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EFFECTS OF K RATE AND PROPORTION OF K SUPPLIED FROM CONTROLLED-RELEASE K ON WATERMELON

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ABSTRACT

On a sandy soil testing low in K, watermelon yield and fruit size was not affected by K rates of 0, 50, 100, and 150 lb K_2O per acre. Leaf K concentration was increased by all K fertilization treatments compared to zero K. Proportion of K from controlled-release K had no effect on watermelon yield or fruit size although leaf K concentration of plants with 18-inch vines was increased in linear fashion by increases in proportion of K from controlled-release K over the range of 0 to 50%.

INTRODUCTION

Watermelons are one of the most important vegetable crops in Florida with about 40,000 acres planted in 1993-94 season (Freie and Pugh, 1995). Average yield in Florida is 230 cwt per acre. Preharvest production costs are 1400 dollars per acre with about 8% of that attributed to fertilizer (Smith and Taylor, 1995). Average fertilization rates for melons and watermelons in Florida were 160 N, 140 P_2O_5, and 210 K_2O (lb/acre) (U.S.D.A., 1990), even though the maximum rates recommended (as of 1995) for soils low in P or K are 150 lb/acre each for N, P_2O_5, and K_2O (Hochmuth and Hanlon, 1995a).

Fertilization rates of K for watermelons in Florida are based on a Mehlich-1 soil test (Hochmuth and Hanlon, 1995b). The fertilization recommendation includes information on fertilizer management so that applied nutrients are used efficiently by the watermelon crop.

The amount of fertilizer K to apply was derived from considerable research spanning almost 40 years. Early work with watermelon fertilization was conducted at Immokalee (Everett, 1960), Leesburg (Brinen et al., 1979; Elmstrom et al., 1973), Live Oak (Locascio et al., 1973;

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Nettles and Lundy, 1958), and Gainesville (Brinen et al., 1979; Halsey, 1959; Fiskel et al., 1967; Locascio et al., 1973). These early studies were largely done with mixed N-P-K fertilizers so that yield responses can not be conclusively attributed to N, P, or K. Most studies showed that maximum yields were realized with 2000 to 2400 lb per acre of 6-8-8 (N-P_2O_5-K_2O), or equivalent. More recent work with N, P, and K on watermelons showed that yield rarely responded to more than 150 lb/acre of each N, P_2O_5, or K_2O (Hochmuth and Hanlon, 1989; Hochmuth et al., 1994). Similar responses to K were reported for Louisiana (Sundstrom and Carter, 1983).

With some crops, controlled-release N has been shown to benefit yields and is recommended for supplying about 25% of the total N (Hochmuth, 1988). Controlled-release N fertilizers have been studied for watermelon in Florida with mixed results. Yield of watermelon was higher with sulfur-coated urea compared to single applications of uncoated urea but not higher than soluble urea applied in several split-applications (Locascio and Fiskel, 1970; 1971). Similar results were found in later studies (Locascio, 1978). Single applications of controlled-release N and K fertilizers maintained soil N and K concentrations in the soil at higher levels than with one application of soluble N or K (Elmstrom et al., 1975).

Recent work with controlled-release N in South Carolina showed no effect on watermelon yield (Garrett, 1994). Work at Live Oak with controlled-release potassium nitrate showed little effect on watermelon yield (Hochmuth and Hochmuth, 1994). When N and K were applied in one preplant application, there was a slight benefit to supplying some N and K from controlled-release potassium nitrate but not when splitting the N and K during the season (Hochmuth and Hochmuth, 1994).

The above work showed that controlled-release N or K fertilizers applied in one preplant application can result in yields equal to several applications of soluble N and K. The objective of the present study was to evaluate a polymer coated potassium nitrate for effects on watermelon yield and fruit size.

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 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 (coated) potassium nitrate (Vicksburg Chemical Co., Vicksburg, Mississippi). 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 (Hochmuth and Hanlon, 1995a) 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 (Hochmuth and Hanlon, 1995b). 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 incorporate fertilizer into soil uniformly. Plots consisted of a single bed 35 ft in length with 7.5 ft between bed centers. Fertilizer rates were calculated on the basis of 8-ft centers to conform to standardized fertilization practices (Hanlon and Hochmuth, 1990). The eight fertilization treatments were arranged in four randomized complete-blocks.

On 16 Mar., 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 Film Products, Hartsville, South Carolina). Drip irrigation tubing (Roberts Ro-Drip) was placed in the center of the bed in a one inch deep groove in the soil. Beds were 24 inches wide and six 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 8 PSI pressure.

On 25 Mar., 'Royal Sweet' watermelon transplants were placed in a single row on each bed at a 36-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. Disease and insect pests were controlled by timely applications of labeled pesticides based on pest scouting of the crop.

On two occasions (29 Apr; vines 18 inches in length with first flowers open and 7 June at 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 spectroscopy (Hanlon et al., 1994).

Watermelon fruits were harvested three times on 1, 9, and 13 June. Fruits were weighed and all fruits of uniform shape and greater than or equal to 12 lb were considered marketable. All data were analyzed by analysis of variance and regression techniques.

RESULTS

The sandy soil used for this potassium study with watermelon tested 23 ppm Mehlich-1 K which is low and recommendation in 1994 was for 120 lb K_2O per acre (Hochmuth 1992). Early fruit yield, however, was not affected by K fertilization treatment (Table 2). Early yield and early fruit size were maximized with at most 50 lb K_2O per acre when 120 lb K_2O per acre were recommended. Likewise, K fertilization did not affect total-season fruit yield or fruit size (Table 2).

Main effects of K rate and proportion of K from controlled-release K did not affect watermelon yield or fruit size (Table 3). Total season yields were very good, 432-452 cwt/A, at least twice the average state yields (Freie and Pugh, 1995).

K fertilization had slight effects on watermelon leaf K concentrations for the first sampling date (plants with 18-inch vines) (Table 4). Without K, leaf K concentration was 2.5% while K fertilization increased leaf K to an average of 3.7%. Leaf K with zero K fertilizer was just below the published sufficiency range for watermelon plants with 18-inch vines and first flowers (Hochmuth et al., 1991). Plants with most K fertilization treatments at second harvest were at the low end of the K sufficiency range. Even though leaf K of plants receiving zero or low K was near deficiency, there were no negative effects on yield and less K than predicted was needed, a result similar to other watermelon studies (Hochmuth and Hanlon, 1989).

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

Treatment	K_2O rate (lb/acre)	Soluble (%)		Controlled release (%)	
		N	K	N	K
1	0	100	100	0	0
2	50	100	100	0	0
3	100	50	100	50	0
4	100	50	75	50	25
5	100	50	50	50	50
6	150	50	100	50	0
7	150	50	75	50	25
8	150	50	50	50	50

Table 2. Effects of K fertilization and proportion of K from controlled-release K on watermelon fruit yield, Live Oak, FL, Spring, 1994.

Treatment		Marketable fruit yield (per acre)		
K_2O (lb/acre)	CRK(%)[y]	Number	Cwt.	Avg. fr. wt. (lb.)
		Early (first harvest)		
0	0	497	112	17.0
50	0	995	213	21.7
100	0	746	169	21.7
100	25	580	122	20.6
100	50	995	219	21.6
150	0	912	182	20.5
150	25	622	132	21.4
150	50	830	188	22.7
Signif.[z]		NS	NS	NS
		Total (3 harvests)		
0	0	1870	378	18.0
50	0	2074	447	17.7
100	0	2074	454	15.7
100	25	2115	425	19.7

Treatment		Marketable fruit yield (per acre)		
K_2O (lb/acre)	CRK(%)[y]	Number	Cwt.	Avg. fr. wt. (lb.)
		Total (3 harvests)		
100	50	1950	418	18.5
150	0	2032	422	17.3
150	25	2157	466	19.5
150	50	2198	466	18.9
Signif.[z]		NS	NS	NS

[z]Treatment effects not significant (NS).
[y]CRK=controlled release potassium ('Multicoat' coated KNO_3).

Table 3. Main effects of K rate and proportion of K from controlled-release K on watermelon yield and fruit size, Live Oak, FL, Spring, 1994.

Treatment		Marketable fruit yield per acre		Avg. fr. wt. (lb.)
K_2O (lb/acre)	CRK (%)[y]	Number	Cwt	
		Early (first harvest)		
100		774	170	21.3
150		788	168	21.5
Signif.[z]		NS	NS	NS
	0	830	176	21.1
	25	602	127	21.0
	50	913	204	22.1
	Signif.[z]	NS	NS	NS
		Total (3 harvests)		
100		2047	432	17.9
150		2130	452	18.6
Signif.[z]		NS	NS	NS
	0	2054	438	16.5
	25	2137	445	19.6
	50	2074	442	18.7
	Signif.[z]	NS	NS	NS

[z]Treatment effects not significant (NS).
[y]CRK=controlled release potassium ('Multicoat' coated KNO_3).

Table 4. Effects of K fertilization and proportion of K from controlled-release K on watermelon leaf N and K concentrations, Live Oak, FL, Spring, 1994.

Treatment		Leaf conc. (%)			
K_2O (lb/acre)	CRK (%)[y]	29 April		7 June	
		N	K	N	K
0	0	6.3	2.5b	4.5	1.9
50	0	6.3	3.4a	4.5	2.3
100	0	6.3	3.5a	4.1	2.0
100	25	6.2	3.6a	3.9	2.1
100	50	6.1	3.4a	3.7	2.2
150	0	6.1	3.8a	4.2	2.5
150	25	6.1	3.9a	4.2	2.4
150	50	6.3	4.1a	3.9	2.5
Signif.[z]		NS	*	NS	NS
		----------Main effects----------			
100		6.2	3.5	3.9	2.1
150		6.2	3.9	4.1	2.5
Signif.[z]		NS	*	NS	NS
	0	6.2	3.6	4.1	2.3
	25	6.2	3.7	4.0	2.3
	50	6.2	3.7	3.8	2.3
	Signif.[z]	NS	L*	NS	NS

[z]Treatment effects not significant (NS).
[y]CRK=controlled release potassium ('Multicoat' coated KNO_3).