High Tunnel Pepper Variety Trial Research Report, 2015 - 2017

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Our Objective: Compare performance of greenhouse and field pepper varieties for colored bell production in unheated high tunnels.

Methods/Details

We planted peppers inside a 30'x60' high tunnel at the NH Agricultural Experiment Station's Woodman Farm in Durham, NH over a three-year period. Plants were seeded on 30 Mar. 2015, 10 Mar. 2016, and 30 Mar. 2017 – and were transplanted into the unheated high tunnel on 28 May 2015, 18 May 2016, and 20 May 2017. *Fertility*: We applied preplant 50 lbs per acre of N and 125 lbs of K2O using a mixture of soybean meal (7-2-1), ProGro (5-3-4), and potassium sulfate (0-0-50) with an additional sidedress (at first fruit harvest) of 50 lbs per acre of N using Nature Safe 13-0-0. During transplant production, we used 15-5-15 Cal-Mg at a rate of 300 ppm N, pulse feeding twice per week. Once in the high tunnel, drip irrigation events were managed using tensiometer readings. Irrigation was turned on once the tensiometer read 15-20 centibars until the meters read 0.

Varieties included

Cultivar	Mature fruit color	Type[z]	Seed source[y]	Developer[x]	Years evaluated
Bentley	Yellow	High-tech	JSS	Enza Zaden	2015, 2016, 2017
Early Sunsation	Yellow	Field	Harris Seeds	Seminis	2015, 2016, 2017
Felicitas	Red	High-tech	JSS	Syngenta	2015, 2016, 2017
Karisma	Red	Field	Harris Seeds	HM Clause	2015, 2016, 2017
Karma	Red	Field	Harris Seeds	HM Clause	2015, 2016, 2017
Moonset	Yellow	Low-tech	JSS	Enza Zaden	2015, 2016
Orange Blaze	Orange	Field	Harris Seeds	Seminis	2015, 2016, 2017
Orangela	Orange	High-tech	JSS	Syngenta	2015, 2016
Sprinter	Red	Low-tech	JSS	Enza Zaden	2015, 2016, 2017
Sympathy	Orange	Low-tech	JSS	Rijk Zwaan	2015, 2016

[z] As reported by seed source, type indicates the production environment recommended for each cultivar. "High-tech" refers to heated greenhouses, "Low-tech" refers to unheated high tunnels, and "Field" refers to open field culture.

[y] Seed sources are: JSS – Johnny's Selected Seeds, Albion ME, and Harris – Harris Seeds, Rochester NY.

[x] Developers are: Enza Zaden (Enkhuizen, Netherlands), HM Clause (Davis CA), Rijk Zwaan (De Lier, Netherlands), Seminis (St. Louis MO), and Syngenta (Basel, Switzerland).

Spacing and Pruning

Plants were spaced 12 inches apart in single rows on 5-foot centers (6 rows in a 30' wide house). Each plot contained 6 plants. Plants were trellised using the Almeria system, where twine was used to corral each plot, looping around vertical supports every six plants. New twines were applied as needed, every 6-12 inches of new growth (see photos at end of report). All fruits that set at the first and second nodes were removed from each plant, to encourage more vigorous plant growth. From then on, four leaders were maintained for each plant. All other lateral branches were removed, leaving a single fruit and flag leaf for each. Plants were pruned weekly throughout the summer.

Data Collection

Fruits were harvested once they were at least 20% colored. In weekly harvests, fruits were weighed and counted after being categorized into marketable or unmarketable due to the following defects: sunscald, Alternaria, Anthracnose, European Corn Borer (ECB) damage, or other (including rots of

unknown reason or misshapen fruit). The relatively few ECB-damaged fruit were later categorized as "marketable" for data analysis, under the assumption that growers would have controlled this pest. At the end of the experiment, all mature green and immature fruit were harvested and weighed to provide an estimate of overall yield potential.

Pest Management

Shortly after transplanting, a low incidence of aphids was observed on a few plants. We effectively controlled the pest through natural colonization of lady beetles plus one inundative release of lacewing larvae in early June. Aphid populations remained low throughout the experiment. A single application of Bt (Dipel DF) was made to control hornworm larvae in 2015 and 2017. Common green lacewing larvae (*Chrysoperla carnea*) were released twice in 2015 and once in 2016 to control aphid populations.

Results and conclusions

Our first harvest took place around 145 days after seeding each year (early August), and harvests continued until **late October-early November**, when frost killed the growing points. We would typically expect to harvest colored bell peppers by early August in the field in Durham, so production was *not* early. This is likely for two reasons – 1) plants were not transplanted into the tunnel as early as they could have been, and 2) the earliest fruits were removed from the plants to encourage plant growth, which delayed first fruit production.

Season-Long Yields of Colored Peppers

Fruit size and cumulative yields (no. and weight of fruit) of marketable mature colored bell pepper fruit from plants grown in high tunnels in 2015, 2016 and 2017 in Durham, NH.

	Avg. fruit size (oz)			Marketable no. fruit per plant						Marketable yield (lb/plant)					
Cultivar	2015	2016	2017	2015[x]		2016		2017		2015		2016	2017	
Bentley	9.7	8.2	8.6	8.3	bc	8.0	b	7.2	bc	5.0	a	4.1	3.9	b
Early Sunsation	9.6	8.1	9.4	7.1	bcd	5.8	b	6.1	bc	4.3	ab	3.0	3.6	b
Felicitas	10.0	10.2	9.4	7.9	bcd	6.1	b	8.8	b	4.9	a	3.9	5.2	a
Karisma	11.1	10.2	11.4	5.4	d	5.8	b	5.6	c	3.8	ab	3.7	4.0	b
Karma	10.9	10.6	8.8	6.0	cd	5.5	b	6.3	bc	4.1	ab	3.7	3.5	b
Moonset	9.1	8.4	–	7.4	bcd	5.9	b	–		4.2	ab	3.1	–	
Orange Blaze	4.2	3.8	3.7	13.4	a	15.4	a	14.2	a	3.5	b	3.7	3.2	b
Orangela	8.4	8.0	–	8.9	b	8.0	b	–		4.7	ab	4.0	–	
Sprinter	8.7	8.0	8.1	7.1	bcd	5.3	b	6.8	bc	3.9	ab	2.6	3.4	b
Sympathy	8.7	8.2	–	8.0	bcd	5.5	b	–		4.3	ab	2.8	–	

Values followed by the same letter are not significantly different from one another. For columns without letter, varieties were not significantly different.

The quality of fruit harvested from all varieties was excellent. Photos of all varieties are shown at the end of this report. The highest yields were produced by Bentley, Felicitas and Orangela, all classified as "High-Tech Greenhouse Peppers" by the seed supplier. Under our conditions,

these varieties performed just as well, and possibly a bit better, than those varieties recommended for low-tech greenhouses and field conditions.

For total weight of marketable fruit, Orange Blaze, a small-fruited type, produced significantly lower yields than both Bentley and Felicita. Otherwise, there were no significant differences. There was a direct relationship between fruit size and number of fruits produced per plant. Orange Blaze (average fruit size around 4 oz) produced significantly more fruit per plant than all other varieties, whereas Karisma (average fruit size around 11 oz) produced the fewest fruits per plant.

The number and percentage of unmarketable fruit was low for all varieties. There were no significant differences between varieties in prevalence of different defects. The most common defect was sunscald, which can be difficult to distinguish from blossom end rot in pepper. The other common defect was Alternaria fruit rot caused by *Alternaria alternata*.

Profitability. In our trial, we obtained yields ranging from 3.5-5 lbs of fruit per plant, with an additional 0.9-1.6 lbs per plant in mature green fruit at the end of the season. Total yields at our spacing corresponded to a range of 46,000-66,600 lbs per acre (or 1.1-1.5 lbs/ft^2). This is slightly lower than yields reported for greenhouse peppers in Florida (1.6-3.0 lbs/ft^2), however, it is more than double typical field pepper yields (23-27,000 lbs per acre). It is considerably less than typical yields for high tunnel tomato production, which can range from 10-20 lbs per plant, or 3-6 lbs/ft^2.

Seed costs vary widely for the varieties evaluated; at the time of writing this report, prices ranged from $0.11 to $1.04 per seed (assuming 250 seed quantities purchased) for the different varieties. The profitability of this crop as an alternative enterprise will depend on 1) actual yields in your system and 2) whether your market(s) will pay premium prices for very high quality colored bells. Further, it may be possible to increase yields by earlier planting, alternative spacing and pruning systems, or other means.

Conclusions. Growing peppers in high tunnels permits the production of very high quality colored fruit. Successful pepper production in tunnels requires attention to various pests (e.g. aphids, hornworms, and European corn borer). More experimentation with the system is required to determine whether yields and earliness may be increased by adjusting planting dates, pruning systems, and other management decisions.

For a more detailed explanation of this work, see the published manuscript: **Sideman, RG. 2020.** *Colored bell pepper yields from cultivars grown in high tunnels in Northern New England*. **HortTechnology 30(3):456-462.** DOI: https://journals.ashs.org/horttech/view/journals/horttech/30/3/article-p456.xml

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Left: A young plant, just before removing the first fruit

Below: Sunscald or blossom end rot lesions on 'Orange Blaze'

Left: Plants in early September, trellised

Above: Alternaria symptoms on assorted varieties

Left: In June, just prior to adding the first twine

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