

POTATO (*Solanum tuberosum*)
Early Blight; *Alternaria solani*
Late Blight; *Phytophthora infestans*
Pink Rot; *Phytophthora erythroseptica*

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Evaluation of potato cultivars and breeding selections to identify resistance in tubers to early blight, late blight and pink rot, 2000.

Eighty-eight cultivars and breeding selections were evaluated in field plots at the Hancock Agricultural Research Station to identify foliar resistance to early blight and late blight in 2000. Results of the foliar evaluations were reported in Volume 16 of Biological and Cultural Tests (On-Line Report 2001:PT66). Tubers from this trial were harvested and stored at ~13 C, 90% RH until inoculation. Replicate sets of tubers were inoculated with: *P. infestans* US-8 genotype, isolate ME93-2a; *A. solani*, WI isolate 100 (As); or *P. erythroseptica*, ND isolate PR-02 (Pe). *P. infestans* inoculum was prepared from cultures grown 11-18 days on rye A agar at 22 C. Tubers were inoculated 29 Nov 00 with US-8, 7.0×10^4 sporangia/ml. Tubers were inoculated 21 Nov 00 with As, 2.5×10^4 spores/ml, prepared from cultures grown 12 days on V8 agar at room temperature (modification of technique of Fry & Pelletier, *Phytopathology* 79:511-517). Tubers were inoculated 7 Nov 00 with Pe, 1.1×10^4 zoospores/ml, grown three days in V8 broth in darkness at 20-22 C, then under continuous light for 48 hr. Zoospore production was induced by incubation at 8 C for 1 hr followed by room temperature for 0.5 hr. For each test line, three replicates of five tubers each were inoculated with each pathogen. Four shallow wounds (2 mm diam, 2 mm deep, spaced 2 cm apart along a line) were made on each tuber and a 10 μ l drop of inoculum was placed on each wound. Tubers inoculated with *Phytophthora* were incubated 68-70 hr at 22 C, and 100% RH. Tubers inoculated with US-8 were then stored at 13 C, 90% RH until evaluated 12 Dec 00. Tubers to be evaluated for pink rot were stored at 22 C until rated 16 Nov 00. Tubers to be tested for early blight were placed in a growth chamber at 13 C, 90% RH immediately after inoculation until evaluated 27 Feb – 3 Mar 01. Storage temperature and relative humidity were typical of conditions used for processing potatoes. For each inoculation, severity of symptoms and incidence of infection (the number of inoculation sites with symptoms) were recorded for each tuber. For late blight, up to one half of each tuber (with the line connecting the inoculation points at the center) was peeled and the percentage of this area with late blight symptoms was estimated. For early blight the length and width were recorded for each lesion. For early and late blight, each tuber was cut in half, along the line connecting the inoculation points and the depth of symptoms was recorded. One depth reading per tuber was taken for late blight (the point of deepest symptom development) but the depth of each lesion was measured for early blight. For pink rot, the tuber was cut in half through the line of inoculation and the percentage of cross sectional area with pink rot symptoms was estimated after incubation at room temperature for 30 minutes.

Each pathogen was successfully inoculated to the test tubers. While all inoculated lines were susceptible to all pathogens, several exhibited high levels of resistance to specific pathogens. No entry exhibited high resistance to all pathogens. Using the average volume of tuber tissue affected by late blight as a guide, two cultivars, Goldrush (33.4 cm³) and Shepody (34.2 cm³), were the most susceptible of the tubers tested. In contrast, several lines had average tuber volume affected by late blight less than 5 cm³. These lines included 2324-1, 461, C31-5-120, LB2-102, LBR4, Pike, Q237-25 (NY 121), Red Lasoda, and W84-75R. A few lines such as A95020-17, A95020-70, LB2-101, LB2-102, LB2-49, LBR7, LBR8, Q237-25 (NY 121) exhibited a field AUDPC for late blight (foliar) of <0.010 and <10cm³ symptomatic tuber tissue. Inoculation methods for *P. erythroseptica* were severe and tubers of most inoculated lines exhibited severe infection. A few lines exhibited significantly less infection although even on these lines, a large proportion of the inoculated tubers was symptomatic. Those lines exhibiting the lowest area of infected tissue included A95053-61, LB2-74, and Perrichoi. Severity of tuber infection by *A. solani* was highly variable between entries. The estimated lesion volume ranged from 1.10 cm³ for Ranger Russet to 0.1 cm³ for many lines. One line, LB2-101 exhibited field resistance to foliar infection to both early and late blight and low susceptibility to tuber infection by *P. infestans* and *A. solani*. Many other lines appear to carry useful resistance to one or more pathogens.

Cultivar or Breeding Selection	Data From Field (2000)					Data From Tuber Inoculation									
	Relative AUDPC ¹			Yield ²		<i>P. infestans</i> (US-8 genotype)					<i>P. erythroseptica</i>		<i>A. solani</i>		
	Early Blight	Late Blight	Combined	Total cwt/A	% US#1 size	Incidence of infection (%)	% Surface area infected	Max. Lesion depth (cm)	Mean area affected ³ (cm ²)	Estimated volume affected ⁴ (cm ³)	Incidence of infection (%)	Mean area affected ⁵ (cm ²)	Incidence of infection (%)	Mean Lesion area (cm ²)	Estimated lesion volume ⁶ (cm ³)
1348 rus	0.023	0.051	0.605	254.6	57.0	100.0	90.3	1.2	41.9	34.1	100.0	92.3	74.6	0.2	0.05
1355-1	0.033	0.079	0.644	129.7	47.8	98.3	39.7	0.7	11.0	5.1	100.0	94.3	55.0	0.1	0.01
1431	0.038	0.097	0.653	171.3	67.2	96.7	47.3	0.6	13.9	5.1	100.0	99.3	95.0	1.6	0.37
1443	0.019	0.098	0.644	469.8	86.5	91.7	54.7	0.6	24.3	11.7	100.0	91.5	95.0	0.9	0.21
1836-3 rus	0.019	0.084	0.634	266.2	35.4	100.0	90.3	1.0	33.9	22.0	100.0	100.0	68.3	0.1	0.01
1876-1 rus	0.037	0.099	0.658	204.2	55.4	100.0	77.3	0.5	30.6	10.4	100.0	100.0	80.0	0.9	0.26
1904-3	0.033	0.101	0.655	260.2	74.9	95.0	38.0	0.5	14.9	5.4	100.0	98.7	98.3	1.5	0.39
1980-4	0.027	0.061	0.625	274.9	58.7	93.8	35.1	0.8	12.6	6.5	100.0	89.7	86.7	0.9	0.29
2020-4	0.068	0.130	0.681	289.4	80.4	100.0	70.7	0.9	25.0	14.3	100.0	99.3	96.7	1.3	0.43
2033-8	0.029	0.073	0.636	325.2	84.0	98.3	38.7	0.6	13.9	5.8	100.0	97.0	56.7	0.1	0.02
2062-1	0.026	0.138	0.672	275.9	67.1	98.3	47.9	0.6	14.7	5.6	93.3	92.7	63.3	0.2	0.04
2249-1 rus	0.022	0.070	0.618	220.9	37.4	98.3	87.3	0.7	31.0	13.7	100.0	99.7	96.7	1.1	0.35
2250-2 rus	0.034	0.080	0.648	168.4	66.2	98.3	89.0	0.7	36.5	16.5	100.0	100.0	66.7	0.1	0.02
2269-1	0.021	0.143	0.675	407.0	87.7	100.0	67.3	0.7	27.8	13.6	100.0	95.7	100.0	1.1	0.37
2275-9 R	0.020	0.094	0.647	232.3	57.2	100.0	61.7	0.5	17.4	5.9	100.0	100.0	91.7	0.5	0.09
2319-6	0.028	0.081	0.633	248.8	75.9	96.7	69.0	1.0	20.5	13.7	100.0	100.0	95.0	0.3	0.05
2319-8	0.037	0.065	0.633	184.9	69.3	100.0	73.0	0.7	21.6	9.5	100.0	98.5	66.7	0.2	0.02
2324-1	0.036	0.062	0.631	386.2	85.4	91.7	17.3	0.5	7.0	2.7	100.0	99.0	81.7	0.3	0.05
2371-1 rus	0.025	0.082	0.645	221.7	47.6	100.0	94.7	1.0	41.7	27.2	100.0	98.0	93.3	0.9	0.31
461	0.008	0.001	0.278	51.2	4.2	76.3	31.0	0.4	5.8	1.7	90.0	88.5	45.0	0.1	0.03
A90586-11	0.020	0.000	0.394	282.7	68.2	98.3	68.3	0.5	32.3	10.9	100.0	93.0	93.3	0.4	0.10
A90586-11	0.025	0.006	0.482	478.2	73.2	100.0	76.0	0.5	37.3	11.3	100.0	92.3	88.3	0.3	0.05
A95020-17	0.017	0.005	0.427	200.4	43.3	100.0	79.7	0.5	23.2	8.6	100.0	94.3	83.3	0.2	0.02
A95020-70	0.009	0.000	0.231	268.4	20.5	86.7	55.7	0.4	18.9	5.7	100.0	94.0	78.3	0.2	0.02
A95053-55	0.015	0.003	0.287	336.1	75.9	90.0	55.3	0.6	28.0	12.7	100.0	94.7	85.0	0.3	0.08
A95053-61	0.016	0.000	0.168	480.9	68.2	98.3	41.0	0.8	24.0	12.8	95.0	74.3	86.7	0.3	0.04
AF1638-5	0.013	0.049	0.605	65.8	50.4	100.0	71.5	0.6	19.3	7.8	100.0	97.0	100.0	0.2	0.02
Amey (B9922-11)	0.032	0.033	0.607	65.8	55.2	100.0	78.4	0.7	20.6	9.2	93.3	93.3	87.5	0.7	0.34
Atlantic	0.014	0.065	0.613	176.2	70.7	100.0	44.0	0.6	12.4	5.0	100.0	93.3	91.7	0.3	0.05
B0564-8	0.033	0.087	0.647	234.0	71.0	100.0	64.7	0.5	17.2	6.3	100.0	100.0	100.0	2.6	0.52
B0692-4	0.018	0.002	0.365	251.7	75.4	98.3	74.0	1.1	28.0	20.4	100.0	98.0	98.3	0.4	0.08
B0766-3	0.029	0.056	0.624	95.8	64.6	100.0	71.3	0.6	17.9	7.1	100.0	100.0	87.1	0.2	0.02
B0767-2	0.019	0.001	0.326	287.5	47.6	95.0	59.0	0.9	23.2	14.8	100.0	97.0	96.7	0.8	0.26

Cultivar or Breeding Selection	Data From Field (2000)					Data From Tuber Inoculation									
	Relative AUDPC ¹			Yield ²		<i>P. infestans</i> (US -8 genotype)					<i>P. erythroseptica</i>		<i>A. solani</i>		
	Early Blight	Late Blight	Com-bined	Total cwt/A	% US#1 size	Incidence of infection (%)	% Sur-face area infected	Max. Lesion depth (cm)	Mean area affected ³ (cm ²)	Estimated volume affected ⁴ (cm ³)	Incidence of infection (%)	Mean area affected ⁵ (cm ²)	Incidence of infection (%)	Mean Lesion area (cm ²)	Estimated lesion volume ⁶ (cm ³)
BC0894-2	0.027	0.061	0.631	73.6	29.8	98.3	68.3	0.5	17.5	6.6	100.0	99.7	85.0	0.2	0.02
C31-5-115	0.024	0.064	0.626	267.2	73.5	96.7	57.0	0.6	17.6	6.7	100.0	100.0	63.3	0.2	0.01
C31-5-120	0.029	0.098	0.652	111.3	32.7	100.0	68.0	0.5	11.8	3.8	100.0	100.0	83.3	0.2	0.02
C75-5-297	0.029	0.028	0.560	285.6	54.7	100.0	52.7	0.4	16.6	5.1	100.0	97.3	91.7	0.3	0.02
Cherry Red (DT6063-1R)	0.018	0.046	0.614	139.4	67.7	100.0	73.3	0.6	21.4	8.8	100.0	99.7	91.7	0.3	0.05
CO86218-2	0.023	0.022	0.584	82.3	46.0	100.0	75.0	0.5	16.9	5.8	100.0	100.0	53.3	0.1	0.01
D. R. Norland	0.032	0.078	0.640	162.6	57.6	100.0	69.3	0.9	23.0	13.9	100.0	99.3	98.3	0.8	0.34
Eva (NY103)	0.022	0.037	0.605	139.4	69.6	100.0	67.7	0.7	21.2	9.8	100.0	99.7	93.3	0.3	0.08
Goldrush	0.025	0.049	0.614	113.7	48.1	100.0	99.3	1.6	31.4	33.4	100.0	99.0	81.7	0.1	0.02
J138 A12	0.014	0.004	0.443	363.0	83.6	100.0	71.3	0.7	27.0	12.7	100.0	83.7	98.3	0.2	0.04
Kennebec	0.014	0.041	0.592	431.7	80.4	100.0	75.7	0.5	33.9	12.8	100.0	94.7	83.3	0.3	0.03
Kenya Baraka	0.019	0.003	0.167	289.4	54.1	100.0	52.0	1.0	19.2	13.0	98.3	85.0	93.3	1.0	0.22
Keuka Gold (NY101)	0.016	0.057	0.621	122.2	60.4	91.7	71.7	0.6	18.1	8.1	100.0	96.7	76.7	0.2	0.02
Keystone Russet (AC83064-1)	0.015	0.080	0.626	92.0	29.6	100.0	87.0	0.4	24.4	7.4	100.0	100.0	88.3	0.9	0.13
KOM D542	0.023	0.016	0.489	207.2	32.1	100.0	89.7	0.9	22.7	14.0	100.0	99.0	96.7	1.7	0.40
LB1-26	0.012	0.003	0.316	403.7	78.7	66.7	28.3	0.9	12.5	9.9	76.7	65.7	100.0	0.2	0.03
LB1-302	0.010	0.001	0.298	302.0	69.7	98.3	76.7	1.0	31.0	21.9	100.0	96.0	75.0	0.2	0.02
LB2-101	0.006	0.000	0.181	493.7	89.1	96.7	47.7	0.5	21.2	6.7	100.0	90.3	76.7	0.2	0.02
LB2-102	0.010	0.001	0.261	350.4	15.6	100.0	32.3	0.3	9.8	2.1	100.0	93.0	88.3	0.4	0.10
LB2-299	0.017	0.013	0.461	191.5	33.1	98.3	51.2	0.5	16.8	6.3	100.0	98.3	92.5	1.0	0.82
LB2-47	0.023	0.022	0.478	195.5	64.9	100.0	73.7	0.5	31.2	10.9	100.0	98.7	100.0	0.5	0.05
LB2-49	0.027	0.000	0.392	260.1	60.7	66.7	33.0	0.4	17.0	6.4	100.0	87.3	100.0	0.6	0.13
LB2-74	0.012	0.001	0.328	301.0	83.2	96.7	71.7	0.9	42.1	21.4	100.0	77.3	98.3	3.6	0.76
LBR1R2R3R4	0.007	0.011	0.508	4.4	0.0	100.0	91.7	1.5	10.4	10.4	100.0	100.0	---	---	---
LBR2	0.016	0.031	0.597	19.8	6.7	100.0	87.9	0.7	15.7	6.6	91.7	89.4	---	---	---
LBR3 tbr	0.014	0.027	0.580	21.3	20.0	100.0	86.4	0.7	20.2	10.1	100.0	100.0	---	---	---
LBR4	0.012	0.042	0.608	56.3	27.1	100.0	64.0	0.5	13.2	4.5	100.0	100.0	62.5	0.2	0.04
LBR5	0.017	0.041	0.589	78.4	1.0	100.0	76.3	0.8	14.3	7.4	100.0	100.0	66.7	0.2	0.02
LBR7	0.022	0.009	0.536	109.4	25.5	100.0	67.7	0.7	16.0	7.5	91.7	82.7	47.5	0.1	0.01
LBR8	0.006	0.000	0.228	34.8	0.0	68.9	49.6	0.8	9.1	6.8	100.0	100.0	76.9	0.6	0.12
NorDonna	0.021	0.053	0.618	183.9	72.1	98.3	41.0	0.5	12.0	4.0	100.0	99.3	100.0	0.6	0.11
NY 112	0.022	0.089	0.643	387.7	80.9	95.0	62.0	0.8	26.0	15.4	100.0	96.0	81.7	0.3	0.05
NY 115	0.030	0.093	0.649	317.5	79.8	98.3	44.0	0.7	17.1	7.6	100.0	97.0	86.7	0.2	0.03
NY 120	0.033	0.055	0.633	442.7	95.2	96.7	68.3	0.6	26.6	10.9	100.0	98.0	90.0	0.3	0.02

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	Early Blight	Late Blight	Com-bined	Total cwt/A	% US#1 size	Incidence of infection (%)	% Sur-face area infected	Max. Lesion depth (cm)	Mean area affected ³ (cm ²)	Estimated volume affected ⁴ (cm ³)	Incidence of infection (%)	Mean area affected ⁵ (cm ²)	Incidence of infection (%)	Mean Lesion area (cm ²)	Estimated lesion volume ⁶ (cm ³)
NYS14-2	0.026	0.076	0.640	264.3	70.6	100.0	80.3	0.6	29.4	12.2	100.0	96.0	88.3	0.8	0.22
NYS28-2	0.023	0.105	0.652	342.7	71.6	100.0	68.3	0.6	26.7	11.0	100.0	99.3	75.0	0.2	0.02
NYS32-3	0.016	0.093	0.643	284.6	71.0	100.0	59.3	0.7	19.7	9.5	100.0	100.0	61.7	0.2	0.02
Perrichoi	0.025	0.003	0.133	394.9	71.7	100.0	32.7	0.7	11.2	5.6	93.3	78.3	98.3	0.5	0.11
Pike	0.023	0.039	0.609	113.3	57.9	97.9	37.6	0.4	9.6	2.8	100.0	100.0	53.3	0.1	0.01
Q237-25 (NY 121)	0.026	0.001	0.473	148.1	60.7	100.0	58.7	0.4	15.1	4.3	100.0	98.7	91.7	0.3	0.05
Ranger Russet	0.021	0.049	0.609	118.6	45.5	98.3	93.0	1.3	31.4	26.4	100.0	98.3	98.3	1.5	1.01
Red LaSoda	0.015	0.027	0.589	69.2	58.1	100.0	70.7	0.5	13.2	4.7	100.0	100.0	100.0	0.7	0.15
Russet Burbank	0.014	0.052	0.606	52.3	4.4	100.0	87.7	0.6	19.2	7.8	100.0	100.0	50.0	0.1	0.01
Russet Norkotah	0.017	0.051	0.620	46.5	26.8	100.0	96.9	1.2	26.2	20.8	100.0	100.0	100.0	0.1	0.01
Shepody	0.021	0.056	0.622	95.8	49.6	100.0	95.0	1.5	33.2	34.2	100.0	99.7	79.9	0.5	0.08
Silverton Russet (AC83064-6)	0.017	0.062	0.616	49.4	8.1	100.0	95.0	1.8	22.5	27.7	100.0	100.0	95.0	0.4	0.03
Snowden	0.026	0.050	0.620	98.0	62.0	91.7	73.7	1.0	17.7	12.1	100.0	100.0	80.0	0.2	0.04
Superior	0.019	0.072	0.633	203.3	75.3	100.0	52.7	0.6	17.5	7.1	100.0	100.0	91.7	0.5	0.15
T450	0.016	0.012	0.519	283.6	76.1	98.3	71.3	0.6	27.5	11.5	100.0	98.5	81.7	0.2	0.02
Umatilla	0.014	0.043	0.601	53.2	14.6	100.0	95.6	0.6	26.5	10.5	86.7	86.3	50.0	0.1	0.01
US-W 4056	0.021	0.022	0.550	66.8	23.3	95.8	85.5	0.8	20.0	11.7	100.0	98.7	92.5	2.3	0.71
W1100R	0.009	0.084	0.631	166.5	51.6	100.0	50.3	0.6	13.2	5.1	98.3	98.7	98.3	0.4	0.09
W84-75R	0.025	0.043	0.610	52.3	0.0	100.0	79.0	0.6	10.8	4.6	100.0	100.0	76.7	0.2	0.02
W870P90	0.023	0.057	0.622	100.7	56.6	100.0	84.7	0.9	24.2	14.9	100.0	99.3	48.3	0.1	0.01
W91-945a	0.017	0.034	0.586	110.4	59.0	100.0	73.7	0.6	19.6	8.0	100.0	98.3	85.0	0.9	0.30
Pr>F ⁸	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.14	< 0.01	0.01	< 0.01	< 0.01
LSD ⁸	0.012	0.029	0.046	82.8	23.1	8.7	16.4	0.3	7.3	6.9	NS	12.2	34.0	0.6	0.29

1 Relative area under the disease progress curve. Data for each observation 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% foliage infection for the entire season would produce a value of 1.0. All relative AUDPC values are expressed as the proportion of this value. Either decreased disease severity or later disease development will contribute to lower relative areas under the disease progress curve. Early blight and late blight AUDPC were calculated from June 27 - July 24 (with late blight values = 0 prior to July 10). By July 24, disease had progressed sufficiently that it was difficult to evaluate early blight and late blight separately for most plots. The combined AUDPC was calculated from early blight data for June 27 and July 3 and the combined foliar disease severity data for the remainder of the season, through September 5. (Biological and Cultural Tests: 16 On-Line Report 2001:PT66).

2 Yield from 5-ft of row, converted to cwt/A. Tubers were graded by hand. They were placed on a section of chain from a grading machine; those that passed through were classed as undersize (<1 7/8 in. diameter), and those that did not were classed as US#1 size or culls.

3 An estimate of the actual surface area of each tuber affected by late blight calculated from tuber dimensions and % of tuber surface showing late blight symptoms.

4 Estimated as one half the volume of an ellipsoid. The volume of an ellipsoid = 4/3 x area x depth. Area and maximum lesion depth were used for the calculation (one volume calculation was done for each tuber).

5 Potatoes were cut in half through the line of inoculation. This is the % of the surface of the cross section with symptoms of pink rot.

6 Estimated as one half the volume of an ellipsoid. The volume of an ellipsoid = 4/3 x area x depth. Area and maximum lesion depth were used for the calculation (volume was calculated for each lesion).

7 Not tested (too few tubers).

8 ANOVA was performed, and Fisher's protected least significant difference (LSD) was calculated. NS = not significant at the $P = 0.05$ (or $P = 0.10$) level. * = Differences between pairs of treatments were significant at $P = 0.10$ (but not at $P = 0.05$).