

### **Evaluation of pepper breeding lines and cultivars for Phytophthora-tolerance and skin separation, 2008.**

These experiments, arranged as a randomized complete block design with 4 replications, were conducted in a field naturally- and artificially-infested with *Phytophthora capsici* at the Rutgers Agricultural Research and Extension Center (RAREC), Bridgeton, New Jersey and in a field naturally- infested with *Phytophthora capsici* at the Martino farm in Vineland, New Jersey. Bell pepper seeds were obtained from cooperating agencies, treated on 3 April with a solution of 4 parts water to 1 part Clorox and seeded on 4 April into 72-cell trays and grown in a greenhouse at RAREC. On 30 May at the on-farm site, twenty one bell pepper breeding lines or cultivars were transplanted by hand with into single rows (18" apart in row) on one-foot high, bare-soil beds (9 plants per plot) on 3 ft centers. On 29 May at RAREC, the same bell pepper breeding lines or cultivars were hand transplanted into double rows (18" in row) on black plastic mulch on 5 ft centers (18 plants per plot) with drip irrigation. Treatment plots were 15 ft long at RAREC and 13.5 ft long at the on-farm site, with guard rows of Phytophthora-susceptible bell pepper 'Camelot' planted on the outside of plots at RAREC. 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. On 27 Aug at RAREC, ten randomly selected fruit from all breeding lines or cultivars were rated for shoulder recess, fruit color, fruit shape, fruit smoothness, fruit gloss, number of lobes, and fruit length and width. All mature pepper fruit from 15 ft of each treatment row were harvested on 5 and 25 Aug. and 19 Sep. at RAREC and on 8 and 27 Aug., 24 Sep. and 10 Oct. at the Martino farm. All fruit were graded, separated and weighed for statistical analysis. Rainfall (in.) for the months of Jun, Jul, Aug and Sep were 3.17, 2.42, 0.97, and 3.95 at RAREC and 2.85, 3.46, 6.10 and 4.03 in. at the on-farm site.

At harvest 1 at RAREC, number and weight of marketable fruit and boxes per acre varied significantly (Table 1). Highest yielding cultivars included Alliance at 581 boxes/A, Aristotle at 483 boxes/A, and Declaration at 444 boxes/A (Table 1). Highest yielding breeding lines included 2074 at 423 boxes/A, 1126B at 411 boxes/A and 2075 at 403 boxes/A. Percent silvering varied significantly and ranged from 1 to 36% depending on cultivar and breeding line (Table 1). Percentage of fruit with silvering was highest in 20719 at 36%, followed by Paladin at 34% and 20809 at 30%. Percent silvering was lowest in 2075 and Alliance at ~2% and Declaration and Camelot at ~3% (Table 1).

At harvest 2 at RAREC, number and weight of marketable fruit and boxes per acre varied significantly (Table 2). Highest yielding cultivars included Paladin at 286 boxes/A and Revolution at 284 boxes/A (Table 2). Highest yielding breeding lines included 1126B at 240 boxes/A and 2075 at 220 boxes/A. Percent silvering varied significantly and ranged from 0 to 18% depending on cultivar and breeding line (Table 2). Percentage of fruit with silvering was highest in 1819 at 18% followed by 20809 and 1126B at 16%. Percent silvering was lowest in Alliance at 0%, 2075 and Camelot at 1% (Table 2).

At harvest 3 at RAREC, number and weight of marketable fruit and boxes per acre varied significantly (Table 3). Highest yielding cultivars included Aristotle at 385 boxes/A and Declaration at 357 boxes/A (Table 3). Highest yielding breeding lines included 20809 at 394 boxes/A and 1126B at 359 boxes/A. Percent silvering varied significantly and ranged from 0 to 20% depending on cultivar and breeding line (Table 3). Percentage of fruit with silvering was highest in 20719 at 20% followed by Aristotle at 17% and 20719 at 15%. Percent silvering was lowest in Alliance and Camelot at 0%, and 2075 and Revolution at ~2% (Table 3).

Average marketable yield (total boxes/A) across all harvest dates varied significantly depending on breeding line and cultivar. At RAREC, average yield was highest in Aristotle at 1107 boxes/A, followed by Alliance at 1105, Revolution at 1077, Declaration at 1020 boxes/A. The lowest yielding cultivars included Paladin at 760 boxes/A and Camelot at 852 boxes/A. Highest yielding breeding lines included 2075 at 1105 boxes/A and 2074 at 996 boxes/A. The lowest yielding breeding lines included 2073 at 707 boxes/A and 20719 at 659 boxes/A (Table 4).

At RAREC in 2008, percent Phytophthora-kill ranged from 0% to 69% depending on rating date, breeding line or cultivar (Figure 1). The lowest percentage of phytophthora-killed plants included breeding lines 20809 and 1126B with 0% and 3%, respectively, which were comparable to phytophthora-tolerant cultivars Paladin and Revolution (Table 5).

At the on-farm site, percent of phytophthora-killed plants at last rating date ranged from 3 to 72% depending on breeding line or cultivar (Figure 2). The lowest percentage of phytophthora-killed plants included 1126B at 3%, followed by 20809 and Paladin at 6%. Percent phytophthora-killed plants were highest in Alliance at 72%, Camelot at 58%, and 2075 at 56% (Table 6). No harvest data was collected at the on-farm site in 2008.

At RAREC, percent silvering varied significantly depending on harvest date, cultivar and breeding line (Tables 1-3). Total percent silvering for combined harvest data ranged from 3 to 23% depending on breeding line or cultivar. Total percent silvering was lowest in breeding lines 2074 and Declaration at ~4% (Table 4). Total percent silvering was also lower in other named phytophthora-susceptible cultivars Alliance at ~5%, Revolution at ~6% and Camelot at 7% compared to phytophthora-resistant cultivars Aristotle at 14% and Paladin at 23% (Table 4).

When fruit were rated at RAREC for quality all entries ranged from a medium green to dark green color which would be acceptable for the New Jersey market. Breeding lines 2073 and 2075 did not have recessed shoulders while Alliance, Revolution and Declaration each had deep recessed shoulders followed by Aristotle and 1819. All entries had had between 3.2 and 3.8 lobes/fruit. The fruit shape ranged from blocky to conical blunt except for 2075 and 20719 which were elongated. No entries had rough fruit and all expressed a glossy appearance, with the exception 2074 where fruit had a dull appearance.

CV/BL	Marketable			Silvering			Total	
	No. Fruit	Wt. Fruit (lb)	Boxes/acre	No. Fruit	Wt. Fruit (lb)	Percent	No. Fruit	Wt. Fruit (lb)
Alliance	81.75	28.05	581.04	1.50	0.75	1.68	99.75	30.40
Aristotle	68.75	23.35	483.68	13.25	5.40	16.50	87.00	29.40
Camelot	55.75	16.10	333.50	1.75	0.35	3.21	76.75	18.30
Revolution	75.75	27.40	567.57	4.25	1.70	5.03	95.25	30.75
Paladin	49.00	13.85	286.89	26.00	8.55	33.65	91.25	24.05
Declaration	60.00	21.45	444.32	1.75	0.55	2.89	74.50	24.30
20809	38.50	12.00	248.57	17.25	7.45	30.12	64.00	20.10
1819	55.75	18.05	373.89	14.25	5.50	19.96	85.00	23.35
1126B	60.25	19.85	411.18	15.50	5.25	19.27	90.00	26.30
20530	54.25	17.20	356.29	15.25	5.65	22.39	80.25	23.90
20719	40.50	12.25	253.75	22.50	8.75	36.00	78.50	22.80
2075	61.75	19.50	403.93	1.00	0.25	1.58	81.25	21.30
2073	45.75	14.60	302.43	9.25	4.15	18.92	83.50	21.35
2074	64.00	20.45	423.61	3.50	1.35	5.04	90.75	24.83
LSD	17.82	6.23	129.06	8.36	3.23	12.42	17.74	6.29

Table 1. Number, weight, and yield of marketable fruit, number, weight and percentage of fruit with ‘silvering’, and number and weight of total fruit at harvest 1 at RAREC in 2008.

CV/BL	Marketable			Silvering			Total	
	No. Fruit	Wt. Fruit (lb)	Boxes/acre	No. Fruit	Wt. Fruit (lb)	Percent	No. Fruit	Wt. Fruit (lb)
Alliance	29.00	9.90	205.07	0.00	0.00	0.00	42.00	
Aristotle	30.50	12.20	252.71	4.50	1.45	12.29	41.00	14.20
Camelot	32.25	12.70	263.07	0.25	0.05	0.40	42.25	14.10
Revolution	33.00	13.70	283.79	1.50	0.50	4.47	40.00	14.75
Paladin	37.50	13.80	285.86	7.25	2.75	16.43	54.75	17.90
Declaration	29.50	11.50	238.21	1.00	0.30	2.69	43.50	13.05
20809	38.75	16.15	334.54	7.50	2.85	15.87	50.75	19.50
1819	25.25	8.95	185.39	5.50	2.10	18.21	45.75	12.95
1126B	32.50	11.60	240.29	6.75	2.45	16.17	44.25	14.55
20530	28.25	19.55	218.54	4.50	1.40	13.83	41.75	12.80
20719	25.25	8.15	168.82	3.25	1.20	10.77	36.25	10.25
2075	26.50	10.65	220.61	0.25	0.10	0.51	33.00	11.65
2073	17.75	5.85	121.18	0.75	0.20	10.62	29.00	5.25
2074	23.50	8.40	174.00	0.50	0.05	13.89	36.00	9.30
LSD	12.99	6.15	127.49	3.01	1.09	8.53	17.20	6.82

Table 2. Number, weight, and yield of marketable fruit, number, weight and percentage of fruit with 'silvering', and number and weight of total fruit at harvest 2 at RAREC in 2008.

CV/BL	Marketable			Silvering			Total	
	No. Fruit	Wt. Fruit (lb)	Boxes/acre	No. Fruit	Wt. Fruit (lb)	Percent	No. Fruit	Wt. Fruit (lb)
Alliance	38.25	11.50	238.21	0.00	0.00	0.00	59.25	12.88
Aristotle	54.00	18.60	385.29	10.75	4.23	16.69	73.75	23.73
Camelot	27.25	8.90	184.36	0.00	0.00	0.00	35.00	9.82
Revolution	53.25	15.68	324.70	0.75	0.28	1.38	73.00	17.30
Paladin	40.25	11.25	233.04	4.50	1.70	10.48	48.25	13.50
Declaration	52.75	17.25	357.32	0.00	0.00	0.00	78.75	19.48
20809	57.50	19.05	394.61	5.25	2.05	8.61	69.00	21.75
1819	40.00	13.68	283.27	2.75	1.25	7.56	65.75	16.50
1126B	53.75	17.38	359.91	6.50	2.58	11.44	64.75	20.50
20530	39.25	13.00	269.29	6.25	2.53	15.47	55.75	16.55
20719	32.75	9.20	190.57	6.25	2.33	20.28	66.25	13.43
2075	45.75	15.75	326.25	1.00	0.48	1.50	66.00	17.80
2073	22.50	7.00	145.00	0.75	0.30	2.22	37.25	8.58
2074	33.50	11.78	243.91	1.75	0.73	9.72	50.50	14.25
LSD	25.34	8.42	174.40	2.85	1.15	10.63	40.23	8.85

Table 3. Number, weight, and yield of marketable fruit, number, weight and percentage of fruit with 'silvering', number and weight of total fruit at harvest 3 at RAREC in 2008.

CV/BL	Total Marketable			Total Silvering			Total Culls		Totals		% Phyto-killed
	No. Fruit	Wt. Fruit (lb)	Boxes/acre	No. Fruit	Wt. Fruit (lb)	Percent	No. Fruit	Wt. Fruit (lb)	No. Fruit	Wt. Fruit (lb)	
Alliance	157.50	53.35	1105.10	8.75	3.50	5.24	47.50	4.32	213.75	61.18	37.50
Aristotle	152.25	53.45	1107.20	25.00	9.93	14.22	27.00	2.80	204.25	66.18	15.28
Camelot	121.75	41.15	852.40	9.25	3.20	7.83	31.50	3.28	162.50	47.63	34.72
Revolution	154.25	52.02	1077.70	10.50	4.08	6.21	49.25	4.90	214.00	61.00	2.78
Paladin	121.75	36.70	760.20	37.25	12.70	22.60	24.75	2.70	183.75	52.10	0.00
Declaration	141.00	49.25	1020.20	6.25	1.95	4.39	47.75	5.38	195.00	56.58	34.72
20809	121.25	39.20	812.00	25.75	10.70	16.87	22.25	2.20	169.25	52.10	0.00
1819	122.25	42.38	877.80	17.25	6.85	12.67	44.25	4.28	183.75	53.50	38.89
1126B	131.75	43.08	892.30	22.75	8.03	14.24	29.25	2.95	183.75	54.05	2.78
20530	117.00	38.60	799.60	22.00	8.23	16.48	33.00	2.93	172.00	49.75	20.83
20719	105.25	31.83	659.20	28.75	10.70	21.93	49.50	4.68	183.50	47.58	52.78
2075	144.00	49.03	1015.50	7.50	2.48	4.90	45.00	3.85	196.50	55.35	40.28
2073	99.97	34.15	707.40	10.25	4.50	8.68	49.75	4.83	159.75	43.48	69.44
2074	143.25	48.08	995.80	6.00	2.30	3.89	56.00	6.08	205.25	56.45	40.28
LSD	38.98	13.65	282.92	10.34	3.99	5.91	29.70	2.05	54.45	15.34	34.79

Table 4. Total number, weight and yield of marketable fruit, and number, weight and percentage of fruit with ‘silvering’, number and weight of total fruit and percentage of plants killed by phytophthora blight at RAREC in 2008.

\*No phytophthora-resistance present in Syngenta lines 20530 or 20719.

		<b>% Phytophthora-killed plants by rating date at RAREC in 2008</b>															
<b>Company</b>	<b>CV/BL</b>	<b>23-Jun</b>	<b>30-Jun</b>	<b>7-Jul</b>	<b>14-Jul</b>	<b>21-Jul</b>	<b>30-Jul</b>	<b>6-Aug</b>	<b>11-Aug</b>	<b>18-Aug</b>	<b>25-Aug</b>	<b>2-Sep</b>	<b>10-Sep</b>	<b>16-Sep</b>	<b>24-Sep</b>	<b>6-Oct</b>	<b>15-Oct</b>
Enza Zaden	E-2073	1.40	6.90	9.70	12.50	15.30	26.40	31.90	38.90	43.10	50.00	61.10	62.50	65.30	66.70	66.70	69.40
Syngenta	RPP-20719	5.50	5.50	5.50	6.90	8.30	13.90	15.30	18.10	19.40	22.20	26.40	34.70	36.10	41.70	50.00	52.80
Enza Zaden	PC-2075	1.40	4.20	4.20	5.50	6.90	8.30	8.30	12.50	13.90	20.83	29.20	33.30	34.70	37.50	38.90	40.30
Enza Zaden	E-2074	1.40	2.80	2.80	2.80	4.20	13.90	15.30	19.40	22.20	27.80	27.80	29.20	33.30	36.10	40.30	40.30
Seminis	PX 0994-1819	1.40	1.40	2.80	6.90	6.90	9.70	12.50	19.40	22.20	30.60	37.50	37.50	37.50	37.50	37.50	38.90
Harris Moran	Alliance	0.00	1.40	1.40	2.80	2.80	2.80	2.80	8.30	8.30	11.10	16.70	19.40	23.60	27.80	34.70	37.50
Stokes	Camelot	0.00	0.00	0.00	0.00	0.00	2.80	8.30	9.70	13.90	18.10	19.40	19.40	22.20	27.80	29.20	34.70
Harris Moran	Declaration	0.00	0.00	0.00	1.40	1.40	2.80	2.80	2.80	2.80	16.70	23.60	30.60	30.60	33.30	33.30	34.70
Syngenta	RPP-20530	1.40	1.40	1.40	2.80	2.80	4.20	5.50	8.30	8.33	13.90	16.70	16.70	19.40	19.40	20.80	20.80
Seminis	Aristotle	0.00	0.00	0.00	0.00	0.00	1.40	1.40	1.40	1.40	4.20	6.90	6.90	8.33	12.50	13.90	15.30
Harris Moran	Revolution	0.00	1.40	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.78	2.80
Seminis	PX 0993-1126B	1.40	1.40	1.40	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80
Syngenta	Paladin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Syngenta	RPP-20809	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<b>LSD</b>	<b>3.22</b>	<b>5.02</b>	<b>6.23</b>	<b>7.38</b>	<b>8.39</b>	<b>15.58</b>	<b>18.49</b>	<b>20.42</b>	<b>21.45</b>	<b>25.00</b>	<b>30.00</b>	<b>31.00</b>	<b>32.30</b>	<b>33.60</b>	<b>34.60</b>	<b>34.80</b>

Table 5. Percentage of phytophthora-killed bell pepper cultivars and breeding lines by rating date at RAREC in 2008.

\*No phytophthora-resistance present in Syngenta lines 20530 or 20719.

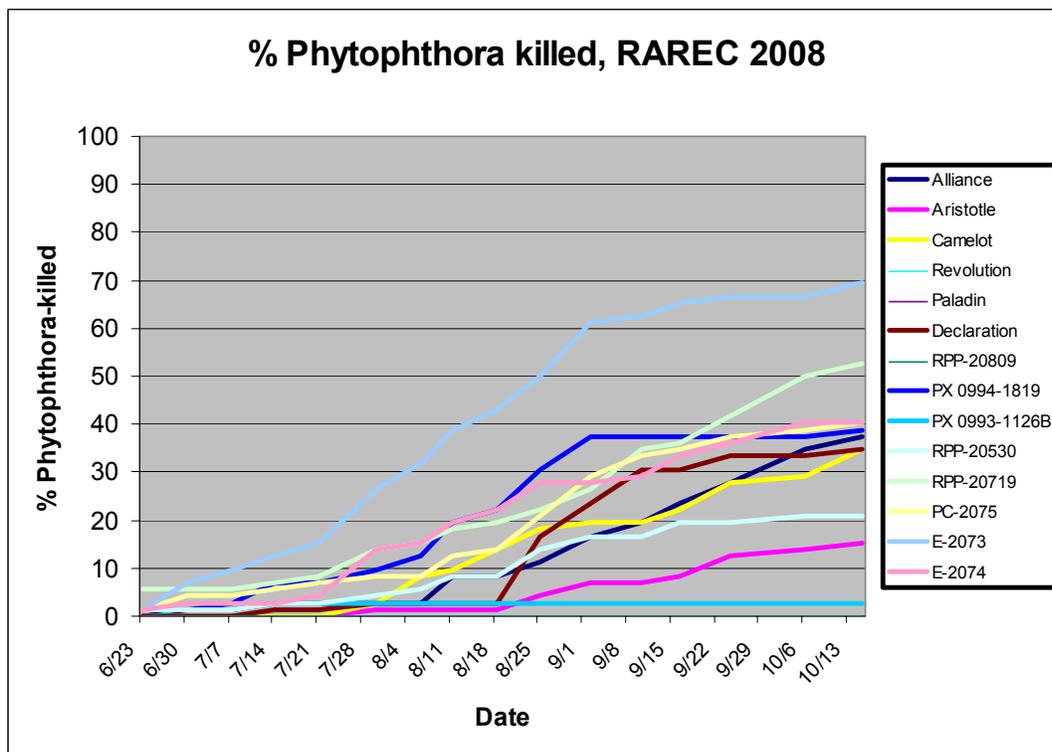


Figure 1. Mean weekly ratings for the percentage of each breeding line or cultivar killed by phytophthora blight from June 23 to Oct. 13 at RAREC in 2008.

\*No phytophthora-resistance present in Syngenta lines 20530 or 20719.

		% Phytophthora-killed plants by rating date at on-farm in 2008																
CV/BL	Company	13-Jun	27-Jun	3-Jul	8-Jul	15-Jul	21-Jul	28-Jul	4-Aug	11-Aug	18-Aug	25-Aug	2-Sep	12-Sep	19-Sep	26-Sep	3-Oct	10-Oct
Alliance	Harris Moran	0.00	5.60	8.30	8.30	19.40	22.20	27.80	36.10	47.20	47.20	55.60	58.30	66.70	69.40	72.20	72.20	72.2
Camelot	Stokes	0.00	16.70	22.20	22.20	22.20	22.20	25.00	25.00	25.00	27.80	36.10	36.10	44.40	52.80	58.30	58.30	58.3
PC-2075	Enza Zaden	0.00	5.60	5.60	5.56	5.60	11.10	13.90	19.40	19.40	19.40	30.60	30.60	36.10	41.70	47.20	50.00	55.6
RPP-20719	Syngenta	0.00	0.00	2.80	2.80	5.60	5.60	5.60	11.10	16.70	16.70	22.20	25.00	30.60	36.10	41.70	41.70	41.7
Declaration	Harris Moran	0.00	2.80	2.80	2.80	2.80	2.80	5.60	8.30	8.30	11.10	19.40	19.40	25.00	30.60	36.10	36.10	36.1
E-2073	Enza Zaden	5.60	2.80	2.80	2.80	2.80	2.80	2.80	5.60	8.30	8.30	16.70	16.70	25.00	27.80	30.60	33.30	33.3
E-2074	Enza Zaden	2.80	0.00	8.30	8.30	13.90	13.90	16.70	16.70	19.40	19.40	27.80	27.80	30.60	30.60	30.60	30.60	30.6
PX 0994-1819	Seminis	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.60	5.60	11.10	13.90	16.70	19.40	22.2
Revolution	Harris Moran	0.00	0.00	0.00	0.00	2.80	2.80	5.60	5.60	8.30	8.30	13.90	13.90	19.40	19.40	19.40	19.40	19.4
Aristotle	Seminis	0.00	5.60	5.60	5.60	8.30	8.30	8.33	8.30	8.30	8.30	11.10	11.10	13.90	13.90	13.90	13.90	13.9
RPP-20530	Syngenta	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	5.60	8.30	11.10	11.10	11.10	11.10	11.10	11.1
Paladin	Syngenta	0.00	0.00	0.00	0.00	2.80	2.80	2.80	2.80	5.60	5.60	5.60	5.60	5.60	5.60	5.60	5.60	5.6
RPP-20809	Syngenta	0.00	0.00	0.00	0.00	0.00	2.80	2.80	2.80	2.80	2.80	5.60	5.60	5.60	5.60	5.60	5.60	5.6
PX 0993-1126B	Seminis	0.00	0.00	2.80	0.00	0.00	0.00	0.00	0.00	0.00	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.8
	<b>LSD</b>	<b>4.85</b>	<b>11</b>	<b>14.8</b>	<b>14.8</b>	<b>17.3</b>	<b>18.5</b>	<b>22.2</b>	<b>23.9</b>	<b>25.7</b>	<b>25.3</b>	<b>25.9</b>	<b>25.5</b>	<b>25.1</b>	<b>25.8</b>	<b>28.3</b>	<b>29.4</b>	<b>30.2</b>

Table 6. Percentage of phytophthora-killed bell pepper cultivars and breeding lines by rating date at on-farm site in 2008.

\*No phytophthora-resistance present in Syngenta lines 20530 or 20719.

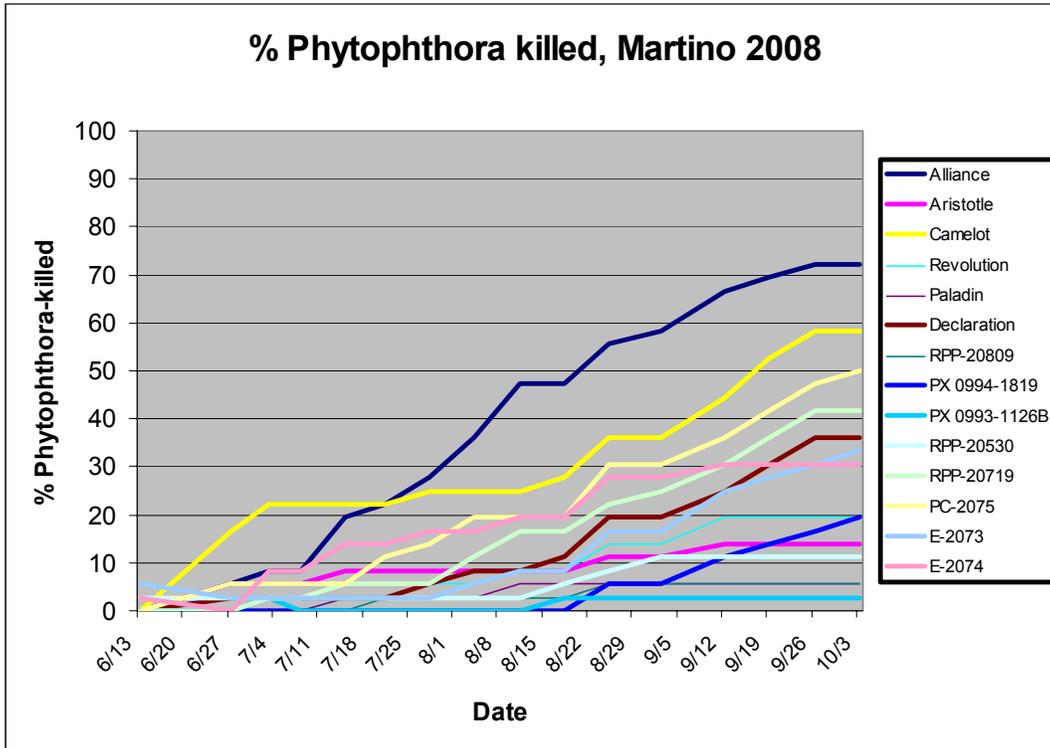


Figure 2. Mean weekly ratings for the percentage of each breeding line or cultivar killed by phytophthora blight from June 13 to Oct. 10 at on-farm site in 2008.

\*No phytophthora-resistance present in Syngenta lines 20530 or 20719.