And other limiting stresses

Plantation nutrient limitations in Lake States and southeastern US

Mark Coleman

Incoming director

Intermountain Forest Tree Nutrition Co-op

University of Idaho
College of Natural Resources

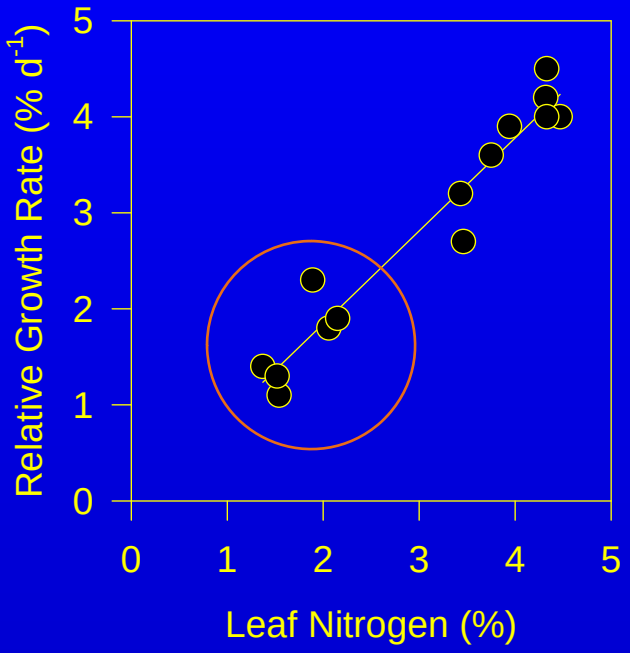
Forest trees respond to regular nutrient additions

- High site vs. low site is obvious example
- Addition rate experiments, greenhouse
- Can nutrient additions in the field achieve similar results?
- What is the influence of other factors?

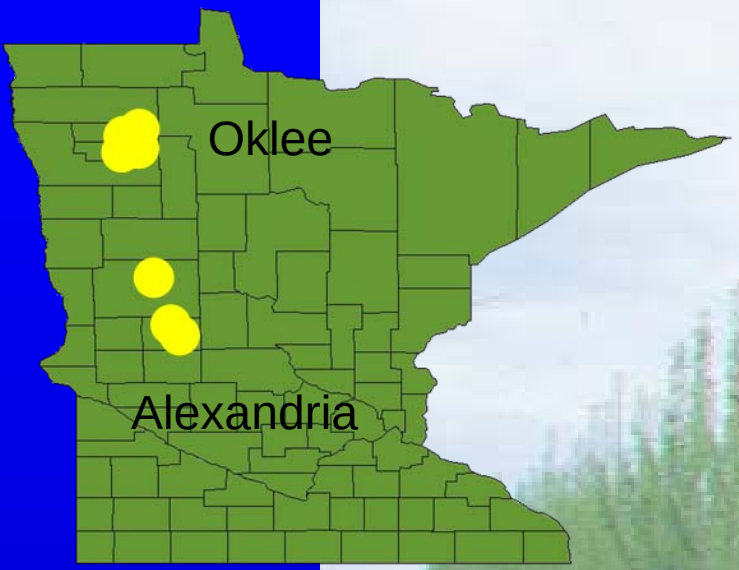
Addition rate experiments

- Fertilizer solution concentration start low
- Concentration increases daily by specified percent
- Match exponential demand of plant growth
- Rate of nutrient addition is directly related to plant growth

Objective: Achieve fertilizer response in field equal to that found in greenhouse



Minnesota hybrid poplar field trials

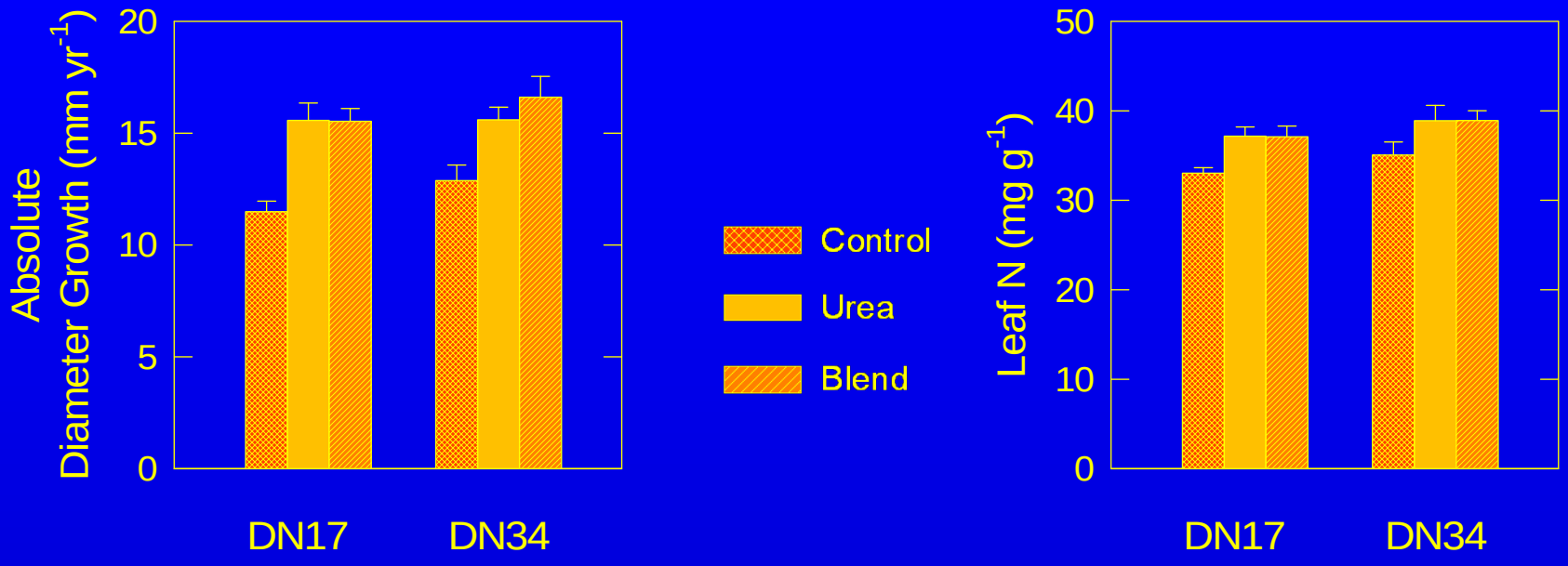


- USDA Forest Service
- Boise Cascade
- Univ. Minn, Crookston
- Agricultural Utilization Research Institute
- DOE, Oak Ridge
- WesMin RC&D
- Minn DNR
- Environmental Forestry Consultants,LLC

Hybrid poplar field trials

- Can leaf N concentrations in field fertilizer trials achieve levels observed in greenhouse?
- Will high field leaf N result in higher productivity?
- Will multi-nutrient blends cause greater response than N-only applications?
- Little or no response observed before neighboring trees created competition

Oklee Fertilizer Trial

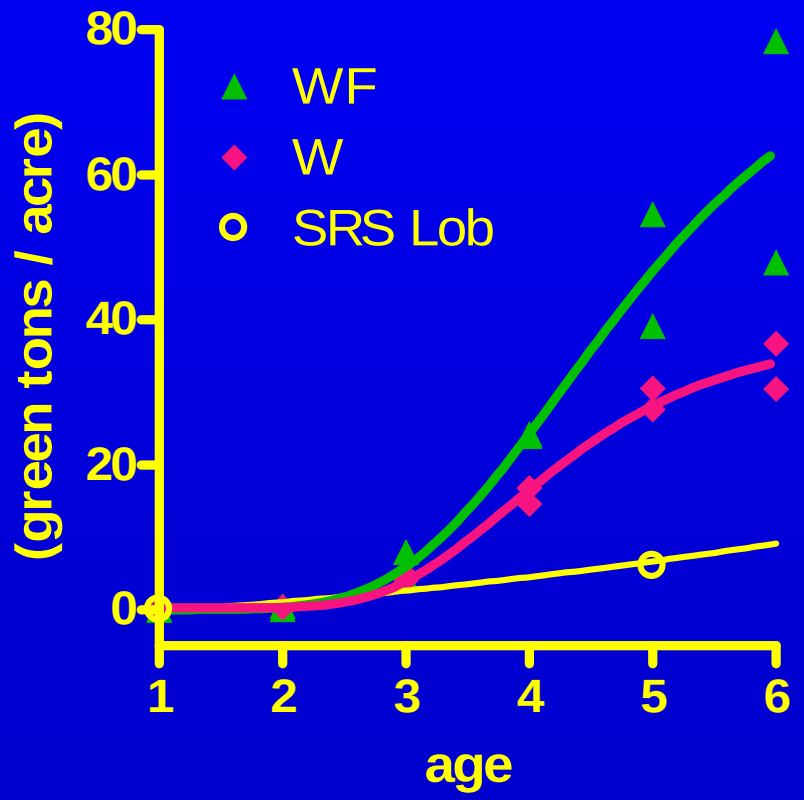


Coleman et al 2006

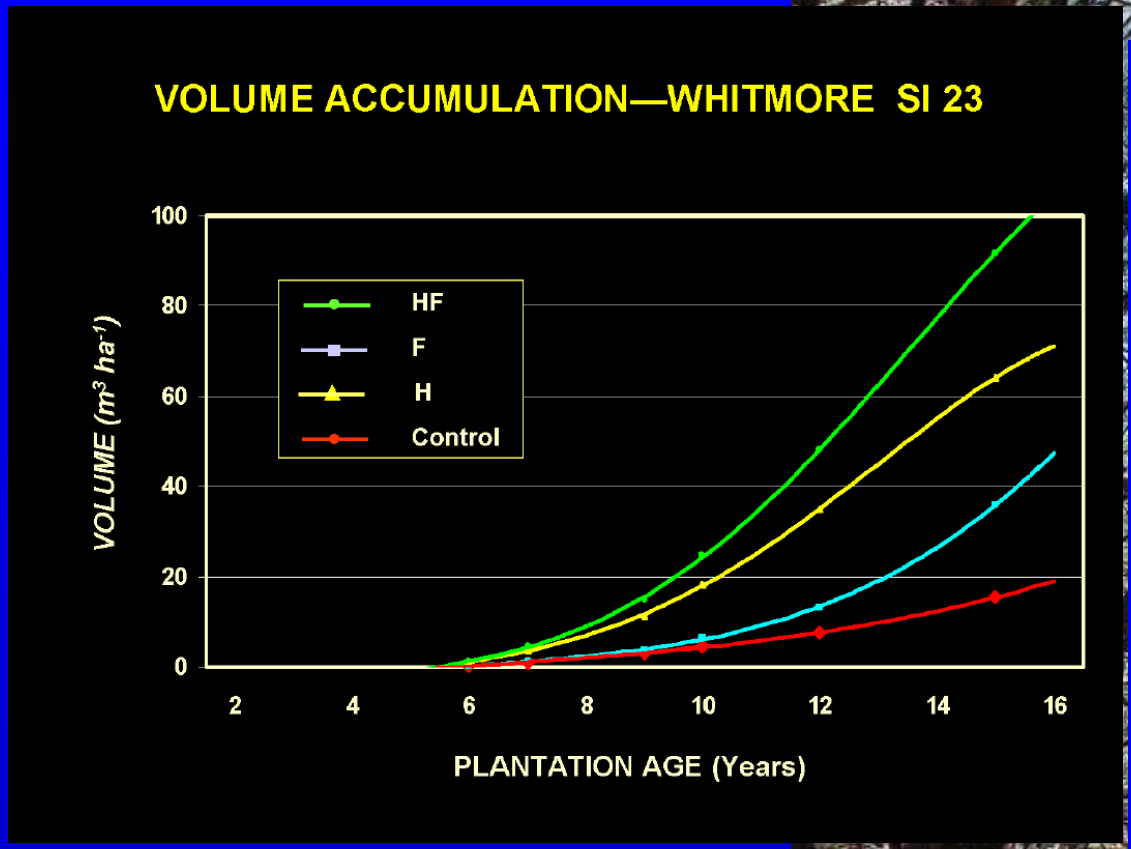
- Three annual additions enhanced production and leaf nutrient concentrations
- Multi-nutrient blend was not an improvement over N-only

7-yr-old Loblolly Pine growing with regular fertilizer additions and complete weed control at Savannah River

Regular nutrient additions enhance loblolly pine production on sandy soil



Garden of Eden



- Ponderosa pine demonstrated response to fertilizer additions
- Requires vegetation control for best response

http://outreach.forestry.oregonstate.edu/forestnutrition/agenda.htm

CONCLUSIONS FROM THE GARDEN OF EDEN STUDY

- Potential productivity in plantations is *far* greater than previously believed.
- On droughty sites, vegetation control is *everything*.
- A key to sustained and accelerated productivity is repeated treatment.

http://outreach.forestry.oregonstate.edu/forestnutrition/agenda.htm

What is maximum productivity for intermountain forests?

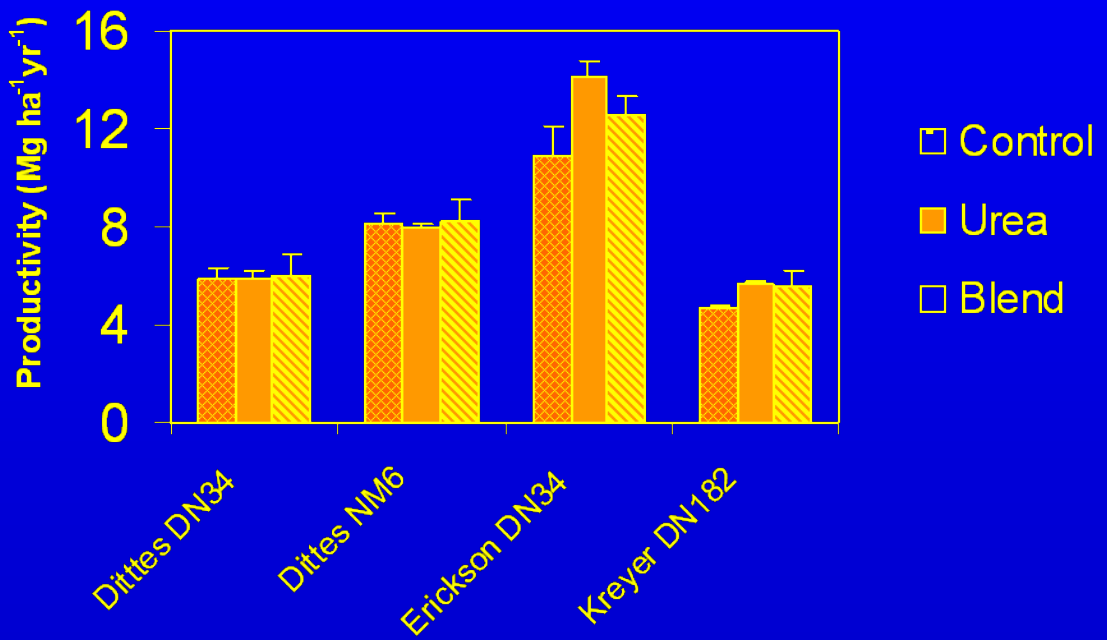
- Choose high productivity site class
- Select genetic stock matched to rock and habitat type
- Assure prime seedling quality
- Complete competition control
- Optimal spacing with properly timed thinning
- Regular nutrient additions using balanced blends

Other limitations decrease forest vigor, and limit response to nutrient additions

- Competition
- Water availability
- Pathogens
- Pests
- Multiple nutrients

Alexandria hybrid poplar trial showed limited response at some locations

2001

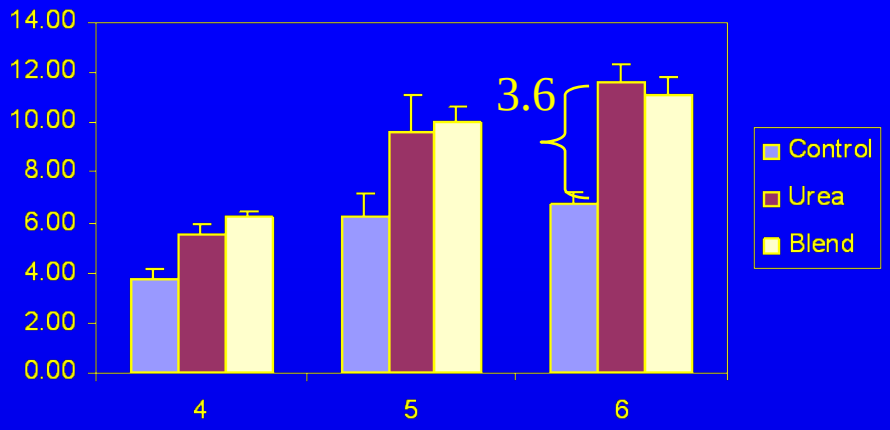


FTC controlled

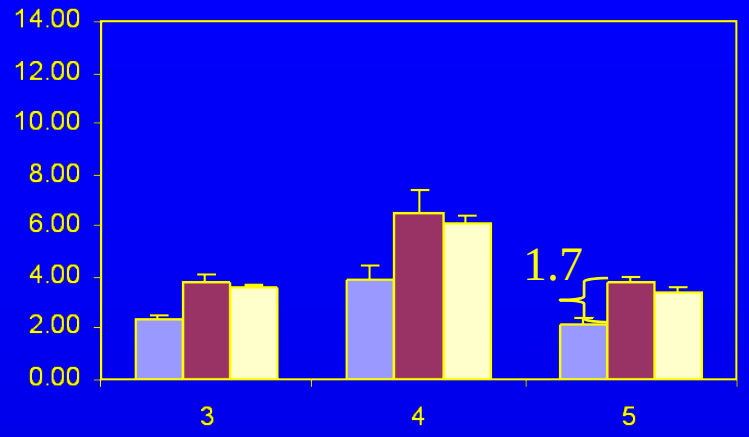
FTC uncontrolled

Annual Productivity (Mg ha^{-1})

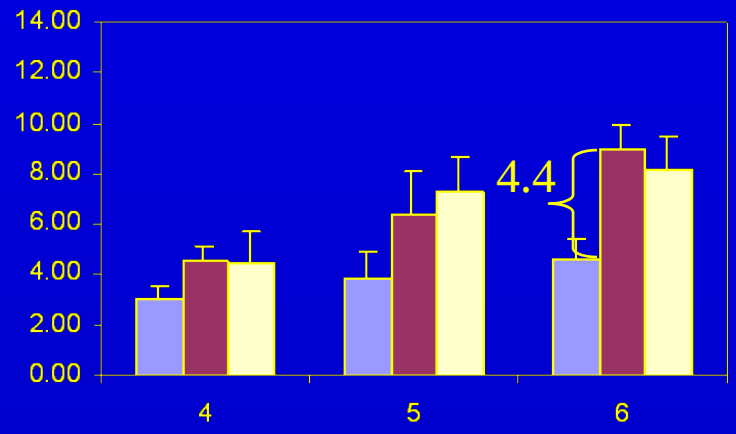
Barth 17



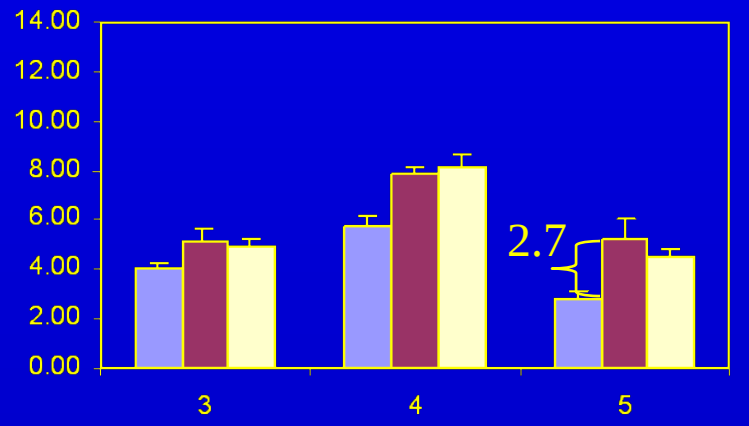
Hofstad 17



Barth 34



Hofstad 34



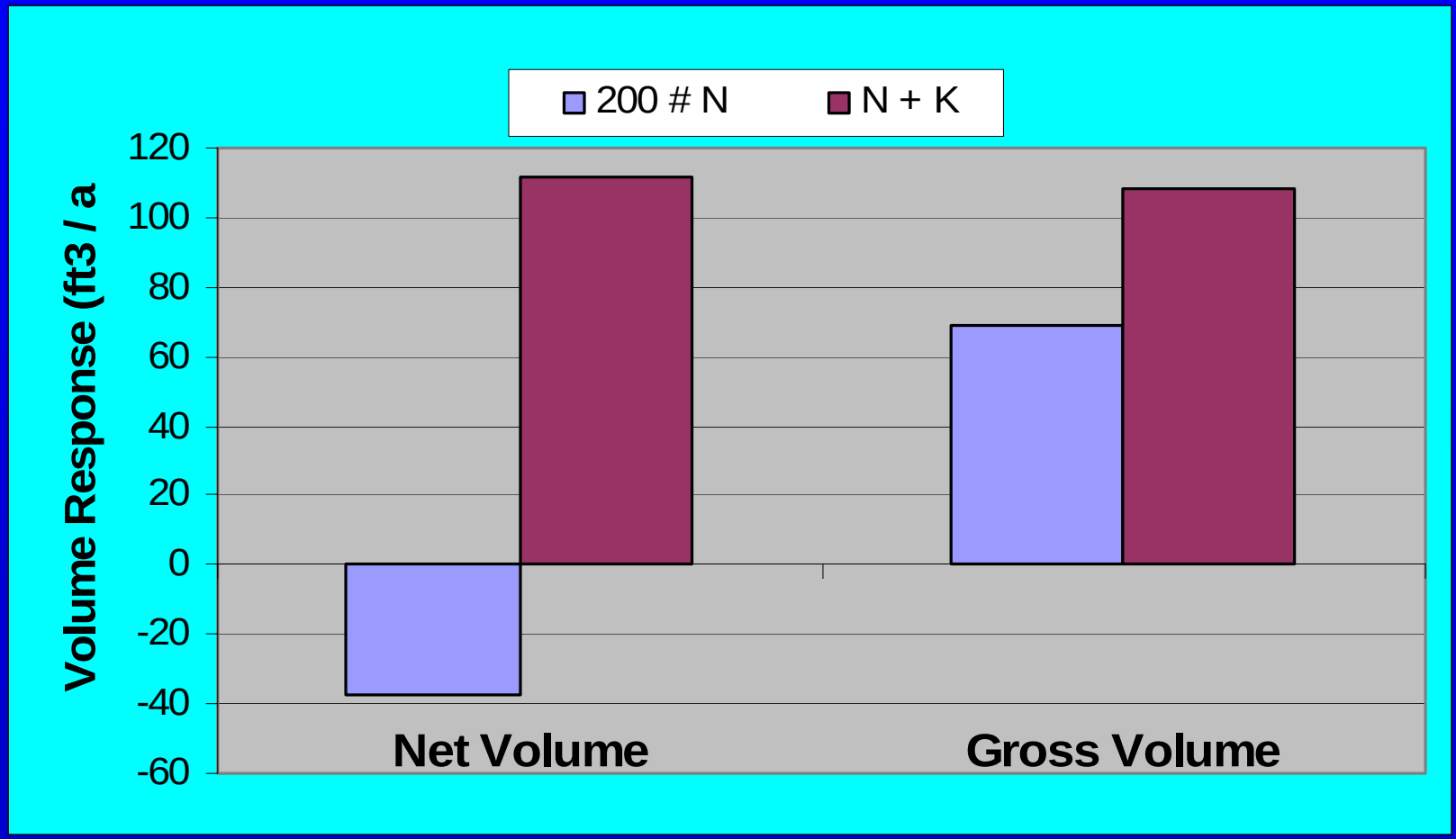
Growing Season

Other limitations decrease response

- Competition
- Water availability
- Pathogens
- Pests
- Other nutrients

IFTNC Montana Ponderosa Pine Trial

Four-year Volume Response



Mining data for rock nutrient supply

- Do geochemical analyses relate to foliage and soil nutrients?
- Do patterns in foliage concentration ratios represent rock weathering?
- Do cation exchange capacity and base saturation define nutrient availability and rock weathering patterns
- Do surficial deposits dilute the signature of underlying rock

Other initiatives

- Geo-spatial tools for identifying unique site types
- Improve understanding of N supply, including organic N, gross N mineralization
- Investigate alternative site enhancements; N fixers, charcoal, lime
- Test and modify rock weathering models to predict multinutrient supply
- Identify new outreach opportunities