

**Evaluation of pepper breeding lines and cultivars for tolerance to the crown rot phase of *Phytophthora* blight and development of skin separation or 'silvering' in fruit, 2012.**

This experiment, arranged as a randomized complete block design with 4 replications, was conducted in a field with a history of *Phytophthora* blight (*P. capsici*) at the Rutgers Agricultural Research and Extension Center (RAREC), Bridgeton, New Jersey. All peppers were grown by a local transplant producer located in Vineland, NJ. On 1 Jun, bell pepper breeding lines or cultivars were hand transplanted into double rows (18 in. in row) on black plastic mulch on 5-ft-centers (18 plants per plot) with drip irrigation. All treatment plots were 15-ft-long with *Phytophthora*-susceptible bell pepper 'Tomcat' planted in 5-ft breaks between plots. Fertility schedule and management of insect and weeds were done according to local recommendation guidelines. Each week, the number of *Phytophthora*-infected plants (out of a total number of 18) were counted and recorded from each 15-ft plot. All mature pepper fruit from 15 ft of each treatment row were harvested on 15 and 30 Aug, 19 Sep, and 9 Oct. All fruit were graded, separated and weighed for statistical analysis. Area Under Disease Progress Curve (AUDPC) values based of the percentage of plants killed by week per plot by *P. capsici* during the trial were calculated (Table 5) and are presented graphically in Figure 1. Rainfall (in.) for the months of Jun, Jul, Aug, and Sep were 8.25, 1.43, 5.14, and 3.44 in., respectively.

The number and weight of marketable fruit and marketable fruit with 'silvering' varied significantly at each harvest depending on pepper cultivar or breeding line. The number and weight of *phytophthora*-infected fruit varied significantly at each harvest depending on pepper cultivar or breeding line. Marketable boxes per acre also varied significantly at each harvest depending on pepper cultivar or breeding line (Tables 1-4). Alliance, Archimedes, Declaration, Intruder, and Vanguard produced the highest total number of marketable boxes per acre (Table 5). Breeding lines PS-1609 and CSX2222 produced the fewest total number of marketable boxes per acre (Table 5). NN30974, NN30627 and Paladin (*phytophthora*-resistant control) had the percentage of total marketable fruit with 'silvering' (Table 5). Camelot, Revolution, and PS-1609 had the fewest total number of marketable fruit with 'silvering' (Table 5). PS-1609, CSX2222, and Camelot (*phytophthora*-susceptible control) had the highest AUDPC values, and accordingly, had the fewest total number of marketable boxes per acre (Table 5).

Table 1. Number and weight of total marketable fruit, number and weight of marketable fruit with 'silvering', percentage of marketable fruit with 'silvering', number and weight of phytophthora-infected fruit, and marketable boxes per acre at harvest 1 on 15 Aug at the Rutgers Agricultural Research and Extension Center in 2012.

Cultivar/Breeding Line	Company	Marketable fruit <sup>z</sup>		Marketable fruit with silvering <sup>y</sup>		% marketable fruit with silvering <sup>x</sup>	Phytophthora-infected fruit <sup>w</sup>		Marketable boxes/A <sup>v</sup>
		No	Wt	No	Wt		No	Wt	
Alliance	Harris Moran	39.25 <sup>u</sup>	13.10	2.50	1.01	29	5.00	0.00	814
Archimedes	Seminis	36.00	11.05	7.50	2.44	21	9.00	0.04	747
Aristotle	Seminis	20.25	6.54	5.50	1.89	16	8.50	0.00	420
Camelot	Seminis	20.75	6.24	0.00	0.00	0	12.50	0.04	431
Declaration	Harris Moran	41.00	13.78	5.25	2.03	8	4.75	0.05	851
PS0994-1819	Seminis	35.50	11.99	16.50	5.86	41	3.25	0.00	737
Revolution	Harris Moran	20.00	6.80	1.75	0.60	29	7.75	0.00	415
E20B.20854	Enza Zaden	25.50	7.56	4.00	1.38	15	1.00	0.00	529
nn030627	Syngenta	18.50	6.13	9.50	3.26	50	2.75	0.00	384
nn030974	Syngenta	25.75	8.99	15.25	5.58	52	1.75	0.00	534
nn031181	Syngenta	25.75	8.57	5.25	1.81	25	4.25	0.00	534
Intruder	Syngenta	28.75	9.32	12.25	4.23	42	0.00	0.00	597
FPP1814	Sakata	19.75	5.75	4.25	1.40	14	11.50	0.00	410
CSX32222	Sakata	5.50	1.60	1.25	0.40	16	6.75	0.00	114
CSX32801	Sakata	28.00	8.98	8.50	2.80	22	2.25	0.00	581
CSX32805	Sakata	16.25	4.60	4.75	1.48	17	11.00	0.00	337
PS 16351609	Seminis	6.50	1.85	0.50	0.21	6	9.75	0.04	135
Vanguard	Harris Moran	58.00	20.64	11.50	4.26	25	0.00	0.00	1204
Paladin	Rogers	26.50	7.85	12.50	3.91	54	3.50	0.00	550
	LSD	27.82	9.7318	10.665	3.81	28	10.46	0.06	577

<sup>z</sup> Number and weight (in lb/plot) of extra-large (>.05 lb), large (.33-.49 lb), and medium-sized (.25-.32 lb) marketable fruit with and without 'silvering' per 15 ft plot.

<sup>y</sup> Number and weight (lb/plot) of extra-large, large, and medium-sized marketable fruit with 'silvering' per 15 ft plot.

<sup>x</sup> Percentage of marketable fruit (extra-large, large, and medium) with 'silvering' per 15 ft plot.

<sup>w</sup> Number and weight (in lb/plot) of phytophthora-infected fruit per 15 ft plot.

<sup>v</sup> Number of boxes (28 lb) per acre of extra-large, large, and medium-sized marketable fruit with and without 'silvering'.

<sup>u</sup> Fisher's Least Significant Difference (LSD) test ( $P=0.05$ )

Table 2. Number and weight of total marketable fruit, number and weight of marketable fruit with 'silvering', percentage of marketable fruit with 'silvering', number and weight of phytophthora-infected fruit, and marketable boxes per acre at harvest 2 on 30 Aug at the Rutgers Agricultural Research and Extension Center in 2012.

Cultivar/Breeding Line	Company	Marketable fruit <sup>z</sup>		Marketable fruit with silvering <sup>y</sup>		% marketable fruit with silvering <sup>x</sup>	Phytophthora-infected fruit <sup>w</sup>		Marketable boxes/A <sup>v</sup>
		No	Wt	No	Wt	No	Wt		
Alliance	Harris Moran	31.75 <sup>u</sup>	10.52	3.50	1.12	17	1.25	0.00	659
Archimedes	Seminis	22.75	7.70	5.25	1.95	22	2.75	0.00	472
Aristotle	Seminis	22.75	7.10	4.25	1.37	17	4.75	0.27	472
Camelot	Seminis	21.75	6.58	0.00	0.00	0	7.00	0.00	451
Declaration	Harris Moran	41.25	13.85	1.25	0.51	2	0.75	0.00	856
PS0994-1819	Seminis	45.00	15.67	10.00	3.73	24	1.00	0.00	934
Revolution	Harris Moran	36.00	11.82	0.75	0.33	5	4.75	0.00	747
E20B.20854	Enza Zaden	20.75	6.43	4.00	1.40	15	1.25	0.00	431
nn030627	Syngenta	31.00	10.96	14.75	5.32	46	4.00	0.36	643
nn030974	Syngenta	26.75	9.33	9.75	3.48	36	0.75	0.07	555
nn031181	Syngenta	23.75	8.28	9.00	3.45	38	1.00	0.00	493
Intruder	Syngenta	29.75	10.34	8.75	3.27	27	0.25	0.00	617
FPP1814	Sakata	20.50	6.54	5.25	1.75	8	9.75	0.00	425
CSX32222	Sakata	8.75	2.56	0.25	0.07	2	5.75	0.00	182
CSX32801	Sakata	28.00	9.10	3.00	0.96	8	2.50	0.11	581
CSX32805	Sakata	17.00	5.26	2.25	0.70	7	1.25	0.00	353
PS 16351609	Seminis	7.25	2.24	1.25	0.41	17	4.25	0.07	150
Vanguard	Harris Moran	41.75	15.78	4.25	1.68	11	1.00	0.15	866
Paladin	Rogers	29.00	8.70	5.00	1.67	26	2.50	0.00	602
	LSD	29.78	10.15	8.75	3.18	23	7.02	0.31	618

<sup>z</sup> Number and weight (in lb/plot) of extra-large (>.05 lb), large (.33-.49 lb), and medium-sized (.25-.32 lb) marketable fruit with and without 'silvering' per 15 ft plot.

<sup>y</sup> Number and weight (lb/plot) of extra-large, large, and medium-sized marketable fruit with 'silvering' per 15 ft plot.

<sup>x</sup> Percentage of marketable fruit (extra-large, large, and medium) with 'silvering' per 15 ft plot.

<sup>w</sup> Number and weight (in lb/plot) of phytophthora-infected fruit per 15 ft plot.

<sup>v</sup> Number of boxes (28 lb) per acre of extra-large, large, and medium-sized marketable fruit with and without 'silvering'.

<sup>u</sup> Fisher's Least Significant Difference (LSD) test ( $P=0.05$ ).

Table 3. Number and weight of total marketable fruit, number and weight of marketable fruit with 'silvering', percentage of marketable fruit with 'silvering', number and weight of phytophthora-infected fruit, and marketable boxes per acre at harvest 3 on 19 Sep at the Rutgers Agricultural Research and Extension Center in 2012.

Cultivar/Breeding Line	Company	Marketable fruit <sup>z</sup>		Marketable fruit with silvering <sup>y</sup>		% marketable fruit with silvering <sup>x</sup>	Phytophthora-infected fruit <sup>w</sup>		Marketable boxes/A <sup>v</sup>
		No	Wt	No	Wt	No	Wt		
Alliance	Harris Moran	25.75 <sup>u</sup>	9.26	1.25	0.51	3	3.75	0.58	534
Archimedes	Seminis	20.25	7.40	6.25	2.50	25	3.00	0.41	420
Aristotle	Seminis	14.75	5.14	3.75	1.42	17	0.50	0.04	306
Camelot	Seminis	9.50	3.09	0.25	0.10	3	11.00	1.58	197
Declaration	Harris Moran	16.75	6.08	2.50	1.11	14	0.25	0.02	348
PS0994-1819	Seminis	17.75	6.31	2.50	0.98	14	5.00	0.65	368
Revolution	Harris Moran	16.00	5.92	0.50	0.21	4	4.75	0.60	332
E20B.20854	Enza Zaden	20.25	6.77	3.00	1.09	11	4.75	0.61	420
nn030627	Syngenta	18.50	7.51	5.75	2.43	23	4.75	0.15	384
nn030974	Syngenta	14.00	5.13	5.00	1.82	34	7.25	1.21	291
nn031181	Syngenta	18.25	7.63	6.00	2.77	27	3.50	0.38	379
Intruder	Syngenta	28.50	10.92	10.50	4.20	37	0.25	0.09	591
FPP1814	Sakata	14.25	4.98	3.50	1.24	31	12.75	0.90	296
CSX32222	Sakata	1.75	0.54	0.50	0.14	17	9.25	1.20	36
CSX32801	Sakata	28.25	9.66	4.75	1.70	11	0.75	0.16	586
CSX32805	Sakata	11.25	3.64	0.50	0.17	7	4.75	0.73	233
PS 16351609	Seminis	1.75	0.54	0.00	0.00	0	5.25	0.48	36
Vanguard	Harris Moran	24.75	9.91	7.00	2.98	29	3.50	0.47	514
Paladin	Rogers	16.25	5.94	10.00	3.70	54	12.25	1.99	337
	LSD	17.33	6.34	5.59	2.32	26	8.82	1.03	360

<sup>z</sup> Number and weight (in lb/plot) of extra-large (>.05 lb), large (.33-.49 lb), and medium-sized (.25-.32 lb) marketable fruit with and without 'silvering' per 15 ft plot.

<sup>y</sup> Number and weight (lb/plot) of extra-large, large, and medium-sized marketable fruit with 'silvering' per 15 ft plot.

<sup>x</sup> Percentage of marketable fruit (extra-large, large, and medium) with 'silvering' per 15 ft plot.

<sup>w</sup> Number and weight (in lb/plot) of phytophthora-infected fruit per 15 ft plot.

<sup>v</sup> Number of boxes (28 lb) per acre of extra-large, large, and medium-sized marketable fruit with and without 'silvering'.

<sup>u</sup> Fisher's Least Significant Difference (LSD) test ( $P=0.05$ )

Table 4. Number and weight of total marketable fruit, number and weight of marketable fruit with 'silvering', percentage of marketable fruit with 'silvering', number and weight of phytophthora-infected fruit, and marketable boxes per acre at harvest 4 on 9 Oct at the Rutgers Agricultural Research and Extension Center in 2012.

Cultivar/Breeding Line	Company	Marketable fruit <sup>z</sup>		Marketable fruit with silvering <sup>y</sup>		% marketable fruit with silvering <sup>x</sup>	Phytophthora-infected fruit <sup>w</sup>		Marketable boxes/A <sup>v</sup>
		No	Wt	No	Wt		No	Wt	
Alliance	Harris Moran	12.00 <sup>u</sup>	3.93	0.75	0.32	5	3.50	0.69	249
Archimedes	Seminis	21.25	7.90	9.75	3.97	31	2.50	0.54	441
Aristotle	Seminis	3.50	1.25	0.50	0.19	4	3.25	0.61	73
Camelot	Seminis	1.75	0.60	0.00	0.00	0	10.25	0.91	36
Declaration	Harris Moran	19.00	6.95	3.50	1.37	38	4.25	0.96	394
PS0994-1819	Seminis	4.50	1.63	1.75	0.59	54	8.25	1.16	93
Revolution	Harris Moran	7.50	2.88	2.25	0.97	8	4.00	0.82	156
E20B.20854	Enza Zaden	9.00	3.16	1.25	0.48	31	9.00	1.78	187
nn030627	Syngenta	20.00	8.21	11.00	4.54	42	6.50	2.04	415
nn030974	Syngenta	11.25	4.24	6.00	2.33	59	2.75	0.63	233
nn031181	Syngenta	11.50	4.63	4.00	1.74	26	4.00	0.58	239
Intruder	Syngenta	33.50	11.93	6.25	2.50	19	2.75	0.80	695
FPP1814	Sakata	5.75	2.07	2.75	1.03	21	7.00	1.17	119
CSX32222	Sakata	2.25	0.69	0.75	0.22	17	4.25	0.58	47
CSX32801	Sakata	8.25	2.76	2.00	0.71	24	7.75	1.65	171
CSX32805	Sakata	14.25	4.87	3.75	1.46	25	3.00	0.37	296
PS 16351609	Seminis	0.75	0.24	0.00	0.00	0	0.50	0.03	16
Vanguard	Harris Moran	18.75	6.90	8.00	3.25	37	10.50	1.25	389
Paladin	Rogers	8.50	2.88	4.50	1.62	28	18.00	2.47	176
	LSD	16.37	6.08	6.65	2.78	36	11.58	2.22	340



<sup>z</sup> Number and weight (in lb/plot) of extra-large (>.05 lb), large (.33-.49 lb), and medium-sized (.25-.32 lb) marketable fruit with and without 'silvering' per 15 ft plot.

<sup>y</sup> Number and weight (lb/plot) of extra-large, large, and medium-sized marketable fruit with 'silvering' per 15 ft plot.

<sup>x</sup> Percentage of marketable fruit (extra-large, large, and medium) with 'silvering' per 15 ft plot.

<sup>w</sup> Number and weight (in lb/plot) of phytophthora-infected fruit per 15 ft plot.

<sup>v</sup> Number of boxes (28 lb) per acre of extra-large, large, and medium-sized marketable fruit with and without 'silvering'.

<sup>u</sup> Fisher's Least Significant Difference (LSD) test ( $P=0.05$ ).

Table 5. Total number and weight of total marketable fruit, number and weight of marketable fruit with 'silvering', percentage of marketable fruit with 'silvering', number and weight of phytophthora-infected fruit, and marketable boxes per acre across all harvests dates at the Rutgers Agricultural Research and Extension Center in 2012.

Cultivar/Breeding Line	Company	Marketable fruit <sup>z</sup>		Marketable fruit with silvering <sup>y</sup>		% marketable fruit with silvering <sup>x</sup>	Phytophthora-infected fruit <sup>w</sup>		Marketable boxes/A <sup>v</sup>	AUDPC Value <sup>u</sup>
		No	Wt	No	Wt	No	Wt			
Alliance	Harris Moran	108.75 <sup>t</sup>	36.80	8.00	2.95	11	13.50	1.27	2256	1753
Archimedes	Seminis	100.25	34.05	28.75	10.85	27	17.25	0.99	2080	2077
Aristotle	Seminis	61.25	20.03	14.00	4.87	22	17.00	0.91	1271	2646
Camelot	Seminis	53.75	16.50	0.25	0.01	0.4	40.75	2.53	1115	3314
Declaration	Harris Moran	118.00	40.66	12.50	5.02	13	10.00	1.03	2448	1852
PS0994-1819	Seminis	102.75	35.59	30.75	11.16	28	17.50	1.80	2132	2012
Revolution	Harris Moran	79.50	27.42	5.25	2.10	7	21.25	1.42	1650	2714
E20B.20854	Enza Zaden	75.50	23.92	12.25	4.35	14	16.00	2.40	1566	955
nn030627	Syngenta	88.00	32.80	41.00	15.54	43	18.00	2.54	1826	1449
nn030974	Syngenta	77.75	27.68	36.00	13.31	45	12.50	1.91	1613	1396
nn031181	Syngenta	79.25	29.11	24.25	9.76	31	12.75	0.96	1644	2149
Intruder	Syngenta	120.50	42.50	37.75	14.19	31	3.25	0.89	2500	0
FPP1814	Sakata	60.25	19.33	15.75	5.41	14	41.00	2.07	1250	3563
CSX32222	Sakata	18.25	5.39	2.75	0.83	12	26.00	1.78	379	4800
CSX32801	Sakata	92.50	30.50	18.25	6.17	15	13.25	1.92	1919	1652
CSX32805	Sakata	68.75	18.38	11.25	3.80	12	20.00	1.09	1219	3053
PS 16351609	Seminis	16.25	4.86	1.75	0.61	8	19.75	0.61	337	5395
Vanguard	Harris Moran	143.25	53.23	30.75	12.17	23	15.00	1.87	2972	1095
Paladin	Rogers	80.25	25.37	32.00	10.89	41	36.25	4.46	1665	1463
		73.01	25.87	23.56	8.89	14	20.63	2.33	1516	2063

<sup>z</sup> Number and weight (in lb/plot) of extra-large (>.05 lb), large (.33-.49 lb), and medium-sized (.25-.32 lb) marketable fruit with and without 'silvering' per 15 ft plot.

<sup>y</sup> Number and weight (lb/plot) of extra-large, large, and medium-sized marketable fruit with 'silvering' per 15 ft plot.

<sup>x</sup> Percentage of marketable fruit (extra-large, large, and medium) with 'silvering' per 15 ft plot.

<sup>w</sup> Number and weight (in lb/plot) of phytophthora-infected fruit per 15 ft plot.

<sup>v</sup> Number of boxes (28 lb) per acre of extra-large, large, and medium-sized marketable fruit with and without 'silvering'.

<sup>u</sup> Arsine-transformed Area Under Disease Progress Curve (AUPDC) value based on number of plants killed by week by *P. capsici*.

<sup>t</sup> Fisher's Least Significant Difference (LSD) test ( $P=0.05$ )

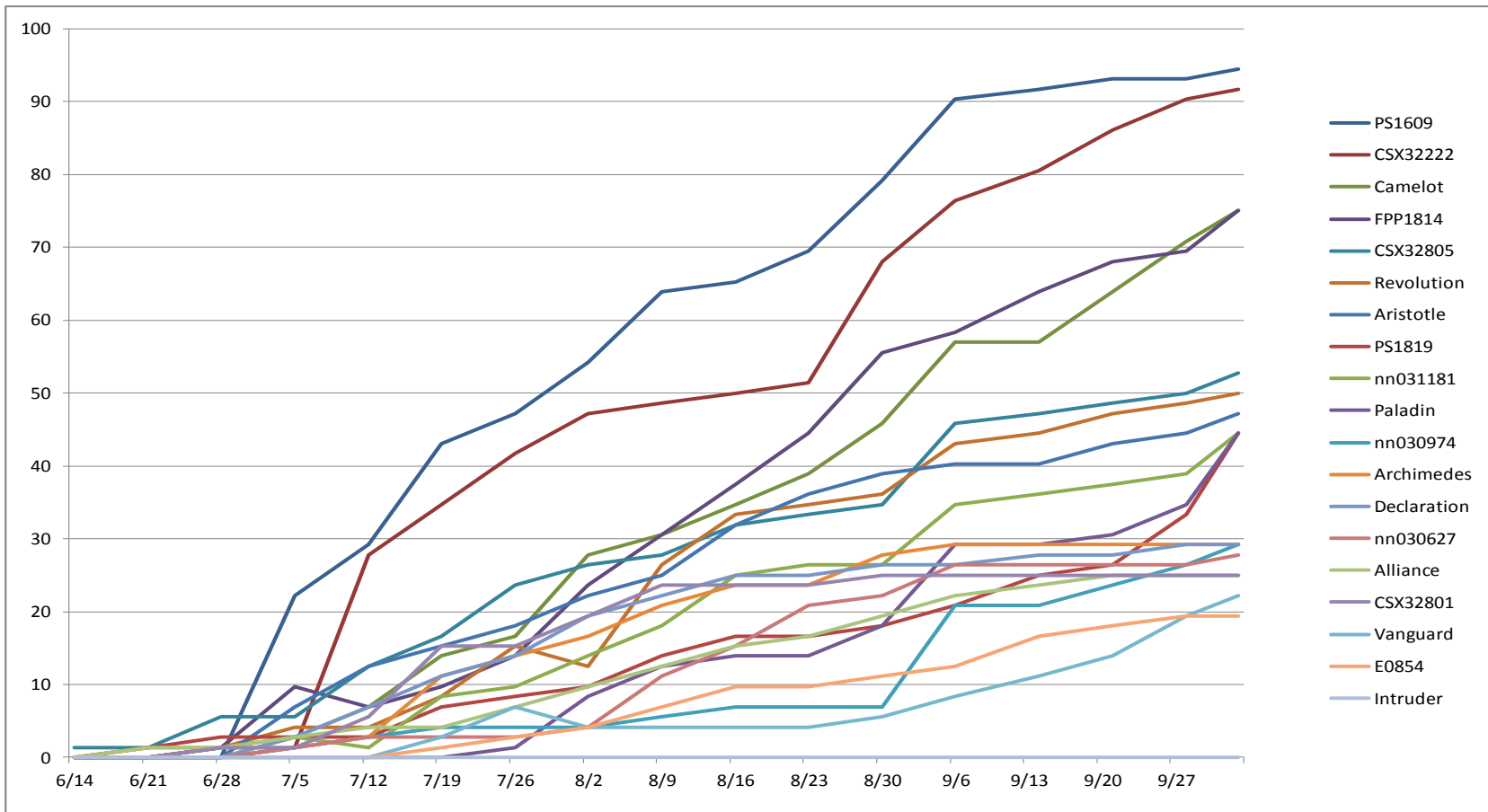


Figure 1. Disease progress curves for cultivars and breeding lines evaluated for resistance to the crown rot phase of *Phytophthora* blight at the Rutgers Agricultural Research and Extension Center in Bridgeton, NJ in 2012.