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Tissue Analysis

A Guide to Nitrogen Fertilization For Russet Burbank Potatoes

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Maximum yield of high quality potatoes requires proper nitrogen nutrition throughout the growing season. A good fertilizer program will supply enough nitrogen to meet the plant's needs. Unnecessarily high nitrogen fertilizer rates promote late season vegetative growth, delay tuber maturity, reduce tuber quality and will add to production costs.

Nitrogen fertilizer application rates based on past experience or crop rotation will not always account for seasonal variation of soil differences between fields. As a result, inadequate nitrogen may be applied to some fields while too much may be applied to other fields.

Plant tissue analysis is a technique that can be used to monitor the nitrogen nutritional status of potato plants to get maximum tuber yield with the least amount of nitrogen fertilizer. This procedure can detect a potential nitrogen shortage in potato plants before visual symptoms appear and before tuber yields are reduced.

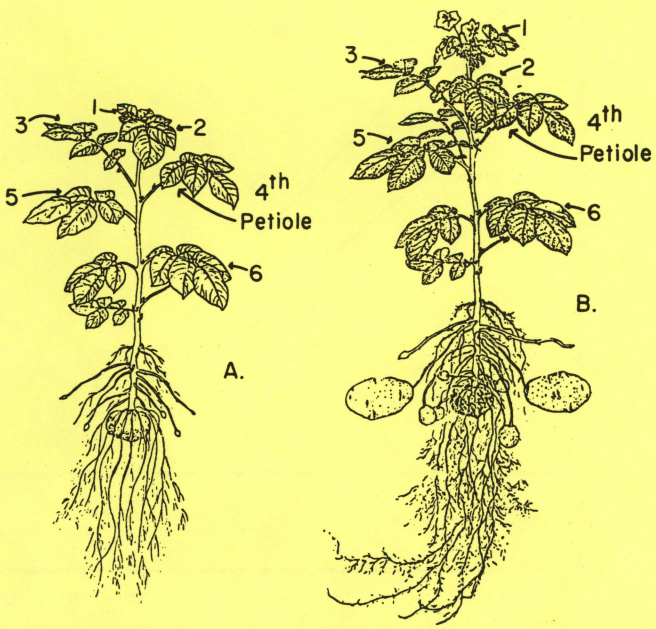

Fig. 1. Diagram of a vegetative shoot (A) and shoot with a floral spike (B). Petioles numbered 4 are used in tissue analyses for NO_3-N and most other nutritional elements.

Petiole Sampling

The petiole is that part of the plant connecting the leaf blade with the stem, and it is used for nitrate (NO_3–N) analysis. Petiole samples must be taken carefully and handled properly to be useful in evaluating the nitrogen status of potato fields. 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. 1 shows the correct petiole to sample on two potato plant types. All leaflets should be stripped off the petiole immediately after sampling (Fig. 2).

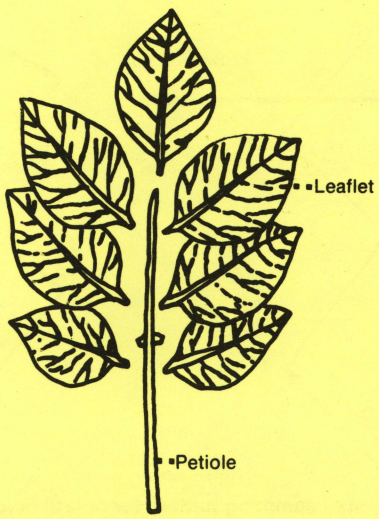

Fig. 2. Remove all leaf tissue from the petiole.

Petioles may be taken as soon as the first leaves are fully expanded; however, the first petiole sample for NO_3–N analysis is generally taken after tuber initiation. Additional samples may be taken anytime during the growing season but should be taken at least once every 2 weeks during tuber growth for measuring changes in the plant's NO_3–N content.

As sample petioles are selected, strip away the leaf tissue, and place the petioles in paper bags. Collect 25 to 30 petioles at random from each sample area (Fig. 3). If the field is not uniform because of soil or management differences, take separate samples from each area (Fig. 4). Label all samples to designate the sample area, field location and date.

Submit samples to the laboratory immediately. If they cannot be delivered the day of sampling, the samples should be refrigerated or air-dried to prevent deterioration.

Interpretation of Petiole Nitrate Content

The concentration of petiole nitrate-nitrogen (NO_3–N) must be interpreted in relation to the stage of growth. Potato petiole NO_3–N concentrations will be higher before tuber set and then decline during the growing season as the developing tubers utilize the nitrogen in growth and development. Growers generally use two methods — preplant nitrogen application and seasonal nitrogen application — of applying fertilizer nitrogen to the potato crop and, depending on the method of application, seasonal petiole NO_3–N concentrations and profiles may be different.

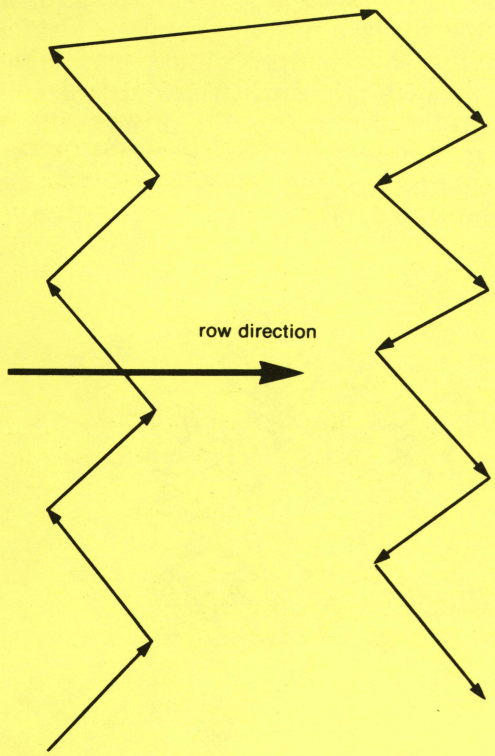

Fig. 3. Suggested sampling pattern for potato field with uniform conditions.

Preplant Nitrogen Application — If all the nitrogen fertilizer is applied preplant or preemergence, petiole NO_3–N concentrations should fall within the ranges shown in Fig. 5. Very early petiole samples, before tuber set, will generally be greater than 24,000 ppm and then decline through the var-

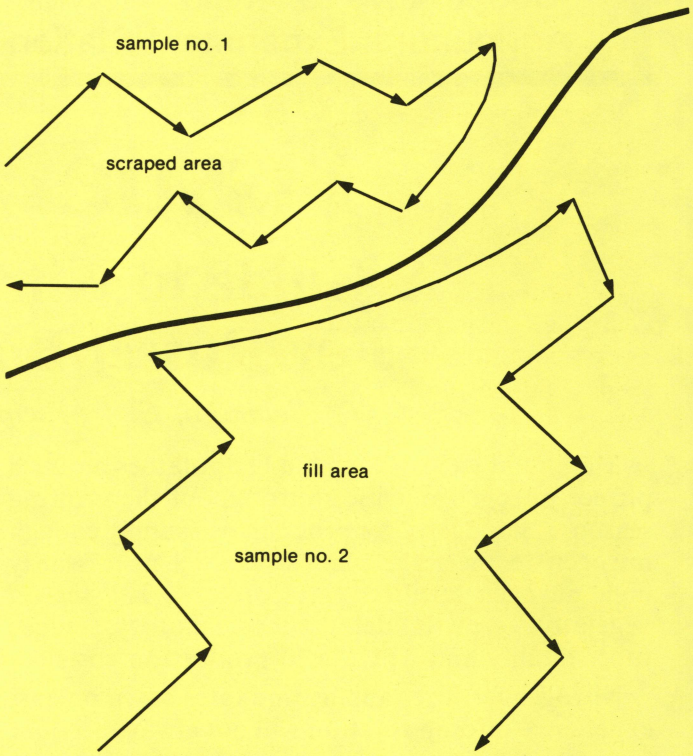

Fig. 4. Suggested sampling pattern for a nonuniform potato field.

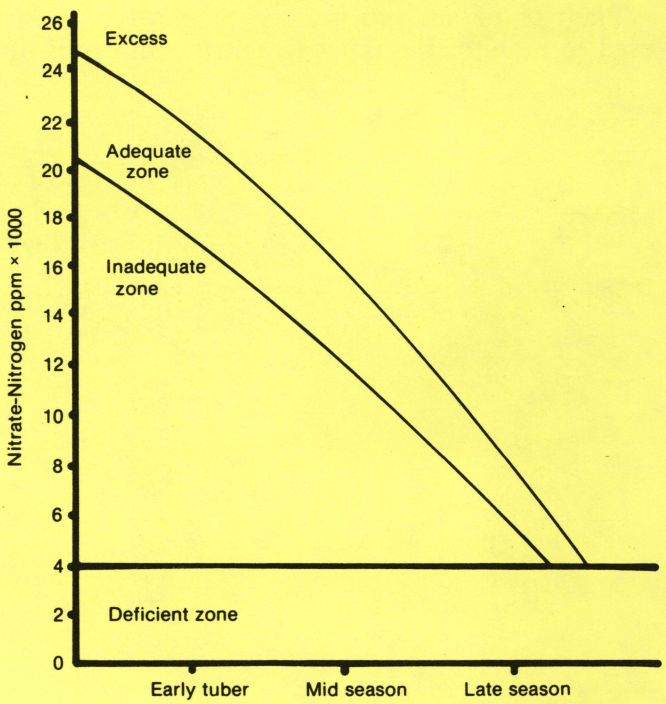

Fig. 5. Suggested NO_3–N concentrations in potato petioles through the growing season when all the nitrogen is applied preplant or shortly thereafter.

ious stages of growth. The decline in petiole NO_3–N concentrations continues through the growing season until levels of less than 8,000 ppm are common at late season.

Since nitrogen is important for continued tuber growth, petiole NO_3–N concentrations should not be allowed to decline below the adequate concentration, or tuber yields and size may be decreased. Petiole NO_3–N concentrations in the excess range (Fig. 5) will promote increased vine growth and can delay tuber development. For proper preplant fertilizer rates, the grower should consult University of Idaho CIS 261, *Idaho Fertilizer Guide: Potatoes.*

Seasonal Nitrogen Application — The majority of potatoes grown in Idaho are fertilized in a program that involves the application of fertilizer nitrogen during the growing season. This practice is very common under sprinkler irrigated potatoes since nitrogen fertilizer applied in the irrigation water can be easily controlled in both timing and amount. The use of seasonal nitrogen applications allows the grower to adjust the nitrogen rates and timing to meet the crop needs, growth rates and length of growing season. Advantages of this type of fertility program are better control of plant nitrogen concentrations for optimum growth rates and improved tuber yields and quality at harvest.

Table 1 shows the petiole NO_3–N concentrations to use in scheduling N fertilizer applications during the different plant growth stages. NO_3–N concentrations of 15,000 ppm through the tuber growth stage are adequate for any maximum plant growth rate. Fig. 6 shows an example where the petiole NO_3–N concentration was maintained by a small preplant N application and three seasonal applications of 40 pounds of nitrogen per acre. By monitoring petiole NO_3–N concentrations during the season, a grower will be able to adjust the fertilizer application amounts and timing needed to maintain the suggested 15,000 ppm petiole NO_3–N concentration.

Table 1. Adequate NO_3-N concentrations in petioles of Russet Burbank potatoes.

Stage of growth	NO_3–N concentration
	(parts per million)
Early tuber set	15,000
Midseason	15,000
Late season	10,000

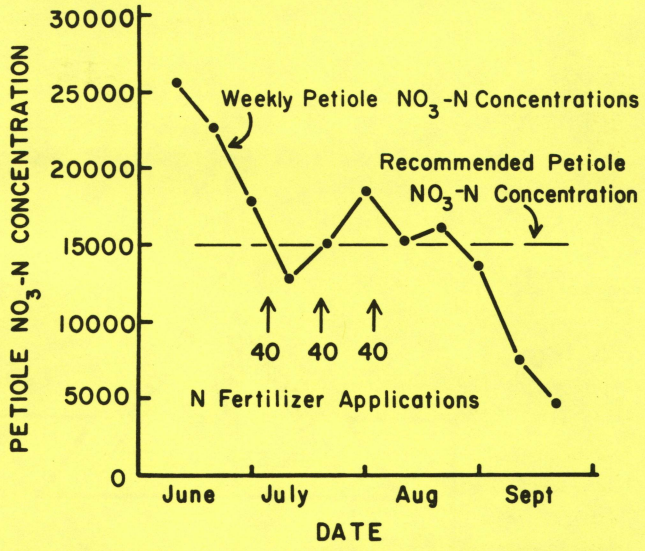

Fig. 6. Petiole NO_3-N concentrations for potatoes. Arrows represent dates of N applications for southcentral Idaho.

Fertilizer applications past August 15th are generally not recommended in most potato production areas of Idaho. Consult CIS 637 *Scheduling Nitrogen Applications for Russet Burbank Potatoes*, for the suggested preplant nitrogen application rate and the dates of seasonal fertilizer applications for the various locations in Idaho.

Summary

Petiole analysis is an effective management tool for evaluating the nitrogen status of potato plants. This procedure can predict a nitrogen deficiency in an established crop before any visual symptoms appear, giving a grower sufficient time to apply additional nitrogen fertilizer before the deficiency develops. In addition, this technique can also be used to manage the nitrogen status of growing potato plants for maximum tuber yields and quality. Growers correctly using this management tool on potatoes should anticipate higher final tuber yields and quality and a reduction in the total amount of nitrogen fertilizer applied.

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