1	2.6
		50	5.4	6.1	5.0	2.7
		Response[z]	NS	NS	NS	NS

[z]Treatment effects were significant at 5% (*) or 1% (**) probability level or not significant (NS).

[y]CRK=controlled-release K (Multicoat KNO_3).