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Petiole Tissue Testing for Nitrogen Management in Potatoes

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Montana seed potato growers are were aware that optimum economic production of this valuable crop is dependent upon the maintenance of sufficient nitrogen (N) in plants throughout the growing season. This requires a high level of management for N fertilization in conjunction with irrigation. Since potatoes are relatively shallowrooted and sensitive to water deficits, the crop is irrigated frequently and some leaching of early-season applied N may occur. Growers, therefore, find it best to apply a portion of their N fertilizer early and the remainder by supplemental application through the irrigation system (fertigation). It is most desirable, to do this in response to crop needs to avoid deficiencies or excesses, and the practice of fertigation provides the opportunity to "fine-tune" N application.

Determination of crop N status in potatoes by petiole tissue testing is a proven technique for identifying crop needs and for adjusting fertigation rates. The petiole is the leaf stem extending from the main shoot and it acts as a conduit for the transport of nutrients taken from the soil to the leaves. By collecting- a representative sample of petioles (third or fourth petiole from the growing tip) from a field, drying the sample immediately (a forced-air drier is best, but a home oven works well also), and performing a laboratory analysis for nitrate (NO_3) concentration (commercial labs will do this), a grower can get a good indication of the current soil N supply.

Critical petiole NO_3 concentrations (CNC's), below which a yield reduction occurs, have been determined for most of the major potato growing areas in the Pacific Northwest region, but not previously in Montana, The objective of this research was to determine CNC's for potatoes under Montana growing conditions as a means to promote efficient N management.

Field experiments were conducted with Russet Burbank potatoes during the 1987, 1988, and 1989 growing seasons at sites in Ravalli, Lake, and Flathead counties of western Montana on soil textures ranging from silty to sandy loam. Sites were located on the Western and Northwestern Agricultural Research Centers and on farmer-cooperator fields. Nitrogen fertilizer rates of 0 to 300 lbs N/a were applied in replicated experimental designs, and an additional topdressing of 60 lbs N/a was applied to one half of each plot three weeks after tuber initiation. Petioles were sampled from plots at tuber initiation and three weeks and six 'weeks later. Yields were determined by weight of harvested tubers from whole plots, and CNC's determined by relation of petiole NO_3 levels to relative yield (yield from a given treatment compared to the highest yielding treatment for the given location).

Petiole NO_3 concentrations are clearly dependent on the rate of applied fertilizer N and tend to decline with seasonal progression (Figure 1). Concentrations range from a high of over 25,000 ppm NO_3-N in heavily fertilized plants early in the season to levels that are virtually undetectable in poorly fertilized plants later in the season. The decline in petiole NO_3 after tuber initiation reflects the demands of tuber formation and bulking. Roots must take in enough N during this period to support both the photosynthetic capabilities of the foliage and the N that is transported to the tubers. This is a crucial period for ensuring an adequate supply of N.

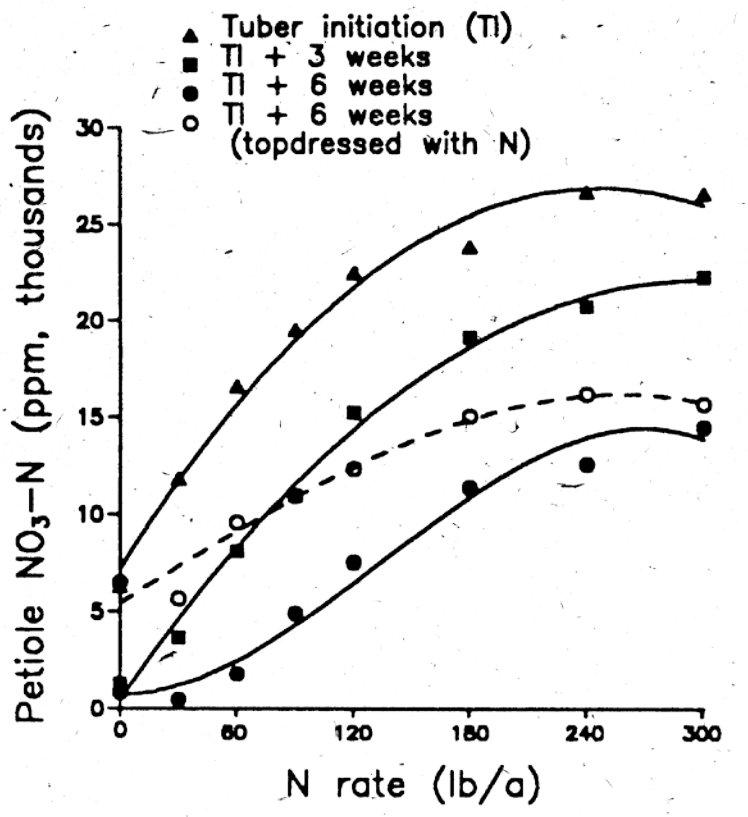

Figure 1. Potato petiole NO_3-N concentration at three sampling dates as affected by N fertilization rate and midseason topdressing.

Supplemental N applications are effective in raising or at least slowing the seasonal decline of petiole NO_3. Figure 1 shows that the plants which received a midseason N topdressing had significantly higher petiole NO_3 levels three weeks after application than the plants without supplemental N. Petiole NO_3 levels are, therefore, sensitive indicators of changes in N supply that occur during the growing season, whether due to management practices or other environmental factors.

Critical petiole NO_3 concentrations were determined to be 25,000 ppm NO_3-N at the time of tuber initiation, 14,000 ppm NO_3-N three weeks later, and 10,000 ppm NO_3 -N at six weeks after tuber initiation (Figure 2). The two later dates were very similar in terms of critical concentration values, and statistical analysis indicates that a common value of 13,000 ppm N O3-N can be reliably used for this period of tuber bulking. In applying these critical concentration values to field production, several points are worth mentioning:

1. The critical value of 25,000 ppm NO_3 -N at tuber initiation is close to the maximum amount found in potato petioles at this early growth stage. It is very important that potatoes receive adequate N early in the growing season. It is difficult for the crop to recover, from deficiencies that may occur by this stage of development,
2. The critical value of 13,000 ppm during tuber bulking is best used as a general guide. Values of 15,000 ppm are being used. in softie other growing areas. These two values represent a good range to shoot for in maintenance of petiole NO_3 through fertigation.
3. Values may differ for other varieties. By using the values given here as a starting point, growers can develop fertilization programs for other varieties as they gain experience.

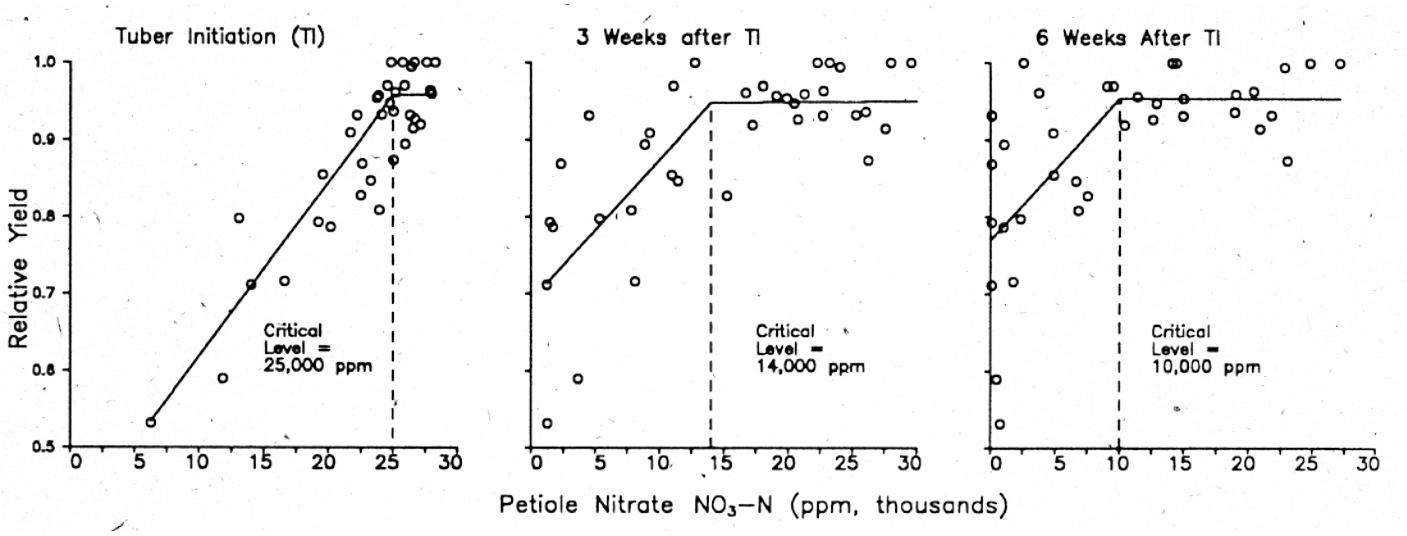

Figure 2. Critical petiole NO3-N levels in potatoes as three sampling as determined by tuber yield response.

Fertilizer Facts

- Petiole testing is an effective tool for managing N in potatoes, especially in fine-tuning supplemental applications through fertigation.
- Potato petiole NO_3-N should be maintained at 25,000 ppm up to the time of tuber initiation.
- Petiole NO_3-N should be maintained in the range of 13,000 to 15,000 ppm during the period of tuber bulking.

Edited by Jeff Jacobsen, Extension Soil Scientist