

## Tissue Nitrate Analysis for Vegetable Crops

Tissue nitrate analysis has proved to be a valuable tool to guide in season applications of nitrogen. The tissue usually sampled for analysis is the leaf petiole, although for some crops the leaf midrib is collected. The petiole is the stem portion of the leaf. Petiole analysis is especially recommended for scheduling nitrogen applications for overhead and drip irrigation and has been used extensively for potato production. Traditional petiole analysis is based on collecting petioles at defined stages of growth, sending the petioles to a laboratory, and then receiving results of the nitrate analysis within 48 hours to one week. Results are presented on a dry weight basis. For most crops, the plant part to sample is the most recently mature leaf. All leaflets or leaf blade portions should be removed immediately and the petiole saved for analysis (see **Figure 3**). For some crops such as cabbage, broccoli, cauliflower, and lettuce, the leaf midrib should be saved for analysis (see **Figure 4**). Time of day can affect tissue nitrate concentrations. To reduce variability, it is recommended that tissue be sampled before noon. Tissue handling is similar to that described above for plant analysis.

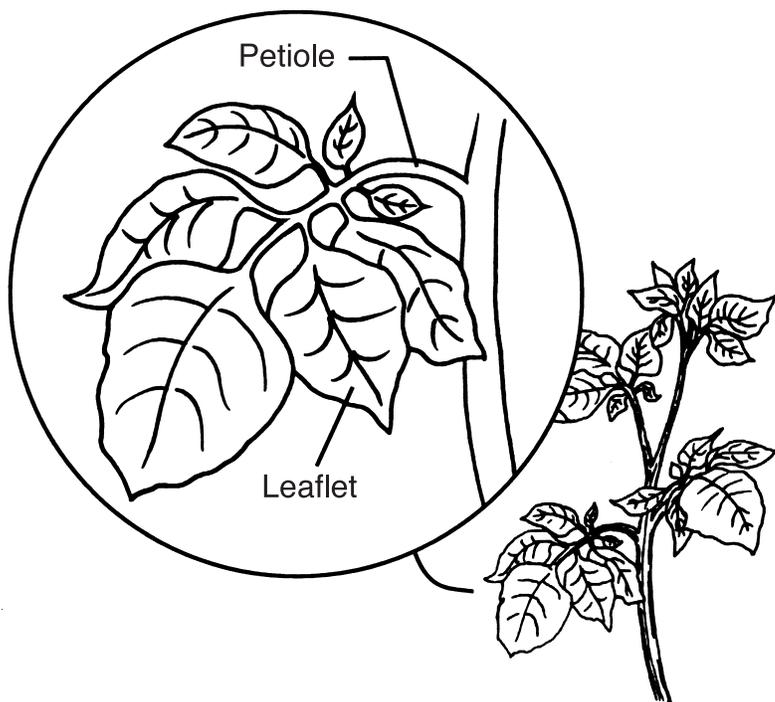
Advances have also been made in quantitative determination of nitrate in petiole sap. Portable nitrate electrodes such as the Cardy meter and color test strips have been shown to be useful for determining nitrogen needs. The advantage of the sap test is that results can be obtained more quickly than with conventional dry weight analysis. The same tissue is collected

for sap analysis as for conventional petiole analysis. The difference is that instead of drying the tissue in a laboratory, the petioles are crushed to express the sap and then the sap is immediately analyzed for nitrate.

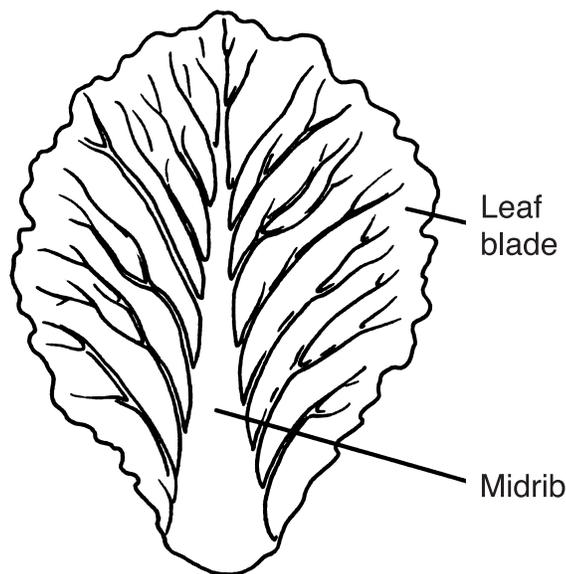
Ideally, petioles should be processed immediately; however, if this is not possible, whole petioles can be stored in a plastic bag on ice in a cooler or in a refrigerator for up to 8 hours or at room temperature for up to 2 hours. Be sure that all leaf blade portions have been removed before storing.

Sap can be expressed with a garlic press or hydraulic sap press. Petioles can also be placed in a plastic bag and then crushed with a rolling pin to express the sap. Follow sap analysis instructions of the manufacturer. For the Cardy meter, sap generally does not need to be diluted. For other portable electrodes or the color test strips, the sap needs to be diluted to obtain an accurate reading.

Most interpretations are on a nitrate-N basis. In some cases, results are expressed on a nitrate basis instead of a nitrate-N basis. To convert from ppm nitrate to ppm nitrate-N, multiply ppm nitrate by 0.225. Nitrate concentrations usually decline as the crop matures and the season progresses. Therefore, interpretation is based on stage of growth. Nitrate-N concentrations on a dry weight or sap basis for selected crops are presented in **Table 47**. If nitrate-N concentrations fall below the sufficiency range, then fertigation with urea-ammonium nitrate is recommended. An application of up to 40 lb N/A can be made with overhead irrigation systems. Smaller (5 to 10 lb N/A) more frequent applications can be made with drip irrigation.



**Figure 3.** Potato leaf consisting of leaflets and petiole.



**Figure 4.** Cabbage leaf consisting of midrib and blade.

**Table 47.** Sufficiency nitrate-N concentration ranges for petioles/midribs of selected vegetable crops on a dry weight and sap basis. Petioles/midribs should be collected from the most recently matured leaf.<sup>1</sup>

| Crop        | Tissue Sampled | Growth Stage                            | ----- Nitrate-N ----- |             |
|-------------|----------------|---|-----------------------|-------------|
|             |                |   | dry weight<br>%       | sap<br>ppm  |
| Broccoli    | Midrib         | Buttoning                               | 0.9 - 1.2             | 800 - 1100  |
| Cabbage     | Midrib         | Heading                                 | 0.7 - 0.9             | NA          |
| Carrots     | Petiole        | Midgrowth<br>1/4 inch diameter shoulder | 0.75 - 1.0            | 550 - 750   |
| Cauliflower | Midrib         | Buttoning                               | 0.7 - 0.9             | NA          |
| Celery      | Petiole        | Midgrowth                               | 0.7 - 0.9             | 500 - 700   |
| Cucumbers   | Petiole        | First blossom                           | 0.75 - 0.9            | 800 - 1000  |
|             |                | Early fruit set                         | 0.5 - 0.75            | 600 - 800   |
|             |                | First harvest                           | 0.4 - 0.5             | 400 - 600   |
| Eggplant    | Petiole        | Initial fruit                           | NA                    | 1200 - 1600 |
|             |                | First harvest                           | NA                    | 1000 - 1200 |
| Lettuce     | Midrib         | Heading                                 | 0.6 - 0.8             | NA          |
| Muskmelon   | Petiole        | First blossom                           | 1.2 - 1.4             | 1000 - 1200 |
|             |                | Initial fruit                           | 0.8 - 1.0             | 800 - 1000  |
|             |                | First mature fruit                      | 0.3 - 0.5             | 700 - 800   |
| Peppers     | Petiole        | First flower                            | 1.0 - 1.2             | 1400 - 1600 |
|             |                | Early fruit set                         | 0.5 - 0.7             | 1200 - 1400 |
|             |                | Fruit 3/4 size                          | 0.3 - 0.5             | 800 - 1000  |
| Potatoes    | Petiole        | Vegetative                              | 1.7 - 2.2             | 1200 - 1600 |
|             |                | Tuber bulking                           | 1.1 - 1.5             | 800 - 1100  |
|             |                | Maturation                              | 0.6 - 0.9             | 400 - 700   |
| Tomatoes    | Petiole        | Early bloom                             | 1.4 - 1.6             | 1000 - 1200 |
|             |                | Fruit 1 inch diameter                   | 1.2 - 1.4             | 400 - 600   |
|             |                | Full ripe fruit                         | 0.6 - 0.8             | 300 - 400   |
| Watermelon  | Petiole        | Early fruit set                         | 0.75 - 0.9            | 1000 - 1200 |
|             |                | Fruit 1/2 size                          | NA                    | 800 - 1000  |
|             |                | First harvest                           | NA                    | 600 - 800   |

NA = Not available.

<sup>1</sup> Portions of this Table were adapted from "Sufficiency Ranges for Nitrate-Nitrogen and Potassium for Vegetable Petiole Sap Quick Tests." G.J. Hochmuth, HortTechnology. Pages 218-222. 1994.