

## REVIEW OF STRAWBERRY NUTRITION AND FOLLAR SAMPLING



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Maintenance of optimum nutritional status of strawberries is dependent on development of a favorable root environment and the availability of elements that are required for normal growth and development. Soil pH is a key factor in maintaining a favorable root environment. It not only affects root growth but influences availability of many nutrients. A pH of 6.0 - 6.2 is generally considered ideal.

Essential elements for plant growth include the major elements nitrogen (N), phosphorus (P), and potassium (K); the secondary elements calcium (Ca), magnesium (Mg), and sulfur (S); and the micronutrients iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), boron (B) and molybdenum (Mo). Major elements are required in greatest quantity. Nitrogen is the most important of these elements and has the most profound influence on yield and quality.

Secondary elements are required in the next greatest quantity. They play significant roles in photosynthesis, cell wall development, and protein production.

Micronutrients are required at very low quantities but are essential for normal growth and development. They generally serve as catalysts for chemical reactions in the plant. Even though micronutrients are required in small quantities, excess quantities of these elements can become toxic.

Strawberry growers have a number of tools at their disposal to help manage crop nutrition. Observation and experience are very important but lack supportive data needed to confirm findings and allow low risk decisions to be made. Soil testing, plant analysis and solution analysis provide growers with basic information on plant nutrition and the usability of irrigation water. By combining this information with data on yield, quality and length of fruiting season, growers can make decisions that enhance profit while also protecting the environment.

A soil test determines residual acidity and allows the prediction of lime requirement for optimum crop performance. Availability of nutrients including Ca, Mg, P, & Mn, Zn and Cu is also determined. A soil test is predictive and is best suited for elements that are not mobile with soil water.

Plant analysis is the chemical evaluation of nutritional status at a given point in the life cycle of a crop. This evaluation complements soil testing and is particularly helpful in looking at the status of elements including N, K, S, and B that are mobile and move with leaching rainfall in sandy soils.

A recent option in plant analysis involves determination of nitrate nitrogen concentration of petioles. This tool appears to offer great potential in fine tuning nitrogen application to maximize both yield and quality and extend the fruiting season. Additional work is needed to fine tune this technique and determine if benefits can be derived from evaluating the status of other essential elements in this plant part.

Low pH is the most significant and predominant problem identified on soil samples submitted from strawberry fields in North Carolina. This is unfortunate since the problem can not be corrected in a timely manner if the crop has already been planted. Low calcium and magnesium usually accompany low pH. Magnesium can also be limiting on sandy soils in which pH is adequate but nutrient-holding capacity is very limited. Soluble salts are a problem where fertilizer application has been excessive and/or moisture inadequate.

Plant tissue samples identify low nitrogen and/or potassium most often. Calcium, magnesium and boron are also limiting in a number of samples. Problems with the other essential elements are seldom found unless liming has been excessive or there is root disease or chemical injury influencing nutrient uptake.

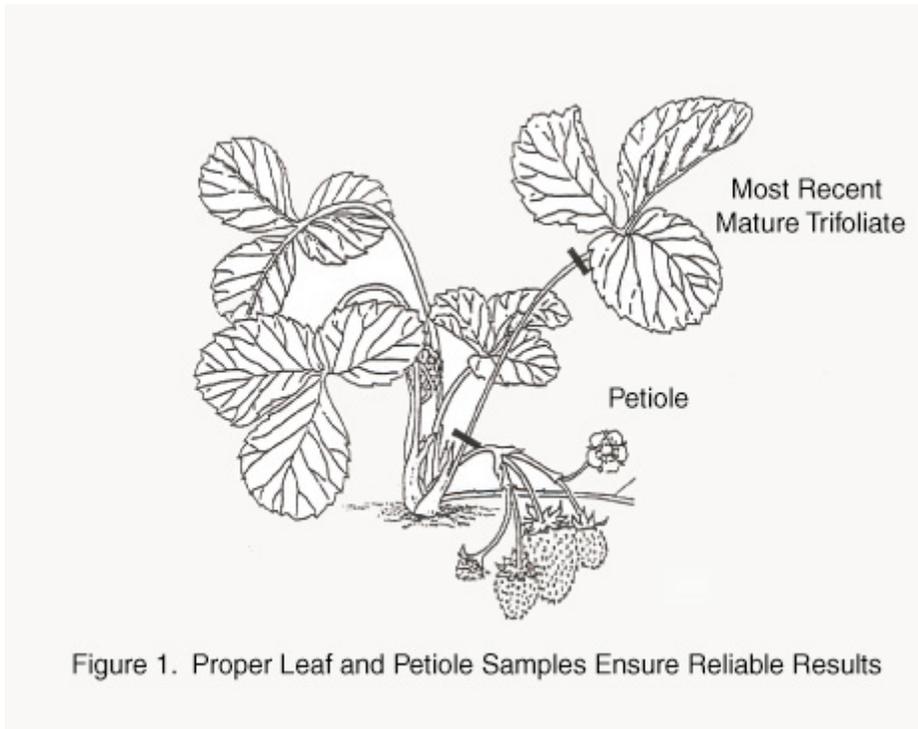


Figure 1. Proper Leaf and Petiole Samples Ensure Reliable Results

A good nutrient management strategy includes addressing as many of the nutritional requirements as possible in preplant applications. Soil pH and calcium saturation should be adjusted three to four months ahead of bed-forming and fumigation. Applications of nitrogen, phosphate, potash, magnesium and micronutrients should be based on soil test recommendation and made at bed-forming. On very sandy soils, it is advisable to apply 1.0 lb of boron and 15 lbs of sulfur per acre. Nitrogen and potash should be applied in quantities adequate to support fall growth. If a good job of fall fertilization is done, the needs of the crop should be met until vegetative growth begins in the spring.

Current fertilization practices of many growers include preplant application of 100-150 lbs N/acre in a slow release form. This practice may be limiting the ability to optimize yield and quality through lack of control of nitrogen availability. Release of nitrogen from sulfur coated urea and subsequent change to the nitrate form is dependent on soil temperature, moisture, enzymes, and microorganisms. Under black plastic, temperatures may increase in the fall to levels that cause early release of nitrogen. This may result in too much nitrogen available early and excess ammonium in the root zone. Ammonium toxicity has been reported where fertilizers contained more than 50% of the nitrogen in the ammonium form. Injury to the root system could also weaken plants and increase vulnerability to disease.

Work by investigators in California (Uchic et. al, 1980) provides evidence of the benefits derived from strategically spaced nitrogen applications in the spring. Higher fruit yields in their studies were associated with nitrogen applied during vegetative growth and fruiting. During this period, petiole nitrate nitrogen values were 3000 - 4000 ppm when nitrogen was adequate.

The plastic hill culture with trickle irrigation and feeding capabilities provides an excellent means for not only meeting nitrogen requirements of the crop but also limiting excess use of fertilizer. Based on current information, leaf and petiole sampling should begin no later than February 15 and continue at two-week intervals through June 15. Nitrogen applications should be made during this period based on petiole nitrate

nitrogen trends. Petiole nitrate nitrogen values should reach 3000 - 4000 ppm by early fruit-picking and then decline gradually to around 500 ppm at the end of harvest.

Sampling technique is very important in providing reliable results. The most recent mature trifoliolate including petioles should be taken from mother plants representing the average appearance of the crop. Fifteen to twenty trifoliolates and petioles are required for the analyses. Petioles should be stripped from the trifoliolates and secured in a bundle with a rubber band or twist-tie. Both the trifoliolates and petioles should be shipped to the Plant Analysis laboratory.

Currently, a total analysis and interpretation is provided on the trifoliolates. Nitrate nitrogen is determined on the petioles and provides an additional evaluation of nitrogen status. In general nitrate nitrogen concentration should never be below 500 ppm. Exceptions to this general rule would be during early winter dormancy (December-January) and after fruiting (July). During plant establishment (fall), petiole nitrate nitrogen should approach 1500 - 2000 ppm. During vegetative growth (early spring), nitrate nitrogen should increase to 3000 - 4000 ppm at early harvest and then decline to 500 ppm by the end of fruiting. Excess nitrate nitrogen (over 10000 ppm) may depress yield and will likely limit quality.

Petiole nitrate nitrogen monitoring has not been perfected. Additional work is needed to fine-tune the sufficiency range to reflect not only optimum yield but best shipping quality. Work is also needed to determine if this plant part can be used to evaluate the status of other important elements. Potassium and perhaps other elements and their relationship to nitrogen may be very important in optimizing quality. It appears that petiole nitrate nitrogen monitoring will play a significant role in managing strawberry nutrition in the future.

#### References

Ulrich, A., M. A. E. Mostafa, and W. W. Allen. 1980. Strawberry Deficiency Symptoms: A visual and plant analysis guide to fertilization. University of California Division of Agricultural Sciences, Berkeley, California 94720.