

Oakes Irrigation Research Site

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Potato Variety Development Agronomic and Storage Trials Oakes, ND – 2009

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Summary

Twelve potato varieties were grown at the Oakes Irrigation Research Site to determine their potential to provide high-quality raw product to local processors. Total yields of 395 – 520 cwt/acre were achieved during 2009; however, usable yields ranged from 154 – 467 cwt/acre depending upon variety. MN18747 (467 cwt/a), Alpine Russet (466 cwt/a), Umatilla Russet (427cwt/a), and Russet Burbank (421 cwt/a) had the highest usable yields of the varieties tested, while Premier Russet (154 cwt/a) and Gemstar Russet (232 cwt/a) had the lowest. Specific gravities were acceptable for all varieties tested, except MN18747 (1.070) which was too low and could lead to crop rejection. Dakota Trailblazer, Gemstar Russet, and MN18747 had the best fry scores at harvest with 100% 0 color using the USDA fry color chart. Further studies investigating nitrogen fertilization of promising new varieties, such as Alpine Russet and Dakota Trailblazer are warranted in south-eastern North Dakota.

Introduction:

One of the goals of the extension potato agronomy program at North Dakota State University and the University of Minnesota is to provide growers with research-based information that can be used to make well informed production decisions. The objective of this project was to evaluate advanced breeding clones and recently-released potato varieties grown in south-eastern North Dakota for potential use as frozen process raw product. Specific objectives were to evaluate and determine if varietal differences existed in: 1)Total yield, 2)Tuber size profile distribution, 3)Usable yield by size class, 4)Specific gravity, 5)Tuber length:width ratio, 6)Internal tuber defects, 7)External tuber defects, 8) Percent usable yield, 9)Tuber sucrose and glucose levels following 0, 3, 6, and 9 months storage, and 10) Fry color following 0, 3, 6, and 9 months storage.

General Materials and Methods:

This study was conducted at the Oakes Irrigation Research Site on a Maddock sandy loam soil. The area was previously cropped to field corn (2006 & 08) and soybean (2007). Following corn harvest, the spring tillage practices included using a double disc with coulter and airway to a depth of 8-10 inches. Two additional field cultivations were performed on 1 May to incorporate pre-plant fertilizer.

Fertility and Irrigation - The residual soil nitrogen from the previous crop of field corn was 34 lb/acre. Soil sulfur tested medium while phosphorus and potassium were very high. A pre-plant, broadcast application of 30N-43P-52K-22S was applied as 11-26-20-8 on 21 April. During planting, an additional 20N-70P-0.5Zn-0.1B was applied as a liquid band below the seed piece. Immediately before hilling on 28 May, 50N was applied as 28-0-0. Subsequent stream-bar applications of 10, 20, 30, 20, 20, 10, and 10 lb/acre of nitrogen as 28-0-0 were made on 22, 29 June, 6, 15, 20, 29 July, and 3 August, respectively. Overhead sprinkler applications

during May (1.0"), June (1.5"), July (4.3"), August (4.0"), and September; (0.75") supplemented natural rainfall during the growing season.

Pest management - Pink rot (*Phytophthora erythroseptica*) was controlled by applying 0.42 oz/1000 linear ft row Ridomil Gold EC (mefenoxam). Following the final cultivation on 9 June, weeds were controlled with 1 oz/acre Matrix (rimsulfuron), 1.5 pt/acre Dual II Magnum (metolachlor), and 0.33 lb/acre Lexone (metribuzin). Early and Late blight were controlled with 2 lb/acre Dithane (26 June, 11, 24 July, & 5 Aug), 5 oz/acre Amistar (2, 17, and 31 July), and 2 pt/acre Bravo Zn (14, 21, 28 Aug & 3 September). Early season Colorado potato beetle and aphid control was achieved with an in-furrow application of 12 oz/acre of Belay (clothianidin).

Treatment Materials and Methods

Plot design, planting, and harvest – Treatments (potato variety) were assigned in a randomized complete block design with four replications. Individual plots were 2 potato rows (6') wide x 20 pieces (20') long. Certified potato seed of all varieties tested were hand cut into 2-2.5 ounce pieces on 4 May, treated with Maxim MZ, and suberized for 7 days at 50°F and 95% relative humidity. Plots were planted on 11 May with a 2-row, assist-feed Harriston planter. Vines were mechanically flailed on 7 September and all potatoes were harvested from each plot using a single-row Grimme harvester.

Yield evaluations – Following harvest, all potatoes were transported to the USDA Potato Worksite in East Grand Forks, MN, where total yield, size profile distribution, usable yield by size class, specific gravity, and length:width ratios were determined.

Quality evaluations – Quality evaluations were done at both the USDA Potato Worksite in East Grand Forks, MN, and by Ag World Support Systems at J.R. Simplot in Grand Forks, ND.

Statistical analysis – Analysis of variance was performed using PROC GLM in SAS v.9.3 and when significant, means were separated using least significant differences.

Results:

Objective 1 – (Total Yield)

Total yields achieved during 2009 ranged from 395 – 520 cwt/acre and analysis of variance indicated significant differences existed between the twelve varieties tested (Table 1). Russet Burbank had the highest total yield numerically, but was statistically equal to MN18747, Alpine Russet, and Umatilla Russet. Bannock Russet, Dakota Trailblazer, Gemstar Russet, MN02419, MN15620, Premier Russet, Prospect, and Ranger Russet all had significantly lower total yields than Russet Burbank.

Objective 2 – (Tuber size profile)

Analysis of variance indicated significant differences between varieties existed in all tuber size classes (< 3, 3 – 4, 4 – 6, 6 – 8, 8 – 10, and over 10 ounces) evaluated (Table 1). Russet Burbank, Dakota Trailblazer, Gemstar Russet, MN18747, Premier Russet, and Prospect had the lowest yield of tubers less than 3 ounces, while MN 15620 and Umatilla Russet had the highest. MN02419, MN15620, MN18747, and Umatilla Russet had the highest yield of 6 – 8 ounce tubers, and Alpine Russet, Russet Burbank, MN02419, MN15620, MN18747, and Umatilla Russet had the highest yield of 8 – 10 ounce tubers. Alpine Russet and Gemstar Russet had the highest yield of tubers greater than 10 ounces.

Objective 3 – (Usable Yield over 3 oz) – Usable yields ranged from 363 – 473 cwt/acre and analysis of variance indicated significant differences existed (Table 2). Alpine Russet, Russet Burbank, MN18747, and Umatilla Russet had the highest usable yield of varieties tested. Bannock Russet, Dakota Trailblazer, Gemstar, Premier Russet, and Prospect had significantly lower usable yield than Russet Burbank. Russet Burbank, Dakota Trailblazer, Gemstar Russet, and Prospect had the highest percentage of usable yield above 6 ounces, while MN02419, MN15620, MN18747, Ranger Russet, and Umatilla Russet had a lower usable yield greater than 6 ounces compared to Russet Burbank. Dakota Trailblazer, Gemstar Russet, Premier Russet, and Prospect had the highest percentage of usable yield above 10 ounces and they were significantly greater than Russet Burbank.

Objective 4 – (Specific gravity)

Average (Table 2) and size class (Table 3) specific gravities for each variety were determined at the USDA Potato Worksite in East Grand Forks, MN. Russet Burbank had an average specific gravity of 1.087 during 2009. All varieties except MN18747 (1.070), Prospect (1.081), Ranger Russet, (1.092), and Dakota Trailblazer (1.096) had gravities of 1.084 – 1.088. The specific gravity of MN18747 is below the rejectable level of 1.075 used by some processors.

Objective 5 – (Length:Width ratio)

The length:width ratio describes the overall shape of potato tubers and is a good indicator of french fry length and process plant recovery. Round tubers have a L:W ratio near 1.0 and result in short french-fries with low recovery rates. As a result, varieties with low L:W ratios are not desirable for the french-fry industry. As the L:W ratio increases to 1.50 – 1.75 tubers are described as blocky or oblong. L:W ratios above 1.75 are described as long or elongated and result in long french-fries with the greatest recovery. Average (Table 2) and size class specific (Table 3) L:W ratios were determined for all varieties evaluated. During 2009, Russet Burbank had an average L:W ratio of 2.0. The blockiest varieties (L:W ratio = 1.6 – 1.7) were Alpine Russet, Bannock Russet, Dakota Trailblazer, MN15620, MN18747, and Prospect. The only variety with a greater L:W ratio than Burbank was Ranger Russet. The most elongated varieties (L:W > 1.7) were Russet Burbank, Gemstar Russet, MN02419, Premier Russet, Ranger Russet, and Umatilla Russet.

Objectives 6 – (Internal defects), 7 – (External defects), and 8 – (Percent usable yield)

Following sizing at the USDA facility in East Grand Forks, all replicates were combined and a 500 lb sample of each variety was delivered to Ag World Support Systems at J.R. Simplot in Grand Forks, ND immediately following harvest for quality evaluations (Table 4). The most prominent internal defect was hollow heart and ranged from 0 – 57% depending upon variety. Russet Burbank (10%), Bannock Russet (15%), Gemstar Russet (38%), and Premier Russet (57%) all had levels of hollow heart (>9%) that could lead to crop rejection by the processor. External defects ranged from 2 – 8% in 2009, with soft rot and sunburn being the most prevalent cause. Total usables ranged from a low of 36 to a high of 93% in the varieties tested. Alpine Russet, Dakota Trailblazer, MN18747, Prospect, and Ranger Russet all had over 90% usables, compared to 81% for Russet Burbank.

Objective 9 – (Tuber sucrose and glucose levels following 0, 3, 6, and 9 months storage)

The results for the sucrose and glucose levels were not available at the time the report was written, but will be included in a final report presented in August.

Objective 10 – (Fry color following 0, 3, 6, and 9 months storage)

Following sizing at the USDA facility in East Grand Forks, all replicates for each variety were combined and tuber samples were taken for fry analysis following 0, 3, 6, and 9 months storage at 48°F. Data for the 0 month fry time is reported here. Fries from Russet Burbank showed some color with only 83% having a score of 0 on the USDA Color Chart, while 16% had a color score of 2. All varieties tested, except Umatilla Russet (75%), had a higher percentage of 0 color fries than Russet Burbank during 2009. One-hundred percent of fries from Dakota Trailblazer, Gemstar, and MN18747 had a color score of 0, the best possible score.

Table 1. Total yield and size profile distribution of twelve potato varieties grown at the Oakes irrigated research site in 2009¹.

Entry	Yield (cwt/acre)							Cull
	Total	< 3 oz	3 – 4 oz	4 – 6 oz	6 – 8 oz	8 – 10 oz	> 10 oz	
Alpine	507	29	15	55	71	72	237	30
Bannock	411	35	7	57	62	65	190	5
Burbank	520	26	11	42	69	78	227	68
Dakota Trailblazer ²	411	17	4	32	47	68	213	32
Gemstar	415	20	4	30	33	38	268	24
MN02419	457	40	18	86	95	81	128	9
MN15620	463	66	23	81	85	83	117	10
MN18747	508	22	17	69	85	75	227	13
Premier	427	19	10	37	47	55	217	43
Prospect	395	17	9	35	56	53	217	10
Ranger	457	29	14	53	74	70	185	33
Umatilla	496	65	24	98	94	71	136	9
LSD (alpha=0.10) ³	41	9	5	11	16	13	33	16

¹Potatoes were planted on 8 May and harvested on 8 September, 2009. Evaluations made by the NDSU Extension Potato Program at the USDA Potato Worksite in East Grand Forks, MN immediately following harvest.

²Dakota Trailblazer tested as AOND95249-1Russ.

³Two values within the same column are significantly different if the difference is equal-to or greater- than the LSD value.

Table 2. Total yield, Usable yield, Specific gravity, and Length:width ratio of twelve potato varieties grown at the Oakes irrigated research site in 2009¹.

Entry	Total Yield		Usable Yield		Specific Gravity ⁵ L:W ratio ⁶	
	(cwt/acre)	Cwt/acre ²	% > 6 oz ³	% > 10 oz	Average of all sizes	
Alpine	507	448	85	53	1.087	1.7
Bannock	411	370	86	52	1.087	1.7
Burbank	520	426	88	53	1.087	2.0
Dakota Trailblazer ⁷	411	362	91	59	1.096	1.7
Gemstar	415	371	91	72	1.084	1.8
MN02419	457	407	74	31	1.088	1.9
MN15620	463	388	73	29	1.087	1.7
MN18747	508	473	82	48	1.070	1.6
Premier	427	365	87	59	1.085	1.8
Prospect	395	368	89	58	1.081	1.6
Ranger	457	395	83	46	1.092	2.1
Umatilla	496	421	71	32	1.087	1.9
LSD (alpha=0.10) ⁸	41	44	3	6		

¹Potatoes were planted on 8 May and harvested on 8 September, 2009. Evaluations made by the NDSU Extension Potato Program at the USDA Potato Worksite in East Grand Forks, MN immediately following harvest.

²Cwt/acre of tubers greater than 3 oz.

³ and ⁴Percentage of usable yield greater than 6 and 10 oz, respectively.

⁵Specific gravity = [Weight in air/(Weight in air - Weight in water)].

⁶L:W ratio = Length of tuber/Width of tuber.

⁷ Dakota Trailblazer tested as AOND95249-1Russ.

⁸Two values within the same column are significantly different if the difference is equal-to or greater- than the LSD value.

Table 3. Relationship between Tuber size, Specific gravity and Length:width ratio for twelve potato varieties grown at the Oakes irrigated research site in 2009¹.

Entry	Specific Gravity ²				Length:Width Ratio ³			
	4-6 oz	6-8 oz	8-10 oz	> 10 oz	4-6 oz	6-8 oz	8-10 oz	> 10 oz
Alpine	1.082	1.091	1.085	1.088	1.6	1.7	1.7	1.9
Bannock	1.087	1.087	1.090	1.084	1.6	1.7	1.7	1.7
Burbank	1.083	1.092	1.089	1.082	1.8	2.0	2.0	2.1
Dakota Trailblazer ⁴	1.095	1.091	1.099	1.098	1.5	1.8	1.7	1.9
Gemstar	1.086	1.084	1.083	1.082	1.6	1.7	1.9	1.9
MN02419	1.086	1.090	1.089	1.088	1.6	2.1	1.8	2.0
MN15620	1.082	1.087	1.092	1.088	1.6	1.6	1.7	1.8
MN18747	1.069	1.069	1.073	1.071	1.6	1.5	1.6	1.8
Premier	1.083	1.089	1.093	1.076	1.6	1.8	1.8	2.0
Prospect	1.087	1.079	1.079	1.081	1.5	1.6	1.6	1.7
Ranger	1.096	1.092	1.090	1.091	2.1	2.0	2.1	2.3
Umatilla	1.085	1.088	1.087	1.086	1.9	1.9	1.9	2.0

¹Potatoes were planted on 8 May and harvested on 8 September, 2009. Evaluations made by NDSU Extension Potato Program at the USDA Potato Worksite in East Grand Forks, MN immediately following harvest.

²Specific gravity = [Weight in air/(Weight in air - Weight in water)] of ten 4-6, 6-8, 8-10, and over 10 oz tubers, respectively.

³L:W ratio = Length/Width of ten 4-6, 6-8, 8-10, and over 10 oz tubers, respectively.

⁴Dakota Trailblazer tested as AOND95249-1Russ.

Table 4. Total usable, Undersize, Internal defects, and External defects of twelve potato varieties grown at the Oakes irrigated research site in 2009¹.

Entry	Total Usable²	Undersize³	Internal Defects (%)		External Defects (%)		
	<i>Percent</i>	<i>Percent</i>	<i>Brown</i>	<i>Center Hollow heart</i>	<i>Other</i>	<i>Soft Rot</i>	<i>Sunburn</i>
Alpine	92	5	0	0	1	0	2
Bannock	78	5	0	15	1	3	1
Burbank	81	3	0	10	3	1	1
Dakota Trailblazer ⁴	93	1	0.7	2	1	1	1
Gemstar	56	2	0	38	2	1	1
MN02419	84	7	0	6	2	1	2
MN15620	85	12	0	0	1	0	2
MN18747	92	4	0	0	2	1	1
Premier	36	1	0	57	6	2	0
Prospect	93	4	0	0	0	0	2
Ranger	91	4	0.7	0	2	1	1
Umatilla	86	9	0	1	1	1	2

¹Potatoes were planted on 8 May and harvested on 8 September, 2009. Evaluations made by Ag World Support Systems at J.R. Simplot in Grand Forks, ND immediately following harvest.

²Total Usable = {Total yield – (undersize + internal defects + external defects)}

³Undersize = Tubers less than 3 ounces.

⁴Dakota Trailblazer tested as AOND95249-1Russ.

Table 5. Specific gravity, Percent solids, USDA fry color, High sugar, and Sugar end analysis of twelve potato varieties grown at the Oakes irrigated research site in 2009¹.

Entry	Specific Gravity ²	Solids (%)	USDA Fry Color ³ (%)					High Sugar ⁴ (%)	Sugar End ⁵ (%)
			0	1	2	3	4		
Alpine	1.084	21.7	93	5	1	1	0	1	0
Bannock	1.087	22.4	97	3	0	0	0	0	0
Burbank	1.083	21.5	83	1	16	0	0	0	0
Dakota Trailblazer	1.101	25.8	100	0	0	0	0	0	0
Gemstar	1.083	21.5	100	0	0	0	0	0	0
MN02419	1.086	22.1	98	2	0	0	0	0	0
MN15620	1.084	21.7	98	2	0	0	0	0	0
MN18747	1.068	18.3	100	0	0	0	0	0	0
Premier	1.085	22.0	96	0	0	4	0	4	0
Prospect	1.080	20.9	97	1	1	0	1	1	3
Ranger	1.091	23.2	98	2	0	0	0	0	0
Umatilla	1.083	21.5	75	25	0	0	0	0	2

¹Potatoes were planted on 8 May and harvested on 8 September, 2009. Evaluations made by Ag World Support Systems at J.R. Simplot in Grand Forks, ND immediately following harvest.

²Specific gravity = [Weight in air/(Weight in air - Weight in water)].

³Center-cut french fries from forty tubers were fried at 375°F for 3.5 minutes and then evaluated based on the USDA french-fry color chart (0 = light, 4 = dark).

⁴High Sugar = Percentage of french fries with a color rating above 3.

⁵Sugar end = Percentage of french fries

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