

**Cultivar Specific Nitrogen Management Profiles
For Irrigated Process Varieties
Inkster, ND 2009**



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Cultivar Specific Nitrogen Management Profiles for Irrigated Process Varieties

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Summary

Twelve russet-skin (Alpine Russet, Bannock Russet, Blazer Russet, Dakota Trailblazer, Russet Burbank, Gemstar Russet, MN02419, ND8229-3, Premier Russet, Prospect, Ranger Russet, Umatilla Russet), five white-skin (Dakota Crisp, Dakota Diamond, Dakota Pearl, MN18747, and Shepody), and one red-skin (MN15620) varieties with potential to be grown as raw product for the chip and frozen process industries were evaluated under four nitrogen treatments (120 lb/a, 180 lb/a, 240 lb/a early, and 240 lb/a late). Total yield, size profile distribution, and the hollow-heart defect were determined for each variety at each nitrogen level. The results indicate that the effect of nitrogen were not dependent upon variety. None of the varieties tested had a higher total yield potential than Russet Burbank, but all but four had a higher percentage of total yield greater than six ounces. Total yield was maximized at 240 lb/a nitrogen applied either early or late in the season. Interestingly, nitrogen treatment had no effect on the total percentage of hollow heart observed during 2009.

Introduction:

Russet Burbank continues to be the most important frozen process variety grown in North Dakota and Minnesota, but it requires high rates of nitrogen and metam sodium in order to provide an acceptable raw product to processors and an economic return to the grower. The goal of this project is to provide growers and industry representatives with nitrogen management guidelines for recently released varieties that have potential to be produced in North Dakota and Minnesota with lower inputs than Russet Burbank. Four nitrogen treatments (Table 1) were evaluated for all eighteen varieties listed in the summary.

Table 1. Nitrogen amount (lb/a) and date of application for the nitrogen treatments evaluated in 2009.

Treatment	Dates of nitrogen application									Total
	5/18	6/10	6/25	7/1	7/7	7/14	7/21	7/28	8/4	
120N	30	30	0	30	10	10	10	0	0	120
180	30	50	10	30	20	20	20	0	0	180
240 Early	30	100	40	30	20	10	10	0	0	240
240 Late	30	50	30	30	40	20	20	10	10	240

General Materials and Methods:

This study was conducted at the Northern Plains Potato Growers Association's Irrigated Research Site located near Inkster, ND.

Soil characteristics and Fertility – The soil was classified as a sandy loam (75.2% sand, 15.4% silt, and 9.4% clay) with 2.1% organic matter and a pH of 6.0. Soil analysis indicated 14 lb/a nitrogen was present in the top 6 inches prior to planting. Furthermore, soil levels of Phosphorus (10ppm), Potassium (275ppm), Sulfur (72lb/a), Zinc (1.89ppm), Iron (52ppm), Manganese (47ppm), and Copper (.41 ppm) were present. During planting, 29 lb/a N, 100 lb/a P, and 1 lb/a Zn was applied in a split band beneath the seed piece. Following planting, additional nitrogen applications were made on 10 June, 25 June, 1 July, 7 July, 14 July, 28 July, and 4 August (Table 1), depending upon nitrogen treatment.

Pest management - Pink rot (*Phytophthora erythroseptica*) was controlled by applying 0.42 oz/ 1000 linear ft row Ridomil Gold EC (mefenoxam) at planting. Early blight, late blight, black dot, and white mold were controlled with applications of Bravo (8 July), Headline+Manzate (17 July), Bravo (22 July), Endura+Manzate (29 July), Bravo Zn (5 August), Scala+Manzate (10 August), Bravo Zn (18 August), and Gavel (25 August and 2,10 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 – A two-factor split-plot design was utilized and treatments were assigned in a randomized complete block design with four replications. Main plots were nitrogen treatment (Table 1) and were 8 potato rows wide and 150 feet long. The split plot was potato variety and was 1 potato row wide and 15 feet long. Seed of all varieties evaluated were hand cut into 2-2.5 ounce pieces on 5 May, treated with Maxim MZ, and suberized for 13 days at 50°F and 95% relative humidity. Plot were planted on 18 and 19 May with a 2-row, assist-feed Harriston planter and harvested on 25 and 26 October using a single-row Grimme harvester.

Nitrogen treatments – During planting, 29 lb/a N, 100 lb/a P, and 1 lb/a Zn was applied in a split band beneath the seed piece to all plots. Varying amounts of nitrogen were applied on 10 June, 25 June, 1 July, 7 July, 14 July, 28 July, and 4 August (Table 1), to main plots depending upon nitrogen treatment. All nitrogen applications after 25 June were hand applied to individual plots as urea (46-0-0).

Yield and quality evaluations – Following harvest, all potatoes were transported to the USDA Potato Worksite in East Grand Forks, MN, and tubers from individual plots were sized according to weight to determine total yield and tuber size profile. Ten tubers each from the 4-6, 6-8, 8-10, and over 10 oz size classes were cut and evaluated for the hollow-heart defect.

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:

Effect of variety and nitrogen treatment on yield

Analysis of variance indicated the interaction between variety and nitrogen treatment was not significant. This means that the effect of nitrogen treatment on yield was not dependent upon the variety tested. As a result, the main effects of variety (Table 2) and nitrogen treatment (Table 4) on total yield and size class distribution are reported.

Effect of variety on Total Yield – Blazer Russet, Dakota Pearl, Gemstar Russet, MN02419, MN15620, MN18747, ND8229-3, Shepody, and Dakota Trailblazer had a significantly lower total yield than Russet Burbank (503 cwt/a) during 2009. All other varieties tested were equal.

Effect of nitrogen treatment on Total Yield – Total yield significantly increased as nitrogen treatment was increased from 120 lb/a nitrogen (409 cwt/a) to 180 lb/a (445 cwt/a). 240 lb/a nitrogen early (474 cwt/a) and late (487 cwt/a) were both significantly higher than 180 lb/a nitrogen, but were not different from each other.

Effect of variety on yield of < 3 oz tubers – All varieties except Dakota Crisp (equal), Dakota Diamond (equal), Dakota Pearl (greater), MN02419 (equal) Ranger Russet (equal), and Umatilla Russet (greater), produced fewer tubers < 3 ounces.

Effect of nitrogen treatment on yield of < 3 oz tubers – The yield of tubers < 3 oz was greatest under the 120 lb/a nitrogen treatment (41 cwt/a), while it was least when 240 lb/a nitrogen was applied late (27 cwt/a).

Effect of variety on yield of 3 – 4 oz tubers – Dakota Diamond, Dakota Pearl, and Umatilla Russet produced more 3 – 4 ounce tubers than Russet Burbank (53 cwt/a), while all other varieties produced fewer.

Effect of nitrogen treatment on yield of 3 – 4 oz tubers – The yield of tubers between 3 – 4 oz was the greatest under the 120 lb/a nitrogen (41 cwt/a), and was significantly decreased under 180 and 240 lb/a nitrogen.

Effect of variety on yield of 4 – 6 oz tubers – All varieties except Dakota Diamond (more) and Umatilla Russet (equal) produced fewer 4 – 6 ounce tubers than Russet Burbank (143 cwt/a).

Effect of nitrogen treatment on yield of 4 – 6 oz tubers – 240 lb/a nitrogen applied late had produced fewer 4 – 6 oz tubers (87 cwt/a) than all other treatments.

Effect of variety on yield of 6 – 8 oz tubers – Alpine Russet, Blazer Russet, Dakota Crisp, Dakota Diamond, ND8229-3, Premier Russet, and Ranger Russet produced the same amount of 6 – 8 oz tuber as Russet Burbank (116 cwt/a), and all other varieties tested produced fewer.

Effect of nitrogen treatment on yield of 6 – 8 oz tubers – Nitrogen treatment had no effect on the yield of 6 – 8 oz tubers.

Effect of variety on yield of 8 – 10 oz tubers – Dakota Pearl and Umatilla Russet produced fewer, and Dakota Diamond, MN02419, MN18747, and Shepody produced the same amount of 8 – 10 oz tubers as Russet Burbank (69 cwt/a). All other varieties tested produced more 8 – 10 oz tubers than Russet Burbank.

Effect of nitrogen treatment on yield of 8 – 10 oz tubers – 120 lb/a nitrogen produced fewer 8 – 10 oz tubers (62 cwt/a) than 180 lb/a nitrogen (79 cwt/a), 240 lb/a nitrogen applied early (82 cwt/a), and 240 lb/a nitrogen applied late (85 cwt/a).

Effect of variety on yield of > 10 oz tubers – All varieties except Dakota Pearl (less), Blazer Russet (equal), Dakota Diamond (equal), MN02419 (equal), MN15620 (equal), and Umatilla Russet (equal) produced more > 10 oz tubers than Russet Burbank (71 cwt/a).

Effect of nitrogen treatment on yield of > 10 oz tubers – 120 lb/a nitrogen produced the fewest amount of tubers > 10 oz (66 cwt/a). Increasing nitrogen to 180 lb/a nitrogen (111 cwt/a) and 240 lb/a nitrogen applied early (123 cwt/a) significantly increased the yield of tubers > 10 oz. 240 lb/a nitrogen applied late produced the greatest amount of tubers > 10 oz (163 cwt/a).

Effect of variety on percent of total yield > 3 oz – All varieties tested had a higher percentage of tubers > 3 oz compared to Russet Burbank (89%), except Dakota Crisp (equal), Dakota Diamond (equal) Dakota Pearl (less), MN02419 (equal), and Umatilla Russet (less).

Effect of nitrogen treatment on total yield > 3 oz – The percentage of tubers > 3 oz significantly increased as nitrogen applied increased from 120 to 240 lb/a nitrogen.

Effect of variety on percent of total yield > 6 oz – All varieties tested had a higher percentage of tubers > 6 oz compared to Russet Burbank (50%), except Dakota Diamond (equal), Dakota Pearl (less), MN02419 (equal) and Umatilla Russet (less).

Effect of nitrogen treatment on total yield > 6 oz – The percentage of tubers > 6 oz significantly increased as nitrogen applied increased from 120 to 240 lb/a nitrogen. There was no difference between 180 lb/a and 240 lb/a nitrogen applied early, while 240 lb/a nitrogen applied late produced the greatest percentage of tubers > 6 oz.

Effect of nitrogen treatment and variety on hollow heart incidence

Analysis of variance indicated there was no interaction between nitrogen treatment and variety on the incidence of the hollow heart defect. As a result, the main effects of variety (Table 3) and nitrogen treatment (Table 5) on the incidence of hollow heart are reported.

Effect of variety on the hollow-heart defect – During 2009, Russet Burbank had a total of 14% hollow heart. Bannock Russet (11%) had an equal percentage of hollow heart, while Blazer Russet (20%) and Premier Russet (31%) had significantly higher percentages. All other varieties tested had lower hollow heart than Russet Burbank.

Effect of nitrogen treatment on the hollow-heart defect – Nitrogen treatment had no effect on the percentage of hollow heart, except in the 6 – 8 oz size class, where the 120 lb/a nitrogen treatment was the highest.

Table 2. Main effect of variety on percent stand, total yield, and tuber size profile of 18 varieties evaluated in the irrigated nitrogen trial near Inkster, ND during 2009.

Variety	Percent Stand	Total	Yield (cwt/acre)						Percent Yield	
			<3oz	3-4oz	4-6oz	6-8oz	8-10oz	>10oz	>3 oz	>6 oz
Alpine	97	508	28	29	109	126	83	132	94	66
Bannock	97	469	27	27	82	95	81	157	94	70
Blazer	99	463	33	38	113	110	77	91	93	59
Burbank	98	503	51	53	143	116	69	71	89	50
Dakota Crisp	98	498	43	32	113	105	96	109	91	62
Dakota Diamond	98	530	52	67	162	123	64	62	89	45
Dakota Pearl	100	361	80	68	121	62	23	8	77	25
Gemstar	97	420	13	14	49	76	82	186	97	81
MN02419	97	455	42	44	110	96	74	96	90	55
MN15620	97	422	33	32	104	93	77	82	92	59
MN18747	93	363	23	23	64	76	61	117	94	69
ND8229-3	96	422	18	18	84	107	85	110	96	71
Premier	99	496	24	25	88	120	112	127	95	72
Prospect	97	476	10	11	47	86	97	227	98	84
Ranger	100	494	31	32	102	119	95	116	94	66
Shepody	98	397	14	17	56	67	66	177	96	76
TrailBlazer	95	430	9	13	55	89	98	167	98	82
Umatilla	97	467	70	69	143	80	48	57	84	38
LSD $\alpha = 0.10$	3	39	10	8	17	16	16	37	3	7

Table 3. Main effect of variety on total percent hollow heart and percent hollow heart in four different size classes in 18 varieties evaluated in the irrigated nitrogen trial near Inkster, ND during 2009.

Variety	Hollow Heart (Percent)				
	<i>Total</i>	<i>4-6oz</i>	<i>6-8oz</i>	<i>8-10oz</i>	<i>>10oz</i>
Alpine	<1	0	0	0	1
Bannock	11	0	4	4	36
Blazer	20	6	16	26	33
Burbank	14	0	9	20	31
Dakota Crisp	<1	0	0	1	0
Dakota Diamond	5	0	1	5	15
Dakota Pearl	4	1	10	6	3
Gemstar	5	0	1	3	15
MN02419	6	0	1	5	18
MN15620	<1	0	0	0	1
MN18747	<1	0	0	1	1
ND8229-3	1	0	0	0	3
Premier	31	4	11	38	76
Prospect	<1	0	0	0	1
Ranger	<1	0	0	0	1
Shepody	2	1	1	0	8
TrailBlazer	1	0	1	1	3
Umatilla	2	0	1	3	6
LSD $\alpha = 0.10$	4	2	5	7	9

Table 4. Main effect of nitrogen treatment on percent stand, total yield, and tuber size profile on irrigated potatoes grown near Inkster, ND during 2009.

Nitrogen Trt	Percent Stand	Total	Yield (cwt/acre)						Percent Yield	
			<3oz	3-4oz	4-6oz	6-8oz	8-10oz	>10oz	>3 oz	>6 oz
120	97	409	41	41	104	94	62	66	90	53
180	97	445	32	31	98	96	79	111	92	63
240 Early	97	474	35	33	100	102	82	123	93	65
240 Late	97	487	27	30	87	95	85	163	94	70
LSD $\alpha = 0.10$	<i>ns</i>	<i>18</i>	<i>5</i>	<i>4</i>	<i>8</i>	<i>ns</i>	<i>8</i>	<i>17</i>	<i>1</i>	<i>3</i>

Table 5. Main effect of nitrogen treatment on the hollow-heart defect observed on irrigated potatoes grown near Inkster, ND during 2009.

Nitrogen Trt	Total	Hollow Heart (Percent)			
		4-6oz	6-8oz	8-10oz	>10oz
120	6	1	5	8	16
180	6	0	3	7	16
240 Early	6	0	2	4	12
240 Late	5	1	2	6	15
LSD $\alpha = 0.10$	<i>ns</i>	<i>ns</i>	<i>2</i>	<i>ns</i>	<i>ns</i>