Tree fertilization: the good, the bad and the completely unnecessary

Seminar roadmap

- Scope of presentation
- Unsupported practices and products
- Better practices

Scope of presentation

- Arboriculture vs. urban forestry and production agriculture
- Peer reviewed literature vs. traditional practices, common sense approaches

What's essential for plant success

- Functional, established roots
- Macronutrients
- Micronutrients
- Water and oxygen
- Beneficial microbes

Fertilizer facts

- Differences among nutrient sources
  - Commercial fertilizers – guaranteed analysis
    - Organic
    - Inorganic
  - Biostimulants – not enough nutrient content to qualify as a fertilizer
- Overuse and misuse of fertilizer
  - Imbalances and toxicities
  - Disrupt uptake of other nutrients
  - Negative effects on beneficial microbes
  - Heavy metal buildup

Products and practices with no consistent, reliable supporting science

- Products
  - Cold hardiness fertilizer
  - Compost tea
  - Kelp products
  - Vitamin B-1 fertilizer
- Practices
  - Fertilizer injections

Claim: "Potassium and/or magnesium will increase tree cold hardiness"

- Science behind potassium and magnesium
  - Potassium (K^+) helps regulate cell membrane activity and water relations
  - Magnesium (Mg^{+2}) is an enzyme co-factor
  - Neither K^+ nor Mg^{+2} is generally deficient in non-agricultural soils
  - K^+ and Mg^{+2} can interfere with each other when added in excess
  - "No clear relation between the pattern of frost hardiness and nutrient concentrations"

- Scientific summary
  - Neither K^{+} nor Mg^{+2} will increase the hardiness of any landscape trees
  - To grow marginally hardy trees, take advantage of microclimates
  - To overwinter marginally hardy trees, insulate them and the soil

Claim: "Compost tea improves tree growth"

- Science behind ACT and soils
  - Few studies published
  - Virtually no differences between soil treated with water and ACT
  - Compost has much greater nutrient content, more microbes than ACT
- Scientific summary
  - ACTs have no demonstrated function as a fertilizer
  - ACTs can contain pathogens
  - ACTs are expensive and energy-wasteful compared to compost

Claim: "Kelps and seaweeds stimulate root growth and plant establishment"

- About kelp
  - The "trees" of marine ecosystems
  - Clearcut to make luxury products
  - Kelp harvesting affects fish and coastal seabird populations
- Scientific summary
  - Weak fertilizer
  - Kelp hormones can stimulate rooting
  - Can contain high levels of toxic heavy metals
  - Generally no different than controls in greenhouse and field experiments
  - No differences compared to well-watered, fertilized plants

Claim: "Vitamin B-1 will help transplants establish"

- Plants make their own vitamin B-1
- Rooting hormones are effective on their own

Claim: "Fertilizer injection is more effective than soil application"

- Most fine roots are close to the soil surface
- Trunk injection can injure trees
- Soil injection is ineffective and a waste of money and resources

Products and practices misapplied to arboriculture

- Products
  - Epsom salts
  - Gypsum
  - Mycorrhizal inoculants
  - Phosphate fertilizer
  - Rock dust
- Practices
  - Foliar fertilizers

Claim: Epsom salts are a "safe, natural way to increase plant growth"

- About Epsom salts
  - Magnesium sulfate
  - Used in intensive tree fruit production
  - Makes water feel silkier
- Scientific summary
  - Generally used to treat magnesium deficiency in production agriculture
  - Adding magnesium to soils with adequate magnesium can cause nutritional imbalances

Claim: "Adding gypsum to your yard or garden will improve soil tilth"

- Agricultural use:
  - Replace sodium in salty soils with calcium
  - Improve heavy clay soils
  - Improve overused agricultural soils
- Gypsum will not:
  - Change acidic or sandy soils
  - Improve water holding capacity
  - Improve most urban soils (saline soils are an exception)
  - Help plants establish

Claim: "Mycorrhizal and probiotic inoculants enhance root growth and plant establishment"

- About inoculants
  - Viability of spores impossible to assess
  - Often contain fertilizers
- Scientific summary
  - Healthy soils have their own populations of mycorrhizae
  - Unhealthy soils won't support mycorrhizae

Claim: "Phosphate fertilizer enhances root growth"

- About phosphorus
  - Most non-agricultural soils have enough phosphorus
  - Phosphate toxicity is one of the most common problems in urban soils
- Scientific summary
  - Phosphorus competes with iron and manganese uptake
  - Excess phosphorus Inhibits mycorrhizal fungi, so roots work overtime
  - Excess phosphorus pollutes aquatic systems

Claim: "Rock dust improves mineral nutrition for trees"

- Agricultural use of rock dust
  - Container media mix
  - Remineralize old agricultural soils
  - Improve CEC in agricultural soils

- Scientific summary
  - Will not increase soil water holding capacity
  - No evidence for use in landscapes
  - Potential for heavy metal contamination
  - Potential for nutrient toxicity

Claim: "Foliar feeding puts nutrients directly into leaves rather than wasting it on the soil"

- Agricultural use of foliar fertilizer
  - Treat deficiencies in intensive tree fruit production
  - Diagnose foliar deficiencies
- Scientific summary
  - Foliar fertilizers only treat foliar symptoms; they don't solve soil deficiencies
  - Repeatedly applying foliar fertilizers is expensive and can injure plants

Rational nutrient management

- Soil tests before ANYTHING is added to a new or existing landscapes
- Proper planting techniques (for functional, established root systems)
  - Root preparation
    - Removal of all barriers to establishment
    - Correction of structural roots
  - Planting at grade
  - Nothing added to the hole but roots, soil and water
- Root zone maintenance
  - Watering
  - Addition of only those nutrients that are deficient
    - Inorganic or organic products – quick fix
    - Organic material as a topdressing – slow food
  - Mulching with arborist wood chips for long term soil nutrition

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