Optimizing Potassium Management for Irrigated Potato Production

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Summary: A field experiment was conducted at the Sand Plain Research Farm in Becker, MN to evaluate the effect of potassium (K) application rate and timing on Russet Burbank yield and quality, petiole K concentrations, and changes in soil test K at different depths in the soil. Soil test K was also measured in another field on samples collected in June and November, to see if K fertilizer recommendations for the following year were affected by time of sampling. Six K treatments were tested: rates of 0, 90, 180, 270, and 360 lb K_2O/A applied preplant, and a split application of 180 lb K_2O/A preplant + 180 lb K_2O/A at emergence. Potassium rate had no significant effect on either total or marketable yield, but total tuber yield was significantly greater with split application of 360 lb K_2O/A than when the same total amount of K was all applied preplant. Potassium rate did have significant effects on tuber size. As K rate increased, there were linear increases in the percentage of tubers greater than 6 oz and greater than 10 oz. Tuber specific gravity decreased significantly as K application rate increased, but other tuber quality factors were unaffected by either K rate or application timing. There was a significant linear increase in petiole K on three sampling dates as K application rate increased. Petiole K was also significantly greater on all three dates with split application of 360 lb K_2O/A than when the same total amount of K was all applied preplant. For soil tests in the fall postharvest, there was a significant linear increase in residual soil K in the 0-6 in. depth as the rate of K fertilizer application increased. There were no significant differences among treatments in soil K at either the 6-12 or 12-24 in. soil depths. For the treatment with no K fertilizer applied, soil K decreased 44 ppm in the 0-6 in. layer, 42 ppm in the 6-12 in. layer, and 21 ppm in the 12-24 in. soil layer between spring preplant and fall postharvest sampling times. These changes show the drawdown in soil K from a potato crop with a total yield of 614 cwt/A. In the 0-6 in. soil depth, only the two 360 lb K_2O/A treatments were able to maintain soil K near the same level in the fall as was measured in the spring. None of the K fertilizer treatments applied in this study prevented drawdown of soil K in the 6-12 or 12-24 in. depths. For soil samples collected from the 0-6 in. soil depth of a field planted to soybeans in 2012 that will be the site of the second year of this K study in 2013, soil test K was lower for samples collected in late June during the growing season than for samples collected in early Nov after harvest. These differences resulted in average K fertilizer recommendations for an ensuing potato crop that were 37 lb K_2O/A greater when they were based on midseason sampling than when they were based on samples collected in the fall.

Background: Numerous questions about soil test potassium levels and potential leaching losses of K were asked over the 2011 growing season. Agronomists noted lower petiole K levels than normal, which prompted questioning of when the soil should be tested for K. The recommended time is in the fall or early spring prior to planting. However, in some cases samples are taken in June of the previous season while soybeans are being grown. Research is needed to determine when soil test K provides a reasonable measure of K availability, how much K might be leaching, and how much soil K drops after growing a crop of potatoes at various K rates.

The objectives of this study were to: 1) evaluate potato response to K fertilizer rate and timing, 2) determine the effect of timing of sampling on soil test K, 3) determine K drawdown following a crop of potatoes, and 3) determine the extent of K movement through the growing season and over the following winter.

Materials and Methods

This study was conducted at the Sand Plain Research Farm in Becker, Minnesota on a Hubbard loamy sand soil. The previous crop was rye. Selected soil chemical properties before planting were as follows (0-6"): pH, 6.5; organic matter, 1.9%; Bray P1, 49 ppm; ammonium acetate extractable K, Ca, and Mg, 101, 904, and 159 ppm, respectively; Ca-phosphate extractable SO_4-

S, 3 ppm; hot water extractable B, 0.2 ppm; and DTPA extractable Zn, 0.7 ppm. Extractable nitrate-N and ammonium-N in the top 2 ft of soil were 12.8 and 3.5 lb/A, respectively.

Four, 20-ft rows were planted for each plot with the middle two rows used for sampling and harvest. Whole "B" seed of Russet Burbank potatoes were hand planted in furrows on April 12, 2012. Row spacing was 12 inches within each row and 36 inches between rows. Each treatment was replicated four times in a randomized complete block design. Belay for beetle control and the systemic fungicide Quadris were banded at row closure. Weeds, diseases, and other insects were controlled using standard practices. Rainfall was supplemented with sprinkler irrigation using the checkbook method of irrigation scheduling.

Six K treatments were tested as described in Table 1 below: 0, 90, 180, 270, and 360 lb K_2O/A applied preplant and a split application of 180 lb K_2O/A preplant + 180 lb K_2O/A at emergence. Preplant K was broadcast and incorporated to a depth of four inches with a field cultivator on April 9. Emergence K was sidedressed on May 17 and mechanically incorporated during hilling. Potassium chloride (0-0-60) was the K source for all treatments.

All treatments received a total of 240 lb N/A applied at planting (30-lb N/A), emergence/hilling (170 lb N/A), and post-hilling (two applications of 20 lb N/A). Nitrogen at planting was supplied as monoammonium phosphate (MAP) and was banded 3 inches to each side and 2 inches below the seed piece using a metered, drop fed applicator. Emergence N applications were supplied as ESN and mechanically incorporated during hilling on May 17 (along with the emergence K treatment). Post-hilling N was applied over the row with a tractor-mounted sprayer as a 28% UAN solution in 25 gal of water/A. The tractor traveled in the irrigation alleys to prevent damage to the crop. Irrigation was applied immediately following application of UAN to simulate fertigation with an overhead irrigation system. Post-hilling N was applied on June 21 and July 2. In addition to N, banded fertilizer at planting (for all treatments) included 136 lb P_2O_5/A, 1.5 lb S/A, 2.0 lb Zn/A, and 0.5 lb B/A applied as a blend of MAP, zinc sulfate and zinc oxide (EZ 20), and boric acid (14% B).

Plant stands and stem number per plant were measured on May 30. Petiole samples were collected from the 4th leaf from the terminal on three dates: June 11, July 10, and Aug 9. Petioles were analyzed for K on a dry weight basis. Vines were killed by mechanical beating on Sept 21 and tubers were machine harvested on Sept 24. Two, 18-ft sections of row were harvested from each plot. Total tuber yield and graded yield were measured. Sub-samples of tubers were collected to determine tuber specific gravity and the incidence of hollow heart, brown center, and scab. Tuber sub-samples were also collected for K analysis, but these results were not available at the time of this report.

Soil samples were collected in the spring and fall from three soil depths (0-6 in., 6-12 in., and 12-24 in.) in each plot and analyzed for ammonium acetate extractable K. Spring samples were collected on Apr 3 before fertilizer application and planting. Fall samples were collected after harvest on Oct 3.

Soil samples were also collected in 2012 from a soybean field that will be rotated to potatoes in 2013 for the second year of this K study. Selected soil chemical properties in this field before

soybean planting were as follows (0-6"): pH, 6.2; organic matter, 1.8%; Bray P1, 66 ppm; and ammonium acetate extractable K, 109 ppm. Additional soil samples were collected from this field to see if there were differences in soil test K between samples obtained during the growing season and in the fall after harvest. Composite samples from eight different areas in the field were collected from the 0-6 in. depth on Jun 21 and Nov 2 and analyzed for ammonium acetate extractable K.

In addition to the treatments studied in 2012, the 2013 K study will include fall applied K treatments of 90, 180, 270, and 360 lb K_2O/A. These treatments were applied to replicate plots on Nov 7, 2012 by the same methods used for preplant K applications in the spring of 2012; potassium chloride (0-0-60) was broadcast and incorporated to a depth of four inches with a field cultivator.

Table 1. Potassium treatments[1] tested on irrigated Russet Burbank potatoes.

Trtmt #	--------- K rate and application timing ----------		
	Total K_2O rate	Preplant	Emergence
	---------- lb K_2O/A ----------		
1	0	0	0
2	90	90	0
3	180	180	0
4	270	270	0
5	360	360	0
6	360	180	180

[1]All K fertilizer was applied as potassium chloride (0-0-60).

Results

Tuber Yield and Size Distribution: Table 2 shows the effects of K rate and timing on tuber yield and size distribution. Potassium rate had no significant effect on either total or marketable yield, but total tuber yield was significantly greater with split application of 360 lb K_2O/A (Treatment #6) than when the same total amount of K was all applied preplant (Treatment #5). Marketable yield was also numerically greater with split application, although this difference was not significant. The split treatment had significantly greater yield of tubers in the 6-10 oz size category, but most of the yield difference between split and preplant applications of 360 lb K_2O/A was accounted for by the significantly greater yield of #2 tubers with split application.

Potassium application rate did have significant effects on tuber size. As K rate increased, tuber yield in the 0-3 oz and 3-6 oz tuber sizes decreased significantly. Because K rate did not affect total tuber yield, this decrease in small tubers was accompanied by comparable significant increases in the >6 oz, >10 oz, and >14 oz tuber size classes as K application rate increased.

Tuber Quality, Stand Count, and Stems per Plant: Tuber specific gravity decreased significantly as K application rate increased (Table 3). The statistical decrease was linear, but differences mainly occurred at the higher 270 and 360 lb K_2O/A rates. Although K rate effects

were significant, the difference between the highest (1.0781) and lowest (1.0731) specific gravities may not have been great enough to have a large effect on frying quality or the amount of harvested dry matter. Potassium rate had no significant effect on the incidence of hollow heart, brown center or scab, and K application timing had no effect on any of these disorders or specific gravity. Plant stand and number of stems per plant were not affected by either K rate or application timing.

Petiole K Concentrations: Petiole K concentrations on three dates as affected by K fertilizer rate and application timing are presented in Table 4. There was a significant linear increase in petiole K on all three dates as K application rate increased. Petiole K was also significantly greater on all three dates with split application of 360 lb K_2O/A than when the same total amount of K was all applied preplant. The higher petiole K concentrations with split application of K fertilizer were associated with the greater tuber yields for this treatment described above (see Table 2 and the "Tuber Yield and Size Distribution" section). Increased efficiency in K uptake with split application suggests that there may have been greater K leaching losses when all of the fertilizer was applied preplant, but soil test data indicated little movement of soil K for any treatment (see the next section "Soil Test K"). In the absence of leaching differences, the reason for increased K uptake with split application is unclear.

Although the linear effect of K rate on petiole K was significant, there were two pairs of preplant treatments that were not significantly different from each other when they were compared individually. Petiole K for the 90 and 180 lb K_2O/A treatments was similar on all three sampling dates. The 90 lb K_2O/A treatment was actually numerically higher on two of the three dates. Petiole K for the 270 and (preplant) 360 lb K_2O/A treatments was also similar on all three dates, with the lower K rate again having numerically greater petiole K concentrations on two of the three dates.

The sufficiency range for petiole K concentrations in potatoes is 8.0-10.0%. This range is for petioles from the fourth leaf from the terminal, as sampled in this experiment, and it was established for petioles sampled 40-50 days after emergence. On June 11 (25 days after emergence), the 270 lb K_2O/A rate was required to maintain petiole K in the 8.0-10.0% range. The 90 and 180 lb K_2O/A rates were slightly below this range and petiole K for the zero K control was only 7.0%. There was a distinct decrease in petiole K for all treatments on the 2nd sampling date (July 10, 54 days after emergence) compared with the 1st, but the decrease was less as the K rate increased. The 360 lb K_2O/A split application was the only treatment that was maintained near the sufficiency range, which was consistent with the yield differences noted above. On the 3rd sampling date (Aug 9, 84 days after emergence), petiole K increased from the 2nd date for treatments receiving 270 lb K_2O/A or more, but decreased or was unchanged for treatments receiving less than 270 lb K_2O/A. The 360 lb K_2O/A split application had petiole K above 8.0%, which was again consistent with its greater yield compared with the 360 lb K_2O/A preplant treatment (Table 2). All treatments had lower petiole K on the 3rd sampling date than on the 1st sampling date.

As discussed below in the "Soil Test K" section, using preplant soil tests for the entire field would have resulted in a K fertilizer recommendation for potatoes (for a yield goal of 500 cwt/A or more) of 300 lb K_2O/A. This is consistent with the required K rate to maximize petiole K in

this experiment, because petiole K concentrations on all three dates increased with preplant K application rate until they plateaued at the 270 and 360 lb K_2O/A rates. Applying more than the recommended 300 lb K_2O/A rate did not increase petiole K when it was all applied preplant, although higher petiole K was achieved with split application of 360 lb K_2O/A. Modifications in application timing could be required to maximize petiole K concentrations.

Soil Test K: Table 5 shows K concentrations in the spring before fertilizer application and in the fall after harvest at the 0-6 in., 6-12 in. and 12-24 in. soil depths. As expected, there were no significant differences among treatments in soil K at any depth before K fertilizer application in the spring. In the fall postharvest, there was a significant linear increase in residual soil K in the 0-6 in. depth as the rate of K fertilizer application increased. There were no significant differences among treatments in soil K at either the 6-12 or 12-24 in. soil depths in the fall. This could indicate that even in this loamy sand soil there was limited movement of K below the zone of K fertilizer incorporation during the growing season.

For Treatment #1, with no K fertilizer applied, soil K decreased 44 ppm in the 0-6 in. layer, 42 ppm in the 6-12 in. layer, and 21 ppm in the 12-24 in. soil layer. These changes show the drawdown in soil K from a potato crop with a total yield of 614 cwt/A (Table 2). For a better-fertilized crop, K drawdown could be greater due to greater K uptake and removal in the same harvested weight of tubers. The increases in petiole K concentration as K application rate increased (Table 4) show that differences in K uptake did occur. Tuber samples were collected for K analysis, so when these results are completed they will show to what extent the amount of K removed in tubers was affected by K application rate.

The change in soil K in the 0-6 in. depth between spring and fall sampling times was significantly less as the rate of K fertilizer application increased. For the two 360 lb K_2O/A treatments, soil K in this depth was relatively unchanged. This indicates that application of 360 lb K_2O/A, or at least something greater than the next highest rate of 270 lb K_2O/A, was necessary to maintain soil K. Based on preplant soil tests for this field, the K fertilizer recommendation for potatoes (for a yield goal of 500 cwt/A or more) would have been 300 lb K_2O/A (using either the 101 ppm K for the field-wide sample reported in the "Materials and Methods" section or the 118 ppm K treatment average for the Spring tests shown in Table 5). Therefore, the current recommendation for ensuring adequate K for crop growth, and limiting substantial drawdown of soil K (at least in the 0-6 in. layer), was consistent with the soil test results from this experiment.

Although 360 lb K_2O/A maintained soil K in the 0-6 in. soil depth (the zone used for standard soil testing and fertilizer recommendations), this K fertilizer rate did not prevent drawdown of soil K in the 6-12 or 12-24 in. depths. Decreases in K in both of these soil layers were not affected by the amount of K fertilizer applied. The average drawdown of K was 44 ppm at 6-12 in. and 22 ppm at 12-24 in. This suggests that similar amounts of K were withdrawn from these depths regardless of differences in K availability in the surface soil. It is unclear if the drawdown is due to actual removal of K from these layers or due to some artifact of the soil K test.

Table 6 shows differences in soil test K, and resulting differences in K fertilizer recommendations for a potato crop, when soil samples are collected at different times. These

samples were from the 0-6 in. soil depth of a field planted to soybeans in 2012 that will be the site of the second year of this K study in 2013. The field will be split into two blocks in 2013 and composite soil samples were collected from what will be four replicates of the experimental treatments in each block. Sampling times were once during the growing season on Jun 26 and again on Nov 2 after soybean harvest.

For seven of the eight sampling areas, soil test K was lower for samples collected during the growing season than for samples collected after harvest. The average difference in soil test K was 16 ppm and these differences resulted in different K fertilizer recommendations for an ensuing potato crop. For midseason sampling the average recommendation (for a yield goal of 500 cwt/A or more) was 350 lb K_2O/A, but for fall sampling the average recommendation was 313 lb K_2O/A. Because average soil test K was greater in the fall than at the end of June, these differences were not due to K uptake by soybeans between the two sampling times and subsequent K removal with the harvested crop. The increase may have been due to differences in soil moisture (wetter in June than November) at the time of sampling.

Conclusions

Potassium fertilizer application rate had no significant effect on tuber yield, but it did have significant positive effects on tuber size. As K application rate increased, yield of small tubers decreased as the proportion of harvested tubers in the >6 oz size class increased. Application timing did affect tuber yield. Total tuber yield was significantly greater (and marketable yield numerically greater) with split application of 360 lb K_2O/A than when the same total amount of K was all applied preplant. Although split application significantly increased yield of 6-10 oz tubers, the overall benefit was limited since most of the yield difference was due to significantly greater yield of misshapen #2 tubers. Tuber specific gravity decreased significantly as K application rate increased, mainly at the 270 and 360 lb K_2O/A rates, but these differences may not have been great enough to have a large effect on processing yield and quality. Although K rate significantly increased tuber size, incidence of the disorders hollow heart brown center that are often associated with larger tubers did not increase.

Petiole samples collected in June, July, and August showed a significant linear increase in petiole K on all three dates as K application rate increased. Petiole K was also significantly greater on all three dates with split application of 360 lb K_2O/A than when the same total amount of K was all applied preplant. The K rate effects on petiole K were associated with the increases in tuber size as K rate increased. And the application timing effects on petiole K were associated with the increases in tuber yield with split application. Although petiole K sufficiency levels for potatoes may not be equally applicable to all three sampling dates, it is worth noting that split application of 360 lb K_2O/A was required to maintain petiole K concentrations within or near the sufficiency range. Soil test data indicated little movement of soil K for any treatment, so the reason for increased K uptake with split application is unclear. Preplant K rates of 270 and 360 lb K_2O/A had similar effects on K concentrations and both maintained petiole K at distinctly higher levels than the lower K rates. This was consistent with the K rate of 300 lb K_2O/A that would have been recommended for this field on the basis of preplant soil tests.

The differences between preplant and postharvest soil tests for the zero K fertilizer treatment showed that the drawdown in soil K from a potato crop with a total yield of 614 cwt/A was 44 ppm in the 0-6 in. layer, 42 ppm in the 6-12 in. layer, and 21 ppm in the 12-24 in. soil layer. In the fall postharvest, there was a significant linear increase in residual soil K in the 0-6 in. depth as the rate of K fertilizer application increased, but only the two 360 lb K_2O/A treatments were able to maintain soil K near the same level in the fall as was measured in the spring. As with petiole K, this was consistent the recommendation to apply 300 lb K_2O/A to this field, since it tells us that the amount of K fertilizer required to maintain soil K was somewhere between the 270 and 360 lb K_2O/A rates. There were no significant differences among treatments in soil K at either the 6-12 or 12-24 in. soil depths and none of the K fertilizer treatments applied in this study prevented drawdown of soil K in these soil layers. The lack of differences in soil K below the 0-6 in. depth suggests that even in this loamy sand soil there was limited movement of K below the zone of K fertilizer incorporation. The relatively shallow incorporation of preplant K fertilizer in this study probably resulted in a greater drawdown of K in the 6-12 in. soil depth than would result from deeper incorporation with a moldboard plow. Field cultivation to a four-inch depth was used in the study to prevent soil and fertilizer movement between neighboring experimental plots that received different rates of K fertilizer. Alternatively, the apparent drawdown may have been due to an artifact of the soil K test.

Soil samples from the 0-6 in. depth of a field planted to soybeans showed differences in soil test K, and resulting differences in K fertilizer recommendations for potatoes, when samples were collected at different times. Soil test K was lower for samples collected in late June than for samples collected in early Nov and this resulted in average K fertilizer recommendations that were 12% greater when based on June samples. Because soil test K was greater in Nov than in June, these differences were not due to K uptake by soybeans between the two sampling times. Differences in soil moisture at the time of sampling have been shown to affect soil test K and the wetter conditions in June than Nov were consistent with increases in exchangeable K for samples collected from drier soil. To minimize the effects of environmental factors on soil test K, it is commonly recommended that soil samples be collected at the same time each year to reduce variability. The effects of sampling time on soil test K can be even greater on soils with higher clay content than the loamy sand soil studied here.

Table 2. Effect of potassium application rate and timing on Russet Burbank tuber yield and size distribution.

Treatment #	K_2O Timing[1] (PP, E)	K_2O Rate (lbs/A)	Tuber Yield										
			0-3 oz	3-6 oz	6-10 oz	10-14 oz	>14 oz	Total	#1s > 3 oz.	#2s > 3 oz	Total Marketable	> 6 oz	> 10 oz
			---------- cwt / A ----------									%	%
1	0, 0	0	72.0	156.2	233.8	122.9	29.7	614.7	388.2	154.4	542.6	62.7	24.5
2	90, 0	90	70.1	168.2	214.7	129.6	60.0	642.7	415.7	156.8	572.6	62.9	29.4
3	180, 0	180	63.5	143.6	207.3	131.8	50.8	597.0	435.1	98.4	533.5	65.3	30.5
4	270, 0	270	63.9	152.4	204.9	124.4	80.7	626.3	407.4	155.0	562.4	65.4	32.5
5	360, 0	360	51.2	124.7	196.7	147.0	72.8	592.3	416.7	124.4	541.1	70.3	37.0
6	180, 180	360	61.9	139.5	229.2	143.0	72.5	646.1	415.3	168.9	584.2	68.7	33.3
		Significance[2]	++	NS	NS	NS	++	NS	NS	++	NS	NS	NS
		LSD (0.10)	14.1	--	--	--	36.7	--	--	45.9	--	--	--
		Contrasts											
		Linear K rate (trt 1,2,3,4,5)	**	*	NS	NS	*	NS	NS	NS	NS	*	**
		Quadratic K rate (trt 1,2,3,4,5)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Preplant vs. Split (trt 5 vs. 6)	NS	NS	++	NS	NS	++	NS	++	NS	NS	NS

[1]PP = preplant, E = emergence/hilling

[2]NS = Non significant; ++, *, ** = Significant at 10%, 5%, and 1%, respectively.

Table 3. Effect of potassium application rate and timing on Russet Burbank tuber quality, plant stand, and number of stems per plant.

Treatment #	K_2O Timing[1] (PP, E)	K_2O Rate (lbs/A)	Tuber Quality				Plant Stand	# of Stems per Plant
			Specific Gravity	HH	BC	Scab		
				----------	----------	%	----------	
1	0, 0	0	1.0774	5.0	1.1	1.0	100.0	2.8
2	90, 0	90	1.0772	4.1	1.1	1.0	100.0	2.9
3	180, 0	180	1.0781	6.4	3.2	3.0	99.3	3.4
4	270, 0	270	1.0749	4.1	4.5	4.0	98.6	3.2
5	360, 0	360	1.0738	14.0	0.0	0.0	98.6	2.8
6	180, 180	360	1.0731	4.1	3.2	3.0	100.0	2.8
		Significance[2]	NS	NS	NS	NS	NS	NS
		LSD (0.10)	--	--	--	--	--	--
		Contrasts						
		Linear K rate (trt 1,2,3,4,5)	*	NS	NS	NS	NS	NS
		Quadratic K rate (trt 1,2,3,4,5)	NS	NS	NS	NS	NS	NS
		Preplant vs. Split (trt 5 vs. 6)	NS	NS	NS	NS	NS	NS

[1]PP = preplant, E = emergence/hilling

[2]NS = Non significant; ++, *, ** = Significant at 10%, 5%, and 1%, respectively.

Table 4. Effect of potassium application rate and timing on petiole K concentrations on three dates.

Treatment #	K_2O Timing[1] (PP, E)	K_2O Rate (lbs/A)	Petiole K		
			11-Jun	10-Jul	9-Aug
			----------	%	----------
1	0, 0	0	7.03	4.57	4.21
2	90, 0	90	7.68	5.59	5.59
3	180, 0	180	7.62	5.81	5.43
4	270, 0	270	8.46	6.62	7.28
5	360, 0	360	8.14	6.76	7.26
6	180, 180	360	9.02	7.70	8.20
		Significance[2]	**	**	**
		LSD (0.10)	0.79	0.74	0.89
		Contrasts			
		Linear K rate (trt 1,2,3,4,5)	**	**	**
		Quadratic K rate (trt 1,2,3,4,5)	NS	NS	NS
		Preplant vs. Split (trt 5 vs. 6)	++	*	++

[1]PP = preplant, E = emergence/hilling

[2]NS = Non significant; ++, *, ** = Significant at 10%, 5%, and 1%, respectively.

Table 5. Potassium concentrations at three soil depths: 1) in the spring before K fertilizer application and planting, 2) in the fall after harvest, and 3) the change in soil K between spring and fall.

Treatment #	K_2O Timing[1] (PP, E)	K_2O Rate (lbs/A)	Soil K[2] (ppm)								
			Spring			Fall			Change from Spring to Fall		
			Soil depth (in.)								
			0-6	6-12	12-24	0-6	6-12	12-24	0-6	6-12	12-24
1	0, 0	0	113	104	75	69	62	54	44	42	21
2	90, 0	90	119	98	78	76	60	61	43	39	17
3	180, 0	180	112	105	75	88	56	50	24	49	25
4	270, 0	270	115	106	72	98	55	54	17	51	18
5	360, 0	360	118	101	74	113	61	49	5	40	25
6	180, 180	360	130	106	79	128	64	55	2	42	24
		Significance[3]	NS	NS	NS	**	NS	NS	++	NS	NS
		LSD (0.10)	--	--	--	21	--	--	35	--	--
		Contrasts									
		Linear K rate (trt 1,2,3,4,5)	NS	NS	NS	**	NS	NS	**	NS	NS
		Quadratic K rate (trt 1,2,3,4,5)	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Preplant vs. Split (trt 5 vs. 6)	NS	NS	NS	NS	NS	NS	NS	NS	NS

[1]PP = preplant, E = emergence/hilling

[2]Ammonium acetate extractable K.

[3]NS = Non significant; ++, *, ** = Significant at 10%, 5%, and 1%, respectively.

Table 6. Effect of sample timing on soil test K and potash recommendations for potatoes.

Sampling location in soybean field		Soil test K[1] (ppm)		Potash recommendation[2] (lb K_2O/A)	
		---------- Time of sampling ----------			
		26-Jun	2-Nov	26-Jun	2-Nov
Block A	Rep 1	81	101	300	300
	Rep 2	72	102	400	300
	Rep 3	60	93	400	300
	Rep 4	68	84	400	300
Block B	Rep 1	69	90	400	300
	Rep 2	83	94	300	300
	Rep 3	91	96	300	300
	Rep 4	85	75	300	400

[1]Ammonium acetate extractable K in the 0 to 6 inch soil depth.

[2]For a yield goal of 500 cwt or more.