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Foliar K Makes Difference On Muskmelon Fruit Quality

Even though soil K concentrations were high, supplemental foliar K treatments improved fruit quality in Texas studies.

Summary: *Adequate potassium (K) fertilization is needed to ensure yields and quality of many fruits and vegetables. However, K supply from soil alone often is not adequate to meet plant needs. Studies in south Texas show that supplementing soil K with foliar K can improve fruit quality characteristics. Fruit from plots receiving supplemental foliar K had higher external and internal fruit tissue firmness than control fruit and this was associated with generally higher soluble solids concentrations (SSC) in both years. All foliar K sources studied had positive effects on fruit quality parameters except for KNO_3, which tended to result in less firm fruit with lower SSC values. These results demonstrated that the apparent K deficiency caused by inadequate uptake can be alleviated by supplemental foliar K applications and that the effectiveness of foliar K will depend not only on the source of fertilizer K, but also on environmental conditions affecting soil K availability and overall plant growth and development.*

Potassium (K) is an essential plant nutrient involved in numerous physiological processes that control plant growth, yield, and quality parameters such as taste, texture, and nutritional/health properties. The majority of K in plant tissues is taken up by the roots from the soil in its ionic form (K+). Even though K is abundant in most soils in Texas, both plant and environmental factors often limit adequate plant uptake. In many crops, K uptake occurs mainly during the vegetative stages of plant growth when root growth is not inhibited by carbohydrate supply. During reproductive development, competition for photoassimilates between developing fruits and vegetative organs limits root activity and nutrient uptake. Environmental factors such as soil type, soil moisture availability, and temperature also tend to control soil solution K levels and plant uptake capacity through a variety of mechanisms. Hence, soil-derived K, which is essential for sugar production, transport, and storage in fruit, is not always optimal during the critical fruit developmental period, and this is partly responsible for poor fruit quality and yield.

Previously controlled environmental studies have shown that supplementing soil K supply with foliar K applications during fruit development and maturation can improve muskmelon fruit quality parameters such as fruit firmness, sugar content, ascorbic acid, and beta-carotene levels. For field-grown plants, increasing soil fertilizer inputs may not be enough to alleviate the developmentally-induced K deficiency, partly because of reduced root activity during reproductive development and also because of competition for binding sites on roots from cations such as calcium and

Treatment	Leaf		Petiole		SSC		Yield	
	(mgK•gdw⁻¹)		(mgK•gdw⁻¹)		(%)		cwt/acre	
	2006	2007	2006	2007	2006	2007	2006¶	2007
Control	11.9cd[z]	12.9b	48.2d	54.3b	9.2b	8.1b	57.8a	182.4b
KCl	11.6d	14.1a	55.2bc	63.4a	10.0ab	9.3ab	59.5a	202.5a
KNO_3	10.7d	13.1b	47.6d	54.9ab	9.7ab	8.7b	54.4a	172.0b
MKP	13.2bc	15.9a	51.6cd	59.4ab	10.6a	10.1a	64.1a	212.0a
K_2SO_4	14.7a	14.9a	50.2cd	58.7ab	10.5a	9.7a	62.3a	206.8a
KTS	13.9ab	16.8a	64.2a	73.9a	10.7a	10.4a	66.8a	229.6a
KM	14.7a	15.4a	57.8b	66.5a	10.3a	9.8a	60.6a	208.8a

[z] Means with the same letter, within a column and location are not significantly different at Duncan's MRT 95% probability level (n=6-16).
¶ 2006 yields are based on a once-over harvest during peak maturity.

Table 1. The effects of foliar potassium (K) sources (potassium chloride – KCl, potassium nitrate - KNO_3, PeaK or Monopotassium phosphate – MKP, potassium sulfate - K_2SO_4, potassium thiosulfate - KTS, and Potassium Metalosate - KM) on tissue K concentrations, soluble solids concentrations (SSC) and yields of field-grown muskmelon ('Cruiser') fruit in south Texas. Weekly foliar K applications were made between fruit set and fruit maturity during the spring growing season in 2006 and 2007.

magnesium. In another study, the beneficial effects of supplemental foliar K application on fruit quality were greater when an organic form of K (Metalosate-K) was used compared to an inorganic source (e.g., KCl). Potassium chloride is the most widely used source of K; however, its relatively high salt index and its high point of deliquescence (POD) limit its use for foliar nutrition. A high POD increases the risk of crystallization following foliar sprays.

The objective of this study was to evaluate the effectiveness of different K salts for foliar K fertilization on muskmelon fruit yield and quality.

Supplementing Works

Overview. Preplant soil tests at our study sites indicated moderate to very high potassium (>550 mg•kg⁻¹) levels, so no K was added to the soil. Phytotoxicity problems were not observed with any of the foliar K sources and concentrations used. The pH levels of spray solutions ranged from 6.5 to 7.7. Unbuffered solutions of most K sources tend to have alkaline pH levels that can cause leaf burns. All treatments were applied early in the morning (0500 to 0800 hr; >80% RH; <25° C; and <1 mph winds) to minimize the potential for leaf burn.

Plant tissues from plots receiving supplemental foliar K treatments generally had higher K concentrations than those from control plots, suggesting that soil K supply alone was not sufficient to saturate tissue K accumulations (Table 1). However, differences in tissue K concentrations among the foliar K sources were not highly significant except for KNO_3 treatments, which generally had the least beneficial effect on tissue K concentrations, perhaps a dilution effect resulting from NO_3-enhanced vegetative growth.

Soluble solids concentrations (SSC) differed significantly among the foliar K treatments in both years and were generally lower in 2007 than in 2006. With the exceptions of KCl and KNO_3, all the other foliar K sources significantly increased fruit SSC levels compared to the control. Although SSC values were generally lower in 2007 than in 2006, the greatest relative benefit from supplemental foliar K was observed in 2007. Unseasonable weather conditions (cold fronts) during the 2007 growing season delayed vegetative development and, as a consequence, there was a substantial overlap between canopy development and fruit maturation. This is a probable reason for the marginal SSC values observed in 2007. Nevertheless, a positive and more pronounced response to foliar K treatments was recorded in 2007. In 2006 similar trends were also observed for total and component sugars (glucose, sucrose and fructose, data not shown) but variability in individual observations resulted in inconsistent trends among the K sources. In 2006, total ascorbic acid and beta-carotene concentrations were also generally increased as a result of supplemental foliar K applications. However, the trends were not consistent among K sources.

Fruit firmness. While foliar K applications generally increased fruit firmness in both years, no significant differences were found among the K sources except for KNO_3, which tended to result in less firm fruit compared to controls. Firmness measurements are a good indicator of fruit texture and shelf life. In a previous study, it was found that fruit firmness was closely correlated with fruit tissue pressure potential, with fruit from K-treated plants having significantly higher values than those of control plants.

Fruit yields did not respond significantly to supplemental foliar K treatments in 2006, averaging 6,000 lbs/A based on a once-over harvest during peak maturity. In 2007, fruit yields averaged 20,100 lbs/A, based on several harvests over a two-week period, and were significantly affected by supplemental foliar K treatments (Table 1). Yields from KCL-treated plots were not significantly different from those of control plots.

Fruit weights. Individual fruit fresh weights of K-treated fruit did not differ significantly from those of fruit from control plots. However, fruit counts from treated plots were slightly greater than those from control plots (data not shown), potentially accounting for the increased yields.

Conclusions

This study generally supports previous controlled environment findings that supplementing soil K supply with foliar K applications during fruit development and maturation can improve muskmelon fruit quality by increasing firmness, sugar content and perhaps yield under unfavorable environmental conditions. Current data also provides additional evidence of differences among potential foliar K sources, with KNO_3 consistently having the least beneficial effects on fruit yield and quality.

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