Oakes Irrigation Research Site

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Processing Potato Variety Trial

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Potato continues to be the most important vegetable and horticultural crop grown in North Dakota and the Northern Plains. Traditionally, North Dakota State University (NDSU) potato cultivar releases have been widely adapted and accepted, significantly impacting production in North Dakota, Minnesota, the Northern Plains, and often throughout North America. The NDSU potato breeding program was established more than 75 years ago as part of the North Dakota Agricultural Experiment Station (NDAES). Since 1930, 24 cultivars have been named and released by the NDAES, in cooperation with the USDA-ARS, and others; additional collaborative releases with state Agricultural Experiment Stations, the USDA-ARS, and Agriculture Canada have also occurred. As a leader in potato breeding, selection, and cultivar development, our goal is to identify and release superior, multi-purpose cultivars that are high yielding, possess multiple resistances to diseases, insect pests, and environmental stresses, have excellent processing and/or culinary quality, and that are adapted to production in North Dakota, Minnesota, and the Northern Plains. The potato improvement team emphasizes late blight, cold-sweetening, Colorado potato beetle, pink rot and *Pythium* leak, silver scurf, sugar end, and aphid and virus resistance breeding. In 2009, we initiated an accelerated effort to develop *Verticillium* wilt resistant cultivars with Dr. Neil Gudmestad's research program in Plant Pathology. This effort is in response to producer needs to aid in production of an economically and environmentally sustainable crop. In order to develop durable and long-term resistance to pests and stresses, breeding efforts continue to include germplasm enhancement to incorporate important pest resistances and improved quality traits via exploitation of wild species and wild species hybrids, in addition to the use of released cultivars and advanced germplasm from around the globe. Breeding, evaluation, and screening efforts are successful because of the cooperative and interdisciplinary efforts amongst the NDSU potato improvement team, the North Dakota State Seed Department (NDSSD), and with potato producers, research and industry personnel in ND, the Northern Plains, and North America.

In order to meet the needs of potato producers, the potato industry and consumers, we have established the following research objectives:

1) Develop potato (*Solanum tuberosum* Group Tuberosum L.) cultivars for North Dakota, the Northern Plains, and beyond, using traditional hybridization that are genetically superior for yield, market-limiting traits, and processing quality.
2) Identify and introgress into adapted potato germplasm, genetic resistance to major disease, insect, and nematode pests causing economic losses in potato production in North Dakota and the Northern Plains.
3) Identify and develop enhanced germplasm with resistance to environmental stresses and improved quality characteristics for adoption by consumers and the potato industry.

Research activities in 2009 ranged from research trial and seed production sites from Langdon to Oakes in North Dakota. Potato cultivar development is a long process requiring 10 to 20 years from hybridizing to naming and release. It involves interdisciplinary teams which evaluate multiple characteristics required by producers and the industry. As with other crops, potato is influenced by seed quality, cultural practices, and the environment. The NDSU potato improvement team works with the North Dakota State Seed Department to certify production from greenhouse seedling crops through advanced field generations. Potatoes in North Dakota are primarily produced from Trail County and north to the Canadian border, and from the Red River west to Towner County. However, during the past 20 plus years, production has moved westward to Kidder, Williams, Emmons and southward to Richland, Ransom and Sargent Counties. At these new and/or expanding locations, potatoes are grown on irrigated, sandy soils. The advantages of production in these areas include more consistent yield and quality

compared to non-irrigated production areas. In 2009, russet-skinned cultivars accounted for 61% of production, while white-skinned cultivars accounted for 23%, reds 15%, and yellow fleshed cultivars 1%. About 60% of potatoes produced in ND and MN are russets for French fry processing. Production in the Oakes area is primarily for processing by one of two North Dakota plants producing French fries and other frozen processed products. Yield and evaluation trials were grown at three irrigated (Larimore, Oakes, and Inkster) and two non-irrigated locations (Hoople and Crystal). The following narrative and tables summarize our 2008 and 2009 research efforts at Oakes. The Oakes processing trials evaluated 15 and 20 clones, respectively in 2008 and 2009. Advancing selections with processing potential from the NDSU potato breeding program were compared to several industry standards and new cultivars developed by the Tri-State program (ID, WA, OR). These replicated trials aid in identifying superior selections with potential for naming and release, assist in identification of strengths and shortcomings of new cultivars and advancing selections, and facilitate development of cultivar specific management profiles, in addition to providing adaptation information.

The highlight of 2009 was the release of AOND95249-1Russ as Dakota TrailBlazer, in December. It offers producers and processors *Verticillium* wilt, pink rot, sugar end, and late blight (field) resistance, in addition to outstanding French fry/frozen processing and tablestock properties. Dakota TrailBlazer has very high specific gravity, long dormancy, and cold sweetening resistance, processing reliably from 42F storage. The most promising dual-purpose russet selections in our program include ND8229-3, AOND95292-3Russ, and ND8068-5Russ; all possess excellent appearance and processing qualities. Characteristics of these selections are summarized in the pages following the 2009 research evaluation tables.

Finally, we would like to acknowledge the encouragement, funding, and resources received from the Oakes area producers, the NPPGA and MN Area II Potato Research Council, JR Simplot Co., Cavendish Farms, and RD Offutt Co. Farm Division, certified seed from Justin Dagen, Mike Jorde, and RD Offutt Co., and the assistance of Leonard Besemann and Heidi Eslinger in maintaining the research plot.

Location:	Oakes Irrigation Research Site, Oakes, ND
Soil type:	Sandy loam
Dates:	
Planting:	April 29, 2008
Vine Kill:	October 8, 2008
Harvest:	October 8, 2008
Days to harvest:	163
Plot information:	
Row width:	36 inches
Seed spacing:	12 inches
Hills per plot:	20
Replicates:	4
Method of planting:	2-row Harriston plot planter; a fungicide seed piece treatment (Maxim MZ) was applied at cutting.
Method of vine kill:	Flailing

Method of harvest: Single row digger, pickup by hand

Fertilizer: April 22 – 28 lbs. N/ac, 44 lbs P_20_5/ac, 55 lbs K_20/ac, 22 lbs S/ac as 10-16-20-8
June 25 – 30 lbs N/ac applied as 32-0-0 via stream-bar
July 1 – 30 lbs N/ac applied as 32-0-0 via stream-bar
July 10 – 30 lbs N/ac applied as 32-0-0 via stream-bar
July 16 – 20 lbs N/ac applied as 32-0-0 via stream-bar
July 24 – 20 lbs N/ac applied as 32-0-0 via stream-bar

Herbicide applied: June 25 – Matrix (1.5 oz/ac) + Sencor DF (14 lb/ac) + NIS (0.25% v/v). Also handweeded to control weeds.

Irrigation: Linear – 13.2 inches over season per ET

Fungicides applied: July 10 – Dithane (2 lbs/ac)
July 17 – Amistar (5 oz/ac)
July 25 – Dithane (2 lbs/ac)
July 31– Amistar (5 oz/ac)
Aug 7– Dithane (2 lbs/ac)
Aug 22– Dithane (2 lbs/ac)

Insecticides applied: Belay (12 oz/ac) applied in furrow with planter.

Table 1. Agronomic and quality evaluations for advanced processing selections and cultivars, full season, Oakes, 2008.

Clone	% Stand	Stems per Plant	Tubers per plant	Specific Gravity	% Hollow Heart[3]
1. AOND95249-1Russ	88	1.7	4.8	1.1133	10
2. AOND95292-3Russ	91	2.2	4.8	1.0877	9
3. ND8068-5Russ	85	2.8	3.8	1.0954	0
4. ND8229-3	78	1.7	5.7	1.0918	3
5. ND049289-1Russ	96	2.6	4.7	1.0917	1
6. Bannock Russet	98	2.7	5.9	1.0973	4
7. A9304-10	95	2.2	5.4	1.0928	1
8. GemStar Russet	90	2.1	4.6	1.0900	19
9. Premier Russet	90	3.5	6.3	1.0993	8
10. Ranger Russet	89	2.2	5.2	1.0975	3
11. Russet Burbank	98	2.9	6.4	1.0878	6
12. Russet Norkotah	89	2.4	5.7	1.0789	6
13. Shepody	95	2.1	3.6	1.0823	3
14. Silverton Russet	94	2.6	5.7	1.0821	0
15. Umatilla Russet	95	2.8	6.8	1.0906	0
Mean	91	2.4	5.3	1.0919	5
LSD ($\propto$=0.05)	12	0.5	0.9	0.0083	9

[1] Vine size – scale 1-5, 1 = small, 5 = large.
[2] Vine maturity – scale 1-5, 1 = early, 5 = late.
[3] Includes hollow heart and brown center

Table 2. Yield and grade for advanced processing selections and cultivars, full season, Oakes, 2008.

Clone	Total Yield Cwt/A	US No. 1 Cwt/A	US No. 1 %	0-4 oz. %	4-6 oz. %	6-12 oz. %	>12 oz. %	Culls %
1. AOND95249-1Russ	283	258	91	8	13	54	23	1
2. AOND95292-3Russ	244	206	84	10	26	53	5	6
3. ND8068-5Russ	98	45	46	54	34	12	0	0
4. ND8229-3	222	183	82	16	25	54	3	2
5. ND049289-1Russ	326	283	87	6	13	40	33	8
6. Bannock Russet	329	275	83	11	18	54	11	5
7. A9304-10	320	280	87	9	15	52	19	4
8. GemStar Russet	272	217	80	9	15	45	20	11
9. Premier Russet	230	162	71	28	27	40	3	2
10. Ranger Russet	212	151	71	18	22	42	7	11
11. Russet Burbank	297	142	47	16	17	25	6	37
12. Russet Norkotah	242	188	78	21	19	40	18	1
13. Shepody	244	203	84	5	10	57	27	11
14. Silverton Russet	277	228	82	16	27	55	10	2
15. Umatilla Russet	212	110	52	46	33	29	0	2
Mean	254	195	75	18	21	41	12	7
LSD ($\propto$=0.05)	44	41	8	6	8	11	10	6

Table 3. Fry evaluation following harvest and after 8 weeks storage at 45°F, full season trial, Oakes, 2008.

Clone	Blackspot Bruise[1]	Fry Color[2]	Stem-end Color[3]	% Sugar End	Fry Color[2]	Stem-end Color[3]	% Sugar End
		Field Fry			45°F		
1. AOND95249-1Russ	1.5	0.30	0.30	0	0.10	0.10	0
2. AOND95292-3Russ	1.3	0.61	0.61	0	0.38	0.46	8
3. ND8068-5Russ	3.4	0.40	1.90	59	0.20	0.53	33
4. ND8229-3	1.4	0.45	0.62	8	0.15	0.15	0
5. ND049289-1Russ	2.1	0.45	0.87	17	0.20	0.40	17
6. Bannock Russet	2.3	0.35	0.35	0	0.15	0.38	8
7. A9304-10	2.0	0.63	0.83	17	0.10	0.22	8
8. GemStar Russet	1.4	0.25	0.48	8	0.10	0.30	8
9. Premier Russet	2.0	0.30	0.63	17	0.15	0.38	8
10. Ranger Russet	2.5	0.75	1.25	25	0.48	0.78	17
11. Russet Burbank	2.1	0.45	1.82	50	0.30	1.83	75
12. Russet Norkotah	2.0	0.96	1.38	33	0.65	1.03	0
13. Shepody	1.4	0.70	1.58	42	0.44	1.64	50
14. Silverton Russet	1.3	0.35	0.74	17	0.15	0.15	0
15. Umatilla Russet	1.8	0.45	0.62	17	0.35	0.78	25
Mean	1.9	0.49	0.93	20	0.26	0.61	17
LSD (α = 0.05)		0.31	1.08	37	0.30	0.94	39

[1] Blackspot bruise determined by the abrasive peel method, scale 1-5, 1=none, 5=severe.

[2] Fry color scores: 0.1 corresponds to 000, 0.3 corresponds to 00, 0.5 corresponds to 0, 1.0 equals 1.0 and subsequent numbers follow rating scale 000 to 4.0.

[3] Any stem end darker than the main fry is considered a sugar end, the worst case scenario. Industry rates a 3.0 and higher as a sugar end.

Location:	Oakes Irrigation Research Site, Oakes, ND
Dates:	
Planting:	May 2, 2009
Vine kill:	Flailed on September 7, 2009
Harvest:	October 8, 2009
Days to vine kill:	128 days
Days to harvest:	159 days
Plot information:	
Row width:	36 inches
Seed spacing:	12 inches
Hills per plot:	20
Replicates:	4
Method of planting:	2-row Harriston plot planter, Admire Pro (8 oz/ac) applied in-furrow. Seed piece treatment (Tops MZ) was applied at cutting on April 28.
Method of harvest:	Machine – single row digger and hand pick up
Irrigation:	Linear – 12.05 inches applied May through September per ET
Fertilizer:	April 21 – 30 lbs N/ac, 43 lbs P_2O_5/ac, 52 K_2O lbs/ac, 22 lbs S/ac as 11-16-20-8 May – 50 lbs N/ac applied as 32-0-0 June 22 – 10 lbs N/ac applied as 28-0-0 via stream-bar June 29 – 20 lbs N/ac applied as 28-0-0 via stream-bar July 6 – 30 lbs N/ac applied as 28-0-0 via stream-bar July 15 – 20 lbs N/ac applied as 28-0-0 via stream-bar July 20 – 20 lbs N/ac applied as 28-0-0 via stream-bar July 29 – 10 lbs N/ac applied as 28-0-0 via stream-bar Aug. 3 – 10 lbs N/ac applied as 28-0-0 via stream-bar
Herbicide applied:	June 9 – Matrix (1 oz/ac) + Lexone (⅓ lb/ac) + Dual (1½ pt/ac) + NIS (0.125% v/v)
Fungicides applied:	June 26 – Dithane (2 lbs/ac) July 2 – Amistar (5 oz/ac) July 11 – Dithane (2 lbs/ac) July 17 – Amistar (5 oz/ac) July 24 – Dithane (2 lbs/ac) July 31 – Amistar (5 oz/ac) Aug 5 – Dithane (2 lbs/ac) Aug 14 – Bravo ZN (2 pts/ac) Aug 21 – Bravo ZN (2 pts/ac) Aug 28 – Bravo ZN (2 pts/ac) Sept 3 – Bravo ZN (2 pts/ac)
Comments:	Hail week of June 14

Table 1. Agronomic and quality evaluations for advanced processing selections and cultivars, full season, Oakes, 2009.

Clone	% Stand	Vine Size[1]	Vine Maturity[2]	Stems per Plant	Tubers per plant	Specific Gravity[3]	% Hollow Heart[4]	Black-spot Bruise[5]
1. AOND95249-1Russ	99	4.5	4.0	1.7	6.0	1.1082	0	2.1
2. AOND95292-3Russ	99	2.8	3.8	1.8	5.0		25	1.4
3. ND6400C-1Russ	98	4.8	3.5	2.6	10.8	1.1019	0	1.7
4. ND6164C-9Russ	94	2.3	1.3	1.5	5.0	1.0716	0	3.1
5. ND6169-10Russ	96	3.5	1.5	1.7	5.6	1.0731	0	3.1
6. ND8068-5Russ	100	1.8	1.0	2.2	5.2	1.0949	0	3.4
7. ND8229-3	96	2.8	3.0	1.8	4.7	1.0934	38	1.2
8. ND049546-15Russ	91	1.8	2.8	1.2	3.5	1.0905	0	2.8
9. ND049589B-5Russ	88	3.3	4.0	1.6	6.1	1.0967	0	1.5
10. WND8624-2Russ	96	2.8	3.0	1.9	7.1	1.0841	0	3.2
11. WND8625-2Russ	98	4.0	1.3	2.1	5.6	1.0830	5	1.9
12. WND8625-3Russ	98	4.0	2.5	2.2	5.6	1.0781	6	1.1
13. Bannock Russet	93	4.3	4.0	2.6	7.1	1.0902	37	1.8
14. Blazer Russet	96	3.3	1.8	3.3	7.3	1.0832	44	2.1
15. Premier Russet	99	3.8	3.8	2.0	5.4	1.0929	73	2.8
16. Ranger Russet	94	3.5	2.5	2.2	5.7	1.0954	0	4.3
17. Russet Burbank	99	4.3	3.3	2.2	5.9	1.0859	5	2.9
18. Russet Norkotah	94	3.0	1.0	2.0	6.6	1.0784	27	2.9
19. Shepody	100	4.5	2.3	2.0	5.1	1.0892	6	1.9
20. Umatilla Russet	95	3.5	1.8	2.8	9.4	1.0874	3	2.4
Mean	96	3.4	2.6	2.1	6.1	1.0988	13	2.4
LSD ($\propto$=0.05)	8	1.0	0.8	0.4	1.5	0.1285	15	0.6

[1] Vine size – scale 1-5, 1 = small, 5 = large.
[2] Vine maturity – scale 1-5, 1 = early, 5 = late.
[3] Determined using weight-in-air, weight-in-water method.
[4] Hollow heart includes brown center.
[5] Blackspot bruise determined by the abrasive peel method, scale 1-5, 1=none, 5=severe.

Table 2. Yield and grade for advanced processing selections and cultivars, full season, Oakes, 2009.

Clone	Total Yield Cwt/A	US No. 1 Cwt/A	US No. 1 %	0-4 oz %	4-6 oz %	6-12 oz %	>12 oz %	Culls %
1. AOND95249-1Russ	418	382	92	5	13	56	23	3
2. AOND95292-3Russ	323	285	88	6	16	60	12	6
3. ND6400C-1Russ	380	240	63	35	29	31	3	3
4. ND6164C-9Russ	299	275	92	6	17	63	12	2
5. ND6169-10Russ	420	386	92	5	8	47	37	3
6. ND8068-5Russ	261	212	81	18	31	43	7	2
7. ND8229-3	304	260	85	6	14	58	12	9
8. ND049546-15Russ	256	208	80	3	11	47	23	16
9. ND049589B-5Russ	374	351	94	5	15	59	20	1
10. WND8624-2Russ	451	424	94	6	18	55	21	0
11. WND8625-2Russ	344	312	90	9	19	47	24	1
12. WND8625-3Russ	305	252	83	15	16	47	19	2
13. Bannock Russet	481	437	91	7	12	45	33	3
14. Blazer Russet	430	388	90	8	21	57	13	2
15. Premier Russet	403	365	91	6	12	50	30	3
16. Ranger Russet	354	321	90	6	17	55	19	3
17. Russet Burbank	412	304	74	9	14	33	27	16
18. Russet Norkotah	422	394	93	7	14	57	23	0
19. Shepody	440	387	88	3	8	44	36	9
20. Umatilla Russet	419	327	78	21	32	39	7	2
Mean	374	325	86	9	17	50	20	4
LSD ($\propto$=0.05)	90	85	7	5	9	9	14	6

Table 3. Shatter bruise potential and French fry evaluations following harvest and after 8 weeks storage at 45F, full season trial, Oakes, 2009.

Clone	Shatter Bruise[1]	Fry Color[2]	Stem-end Color	% Sugar End[3]	Fry Color[2]	Stem-end Color	% Sugar End[3]
		Field Fry			Following 8 wks. at 45°F		
1. AOND95249-1Russ	4.4	0.63	1.09	58	0.70	.078	17
2. AOND95292-3Russ	1.6	0.58	0.58	0	0.30	0.30	0
3. ND6400C-1Russ	1.5	0.40	0.53	25	0.44	0.53	17
4. ND6164C-9Russ	2.1	1.04	1.34	17	1.13	1.33	42
5. ND6169-10Russ	2.3	1.00	1.38	25	1.79	1.79	0
6. ND8068-5Russ	2.0	0.40	0.53	25	0.35	0.49	17
7. ND8229-3	1.8	0.45	0.45	0	0.40	0.40	0
8. ND049546-15Russ	1.5	0.45	0.96	67	0.35	0.69	33
9. ND049589B-5Russ	2.0	0.35	0.41	8	0.25	0.31	8
10. WND8624-2Russ	2.3	0.88	0.88	0	1.38	1.5	8
11. WND8625-2Russ	2.7	0.84	0.92	17	0.58	0.63	8
12. WND8625-3Russ	2.0	2.00	2.00	0	1.54	1.54	0
13. Bannock Russet	1.9	0.79	1.09	25	1.71	2.0	25
14. Blazer Russet	2.4	1.50	1.50	0	0.88	1.17	25
15. Premier Russet	1.3	0.48	0.48	0	0.49	0.79	13
16. Ranger Russet	2.3	0.58	0.94	67	0.75	1.17	25
17. Russet Burbank	1.4	0.71	1.00	42	0.96	1.79	67
18. Russet Norkotah	2.1	1.25	1.42	17	2.0	2.0	0
19. Shepody	1.8	1.38	1.58	25	1.04	1.50	42
20. Umatilla Russet	1.3	0.63	1.08	75	0.63	0.75	25
Mean	2.0	0.82	1.01	25	0.89	1.08	19
LSD (α = 0.05)	2.0	0.61	0.59	43	0.66	0.79	47

[1]Shatter bruise is evaluated using a bruising chamber with digger chain link baffles. Tubers are stored at 45°F prior bruising. Shatter bruises are rated on a scale of 1-5, with 1 = none and 5 = many and severe.
[2]Fry color scores: 0.1 corresponds to 000, 0.3 corresponds to 00, 0.5 corresponds to 0, 1.0 equals 1.0 and subsequent numbers follow rating scale 000 to 4.0.
[3]Any stem end darker than the main fry is considered a sugar end, the worst case scenario. The processing industry defines a sugar end as a 3.0 or darker.