Optimum Fertilization for Tree Plantations

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Optimum Fertilization

- Biological
- Economical
- Environmental

Basic Tree Crop Nutrition

Rapid Growth =
High Demand

Nutrient Depletion =
Low Yields

Depends on
Stage of Stand
Development

Three General Nutritional Stages

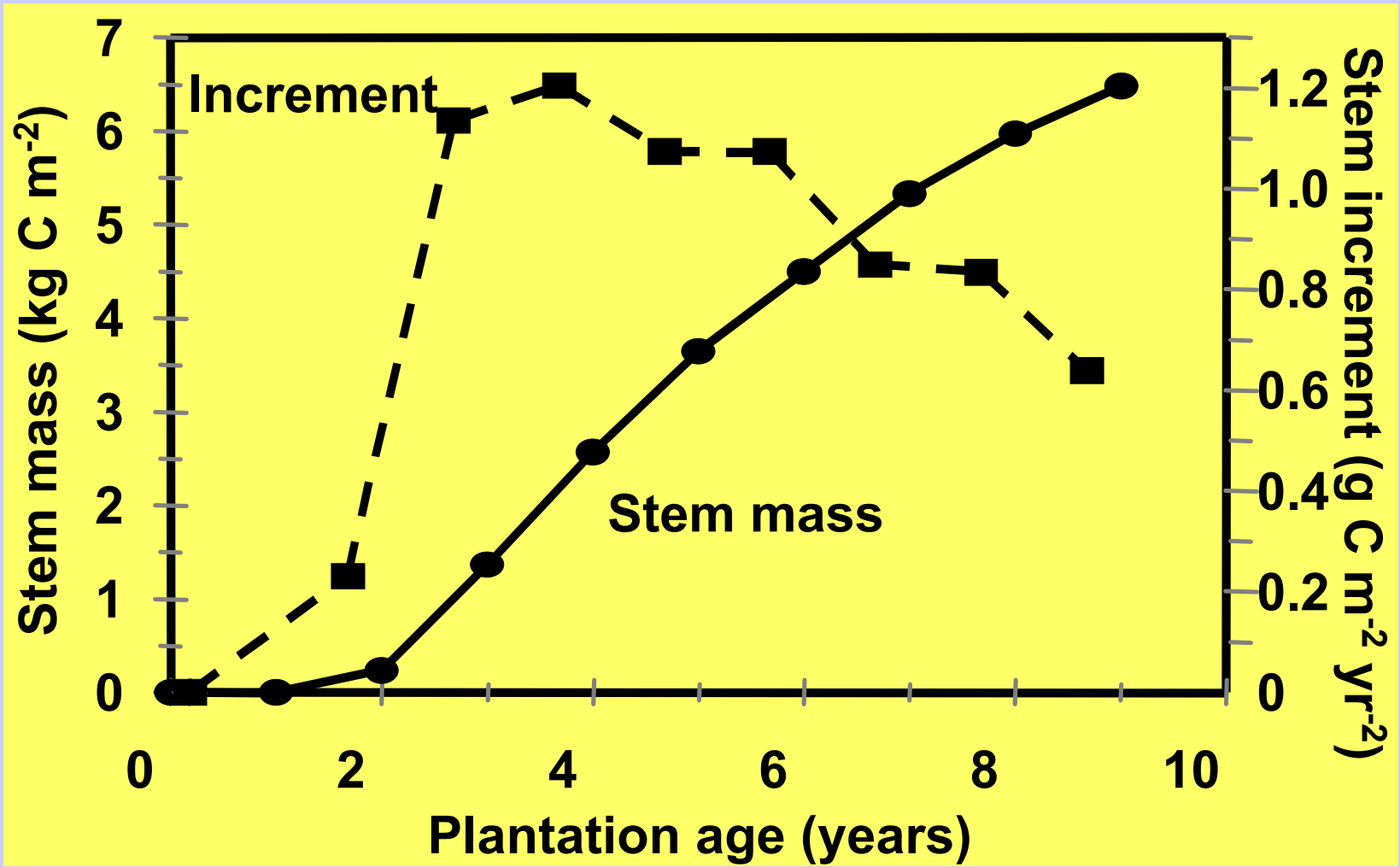
Establishment	Rapid Growth	Maintenance

Two Growth Phases

Before Canopy Closure

After Canopy Closure

General Pattern of Tree Growth




Key is Canopy Closure

Before Canopy Closure

- *Establishment Stage*
  - little nutrient accumulation
  - split applications N,P,K 4 oz or 100g\tree
    - **planting**
    - **repeat w/in 6 months**

- ***Little effect on long term fertility***
- ***Good root zone development***

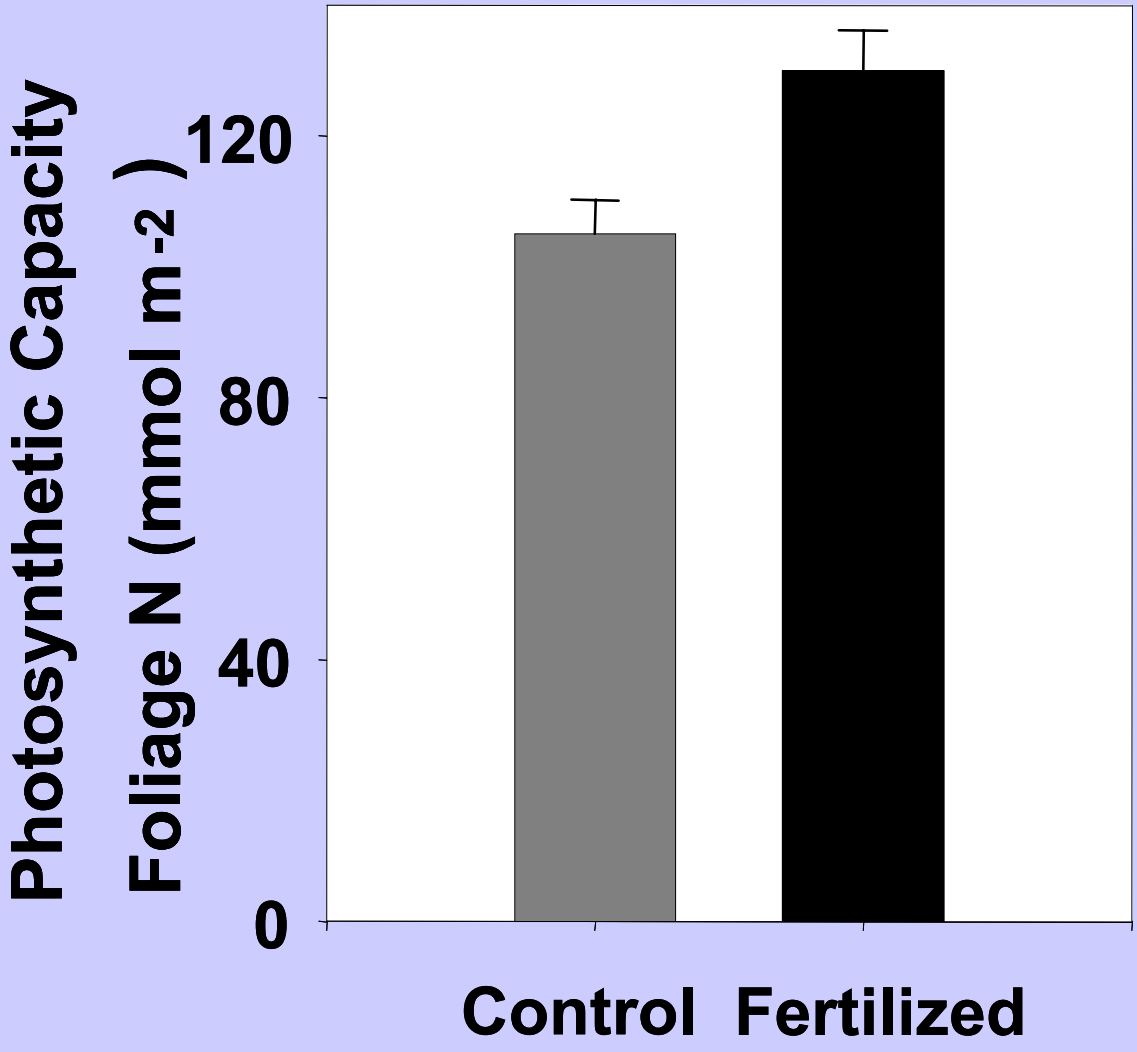
Before Canopy Closure

Eucalyptus N demand during

Rapid Growth Stage in Hawai‘i

Soil Nitrogen Content		
<0.45%	0.45% to 0.60%	>0.60%
570 kg\ha	350 kg\ha	260kg\ha

High Nitrogen = High Photosynthesis



High Photosynthesis = High Production

High Leaf Area = High Production

Poor nutrition =
Low leaf area
= low production

After Canopy Closure

- Nutrient accumulation greatest in stem
- Leaf biomass reaches equilibrium
- Large proportion of nutrient requirement met by recycling

Nutrients in a *Eucalyptus saligna* Plantation

% of Total

	N	P	K	Ca	Mg
Trunk	12	49	24	08	14
Bark	08	09	15	27	30
Branches	17	14	26	34	17
Leaves	63	28	35	31	39
Total	100	100	100	100	100

Choice of Fertilization

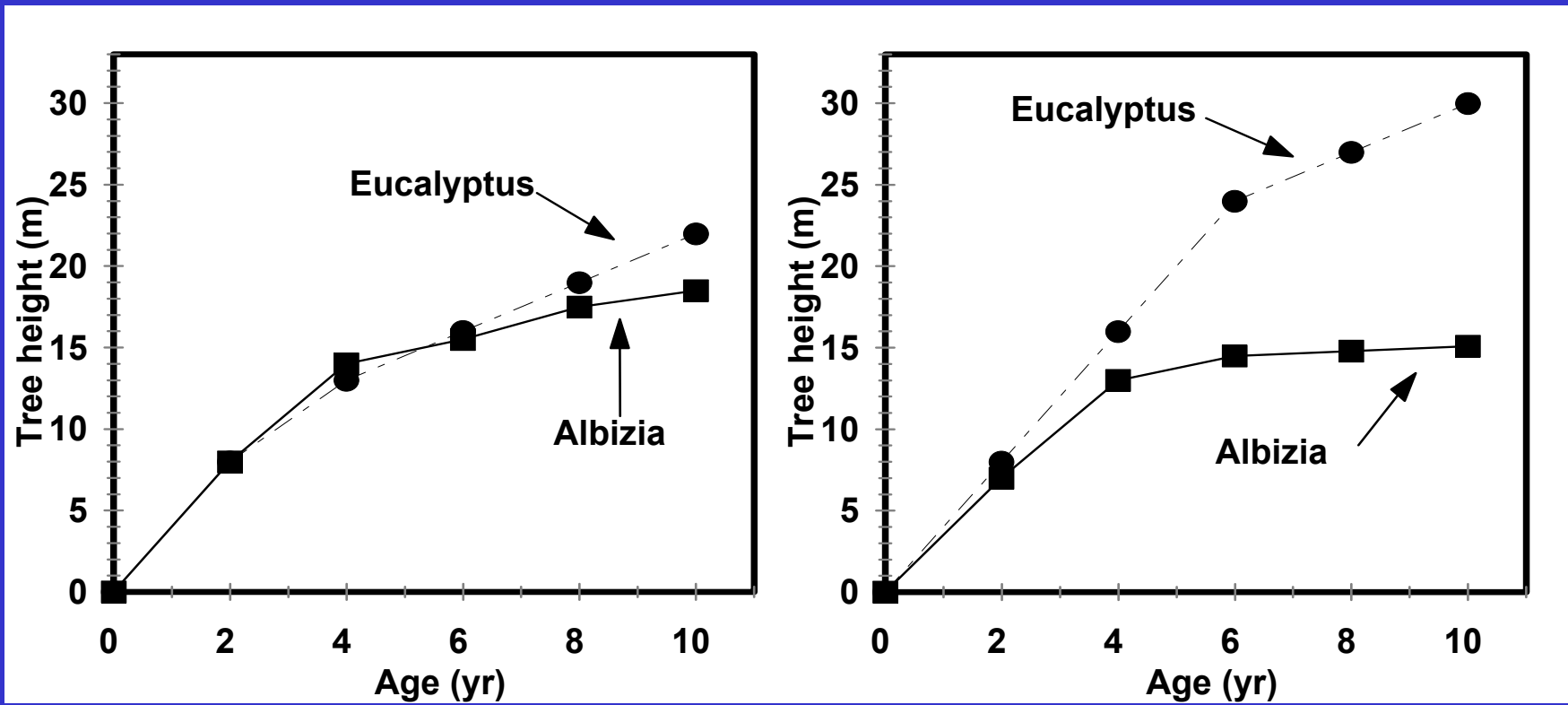
- Mineral Applications
  - **correction of known deficiencies**
  - **establishment on poor soil conditions**
  - **stimulating growth**
  - **timing**

Choice of Fertilization

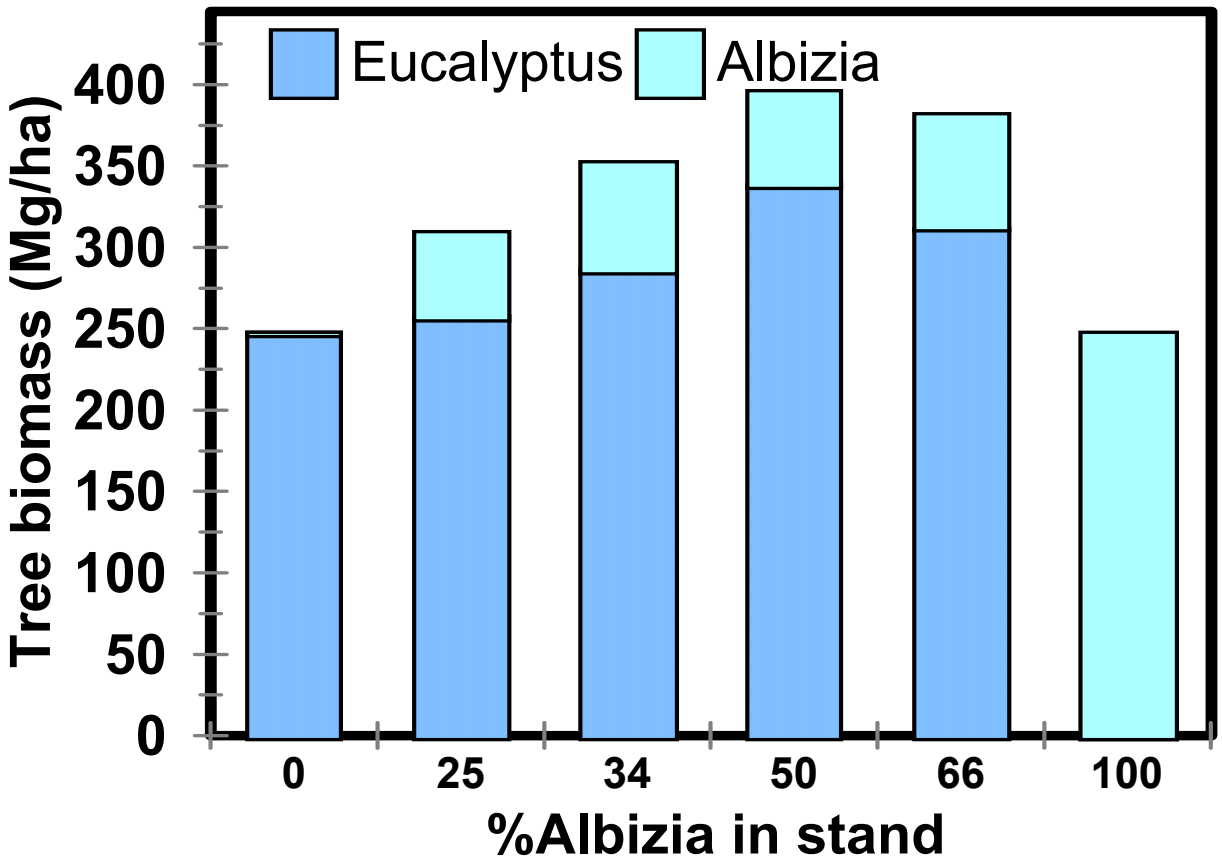
- Intercropping with Nitrogen Fixing Trees
  - **N availability limits growth**
  - **N fixation rates substantial**
  - **little competition to crop tree**

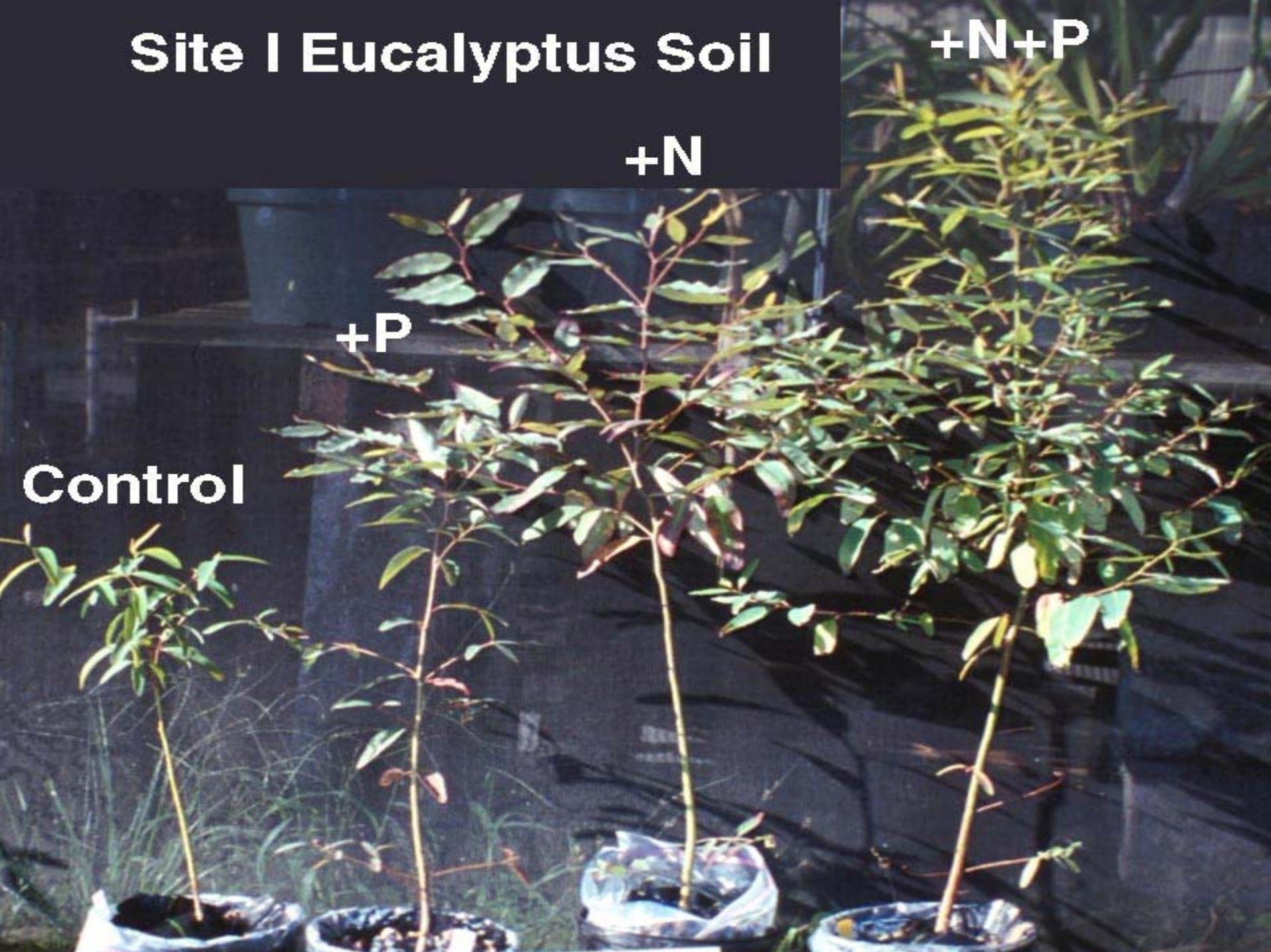
Crop Tree Height Effects

Pure stands ***Mixed stands***



Crop Tree Biomass Effects




Site I Eucalyptus Soil
+N+P
+N
+P
Control

Greenhouse Soil Bioassay Trails

Biological Nitrogen Fixation

Atmospheric Nitrogen N_2

to

Ammonia NH_3

N Fixation vs Mineral N

- Continuous moderation
- Organic
- Long term effects

- Single large pulse
- Inorganic
- Short term effects

Problem: Trees that fix N (for example Acacia, Albizia, or Casuarina) are very often invasive weeds

Take home lessons

- Fast-growing trees demand nutrients.
- There are stages in a tree's growth, and fertilizing while the canopy develops is critical.
- Leaves demand more nutrients to develop than wood does. Low fertility can lead to sparse crowns and low production.
- Look into organic sources that may be available.
- Integrating N-fixers into the system can have long-term benefits.

Reference: *Optimum fertilization for tree plantations in Hawaii.* Randy Senock. In: Growing Working Forest for Hawaii's Future.