Fertility Management in the Landscape

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Proper nutrient management in landscapes is important to maintain the integrity and aesthetics of plant material while simultaneously preventing nutrient runoff into neighboring environments. Strict regulations regarding runoff water quality are being enforced for many agricultural sites such as nurseries and farming systems. High nitrate (NO_3) concentrations (>10 ppm NO_3-N) in runoff waters have become a major concern with respect to fertilizer usage. It is imperative that landscape installation and maintenance programs incorporate sound cultural and fertilization practices that will simultaneously optimize landscape quality and minimize the likelihood of fertilizer runoff.

There are <u>three goals</u> with regard to fertility management in agricultural systems:

1. Optimize plant performance (growth, quality).
2. Optimize fertilizer use efficiency.
3. Minimize/eliminate nutrient runoff.

To achieve the above goals, four areas of landscape management must be addressed:

1. Soil Preparation
2. Plant Selection
3. Fertilizer Management
4. Irrigation Management

<u>Soil Preparation</u>

**Soil Testing.* Always conduct a soil test when preparing a landscaped area. It is easier and less costly to correct chemical and physical problems of the soil before plants are installed.

**Drainage.* Adequate drainage is required. Poor drainage is often one of the primary causes of poor plant performance of landscapes. Plant roots are unable to take up water and nutrients in poorly drained soils.

**Water Holding Capacity*

+*Sandy Soils* – Additions of organic matter will increase water holding and nutrient retention capacity of soils. This will improve irrigation and fertilization efficiency of the site.

+*Clay Soils* - Heavy clays need to be amended to increase aeration for the root systems.

**pH.* A pH optimum of 6.5 to 7.5 is ideal for most crops. A pH of 5.0 to 6.0 is ideal for acid-loving plants such as ferns, camellia, azalea, and many other Ericaceous crops. In California, high pH is usually the reason for chlorosis of new foliage in azaleas and camellias.

**Fertility*.* After a proper soil test, adjustments can be made to optimize the initial fertility status of the soil. This should be done prior to planting.
**Salinity*.* High salinity will cause root necrosis in severe cases, limiting water and nutrient uptake. Salinity may be caused by poor drainage or over fertilization.
**Mulching.* Through proper mulching, water evaporation from soil is minimized.

<u>Plant Selection</u>
**Root System.* Select plants that are not root-bound in containers. If some root circling has occurred in containers, loosen roots to prevent continued circling once planted in the landscape.
**Root to Shoot Ratio.* Do not select plants with excessive shoot growth relative to roots. These plants will need frequent watering, which increases the likelihood of nutrient runoff from the landscape.
**Trunk Integrity.* Inspect trunks for any diseases or mechanical injury. Damaged trunks will inhibit water and nutrient uptake to shoots and carbohydrate translocation to roots.

<u>Fertility Management</u>
**Fertilization Method – Liquid vs. Granular.* Controlled Release Fertilizers offer slower release of nutrients over time. Nutrient availability in most formulations is based on temperature, with release rates increasing as temperature increases.
**Nutrient Balance.* The most important aspect of fertilization is nutrient balance. Many nutritional deficiencies are induced by over fertilization with a few essential nutrients (primarily nitrogen, phosphorus and potassium) without application of the other essential nutrients such has calcium, magnesium, etc. This occurs because not all bulk fertilizers contain all major essential elements in the relative proportions needed to optimize growth. Therefore, symptoms of calcium and especially magnesium deficiencies are occurring, through over fertilization with potassium and nitrogen. (See 'Nutrition Notes Handout' for a detailed description of nutrient deficiency and toxicity symptoms and the soil, environmental and cultural conditions that may be associated with these symptoms). These symptoms are evident in palms such as *Phoenix canariensis* and some dicots.
**Timing of Fertilizer Applications.* It appears that ornamentals take up the majority of nutrients after the flush of vegetative growth is reaching maturity not during the active growth of the flush. Therefore the best time for fertilizer application is in spring so that fertilizer is available as growth flushes begin maturing. Winter fertilization may result in nutrient runoff. The exception occurs for winter-growing shrubs and growth of cool-season annuals.

<u>Irrigation Management</u>
Next to fertilization programs, irrigation practices will have a major impact on the three objectives (plant performance, fertilizer use efficiency, and nutrient runoff). Irrigation management will be discussed at other stations.

Nutrition Notes

This should serve only as a general guideline since nutrient requirements will vary by differences in climate, cultural conditions and plant species.
The following list gives a general description of characteristics associated with each element.
*Number range (percentage or ppm) gives approximate nutrient concentrations for healthy plants.
*Nutrient Interactions (Toxicity) - describes possible deficiencies of other elements if said element is available in high quantities.
*Nutrient Interactions (Deficiency) – lists other elements, which when in high quantities, may induce deficiencies of said element.

Nitrogen (N) – mobile (1.0-6.0%)
Deficiency Symptoms
Mild. Uniform yellowing and senescence of older leaves.
Severe. Canopy chlorotic, plants stunted.
Soils
*Waterlogged; anaerobic; leached sandy soils may be nitrogen deficient.
Nutrient Interactions
Toxicity. NH_4^+ - competes with K, Ca, Mg. Ammonium uptake is optimum at neutral pH and uptake decreases at lower soil pH. Symptoms of ammonium toxicity include leaf necrosis, stem lesions and stunted root and shoot growth.
NO_3^- - competes with P and S. Nitrate uptake is optimum between pH 4.5 and 6.0.

Phosphorus (P) – mobile (0.2-0.5%)
Deficiency Symptoms
Mild. older leaves turn dark green to purple. Stems of herbaceous plants become dark red.
Severe. older leaves dark purple necrotic spots.
Soils
*pH. Precipitates with Fe (low pH) or Ca (high pH), inducing deficiency of Fe and P or Ca and P, respectively.
*Cold, wet soils induce P deficiency
Nutrient Interactions
Toxicity. P competes with Fe, Zn, and Cu.
Deficiency. Fe, Zn, Al, and Ca compete with P.

Potassium (K) – mobile (1.5-4.0%)
Foliar K:N ratio 1:1 considered ideal.
Deficiency symptoms
Mild. chlorosis and necrosis develop initially on leaf margins of 2nd and 3rd oldest leaves. Monocots exhibit orange-tan speckling.
Fruit and flower quality decrease (shorter shelf-life).
*Treatment - fertilizer (soil + foliar) effective only on newer leaves. Older necrotic leaves will not recover.
Soils
*Sandy, acid soil; organic soil; peat-based mix.
Nutrient Interactions
Toxicity. K competes with Ca and Mg.
Deficiency. Ca and Mg compete with K.

Calcium (Ca) – immobile (0.5-1.5%)
Foliar Ca:Mg ratio of 2:1 and K:Ca ratio of 4:1 considered ideal
Deficiency Symptoms
Mild. New leaves chlorotic, deformed, stunted.
Severe. Leaf necrosis, meristem dies.
Problematic Situations
*Dry soils, erratic irrigation.
*High humidity, which reduces transpiration.
Nutrient Interactions
Toxicity. Ca competes with Fe, Mn, Zn, Cu.
Deficiency. K and NH_4^+ compete with Ca.

Magnesium (Mg) – mobile (0.15-0.40%)
Foliar Ca:Mg ratios of 2:1 and K:Mg ratios of 8:1 considered ideal.
Deficiency Symptoms
Mild. Interveinal chlorosis of older leaves. Midribs remain green. In monocots, leaf chlorosis is striped or on leaf margins.
Severe. Older leaves become necrotic.
Dolomite and MgO - slow release forms for acid soils.
Fertilizer (soil + foliar) effective only on newer leaves.
Problematic soils
*Sandy soils; leached soils; organic media.
*pH. Low (<4.5) and high (<6.0) pH soil.
Nutrient Interactions
Toxicity. Mg competes with Mn.
Deficiency. K, NH_4^+, Ca, Na and Al (acid soils) compete with Mg.

Sulfur (S) – primarily immobile (0.15-0.50%)
Foliar S:N ratio of 1:14 considered ideal
Deficiency Symptoms
rare – atmospheric S from ocean and pollution.
Mild. Uniform chlorosis of old and new leaves.
Severe. Leaflet tips necrotic, stunted growth.
Problematic soils
*Nitrogen – high N may cause S deficiency.
*leaching – excess leaching.
Nutrient Interactions
Toxicity. Atmospheric SO_2 0.5-0.7 S/m^3 causes necrosis of tissue.

Iron (Fe) – immobile (50-75 ppm)
Deficiency Symptoms.
Mild. Interveinal chlorosis of young leaves. Chlorosis of younger leaves with green spots.
Severe. New leaves white or necrotic and stunted.
*Correctional treatments – Foliar sprays of iron sulfate or Fe chelates. Soils of high pH should be acidified. Acid fertilizers such as NH_4 rather than compounds of NO_3^--N will also reduce soil pH.
Foliar fertilization will be effective, but temporary. Soil must be corrected to prevent continued chlorosis.
Problematic conditions
*Poorly aerated soils; wet soils
*High pH cause "lime-induced chlorosis" = reduced Fe uptake into plant and physiologically unavailable Fe in plant.
*Cool soils, where roots are not actively growing, may induce iron deficiency. Foliar sprays cannot correct

chlorosis caused by cool soils. Once soils warm, new leaves will emerge healthy.

Nutrient Interactions

Toxicity. Excessive Fe in flooded soils – brown speckling on leaves – seen in rice.

Deficiency. Ca (high pH), P, B, Cu, Mn compete with Fe.

Manganese (Mn) – immobile (10-200 ppm)

Deficiency Symptoms.

Mild. varies among plant species. Chlorosis between veins of older leaves.chlorosis. "Frizzletop" in palms. Gray speckling at base on leaf bladed in monocots.

*Correctional treatments – Foliar sprays of manganese sulfate or Mn chelates will correct the chlorosis.

Special notes:

Soils

*acid soils (pH <5.4) may cause Mn toxicity

Environment

*Cold temperatures will induce Mn deficiency for some palms growing outside the recommended regions of culture. Chlorosis caused by cool soils cannot be corrected by foliar sprays. Once soils warm, new leaves will emerge healthy.

Nutrient Interactions

*Toxicity. Excessive Mn may induce symptoms of Fe, Zn, Cu, and/or Ca deficiencies. In acid soils, Mn toxicity appears as marginal yellowing of young leaves with central green area and black speckling in leaves and stems "measles".

*Deficiency. Excessive fertilization with Mg, Ca, or K may induce Mn deficiency.

Copper (Cu) – immobile (2-20 ppm)

Deficiency Symptoms.

New leaves emerge stunted and necrotic, especially near the leaf tips. In monocots, young leaf tips will turn white.

Special notes:

Soils

*Peat soils tightly bind Cu and therefore are more likely to induce Cu deficiencies

Nutrient Interactions

*Toxicity. Copper containing fungicides can induce Cu toxicity. Excessive Cu may induce symptoms of Fe deficiency. Root growth stunted.

*Deficiency. Excessive fertilization with Mn or Fe may induce Cu deficiency.

Boron (B) – immobile. (~20ppm)

Deficiency Symptoms.

Stunted growth and dieback of apical meristem followed by sprouting of lateral stems. Cracked roots and necrosis of meristems.

Soils and Waters

*Boron is often easily leached from soils in areas of regular rainfall. However, in dry desert regions, boron may accumulate to high concentrations.

*Boron levels above 5 ppm in water is toxic to many crops, causing symptoms of leaf tip necrosis

Nutrient Interactions

*Toxicity. Since B is required in such small quantities, B toxicity can easily occur with over fertilization.

Zinc (Zn) – immobile. (15-50 ppm)

Deficiency Symptoms.

Interveinal chlorosis and yellow mottling of new leaves. Decreased stem growth, which appears as rosetting of terminal leaves.

Special notes:

Nutrient Interactions

*Toxicity. High Zn in soil (>200 ppm) may induce Fe, Mn or P deficiencies.

*Deficiency. High concentrations of Cu, Ca, Mg and Fe may induce Zn deficiency.

Molybdenum (Mo) – (0.15-0.30 ppm)

Deficiency Symptoms.

Older then younger leaves become chlorotic to yellow-green and leaf margins will roll in. In severe cases, leaf lamina will not develop, leaving only the leaf midrib. "Whiptail" in Brassicas.

Soils

*Sandy acid-leached soils may be Mo deficient

Nutrient Interactions

*Deficiency. Excess sulfates may induce Mo deficiency.

Literature Cited

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