Leaf Analysis — Fertilization Guide for the Future

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There are various approaches to fertilization programs and deciding the kind of fertilizers to use. One of the oldest and one of the first methods to use is visual plant symptoms. The grower looks at a crop, decides whether or not it is deficient in a certain element, and applies fertilizer accordingly. More recently, it has been recognized that toxicity is a problem. The carnation boron deficiency scare resulted in growers applying too much boron resulting in toxic symptoms. The use of plant symptoms as a guide for fertilization programs presents the problem that by the time deficiency or toxicity symptoms show, growth is retarded.

Standard Fertilization Program

The standard fertilization program presents a method of deciding in advance the application of a certain quantity of fertilizer at a certain time consistently throughout the year. Such a pre-planned consistent fertilization program requires some standardization. Soil mixtures, watering programs, planting, pinching, disbudding, lighting, and shading all have to be standardized to permit a programmed type of fertilization.

Essential Plant Elements

In most cases the three essential elements for plant growth, carbon, hydrogen, and oxygen, are adequately supplied. It is now recognized that there can be a deficiency of carbon for plant growth in terms of carbon dioxide fertilization. Nitrogen, phosphorus, potassium, calcium, surphur and magnesium are the major elements required by plants in large quantities. The trace elements are boron, manganese, zinc, copper, molybdenum, and iron. Present standard methods for guiding fertilization programs employ soil tests that concern twelve elements. The soil test, however, is used basically for testing nitrogen, phosphorus, potassium, magnesium, and calcium. Most soil laboratories do not test for trace elements since the test is rather difficult and the quantities of trace elements present in the soil are relatively small for evaluation. Soil tests are still a useful guide for fertilizing greenhouse crops since they effectively tell the presence or absence of elements.

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Leaf Analysis *(Continued)*

Even though soil tests do not give the whole story, they should not be discarded.

Leaf Analysis and What it Involves

Supposedly, leaf analysis will indicate if elements are present in the plant and is basically used to tell if the elements have gone from the soil into the plant. There are many problems with leaf analysis. If an element is present in the soil it usually ends up in the plant; however, occasionally this doesn't happen. Many times, material is "tied up" in the soil. If the soil pH is extremely low or high some of the trace elements may or may not get into the plant. In some cases, elements get into the leaves but don't do the job they are supposed to do. Iron is noted for this.

It must first be decided where the leaf sample is to be taken. Calcium and boron will first become deficient in the bud of roses. There may be satisfactory quantities of calcium and boron at the plant base but they are of no use in terms of the bud. Likewise with carnations, there may be adequate amounts of boron to maintain the plant vegetatively but because the element has not moved to the top of the plant it is deficient and results in adverse effects. Therefore, to test for calcium and boron, normally the best part of the plant to sample is the top.

Iron, manganese, sulphur and copper usually become deficient first in the upper leaves or upper part of the stem. To test for these elements alone would require sampling from the plant top. Potassium, magnesium and zinc usually become deficient first in the bottom of the plant. Therefore, to test for these elements alone a plant sample would be taken from this area. Nitrogen and phosphorus deficiencies show on the whole plant and sampling from the whole plant would show good results.

This presents a dilemma in terms of the grower and the researcher in trying to decide where to take a leaf sample in terms of all elements. Is there one section on a plant that will give a good indication of all elements? On the basis of research, particularly with fruit crops, it has been decided that a leaf from the middle of the plant on current year's growth is probably a good sample for all elements. This has not been decided completely for greenhouse crops but it is the objective of many research projects across the country.

Leaf samples should be dried quickly. If this is not possible then samples should be kept under refrigeration so there will be little change. The leaves should be cleaned by washing off spray residue. This is particularly so when using Parzate which leaves a residue of manganese, and Fermate, which leaves a residue of iron. Such residues would confuse the end results. It is suggested that the leaves be washed in distilled water and scrubbed with cotton. After washing the sample is dried which takes 24 to 48 hours at about 70° C. This rapidly dries off the water contained in the leaves and avoids a change in leaf composition or dry weight which could effect the final analytical results.

Next, the leaf is ground into a fine enough powder to pass through a 40 to 60 mesh screen. After grinding, the sample is dried again in either a dessicator or oven. From this a one-half or one gram sample is weighed out to four decimal places.

The sample is then ashed by burning in a muffle furnace at 500° C. for 24 hours. The residue is basically the minerals picked up by the plant and present in the leaves. These minerals, or ash, are diluted in a buffer solution and go through the steps of analysis which is the easiest part because of the automatic equipment used. An automatic recording spectograph will analyze a sample of 12 to 14 elements in approximately two minutes. This, however, involves an investment of $30 to $50,000.

There is a lot of time, effort and man hours involved in preparing the sample before analysis. There is a series of figures which have to be translated into terms of p.p.m. or percentage of element present in the leaf. Then the most important part—what do they mean, how are the analysis terms interpreted? Minimum-maximum spreads have been established or are being established for each tested element for normal growth of various crops. Even though soil tests do not indicate deficiencies or excesses of certain elements, a deficiency may be indicated in leaf analysis.

In the future, leaf analyses are going to be used as guides for long term fertilization. Soil tests are still adequate for day-to-day guides. Leaf analyses are going to have greater value in diagnosing problem situations where other information doesn't give the answer. Finally, leaf analysis will be used as a research tool to help decide what the proper balance in the soil or plant should be for various nutrient elements.