2017

Potassium Applications and Yellow Shoulder Disorder of Tomatoes in High Tunnels

Elizabeth Maynard
Purdue University - Main Campus, emaynard@purdue.edu

Israel S. Calsoya
Purdue University

Jill Malecki
Purdue University

Potassium Applications and Yellow Shoulder Disorder of Tomatoes in High Tunnels

Elizabeth T. Maynard, Israel S. Calsoyas, and Jill Malecki, Purdue University, P.O. Box 1759, Valparaiso, IN 46384 emaynard@purdue.edu

Experience suggests that tomatoes grown in unheated high tunnels can suffer significant loss in quality due to yellow shoulder disorder, particularly in susceptible varieties. The work reported here was conducted to determine whether incidence and severity of the disorder could be influenced by applying potassium fertilizers.

Materials and Methods

The trial was conducted in two 30 ft. X 48 ft. high tunnels on a Tracy sandy loam soil at the Pinney Purdue Ag Center in Wanatah, Indiana. High tunnel 1 was managed using organic practices and high tunnel 2 was managed conventionally. In high tunnel 1, 1,286 lb/A 13-0-0 fertilizer was applied and incorporated before planting. In high tunnel 2, 30 lb./A N from urea was applied before planting and 4.6 lb./A/wk N from UAN (1.5 gal/A/wk) was applied in irrigation for 9 weeks. Tomato varieties Red Deuce and Big Beef were seeded in 72-cell trays on March 31, 2015 and transplanted into high tunnels on May 7, 2015. Rows were 4 ft. apart and plants 21 inches apart in the row. Big Beef plants were pruned to two main stems and each stem was supported by a vertical string. Red Deuce plants were pruned up to but not including the branch just below the first flower cluster on the main stem. Stems of Red Deuce plants were supported by vertical strings–initially two stems per plant and then additional stems were supported as they got large enough to need support, for a total of 4 to 6 strings per plant. Plants were irrigated through two drip lines per row when tensiometers 6 inches deep exceeded 20 kPa soil water tension, resulting in 600-700 gallons per tunnel per week. Caterpillars were managed with one application of Dipel®, active ingredient *Bacillus thuringiensis*. Weeds were controlled by handweeding. Thermostatically-controlled roll-up sides were set to open when tunnel air temperature exceeded 80°F and close when tunnel air temperature dropped below 60°F. End walls were opened during the day and closed in the evening beginning at the end of May; at the beginning of July end walls were left open unless outside temperatures dropped below 50°F.

Each variety was treated as a separate experiment and each tunnel as a separate location. In each tunnel, two replications of four potassium treatments were established for each variety in a randomized complete block design. Treatment NONE had no potassium fertilizer. Treatment PRE had 300 lb./A K2O applied and incorporated before transplanting. This was the recommended maintenance amount based on a soil test of 120 ppm K. Treatment PRE-FERT had 126 lb. K2O applied in irrigation at 14 lb./week for 9 weeks, in addition to a preplant application as above. Treatment PRE-FERT-FOL was the same as PRE-FERT plus foliar application of K2O at 3.5 lb./A/week for 7 weeks. The potassium fertilizer was potassium sulfate in high tunnel 1 and potassium chloride in high tunnel 2. The experimental unit was 4 plants, 7 ft of row.

Recently mature tomato leaves were collected from each plot on July 15, dried, and sent to a commercial lab for determination of nutrient content.

Originally published in Midwest Vegetable Trial Report for 2016. Compiled by Elizabeth T. Maynard and Brad Bergefurd, Dept. of Horticulture and Landscape Architecture, Office of Agricultural Research Programs, Purdue University, W. Lafayette, Indiana. February 2017

Tomatoes were harvested from the center two plants in each plot July 27 – August 22, graded into marketable (USDA No. 1 or No. 2) and cull, counted and weighed. Several methods were used to assess yellow shoulder disorder. For a subset of fruit the percentage of the stem end of the fruit that was not red was estimated using the Horsfall-Barratt scale. When the disorder was present, severity on individual fruit was rated on a scale of 1 (slight) to 3 (severe). The number of fruit with severe yellow shoulder were counted and the percent of total fruit determined. Fruit that were culled due to yellow shoulder disorder were counted and percent of all culls determined.

Results and Discussion

Powdery mildew arrived early in the season and was not controlled.

Potassium treatments did not significantly influence marketable or total yield harvested through August 22 for either variety (Figure 1). Harvest could have continued for another month so it is not possible to know whether yield potential was influenced by potassium treatments.

Examples of yellow shoulder disorder are illustrated in Figure 2.

The percent of tomato fruit shoulder area that was not red was not affected by potassium treatment for Big Beef. For Red Deuce, the PRE treatment had more yellow on fruit shoulders than NONE or PRE-FERT, and PRE-FERT-FOL was intermediate (Table 1). High tunnels did not differ (data not shown).

The potassium content of leaf tissue was higher in high tunnel 1 than high tunnel 2 for Big Beef, but did not differ for Red Deuce (Table 2). For Big Beef, NONE and PRE treatments had lower leaf potassium than PRE-FERT-FOL, and PRE-FERT was intermediate. For Red Deuce, the PRE treatment had the highest leaf potassium content and other treatments did not differ from one another.

Although the potassium treatments did not influence yellow shoulder disorder in any consistent way, the amount of yellow shoulder disorder observed in individual treatment plots was negatively correlated with the leaf potassium content in that plot. Figure 3 shows that the severity of yellow shoulder disorder, the percent of cull fruit that had yellow shoulder disorder, and the percent of all fruit that had severe yellow shoulder disorder decreased as the leaf tissue potassium content increased.

From this preliminary work it isn't possible to make recommendations for reducing yellow shoulder disorder with potassium applications. Plots with higher leaf potassium content tended to have less fruit with severe yellow shoulder disorder, but increasing the amount of potassium fertilizer applied did not significantly reduce the disorder. Additional work is needed.

Acknowledgments

J. Leuck and Pinney-Purdue Agricultural Center staff assisted with crop management. C. Brown assisted with harvest.

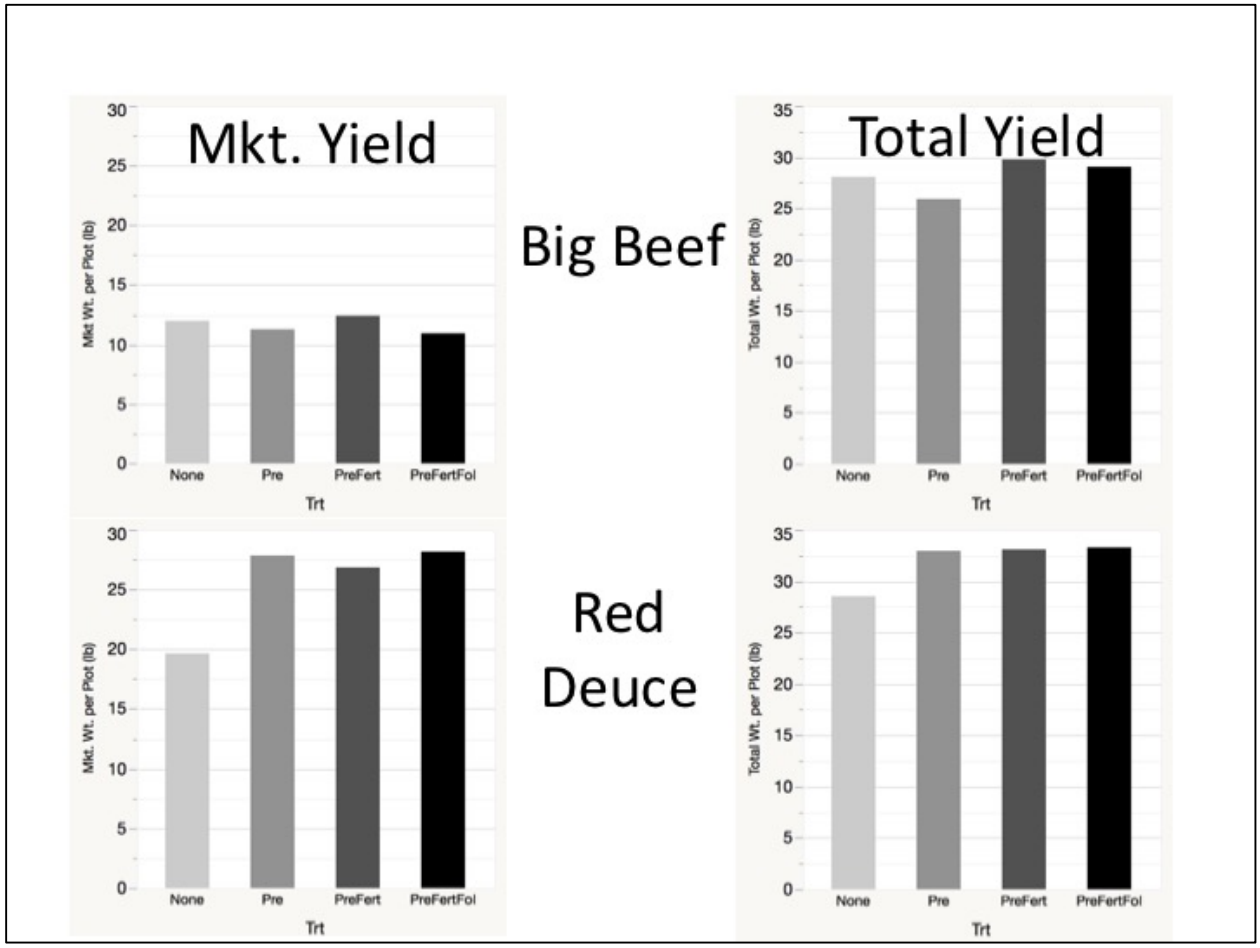

Figure 1. Marketable and total yield harvested from July 27 through August 22 for tomato varieties Big Beef and Red Deuce grown in high tunnels with various potassium fertilizer treatments, Wanatah, Indiana, 2015. None: no K fertilizer; PRE: 300 lb./A K2O preplant; PRE-FERT: PRE + 126 lb./A K2O applied in irrigation over 9 weeks; PRE-FERT-FOL: PRE-FERT + K2O at 3.5 lb./A/week for 7 weeks. Two plants were harvested per plot.

Figure 2. Examples of yellow shoulder disorder observed on tomato fruit.

Table 1. Percent of fruit shoulder area that is not red for tomato varieties Big Beef and Red Deuce grown with varying potassium fertilizer treatments in high tunnels, Wanatah, Indiana, 2015.[1]

Potassium Trt.	Big Beef		Red Deuce	
NONE	21.6		11.6	b
PRE	17.5		16.1	a
PRE-FERT	22.6		11.7	b
PRE-FERT-FOL	18.2		14.3	ab

[1]None: no K fertilizer; PRE: 300 lb./A K_2O preplant; PRE-FERT: PRE + 126 lb./A K_2O applied in irrigation over 9 weeks; PRE-FERT-FOL: PRE-FERT + K_2O at 3.5 lb./A/week for 7 weeks. Means within a column followed by the same letter do not differ at P<.05 based on Fisher's protected LSD.

Table 2. Leaf potassium content for tomato varieties Big Beef and Red Deuce grown in high tunnels with varying potassium fertilizer treatments, Wanatah, Indiana, 2015.[1]

High Tunnel	Big Beef		Red Deuce	
1	3.39	a	3.36	
2	2.53	b	2.59	
Potassium Trt				
NONE	2.77	b	2.82	b
PRE	2.83	b	3.36	a
PRE-FERT	3.04	ab	2.83	b
PRE-FERT-FOL	3.21	a	2.89	b

[1]None: no K fertilizer; PRE: 300 lb./A K_2O preplant; PRE-FERT: PRE + 126 lb./A K_2O applied in irrigation over 9 weeks; PRE-FERT-FOL: PRE-FERT + K_2O at 3.5 lb./A/week for 7 weeks. Means within a column followed by the same letter do not differ at P<.05 based on Fisher's protected LSD.

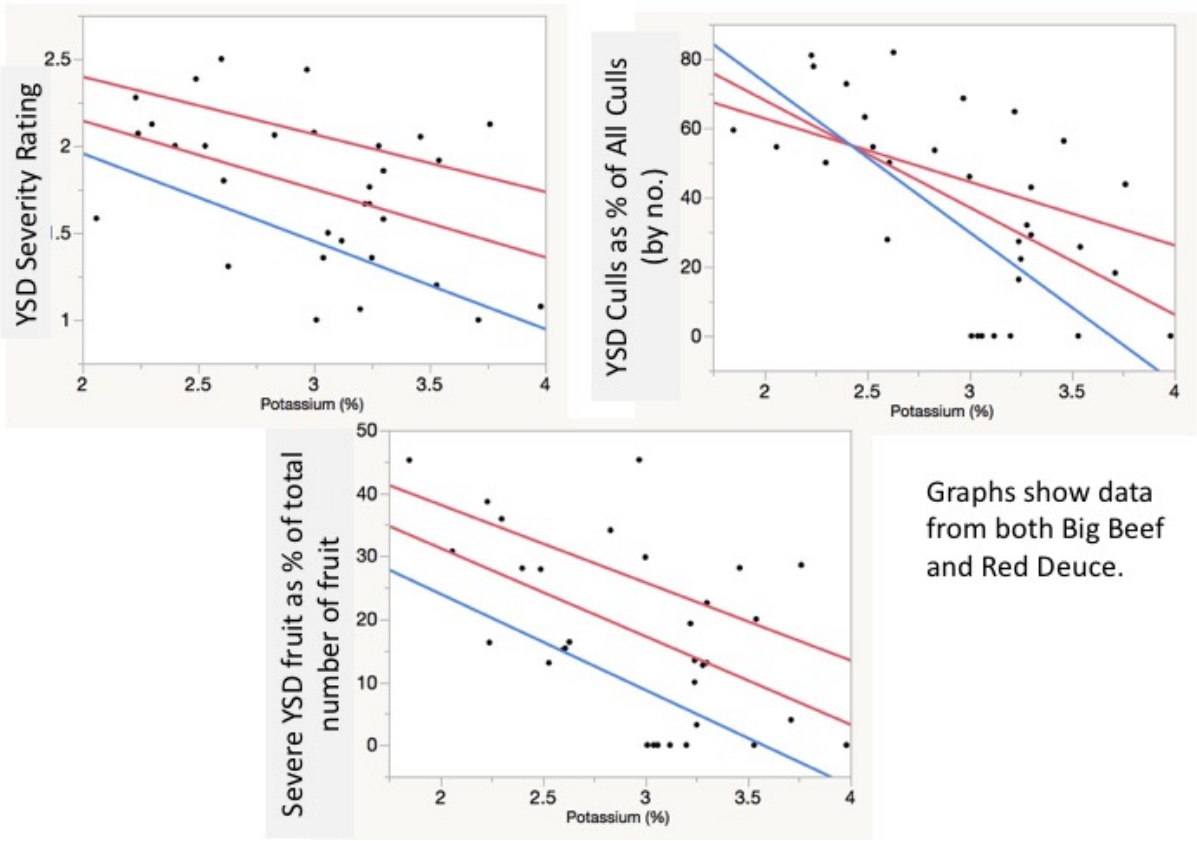

Figure 3. Tomato yellow shoulder disorder (YSD) severity, percent of culls due to YSD, and percent of all fruit with YSD versus tomato leaf potassium content (percent dry weight). Severity rating for fruit that showed the disorder ranged from 1 (slight) to 3 (severe). Each point represents one experimental unit. Graphs show data from Big Beef and Red Deuce and both high tunnels. The lines represent linear fits for Big Beef only (red, top line), Red Deuce only (blue, bottom line) and both varieties (red, middle line). $P<.05$ for all regressions. The trial was conducted in 2015 in Wanatah, Indiana.