Monday Afternoon, August 23, 1976

The afternoon session convened at 1:30 p.m. with Mr. Andy Knauer serving as moderator.

LEAF ANALYSIS — A GROWTH INDICATOR

ELTON M. SMITH

The Ohio State University
Columbus, Ohio 43210

Abstract. Leaf analysis, a well established diagnostic tool, should be used by the nursery industry, along with soil analysis, to diagnose suspected nutritional disorders, detect deficiencies prior to visual manifestation and, most important, to monitor the mineral status of plants during the growing season. Sufficient values are listed for 12 elements as a guideline for fertilizer determinations.

What is Leaf Analysis? The terms "plant," "tissue," "foliar" and "leaf" analysis have all been used synonymously to describe the procedure used to determine the nutritional condition of the entire plant. The term "leaf analysis" will be used in this discussion since the leaf or foliage is the most frequently used tissue. Leaf analysis utilizes the relationship that has been found to exist between the nutrient content of a leaf and the growth and yield of that plant.

Leaf Analysis Background. Leaf analysis has been used for years as a method of diagnosing plant nutrient disorders and making fertilizer recommendations for many agronomic and horticultural crops. The mid to late 1930's was the beginning of a popular trend to develop leaf analysis as a useful research and production technique. The first grower service laboratories were established by Kenworthy at Michigan State University in 1949. Benjamin Wolf in Florida in 1949 and by O.A. Matkin in California in 1950 (2). Private or University laboratories have now been established in most states for leaf analysis in both horticultural and agronomic crops.

In landscape or ornamental horticulture the utilization of leaf analysis by the industry has been much slower because research has been limited to only a few species. Early work in ornamentals centered on the genus *Taxus* by Boonstra, Kenworthy and Watson (1) in 1957 and Kelly and Shier (5,6) in 1965. Work with a wider group of trees and shrubs was conducted by Cannon, Chadwick and Reisch (3) in 1960, Davidson (4) in 1960, Smith (8) in 1972 and Lumis (7) in 1975.

Advantages of Leaf Analysis. Much of the current information on ornamentals nutrition, as well as other crops, can be attributed to the adaptation of leaf analysis. Prior to the general

use of leaf analysis, many fertility experiments were conducted to determine the effects of a given type or rate of fertilizer on a crop, but without leaf analysis much of their value was lost for anything but localized recommendations or comparisons. Through leaf analysis, however, this mineral leaf value-growth relationship has been found to be sufficiently reliable from year to year and from one soil type or cultural condition to another that standards have been developed for various crops. Thus, leaf analysis represents a more universal means of determining plant nutrient condition.

Another advantage of leaf analysis is that it is a more accurate procedure to determine plant nutrition status than visual evaluations, rapid tissue tests and soil tests. Leaf analysis, however, should be used in conjunction with soil testing in order to continue to obtain soil pH, soluble salts, base exchange capacity, percent base saturation and organic matter level.

How is Leaf Analysis Used in the Nursery Industry? Leaf analysis is used by the landscape and grounds maintenance sectors primarily for diagnosing nutritional disorders. Most samples arriving in The Ohio State University laboratories have dealth with chlorosis problems of maples, oaks, pines and an assortment of shrubs.

Although producers are using this procedure for diagnostic reasons, more growers each year are utilizing leaf analysis as a method of monitoring their nutritional program. Container plant producers on liquid fertilizer programs utilize leaf analysis most frequently, as expected. A monitoring program every 2 to 4 weeks allows producers to adjust their fertilizer injections according to plant mineral element levels and, thereby, program growth accordingly. Another advantage of a monitoring system is the opportunity to detect suspected nutrient deficiencies before unsatisfactory growth occurs.

The greatest return from fertilizer dollars is to achieve optimum plant growth with minimum investment. The utilization of leaf analysis, the most modernistic technique available, will assist in determining the proper amount of fertilizer to apply. The cost conscious nurseryman utilizes a leaf analysis service as a plant growth indicator.

Sampling Guidelines. The optimum time of year to sample plants, since mineral element levels vary during the season, is between late June and late September in Ohio. Samples should be taken by removing the most recently matured leaves from 15 to 20 or more healthy plants or from as many different plants as possible showing a suspected disorder. Depending on leaf size, between 30 and 50 leaves should be removed from deciduous plants and broadleaf evergreens. All tissue samples should be

taken from the current season's growth and should be free of insect and disease infestations as well as other disorders.

The leaf analysis program, in those states offering such a service through a Land Grant University, is usually administered through the County Cooperative Extension Service. A number of private laboratories also offer leaf analysis services. A routine leaf analysis will usually cost between $7.00 and $30.00 depending on the laboratory.

Acceptable Values. Through survey research, fertilizer rate studies and analysis of grower reports during the past several years at Ohio State University, leaf analysis guidelines have been developed for woody ornamentals (9). Sufficient ranges are outlines below based on determination of nitrogen by the automated Kjeldahl process and of all other elements by direct reading emission spectrograph.

Nitrogen — A range of 2.0 to 4.5% is recommended with levels closer to 2% by late summer.

Phosphorus — A range of 0.2 to 0.6% is usually sufficient for healthy foliage and satisfactory flowering.

Potassium — Levels between 1.5 and 3.5% should be maintained, although evergreens often exhibit levels closer to 1.0%.

Calcium — A range of 0.5 to 2.5% is usually found; however, early in the season and in soft growth of terminal cuttings levels are lower.

Magnesium — The desired range is between 0.3 and 1.0% with the exceptions noted with calcium above.

Manganese — Levels vary between 30 and 800 ppm.

Iron — A range of 50 to 700 ppm is considered sufficient although variations exist and deficiencies may occur above 50 ppm.

Boron — Levels between 20 and 50 ppm are satisfactory.

Copper — Growth of plants is satisfactory when copper levels are between 10 and 50 ppm.

Zinc — Thirty to 75 ppm are considered necessary for optimum growth.

Molybdenum — a range of 0.6 to 6.0 ppm is sufficient.

Aluminum — Levels above 800 ppm are likely to be toxic.

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COMPOSTING SEWAGE SLUDGE IN THE NURSERY

HAROLD E. STONER
Westminster Nurseries, Inc.
Westminster, Maryland 21157

In 1974, Dr. Francis Gouin introduced to this Society, the possibilities of using composted sludge in container growing mixes. His talk aroused my interest enough, that upon returning home, we immediately procured 40 tons of digested sludge from one of the Baltimore waste-water treatment plants. We composted this material using 2 parts aged hardwood bark and 1 part digested sludge. After composting thru the months of January, February, and March, using a front-end loader to turn the pile, a test was taken. The results were: pH 5.6, magnesium 300+ (V.H.), phosphate 510 (V.H.), potash 258 (H), soluble salts 3200 ppm (hot).

We consulted with Dr. Gouin, and a decision was made to add soil to reduce the soluble salts to a safe level. We used a half compost and half top soil mix for planting 500 shade and flowering trees in baskets. When the planting was completed, they were heeled-in with a hardwood bark mulch and top-dressed with nitrogen. There was not much different at first from our previous method of using a highly organic top soil, but as soon as mid-summer came and we got less and less rain,