

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 |
| $P > F$ 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 | $P > F$ 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)