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TISSUE ANALYSIS
A Guide to Nitrogen Fertilization Of Idaho Russet Burbank Potatoes

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Maximum yield of high quality potatoes requires adequate nitrogen nutrition throughout the growth period. A good fertilizer program will supply enough nitrogen to meet the plant's needs — but not excessive nitrogen. Unnecessarily high nitrogen fertilizer rates promote late-season vegetative growth, delay tuber maturity, may reduce tuber quality and will add to production cost.

Fertilizer rates based on past experience or experiment station plots will not account for seasonal variation, soil carryover of fertilizer from previous crops or soil differences between fields. As a result, inadequate nitrogen may be applied in some cases, too much in others.

Plant tissue analysis is a technique that offers the potential for controlling nitrogen nutrition to obtain maximum potato yield with the least amount of nitrogen fertilizer. This tool will detect nitrogen shortage in potato plants before visual symptoms appear and before yield has been reduced.

Sampling

Plant tissue samples must be taken carefully and properly to be useful in judging the nitrogen nutritional status of potatoes.

Petioles — that part of the plant connecting the leaf blade with the stem — are used for nitrate analysis. Select the petiole of the newest fully expanded leaf on the main stem. This will usually be the fourth or fifth leaf from the top, when the plants are growing rapidly (Fig. 1). As rate of growth slows down, the second or third leaf may be fully expanded.

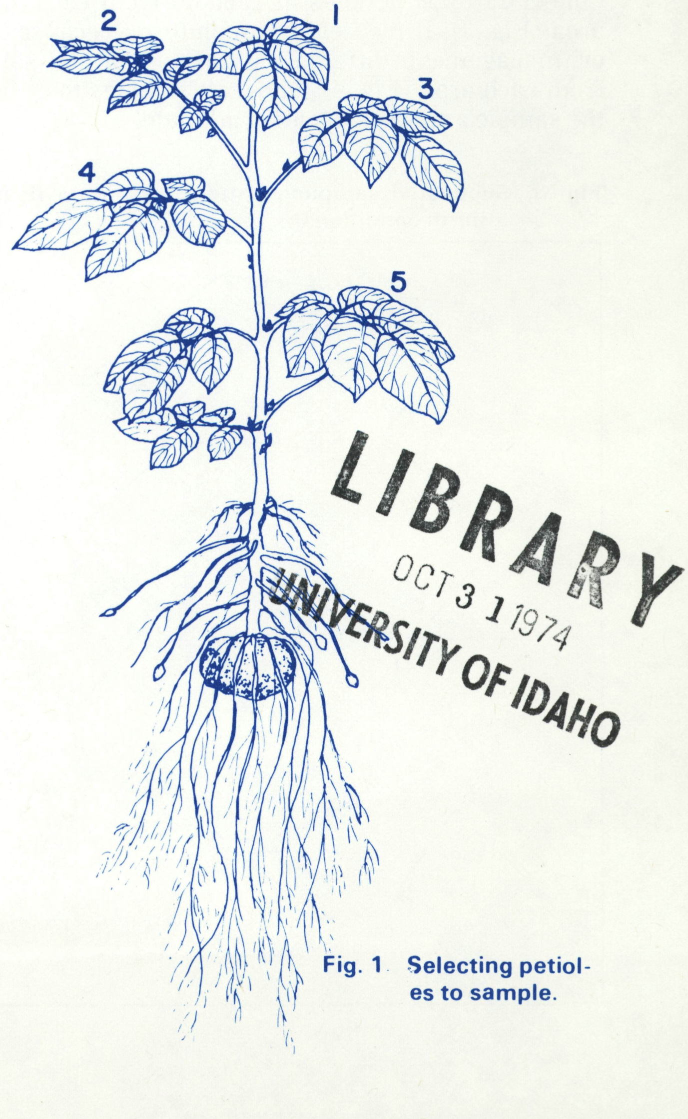


Fig. 1. Selecting petioles to sample.

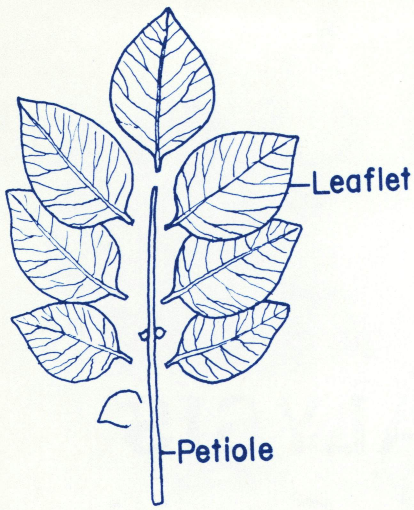
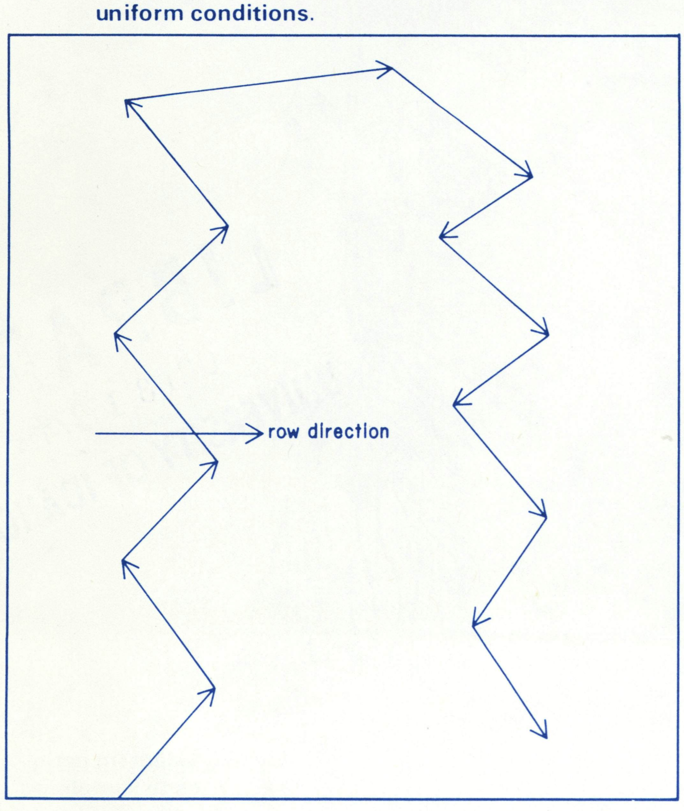


Fig. 2. Remove all leaf tissue from the petiole.

Samples may be taken as soon as the first leaves are fully expanded. The preferred time to take the first sample is at tuber initiation. Additional samples may be taken any time during the growing season.

As sample petioles are selected, strip away the leaf tissue (Fig. 2) 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.

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



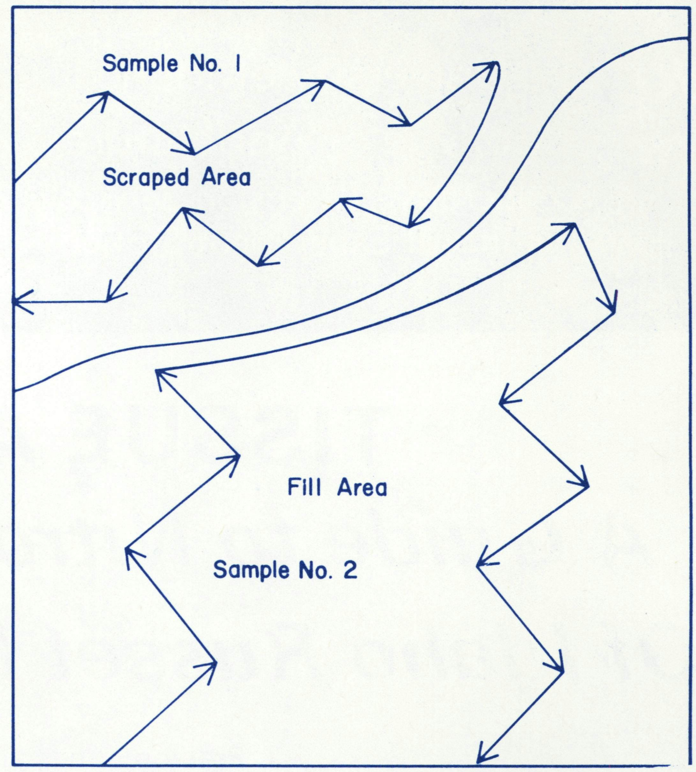


Fig. 4. Suggested sampling pattern for a non-uniform potato field.

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

The level of nitrate-nitrogen in petioles of potatoes must be interpreted in relation to the stage of plant development. With an adequate supply of nitrate-nitrogen in the soil, the level in the petiole will be much higher in early season than later when plants are more mature and the soil nitrogen supply has been reduced.

Figs. 5, 6, and 7 are typical graphs of NO_3-N content in potato petioles and potato yields at 3 locations in Idaho. Nitrate-nitrogen in petioles from plots receiving low nitrogen declined rapidly and showed visual deficiency symptoms by late June and early July. Yield without nitrogen fertilizer was very low. Potatoes receiving 60 and 120 pounds of nitrogen per acre had higher initial levels of nitrate-nitrogen in petioles and declined to deficient levels later in the growing season. Yields for these were higher than the check but were still lower than the maximum achieved with 180 pounds of nitrogen per acre. At the 180-pound fertilization level, nitrate-nitrogen in the petioles was adequate until late in the growing season. Deficiency symptoms did not appear until August.

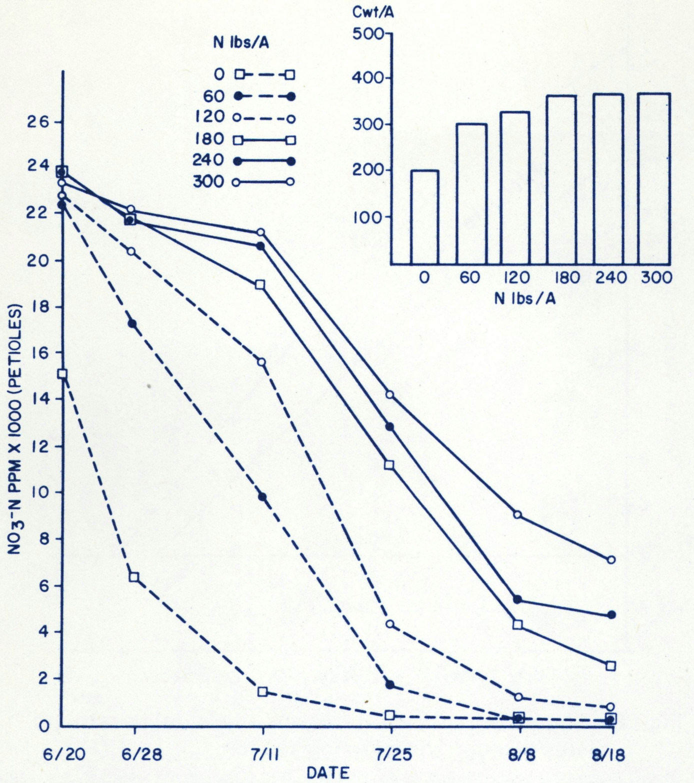


Fig. 5. Nitrate-nitrogen in potato petioles and potato yield at various nitrogen fertilizer rates, Aberdeen, 1972.

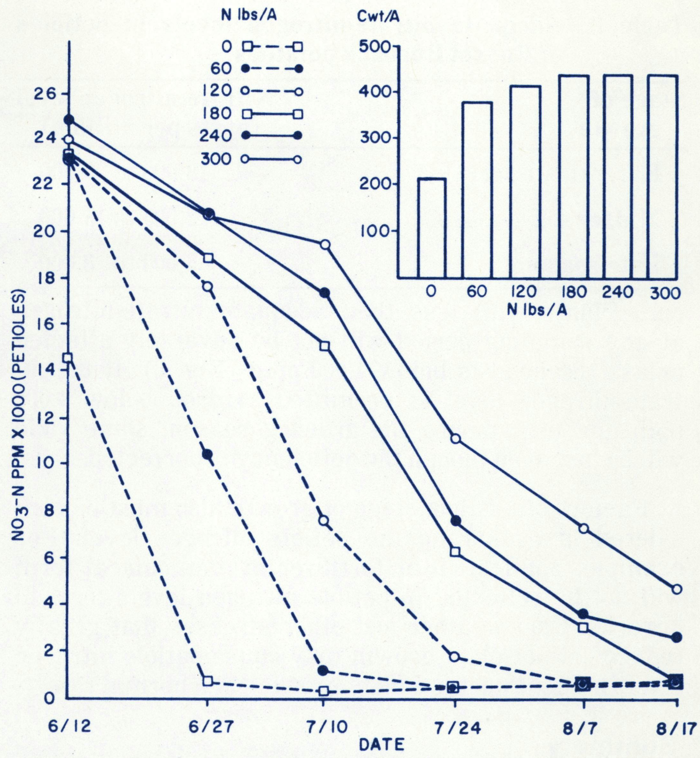


Fig. 6. Nitrate-nitrogen in potato petioles and potato yield at various nitrogen fertilizer rates, Parma, 1972.

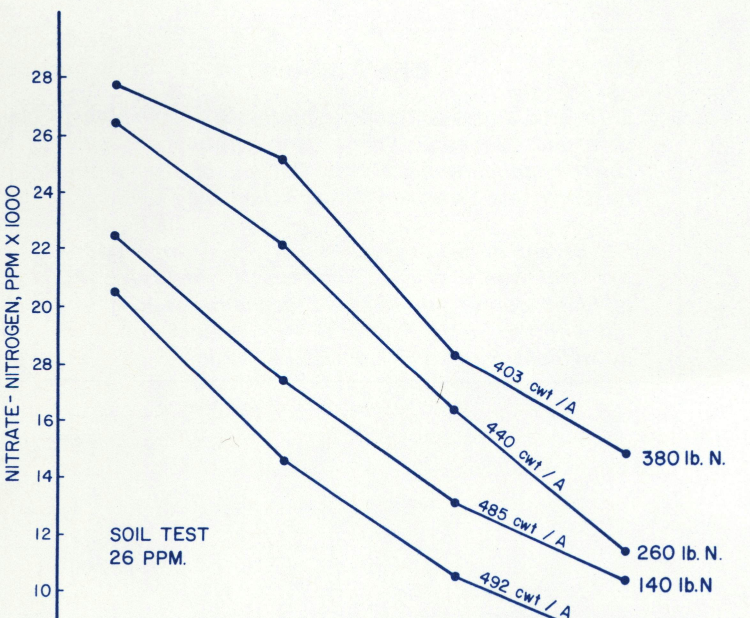


Fig. 7. Nitrate-nitrogen in potato petioles and potato yield at various nitrogen fertilizer rates, Parma, 1973.

Although higher nitrogen fertilizer rates kept the plants green longer, they did not increase yield over the 180-pound rate. Therefore, the nitrate-nitrogen found in potato petioles in the 180-pound plots is an adequate level for potatoes at each stage of growth. These desired levels are summarized in Table 1 and Fig. 8.

The range of nitrate-nitrogen suggested for each stage of growth will carry the potato plant through the growing season. If the level of nitrate-nitrogen in a petiole sample is appreciably below the suggested levels for a particular stage of growth, the plant will need more nitrogen. Therefore, potential deficiencies can be identified and corrected before yield losses oc-

Table 1. Adequate nitrate-nitrogen levels in petioles of Russet Burbank potatoes.

Stage of growth	Nitrate-nitrogen level (parts per million)
Early tuber set	18,000 to 22,000
Midseason	12,000 to 15,000
Late season	6,000 to 8,000

cur. Plants with less than adequate nitrate-nitrogen at any sampling period will not be adversely affected unless the level is below 4,000 ppm (Fig. 8). If the nitrate-nitrogen level is permitted to drop below 4,000 ppm any time during the growing season, some yield will be lost even though the deficiency is corrected.

Factors other than stage of growth also must be considered in evaluating the petiole nitrogen level. For example, application of fertilizer in ammoniacal form will not be reflected in petiole nitrogen levels for 1 to 3 weeks. Cold weather and other stresses that greatly reduce rate of plant growth may cause petiole nitrogen levels higher than for a plant growing at a normal rate.

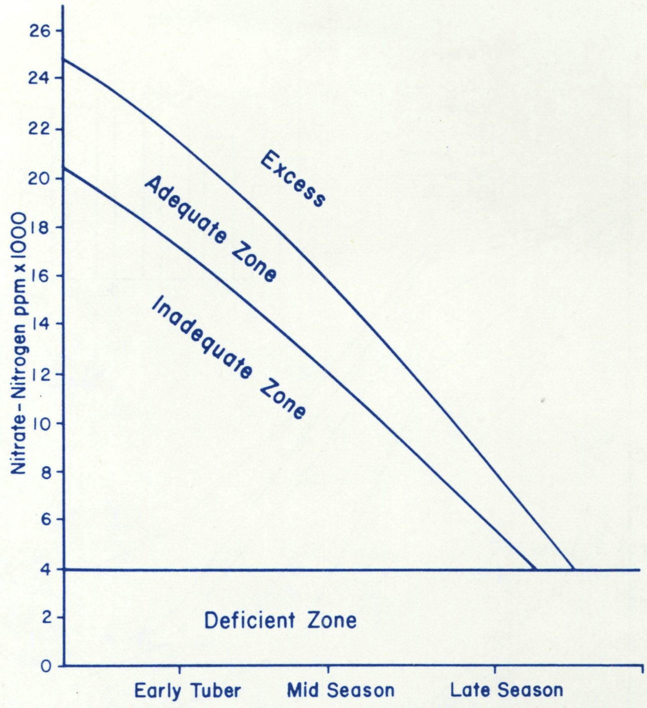


Fig. 8. Suggested nitrate-nitrogen levels in potato petioles through the growing season.

Summary

Petiole analysis for nitrate-nitrogen is an effective tool for determining nitrogen needs of potatoes. This tool will predict nitrogen deficiencies in an established potato crop before visual deficiency symptoms appear. The grower then has time to apply additional fertilizer before damage occurs. By periodic sampling during the season, the grower can be assured that potato yield is not restricted by a shortage of nitrogen. At the same time, he can avoid excessive application of nitrogen fertilizer.

Petiole analysis does not indicate how much fertilizer is needed to correct a deficiency, but it does accurately predict the occurrence of nitrogen shortage. Growers should find this tool useful in evaluating the effectiveness of current fertilizer programs and in planning a fertilizer program for the following year.

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