

Organically Managed, High Tunnel and Open Field Strawberry, Tomato and Lettuce Variety Trial Research Summary

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Introduction

High tunnels extend the production season, and increase earliness of harvest, fruit quality, yield and crop marketability of high-value crops, but have been underutilized in the Southeast. In this study, a comparison of yield and quality of six strawberry varieties, four tomato varieties, and six lettuce varieties was conducted in high tunnel (HT) and open field (OF) production systems using organic management practices. Furthermore, size, firmness, color, soluble solids content, titratable acidity, and the ratio of soluble solids content to titratable acidity were evaluated for the strawberry cultivars. These quality parameters were compared among winter HT, spring HT, and spring OF production systems.

Materials and Methods

This study was conducted at the East TN AgResearch and Education Center (ETREC) Organic Crops Unit in Knoxville, TN. Within each tunnel or field plot, one row was dedicated to each of the crops. Each variety plot measured 14 feet long with 28 strawberry plants spaced 1 foot apart in a double staggered row, 7 tomato plants spaced 2 feet apart in a single row, or 28 lettuce plants spaced 1 foot apart in a double staggered row.

Black plastic was laid by hand in the HTs and a plastic layer was used in the OF to make flat beds. Preplant fertilizer (soybean meal: 7.00 total N, 0.40 elemental P, 0.66 elemental K) was applied at a rate of 30 lbs N/acre. Liquid fish fertilizer (2.00 total N, 0.40 elemental P, 0.17 elemental K) was applied via drip tape at a rate of 1 lb N/acre/day once per week.

Insecticides were applied as needed: PyGanic (aphids), M-Pede (silverleaf whiteflies and tarnished plant bug), Aza-Direct (tarnished plant bug), and Dipel (tomato hornworm and true armyworm). Predatory mites were released to control the two-spotted spider mite on strawberries. A class C large earth bumblebee hive was placed in each high tunnel for supplemental strawberry pollination. Three applications of copper hydroxide were applied to tomatoes to prevent late blight.

Winter HT strawberry harvests began 2 December 2011 and continued until 12 January 2012. Fruit quality was measured on 20 berries from each subplot/cultivar, but only 15 berries were tested in the winter HT due to the low number of fruit. Spring HT harvests resumed 2 March and continued until 14 June. Spring OF harvests began 6 April and continued until 29 June.

Tomato harvests in the HT began 14 June (75 DAT) and ended 22 August (144 DAT) while OF harvests began 5 July (60 DAT) and ended 22 August (108 DAT).

Lettuce harvests in the HT began 12 April (43 DAT) and ended 27 April (58 DAT) while the OF harvests began 13 May (42 DAT) and ended 1 June (61 DAT).

Results

Strawberry Trial

2011-2012	Avg. Berry Size (ozs)	Firmness (grams)	SSC (%)	Total Yield (lbs/plant)	Marketable Yield (lbs/plant)	% Marketable (lbs/plant)
Winter HT						
San Andreas	0.73 cde	347.0 a	8.79 b	0.09 i	0.02 h	25 g
Albion	1.08 a	306.4 ab	9.85 a	0.09 i	0.04 h	49 b-e
Seascape	0.83 bcd	330.2 ab	9.84 a	0.04 i	0.02 h	42 e
Chandler	.	.	.	0.04 i	0.02 h	17 g
Radiance	1.02 ab	242.6 c	9.22 ab	0.18 i	0.11 gh	57 bcd
Strawberry Festival	0.87 abc	299.7 b	9.60 ab	0.13 i	0.07 gh	47 def
Spring HT						
San Andreas	0.42 f	182.9 de	5.31 gh	0.66 fg	0.40 de	58 a-e
Albion	0.50 ef	184.1 de	5.98 fg	0.49 h	0.22 fg	47 cef
Seascape	0.51 ef	155.8 ef	6.30 ef	0.60 gh	0.35 ef	56 b-e
Chandler	0.43 f	121.8 f	5.12 hi	0.86 cde	0.49 cde	56 b-e
Radiance	0.45 f	197.1 cd	4.55 i	1.06 ab	0.66 ab	61 abd
Strawberry Festival	0.52 ef	188.6 de	5.94 fg	0.79 def	0.46 de	57 a-e
Spring OF						
San Andreas	0.55 ef	206.7 cd	6.32 f	0.99 abc	0.64 bc	64 abc
Albion	0.59 def	189.9 de	7.59 c	0.73 efg	0.46 de	64 abc
Seascape	0.55 ef	194.6 cde	7.45 c	0.75 efg	0.49 de	64 abc
Chandler	0.39 f	128.6 f	7.38 cd	0.93 bcd	0.55 bcd	59 bcde
Radiance	0.49 ef	201.7 cd	6.73 def	1.06 ab	0.68 b	64 abc
Strawberry Festival	0.40 f	214.9 cd	7.04 cde	1.12 a	0.84 a	74 a
<i>P value</i>	<i>0.0057</i>	<i>0.0025</i>	<i>0.0077</i>	<i>0.0031</i>	<i>0.0102</i>	<i>0.0010</i>

Quality was highest in the winter HT system but yields were lowest. The spring OF system produced higher yields, but quality was reduced. Albion attained the best quality among cultivars, while Strawberry Festival produced the highest marketable yield (weight and number of fruit).

Tomato Trial

2011 Cultivar x production system	Location	Total Yield (lbs/ plant)	Market. Yield (lbs/plant)	% Marketable (lbs)	Average Marketable Weight per Fruit
Celebrity	High Tunnel	17.46	7.43	41.2 bcd	0.19 cd
Cherokee Purple		10.56	4.96	46.2 bc	0.33 a
Early Girl		19.18	11.79	61.4 a	0.11 f
Red Defender		13.93	6.59	47.0 b	0.22 bc
Celebrity	Open Field	10.76	3.79	34.7 cd	0.22 bc
Cherokee Purple		6.44	2.05	31.8 d	0.30 a
Early Girl		10.14	6.68	65.8 a	0.15 e
Red Defender		9.24	6.04	64.3 a	0.19 cd
<i>P-value</i>			0.1418	0.1026	0.0047

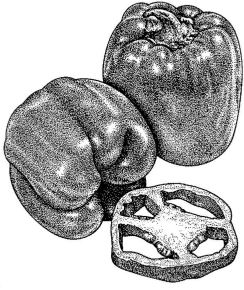
HTs increased yields compared to the OF. Early Girl had greater yields than the other three cultivars, and Cherokee Purple had the lowest yields. While lower than other cultivars, Cherokee Purple yields were more than two times greater in the HT versus the OF production system, and price premiums attained for organic heirlooms can help offset yield differences.

Lettuce Trial

2011 Cultivar x Production System	Location	Total Yield (lbs/plot)	Market. Yield (lbs/plot)	% Marketable (lbs/plot)
New Red Fire	High Tunnel	17.64 c	17.42 cde	99 a
Green Star		27.56 b	25.35 b	92 ab
Ermosa		29.32 b	15.87 cde	54 c
Adriana		32.63 b	18.08 b-e	55 c
Jericho		48.06 b	21.61 bc	45 d
Coastal Star		43.65 a	41.01 a	94 b
New Red Fire	Open Field	12.79 e	12.79 def	100 a
Green Star		17.42 de	17.42 cde	100 a
Ermosa		20.28 cd	19.84 bcd	98 a
Adriana		23.59 c	22.05 bc	93 ab
Jericho		61.51 a	5.73 f	9 f
Coastal Star		50.49 b	11.02 ef	22 e
<i>P-value</i>		<.0001	<.0001	<.0001

HTs increased total yields compared to the OF except the cultivars Jericho and Coastal Star, and HTs increased marketable yields for Green Star, Jericho and Coastal Star. The OF had higher percent marketable yields excluding Jericho and Coastal Star. Bolting occurred more often in the HTs compared to the OF, due to increased temperature.

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2013 Organically Managed Pepper Variety Trial

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Introduction

Pepper production in Tennessee consists of sweet, hot, and pimento cultivars. On average, Tennessee produces 700 to 900 acres of peppers and 75 percent of those are bell types. Nearly all the bell peppers are produced for fresh market, and Tennessee contributes ten percent of total U.S. bell pepper production. Cost varies in pepper production with the highest cost occurring when hybrid varieties are grown as these seeds carry a greater cost than non-hybrid seed. Hybrid seeds can lead to greater yields and better quality fruit. The purpose of this trial was to evaluate six pepper varieties grown organically.

Materials and Methods

This study was conducted at the ETREC Organic Crops Unit in Knoxville, TN. Six week old plants were transplanted 8 May. A total of 6 varieties were evaluated and replicated 4 times in a randomized complete block design. Each plot measured 15 feet long with 10 plants spaced 3 feet apart in a double-staggered row with row spacing of 5 feet.

Fertilizer, 90 lb/acre (Nature Safe 8-5-5), was broadcast in the planting rows 2 weeks after transplanting. Plants were initially irrigated when transplanted, but supplement irrigation was not needed due to the large amount of rain received.

Plants were scouted once a week for insects and diseases but no chemical applications were necessary. The brown marmorated stink bug caused significant damage to the fruit but no organic controls are currently available.

Harvest data shown here represents the time period between 12 July (65 days after planting) and 14 August (90 days after planting).

Variety	No. of harvests	Total Yield/Plant (lbs)	Marketable Yield/Plant (lbs)	% Marketable (lbs)
900 (EZ)	5	0.94	0.35 b	37 bc
Sprinter (EZ)	5	0.77	0.18 b	23 c
Milena (EZ)	5	1.32	0.60 a	47 ab
Abay (EZ)	5	0.79	0.22 b	24 c
Lipstick (JS) (pimiento)	5	1.11	0.61 a	55 a
Sweet chocolate (PV)	4	0.57	0.23 b	41 b
<i>p value</i>		<i>0.0596</i>	<i>0.0004</i>	<i>0.0011</i>

2013 Organically Managed Tomato Variety Trial

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Introduction

Tomato production in Tennessee ranks fourth in the country and makes up 3 percent of the U.S. fresh market tomato industry. On average, more than 4,000 acres are planted annually and is estimated to be valued at \$10 million. Many growers utilize greenhouses for out of season tomato production and tomato production costs vary. Tomato varieties differ among operations, and both hybrid and heirloom varieties are used for fresh market production. Hybrid seeds generally carry a higher price but higher quality and yield may offset seed costs. The purpose of this study was to compare six varieties of tomato grown organically.

Materials and Methods

This study was conducted at the ETREC Organic Crops Unit in Knoxville, TN. Six week old plants were transplanted 14 May. A total of 6 varieties were evaluated and replicated 4 times in a randomized complete block design. Each plot measured 20 feet long with 10 plants spaced 2 feet apart in a single row with row spacing of 5 feet.

Fertilizer, 90 lb/acre (Nature Safe 8-5-5), was broadcast in the planting rows 2 weeks after transplanting. Plants were initially irrigated when transplanted, but supplement irrigation was not needed due to the large amount of rain received.

Plants were scouted once a week for insects and diseases and no insecticidal applications were necessary. Due to the wet and cool summer, preventative measures were taken to prevent the onset of fungal diseases. Two sprays of copper hydroxide (77% a.i. (Champ WG; Albaugh, Inc., Ankeny, IA)) at label rate of 80 grams per gallon water were applied on 12 and 26 July.

Harvests began 14 May (62 days after planting) and ended 14 August (92 days after planting). Fruits were weighed by plot and then divided by the number of plants to determine the weight per plant.



Variety	No. of Harvests	Total Yield/Plant (lbs)	Marketable Yield/Plant (lbs)	% Marketable (lbs)
Montesino (EZ) (grape)	15	5.39 b	5.37 b	99 a
Toronjina (EZ) (cherry)	16	7.22 a	7.01 a	97 b
<i>p value</i>		<i>0.0155</i>	<i>0.0188</i>	<i>0.0132</i>
Watonga (EZ)	11	8.17 a	7.42 a	90 a
687 (EZ)	10	5.18 bc	4.54 b	87 a
Cherokee Purple (SoC)	12	6.91 ab	4.23 b	63 b
Valencia (PV)	10	3.87 c	3.36 b	87 a
<i>p value</i>		<i>0.0417</i>	<i>0.0169</i>	<i>0.0041</i>

Seed source: EZ=Enza Zaden, PV=Peaceful Valley and SoC=Seeds of Change

2013 Organically Managed Zucchini Variety Trial

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Introduction

Squash and zucchini production for both fresh market and processing is an important commodity in Tennessee. Tennessee produces 2 to 3 % of U.S. produced squash and zucchini with the majority being grown for the fresh market. In recent years, squash and zucchini production has decreased from 1,500 acres in 2002 to 700 acres in 2011. However, fresh market consumption continues to demand high quality fruits. Hybrid seeds are becoming increasingly popular. Their ability to tolerate pest pressure and resist diseases has become more and more attractive to growers. This study focused on yield and marketability of two varieties of summer squash grown organically.

Materials and Methods



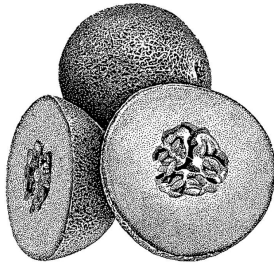
This study was conducted at the East TN AgResearch and Education Center (ETREC) Organic Crops Unit in Knoxville, TN. Plants were direct seeded 12 June. A total of 2 varieties were evaluated and replicated 4 times in a randomized complete block design. Each plot measured 20 feet long with 10 plants spaced 2 feet apart in a single row with row spacing of 4 feet.

Fertilizer, 90 lb/acre (Nature Safe 8-5-5), was broadcast in the planting rows once plants grew 2 to 3 true leaves. Plants were initially irrigated when seeded, but supplement irrigation was not needed due to the large amount of rain received.

Plants were scouted every two days for insects and diseases but no chemical applications were necessary. Squash bug adults and eggs were hand-picked during field scouting to reduce pest populations.

Harvests began 15 July (33 days after planting) and concluded 14 August (63 days after planting). Fruits were weighed by plot, and then divided by the number of plants to determine the weight per plant.

Variety	No. of Harvests	Total Yield/Plant (lbs)	Marketable Yield/Plant (lbs)	% Marketable (lbs)
Dunja (EZ)	23	3.45	3.19	93
Desert (EZ)	22	3.92	3.62	93
<i>p value</i>		<i>0.6957</i>	<i>0.6643</i>	<i>0.9798</i>



2013 Organically Managed Melon Variety Trial

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Introduction

Cantaloupe production is an important commodity when it comes to Tennessee's agricultural system and comprises 1 percent of the U.S. acreage. Cantaloupe production contributes close to \$5 million into the state's agricultural economy with about 1,000 acres of commercial cantaloupes grown each year. Weather is a major factor that determines the amount of cantaloupes grown and harvested in a given year. Cantaloupes are very sensitive to cool temperatures and growth is stunted if exposed to temperatures below 50 °F. Large amounts of rain also reduce the sugar content and cause the skin to crack prior to ripening. In recent years selected hybrid varieties have significantly increased production for wholesale markets. This study focused on yield and marketability of two varieties of Italian netted melons, Magnificenza and Tirreno, grown organically.

Materials and Methods

This study was conducted at the ETREC Organic Crops Unit in Knoxville, TN. Plants were direct seeded 12 June. A total of 2 varieties were evaluated and replicated 4 times in a randomized complete block design. Each plot measured 20 feet long with 10 plants spaced 2 feet apart in a single row with row spacing of 8 feet.

Fertilizer, 90 lbs/acre (Nature Safe 8-5-5), was broadcast in the planting rows once plants grew 2 to 3 true leaves. Plants were initially irrigated when seeded, but supplement irrigation was not needed due to the large amount of rain received.

Plants were scouted once a week for insects and diseases but no chemical applications were necessary.

Cantaloupes have not been harvested yet.

For more information, contact Annette Wszelaki at annettew@utk.edu or 865.974.8332, or visit <http://organics.tennessee.edu> or <http://vegetables.tennessee.edu>.

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