Leaf Tissue Testing for Hemp

► Why do leaf tissue testing? How can it help me? How do I do it? Plant analysis or leaf tissue testing is the best option when deciding if more fertilizer is needed to meet your expected yields.

Leaf tissue testing, including for hemp (*Cannabis sativus*) can help identify any "hidden hunger" that might exist in a crop. A hidden hunger develops when a crop needs more of a given nutrient but has shown no deficiency symptoms.

Leaf tissue testing is the chemical evaluation of essential element concentrations in plant tissue. Essential elements include those that are required to complete the life cycle of a plant. The elements carbon (C), oxygen (O), and hydrogen (H) are supplied by the atmosphere and water and are not generally considered limiting. Most emphasis is placed on essential elements supplied by soil or feeding solutions. Macronutrients—nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and sulfur (S)—are required in the greatest quantities. Micronutrients—iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), boron (B), molybdenum (Mo), and chlorine (Cl)—are required in very small quantities. Toxicities of micronutrients are equally important and yield limiting, as are deficiencies. Plant analysis is also effective in diagnosing toxicities of micronutrients.

The interpretation of plant analysis results is based on the principle that healthy plants contain predictable concentrations of each essential element. Auburn University's Soil, Forage, and Water Testing Lab can provide nitrogen concentrations as well as those of the other essential macro- and micronutrients to aid in fertilizer application decisions. A program of periodic leaf tissue sampling and analysis will help you optimize your fertility program and often can allow you to correct deficiencies before symptoms become apparent. In most economically important crops, the best indicator samples have been identified. These samples are collected and analyzed, and the results are compared to a set of values.

In most crops, we can compare values from our analysis to those of established, recognized values. These are called *critical values* or *sufficiency values*. For example, a significant amount of research has been conducted on

tomatoes, and sufficiency values have been identified for six stages of growth starting from mid-bloom of the first flower cluster though mid-bloom of the sixth flower cluster. For hemp, however, those values have been broadly defined and are currently being more fine-tuned.

Critical values are defined as the concentration at which there is a 5 percent to 10 percent yield reduction. The use of critical values for practical interpretation has limited value. It is best suited to diagnose severe deficiencies and has little application in identifying hidden hunger. Symptoms are generally visibly evident when nutrient concentrations decrease below the critical value. Critical values play an important role in establishing lower limits of sufficiency ranges. With hemp, survey values approximate the critical values for deficiency or toxicity, but additional research data is required to verify this assumption under a wide range of growing conditions.

Sufficiency values are nutrient element concentrations for plants where deficiency, sufficiency, and toxicity levels have been well established through scientific evaluation over a broad range of growing conditions.

Sufficiency ranges represent the upper and lower sufficiency values. Interpretation offers significant advantages over the use of critical values. First, hidden

hunger in plants can be identified because the beginning of the sufficiency range is clearly above the critical value. Sufficiency ranges also have upper limits that provide some indication of the concentration at which the element may be in excess.

Because hemp is a recent development as a crop in Alabama, limited data is available from leaf tissue testing. With hemp, only critical values have been identified, and these are presented as survey ranges in tables 1. These ranges were developed from limited testing of multiple cultivars over a limited number of growing conditions. With more sampling, we will be able to develop sufficiency ranges that will be more narrowly defined with all of their benefits as described above. With these ranges, you will have a target and baseline for your fertilizer program. With this information, you can evaluate your crop's nutrient health and make appropriate corrective actions, if needed. Leaf tissue sampling provides the only method to evaluate your crop's nutrient status.

How to Collect a Sample for Analysis

Collect the most recently mature leaf (MRML) or the most recently expanded leaf. It is generally the third to fifth leaf down from the growing point. For hemp, collect 1 to 2 MRMLs from 20 to 30 plants growing in like conditions for a good sample. If fields are uniform in soil type, etc., one sample should be sufficient.

Place the sample in a paper bag or similar container. *Never use plastic zip bags.* Keep the sample cool but do not freeze. Submit samples to a local soil testing lab, but call the lab before sending to ensure that they have the proper permits and can accept the samples.

It is also a good idea to include a soil sample with your leaf tissue sample. The soil sample may aid in interpreting any issues that are identified from your leaf tissue sample. Knowing the nutrient levels in your soil will help develop a strategy for any corrective issues. Submit one soil sample from each location sampled. Request a routine soil analysis. Identify and label all samples to their corresponding sites. A copy of your permit is required for shipping and is required by the lab receiving the samples. Failure to include the permit may result in sample processing delays or rejection of the sample. Include a copy of your hemp grower's permit. The US Postal Service will accept hemp samples but other carriers will not at this time. Overnight your samples to the lab to make sure that samples arrive in good shape.

Scientific name: *Cannabis sativa*	**Plant part: 25 mature leaves (MRMLs) from new growth**
Season: Vegetative prior to flowering	**Data type: Survey Range**

Table 1. Sufficiency Ranges of Macronutrient and Micronutrients in Hemp

MACRONUTRIENT	PERCENTAGE
Nitrogen (N)	3.30 to 4.76
Phosphorus (P)	0.24 to 0.49
Calcium (Ca)	1.47 to 4.42
Magnesium (Mg)	0.40 to 0.81
Sulfur (S)	0.17 to 0.26
MICRONUTRIENT	**PPM**
Iron (Fe)	100 to 150
Manganese (Mn)	41 to 93
Boron (B)	56 to 105
Copper (Cu)	5 to 7.1
Zinc (Zn)	24 to 52
Molybdenum (Mo)	0.5 to 1.5

Source: Plant Analysis Handbook, IV (2014) Micro-Macro Publishing, Inc. Used with permission.

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