

## Bell Pepper Variety Trial – Olympus and Revolution

### Staff Contact:

**Liz Kolbe** – (515) 232-5661  
[liz@practicalfarmers.org](mailto:liz@practicalfarmers.org)

### Cooperators:

- Rick Hartmann - Minburn
- Susan Jutz - Solon
- Tim Landgraf - Kanawha
- Alice McGary - Ames
- Mark Quee - West Branch

### Funding By:

CERES

### Web Link:

[http://bit.ly/pfi\\_horticulture](http://bit.ly/pfi_horticulture)

### In a Nutshell

- Five farmers compared two bell pepper varieties, Olympus and Revolution, to determine which produces better in Iowa's climate.
- Each farm planted four randomized pairs of research plots, each pair with 10-20 plants of each variety.

### Key Findings

- Pepper yield was significantly different by farm, but treatment (variety) also had a significant effect on yield. Revolution yield was significantly higher than Olympus when all farms were analyzed together.
- Revolution produced more pounds and number of peppers per ft<sup>2</sup> and per plant than Olympus at three of five farms. The remaining two farms saw no difference in yield between the varieties.
- Average plant yield of green bell peppers across all farms was 4.3 lb/plant for Revolution and 4.03 lb/plant for Olympus.
- Plant spacing was different by farm, but end-of-season yield for green bell peppers ranged from 1.82 – 2.66 lb/ft<sup>2</sup>.

Project Timeline:

March 2015 - October 2015



*Pepper plant at Rick Hartmann's farm on July 21.*

with geography. In this trial, a group of farmers chose two varieties (Revolution and Olympus) to compare during 2015. Revolution and Olympus were selected because of positive farmer experience, the varietal similarities, and the availability of organic and untreated seed.

In past years, other states have performed multiple variety trials for bell peppers, some including the varieties selected for this trial, Revolution and Olympus. A variety trial in Pennsylvania found that at several trial sites Revolution had higher yields of large-sized fruits, but overall did not have yields significantly different than many other varieties (Sanchez et al., 2011). A Rhode Island variety trail landed Revolution and Olympus in the middle of the pack, with Olympus having a slightly higher yield (though significance was not reported) (Brown, 2014). In 2013 variety trials in Maine, Revolution yield was

not significantly different than 19 other varieties tested, but raw yield values were in the bottom third of the field (Hutton and Handley, 2014).

Though many enjoy trying out specialty peppers, growers in this trial were curious which hybrid bell pepper varieties were best adapted to Iowa conditions. Farmer-researcher Rick Hartmann chose to participate in this project due to the "lack of vegetable yield data for commercially available crops as they relate to Iowa growing conditions." Tim Landgraf echoed that he hoped the project will, "help us identify pepper varieties that are consistent producers in northern Iowa." For farmer-researcher Mark Quee, this project mimics a 2013 pepper variety trial he conducted, evaluating the cost-effectiveness of disease-resistant Catronia against California Wonder (Ogawa and Quee, 2013).

### Background

Bell peppers are popular with vegetable farmers in Iowa. Peppers are familiar to consumers, continuously productive, and can wait patiently on the plant for harvest. Like all crops, proper soil condition, grower management, and weather impact pepper yield. Variety also plays a key role, and varietal performance varies

## Methods

This project was conducted at five Iowa farms: Rick Hartmann (Small Potatoes Farm in Minburn), Susan Jutz (ZJ Farms in Solon), Tim Landgraf (One Step at a Time Gardens in Kanawha), Alice McGary (Mustard Seed Community Farm in Ames), and Mark Quee (Scattergood Farm at the Scattergood Friends School in West Branch).

Each farmer planted four replications of each of the two pepper varieties in a randomized, paired trial. Plants per plot at each farm ranged from 10 to 20, and spacing, mulch, and irrigation practice was determined by farm, and noted in **Table 1**. Plants for the trial were started indoors and transplanted to the field. The pepper varieties used were Olympus and Revolution. Olympus is an organic hybrid pepper from Johnny's Seeds, 65 days to maturity and 85 days to ripe red. Revolution is also a green-to-red hybrid pepper, with 72 days to maturity. Revolution seeds were pelleted and untreated, purchased from Harris Seeds.

Farmers harvested peppers successively through the season on multiple dates, harvesting all mature peppers during each harvest. At each harvest, fruits were deemed marketable or cull and then weighed and counted. Four of the five farms harvested peppers primarily at the green stage, Quee waited for harvest until peppers turned fully red. Planting and harvest dates are noted in **Table 1**.

Data were analyzed using JMP Pro 11 (SAS Institute Inc., Cary,

NC) and comparisons among measured variables employ least squares means for accuracy. A repeated measures approach was used to examine the effects of harvest date, treatment, and their interaction on cumulative pepper yield. For some yield characteristics (percent cull, fruit weight) and end-of-season averages across farms, means are compared using Tukey's least significant difference (LSD). Statistical significance is reported at the  $P \leq 0.10$  and  $P \leq 0.05$  levels.

## Results and Discussion

Across sites, growing degree days in 2015 were lower than the 30-year average in May, June, July and August, higher during September, and similar during October, as seen in **Table 2**. McGary, Jutz, Quee and Hartmann had above average rainfall during 2015. In June 2015 alone, McGary and Hartmann had four to six inches more than the average rainfall.

**Table 1**

Production Practices and Trial Design by Farm					
Farm	Rick Hartmann	Susan Jutz	Tim Landgraf	Alice McGary	Mark Quee
Start date	Mar. 18	Apr. 5	Mar. 6	Mar. 24, Apr. 22	Mar. 22
Transplant Date	May 23	May 26	June 10	May 27	May 22
In-Row Spacing	18 in.	16 in.	18 in.	18 in.	23.4 in.
Btwn-Row Spacing	56 in.	16 in.	24 in.	48 in.	~30 in.
Configuration	single row	staggered double row in 24 in. bed with 24 in. path between beds	double row in 60 in. bed	single row	double row in 63 in. bed
Mulch	none	black plastic	black plastic on half of plots	straw, July 30	none
Irrigation	drip	drip	drip	none	drip
plants/plot	12	10	20	16	19
Harvest Window	July 22 - Oct. 13	July 30 - Oct. 14	Aug. 10 - Oct. 11	July 20 - Oct. 15	Sept. 7 - Oct. 5
Plot ft <sup>2</sup>	84	13.3	75	96	102
Dimensions	4.66 ft x 2.5 ft x 12	2 ft x 1.33 ft x 5	5 ft x 1.5 ft x 10	4 ft x 1.5 ft x 16	5.25 ft x ~2 ft x 10

**Table 2**

**Total Monthly Rainfall and Growing Degree Days (GDD) (Base 50°F) for 2015 and Long-term Averages<sup>a</sup>**

Month	McGary				Landgraf				Jutz and Quee				Hartmann			
	GDD		Rainfall (in.)		GDD		Rainfall (in.)		GDD		Rainfall (in.)		GDD		Rainfall (in.)	
	2015	Avg.	2015	Avg.	2015	Avg.	2015	Avg.	2015	Avg.	2015	Avg.	2015	Avg.	2015	Avg.
May	413	412	4.5	4.7	316	356	4.9	4.3	426	456	6.1	4.8	376	385	6.2	4.7
June	556	610	9.0	5.0	550	565	4.6	5.1	605	658	6.8	5.2	596	594	11.6	5.3
July	663	718	4.9	4.6	639	677	3.8	4.2	706	772	6.4	4.5	697	713	5.8	4.3
Aug.	578	658	8.7	5.0	552	609	6.1	4.0	614	719	5.0	4.6	619	650	3.3	4.1
Sept.	574	490	7.1	3.4	550	430	3.3	2.9	617	531	4.4	3.2	601	468	6.6	3.4
Oct.	239	239	1.5	2.4	211	191	1.2	2.1	260	267	2.1	2.8	255	228	0.9	2.4

<sup>a</sup> Rainfall and growing degree day data accessed from weather stations nearest farm locations (Iowa Environmental Mesonet, 2015). McGary: AMES-8-WSW; Hartmann: PERRY; Jutz and Quee: IOWA-CITY; Landgraf: Iowa – North Central Climate Division.

**Cumulative yields by farm**

**Figure 1** shows cumulative yields through the season at each farm. Bold lines represent the varietal average and lighter lines show the individual plot yields. Using repeated measures analysis, average yields for Revolution were statistically greater than Olympus at Hartmann, Landgraf, and Quee. The vertical dotted lines in **Figure 1** represent the date at which cumulative yields of the two varieties became (and remained) different. This generally occurred early in the harvest schedule in mid-August.



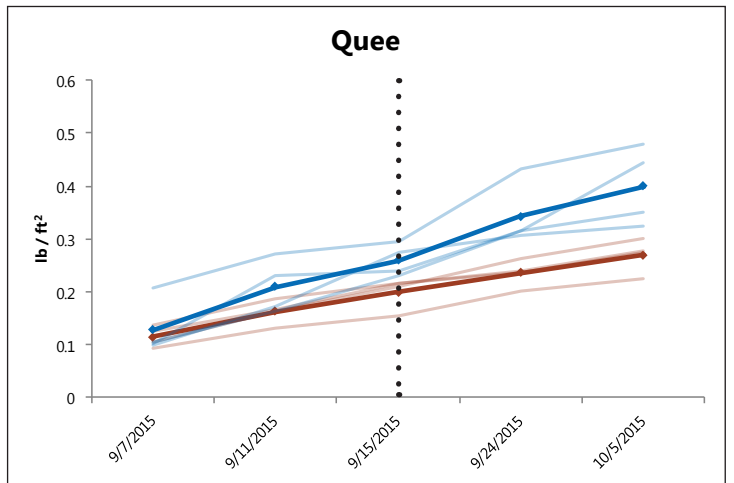
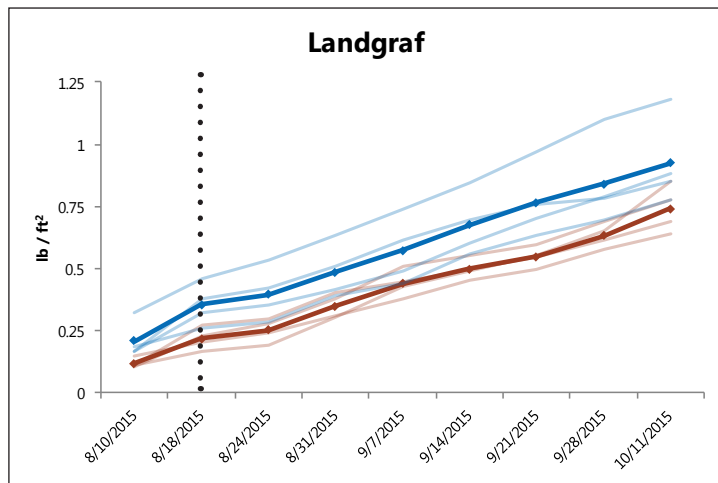
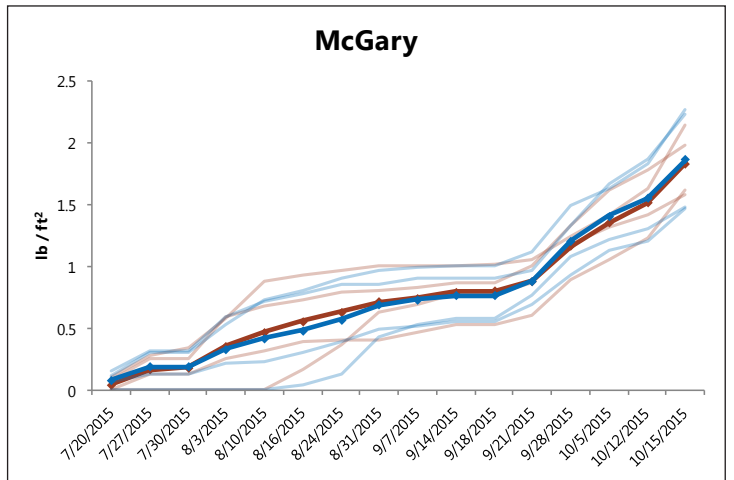
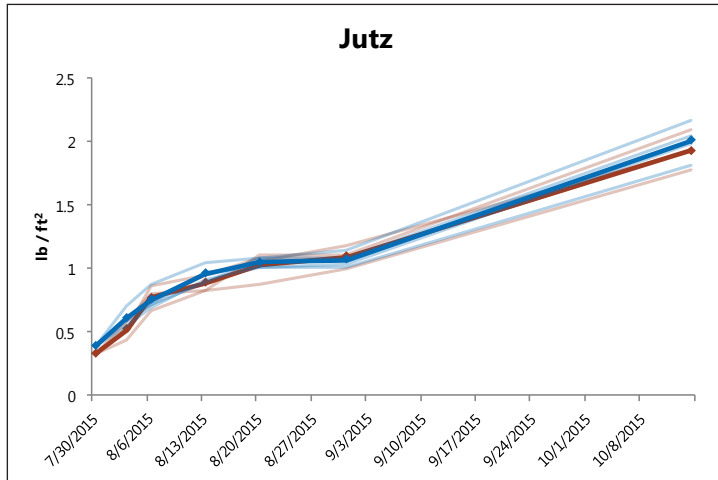
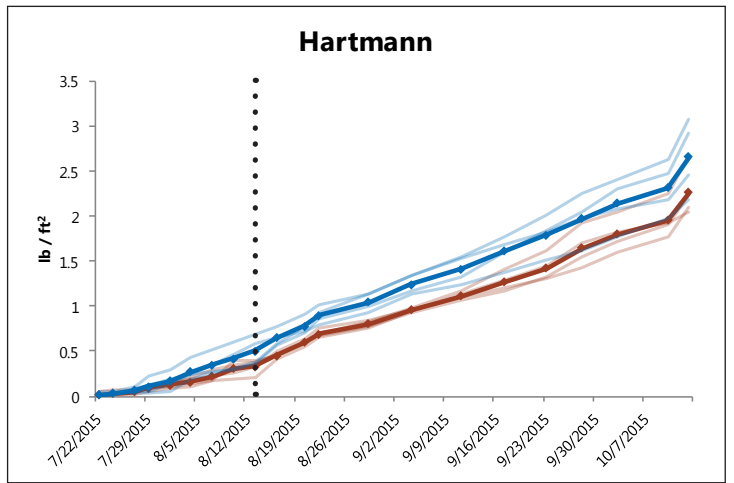
Pepper plants in the variety trial at McGary's Mustard Seed Farm.

**Figure 1**

**Cumulative Yield at Each Farm**

Figure 1. Cumulative yield shown in lb/ft<sup>2</sup> at each farm. Bold lines are the average values for each variety; light lines are individual plot values. The last date is the final yield. The dotted vertical lines indicate the date at which average yields of Olympus and Revolution became and remained significantly different. In plots without vertical dotted lines, yield in lb/ft<sup>2</sup> were not significantly different at  $P \leq 0.10$ .

- Olympus 1
- Olympus 2
- Olympus 3
- Olympus 4
- Olympus Mean
- Revolution 1
- Revolution 2
- Revolution 3
- Revolution 4
- Revolution Mean





## End-of-Season Summary

Yield and yield components for the two pepper varieties by farm and the average across all farms can be seen in **Table 3**. Average end-of-season yields of marketable fruit differed by farm. This finding was expected, because farmers employed their preferred farming practices. This created farm-to-farm differences, including row configurations, spacing, harvest frequency, disease and pest control practices, mulching, and irrigation, as detailed in **Table 1**. Regardless of variety, pounds of marketable fruit per ft<sup>2</sup> were highest at Hartmann's, followed by Jutz, McGary and Landgraf. Yields were far lower at Quee because he only harvested peppers that had turned fully red, requiring peppers to stay on the plants longer and limiting additional fruit set. Quee did not collect cull data.



Transplanted peppers on May 23 at Rick Hartmann's Small Potatoes Farm.

**Table 3**

**End-of-season yield and yield components**

Farm	Yield (lb/ft <sup>2</sup> )		Fruit Count (No. of fruit/ft <sup>2</sup> )		Fruit Weight (lb/fruit*)		Plant Yield (lb/plant)		Plant Fruit Count (No. of fruit/plant)		Cull Fruit (% No. of fruit)	
	Olympus	Revolution	Olympus	Revolution	Olympus	Revolution	Olympus	Revolution	Olympus	Revolution	Olympus	Revolution
Hartmann	<b>2.26</b>	<b>2.66</b>	<b>1.64</b>	<b>1.89</b>	0.46	0.47	<b>5.27</b>	<b>6.20</b>	<b>11.48</b>	<b>13.21</b>	<b>12%</b>	<b>9%</b>
Jutz	1.92	2.00	4.50	4.58	0.36	0.35	2.57	2.67	6.00	6.10	25%	23%
Landgraf	<b>0.74</b>	<b>0.92</b>	<b>2.04</b>	<b>2.43</b>	0.36	0.38	<b>2.77</b>	<b>3.46</b>	<b>7.64</b>	<b>9.13</b>	<b>8%</b>	<b>4%</b>
McGary	1.87	1.82	1.61	1.45	<b>0.55</b>	<b>0.59</b>	5.25	5.12	9.68	8.69	25%	22%
Quee**	<b>0.27</b>	<b>0.40</b>	<b>0.61</b>	<b>0.43</b>	0.63	0.66	<b>1.44</b>	<b>2.15</b>	<b>2.29</b>	<b>3.26</b>	.	.
Average***	<b>1.69</b>	<b>1.86</b>	2.43	2.60	<b>0.43</b>	<b>0.45</b>	4.03	4.3	8.79	9.20	17%	15%

By farm, values in bold are significantly different at  $P \leq 0.10$  using repeated measures analysis. Significant differences in all-farm averages were determined using Tukey's LSD.

\* Indicates categories for which end of season means were compared using Tukey's LSD.

\*\* Quee harvested red peppers only. All other cooperators harvested at mature green with some green-turning-red.

\*\*\* Because Quee's values represent a different stage of crop maturity, they were omitted from the farm-average mean calculation.

Though yields of marketable fruit varied by farm, the overall treatment effect of pepper variety on yield (lb fruit/ft<sup>2</sup>) was significant at  $P \leq 0.05$ , with Revolution producing an average of 1.69 lb/ft<sup>2</sup> and Olympus producing 1.50 lb/ft<sup>2</sup>. Similarly, fruit count was different at  $P \leq 0.10$ . Revolution produced an average of 2.53 fruit/ft<sup>2</sup> compared to Olympus' 2.30 fruit/ft<sup>2</sup>. The average weight of each marketable fruit produced was also significantly different at  $P \leq 0.05$ , with Revolution being slightly bigger (0.45 lb/fruit) than Olympus (0.43 lb/fruit). Across farms, the treatment effect of variety did not extend to plant yield, plant fruit count, or percent cull fruit, though some of these yield characteristics differed at certain farms.

When considering farms individually, yield differences were seen at Hartmann, Landgraf and Quee, with greater yields of marketable fruit coming from Revolution. At these farms, Revolution outpaced Olympus in terms of fruit count, plant yield and plant fruit count. Though McGary did not have differences in yield or plant yield, Revolution tended to produce larger fruits. At Hartmann and Landgraf, Olympus produced a significantly higher percent of cull fruit than Revolution (12% vs 9% at Hartmann; 8% vs. 4% at Landgraf), (**Table 3**). Rick Hartmann noted that Olympus plants were taller (with longer branches) and were more prone to sunscald than Revolution.



Marketable Olympus



Cull Olympus



Marketable Revolution



Cull Revolution

Marketable and cull fruit at Susan Jutz's farm. Cull fruit include misshapen fruit and fruit exhibiting sunscald.

In an environment with high wind and storm events, taller plants can be more susceptible to plant toppling, breakage and secondarily non-marketable (cull) fruit. His farm had several high rain and high wind events in 2015 (**Table 2**), causing many plants to topple over. In the end, Hartmann trellised the plants to counter these events, and was pleased with the result.

### Conclusions and Next Steps 2015

On three of the five farms, Revolution out-performed Olympus. Two of these farms, Hartmann and Landgraf harvested at the mature green stage, one farm, Quee, harvested all peppers when fully red. Greater end-of-season yields were generally attributed to more fruit produced by Revolution plants. At these farms, cumulative yields for Revolution began to exceed those for Olympus by mid-August and remained greater throughout the rest of season. On the remaining two farms, Jutz and McGary, average yields between the two varieties were not different.

Rick Hartmann was impressed by the performance and production of Revolution. He plans to dedicate a larger portion of pepper space to Revolution after seeing the results on his farm and others.

No differences in yield between Revolution and Olympus were discernible at Susan Jutz's farm, but she was glad to have given the two varieties another shot (she's tried both in the past) to compare with her preferred red bell pepper variety, Ace. Said Susan, "We started the Ace 20 days later than the Revolution and Olympus, transplanted to the field seven days later, and were 10 days earlier." She informally noted the yield per plant from Ace was better, but the yields could not be compared statistically. Susan's Ace yields for green and red peppers during 2015 can be found in a Practical Farmers' Research Report: Demonstration Project: Pepper Seedlings in Soil Blocks and Plug Trays.

Tim Landgraf reflected that favorable weather this year allowed plants to develop with little stress. He wonders if a season with more inclement weather would produce different results from the two varieties.

Mark Quee was not surprised by the results on his farm (Revolution produced higher yields of red peppers). Prior to the trial, he felt Revolution was the better variety for his farm, and was relieved his speculation was confirmed by the data.

All participating farmers were happy to have multiple farmer-researchers involved to create a more robust data-set, and hope to do projects with similar structure next season.



**Rick Hartmann with freshly harvested peppers.**



**Tim Landgraf harvesting peppers on October 11.**

### References

- Brown, R. 2014. No 2 2013 Pepper Variety Trial. Rhode Island Agricultural Experiment Station, University of Rhode Island, Kingston RI.
- Hutton, M., and D. Handley. 2014. Evaluation of Sweet Pepper Varieties 2013. University of Maine, Highmoor Farm.
- Iowa Environmental Mesonet. 2015. Climodat Reports. Iowa State University, Ames, IA. <http://mesonet.agron.iastate.edu/climodat/> (accessed Nov. 2, 2015).
- Ogawa, T. and M. Quee. 2013. Bell Pepper Variety Trial: California Wonder Versus Catronia. Practical Farmers of Iowa, Ames, IA. <http://practicalfarmers.org/farmer-knowledge/research-reports/2013/bell-pepper-variety-trial-california-wonder-versus-catronia/> (accessed Dec. 1, 2015).
- Sanchez, E., T. Butzler, S. Bogash, T. Elkner, E. Oesterling, M. Orzolek, and L. Stivers. 2011. Pennsylvania Statewide Bell Pepper Cultivar Evaluation. HortTechnology 21(3): 384–390.

### PFI Cooperators' Program

PFI's Cooperators' Program gives farmers practical answers to questions they have about on-farm challenges through research, record-keeping, and demonstration projects. The Cooperators' Program began in 1987 with farmers looking to save money through more judicious use of inputs. If you are interested in conducting an on-farm trial contact Stefan Gailans @ 515-232-5661 or [stefan@practicalfarmers.org](mailto:stefan@practicalfarmers.org).