Foliar Analysis of Carnations

Part I: Introduction

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Particularly in the past few years many of us in the Floriculture industry have been hearing of foliar analysis or tissue analysis as it is also termed. Foliar analysis is a technique for determining the mineral nutrient status of a crop. To do this, portions of a plant, or the entire plant in some cases, are collected and analyzed for their mineral nutrient content.

This technique approaches the problem of nutrient status not by a process of estimating the levels of nutrients available to the plant in the soil, but rather by determining the quantities of nutrients accumulated by the plant. This means that the factors regulating the availability of nutrients to the plant do not enter into foliar analysis as they do in soil anaylsis. These factors must, however, be taken into consideration when corrective measures are developed for conditions determined through foliar analysis.

Attention is also being focused on foliar analysis because with modern instrumentation, analyses for trace elements such as boron, manganese, copper and zinc can easily be incorporated into the scheme of analysis. With the purer forms of fertilizer used for liquid fertilization today and the tendency toward formulating ones' own fertilizer from trace element-free carriers it is becoming increasingly important to adapt fertilization programs to involve trace elements. Along with the use of trace elements comes the need for a system to evaluate trace element status.

Although foliar analysis is relatively new to the Floriculture industry, to the best of our knowledge its origin dates back to the work of Weinhold (1) in the early 1860's. He conceived the idea of using an analysis of the plant as an indication of the nutrient status of the soil in which the plant is growing. This work was verified by others such as Hellriegel (1) in 1867 who noted in experiments with barley that the K content of both grain and straw increased with increasing supply in the sand in which plants were grown. As early as 1882 it was realized by Heinrich (1) that certain organs of the plant might be superior to the whole plant in determining the soil nutrient status. He gave evidence that the roots of oat plants were the ideal organ to use when determining N status

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since a depletion of N occurred sooner here than in the rest of the plant.

Many basic concepts of foliar analysis were developed in the latter half of the 19th century and the early decades of the present century. Owing to the tedious chemical analyses of the times and to a lack of analytical instrumentation the technique of foliar analysis was confined to experimentation.

Up until the third decade of this century much of the research was conducted in countries centering around Germany and Sweden. At this time research in these countries was redirected along the lines of biological soil analysis while in the United States and England plant analysis experienced a rebirth.

The early work in this country favored the analysis of extracted plant sap. While the chemical content of plant sap did correlate with nutrient levels in the soil, in the mid-and late-thirties the system gave way to the present day system of analyzing whole or intact tissue. This new system is free of the difficulties involved in procuring a sample of plant sap.

Out of this present technique of foliar analysis has come the development of systems of analysis for a wide variety of crops. While there are numerous publications dealing with foliar analysis one need only refer to a couple such as Reuther 1961 (4) and the May-June 1962 issue of Better Crops with Plant Food (2) to find schemes of analysis for cotton, cabbage, celery, lettuce, melons, potatoes, tomatoes, sweet corn, sugar beets and citrus trees.

Little work has been done with floricultural crops. However there is a very definite need for foliar analysis in our field. In our work at Cornell we are in the process of developing a scheme of foliar analysis for the carnation plant. The early results of this work have been published in volume 83 of the Proceedings of the American Society for Horticultural Science (3). In this phase of the work a technique for sampling of the plants was developed. In the second phase of the work, now nearing completion, optimum tissue nutrient concentrations which can be associated with optimum yield are being determined. The third phase of the work, also to be completed early this summer, involves an understanding of both the limitations of foliar analysis and the various uses to which it can be applied.

Some general observations which have come out of our work follow. It has been well documented that increased or decreased uptake of a mineral nutrient often has an enhancing or inhibiting influence upon the uptake of other mineral nutrients. These interplays between mineral nutrients are termed "ion interactions." As a result of ion interactions a mineral nutrient "B" may become lacking in the plant even though it is present in the soil in adequate quantity. While the visual symptoms expressed in the plant may be those of mineral "B" it is the causal mineral "A" which must be amended in the soil to correct the problem. Through foliar anaylsis we are able to separate the causal elements from those which are merely the effect.

Foliar analysis tends to give nutritional trends in the carnation plant. This is an advantage in the sense that these values are relatively stable and do not reflect to anywhere near the degree that soil does, sudden temporary changes in the soil nutrient reservoir. By plotting a sequence of results from foliar analyses it can be readily ascertained whether the nutritional status of the crop is above, below or normal for the existing conditions and also whether nutrient uptake is increasing or decreasing.

At the same time this factor of stability can be a disadvantage since it prevents the immediate appraisal of rapid changes within the soil. This brings us to the conclusion that foliar analysis will in all probability be used along with soil analysis by the florist. The combination will yield a tool far more useful than either alone and will give us a means of probing deeper into the realm of plant nutrition.

The results of our studies will be presented in a subsequent series of articles.

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