

Organic Seed Partnership

Early CMV Resistant Red Bell Peppers 2006 Replicated Trial Report

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As part of the Organic Seed Partnership (OSP) we evaluated bell pepper varieties and advanced breeding lines in replicated trials at Cornell University, University of California at Davis, and Oregon State University. These varieties included the organic standards Cal Wonder, Early Red Sweet, Orion and King of the North, the new variety New Ace as well as 4-5 advanced CMV tolerant Cornell breeding lines at each site. All sites were either certified organic, or at the least managed organically. The objective of the trials was to compare newly developed peppers from the Cornell breeding programs with standards used in organic production.

2006 Early CMV Resistant Red Bell Pepper Replicated Trial Summary:

Overall, we got a good assessment of how several organic standards, a new variety, and several breeding lines did at three different sites in one year. Several generalizations can be made from the three sites:

- Early Red Sweet is an very early, prolific, but small red pepper with thin flesh.
- Orion and Cal Wonder are very large peppers with thick flesh, but produce poorly in New York and Oregon. From general observations at the Freeville site it appeared that these varieties may have suffered from inadequate fertility could have benefited from increased fertility compared to the other varieties.
- Several of the experimental lines show promise for earliness, flavor, and good yields. In particular, NY05-454A-17 and NY05-460A-27 did well in New York and NY05-477E-9 and NY05-454C-2 did well in Oregon, all performing better than or equivalent to a number of the standard varieties. Although there were problems with the trial at UCD the Cornell lines generally held rank with a number of the standards, in particular NY05-454A-17 with respect to both yield and fruit size. In situations where CMV is present these breeding lines would be expected to perform quite a bit better than the standards.
- Additional years of trialing are needed to fully access their potential in different areas of the country.

Cornell University- Freeville Organic Vegetable Research Farm

Materials and Methods:

Nine varieties were evaluated in this trial - 4 were organic standards, 1 was a new variety, and 4 were newly developed Cornell lines. Plants were started in the greenhouse on April 14th and transplanted to the field on June 6th, 2006. Each plot consisted of 12 plants planted in double rows on plastic covered 40" beds spaced 7' apart. Plant spacing within rows was 16". Prior to bed forming dairy compost was spread at a rate of 8.76 tons/acre. Analysis of the compost indicated it was equivalent to 217 pounds of nitrogen per acre. At transplanting, each plant was watered in with a dilute fish emulsion. All beds had drip irrigation, but because of a very wet season, it was never used. No sprays were used to manage insects or disease.

Pepper harvest began as soon as ripe fruit were noticed, August 21st, 11 weeks after transplant, and continued every week until threat of frost on October 3rd. Only red fruit were harvested each week. Number of fruit, total mass, and marketable mass were recorded for each plot. A representative fruit from each plot was measured each week for size (length x width) and wall thickness.

Results:

The summer of 2006 was characterized by above normal precipitation and below normal temperatures. Overall, we had a successful pepper season with good yields of red fruit (Table 1). Cornell line’s NY05-454A-17 and NY05-460A-27 had the highest marketable yields, which were not significantly different than the marketable yield of the hybrid New Ace. All four Cornell lines out yielded King of the North, a standard for early season organic production. Cornell line’s NY05-451A-17 had the greatest number of marketable fruit, and was not significantly different from the number of fruit produced by New Ace and Early Red Sweet.

Table 1. Red bell pepper yield, Cornell Organic Farm, Freeville NY

Variety*	Total Fruit (#/plant)	Marketable Fruit (#/plant)	Total Yield (kg/plant)	Marketable Yield (kg/plant)
NY05-454A-17	7.7 ab	7.2 a	0.96 a	0.90 a
New Ace	6.5 abc	5.8 ab	0.88 ab	0.81 ab
NY05-460A-27	5.1 cd	4.6 bc	0.74 abc	0.68 abc
Early Red Sweet	8.6 a	8.0 a	0.64 bc	0.61 bc
NY05-465E-9	4.1 d	3.7 bc	0.59 c	0.54 c
NY05-458E-36	6.1 bcd	4.4 bc	0.78 abc	0.50 c
King of the North	4.0 d	3.0 cd	0.66 bc	0.46 c
Orion	1.0 e	0.7 d	0.25 d	0.17 d
Cal Wonder	1.0 e	0.7 d	0.20 d	0.14 d
LSD**	2.3	2.3	0.27	0.26

*Varieties sorted by Marketable Yield

**LSD: Least significant difference between two means. Means with the same letter are not significantly different from each other at $p \leq 0.05$.

Cornell line NY05-460A-27 was equivalent to King of the North, New Ace, Cal Wonder and Orion with respect to fruit size (Table 2). Cornell line NY05-454A-17 was slightly smaller, but still was equivalent to New Ace, and had flesh that was comparable to or thicker than all of the standards Orion, King of the North, Cal Wonder and New Ace. Early Red Sweet and New Ace were the earliest, with first harvest beginning on August 21st, about 8 and 1/2 weeks after transplant (Figure 1). All the others did not start until September 11th, about 14 weeks after transplant. The overall best performers among the Cornell breeding lines was NY05-454A-17 and NY05-460A-27.

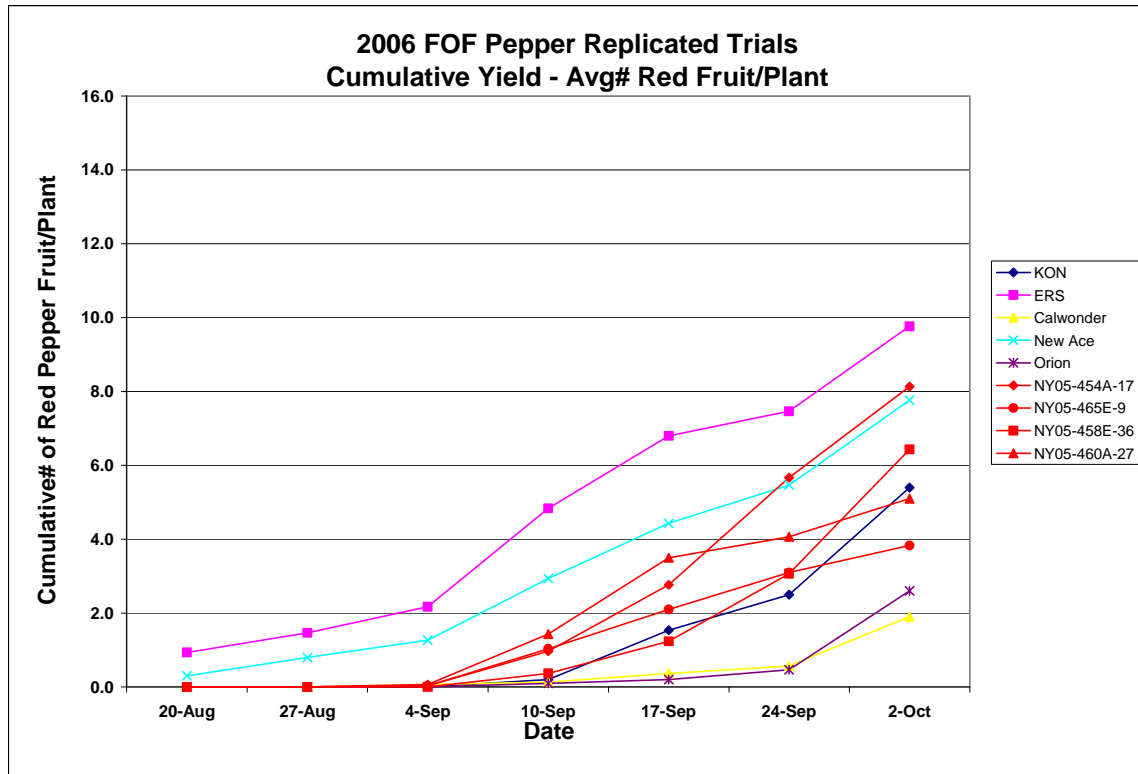
Table 2. Red bell pepper fruit characteristics, Cornell Organic Farm, Freeville NY

Variety*	Average Fruit Weight (g)	Average Length (cm)	Average Width (cm)	Fruit Size - Average Length x Average Width	Fruit Thickness (mm)
Orion	248.6 a	8.6 bc	9.2 a	78.5 a	6.3 a
King of the North	162.3 b	9.4 abc	8.1 bc	76.7 a	6.1 a
Cal Wonder	220.1 a	8.9 abc	8.6 b	76.1 a	6.3 ab
NY05-460A-27	149.2 bc	9.7 ab	7.7 cd	74.3 a	4.6 bc
New Ace	137.1 bc	10.1 a	7.2 de	72.8 ab	4.6 bc
NY05-465E-9	149.1 bc	8.5 bc	7.9 c	66.9 abc	5.3 ab
NY05-454A-17	124.8 bc	8.5 bc	7.1 ef	60.2 bc	5.1 ab
NY05-458E-36	118.1 c	8.4 c	7.2 de	60.1 c	5.8 ab
Early Red Sweet	75.1 d	7.0 d	6.6 f	46.4 d	3.2 c
LSD**	38.4	1.3	0.5	12.7	1.6

*Varieties sorted by Fruit Size

**LSD: Least significant difference between two means. Means with the same letter are not significantly different from each other at $p \leq 0.05$.

Figure 1. Red bell pepper earliness, Cornell Organic Farm, Freeville NY



University of California at Davis- UC Davis Student Farm

Materials and Methods:

Ten varieties were evaluated in this trial - 4 were organic standards, 1 was a new variety, and 5 were newly developed Cornell lines. Plants were started in the greenhouse on April 7th and transplanted to the field on May 23rd, 2006. Each plot consisted of plants in a single row 12” apart on 30” centers. Feather meal (12-0-0) was used as fertilizer. All rows had drip irrigation. Survival in the field was poor and this appeared to be due to the fact that fertilizer and irrigation was not set close enough to the row. As a result, there were a variable number of plants harvested from each variety (5 to 23).

Pepper harvest began as soon as ripe fruit were noticed on August 17th, about 12 weeks after transplant, and continued for every week until October 30th. Only red fruit were harvested each week. Number of fruit, total mass, and marketable mass were recorded for each plot. A representative fruit from each plot was measured each week for size (length x width) and wall thickness.

Results:

A high incidence of sun scald on all varieties severely reduced the number of marketable fruit. Inadequate moisture and fertility may have led to below normal leaf canopy, fruit size and weight. It appeared that the drip irrigation may have been too far from plants. Overall, Cornell lines NY05-454A-17 ranked the best with respect to yield and was comparable to or better than New Ace, Cal Wonder and King of the North. NY05-454A-17 and NY05-446G ranked best for fruit size and wall thickness and were comparable or better than New Ace and Cal Wonder. King of the North produced the largest fruit with the thickest walls. Both King of the North and NY05-477E-9 had the best overall appearance (Table 3 and 4). Orion was the besting tasting while NY05-446G had a very appealing and unusual fruity flavor. This trial was smaller in size so no statistical analysis was performed.

Table 3. Red bell pepper yield, UC Davis Student Farm, California

Variety*	Total fruit (#/plant)	Marketable Fruit (#/plant)	Total Yield (kg/plant)	Marketable Yield (kg/plant)
Early Red Sweet	16.8	9.2	2.05	1.07
NY05-454A-17	15.8	8.0	1.81	1.05
New Ace	15.9	7.6	1.79	1.02
Cal Wonder	11.4	4.3	1.89	0.98
NY05-477E-9	17.0	8.0	1.67	0.96
King of the North	11.6	5.1	1.79	0.87
Orion	13.1	3.5	2.00	0.69
NY05-446G	12.2	4.9	1.45	0.68
NY05-425N	12.3	5.7	1.33	0.68
NY05-454C-2	13.7	5.8	1.36	0.62

* Varieties sorted by Marketable Yield

Oregon State University- Lewis Brown Horticulture Farm

Materials and Methods:

Nine varieties were evaluated in this trail - 4 were organic standards, 1 was a new variety, and 4 were newly developed Cornell lines. Plants were started in the greenhouse on May 1st and transplanted to the field on June 14th, 2006. Each plot consisted of 12 plants planted 24" apart in 30" single rows. Biogrow 9-3-5 Fish manure (550 lb/A) was applied prior to planting. Overhead irrigation was used. No sprays were used to manage insects or disease.

Pepper harvest began as soon as ripe fruit were noticed on September 20th, about 14 weeks after transplant, and continued for every week until October 18th. Only red fruit were harvested each week. Number of fruit, total mass, and marketable mass were recorded for each plot. A representative fruit from each plot was measured each week for size (length x width) and wall thickness.

Results:

Cornell lines NY05-477E-9 and NY05-454C-2 had the highest yields overall. These yields were equivalent to Early Red Sweet and significantly improved over the yields of King of the North, New Ace, Orion and Cal Wonder. Standard checks Cal Wonder and Orion were extremely late with low productivity.

Table 5. Red bell pepper yield, Lewis Brown Horticulture Farm, Oregon State

Variety*	Total fruit (#/plant)	Marketable Fruit (#/plant)	Total Yield (kg/plant)	Marketable Yield (kg/plant)
NY05-477E-9	10.7 bc	9.1 bc	1.29 a	1.09 a
NY05-454C-2	12.2 ab	10.5 ab	1.26 a	1.08 a
Early Red Sweet	15.0 a	13.2 a	1.06 ab	0.93 ab
New Ace	7.5 cd	6.1 cd	0.76 bc	0.62 bc
NY05-454A-17	8.3 cd	6.5 cd	0.71 bc	0.56 bc
King of the North	5.5 de	4.1 de	0.75 bc	0.56 bc
NY05-425N	6.6 d	6.1 cd	0.60 bc	0.55 bc
Orion	2.2 e	1.7 e	0.52 c	0.41 c
Cal Wonder	2.4 e	1.6 e	0.42 c	0.28 c
LSD**	3.7	3.2	0.47	0.40

*Varieties sorted by Marketable Yield

**LSD: Least significant difference between two means. Means with the same letter are not significantly different from each other at $p \leq 0.05$.

With respect to fruit size and thickness of flesh, the Cornell lines tended to be smaller and thinner than the standards Orion, Cal Wonder and King of the North, but all 4 experimental lines were comparable in size and fruit thickness to the hybrid New Ace.

Table 6. Red bell pepper fruit size, Lewis Brown Horticulture Farm, Oregon State

Variety	Average Fruit Weight (g)	Average Length (cm)	Average Width (cm)	Fruit Size - Average Length x Average Width	Fruit Thickness (mm)
Orion	238.6 a	10.5 a	8.5 a	89.7 a	8.7 a
Cal Wonder	177.9 b	9.5 bc	7.9 a	74.8 b	7.5 ab
King of the North	145.5 c	10.4 a	7.1 b	74.1 b	6.7 bc
NY05-477E-9	120.2 d	8.7 cd	7.0 b	60.6 c	5.5 cde
NY05-454C-2	101.7 de	10.0 ab	6.0 c	60.3 c	6.3 bcd
New Ace	101.4 de	9.8 ab	5.9 c	57.8 c	4.8 de
NY05-425N	89.5 ef	9.4 bc	6.0 c	56.4 cd	6.1 bcd
NY05-454A-17	86.6 ef	9.3 bc	5.9 c	55.2 cd	5.2 cde
Early Red Sweet	71.0 f	8.0 d	5.8 c	46.0 d	4.1 e
LSD**	23.6	0.9	0.7	10.9	1.6

*Varieties sorted by Fruit Size

**LSD: Least significant difference between two means. Means with the same letter are not significantly different from each other at $p \leq 0.05$.

Despite the long warm season, peppers were late maturing (Figure 3). Wide fluctuations in temperature early in the season may have delayed growth and onset of flowering. Harvest for Early Red Sweet and New Ace started September 20th, 14 weeks after transplant. This was followed by the Cornell lines and King of the North on Oct 4th, 16 weeks after transplant. Cal Wonder and Orion did not produce fruit until October 11th, 17 weeks after transplant.

Figure 3. Red bell pepper earliness, Lewis Brown Horticulture Farm, Oregon State

