

Evaluation of potato cultivars and breeding selections to identify resistance to early blight - Hancock, 2008

A trial was established 24 Apr at the Hancock Agricultural Research Station, in central WI, to evaluate foliar reaction of 56 potato cultivars and breeding selections to early and late blight. Small whole tubers or hand-cut seedpieces (approximately 2 oz) were mechanically planted in a randomized complete block design with three replications. There were five plants per replicate of each test line. Sets of four Dark Red Norland potatoes (highly susceptible to both early and late blight) were planted between pairs of test lines within a row. Rows with test lines were alternated with rows of Russet Burbank (also susceptible to both early and late blight) to help minimize interplot interference. Spacing was 12 in. within the row and 36 in. between rows. The soil type was Plainfield loamy sand, pH 6.4. Fertilizer applied was: 0-0-60, 365 lb/A, broadcast 8 Apr; 6-24-24, 550 lb/A, banded in the row at planting; and sidedress applications on 13 May (21-0-0-24S, 350 lb/A) and 3 Jun (Cal-Sul, 500 lb/A + 46-0-0, 315 lb/A). To compensate for nitrogen lost to leaching due to heavy rains in June and July, 28% UAN was applied through the irrigation, 30 lb N/A, on 23 Jun, 8 and 15 Jul. Insects were controlled with Platinum incorporated at a rate equivalent to 8.25 oz/A in the fertilizer applied at planting, and foliar applications of Agri-Mek .15 EC (12.0 fl oz/A) on 26 Jun, Coragen (5.0 fl oz/A) on 18 Jul and Avaunt 30 DG (6.0 oz/A) on 22 Aug. Lorox DF (1.0 lb/A) + NIS 80/20 (1.0 pt/A) 6 May, Sencor DF (0.5 lb/A) 11 Jun, Poast (1.5 pt/A) + Crop Oil Concentrate (2.0 pt/A) 19 Jun and Matrix (0.5 oz/A) + NIS 80/20 (0.25 pt/A) 19 Jun were applied for weed control. No fungicides were applied to the plots, and plots were not inoculated, but relied on natural dispersal of inoculum for disease establishment. Only early blight caused by *Alternaria solani* was observed in the trial. Varieties were included in the trial for late blight evaluation also, but no late blight (caused by *Phytophthora infestans*) was observed in Wisconsin during the 2008 growing season. Early blight severity was rated weekly from 17 Jun – 2 Sep using the Horsfall-Barratt rating scale. Applications of Reglone (1.0 pt/A) + NIS 80/20 (1.0 pt/A) were made 3 and 8 Sep to kill vines at the end of the season but tubers were not harvested this year. Rainfall recorded during the growing season (in.) was: 20-30 Apr (1.55); May (3.25); Jun (6.71); Jul (4.52); Aug (2.4); 1-16 Sep (1.47). An additional 18 in. of water was applied as overhead sprinkler irrigation in 36 applications (1 May – 14 Sep).

This trial intentionally received no applications of fungicide in order to allow the natural progression of early blight under field conditions. Two popular commercial cultivars, Dark Red Norland and Russet Burbank, were helpful in comparing disease reaction on advanced breeding lines. The first symptoms of early blight were observed on 17 Jun. By the end of July, disease severity on the highly susceptible Dark Red Norland exceeded 98%. Disease severity on Russet Burbank did not reach 98% until 18 Aug. Disease pressure in these plots was extreme from mid July throughout the month of August. While disease progressed rapidly on Dark Red Norland and Russet Burbank, disease progress was significantly slower on several breeding lines as demonstrated in the relative AUDPC. The rAUDPC's on Dark Red Norland and Russet Burbank were 0.659 and 0.487, respectively, and as low as 0.309, 0.286 and 0.281 for F.EB15, AO2507-2LB, and COTX94218-1R, respectively. Twelve breeding lines demonstrated rAUDPC values less than 0.400, significantly less than the rAUDPC values for Dark Red Norland and Russet Burbank. These low rAUDPC values represent slowed disease progress over the course of the growing season and demonstrate progress in developing cultivars with improved disease resistance.

Table 1. Foliar disease severity for potato cultivars and breeding selections.

Cultivar or Line	Source ²	Ma- tur- ity ³	Foliar Disease Severity - Early Blight (%) ¹											Relative AUDPC ⁴
			24 Jun	1 Jul	7 Jul	14 Jul	21 Jul	28 Jul	4 Aug	11 Aug	18 Aug	25 Aug	2 Sep	
Dk Red Norland	Com	E	0.0	2.0	3.9	10.9	87.7	98.1	97.8	98.1	98.4	98.4	99.4	0.659
Russet Burbank	Com	L	1.2	1.4	2.3	4.1	10.0	51.7	64.6	90.3	98.4	99.3	100.0	0.487
AC 96052-1RU	CSU		0.2	1.4	1.7	2.8	6.2	30.0	61.7	62.1	66.3	81.9	92.5	0.373
CO 97087-2RU	CSU		1.1	1.2	2.2	2.7	9.7	54.2	84.4	88.8	87.3	94.4	95.5	0.486
AC97521-1R/Y	CSU		0.0	1.6	1.7	3.6	10.6	46.3	47.1	68.2	82.9	93.1	97.0	0.417
CO97226-2R/R	CSU		0.3	2.3	3.1	5.6	17.5	68.8	65.0	67.5	77.2	83.4	90.2	0.448
CO97232-1R/Y	CSU		1.0	0.9	2.5	5.7	70.6	96.8	99.1	99.4	99.7	99.7	99.8	0.639
CO97232-2R/Y	CSU		0.3	1.2	1.6	3.7	15.7	76.9	95.2	95.8	97.2	98.1	98.6	0.549
CO97233-3R/Y	CSU		0.5	1.6	2.5	3.9	18.9	55.8	75.6	76.9	91.4	95.1	97.3	0.484
CO96141-4W	CSU		0.5	1.6	2.7	4.7	8.7	70.0	82.2	93.3	95.3	96.9	98.0	0.518
CO97043-14W	CSU		0.6	1.9	3.0	3.9	16.4	74.4	76.3	89.8	91.4	96.6	95.6	0.515
CO97065-7W	CSU		0.6	1.4	2.7	4.1	14.8	76.0	96.4	97.1	97.8	97.8	98.1	0.551
F.EB1	F-L		0.2	0.5	1.2	2.7	4.5	26.7	65.0	92.8	99.8	100.0	100.0	0.457
F.EB2	F-L		0.5	0.0	1.6	2.7	5.0	39.6	52.9	68.3	80.0	92.7	97.2	0.405
F.EB3	F-L		0.0	0.4	2.4	4.1	7.2	52.5	64.6	78.1	85.0	90.1	94.8	0.445
F.EB4	F-L		0.9	1.6	2.5	3.1	9.4	52.5	67.5	85.0	89.8	96.9	97.0	0.471
F.EB5	F-L		0.0	0.9	1.1	1.9	5.0	16.7	66.8	97.3	99.2	99.2	99.4	0.452
F.EB6	F-L		0.2	0.3	0.5	2.5	5.6	34.6	62.2	85.7	95.1	97.7	98.9	0.448
F.EB7	F-L		0.3	1.2	2.0	3.4	5.6	29.6	59.2	73.1	93.1	97.7	99.3	0.429
F.EB8	F-L		0.6	0.6	0.8	2.8	4.0	20.0	54.6	74.4	83.8	94.4	95.2	0.397
F.EB10	F-L		0.5	0.5	1.7	3.4	5.0	14.1	31.3	70.0	90.3	98.3	99.5	0.378
F.EB11	F-L		0.2	1.6	2.7	3.7	8.1	43.1	63.2	83.0	96.1	97.8	99.3	0.463
F.EB13	F-L		0.2	0.8	2.2	2.3	4.8	13.1	49.2	80.2	95.8	99.4	99.7	0.412
F.EB15	F-L		0.2	0.6	1.1	2.3	4.7	15.0	36.9	60.8	63.8	76.3	74.4	0.309
FL1867	F-L		0.5	0.2	1.4	2.3	7.0	35.8	87.8	98.9	99.8	100.0	100.0	0.498
FL1879	F-L		0.0	1.1	1.9	2.8	4.4	11.2	39.4	71.3	88.4	96.1	98.8	0.380
A98345-1	ID	EM	0.5	0.8	2.3	3.3	9.1	16.9	29.6	55.8	70.0	84.4	93.4	0.332
A96814-65LB	ID	ML	1.1	2.7	3.7	4.8	7.8	59.6	67.5	74.4	87.0	95.9	98.8	0.467
A00324-1LB	ID	EM	0.7	1.7	2.5	3.3	6.9	57.5	67.5	76.6	79.2	93.4	95.9	0.450
A02507-2LB	ID	ML	0.2	0.6	1.4	2.5	4.1	7.5	22.9	52.5	65.0	73.4	89.7	0.286
A95109-1	ID	E	0.0	0.5	0.8	2.0	4.4	15.6	63.8	84.4	96.1	99.4	99.5	0.431
AOA95154-1	ID	ML	0.2	0.9	1.1	2.3	6.9	43.8	66.9	72.5	71.9	85.9	87.2	0.408
A0008-1TE	ID	E	0.2	0.2	1.1	2.8	11.9	77.2	98.4	98.9	100.0	100.0	100.0	0.555
Yukon Gem	ID	M	0.8	1.4	1.7	4.7	19.7	78.6	82.5	92.7	97.0	99.5	99.8	0.542
AOTX91861-4R	TAMU	ML	0.2	1.9	3.1	5.3	39.0	68.8	72.5	78.8	86.9	91.6	94.7	0.508
AOTX93483-1R	TAMU	L	0.3	0.5	1.9	3.9	9.7	49.2	55.8	68.8	68.8	85.9	90.8	0.402
ATTX00289-6Y/Y	TAMU	M	0.2	0.2	2.0	4.8	18.3	78.4	87.3	95.9	98.4	98.7	99.4	0.548
ATTX98453-6R	TAMU	ML	0.2	1.6	2.3	3.3	10.9	71.9	96.1	98.7	98.0	99.0	98.6	0.545
BTX2332-1R	TAMU	ML	0.3	2.0	2.5	5.6	12.8	64.6	62.9	73.3	81.6	90.9	95.3	0.457
COTX94218-1R	TAMU	L	0.0	0.5	1.2	2.8	3.3	9.7	10.6	45.0	65.0	81.9	96.6	0.281
NDTX4828-2R	TAMU	ML	0.5	0.8	1.4	2.7	7.2	35.4	66.3	87.5	98.4	98.8	99.5	0.462
NDTX5003-2R	TAMU	M	0.0	1.2	2.0	3.7	8.1	47.1	80.0	93.0	96.3	95.3	95.3	0.488
NDTX731-1R	TAMU	EM	0.4	2.0	3.2	8.4	44.4	85.4	96.1	97.7	95.0	98.3	98.6	0.594
NDTX7590-3R	TAMU	M	0.6	0.6	2.0	4.7	24.0	88.0	99.5	99.8	97.8	99.7	99.7	0.580
W2309-7	UW		0.0	1.6	2.2	3.7	7.0	66.4	84.1	93.0	97.2	98.8	98.0	0.517
W4016-4	UW		0.6	2.0	2.7	4.1	9.9	11.7	37.1	68.1	87.0	86.5	92.2	0.368
W4013-1	UW		0.2	0.6	2.1	3.3	13.7	83.1	88.1	94.7	95.1	96.3	96.3	0.539
W4697-2Rus	UW		0.8	1.1	2.1	2.5	14.3	47.3	65.1	87.1	95.0	96.4	97.8	0.474
W2310-3	UW		0.3	0.9	1.4	2.5	3.7	8.7	26.3	72.1	87.7	94.1	95.3	0.359
W2609-1R	UW		0.5	2.0	2.7	6.6	49.4	91.1	97.9	97.1	96.7	96.6	97.3	0.602

Cultivar or Line	Source ²	Ma- tur- ity ³	Foliar Disease Severity - Early Blight (%) ¹											Relative AUDPC ⁴
			24 Jun	1 Jul	7 Jul	14 Jul	21 Jul	28 Jul	4 Aug	11 Aug	18 Aug	25 Aug	2 Sep	
W3952-3Rus	UW		1.2	2.0	2.2	3.1	14.4	44.4	66.9	82.2	89.6	93.4	97.4	0.461
W6234-4Rus	UW		0.5	0.8	1.4	3.7	9.1	64.0	76.9	95.7	96.4	97.1	99.0	0.509
W2683-2Rus	UW		0.2	0.0	1.0	2.7	3.7	13.3	29.7	81.9	90.2	97.3	99.2	0.383
W2438-3Y	UW		0.8	1.5	2.0	2.5	4.8	20.0	57.3	76.8	82.0	89.7	92.6	0.396
W2253-5Rus	UW		0.8	2.3	3.3	6.1	27.9	49.2	75.9	91.7	96.8	99.4	100.0	0.517
W2717-5	UW		1.0	1.7	2.3	4.4	14.1	72.5	73.8	93.6	93.5	96.6	98.3	0.516
<i>P</i> > <i>F</i> ⁵			0.08	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
LSD			NS	1.2	1.3	2.0	16.6	20.7	17.1	12.2	8.2	5.3	3.9	0.050

1 Severity rated on a Horsfall-Barratt scale of 0 (no infection) to 11 (all foliage and stems dead). Ratings were converted to percentages.

2 Sources of material used in this trial

Com	Commercial grower
CSU	Colorado State University - David Holm
F-L	Frito-Lay, Scarlet Sweeney
ID	USDA/ARS Aberdeen, ID - Rich Novy
TAMU	Texas A & M University - Creighton Miller
UW	UW Potato Breeding Program - Jiwan Palta, Bryan Bowan and Felix Navarro

3 Maturity group: E = Early; EM = Early-Medium; L = Late; L-VL = Late to Very Late; M = Medium; ML = Medium to Late; NK = Not known; VL = Very Late

4 Relative area under the disease progress curve. Data for each date were plotted on a graph and the area under the line was calculated for each treatment providing a measure of the relative severity of disease throughout the season. A disease rating of 100% for the entire season would produce a value of 1.0. All relative AUDPC values are expressed as a proportion of this value. Either decreased disease severity or later disease development contribute to lower relative areas under the disease progress curve.

5 Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated (alpha=0.05).

Table 2. Data ranked according to relative AUDPC (increasing)

Cultivar or Line	Relative AUDPC ¹	Cultivar or Line	Relative AUDPC ¹	Cultivar or Line	Relative AUDPC ¹
COTX94218-1R	0.281	CO97226-2R/R	0.448	W2717-5	0.516
A02507-2LB	0.286	F.EB6	0.448	W2309-7	0.517
F.EB15	0.309	A00324-1LB	0.450	W2253-5Rus	0.517
A98345-1	0.332	F.EB5	0.452	CO96141-4W	0.518
W2310-3	0.359	F.EB1	0.457	W4013-1	0.539
W4016-4	0.368	BTX2332-1R	0.457	Yukon Gem	0.542
AC 96052-1RU	0.373	W3952-3Rus	0.461	ATTX98453-6R	0.545
F.EB10	0.378	NDTX4828-2R	0.462	ATTX00289-6Y/Y	0.548
FL1879	0.380	F.EB11	0.463	CO97232-2R/Y	0.549
W2683-2Rus	0.383	A96814-65LB	0.467	CO97065-7W	0.551
W2438-3Y	0.396	F.EB4 (purple)	0.471	A0008-1TE	0.555
F.EB8	0.397	W4697-2Rus	0.474	NDTX7590-3R	0.580
AOTX93483-1R	0.402	CO97233-3R/Y	0.484	NDTX731-1R	0.594
F.EB2	0.405	CO 97087-2RU	0.486	W2609-1R	0.602
AOA95154-1	0.408	Russet Burbank	0.487	CO97232-1R/Y	0.639
F.EB13	0.412	NDTX5003-2R	0.488	Dk Red Norland	0.659
AC97521-1R/Y	0.417	FL1867	0.498	<i>P</i> > <i>F</i> ²	< 0.01
F.EB7	0.429	AOTX91861-4R	0.508	LSD	0.050
A95109-1	0.431	W6234-4Rus	0.509		
F.EB3	0.445	CO97043-14W	0.515		

1. Relative area under the disease progress curve. Data for each date were plotted on a graph and the area under the line was calculated for each treatment providing a measure of the relative severity of disease throughout the season. A disease rating of 100% for the entire season would produce a value of 1.0. All relative AUDPC values are expressed as a proportion of this value. Either decreased disease severity or later disease development contribute to lower relative areas under the disease progress curve.

2. Analysis of variance was performed on data, and Fisher's protected least significant difference (LSD) was calculated (alpha=0.05)