

PEPPER, BELL (*Capsicum annuum*)
Phytophthora blight, *Phytophthora capsici*

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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, 2011.

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 21 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 plot. All mature pepper fruit from 15 ft of each treatment row were harvested on 31 Aug and 18 Sep. All fruit were graded, separated and weighed for statistical analysis. Rainfall for the months of Jun, Jul, Aug, and Sep were 3.53, 5.83, 22.62, and 5.00 in., respectively.

The number and weight of marketable fruit and fruit with 'silvering' varied significantly depending on pepper cultivar or breeding line (Tables 1 and 2). In general, yields were lower than normal due to poor weather conditions and to an outbreak of anthracnose fruit rot during the production season. Area Under Disease Progress Curve values varied significantly depending on bell pepper cultivar or breeding line (Table 2; Figure 1). The percentage of plants killed by *Phytophthora* blight were highest in the susceptible cultivars Alliance and Camelot (Table 3; Figure 2). The AUDPC values and percentage of plants killed by *Phytophthora* blight were unusually high in the standard *phytophthora* tolerant cultivars, Paladin and Aristotle traditionally used in this study (Table 2; Figure 1). *Phytophthora*-tolerant cultivars such as 1819, Revolution, and Declaration performed normally. One breeding line, RPP31024, performed extremely well against *Phytophthora* blight, but yield was low compared other breeding lines and cultivars in this trial (Table 2).

Table 1. Number and weight of marketable fruit, fruit with silvering, and total marketable fruit at harvest 1 at the Rutgers Agricultural Research and Extension Center in 2011.

Cultivar/Line	Good fruit ^z			Fruit with silvering ^y			Marketable fruit ^z		
	No.	Wt.	box/acre	No.	Wt.	box/acre	No.	Wt.	box/acre
Alliance	6.25 bcd ^w	2.60 bcd	54.06 bcd	12.50 b-f	4.94 b-g	102.51 b-g	18.75 b-e	7.54 b-e	156.56 b-e
Archimedes	2.75 d	0.86 d	17.90 d	13.00 b-f	5.13 b-g	106.55 b-g	15.75 b-e	5.99 cde	124.45 cde
Aristotle	5.00 a	1.87 d	38.91 d	20.25 a-d	7.74 a-d	160.76 a-d	25.25 a-d	9.62 bc	199.67 bc
Camelot	6.00 a	1.95 d	40.62 d	1.00 f	0.39 g	8.09 g	7.00 e	2.34 de	48.71 de
Declaration	15.50 a	6.27 a	130.21 a	16.75 a-e	7.13 a-e	148.00 a-e	32.25 ab	13.4 ab	278.21 ab
1819	1.75 d	0.71 d	14.84d	11.75 c-f	4.85 b-g	100.69 b-g	13.50 cde	5.56 cde	115.56 cde
Revolution	13.00 ab	5.62 abc	116.72 abc	8.75 def	3.88 b-g	80.62 b-g	21.75 a-e	9.51 bc	197.34 bc
RPP20809	4.25 cd	1.58 d	32.89 d	7.75 def	3.36 c-g	69.88 d-g	12 cde	4.95 cde	102.77 cde
RPP30525	2.75 d	0.94 d	19.51 d	22.50 abc	8.13 abc	168.80 abc	25.25 a-d	9.07 bcd	188.31 bcd
RPP30570	1.75 d	0.56 d	11.67 d	2.25 f	0.83 g	17.38 g	4.00 e	1.40 e	29.05 e
RPP30579	8.50 a-d	3.12 a-d	64.74 a-d	10.00 c-f	3.60 c-g	74.81 c-g	18.50 b-e	6.72 b-e	139.55 b-e
RPP30598	0.75 d	0.26 d	5.50 d	6.00 ef	1.97 fg	41.04 fg	6.75 e	2.24 de	49.54 de
RPP30627	1.00 d	0.32 d	6.75 d	16.00 a-e	6.21 a-f	129.01 a-f	17.00 b-e	6.54 b-e	135.76 bc-e
RPP30974	3.00 d	1.22 d	25.42 d	11.00 c-f	4.43 b-g	91.92 b-g	14.00 cde	5.56 cde	117.34 cde
RPP31024	1.00 d	0.38 d	7.89 d	8.75 def	2.95 d-g	61.32 d-g	9.75 de	3.33 cde	69.20 cde
RPP31078	3.00 d	1.26 d	26.25 d	15.25 a-e	6.73 a-f	139.75 a-f	18.25 b-e	8.00 b-e	166.00 b-e
RPP31096	3.00 d	1.07 d	22.20 d	26.25 a	8.48 ab	175.96 ab	29.25 abc	9.55 bc	198.16 bc
RPP31153	4.00 cd	1.53 d	31.85 d	9.25 def	3.45 c-g	71.59 c-g	13.25 cde	4.98 cde	103.44 cde
RPP31179	2.00 d	0.79 d	16.45 d	13.00 b-f	5.14 b-g	106.81 b-g	15.00 b-e	5.94 cde	123.26 cde
RPP31181	12.00 abc	5.78 ab	120.04 ab	25.00 ab	11.00 a	228.41 a	37.00 a	16.79 a	348.45 a
Vanguard	2.25 d	0.80 d	16.76 d	7.50 def	2.89 efg	60.02 efg	9.75 de	3.70 cde	76.78 cde
Paladin	6.50 cbd	2.32 cd	48.30 cd	19.50 a-d	6.68 a-f	138.61 a-f	26.00 a-d	9.00 bcd	186.90 bcd

^z Number and weight (in lb/plot) of marketable fruit without 'silvering'.

^y Number and weight (lb/plot) of fruit with 'silvering'.

^x Total number and weight (lb/plot) of marketable fruit with and without 'silvering'.

^w Means followed by the same letters are not significantly different according to Fisher's Least Significant Difference (LSD) test ($P=0.05$)

Table 2. Number and weight of marketable fruit, fruit with silvering, phytophthora-infected fruit, total marketable fruit at harvest 2 and AUDPC value based on the total percentage of plants killed by phytophthora blight at the Rutgers Agricultural Research and Extension Center in 2011.

CV/Lines	Good fruit			Fruit with silvering			Phytophthora-infected fruit		Marketable fruit			AUDPC
	No.	Wt.	box/acre	No.	Wt.	box/acre	No.	Wt.	No.	Wt.	box/acre	value
Alliance	12.75 a	3.42 ab	71.07 ab	1.00 d	0.33 g	6.90 g	6.00 bcd	1.22 bcd	13.75 bcd	3.75 abc	77.97 abc	2560 ab
Archimedes	19.25 ab	4.98 ab	103.39 ab	10.00 abc	3.86 a-e	80.10 a-e	2.50 d	0.69 bcd	13.5 bcd	8.84 a	183.94 a	1320 cde
Aristotle	10.00 abc	3.08 ab	64.02 ab	3.00 cd	1.19 d-g	24.7 d-g	16.50 abc	2.57 ab	13.00bcd	4.27 abc	88.71 abc	2562 b
Camelot	12.25 abc	3.10 ab	64.38 ab	0.75 d	0.17 g	3.63 g	27.50 a	4.20 a	13.00 bcd	3.27 bc	68.01 bc	3185 a
Declaration	21.00 a	6.12 a	127.04 a	1.50 d	0.56 g	11.67 g	7.50 bcd	1.71 bcd	22.5 a-d	6.68 abc	138.72 abc	1246 cde
1819	17.00 abc	4.64 ab	96.33 ab	5.75 bcd	2.00 c-g	41.55 c-g	10.25 bcd	1.84 bcd	22.75 a-d	6.64 abc	138.89 abc	1582 b-e
Revolution	15.75 abc	5.18 ab	107.39 ab	1.50 d	0.55 g	11.52 g	6.50 bcd	1.65 bcd	17.25 a-d	5.73 abc	118.90 abc	1186 cde
RPP20809	12.00 abc	3.80 ab	78.90 ab	2.50 cd	0.91 efg	18.99 efg	16.50 abc	0.96 bcd	14.5 bcd	4.71 abc	97.89 abc	1406 cde
RPP30525	13.25 abc	3.57 ab	74.08 ab	16.00 a	5.34 a	110.86 a	6.75 bcd	1.30 bcd	29.25 ab	8.91 a	184.94 a	1813 bcd
RPP30570	6.75 c	1.86 b	38.65 b	0.75 d	0.25 g	5.09 g	0.75 d	0.15 d	7.50 d	2.10 c	43.73 c	2239 abc
RPP30579	17.25 abc	4.43 ab	91.93 ab	3.75 cd	1.12 d-g	23.29 d-g	7.00 bcd	1.34 bcd	21.00 a-d	5.55 abc	115.22 abc	1175 cde
RPP30598	9.25 bc	1.98 b	42.09 b	17.25 a	5.15 ab	106.92 ab	3.25 cd	0.59 cd	26.50 abc	7.13 abc	148.01 abc	1320 cde
RPP30627	10.00 abc	2.77 ab	57.48 ab	7.00 cde	2.52 a-g	52.29 a-f	7.25 bcd	1.14 bcd	17.00 a-d	5.29 abc	109.77 abc	1496 b-e
RPP30974	13.75 abc	3.98 ab	82.59 ab	11.50 ab	4.87 abc	101.05 abc	5.50 bcd	1.01 bcd	25.25 abc	4.65 abc	183.64 ab	1008 de
RPP31024	14.25 abc	3.48 ab	72.26 ab	5.00 bcd	1.52 d-g	31.64 d-g	1.50 d	0.23 d	19.25 a-d	5.00 abc	103.91 abc	648 e
RPP31078	13.00 abc	3.19 ab	66.25 ab	10.00 abc	4.01 a-d	83.11 a-d	5.25 bcd	0.98 bcd	23.00 a-d	7.19 abc	149.35 abc	1572 b-e
RPP31096	5.75 c	2.05 b	42.59 b	7.00 bcd	2.6 a-g	53.95 a-g	6.00 bcd	1.66 bcd	12.75 bcd	4.65 abc	96.54 abc	1431 cde
RPP31153	12.25 abc	3.21 ab	66.77 ab	6.00 bcd	2.23 b-g	46.28 b-g	7.25 bcd	1.19 bcd	18.25 a-d	5.44 abc	113.04 abc	1771 bcd
RPP31179	11.50 abc	3.69 ab	76.57 ab	10.00 abc	3.91 a-d	81.08 a-e	9.25 bcd	1.31 bcd	21.50 a-d	7.59 abc	157.65 abc	1308 cde
RPP31181	11.75 abc	3.59 ab	74.39 ab	1.75 d	0.76 fg	15.67 fg	8.00 bcd	1.15 bcd	13.50 bcd	4.34 abc	90.06 abc	1658 b-e
Vanguard	9.25 bc	2.68 ab	55.56 ab	3.25 cd	1.12 d-g	23.24 d-g	5.00 bcd	1.18 bcd	12.50 cd	3.79 abc	78.80 abc	1584 b-e
Paladin	20.00 ab	5.33 ab	110.6 ab	12.00 ab	3.72 a-f	77.19 a-f	17.75 ab	2.29 abc	32.00 a	9.05 a	187.79 a	1815 bcd

^z Number and weight (lb/plot) of marketable fruit without 'silvering'.

^y Number and weight (lb/plot) of fruit with 'silvering'.

^x Total number and weight (lb/plot) of marketable fruit with and without 'silvering'.

^w Means followed by the same letters are not significantly different according to Fisher's Least Significant Difference (LSD) test ($P=0.05$).

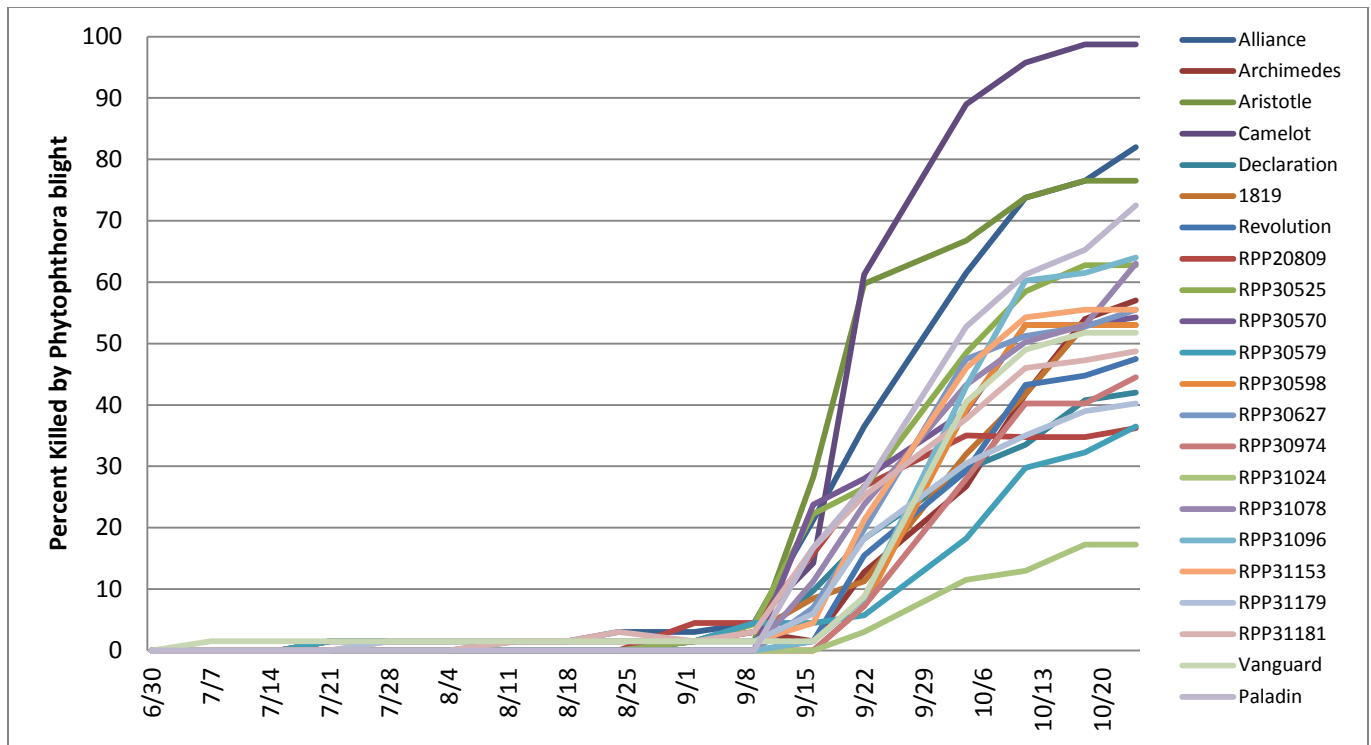


Figure 1. Disease progress curves for cultivars and breeding lines evaluated for resistance to the crown rot phase of Phytophthora blight at the Rutgers Agricultural Research and Extension Center in Bridgeton, NJ in 2011.

Table 3. Percentage of bell pepper cultivar or breeding killed by week by Phytophthora blight in 2011 at the Rutgers Agricultural Research and Extension Center in 2011.

	6/30	7/7	7/15	7/21	7/28	8/4	8/12	8/18	8/24	9/2	9/9	9/16	9/22	10/4	10/11	10/18	10/24
Alliance	0.00	0.00	0.00	1.50	1.50	1.50	1.50	1.50	3.00	3.00	4.50	21.25	36.50	61.50	73.75	76.50	82.00
Archimedes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	3.00	1.50	12.75	26.75	41.75	54.00	57.00
Aristotle	0.00	0.00	0.00	0.00	0.00	0.00	1.50	1.50	1.50	1.50	1.50	28.25	59.75	66.75	73.75	76.50	76.50
Camelot	0.00	0.00	0.00	1.50	1.50	1.50	1.50	1.50	1.50	1.50	4.50	14.25	61.25	89.00	95.75	98.75	98.75
Declaration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	1.50	9.75	18.25	29.50	33.50	40.75	42.00
1819	0.00	0.00	0.00	1.50	1.50	1.50	1.50	1.50	1.50	1.50	3.00	8.50	11.25	32.00	41.75	53.00	53.00
Revolution	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	15.50	29.25	43.25	44.75	47.50
RPP20809	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.50	4.50	15.75	26.75	35.00	34.75	34.75	36.25
RPP30525	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	4.25	22.25	26.50	48.50	58.50	62.75	62.75
RPP30570	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.75	28.00	39.00	53.00	53.00	54.25
RPP30579	0.00	0.00	0.00	1.50	1.50	1.50	1.50	1.50	1.50	1.50	4.50	4.50	5.75	18.25	29.75	32.25	36.50
RPP30598	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.25	39.25	53.00	53.00	53.00
RPP30627	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	19.75	47.50	51.25	52.75	55.50
RPP30974	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.25	28.00	40.25	40.25	44.50
RPP31024	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	11.50	13.00	17.25	17.25
RPP31078	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.25	23.75	43.25	50.25	53.00	63.00
RPP31096	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	8.50	43.00	60.25	61.50	64.00
RPP31153	0.00	0.00	0.00	0.00	1.50	1.50	1.50	1.50	1.50	1.50	1.50	4.50	21.25	46.00	54.25	55.50	55.50
RPP31179	0.00	0.00	0.00	0.00	1.50	1.50	1.50	1.50	1.50	1.50	1.50	6.00	18.25	30.50	35.00	39.00	40.25
RPP31181	0.00	0.00	0.00	0.00	0.00	0.00	1.50	1.50	3.00	1.50	3.00	16.75	25.25	37.75	46.00	47.25	48.75
Vanguard	0.00	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	8.75	40.50	49.00	51.75	51.75
Paladin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.75	26.50	52.75	61.25	65.25	72.50