

2016 Evaluation of Determinate Tomato Varieties for High Tunnel Production in Kansas

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High tunnel (hoop house) production of vegetables has become quite common in Kansas. The high tunnels protect crops from Kansas harsh environmental conditions such as wind and storm damage. In addition to protection, determinate tomato crop requirements (planting date, soil temperature, crop height, etc), high tunnels provide an excellent system for tomato production. Therefore, this system protects the crop, lengthens the growing season, and therefore increasing economic impact for the grower (Carey et al, 2009).

We conducted a variety trial of determinate tomatoes grown in a high tunnel to determine which cultivar is best suited for hoop house cultivation in the Great Plains. Ten commercially available varieties were tested and yields ranged from 15.0 to 21.6 lbs of total fruit per plant. The three varieties with the highest marketable fruit weight per plant in order from highest number were 'Primo Red', 'Red Morning', and 'Red Deuce'. 'Red Deuce' had the largest marketable fruit size this season as well as in 2014 and 2015. 'Primo Red' had the highest percentage marketability by fruit number and weight this season as well as in our other similar variety trials in 2013, 2014 and 2015.

Introduction

Fresh-market tomatoes in Kansas are a valuable crop that is sold through farmers markets, CSA's, on-farm sales, wholesale markets and restaurant sales. Results from a survey conducted by the Kansas Rural Center in 2015 indicated that tomatoes are the most commonly-grown crops in high tunnels in Kansas. Similarly, tomatoes are the most popular crop grown in the central United States (Knewton et al, 2010).

In four-season high tunnels, indeterminates are often used in addition to determinate and heirloom varieties. However, in three season high tunnels, a vertical trellis system typically cannot be supported by the tunnel frame and planting dates are only slightly earlier than traditional field plantings. This offers a unique situation where determinates and/or semi-determinates grown in raised-bed plasticulture under stake-and-weave management are more practical than indeterminates and/or heirloom varieties. The goal of our study was to investigate the performance of ten determinate hybrid varieties for fresh-market production in a three-season high tunnel.

Materials and Methods

The trial was conducted at the Olathe Horticulture Research and Extension Center located approximately 30 miles southwest of Kansas City. Transplants were grown in soilless potting media using 50-cell propagation trays. Seeds were sown on 29 February 2016 and transplanted to 50-cell trays on 10 March. Transplants were set on 18 April in one bay of a multi-bay high tunnel (96' x 200' Haygrove Multibay High Tunnel). The trial was planted into four rows with

each row consisting of one replication. The high tunnel trial had five plants per plot and in-row spacing was 18", which is typical of commercial tomato production. Plastic mulch and drip irrigation were employed and the stake-and-weave method was utilized to trellis the plants vertically. Fertigation was carried out at a rate of 10 lbs nitrogen/acre per application on 29 April, 1 June and 30 June and 1 August. Potassium nitrate was used for the first and third fertigation events and calcium nitrate was used for the second and fourth fertigation. Harvesting was carried out from 28 June through 27 September. During the last harvest, all fruit larger than 5 cm were picked. Fruit were graded for marketability and fruit number and weight were recorded. Average fruit size and percent marketability were determined and are presented below. All data were analyzed using ANOVA (PlotIt, Scientific Programming Enterprises, Haslett, MI), and a mean separation test was carried out by using an F-protected least significant difference (LSD) test. A separate analysis was carried out for each individual observation and the results of the LSD test are shown where statistically significant treatment effects occurred.

Results and Discussion

'Primo Red' had the highest marketable and total yield at 19.6 and 21.6lb per plant respectively. 'Primo Red' also resulted the highest marketable and total yield per plant in our 2013, 2014 and 2015 variety trials. 'Primo Red' marketable yield was statistically similar to 'Red Morning', 'Red Deuce' and 'BHN589'. 'Red Deuce' had the highest average fruit size in marketability and total resulting in .43 and .42lb respectively. The results were similar in our 2013, 2014 and 2015 variety trials. 'Red Deuce' marketable fruit size was statistically similar to 'Summerpick', 'Skyway', 'Primo Red', and 'Red Morning'. For the third year in a row, 'Primo Red' resulted in the highest percentage marketability by number at 89.7% and by weight at 90.7%.

The major portion (>80%) of the fruit quality problems seen in this trial were the result of blossom end rot (BER). Although the cull fruit were not graded specifically for this issue, the results seen in this study were most likely the result of a lower incidence of BER.

'Primo Red' was a consistent producer throughout the season with an average marketable fruit size of 0.38 lbs/fruit. When reviewing harvesting trends, particularly by marketable fruit weight per plant, three seasonal flushes were observed. There were two large flushes, 14 July and 6 September and one small flush on 25 July. 'Primo Red' had the largest fruit produced on 14 July and tied with 'Red Deuce' on 6 September. During the small flush, 'Primo Red' still produced well and came in the third highest mean fruit weight. 'Red Deuce' produced its largest mean fruit size at that time resulting in .61 lb/fruit.

Another variety that is known for its high lycopene levels, 'Tasti Lee', was also a season consistent producer with smaller fruit between 0.21 and 0.40 lbs/fruit. and had a mid-season flush (from 14 to 25 July) with average fruit size at .40 lbs/fruit. Several varieties showed good potential for early-season production, which can be advantageous for marketing high-value fruit. In particular, 'Primo Red', 'Scarlet Red', and 'BHN 589' showed the highest yields during the mid-weeks of July (data not shown). 'Primo Red', 'Red Deuce' and 'Red Morning' also showed very strong production in the early part of September, which may be useful for growers looking to cater to late markets.

Table 1. Marketable and total per plant fruit yield of tomato varieties grown in a three-season high tunnel in Olathe, Kansas.

Variety	Marketable		Total	
	Number	Wt (lbs)	Number	Wt (lbs)
Primo Red	51.9 d	19.6 d	58.0 ab	21.6
Red Morning	48.0 cd	17.9 cd	56.9 ab	20.3
Red Deuce	38.4 abc	16.7 bcd	46.0 a	19.4
BHN 589	47.5 cd	16.2 bcd	62.5 b	20.1
Richmond	43.0 bcd	14.0 abc	48.6 ab	15.9
Tasti Lee	42.7 bcd	13.4 abc	50.7 ab	15.5
Summerpick	33.4 ab	12.9 ab	43.0 a	16.5
Scarlet Red	37.8 abc	12.7 ab	49.9 ab	16.8
Fletcher	40.3 bc	12.6 ab	49.2 ab	15.0
Skyway	28.4 a	10.9 a	45.3 a	16.2
LSD _(0.05)	10.30	4.83	15.21	6.58

Table 2. Mean tomato fruit size (lbs) and marketability of tomato varieties grown in a three-season high tunnel in Olathe, Kansas.

Variety	Average Fruit Size (lbs)		Percent Marketability			
	Marketable	Total	Number		Weight	
Red Deuce	0.43 e	0.42 e	83.6%	bc	86.2%	bc
Summerpick	0.39 de	0.38 de	80.3%	bc	81.2%	bc
Skyway	0.38 cde	0.35 bcd	64.0%	a	68.7%	a
Primo Red	0.38 cde	0.37 cde	89.7%	c	90.7%	c
Red Morning	0.37 bcde	0.36 bcd	84.7%	bc	88.1%	bc
BHN 589	0.34 abcd	0.32 ab	76.6%	b	81.0%	bc
Scarlet Red	0.33 abcd	0.33 abcd	78.2%	bc	78.6%	ab
Richmond	0.32 abc	0.32 abc	88.4%	c	88.2%	bc
Fletcher	0.32 ab	0.31 ab	82.5%	bc	84.5%	bc
Tasti Lee	0.31 a	0.30 a	83.4%	bc	85.4%	bc
LSD _(0.05)	0.0599	0.0512	11.51		10.55	

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