

ADDITIONAL RESULTS FROM  $^{15}\text{N}$  TRACER STUDIES ON NITROGEN UPTAKE  
BY RUSSET BURBANK POTATOES <sup>1</sup>

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Last year at this conference preliminary results were presented from our work using the  $^{15}\text{N}$  tracer technique to study N utilization by potatoes. The original study has been extended to verify our first results and to evaluate some other factors. It was observed that  $^{15}\text{N}$ -enriched  $\text{NH}_4\text{NO}_3$  applied at intervals from June to late August was taken up rapidly by potato plants to give high levels of  $^{15}\text{N}$  in petioles within ten days or less after any given application (1). Subsequent fertilization with unenriched fertilizer brought a rapid decrease in the labeled N content of petioles which indicates that any N taken up was also rapidly translocated from petioles. Most of the tagged N applied in June and July was translocated from tops to tubers with a large part of the N applied in August remaining in plant tops. The sum of the labeled N detected in the tops and tubers accounted for up to 60 percent of the N applied.

#### METHODS

The experimental site was located 5 miles west of Plymouth, Washington on sandy soil under solid-set sprinkler irrigation. Russet Burbank potatoes were planted April 21 in 34-inch rows by handspacing seed pieces at 9-inch spacings in furrows that were opened and closed by tractor-mounted equipment. The N treatments were arranged in split plots in a randomized complete block design with three replications. The main plots were N rates of 300 and 500 lb/A achieved by applying 100 or 200 lb N/A May 11 followed by either 20 or 30 lb N/A in 10 weekly increments on split plots to give the respective N rates. Each time the 20- and 30-lb N increments were applied a different small plot (3 rows x 6 ft long) received the same rate of  $\text{NH}_4\text{NO}_3$  alternately enriched with  $^{15}\text{NH}_4\text{NO}_3$  or  $\text{NH}_4^{15}\text{NO}_3$  fertilizer. Fertilizer was sprayed on followed immediately by sprinkler irrigation. Potato petioles were sampled weekly for  $\text{NO}_3$  and  $^{15}\text{N}$  analysis. Samples of whole plants (tops and tubers) and soil were sampled every month and analyzed for  $^{15}\text{N}$  to follow the total N distribution of tops, tubers and soil.

#### RESULTS

The two N rates produced contrasting growth patterns of potato tops and tubers (Table 1). Treatment with 500 N accelerated dry matter accumulation in tops and slowed tuber bulking at first as compared with 300 N. The results of petiole analysis in 1982 showed trends similar to 1981. Petioles decreased from an average of 1.8 percent  $\text{NO}_3\text{-N}$  early in the season down to 0.8 percent at the end of August (Fig. 1). Petioles sampled one week after treatment with  $\text{NH}_4^{15}\text{NO}_3$  contained nearly the peak amounts of  $^{15}\text{N}$  (Fig. 2). Treatments with  $^{15}\text{NH}_4\text{NO}_3$  gave substantially lower  $^{15}\text{N}$  enrichment of petiole  $\text{NO}_3$  the first part of the season (Fig. 3). One could probably attribute the low results with  $\text{NH}_4$  enrichment to the delay in nitrification of  $\text{NH}_4$  to  $\text{NO}_3$  in the soil prior to plant uptake. Alternate  $^{15}\text{N}$  labeling of  $\text{NH}_4$  and  $\text{NO}_3$  of  $\text{NH}_4\text{NO}_3$  gives an ideal approach for comparing utilization of these two forms of N.

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2 Soil Scientists at Prosser and Pullman, respectively.

Both total N concentration and uptake in tips were higher with 500 N than for 300 N from mid to late season (Table 2, 3). The total N removal by tubers was about the same for both N rates at harvest where removal stood at more than 200 lb N/A.

#### SUMMARY

Table 4 summarizes the results for the season showing the percent recovery of  $^{15}\text{N}$  supplied as  $\text{NO}_3$  which was not very different than results for  $\text{NH}_4$ . The extent of N utilization decreased in going from 300 to 500 lb N/A. From the standpoint of yield there was little advantage in applying the higher rate of N. Generally 50 to 60 percent of the  $^{15}\text{N}$  applied through May, June and July as part of the 300 N rate was utilized by tops and tubers (Table 4). The application of  $^{15}\text{N}$  in August showed a marked drop in percent  $^{15}\text{N}$  recovery particularly in conjunction with 500 lb N/A. Results in 1981 also followed a trend of decreased recovery for  $^{15}\text{N}$  applications in August. When incremental N Fertilization is needed through the season, a tentative conclusion from these results would be to apply the heaviest increments through June and July with lower amounts in August.

#### LITERATURE CITED

1. Cheng, H. H. and Steve Roberts. 1982.  $^{15}\text{N}$  tracer studies on nitrogen uptake by Russet Burbank potatoes. 21st Annual Washington State Potato Conference, Moses Lake, pp 69-73, Feb. 2-4.

Table 1. Effect of nitrogen on Russet Burbank potatoes in the  $^{15}\text{N}$  study, 1982.

Sampling date	Dry Tops		Fresh Tubers	
	300 N	500 N	300 N	500 N
	-----lb/A-----		-----T/A-----	
6/22	1630	1890	0.54	0.93
7/20	4610	5260	12.3	8.7
8/17	4470	5640	23.9	15.6
9/28	--	--	31.0	28.8

Table 2. Effect of nitrogen on percent nitrogen (dry basis) in potato tops and tubers, 1982

Sampling date	Tops, %N		Tubers, %N	
	300 N	500 N	300 N	500 N
6/22	4.5	4.8	1.8	2.1
7/20	3.1	4.1	1.6	1.8
8/17	2.4	3.4	1.7	1.6
9/28	--	--	1.7	1.7

Table 3. Effect of nitrogen on total nitrogen uptake of potato tops and tubers, 1982.

Sampling date	Tops		Tubers	
	300 N	500 N	300 N	500 N
	-----lb/A-----			
6/22	74	91	3	6
7/20	143	213	73	60
8/17	106	193	159	100
9/28	-	-	212	222

Table 4. The percent  $^{15}\text{N}$  recovery in tops plus tubers from N fertilizer enriched with  $\text{NH}_4^{15}\text{NO}_3$  at different dates, 1982.

$^{15}\text{N}$ Applied	% of $^{15}\text{N}$ recovery (tops + tubers) on date					
	6/22		7/20		8/17	
	300 N	500 N	300 N	500 N	300 N	500 N
5/11	34	27	61	44	49	32
6/15	39	34	59	48	54	36
6/29			78	55	60	39
7/13			59	42	48	37
7/27					56	47
8/10					27	15
N rate mean	37	31	64	47	49	34

Figure 1. Average percent  $\text{NO}_3\text{-N}$  in petioles of potatoes through the season.

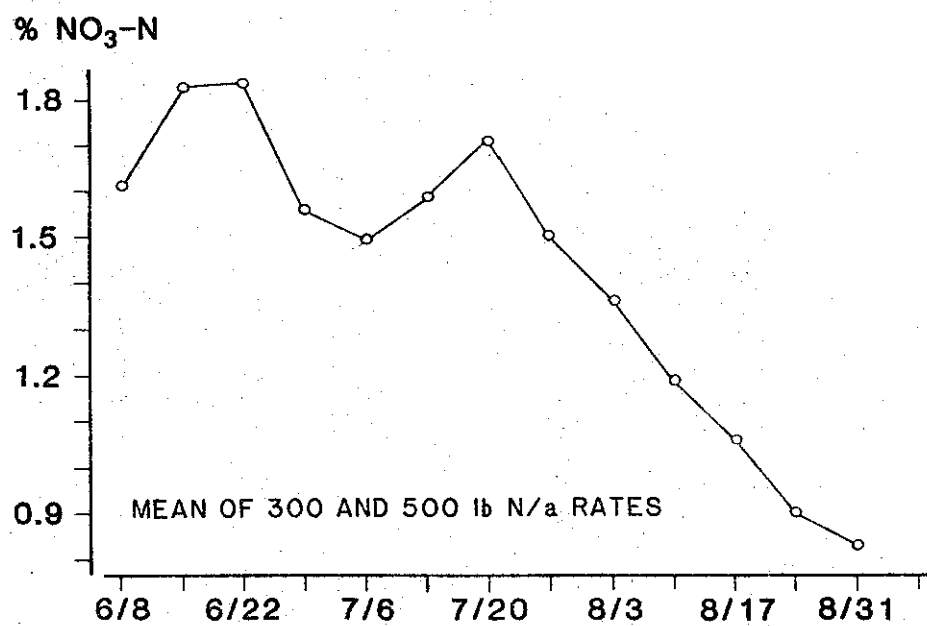


Figure 2. Percent  $^{15}\text{N}$  in potato petioles after receiving N fertilizer enriched with  $\text{NH}_4^{15}\text{NO}_3$  on different application dates, 1982.

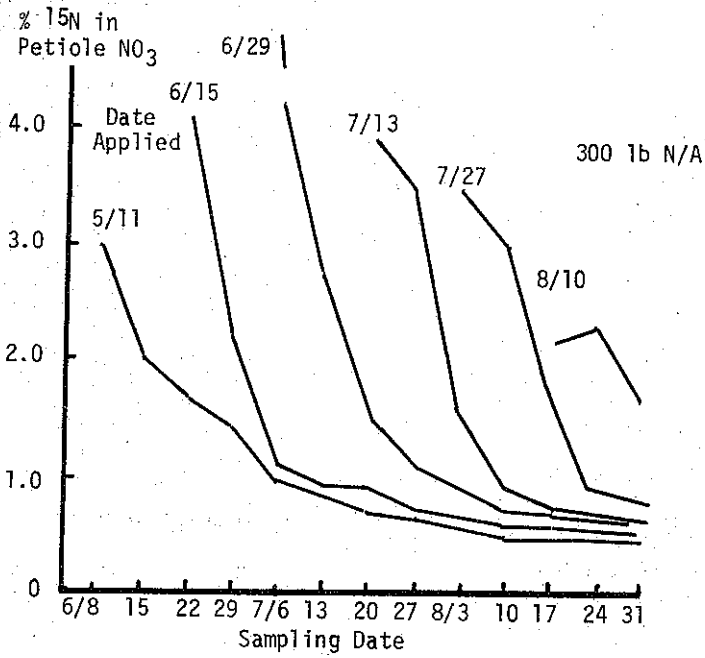


Figure 3. Comparison of petiole  $\text{NO}_3$  of potatoes receiving N fertilizers enriched with  $^{15}\text{NH}_4\text{NO}_3$  and  $\text{NH}_4^{15}\text{NO}_3$  on 5/11/1982.

