

## Horticulture and Crop Science

# Grapevine Nutrient Management: Petiole Sampling and Analysis

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Grapevine nutrient status can be determined by three methods:

1. Observing visual symptoms
2. Analyzing vine tissue samples
3. Performing soil tests

These methods should be performed regularly by scouting visual symptoms each season, analyzing tissue samples either annually or every other year, and performing soil tests both prior to planting and once every 3 to 5 years after planting.

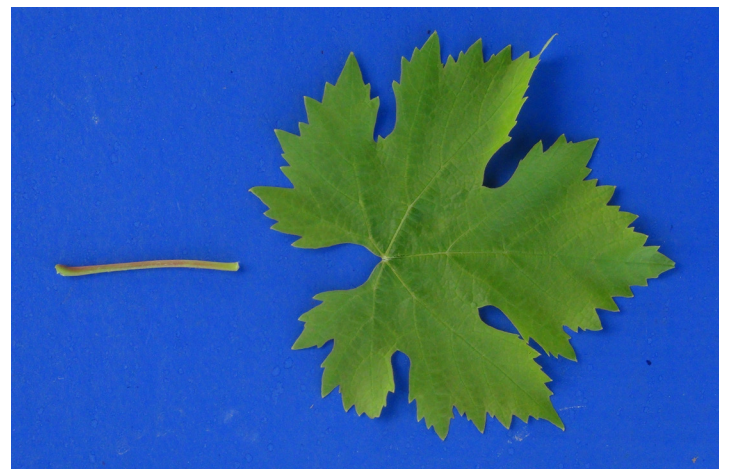
Of these three analyses, **tissue analysis** is the preferred tool for monitoring the nutrient status of your grape varieties. Tissue analysis serves two purposes: 1) determine the nutrient status of the vine; and 2) identify a suspected nutrient deficiency observed in the vineyard. By directly monitoring vine nutrient status, fertilizer programs can be tailored as needed and may end up cutting grower costs.

While tissue analysis may be performed on different types of tissues (petiole and leaf blades), **petiole** tissue analysis (**Fig. 1**) is recommended for the Eastern US. This is primarily due to a lack of historical data for nutrient range recommendations of leaf blade tissue in our region.

## Answers to common questions about petiole analysis:

**Soil vs. Tissue Testing:** Soil testing is important both before planting and for established vineyards to monitor the overall balance of major nutrients and soil pH, a primary determinant of nutrient availability.

However, there is a poor relationship between soil and plant nutrient levels. While a soil may be high on a specific nutrient, the same nutrient may be deficient in the vine; or the vine may show adequate levels of another nutrient while the soil test indicates a deficiency. This poor relationship may be explained by several factors related to the vine (e.g., crop levels), soil properties (e.g., soil pH, compaction), and environmental conditions (e.g., excessive rainfall, drought). For these reasons, petiole analysis is generally more useful and reliable for judging vine nutrient status than soil tests alone. However, the combination of soil and plant analysis provides the best assessment of fertility status and adjustment needs.



*Figure 1. Example of a petiole (left) and leaf blade (right).*

## Timing of Petiole Sampling:

**Trouble-shooting foliar symptoms:** If you observe leaf symptoms and suspect a nutrient deficiency, collect petiole samples from vines showing leaf symptoms and from healthy asymptomatic vines. The two samples should be sent and analyzed separately for comparison purposes. This will allow you to diagnose whether the problem is related to the vine nutrient status. For trouble-shooting purposes, samples should be collected anytime leaf symptoms appear during the growing season.



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#### *Routine vine nutrient assessment:*

**Full-bloom (Fig. 2):** When approximately 50 to 80% of flower caps have fallen, sample petioles from leaves that are opposite to inflorescences (flower clusters; **Fig. 3**). For general vine nutrient assessment, bloom time sampling is not recommended due to the frequent changes in tissue nutrient concentrations. However, bloom time sampling may be useful as a follow up to nutrient adjustments during the previous season.

**Veraison (Fig. 4):** Initiation of fruit ripening, which corresponds to 70 to 100 days following bloom (Mid July – Mid August), is the ideal time for routine petiole sampling. This is due to the increased stability of nutrient concentrations relative to earlier in the season during bloom. For example, veraison sampling gives a better measure of Potassium (K) levels, which are especially critical for wine grapes since they are related to wine quality (e.g., high fruit K leads to high pH and unstable wines).

#### **Which vines should I sample?**

- If you grow more than one variety, sample each variety separately
- It is unnecessary to sample non-bearing vines (1<sup>st</sup> and 2<sup>nd</sup> year of establishment) unless you observe foliar symptoms
- Begin tissue analysis when vines are producing (usually 3<sup>rd</sup> year) and repeat every year until yields are stable and yearly fertilizer needs are determined
- For mature vines, tissue analysis is done annually or every other year

**Where do I send my samples?** The following is a list of labs that perform tissue analysis for a fee. Petiole analysis is usually performed for nitrogen, phosphorus, potassium, magnesium, calcium, manganese, iron, zinc, boron, and copper. Laboratory results will show the level of each nutrient and describe them as “adequate,” “deficient,” or “excessive”.



**Figure 2.** Shoot and inflorescence (flower cluster) development at bloom.

1. A & L Great Lakes Lab, Inc.  
3505 Conestoga Drive  
Fort Wayne, IN 46808  
219-483-4759  
<https://algreatlakes.com>
2. Agricultural Analytical Services  
The Pennsylvania State University  
University Park, PA 16802  
814-863-6124  
<https://agsci.psu.edu/aasl>
3. Brookside Farm lab  
200 White Mountain Dr.  
New Bremen, OH 45869  
419-977-2766  
<https://www.blinc.com/>
4. Dairy One  
730 Warren Rd.  
Ithaca, NY 14850  
607-257-1272  
<https://dairyone.com>
5. Spectrum Analytics  
1087 Jamison Rd. NW  
Washington Court House, OH 43160  
800-321-1562  
<https://www.spectrumanalytic.com>



**Figure 3.** Petiole sampling at full-bloom. Select petioles located opposite to clusters when sampling at full-bloom.



**Figure 4.** Fruit development at veraison (initiation of fruit ripening).



Table 1. Suggested normal ranges for nutrients from grape leaf petioles

| Nutrient       | Normal range at full-bloom <sup>1</sup> | Normal range at Veraison <sup>2</sup> |
|----------------|---|---------------------------------------|
| Nitrogen (N)   | 1.20 – 2.20%                            | 0.90 – 1.30 %                         |
| Phosphorus (P) | 0.17 – 0.30%                            | 0.16 – 0.29 %                         |
| Potassium (K)  | 1.50 – 2.50%                            | 1.50 – 2.50 %                         |
| Calcium (Ca)   | 1.00 – 3.00%                            | 1.20 – 1.80 %                         |
| Magnesium (Mg) | 0.30 – 0.50%                            | 0.26 – 0.45 %                         |
| Manganese (Mn) | 25 – 1,000 ppm <sup>3</sup>             | 31 – 150 ppm                          |
| Iron (Fe)      | 30 – 100 ppm                            | 31 – 50 ppm                           |
| Copper (Cu)    | 5 – 15 ppm                              | 5 – 15 ppm                            |
| Boron (B)      | 25 – 50 ppm                             | 25 – 50 ppm                           |
| Zinc (Zn)      | 30 – 60 ppm                             | 30 – 50 ppm                           |

<sup>1</sup>Values are based on petioles taken at full-bloom. Source: Wine Grape Production Guide for Eastern North America, 2008.

<sup>2</sup>Values are based on petioles taken at veraison between 15 Jul and 15 Aug. Source: Midwest Grape Production Guide, 2005.

<sup>3</sup>ppm is parts per million

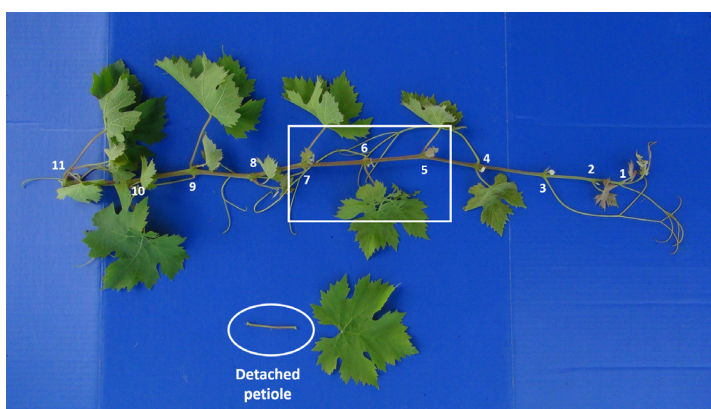


Figure 5. Petiole sampling during veraison, mid-July through mid-August. Select petioles located between leaves 5 to 7 from the shoot tip.



Figure 6. Collect petioles in brown paper bags. Ensure petioles are dried before shipping to prevent mold development and breakdown of petiole tissue.

#### Additional resources:

- 1) Dami et al. 2005. Midwest Grape Production Guide. Ohio State University Bulletin 919.
- 2) Moyer et al. Vineyard Nutrient Management in Washington State. Washington State University Bulletin #EM11E.
- 3) Wolf. 2008. Wine Grape Production Guide for Eastern North America. NRAES-145.

#### What should I sample?

- At veraison, sample 1 or 2 petioles per vine for each variety
- Sample petioles from mature, fully expanded leaves located 5 to 7 leaves from the shoot tip (**Fig. 5**)
- Detach each petiole from the leaf blade immediately
- Place petioles in a paper (not plastic) bag (**Fig. 6**)
- Label each sample and keep records of the following: varieties sampled, vineyard block where samples are collected, sampling date, and vineyard conditions
- Prior to shipping, allow samples to dry either by oven at 200°F for 30 minutes or one day in a warm, dry, well-ventilated location

**Common nutrient deficiencies in Ohio vineyards?** Nitrogen (N), Potassium (K), and magnesium (Mg) are the most common nutrient deficiencies observed either visually or by petiole analysis. Other nutrient problems occur occasionally and include boron (B), zinc (Zn), and iron (Fe). Normal ranges for nutrient levels at full-bloom and veraison are listed in **Table 1**.

#### Take Home Message

Be proactive not reactive: Do not wait until you see visual symptoms to correct a nutritional problem. If you see it, the problem already exists, and the damage has already been done on growth, yield, and fruit quality. The goal of fertilization is to prevent nutrient deficiencies and excesses from occurring in the first place.