



Nitrogen Management for Potatoes: Petiole Nitrate Testing



GHG Taking Charge Team Factsheet

Petiole nitrate testing can be used to improve fertilizer nitrogen management for your potato crop. The factsheet “Nitrogen Management for Potatoes: General Fertilizer Recommendations” can be used to estimate the fertilizer nitrogen requirement for your potato crop using average values for manure, crop and soil nitrogen credits. However, the actual nitrogen benefits from these sources can vary from field-to-field and year-to-year. Petiole nitrate testing provides a means of monitoring the nitrogen status of your potato crop during the growing season. This factsheet outlines how you can use petiole nitrate testing to improve fertilizer nitrogen management of your potato crop.

Why do we need good nitrogen management?

Sound nitrogen management for potatoes makes good economic and environmental sense. Optimal nitrogen fertilization is essential for achieving commercial tuber yield and size requirements and results in maximum economic return. In addition, proper nitrogen management reduces the risk of nitrate leaching to groundwater, and reduces the risk of nitrous oxide emissions, a greenhouse gas.

How does petiole nitrate testing work?

Our goal in optimizing crop nitrogen management is to match the nitrogen supply to the crop nitrogen demand. The optimal fertilizer nitrogen rate for a potato crop varies

from field-to-field and from year-to-year due to variation in both crop nitrogen demand and soil nitrogen supply. Petiole nitrate testing provides a means of determining the nitrogen status of the potato crop.

The potato crop takes nitrogen up from the soil mostly in the form of nitrate. The nitrate is transported to the leaf, where it is reduced to ammonium and incorporated into organic nitrogen compounds. Nitrate concentration in the petiole reflects the balance between recent nitrate uptake by the potato root system, and nitrate reduction in the leaf in response to crop growth.

How can I use petiole nitrate testing?

Petiole nitrate testing can be used in two ways. First, testing during the growing season can be used to determine if additional nitrogen application is required to meet the crop nitrogen demand. Second, testing late in the growing season can be used as a “report card” to evaluate the nitrogen management for that field.

How do I collect a petiole sample?

For best results, collect petiole samples every 7-10 days beginning about 40-45 days after planting. Sampling should continue until at least 90 days after planting to monitor crop nitrogen status. Petiole nitrate sampling as a “report card” should be done just prior to topkill.

To collect a petiole sample, make a large loop through the field and collect about 30 leaves. Start well into the field to avoid field border effects. Avoid parts of the field that are exceptionally good or bad. Move diagonally across rows to avoid taking multiple samples from the same row. You want the sample you collect to be representative of the field.

Sample the fourth or fifth leaf from the top of the plant. The goal is to get the youngest fully expanded leaf. The recommendations for this factsheet are calibrated based on this leaf. Older or younger plants will have a different petiole nitrate concentration which will affect test results. If you are uncertain as to which leaf to choose, choose an older leaf rather than a younger leaf. A leaf which is not fully



Figure 1. Petiole nitrate testing is an effective way of monitoring the nitrogen status of a potato crop.

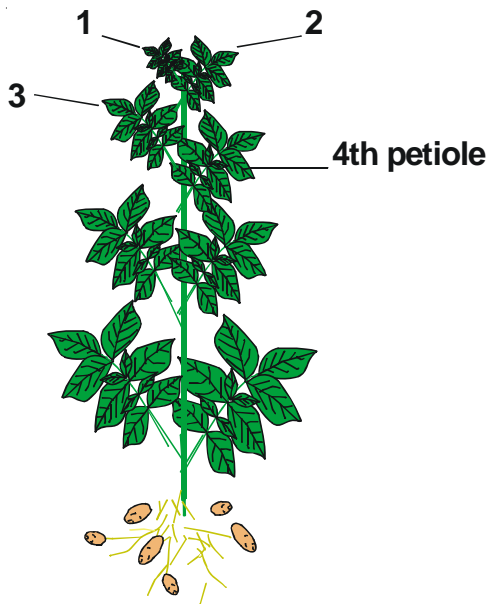


Figure 2. Sample the youngest fully expanded leaf. This is usually the fourth or fifth leaf from the growing tip.

expanded will have a much lower petiole nitrate concentration and will underestimate the correct petiole nitrate concentration.

Once you collect the leaf, immediately peel off the leaf blades and save the petiole. Place the petioles in a labelled paper bag or envelope. Keep samples cool (for example in a picnic cooler with icepacks). If necessary, rinse any soil off of the petioles and pat dry with a paper towel.

Fresh petiole samples can be delivered immediately to a soil test lab. If kept fresh, the petiole samples must be kept cool until delivered to obtain good test results. Petiole samples can also be dried at low temperatures in an oven, no higher than 60 °C (140 °F). Petioles samples should be analyzed for nitrate-nitrogen concentration on a dry weight basis.



Figure 3. Immediately remove all leaflets and keep the petiole. Petioles should be kept cool or oven dried before being delivered to a soil test lab.

Petiole nitrate concentrations can change somewhat over the course of the day. Sampling at the same time each day will result in better consistency in test results.

How do I interpret the results of in-season petiole nitrate testing?

What is most important is to track changes in petiole nitrate concentrations over time. Petiole nitrate concentrations can change from day to day in response to environmental conditions, therefore a single petiole nitrate concentration is difficult to interpret. By tracking changes in petiole nitrate concentration over time you will get a more accurate picture of the nitrogen status of your crop.

Compare your petiole nitrate test results to the standard curves shown in Figure 4 for Russet Burbank or Figure 5 for Shepody. These standard curves show the optimal range of petiole nitrate concentration for different numbers of days after planting. Note that the standard curves vary with potato variety, so interpretation of petiole nitrate concentration of other potato varieties must be done with caution.

An example of the petiole nitrate concentration for a Russet Burbank crop with an optimal nitrogen supply is shown in Figure 6. Petiole nitrate concentration varies from sampling date to sampling date, but remains within the “optimal” range over the course of the growing season. The decrease in petiole nitrate concentration over the growing season is normal as the soil nitrogen supply is depleted and as the potato canopy increase in size. Petiole nitrate concentration at the end of the growing season is low, but still in the optimal zone. This means that the crop had a sufficient nitrogen supply to meet tuber yield and size distribution targets, and that soil nitrogen supply has been mostly depleted by the end of the growing season.

An example of a nitrogen deficient Russet Burbank crop is also shown in Figure 6. Petiole nitrate concentration starts out in the optimal zone, but quickly decreases over time as the crop depletes the soil nitrogen supply. Once the petiole nitrogen concentration enters the “deficient” zone, you may need to consider adding additional nitrogen fertilizer to your crop.

Cautionary note: Interpret petiole nitrate concentrations with care if your potato crop is experiencing drought stress. Dry soil conditions limit crop nitrate uptake and can result in low petiole nitrate concentrations. Adding additional fertilizer nitrogen under these conditions may result in excess nitrogen supply to the crop following the next rainfall.

An example of a Russet Burbank crop with an excessive nitrogen supply is also shown in Figure 6. In this case, petiole nitrate concentration is high early in the growing season and remains high as the growing season progresses. The high petiole nitrogen concentration at the end of the

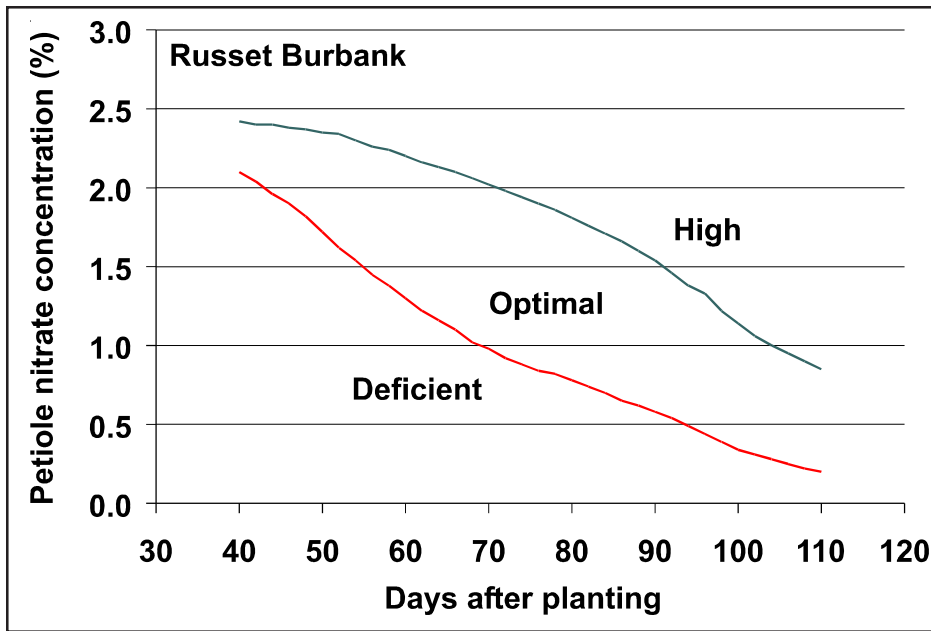


Figure 4. Standard curves for petiole nitrate-nitrogen concentration for Russet Burbank. Information is adapted from results of Gregory Porter, University of Maine

growing season means that the potato crop could not use all of the soil nitrogen supply. High petiole nitrate concentration late in the growing season often means the crop is at risk for low tuber specific gravity, and that there is an increased risk of nitrogen loss to the environment.

Interpretation of petiole nitrate concentrations should be done with care for late planted crops. Late planting reduces crop growth potential and therefore reduces crop nitrogen demand. The standard charts assume that the potato crop was planted at the average date for your area.

The standard curves are for petiole nitrate concentration on a dry weight basis. In some cases, petiole nitrate testing can be done using sap expressed from fresh petioles. Use of petiole sap is not recommended for non-irrigated potato fields due to variation in water content of the petioles. Note that the standard curves in this factsheet are for petiole nitrate concentration on a dry weight basis only and different standard curves are required when testing is done using fresh petiole sap.

What do I do if my petiole nitrate concentration is low?

You may want to apply additional fertilizer nitrogen to your crop if petiole nitrate testing indicates that your potato crop may be nitrogen deficient, and if your crop is not drought stressed. This can be done by adding feed grade urea

to the tank when applying foliar fungicides. Apply no more than about 10 lb/ac of urea in a 25 gal/ac spray volume in a single application. Apply foliar urea no more than once every three days to avoid leaf burn.

If you can apply granular fertilizer or apply nitrogen through an irrigation system, apply no more than 30 lb/ac of actual nitrogen at one time to reduce the risk of tuber defects.

Apply additional nitrogen during the growing season only as required to meet the crop nitrogen demand. Excess nitrogen application, especially late in the growing season, can reduce tuber specific gravity and may make topkill difficult.

Do not apply foliar nitrogen fertilizer if your crop is experiencing drought stress. The crop cannot use foliar applied nitrogen under these conditions, and

there is the risk of having an excess nitrogen supply to your crop when rainfall does occur.

How do I interpret the “report card” petiole nitrate testing results?

The “report card” testing can only be used to identify fields where the supply of nitrogen to the crop was greater than the nitrogen requirement of the crop. Petiole nitrate concentration just prior to topkill should be quite low, less than about 0.5 to 0.8%. If your petiole nitrate concentra-

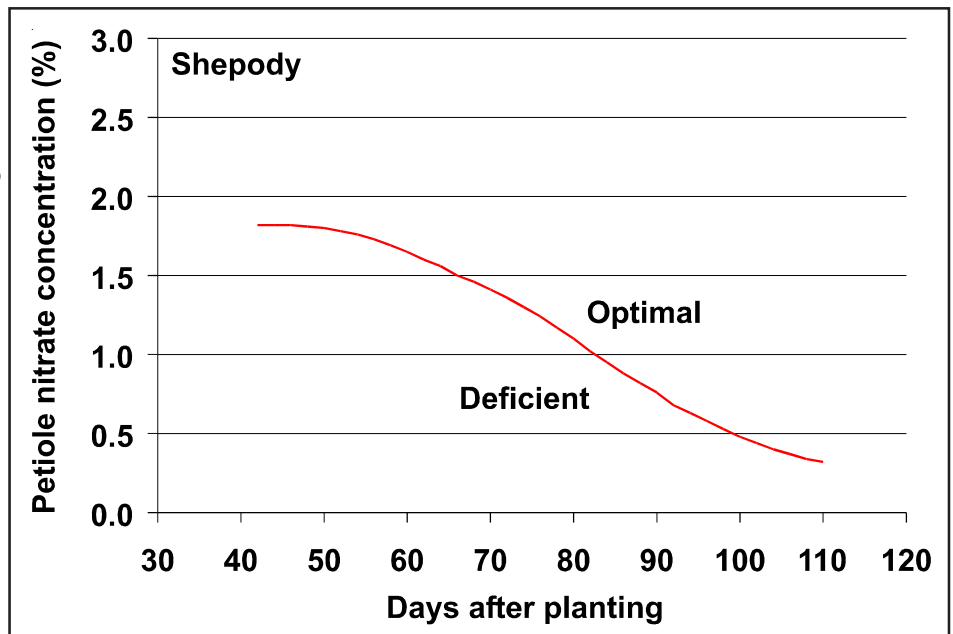


Figure 5. Standard curve for petiole nitrate-nitrogen concentration for Shepody. Information is adapted from results of Gregory Porter, University of Maine

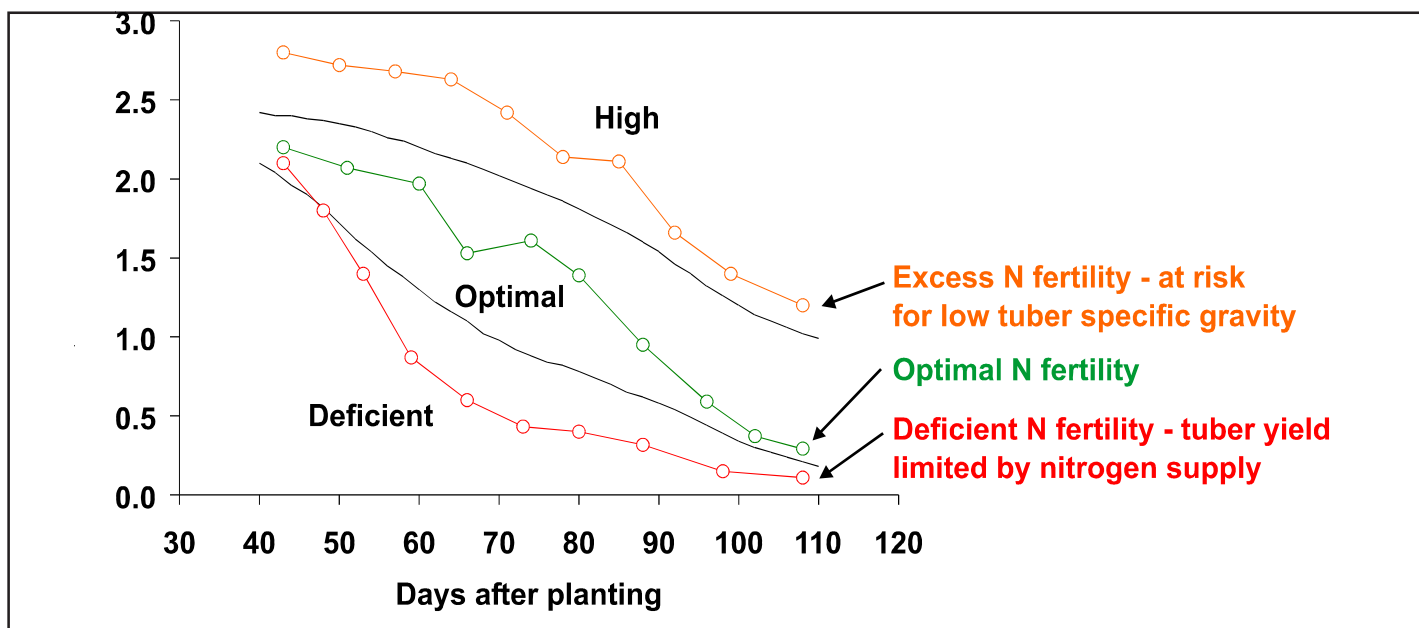


Figure 6. Examples of petiole nitrate concentration results for a Russet Burbank crop with excessive, optimal and deficient nitrogen fertility:

Excessive nitrogen fertility - Petiole nitrate concentrations remain in the “high” range, and are high late in the growing season. This crop is at risk for low tuber specific gravity, and vines may be difficult to kill.

Optimal nitrogen fertility - Petiole nitrate concentrations remain in the “optimal range”, and are low at the end of the growing season. This crop received sufficient nitrogen to obtain high tuber yields, and did not leave an excess nitrogen supply in the soil.

Deficient nitrogen fertility - Petiole nitrate concentrations rapidly dropped into the “deficient” zone. Without additional nitrogen application, this crop will have reduced tuber yield.

tion is higher than this level, this means the potato crop has not depleted the soil nitrogen supply. Excess soil nitrogen supply late in the growing season may make the potato crop at risk for low tuber specific gravity. Excess soil nitrogen supply also increases the risk of nitrate leaching to groundwater. If your fields have consistently high petiole nitrate concentration before topkill, you may want to consider reducing your fertilizer nitrogen inputs in future.

Contacts:

For further information on these petiole nitrate recommendations or on general fertilizer nitrogen recommendations, contact your local Crop Development Officer (1-888-NBAGRIC or 1-888-622-4742) or Nutrient Management Specialist (1-506-453-2109) with the New Brunswick Department of Agriculture and Aquaculture, or contact your local agronomist, crop consultant or agri-environmental club coordinator.

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