Effects of varying potassium levels on yields and petiole potassium levels for organically fertilized high tunnel tomato

Connor Eaton[1], Rebecca Grube Sideman[2], Heather Bryant[2], Mark Hutton[3],Bruce Hoskins[4], Eric Sideman[5]

University of New Hampshire Dept. of Biological Sciences[1], University of New Hampshire Cooperative Extension[2], University of Maine Cooperative Extension[3], University of Maine Soil Analytical Lab[4], Maine Organic Farmers and Gardeners Association[5]

Introduction

In the Northeast U.S., preplant applications of organic sources of fertility are commonly used by both conventional and organic producers growing tomatoes in-ground in unheated high tunnels. Based on the common occurrence of yellow shoulders and other fruit disorders related to potassium (K) deficiency, we hypothesized that K may frequently be a limiting factor for yield and fruit quality in high tunnel tomato.

Objective: *Our objective was to investigate the relationship between applied potassium (K) and fruit yield for high tunnel tomato crops using organic sources of fertility.*

Methods

In 2014, tomatoes were grown in high tunnels in Durham, NH and North Haverhill, NH (*cv. Geronimo)* and Monmouth, ME (*cv. Rebelski*). Depending on location, tomatoes received 6 (*N. Haverhill)* or 7 (*Durham and Monmouth*) levels of K, holding nitrogen (N) and phosphorus (P) constant (Table 1). Organic source of nutrients included K_2SO_4 (0-0-56.1), soybean meal (7.6-1.4-2.6) and blood meal (15-0.3-0.4). On 18-Aug. and 18-Sep. in Durham, NH, 20-Aug. and 24-Oct. in North Haverhill, NH, and 22-Aug. and 14-Oct. in Monmouth, ME, petiole sap K was measured using a Laqua twin ion potassium meter (Spectrum Technologies, Aurora, IL) and yield data were collected weekly throughout the harvest season.

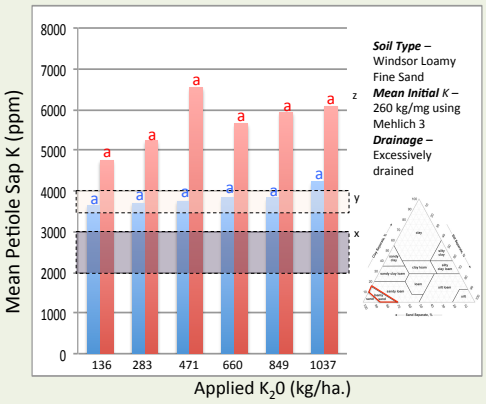
Tomato Yield Response to Applied K

Treatment (kg/ha)			Mean Cumulative Fruit Weight per plant (g)		
Total Applied N	Total Applied P_2O_5	Total Applied K_2O	N. Haverhill, NH	Durham, NH	Monmouth, ME
423	83	136	6599.3	3453.2 ab	2974.5
423	83	283	5338.7	2943.5 a	2861.3
423	83	471	5803.8	3805.4 ab	3228.0
423	83	660	7031.7	3863.6 ab	2952.0
423	83	849	6144.3	3763.3 ab	2621.0
423	83	1037	6987.4	4038.1 b	2720.0
423	83	1226	---[z]	3740.2 ab	2932.1

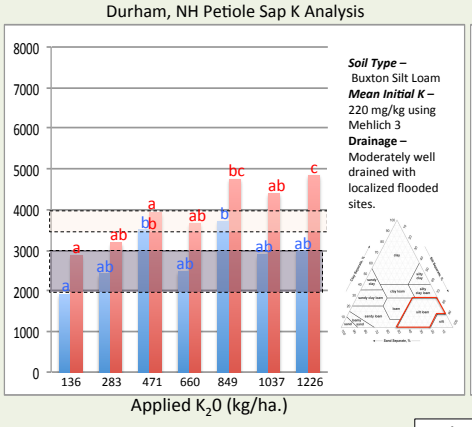
[z] Treatments not performed.

Unless data are followed by different letters within a column, no significant differences were seen using Tukey's HSD test ($p<.05$).

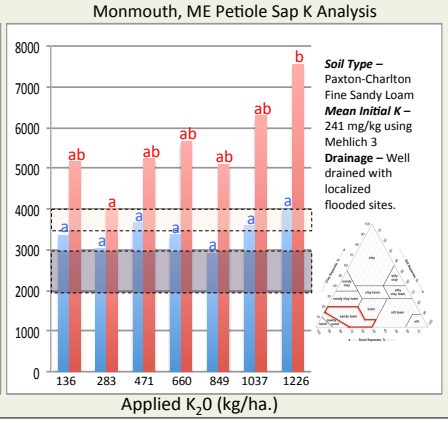
North Haverhill, NH Petiole Sap K Analysis



Durham, NH Petiole Sap K Analysis



Monmouth, ME Petiole Sap K Analysis



[z] Separation statistics indicate differences in compared means within each site per plant date. Blue letters indicate beginning of harvest and red letters indicate with end of harvest analysis. Different letters above a column represent significant differences using Tukey's HSD test ($p<.05$).

[y] denotes petiole sap K sufficiency ratings for greenhouse tomato during harvest season (3500-4000 ppm) (Hochmouth, 2015)

[x] denotes petiole sap K sufficiency ratings for field tomato during harvest season (2000-3000 ppm) (Hochmouth, 2015)

Start of Harvest
End of Harvest

Range of severity of Yellow Shoulder as a result of varying levels of K deficiency seen in a susceptible variety. Fruit harvested in the current replication of the study in Monmouth, ME. Photo credit: Mark Hutton, Jul-17 2015.

Early harvest season in North Haverhill, NH (20-Aug 2014).

Results

- Supplemental K_2O levels had a significant effect on fruit yield in Durham, but not in N. Haverhill or Monmouth. K_2O levels did not have a significant effect on fruit size.
- Early in the harvest season, petiole K was below sufficiency levels for several treatments including high K treatments, in both Durham and Monmouth. Late in the harvest season, petiole K was above sufficiency levels for all treatments in N. Haverhill and Monmouth.
- Significant differences in petiole sap K were seen in Durham and Monmouth, the sites with the highest K buffering capacity soil textures. Significant differences in petiole sap K were not seen in N. Haverhill, the site with the lowest K buffering capacity soil texture.

Summary

K level alone did not affect high tunnel tomato fruit yield or size. Initial soil K, plus the presence of K in organic N sources may have obscured the effects of low K treatments. Despite some petiole K levels being below greenhouse sufficiency ratings, the lack of yield response limits its applicability to high tunnel tomato and suggests that high tunnel tomato may have different petiole K sufficiency levels. The analysis of pre-season and post-season soil test data is underway, and preliminary analysis shows that end-of-season soil K levels were much lower than beginning-of-season tests, suggesting that tunnel tomatoes removed more K from the soil than was added. Currently, the experiment is being repeated in the same sites, using a tomato cultivar susceptible to yellow shoulder to assess whether quality response to applied K provides a more accurate understanding of K requirements in high tunnel tomato than yield.

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With questions, contact us at cmg87@wildcats.unh.edu or becky.sideman@unh.edu