Multinutrient Forest Fertilization

Inland Empire Reforestation Council

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N - Only

Multinutrient

Motivation Of Speaker
- Potlatch Staff – Policy Explanation
- New Coop Direction
- Logical Argument

Forest Nutrition
Quick Review of Basic Concepts

Warning! Science Content! Attention! Contenu Scientique!

- Nutrient status and productivity of forest site types vary:
  - Light, temperature and MOISTURE
  - Rocks – Basalts > Granites > Metasedimentary (vary) - Mixed (vary)
  - Soils – Surficial Deposits - Ash Caps, Loess, alluvial and tertiary
  - Soil Depth & Coarse Fragments
- Nutrient status (demands) differ by species
  - GF > DF > WP > PP > LPP > WL
- Nutrient deficiencies in Inland NW forests
  - N (almost always) – K,S,B (common) – Cu,Zn,Mg,Fe (occasional) – P(?)
- Forest tree nutrients must be kept in proper balance
  - Another green plant!
  - Definition essential nutrient element – completion of life cycle
  - Tissue concentrations each element
  - Ratios of essential element concentrations

Reasons for Forest Fertilization in the Inland Northwest

- Provide significant resource improvement and financial returns
- Enhance forest stand health and growth
- Enhance growth of non tree vegetation and / or improve the forage base
- Rehabilitate nutrient deficient sites
- Help seedlings/saplings achieve or maintain free to grow status
- Increase rate of crown closure for young stands and after thinning treatments
- Maintain a fast growing and high nutrient demanding stand
- Amend nutrients removed during management activities???

Nitrogen Fertilization

This presentation: A Struggle with the logic that has developed over the last 40 years

Given that:

- Nitrogen is the most commonly deficient nutrient.
- Aerial fertilization with multinutrients is very expensive.

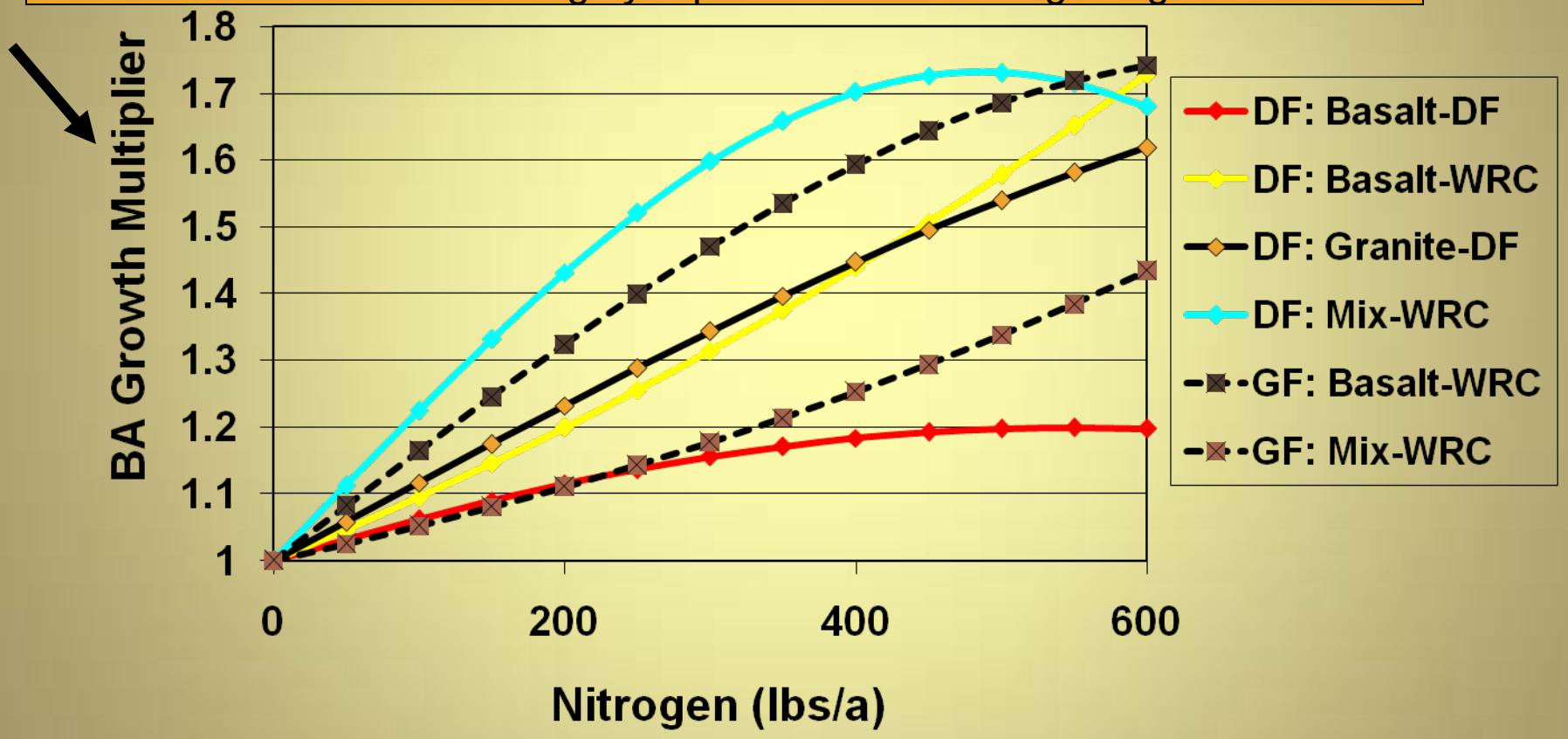
Does it follow that:

- N only fertilization is much cheaper and therefore results in a better economic return? Even if response is not as great?
- The most limiting growth factor should be the most economical production limitation to correct. Right?

Let's look at some N only fertilization results

Nitrogen Fertilization Response Across IFTNC Forest Health Sites

"Multiplier" – Response expressed as a programming adjustment in Growth & Yield Models. Roughly equivalent to % change in growth rate



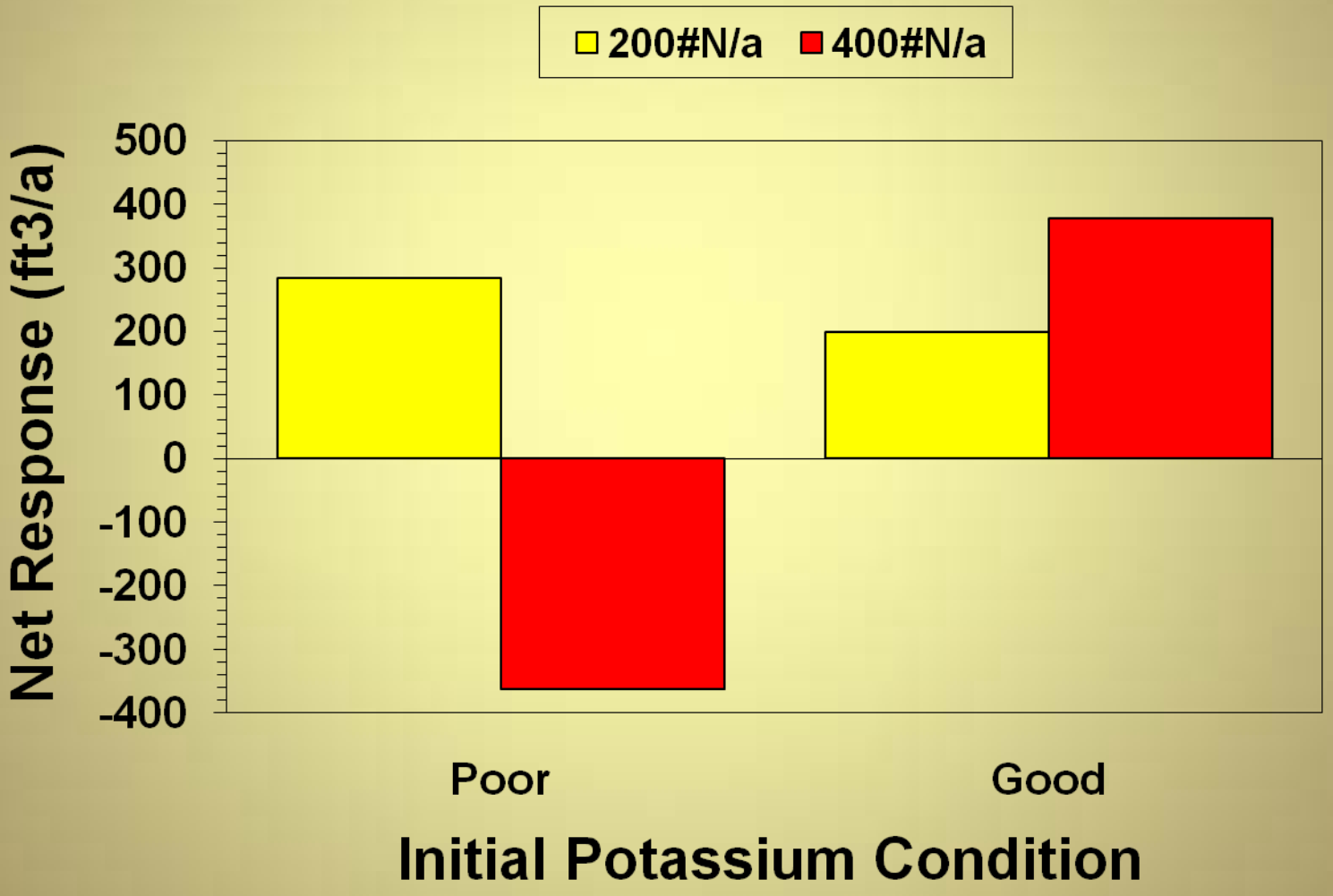
200 N BA Response ranges from ~15-45% but is site dependent.

But wait there's more!

“Square Death”

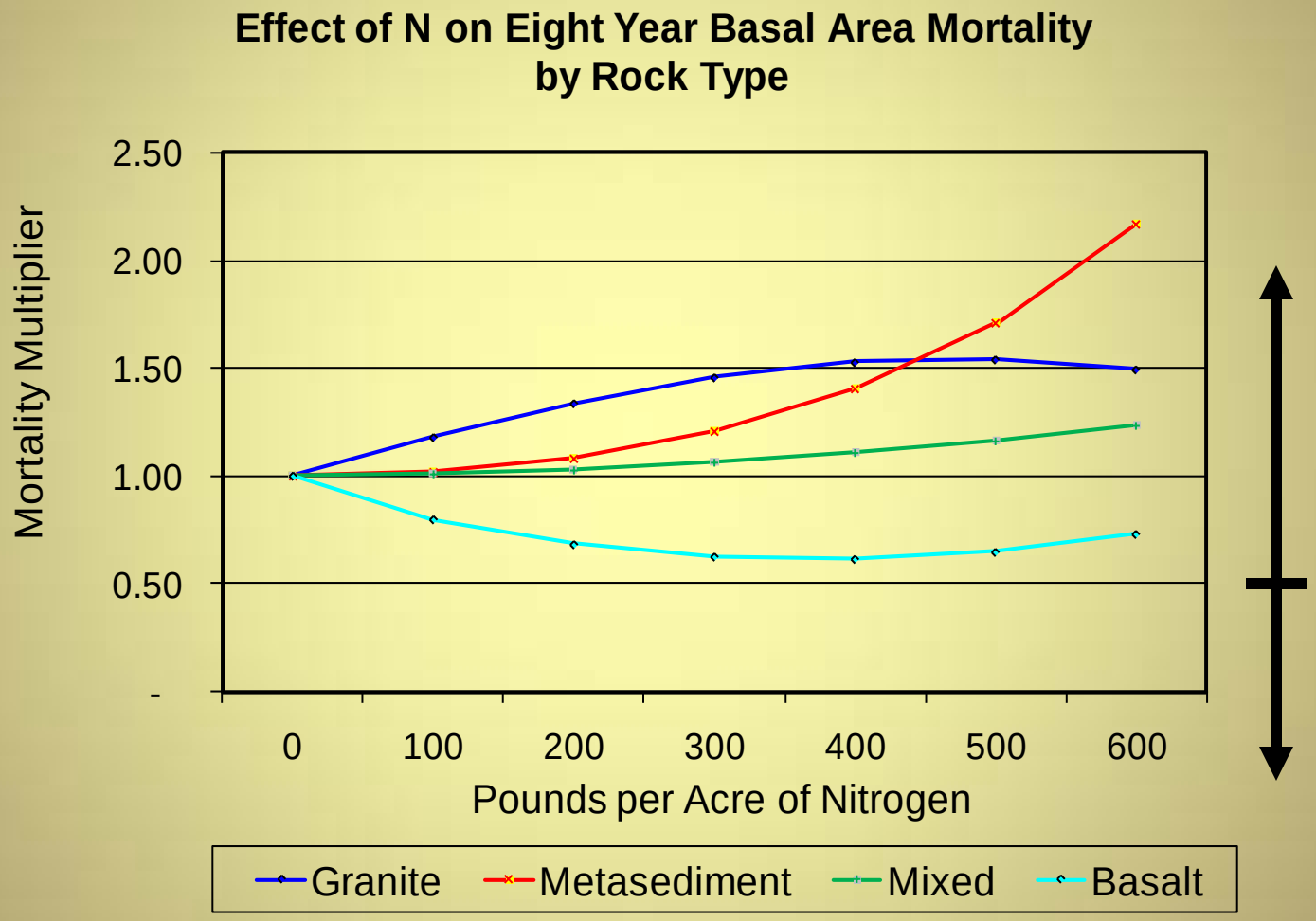
Both stands were N deficient. What happened?
Other than occasionally stimulating dramatic mortality, what other effects have we seen?

10 Year Net Volume Response By Initial Potassium Condition



The reason for our interest in Potassium. How can we tell where K is OK?

(Growth & Yield Model) Basal Area Mortality Multiplier



- We learned that mortality functions seemed to be somehow related to rock type.
- Thus, we became Jr. Assistant Geologists.

Multinutrient Fertilization

Argument:

- Nitrogen is usually the most limiting essential nutrient element
- But it seems to usually not be a good idea to fertilize with N alone.

The logical mind would think that:

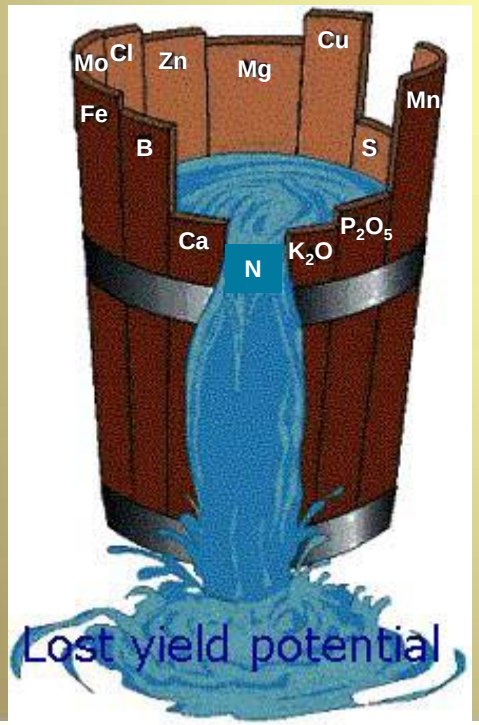
- The most limiting growth factor should be the most economical production limitation to correct .

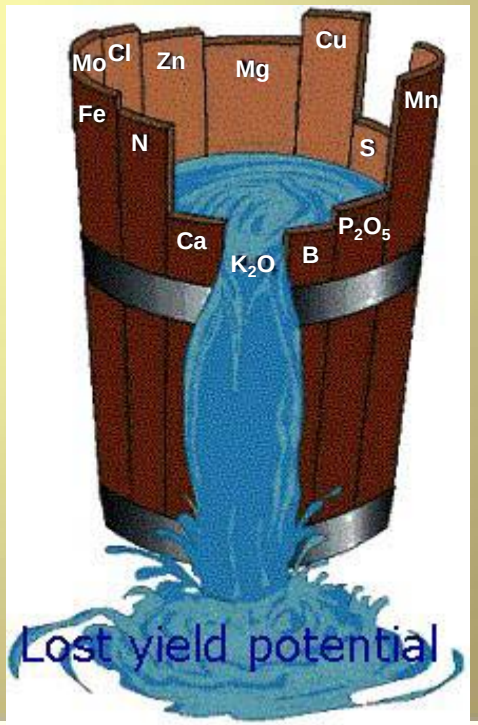
But:

- Nitrogen only treatments often induce other growth limiting nutrient deficiencies
- Essential nutrients must be present in proper quantities and ratios one to another for best growth and health
- Susceptibility to diseases and pests is almost always worse with nutrient deficiencies, excesses or imbalances.

The Barrel Analogy

- The " Control Barrel"
- The "N-Only Barrel"
- The "Multi-Nutrient Barrel"





Second Quick Review of Basic Concepts

Warning! Science Content! Attention! Contenu Scientique!

Determination of nutrient status

- Foliar nutrient analyses – comparisons to critical standards and regional levels
- Foliar nutrient ratio assessment
- Soil tests

Challenging trees with fertilizer mixes to see what they "want" – Screening Trials and other assessments

- Typical Fertilizer Formulations
  - "N-Only"
  - "Best Guess"– N,K,S,B,
  - "Complete" – N,P,K,S,B,Cu,Mg,Zn,Fe etc.
- Screening trial responses and analyses
  - Needle biomass increase / decrease
  - Nutrient concentrations
  - Graphical displays of nutrient status
- Growth & Yield Trials

Multinutrient G&Y trials – Presumably the next coop field trial emphasis.

Douglas-fir Foliar B Concentrations by Silvicultural Treatment

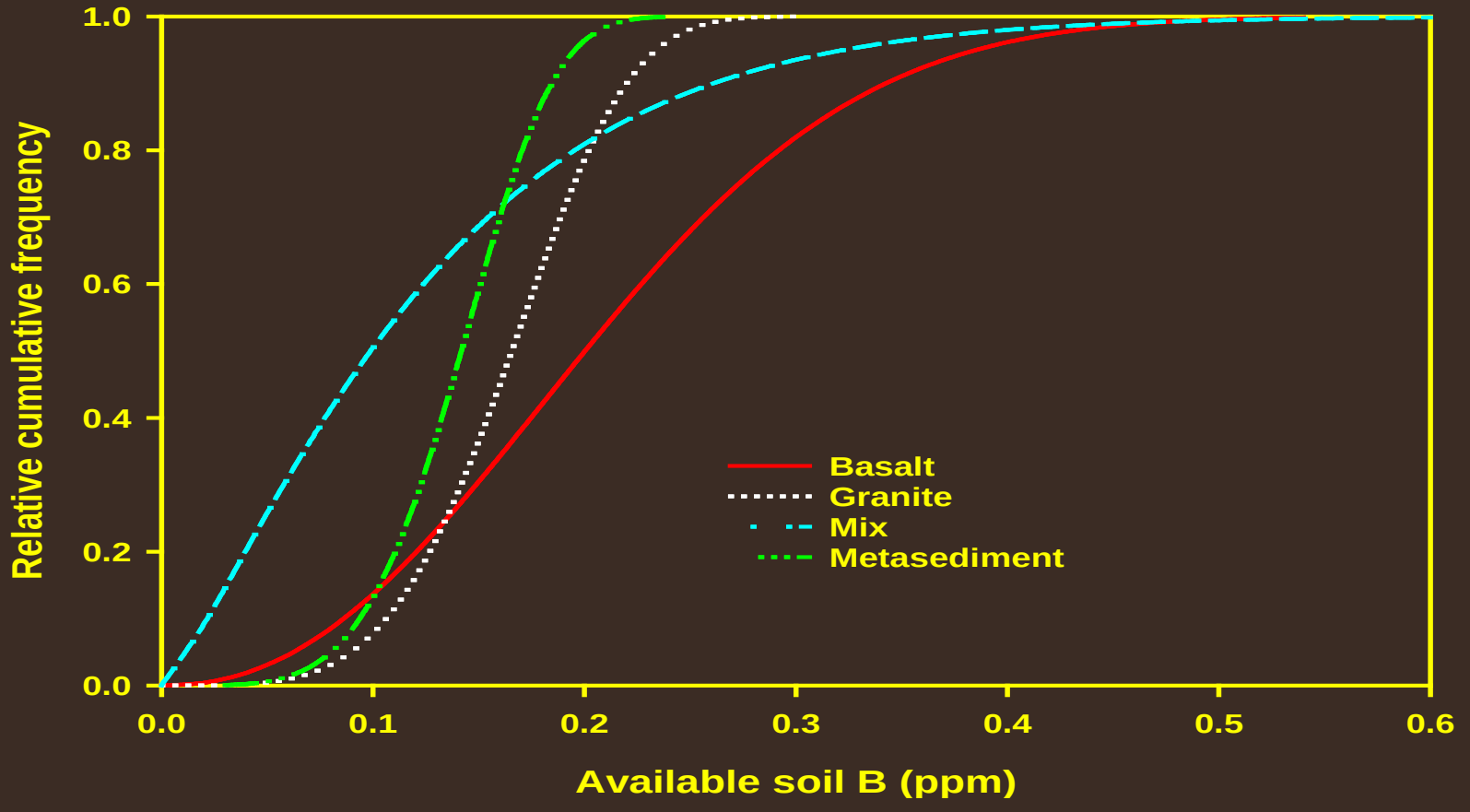
Some Info on another regionally important nutrient element - Boron

Dilution Effect expressed as foliar content

Boron/Nitrogen Foliar Nutrient Ratios

Dilution effect expressed as a critical nutrient ratio.

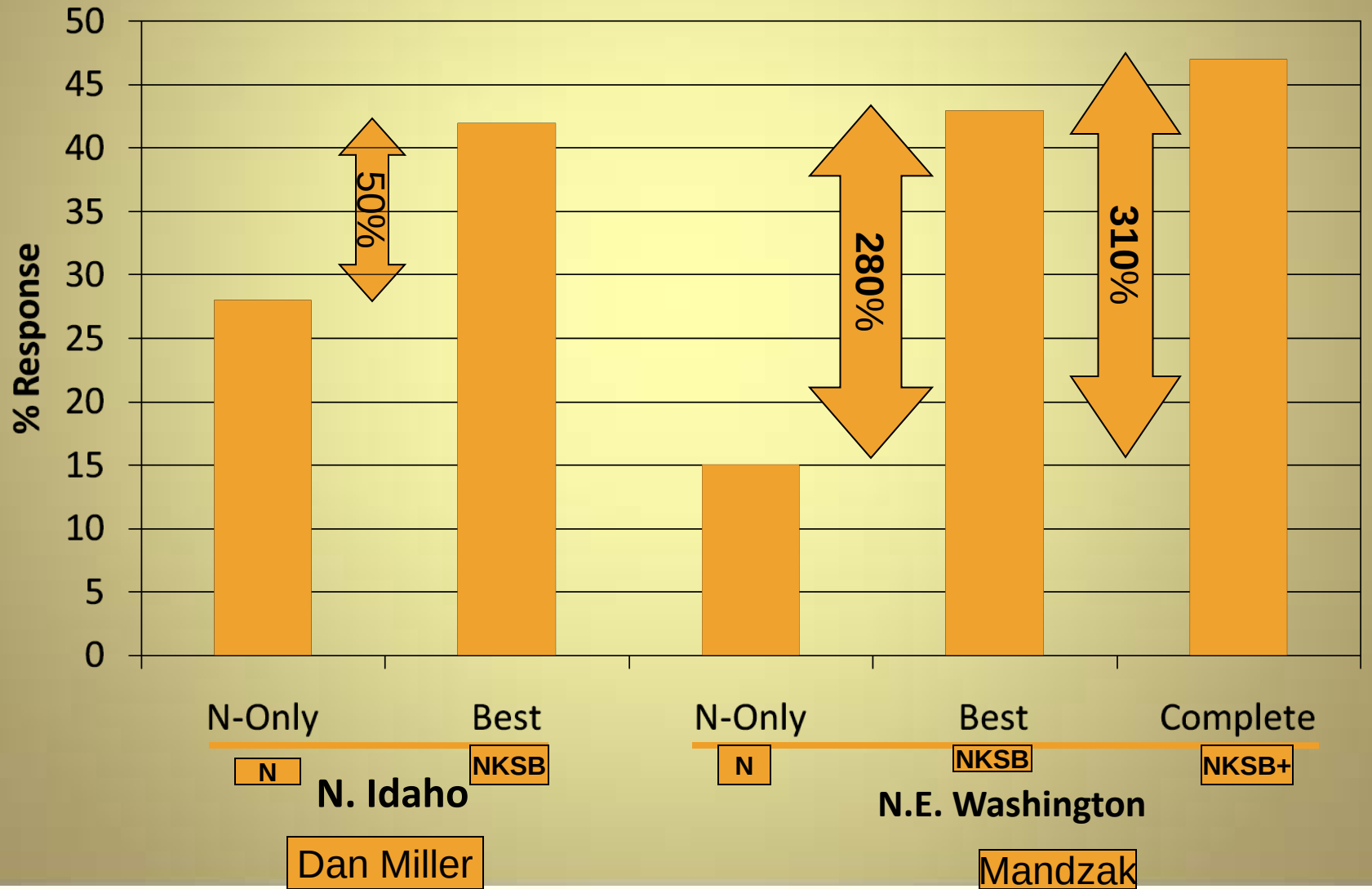
Distribution of Soil Boron by Rock Type



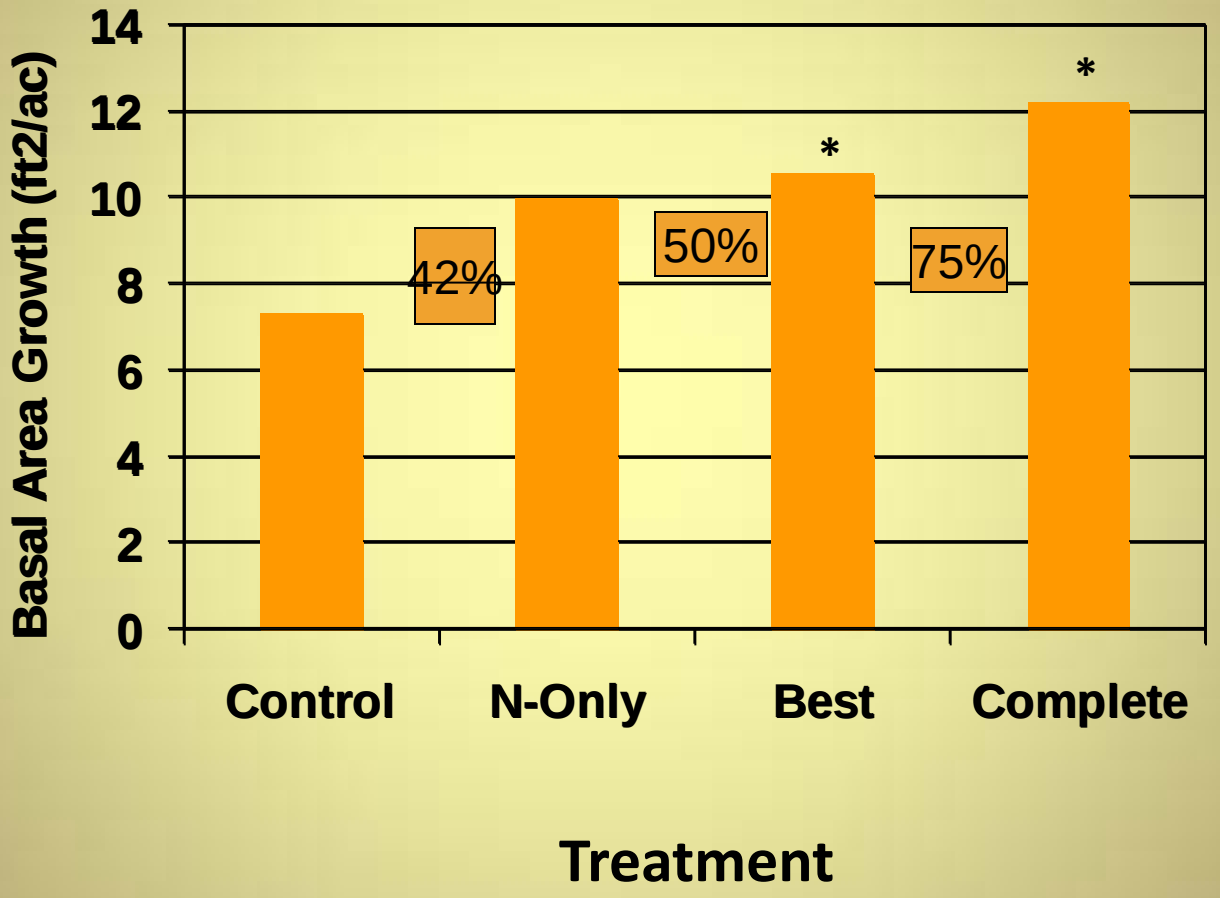
Soil available B varies widely, soil parent material influence

Multinutrient Screening Trial Studies

Average BA Response for Douglas-fir Across All Sites



Multinutrient Long Term Growth and Yield Study
NEWA - Douglas-fir 2-Year Basal Area Growth



GF/Glacial (metasediment)

* significant ($p \leq 0.10$)

So Again: Why Multinutrient Fertilization?

At first we thought that:

- We should fertilize sites with N only fertilizer because the likelihood of additional response from other added nutrients is likely to be in the economic realm of diminishing returns.

Now we think that:

- Unfortunately this is untrue because on most regional sites we do see deficiencies, dilution and imbalances of nutrients caused by N application.
- The proportion of stands showing good long term net growth response has steadily increased along the continuum of N only, N+K, NKSB, and $NKSB^{+}$.

We will be the first to tell you if we find site types that will respond in a healthy way to lower cost treatments!

Terry's Take Home Messages

Forest productivity as it relates to the nutrient pool is a function of the parent material, soil characteristics, species demand and other site quality factors

Silvicultural prescriptions need to be tailored to the site conditions

John's Take Home Messages

- Fertilization in the Inland Northwest can provide significant resource improvement and financial returns if you know what you are doing!
- Depending on fertilizer elements and quantities applied, fertilization can enhance health and growth or be lethal.
- The name of the game is proper site type specific nutrition diagnosis which will lead us to effective multinutrient fertilization.
- Not covered today - stand age, density and organization "economic philosophy" also control fertilization decisions.

Quick and dirty multinutrient fertilization economics: Years to pay back fertilization expense

- Assume:
  - Candidate stand productivity – 100 FT3/Ac/Yr
  - Bd ft / Cu ft ratio – 5
  - Stumpage - $400
  - Base value yield - 100*5*$400*.001 = $200 Ac /yr
  - Fertilizer cost applied $200
  - Growth can be harvested as an ACE in another mature ready to harvest stand (Reasonably regulated forest)
- Calculations:
  - 100% response: Fert Cost ($200) / Base Value Yield (200 * 100%) = 1 yr to pay back fertilization
  - 50% response: = 2 yrs
  - 10% response: = 20 yrs

Coop Direction: Multinutrient trials

John's Opinion:

- Peter Mika's Rock type / Species / Habitat type Matrix. Use where soil data unavailable
- Where possible intersect geology & NRCS soil map unit GIS layers to create new polygons.
- Classify acres by parent materials in soil profile (Ex: Ash over loess over basalt)
- Sub classify by mineralogy and / or Habitat Type
- Create site type DB
- Sort by acres : Determine highest priority site types
- Compare common site types with existing / completed screening trials.
- Create list of site type / species screening trials needed at IFTNC Province level & schedule
- Install fixed area plot G&Y trials in site types with completed screening trials with "successful" treatments and growth responses.

Questions?