Species and Stocktype Selection: What Works Best?

Inland Empire Reforestation Council
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Outline

- Target Plant Concept
- Stocktype Selection: an analysis
- Stocktype study conundrums of yesteryear
- Improved science
- Better understanding

STOCK TYPES

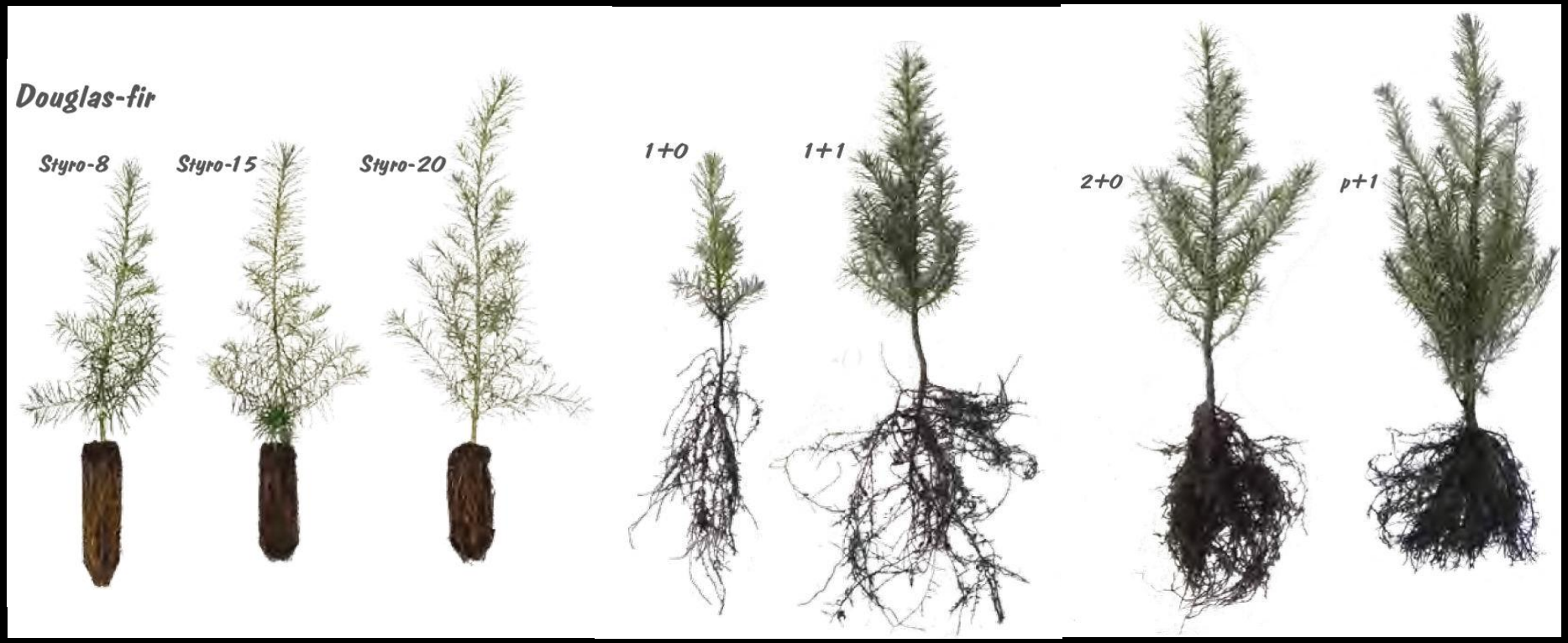
A long time ago, in a nursery far, far away....

What is a stocktype?

<u>Douglas-fir</u>

- Styro-8
- Styro-20

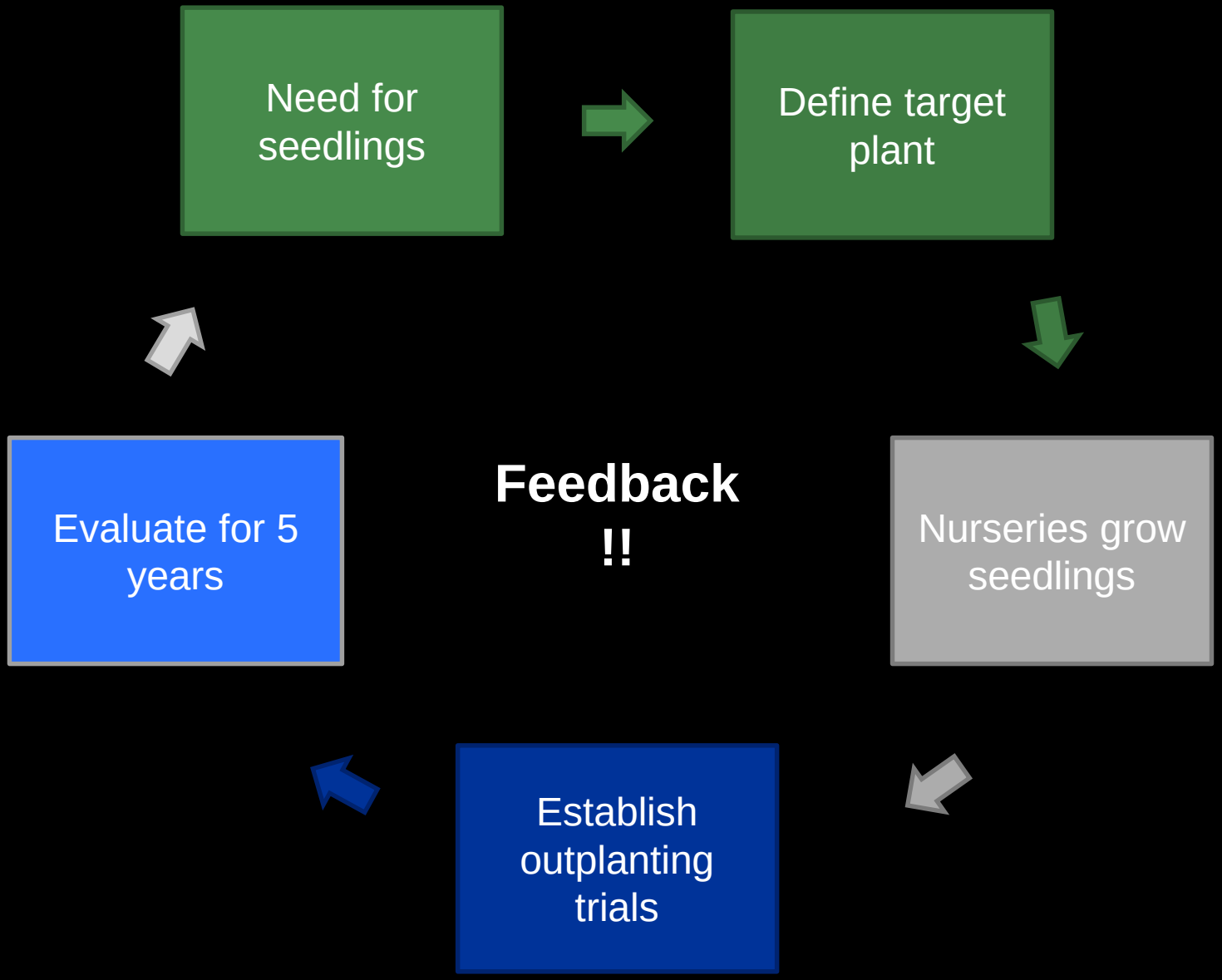
- 1+1
- P+1
- Fdc PSB 615A 1+0 Sp

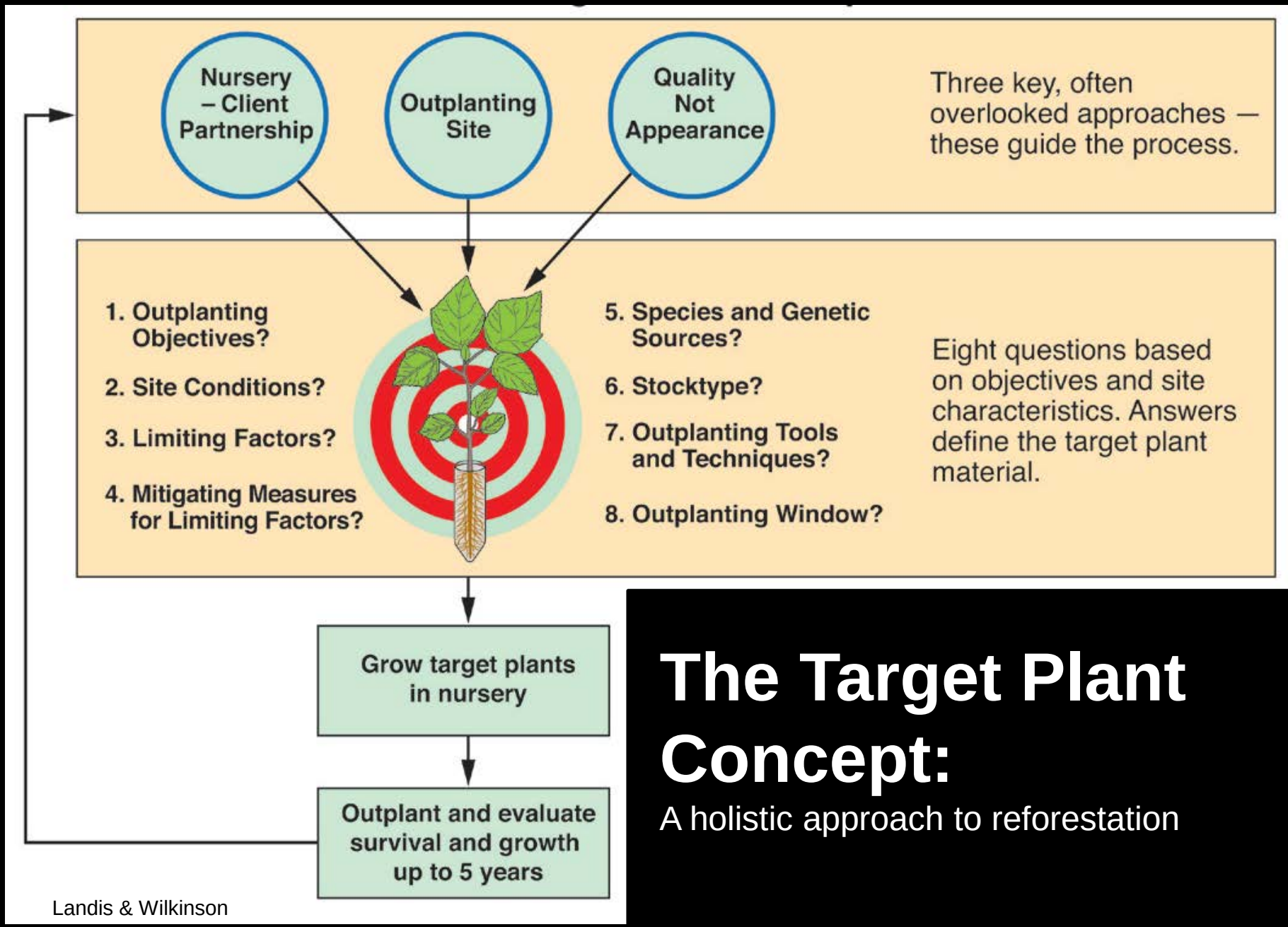


(Rose and Haase 2006)

Traditional models

New model


Need for seedlings
Define target plant
Nurseries grow seedlings
Establish outplanting trials
Evaluate for 5 years
Feedback !!



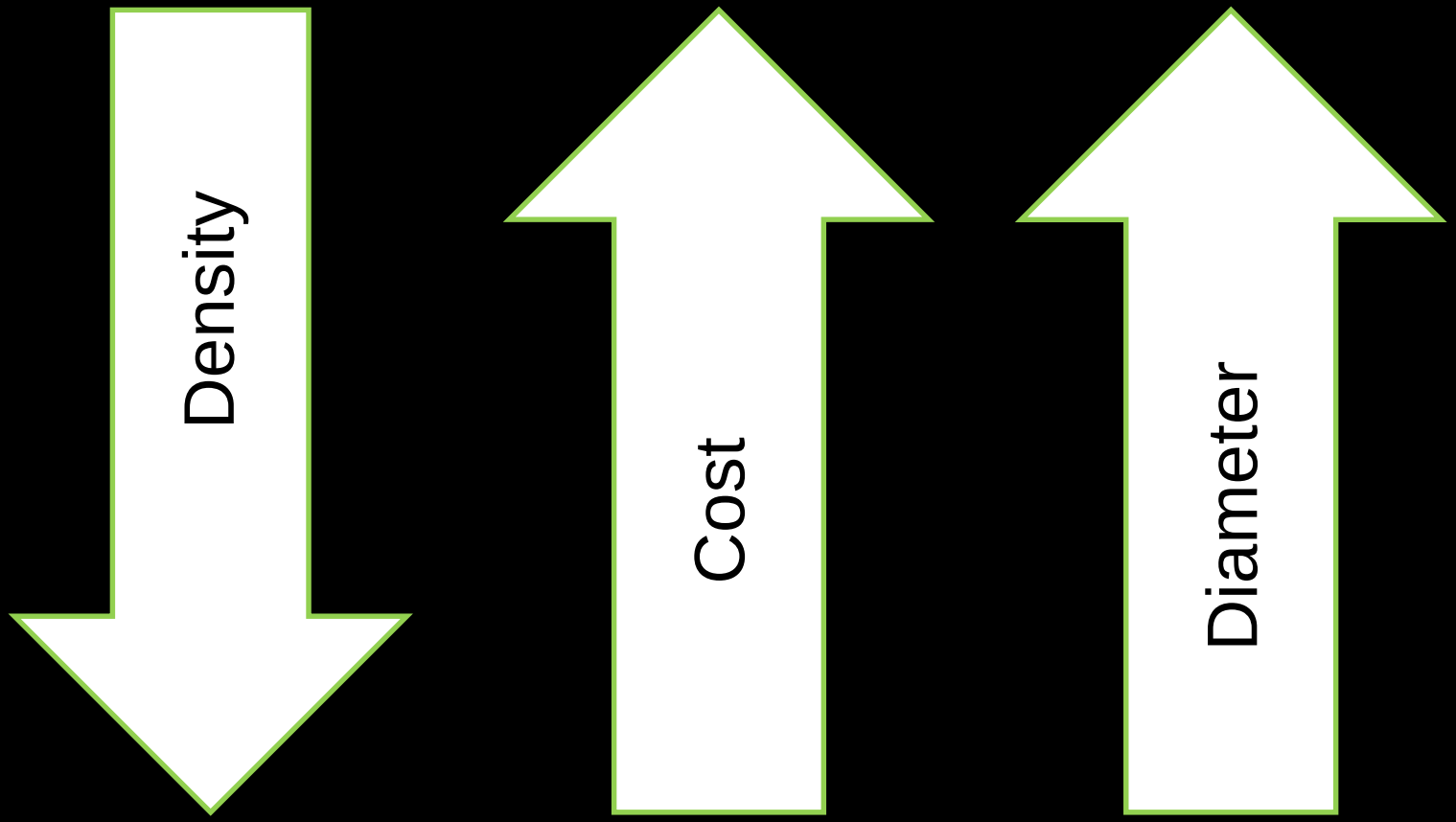
The Target Plant Concept:

A holistic approach to reforestation

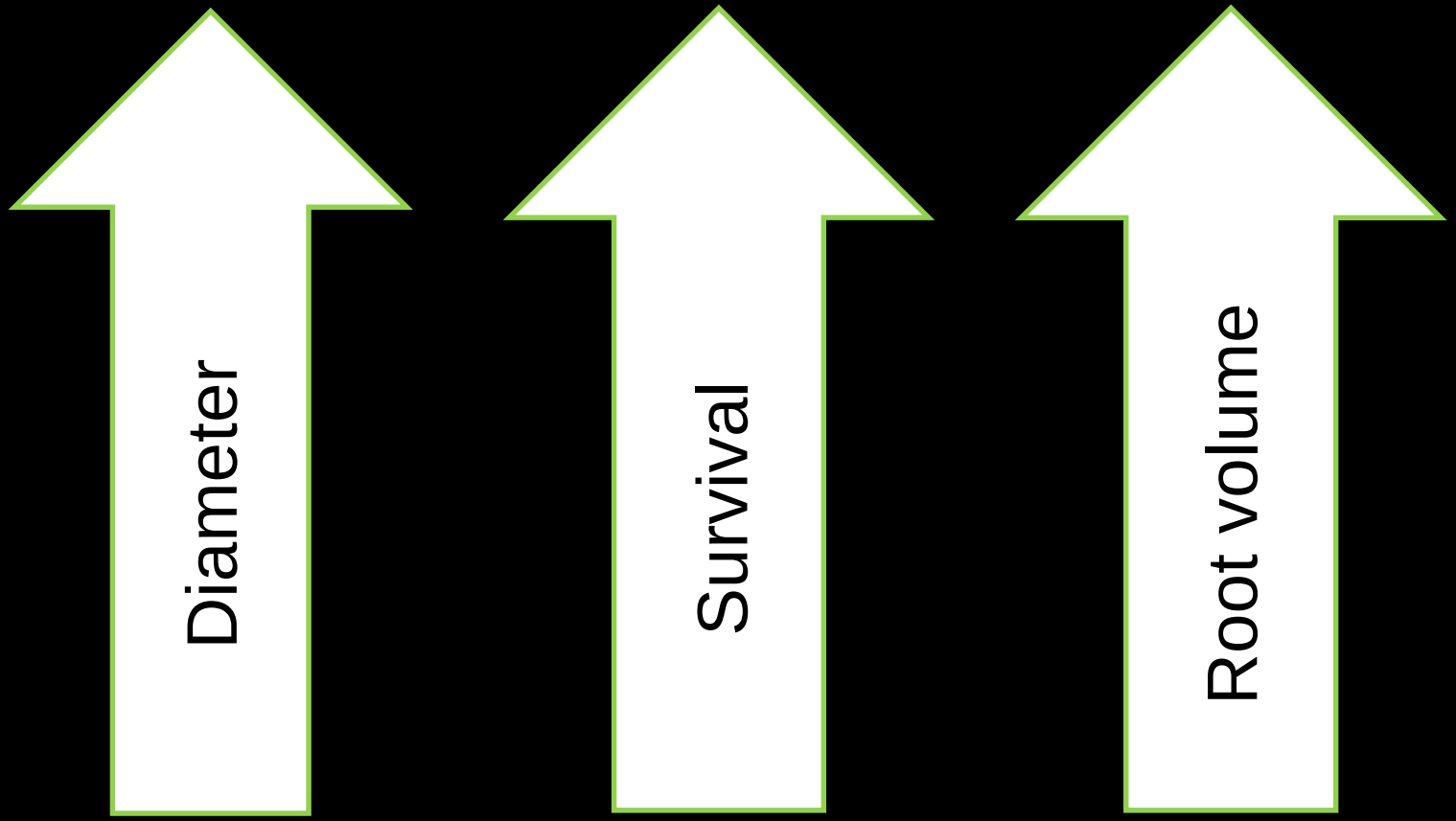
Stocktype Analysis

Trends in $$ and Survival

Generalities...



Generalities...



Generalities...

Bareroot

- Less expensive
- Longer horizon
- More difficult to plant
- More vulnerable during shipping
- More root damage
- More “natural” roots

Containers

- More expensive
- Shorter horizon
- Easier to plant
- Less vulnerable during shipping
- Less root damage
- More root deformation

Realities...

- Budgets are scorched
- Evaluation metrics
- Falling behind with reforestation
- Nurseries can provide high-quality plants of any stocktype
- Bareroot capacity > container capacity

Region 1 — Three-year Survival
1999 through 2015

Species	BR	C	BR versus C
DF	72	71	+1
ES	64	79	-15
LP	69	78	-9
PP	66	81	-15
WL	68	68	0
WP	70	76	-6

Doug-fir, Larch, and White Pine

- Assumptions:
  - Target TPA = 300
  - Seedlings
    - BR (2+0) = $344/1000
    - C (160/90) = $453/1000

- Doug-fir and larch:
  - Total BR cost = $143 ($0.48 / surviving seedling)
    - *($344/1000) x 417 TPA = $143 / (417 TPA x 72% survival) = $0.48 per surviving seedling*
  - Total C cost = $192 ($0.64 / surviving seedling)
    - *($453/1000) x 423 TPA = $192 / (423 TPA x 71% survival) = $0.64 per surviving seedling*
  - Containers cost 34% more*
- White pine
  - Total BR cost = $148 ($.0.49 / surviving seedling)
    - *(344/1000) x 429 TPA = $148 / (429 TPA x 70% survival = $0.49 per surviving seedling*
  - Total C cost = $179 ($0.64 / surviving seedling)
    - *($453/1000) x 395 TPA = $179 / (395 TPA x 76% survival) = $0.60 per surviving seedling*
  - Containers cost 21% more*

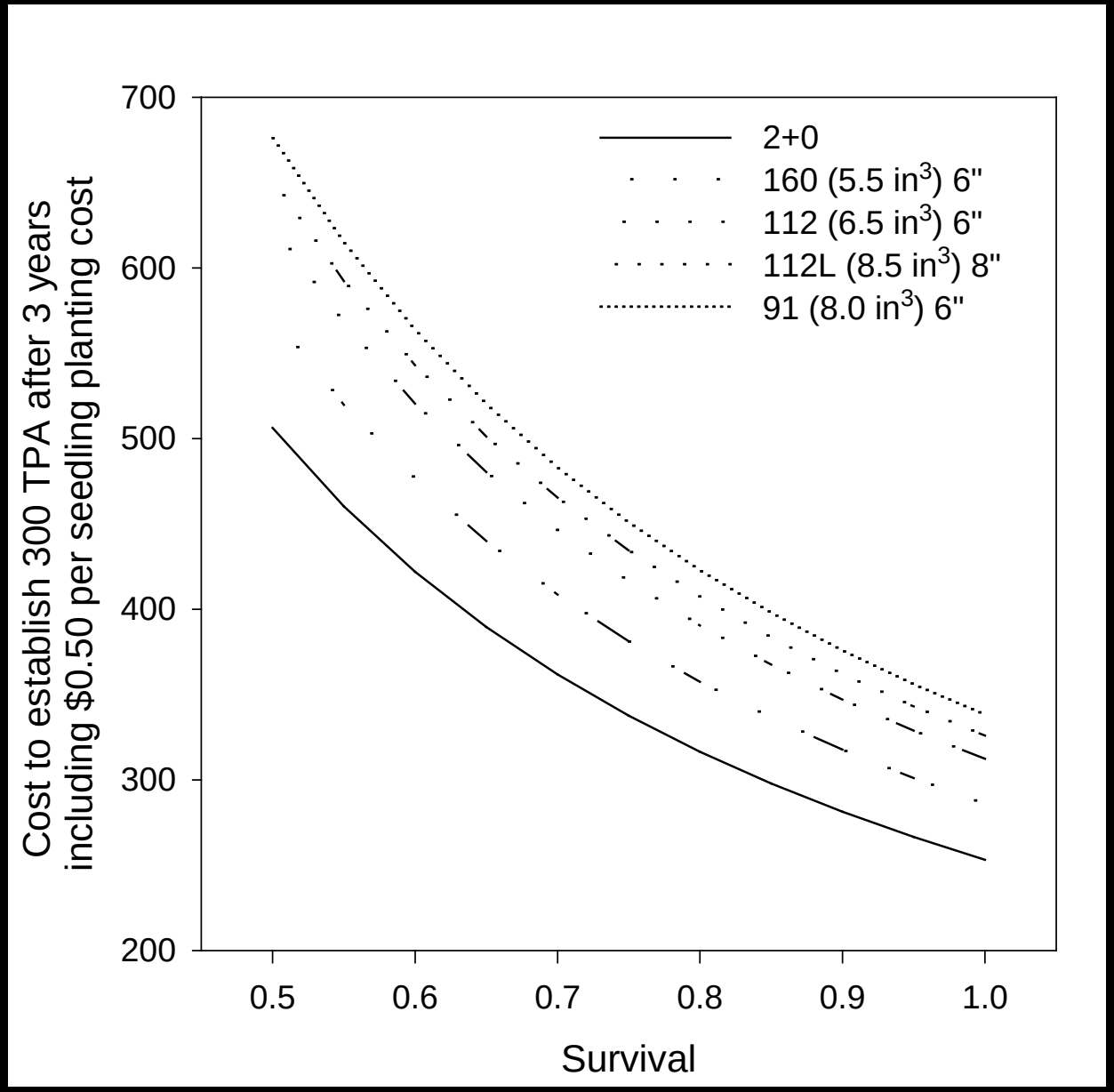
**Assuming all other costs are equal*

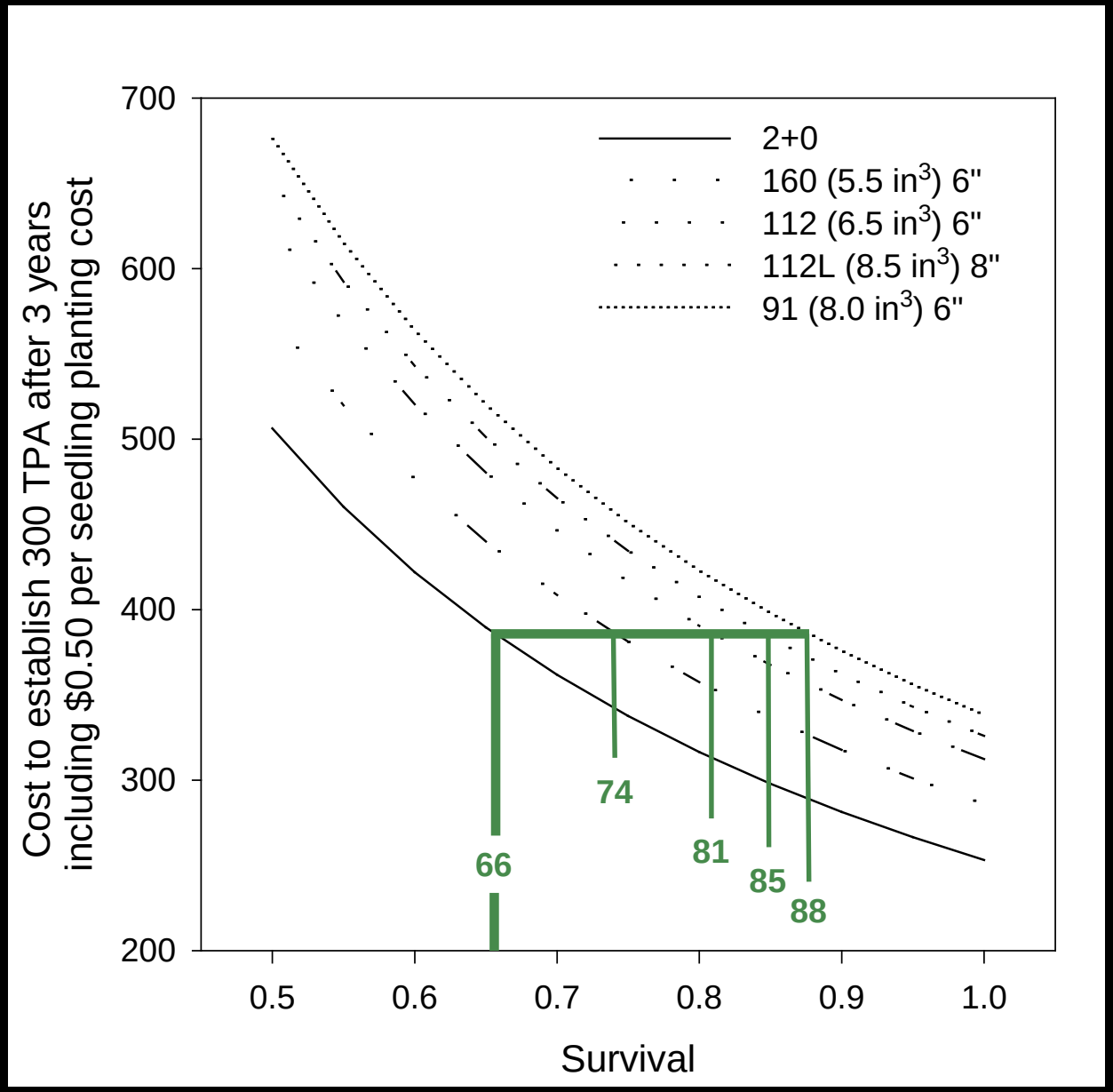
Region 1 — Three-year Survival
1999 through 2015

Species	BR	C	BR versus C
DF	72	71	+1
ES	64	79	-15
LP	69	78	-9
PP	66	81	-15
WL	68	68	0
WP	70	76	-6

- Spruce and ponderosa pine:
  - Total BR cost = $159 ($0.53 / surviving seedling)
    - *($344/1000) x 462 TPA = $159 / (462 TPA x 65% survival) = $0.53 per surviving seedling*
  - Total C cost = $170 ($0.57 / surviving seedling)
    - *($453/1000) x 375 TPA = $170 / (375 TPA x 80% survival) = $0.57 per surviving seedling*
  - Containers cost 7 % more*

**Assuming all other costs are equal*


Cost to establish 300 TPA after 3 years
including $0.50 per seedling planting cost
700
600
500
400
300
200
0.5
0.6
0.7
0.8
0.9
1.0
Survival
2+0
160 (5.5 in3) 6"
112 (6.5 in3) 6"
112L (8.5 in3) 8"
91 (8.0 in3) 6"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112L (8.5 in3) 8"
91 (8.0 in3) 6"
66
74
81
85
88

Take home

Important considerations:

- Monitoring and evaluations
- The nursery/client partnership
  - Seedling quality
  - Stocktype development
- Proper testing
  - Stocktype testing

Why conduct a stocktype study?

We know:

- Selection may have influence over survival and early growth of seedlings

How?

- Minimizing the effects of site limiting factors
  - Drought
  - Physical damage
  - Competing vegetation
  - Animals
  - Site preparation

Why conduct a stocktype study?

- New stocktypes
- Old paradigms
- Species
  - Native plants
- Economics
- Bureaucracy

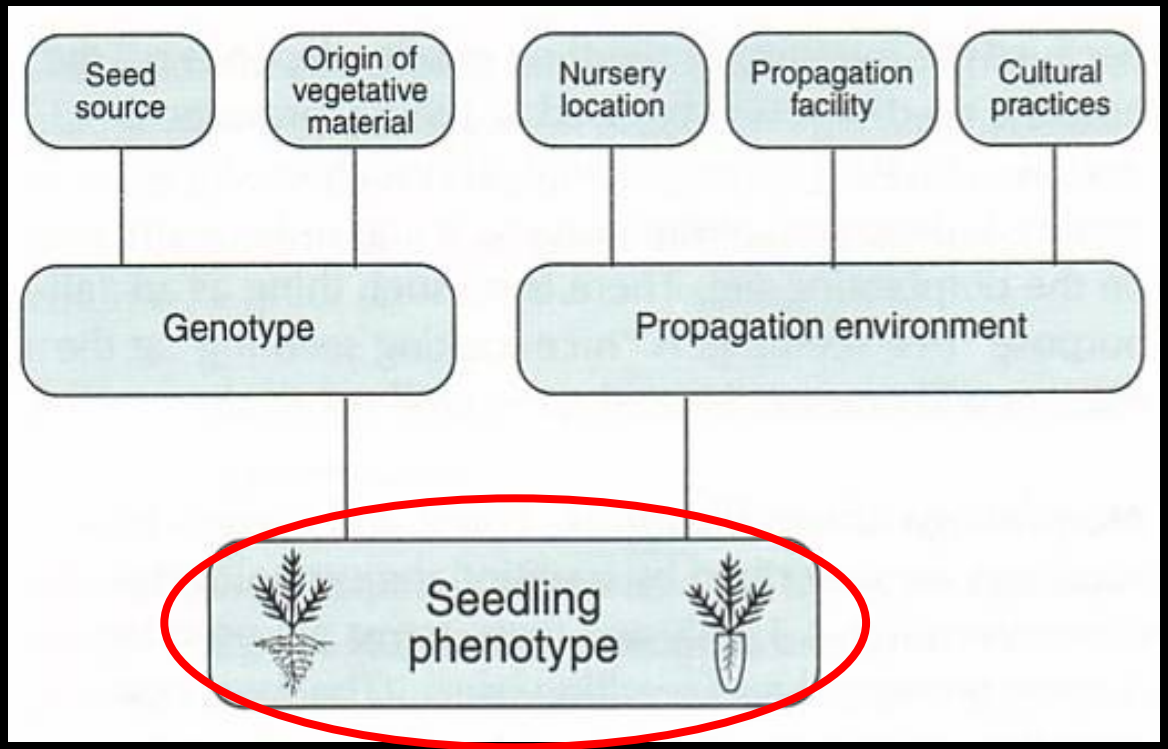
Why conduct a stocktype study?

- Unique planting conditions
  - Site limiting factors
  - Climate
  - Site preparation treatments
  - Restoration areas

Problems with past stocktype studies

Confounding variables:

- Seedling Quality
- Seed sources
- Nurseries
- Density effects
- Culturing regimes
- Statistics
- Single year analyses
- No reference to physiology



Key Considerations

PRACTICE OF FORESTRY

Conducting Seedling Stocktype Trials: A New Approach to an Old Question

Jeremiah R. Pinto, R. Kasten Dumroese, Anthony S. Davis, and Thomas D. Landis

ABSTRACT

Seedlings for reforestation and restoration come in many shapes and sizes, i.e., a variety of stocktypes. With so many choices available, land managers commonly ask which stocktype will best meet their management objectives. For years, stocktype studies have been initiated in search of an answer to this question, but few have been done without some degree of confounding. Past studies often confounded seed sources, nurseries, and culturing regimes, and/or failed to address differences in initial seeding quality, which sometimes led to inappropriate conclusions. This article reviews the reasoning behind stocktype studies, reviews common pitfalls of past studies, and suggests some key considerations to making future stocktype studies a viable resource to the practicing forester.

Keywords: target plant concept, outplanting, seedling quality, container, bareroot

materials for a site. The defined target plant material can then be produced by the nursery manager through manipulation of the growing environment to influence resulting phenotype. By varying, e.g., bareroot seedbed density or container type, seedling phenotype can be modified, even among seedlings coming from the same seed source grown the same year (Endean and Carlson 1975, Simpson 1991, Pinto et al. 2008).

Phenotypic variation of seedlings (e.g., height, branching pattern, root collar diame-

Table 2. A stocktype study checklist: Key considerations to minimize confounding variables.

Identify the stocktype study objective—Isolate the variable being tested to reduce error
Genetic sources—All stocktypes grown with the same genetic source(s)
Propagation environments—Should have similar edaphic, temperature, light, and vapor pressure deficit[a]
Seedling physiology/quality—Should be uniform across stocktypes
a. Mineral nutrition is adequate
b. Irrigation regimes adjusted according to stocktype
c. Hardening and storage regimes should be sufficient and similar
Study design—Use a solid statistical design for appropriate analysis and interpretation
Outplanting—Include multiyear analyses to account for year-to-year variation or use controlled environments (growth chambers or controlled field conditions)

[a] Except when the study involves both bareroot stock and greenhouse container stock, whereby the different propagation environments and different cultural practices are an inherent part of the stocktype study.

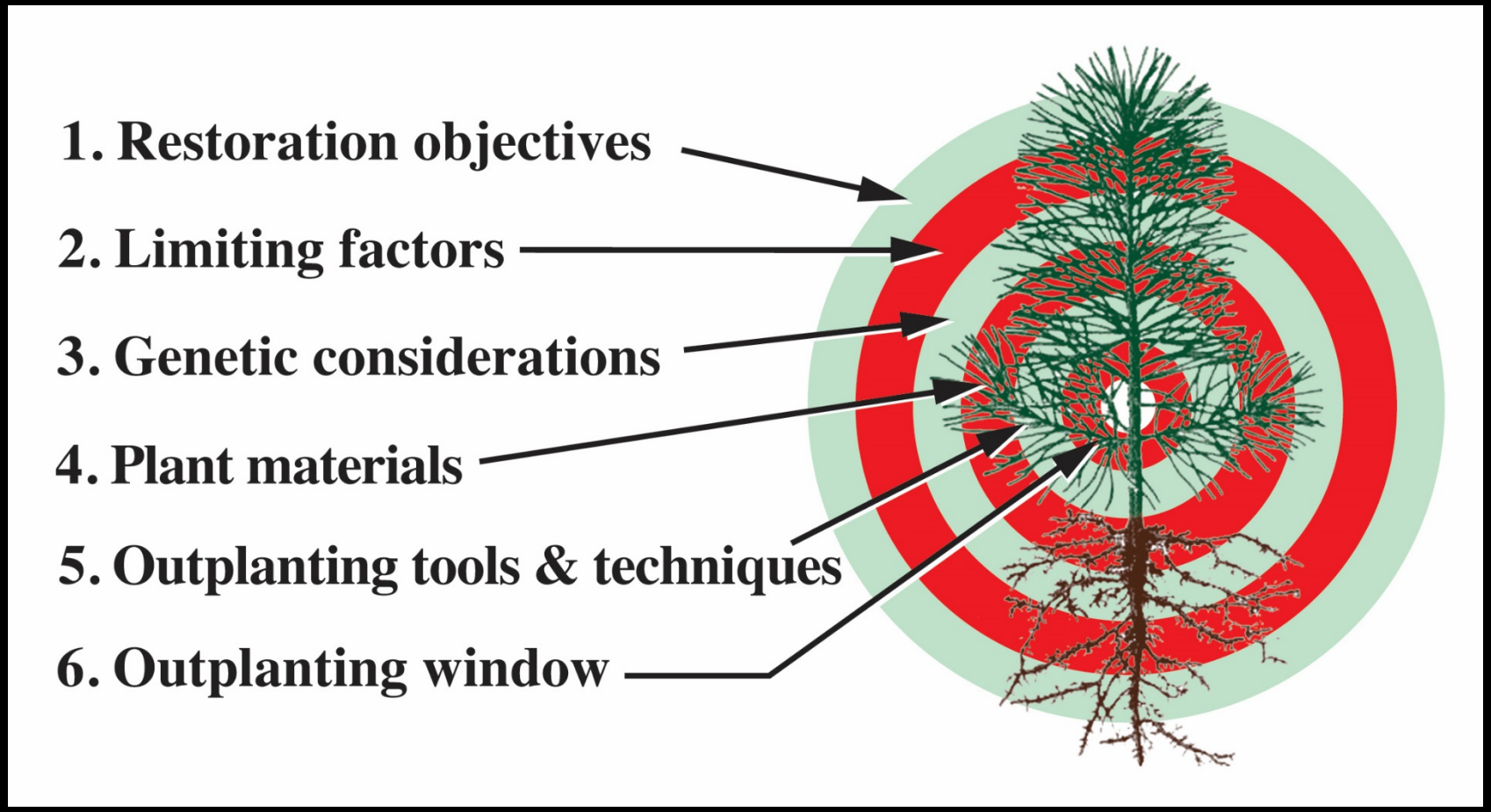
Pinto et al. 2011
Treesearch: http://www.treesearch.fs.fed.us/pubs/38391

Key Considerations

- Identify your objective
- Genetic sources
- Propagation environments
- Seedling physiology/quality
  - Nutrition
  - Irrigation
  - Hardening and storage
- Study design
- Outplanting

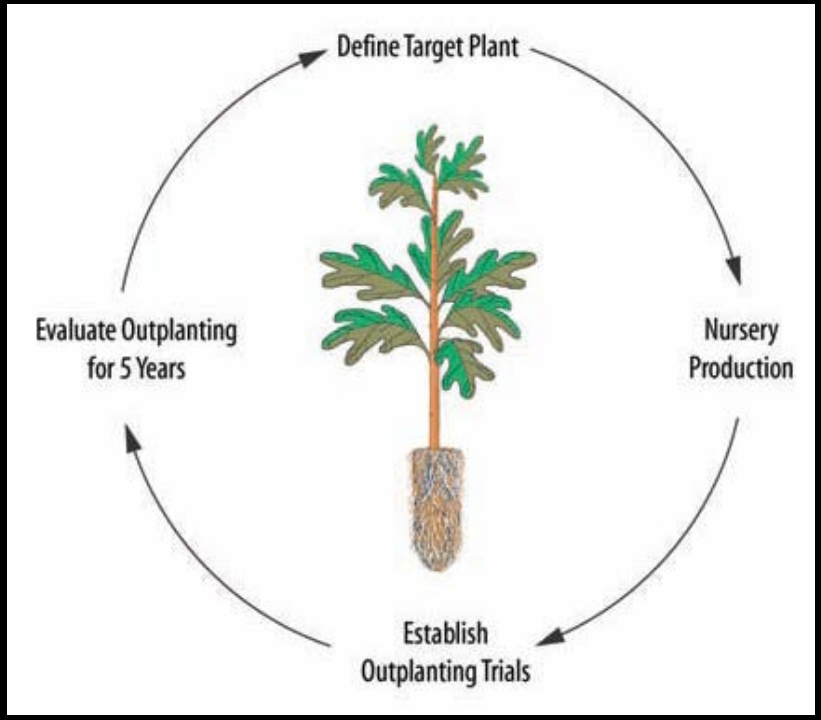
Summary

1. Start with the Target Plant Concept



Summary

2. Consider the audience or end user
3. Minimize confounding variables
4. Optimize nursery production and storage
5. Correctly establish outplanting trials
6. Evaluate



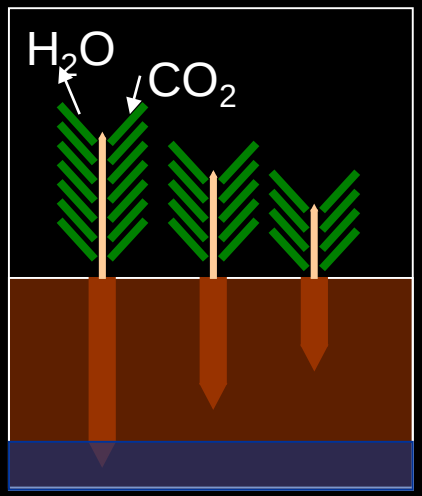
Implementation & Results

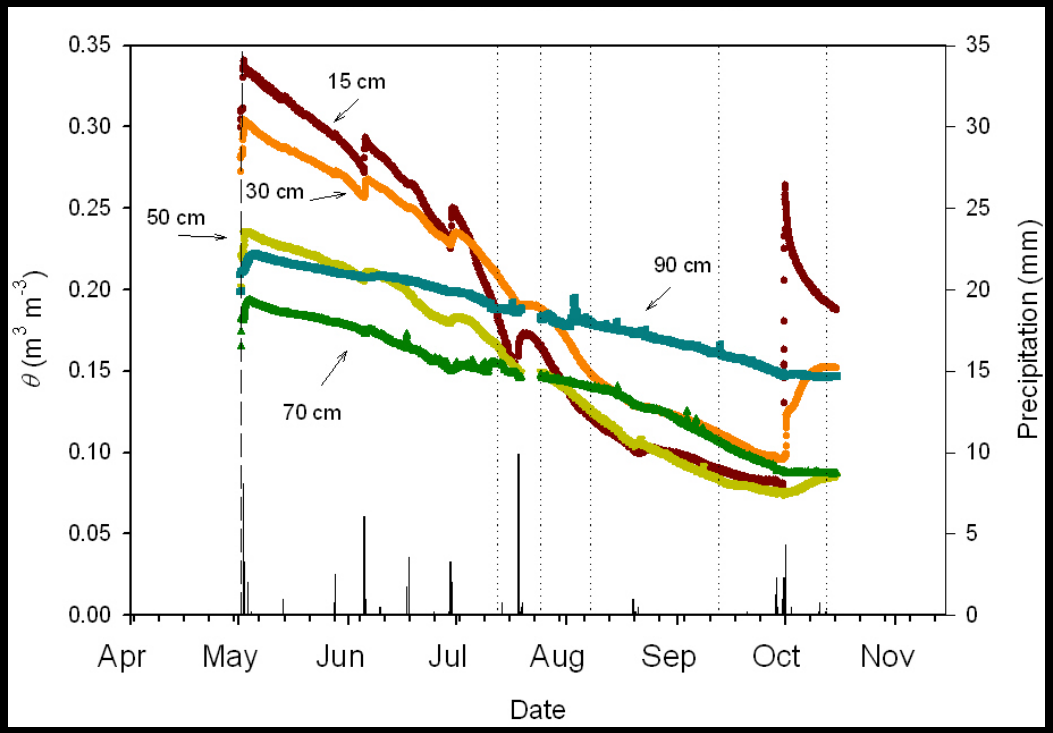
New technique evaluation

- Ponderosa pine
  - Comparing stocktypes
  - Comparing nurseries
  - Variables
    - Morphology and Physiology
      - %N
      - Water-use efficiency
      - S:R

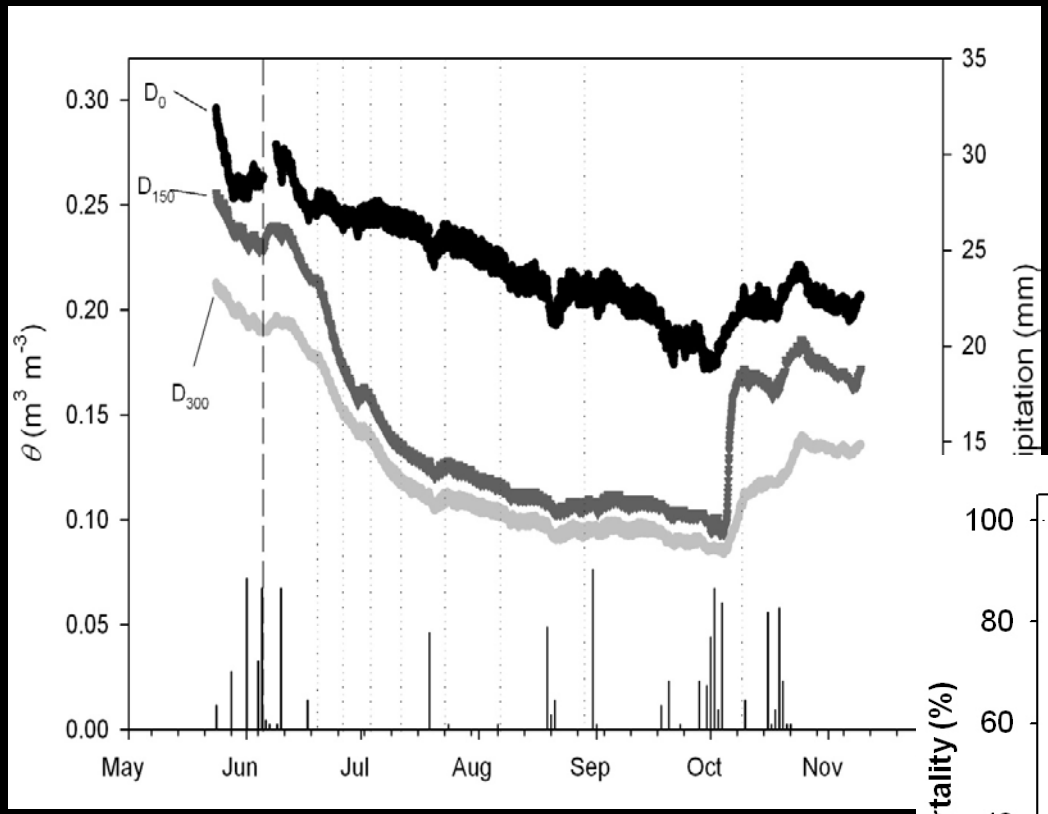
Ponderosa pine

- Nursery
- Field
- Controlled environment

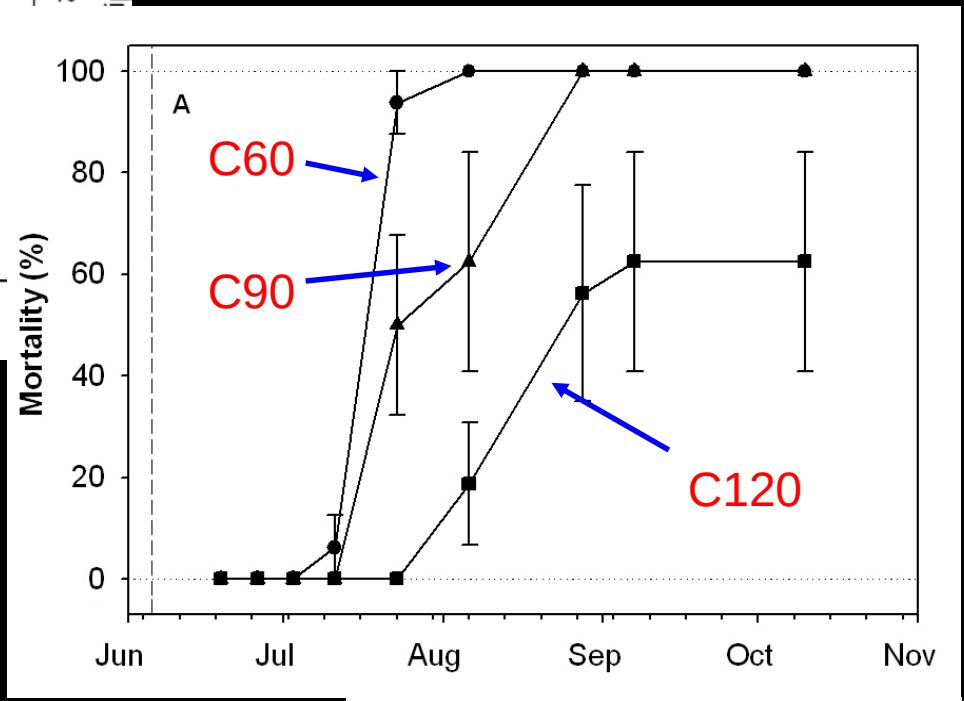




Outplanting: Controlled Environment

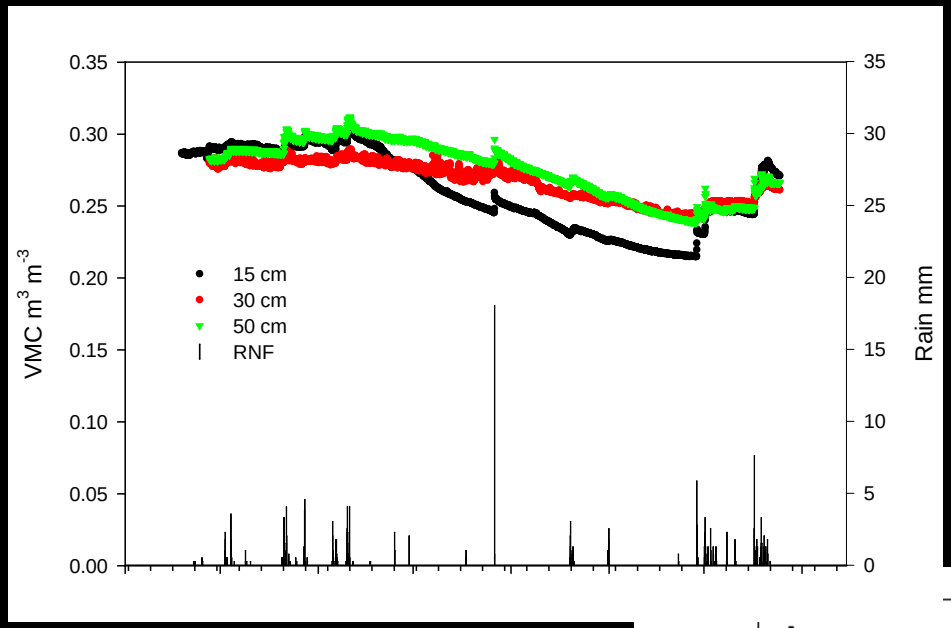


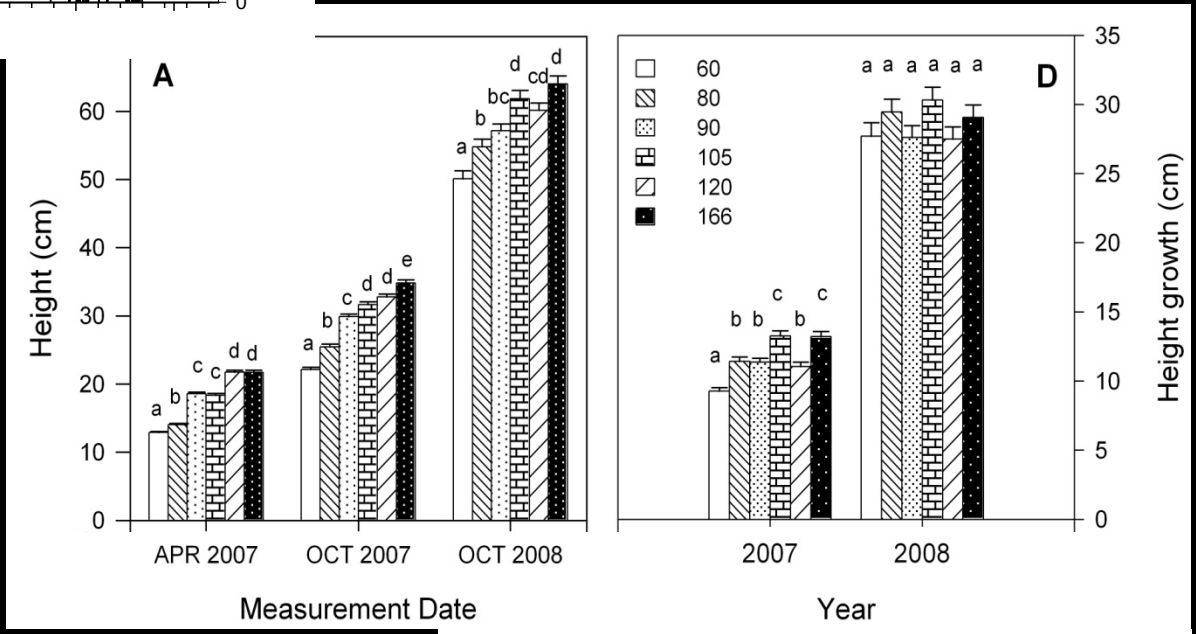
Vegetative Competition to induce drought



Pinto et al. Can. J. For. Res. Vol. 42, 2012

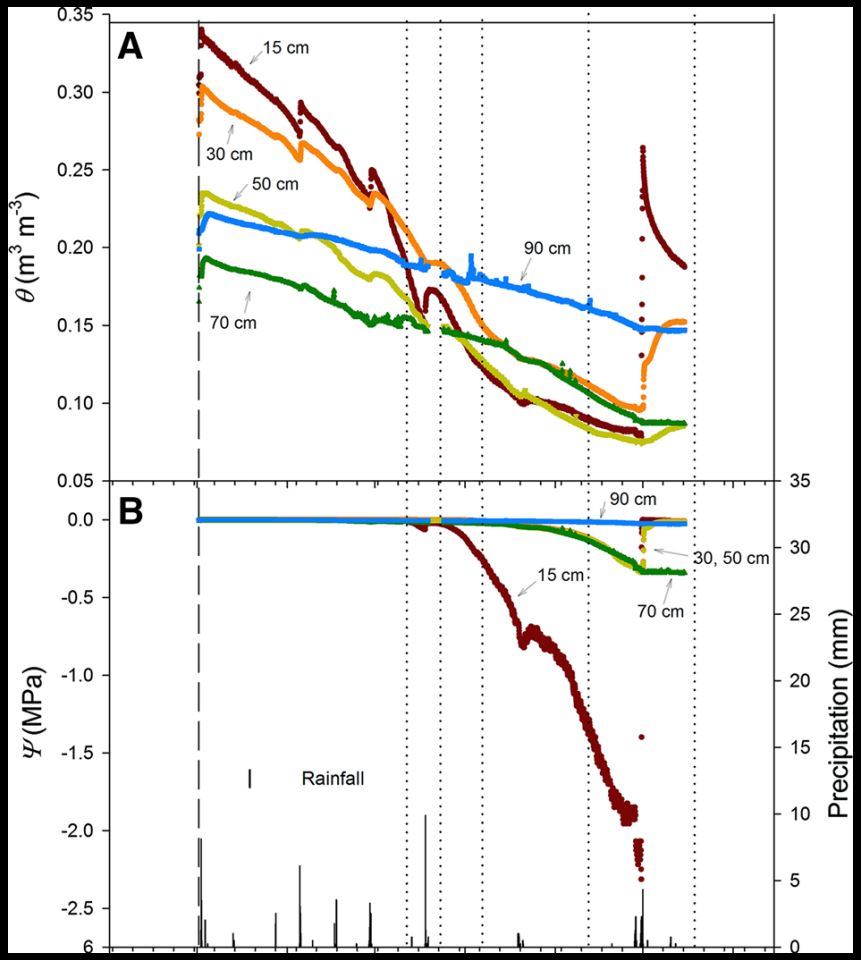
Outplanting: Forest (high amount of site prep)

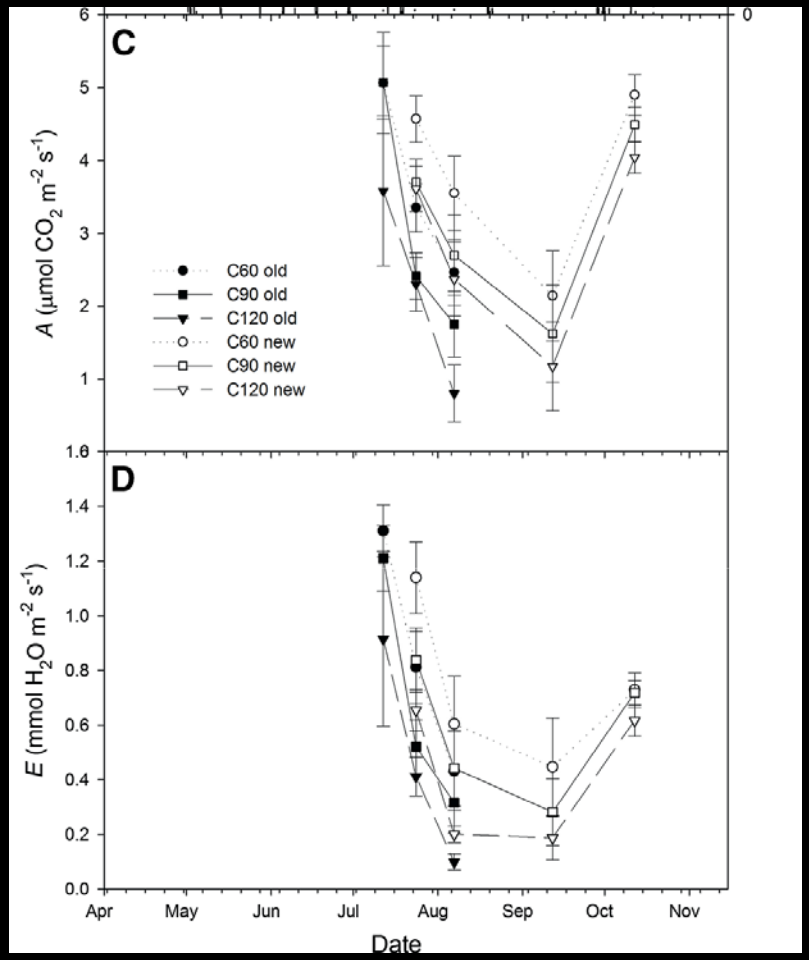




J.R. Pinto et al. / Forest Ecology and Management 261 (2011) 1876–1884

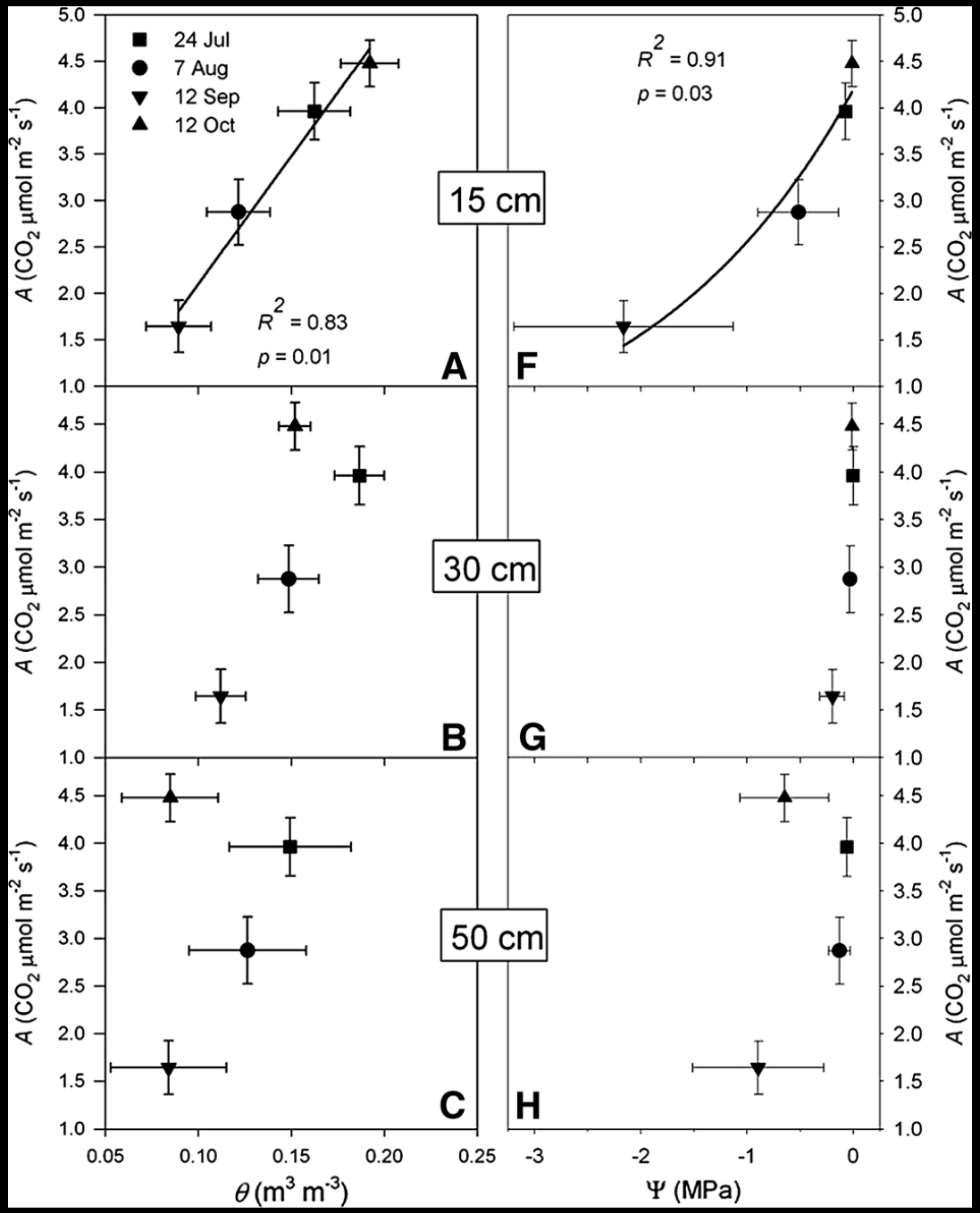
Outplanting: Forest (low amount of site prep)





Pinto et al. New Forests (2016) 47:223–241

Outplanting: Forest (low amount of site prep)



Conclusions

- Good stocktype studies are hard to do
- New methodology
  - Better science
  - Meaningful conclusions
  - Seedling quality!

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