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Scheduling Nitrogen Applications For Russet Burbank Potatoes

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Seasonal nitrogen (N) fertilizer applications compared to a single preplant application usually increase fertilizer use efficiency and prevent the delay of tuber enlargement caused by high concentrations of preplant N. Research results show that the proper use of seasonal N applications has the potential to optimize potato yields and quality by encouraging earlier tuber growth and by maintaining maximum tuber growth rates until harvest or vine kill.

Nitrogen fertilizer applications should be scheduled to supplement the N available from soil sources according to the crop's N requirements during different growth stages. The potato plant's growth cycle can be divided into four growth stages based on top and tuber growth and nutrient uptake (Table 1).

Table 2 gives the recommended soil and petiole $\text{NO}_3\text{-N}$ concentrations to use in scheduling seasonal N fertilizer applications during the different plant growth stages. Maintenance of these $\text{NO}_3\text{-N}$ concentrations during growth have been shown to be adequate for maximum tuber yields in Idaho.

Preplant Nitrogen Fertilizer Applications

The preplant N fertilizer application is determined by the preplant soil $\text{NO}_3\text{-N}$ concentrations and the location in Idaho. Table 3 shows the amounts growers should apply. These preplant N fertilizer applications, along with the residual soil $\text{NO}_3\text{-N}$ and the N mineralized from soil organic sources, will provide an adequate amount of available N for early

season vegetative development and sufficient available N at the start of Growth Stage II. Higher N fertilizer applications will encourage excessive vegetative growth and delay tuber enlargement. Further N fertilizer applications will be necessary during Growth Stages II and III for continued maximum tuber growth.

Table 1. Russet potato plant growth stages.

Growth stage	Description
I	Vegetative — describes plant development from planting until the start of tuber initiation.
II	Tuberization — lasts 10 to 14 days with tubers being formed at the tips of the stolons but not appreciably enlarging. The plant may have a few open flowers at the end of this stage.
III	Tuber growth — the phase where tuber growth is linear if all growth conditions are optimum.
IV	Maturation — the period during which the vines start to yellow, leaf loss is evident and tuber dry weight increases are mainly from translocation of materials from the tops and roots into the tubers.

Table 2. Recommended soil and petiole $\text{NO}_3\text{-N}$ concentrations for use in scheduling seasonal nitrogen applications during different potato growth stages.

Sample	Growth stage			
	I	II	III	IV
	NO ₃ -N concentrations (ppm)			
Soil (0 to 18")	15*	15-10	10	<10
Petiole (4th)	—	15,000	15,000	<10,000

* $\text{NO}_3\text{-N}$ concentration at the end of Growth Stage I.
Adjustments are made with preplant applications of N fertilizer (See Table 3).

Table 3. Recommended preplant nitrogen fertilizer applications according to preplant soil NO₃-N concentrations and location.

Preplant soil NO ₃ -N test (0 to 12") (ppm)	Location in Idaho		
	SE*	SC*	SW*
	(lb N/acre)		
0	90	105	120
5	60	75	90
10	30	45	60
15	0	15	30
20	—	0	0

*SE, SC, SW — southeastern, southcentral and southwestern Idaho, respectively.

Seasonal Nitrogen Fertilizer Applications

The estimated dates for the seasonal N applications for southwest, southcentral and southeast Idaho are shown in Table 4. These dates are for a "normal" year and are based on an average of 120 pounds N per acre being mineralized from soil organic matter during the growing season and on the preplant N fertilizer applications recommended in Table 3. Actual application dates can be scheduled from petiole NO₃-N concentrations and may vary depending on seasonal temperatures, disease incidence, length of growing season, date of planting, leaching losses, etc.

The first seasonal N fertilizer application should be made by the end of Growth Stage II. Additional N fertilizer should be applied during Growth Stage III to maintain the petiole NO₃-N concentrations shown in Table 1. Growers are encouraged to monitor and record the plant and soil NO₃-N concentrations every 10 to 14 days in every field in scheduling N fertilizer applications for the optimum N response. Fig. 1 illustrates seasonal petiole NO₃-N concentrations where the desired levels were maintained by three seasonal applications of 40 pounds N per acre. Petiole NO₃-N concentrations will usually be greater than 15,000 ppm during Growth Stages I and II when using the preplant N fertilizer recommendations in Table 3.

Three applications of 40 pounds N per acre during the growing season have provided adequate N for normal crop development in Idaho. An

Table 4. Estimated seasonal N fertilizer application dates for Idaho.

Application number and amount	SW-Idaho	SC-Idaho	SE-Idaho
1 40 lb/acre	June 25	July 1	July 5
2 40 lb/acre	July 15	July 15	July 25
3 40 lb/acre	Aug. 1	Aug. 1	(Aug. 15)
4 40 lb/acre	Aug. 15	(Aug. 20)	
5 40 lb/acre	(Sept. 5)*		

*Dates in parenthesis may only require a 20 lb N/acre application.

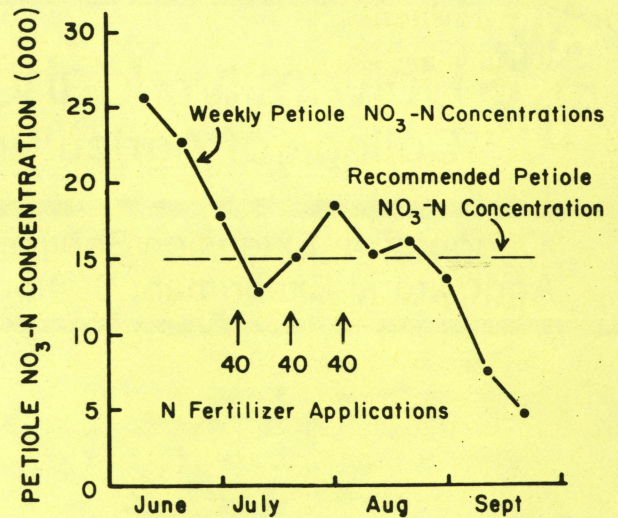


Fig. 1. Petiole NO₃-N concentrations for potatoes. Arrows represent dates of N applications for southcentral Idaho.

additional 20 pounds N per acre may sometimes be required to maintain late season tuber growth. Maximum nitrogen additions during the growing season, assuming negligible leaching losses, would be 180, 140 and 100 pounds N per acre for southwest, southcentral and southeast Idaho respectively.

Petiole Sampling

Petioles selected for tissue analyses should be from the last fully-expanded leaf, usually the fourth petiole from the top of the growing tip. Fig. 2 shows the correct petiole to sample on two potato plants. All leaflets should be stripped off the petiole immediately after sampling.

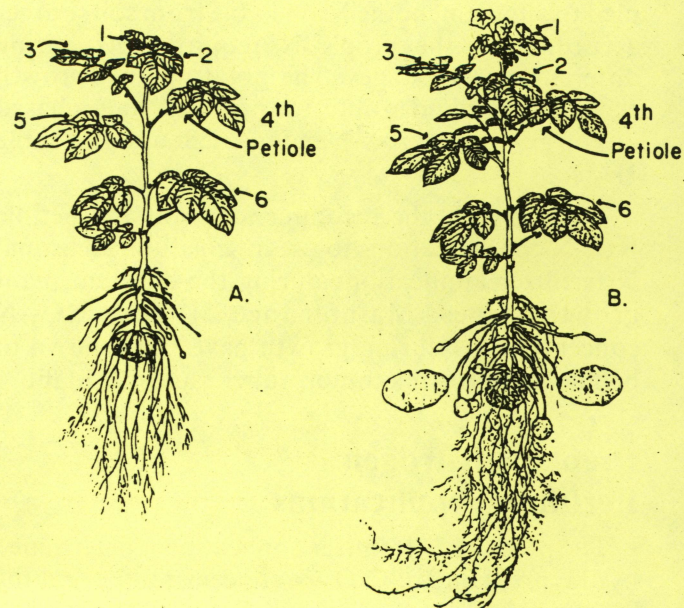


Fig. 2. Diagram of a vegetative shoot (A), and shoot with a floral spike (B). Petioles numbered 4 are used in tissue analyses for NO₃-N and most other nutritional elements. See University of Idaho CIS 240 for more detailed tissue analysis information.

General Comments

1. This guideline is not intended to replace University of Idaho CIS 261, *Idaho Fertilizer Guide for Potatoes*, but to offer assistance for growers who want to use N applications through the growing season based on crop needs.

2. The use of seasonal N applications allows the grower to adjust his N fertilizer applications according to crop needs, growth rates and length of season. Nitrogen leaching can be minimized by the applications at intervals during the season. The total N fertilizer used may be decreased 20 percent because of better management and increased efficiencies. Tuber yields may increase 10 to 15 percent with similar or improved tuber quality characteristics.

3. The preplant N fertilizer to be applied is determined by the soil $\text{NO}_3\text{-N}$ concentration in the 0 to 12 inch soil depth. Soil samples must be representative of the area to be fertilized.

4. The first seasonal N fertilizer application (40 lb N/acre) should be made at the start of tuber enlargement. Additional N fertilizer should be applied according to the $\text{NO}_3\text{-N}$ concentrations in the potato petioles. The 40 pounds per acre or two consecutive 20 pounds N per acre applications are recommended since some actively growing crops can use 20 pounds N per acre in 4 to 5 days.

5. Always sample the same petiole from the growing tip for $\text{NO}_3\text{-N}$ analysis as shown in Fig. 2. Soil samples taken during the growing season for

$\text{NO}_3\text{-N}$ concentration should be from the 0 to 18 inch depth to represent the plant's rooting depth in most Idaho soils.

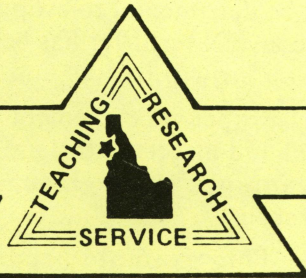
6. The final N fertilizer applications should be made by Aug. 15 in most areas of Idaho. During rapid tuber growth, each 40 pounds N per acre fertilizer application may last for 10 to 15 days while late season applications may last up to 3 weeks. Too much N fertilizer applied late in the growing season can be detrimental to crop yields and quality when excessive N fertilizer has been used during the early season growth period.

7. Proper management of irrigation, disease, weed and insect control are essential to obtain yield advantages through seasonal applications of nitrogen.

8. This example program assumes that the previous crop residues were returned to the soil by fall incorporation and are then accounted for by the early-spring soil test.

9. This N fertilizer guide is based on research conducted by UI and USDA personnel. These fertilizer suggestions are designed to produce high potato tuber yields if other factors are not limiting production. For recommendations on other nutritional elements, see University of Idaho CIS 261, *Idaho Fertilizer Guide: Potatoes*.

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