Potato Variety Response to Nitrogen Fertilizer Rate

Kenneth A. Rykbost and Brian A. Charlton[1]

Abstract

Research on potatoes in other regions has indicated lower nitrogen fertilizer requirements for Texas and Colorado strains of Russet Norkotah, compared with the standard Russet Norkotah. Standard Russet Norkotah and the Texas strain, TXNS 112 were compared at 120, 160, 200, and 240 lb N/acre at Klamath Experiment Station (KES) in 2000. Both clones produced economically optimum yields at 160 lb N/acre. Averaged over both selections, the difference in total No. 1 yield between 120 lb N/acre and higher N rates was statistically significant. The response was similar for Russet Norkotah and TXNS 112. Failure to observe a yield response to nitrogen rates above 160 lb N/acre in a year with high yields is consistent with previous research at KES with standard Russet Norkotah.

A second experiment at KES evaluated effects of the same nitrogen rates on late maturing Russet Burbank, Klamath Russet, Gem Russet, and AO87277-6. Total yield of No. 1s was significantly lower for Russet Burbank than the other selections. Although numerically higher No. 1 yields were observed at the highest N rate for each selection, differences were not statistically significant. Averaged over four selections, No. 1 yields were nearly identical for the three lower rates and about 30 cwt/acre higher for the 240 lb N/acre rate. Significant differences were found among varieties for all yield parameters except total yield. Significance was not found for any yield parameter for N rates. The interaction between variety and nitrogen rate was not statistically significant for any parameter.

Introduction

New potato varieties and several strains of Russet Norkotah from Colorado and Texas are offering growers alternatives to the standards, Russet Norkotah and Russet Burbank, for fresh market crops in the Klamath Basin. Experience in other regions suggests that less nitrogen fertilizer is required for the Norkotah strains than for the standard variety. The new selections Klamath Russet, Gem Russet, and AO87277-6 are similar in maturity to Russet Burbank. Response to nitrogen rates under local conditions has not been evaluated for these selections. However, previous experience with Klamath Russet and Gem Russet has shown both varieties are slow to emerge and both maintain vigorous vines late in the season. Reduced nitrogen rates may hasten maturity for these clones, which would be advantageous in the short growing season experienced locally.

Fertilizer efficiency has become more important in cropping systems for environmental as well as economic reasons. While extensive research has failed to document economic potato yield responses

[1] Superintendent/Professor and Faculty Research Assistant, respectively, Klamath Experiment Station, Klamath Falls, OR.

Acknowledgements: Partial funding of the research by the Oregon Potato Commission, the Cooperative State Research, Education, and Extension Service (CSREES), and the USDA Agricultural Research Service (ARS) is gratefully recognized.

to N rates above about 180 lb N/acre on mineral soils at KES or 150 lb N/acre on organic lakebed soils at Tulelake, California, many crops in the Klamath Basin are fertilized at rates well above 250 lb N/acre. The recent emphasis on agricultural practices in development of local management plans to protect water quality provides justification for reevaluation of fertilizer requirements for standard and new varieties. Fertilizer costs are expected to rise significantly in the near term. Studies were conducted at KES in 2000 to compare nitrogen fertilizer response for the new varieties with standard fresh market varieties.

Procedures

Separate experiments were conducted for early maturing Russet Norkotah and TXNS 112 and late maturing Russet Burbank, Klamath Russet, Gem Russet, and AO87277-6. Both experiments were split-plot designs with variety as the main plot and N rate as the split-plot. Individual plots were two 43-ft-long rows with 3 replications for early varieties and 4 replications for late maturing varieties.

All seed was hand-cut to 1.5-2.5 oz/seedpiece and treated with Tops MZ (thiophanate-methyl, mancozeb, Gustafson) 10 days before planting. Seed was suberized at approximately 55^0F and 95 percent relative humidity. Seed was planted in 32-in rows with a 2-row, assisted-feed planter on May 18. In-row seed spacing was 12 in for Russet Burbank and Gem Russet and 8.7 in for the other varieties. All plots received 120 lb N, 60 lb P_2O_5, 60 lb K_2O, and 140 lb S/acre banded on both sides of rows at planting. Additional N fertilizer was applied as Solution 32 with a conventional ground sprayer and incorporated with a rolling cultivator on May 31. Cultural practices for weed, insect, and disease control are described on pages 19-20. Irrigation was applied with solid-set sprinklers arranged in a diamond pattern at 40- by 48-ft spacing. Total water applied during the growing season including rainfall was approximately 20 in. Vines were desiccated with Diquat (diquat-dibromide, Seneca) applied at 1.0 pt/acre on September 9 for early-maturing varieties and September 15 for late-maturing varieties.

Before harvest, 3-ft borders were hand-dug between plots to eliminate N-rate border overlap affects. Tubers were harvested with a one-row, digger-bagger on September 25 for early varieties and October 4 for late varieties. In the early-maturing trial, all tubers from both rows were weighed in the field. Approximately 120-lb samples were stored and graded in mid-October. In the late-maturing trial, all tubers from one row were stored and graded.

Ten large tubers (usually >16 oz) from each sample were cut lengthwise and inspected for internal defects. USDA grade standards were used to separate B size (<4 oz), U.S. No. 1s (4-8 oz, 8-12 oz, and >12 oz), U.S. No. 2s, and culls. A 10-lb sample of No.1s in the 8- to 12-oz size fraction was used to determine specific gravity by the weight-in-air, weight-in-water method. No. 1 yields were not adjusted to account for external blemishes such as rhizoctonia or internal defects such as hollow heart or corky ringspot. All yield and specific gravity data were analyzed statistically using MSU STAT software. Least significant differences (LSD) are based on Student's *t* at the 5 percent probability level.

Results and Discussion

Excellent stands were achieved in all selections although emergence timing was different in the late-maturing varieties.

Klamath Russet and Gem Russet were about 10 days later than Russet Burbank in achieving full emergence. Plant canopies were more vigorous at high nitrogen rates in all varieties. Vines were senescing rapidly at the time of vine desiccation for Russet Norkotah and TXNS 112, but were quite vigorous in late-maturing selections at vine desiccation.

TXNS 112 produced a slightly higher average yield of No. 1s than standard Norkotah. Both varieties achieved optimum yield at 160 lb N/acre (Table 1). Contrary to reports from other regions suggesting Norkotah strains require less N than standard Norkotah, the yield response to increasing the N rate from 120 to 160 lb N/acre was substantially greater for TXNS 112. Averaged for both varieties, the increases in total yield and total No. 1 yield from 120 to 160 lb N/acre were statistically significant. Differences among the three highest rates were not significant. Nitrogen rates did not affect individual yield components significantly. The incidence of hollow heart was slightly higher in TXNS 112 (8 percent) than in standard Norkotah (2 percent) (data not shown). Minor affects of N rate on specific gravity were not significant.

Nitrogen response was quite similar for all late maturing varieties (Table 2). Averaged over varieties, total No. 1 yields were nearly identical for the three lowest rates. The increase of about 30 cwt/acre for the highest rate occurred in each variety. A trend for larger tuber size at higher N rates, evident in yield of tubers >12 oz, is consistent with previous experience with other varieties at KES. The only significant affect of N rate in this experiment was the reduction in specific gravity for high N rates.

Yield differences among varieties were also consistent with past experience at KES. Russet Burbank had significantly lower No. 1 yields and higher cull yields than all other varieties. No. 1 yields were intermediate for Gem Russet and highest for Klamath Russet and AO87277-6. Klamath Russet tubers had significantly lower specific gravity than the other varieties, as expected. Hollow heart incidence was significantly higher in Russet Burbank (31 percent) and Klamath Russet (18 percent) than in Gem Russet (3 percent) or AO87277-6 (0 percent) (data not shown). The potential for hollow heart in large tubers has been commonly recognized for Russet Burbank and Klamath Russet. Brown center was also a serious problem in Russet Burbank (40 percent) but it was not observed in any of the other varieties. N rate did not affect the incidence of either hollow heart or brown center.

Summary

The failure of any potato variety to produce large yield responses to the N rates evaluated in a year of very high yields indicates modest nitrogen rates are sufficient in the short-season conditions experienced in the Klamath Basin. A 3-year study with Russet Burbank and numerous studies with new varieties and advanced selections have reached the same conclusions in previous years. In recognition of increased nitrogen fertilizer costs, and a growing concern for the potential affects of excess fertilizer use on water quality, reduced nitrogen use in potato production makes economic and environmental sense.

Table 1. Effect of nitrogen rate on yield, grade, and tuber size distribution of potato varieties Russet Norkotah and Russet Norkotah Strain TXNS 112 grown at Klamath Falls, OR, 2000.

		Yield U.S. No. 1s				Yield				Specific
Variety	Trt.[1]	4-8 oz	8-12 oz	>12 oz	total	<4 oz	No. 2s	culls	total	Gravity
		cwt/acre								
Russet Norkotah	1	141	135	101	378	21	16	4	420	1.075
	2	160	124	122	406	27	25	3	460	1.073
	3	113	127	144	384	27	22	8	441	1.070
	4	153	145	112	409	37	2	14	463	1.070
TXNS 112	1	174	97	78	349	53	26	3	430	1.075
	2	186	140	116	441	50	16	1	508	1.074
	3	151	134	125	410	37	32	2	482	1.075
	4	161	145	123	429	43	25	0	497	1.074
Variety main effect:										
Russet Norkotah		142	133	120	394	28	16	7	446	1.072
TXNS 112		168	129	111	408	46	25	1	479	1.074
CV (%)		44	8	32	10	6	109	25	8	0.9
LSD (.05)		NS	NS	NS	NS	4	NS	2	NS	NS
Fertilizer main effect:										
1		158	116	90	364	37	21	3	425	1.075
2		173	132	119	423	39	20	2	484	1.074
3		132	131	135	397	32	27	5	462	1.072
4		157	145	118	419	40	13	7	480	1.072
CV (%)		18	14	23	7	24	48	126	5	0.5
LSD (.05)		NS	NS	NS	38	NS	NS	NS	28	NS

[1]Treatment: 1 = 120-60-60, 2 = 160-60-60, 3 = 200-60-60, 4 = 240-60-60.

Table 2. Effect of nitrogen rates on yield, grade, and tuber size distribution of Russet Burbank, Gem Russet, Klamath Russet, and AO87277-6 potato varieties grown at Klamath Falls, OR, 2000.

Variety	Trt.[1]	Yield U.S. No. 1s				Yield				Specific
		4-8 oz	8-12 oz	>12 oz	total	< 4 oz	No. 2s	culls	Total	Gravity
		cwt/acre								
Russet Burbank	1	238	120	57	415	80	50	66	610	1.088
	2	225	147	47	420	75	32	44	570	1.086
	3	257	102	48	407	85	41	86	619	1.082
	4	242	148	67	457	75	36	43	611	1.081
Gem Russet	1	158	169	175	501	20	23	11	555	1.087
	2	164	171	173	509	20	23	6	558	1.086
	3	135	145	229	508	14	43	5	571	1.085
	4	150	177	216	542	20	27	13	602	1.084
Klamath Russet	1	219	156	169	545	46	29	5	624	1.081
	2	198	162	186	546	39	24	7	615	1.081
	3	157	167	206	530	40	25	7	602	1.079
	4	161	160	254	574	43	29	2	648	1.1
AO87277-6	1	252	181	122	554	48	20	9	631	1.092
	2	222	177	142	541	45	27	4	616	1.089
	3	266	180	111	557	55	19	9	638	1.087
	4	252	185	134	571	59	20	5	656	1.084
Variety main effect:										
Russet Burbank		241	129	55	425	79	40	60	603	1.084
Gem Russet		152	165	198	515	18	29	9	571	1.086
Klamath Russet		184	161	204	549	42	27	5	622	1.08
AO87277-6		248	181	127	555	51	22	7	635	1.088
CV (%)		30	22	60	14	61	66	69	12	1
LSD (.05)		49	28	70	56	23	15	11	NS	0.003
Fertilizer main effect:										
1		216	156	131	503	48	31	23	605	1.087
2		202	164	137	504	45	27	15	590	1.086
3		204	149	148	501	48	32	27	607	1.083
4		201	167	168	536	49	28	16	629	1.082
CV (%)		13	15	28	9	19	47	79	8	1
LSD (.05)		NS	NS	NS	NS	NS	NS	NS	NS	0.002

[1]Treatment: 1 = 120-60-60, 2 = 160-60-60, 3 = 200-60-60, 4 = 240-60-60.