

Defining tipping points in seedling survival and growth with competition thresholds

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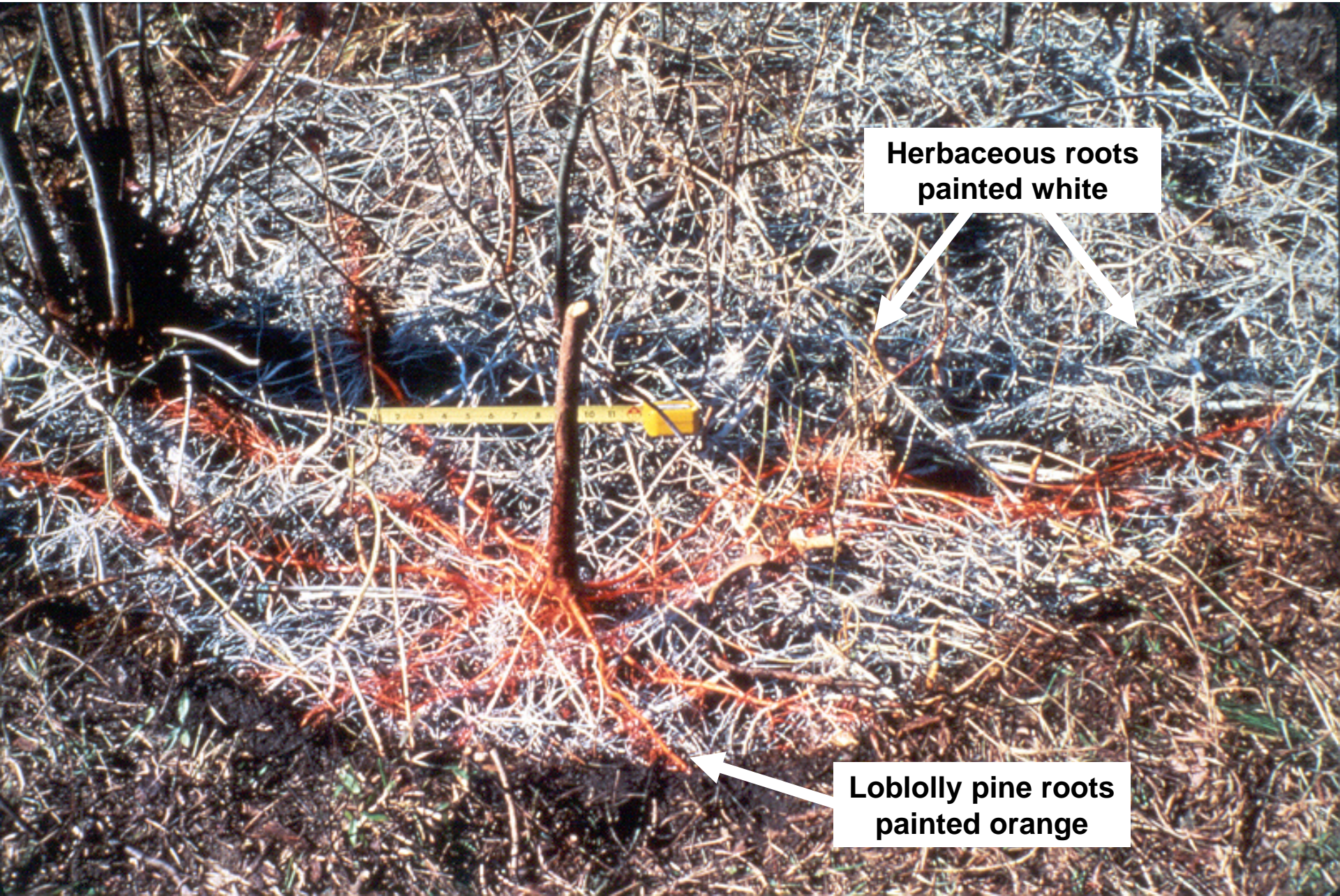
Forest Vegetation Management

- The practice of efficiently channeling limited site resources into desirable trees rather than into undesirable tree species or non-tree vegetation (often for commercial wood production)
- Broad array of management that:
 - Inhibits/retards initial weed establishment
 - Reduces the size/number of weeds to acceptable levels
 - Maintains the presence of diverse populations of plant species
 - Recognizes weeds in one situation may be desirable in another

FVM Based on Competition for Resources

- Grasses and Forbs
 - Dense cover, high growth rates, dense root systems
 - Water and nutrients competition in upper soil horizons
 - Light competition only for small seedlings
- Small shrubs
 - High aerial growth, dense cover
 - Competition for light, also for water and nutrients
- Tall shrubs/mid-story trees
 - Can overtop crop trees
 - Competition for light, water, and nutrients

Root Competition From Herbaceous Vegetation

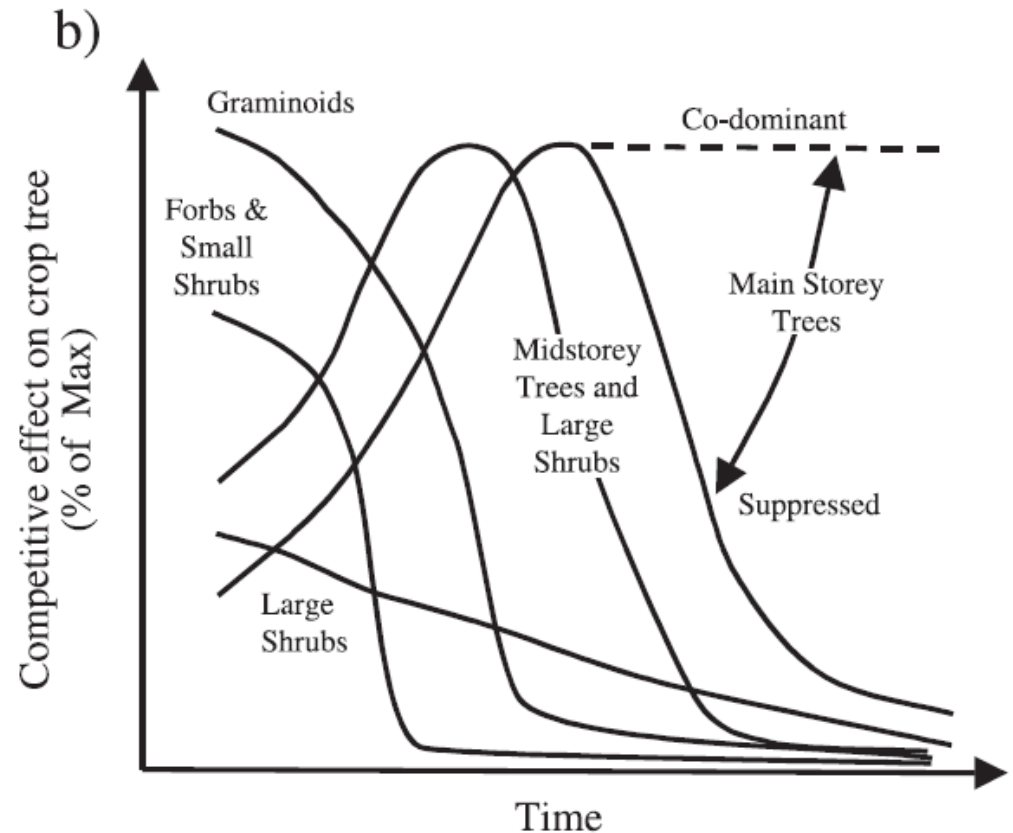


**Herbaceous roots
painted white**

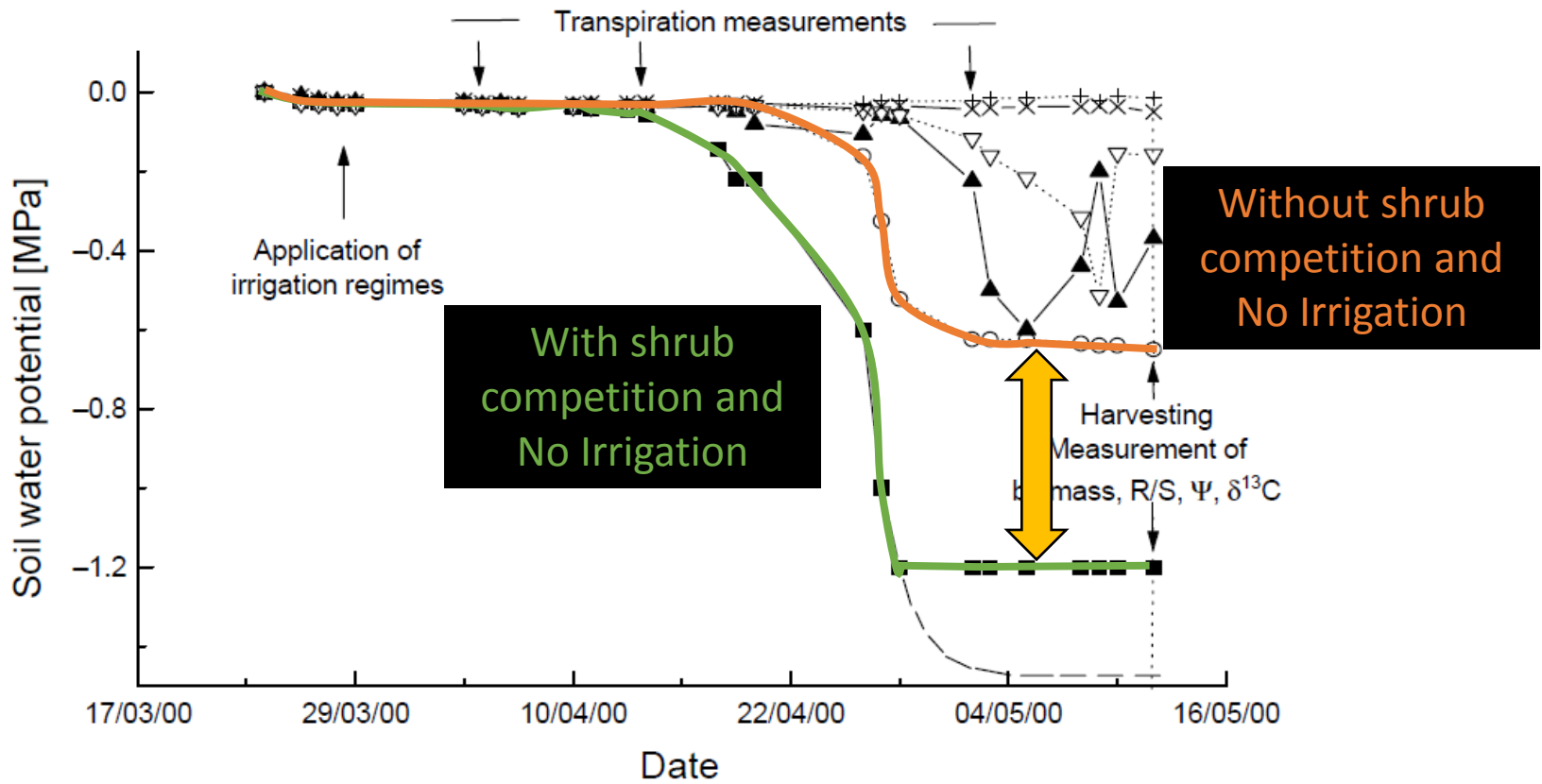
**Loblolly pine roots
painted orange**

Type of competition changes with time

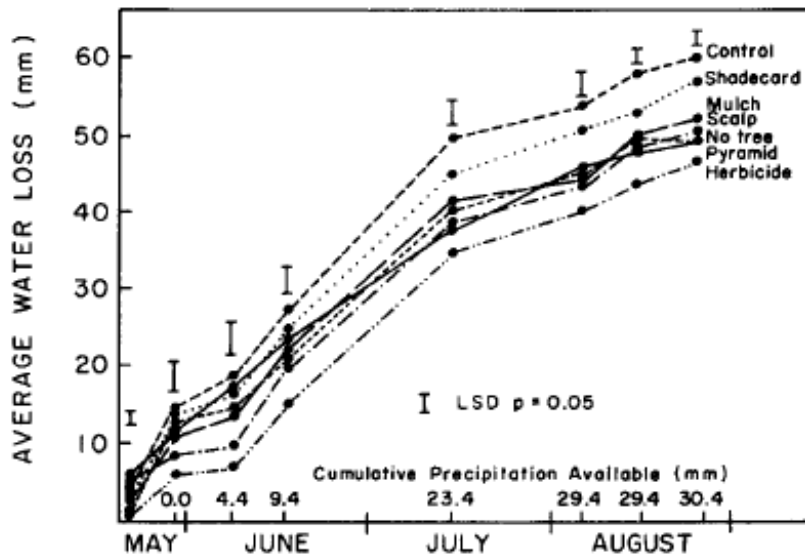
- Grasses and forbs most competitive when trees are young
- Effects of tree competition more important with time



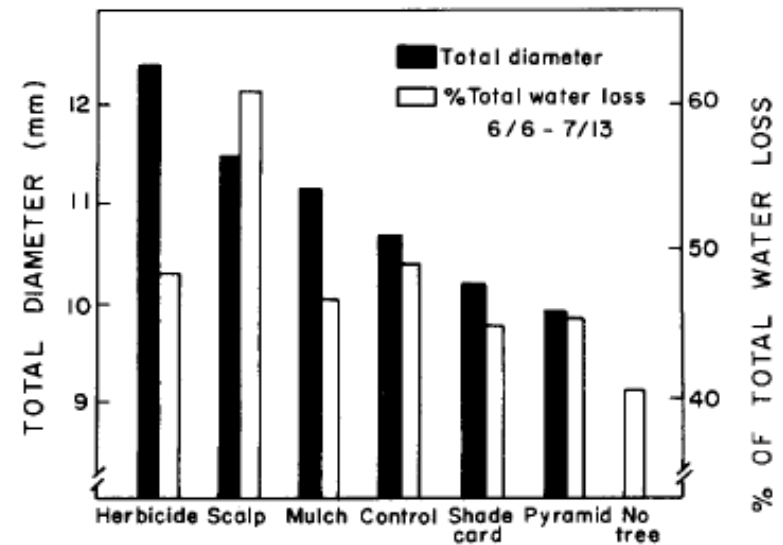
Shrub Competition Effects on Soil Moisture



Competition Control and Soil Treatment Effects on Douglas-fir in SW Oregon



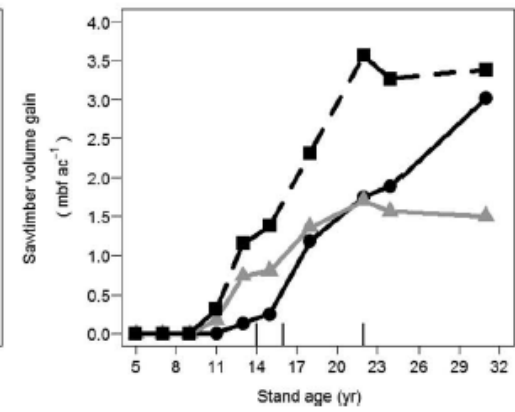
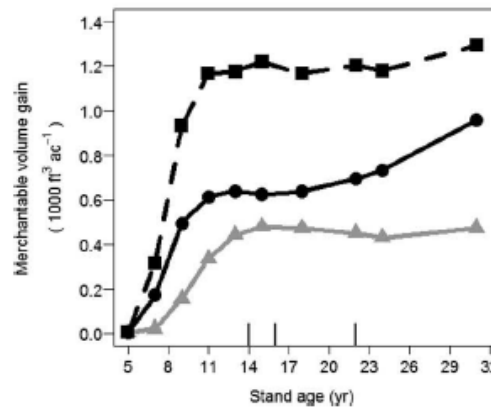
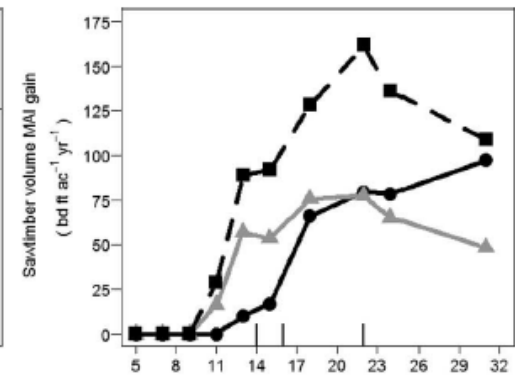
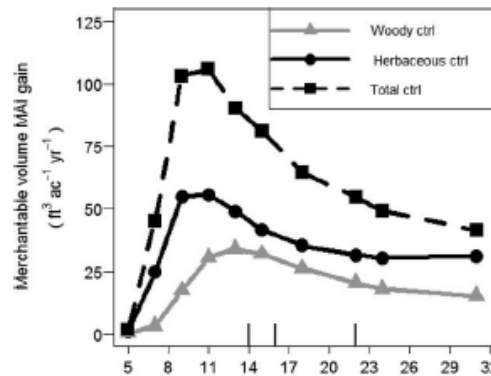
Controlling vegetation without disturbing the soil surface (herbicide) or shading soil resulted in lower water loss (tree use + evaporation)



Greatest growth associated with lowest water loss

Early Competition Causes Long-term Reductions in Forest Productivity

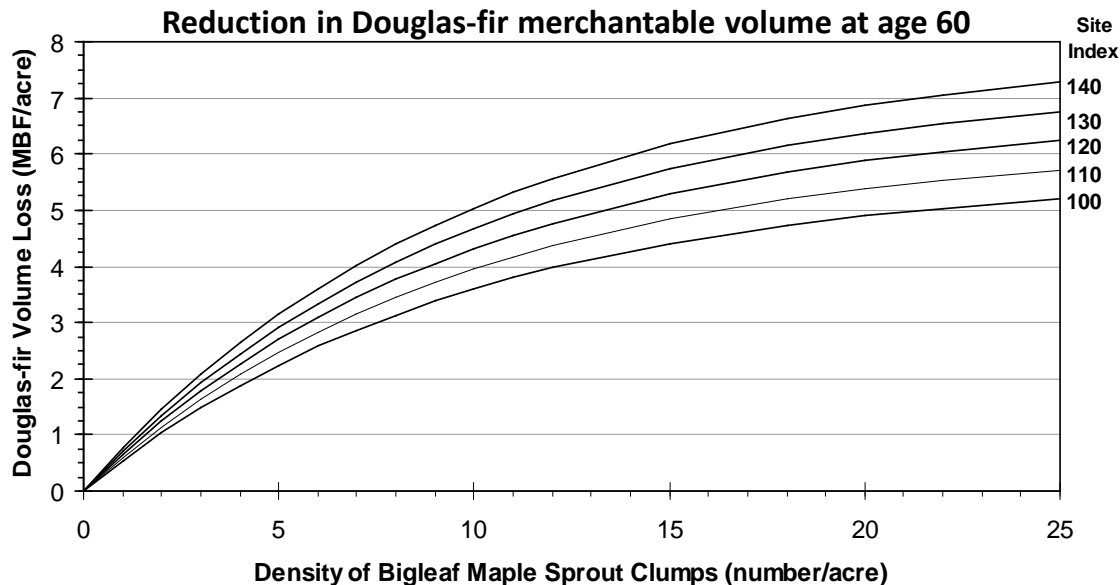
Early competition reduced stand growth and total biomass production after 32 years



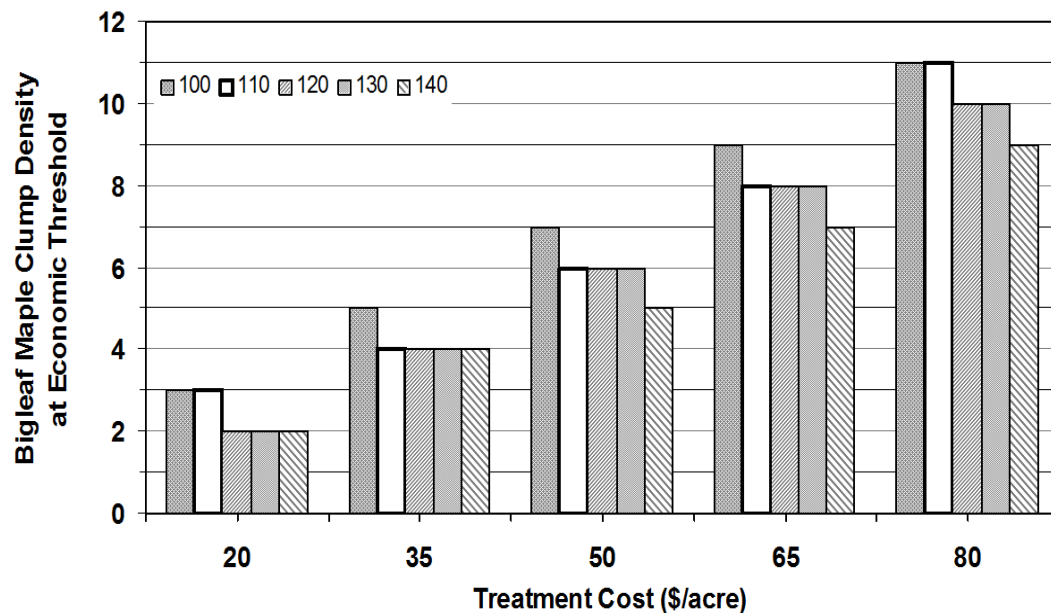
Thresholds

- Threshold: a time when management actions are required to prevent a loss in yield
- Economic Optimum threshold: level of competing vegetation above which vegetation should be controlled to optimize financial returns over the long term
- Competition threshold: level of competing vegetation abundance where an abrupt increase or decrease in the rate-of-change of tree growth or survival are observed

Economic Optimum Threshold for Bigleaf Maple Clumps



Economic threshold density of bigleaf maple sprout clumps at various treatment costs and site indices. Assumptions: interest rate = 7%; Douglas-fir stumpage value = \$500/MBF; and bigleaf maple stumpage value = \$3.50/ft³



How Much Competition Reduces Survival and Growth?

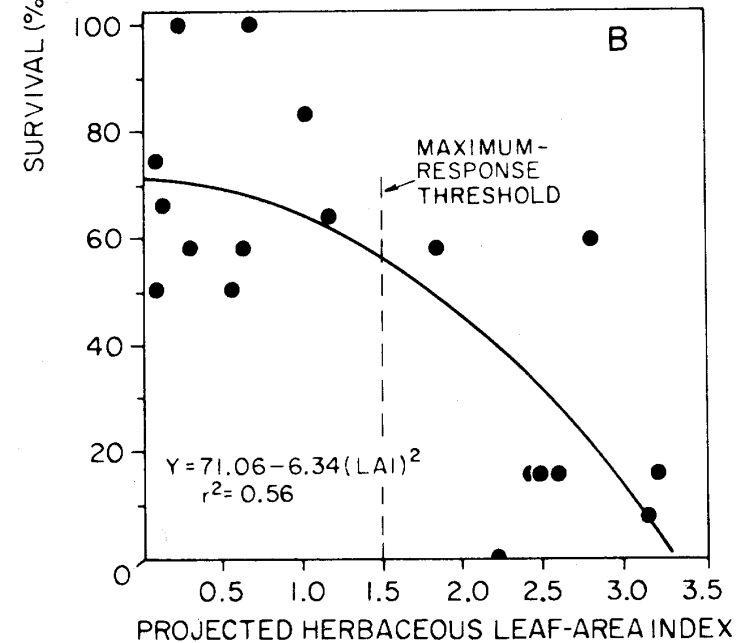
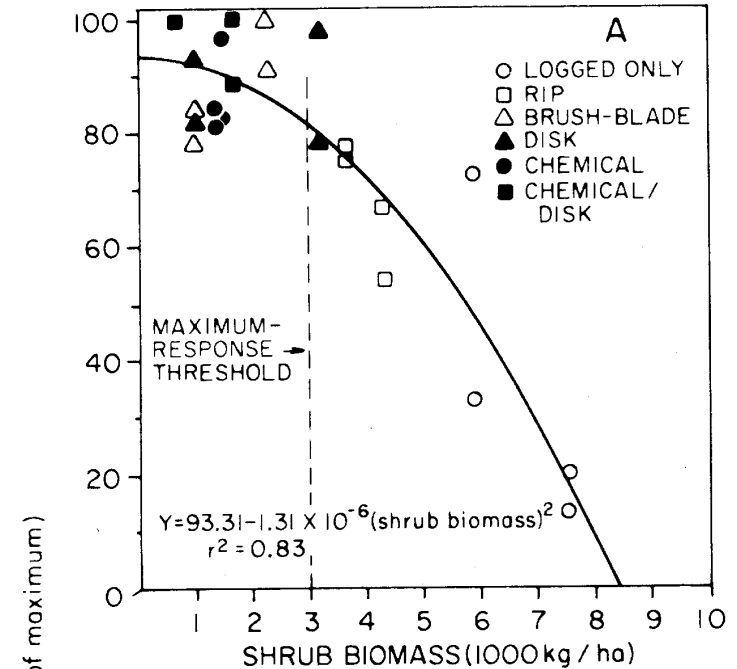


Does All Competition Need to Be Controlled?



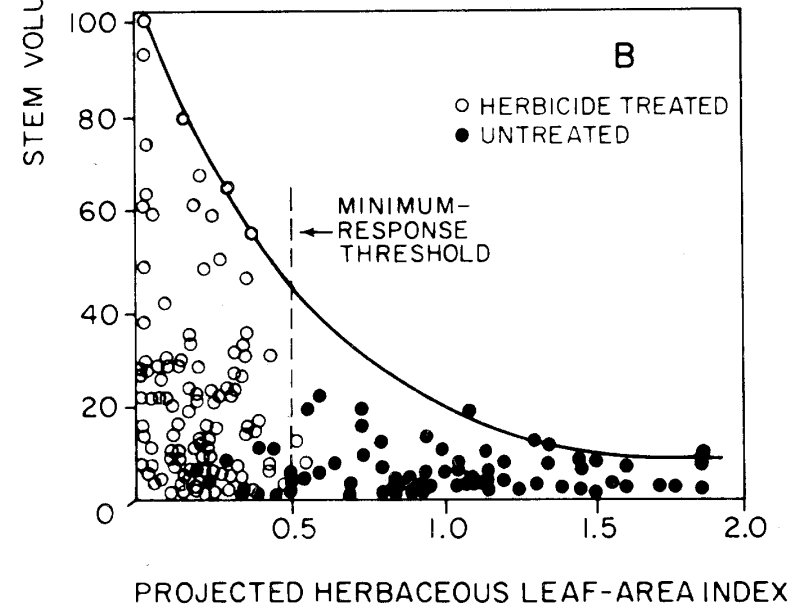
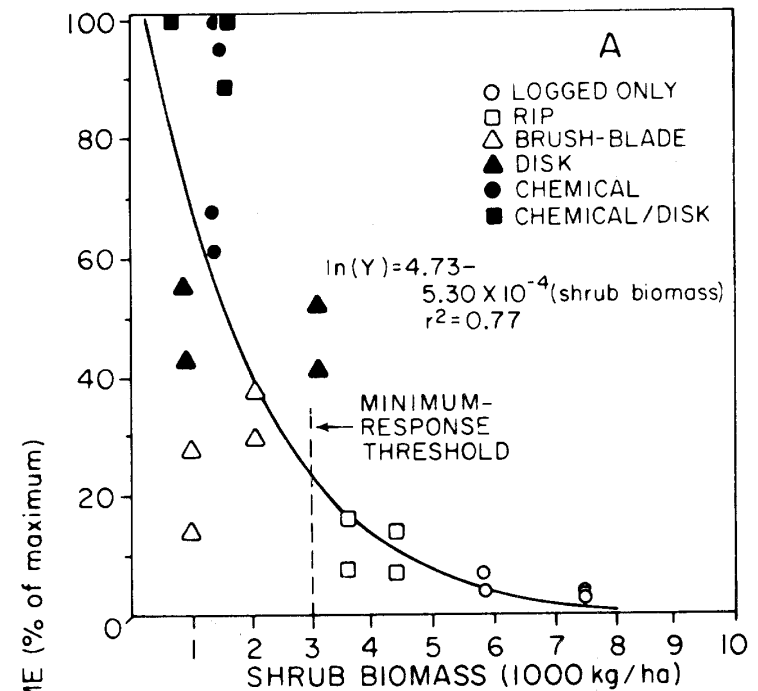
Competition Thresholds

- Survival response to competing vegetation
- Maximum threshold: amount of competing vegetation at which further control does not increase response



Competition Thresholds

- Growth response to competing vegetation
- Minimum threshold: degree of control needed before additional gains from control can produce a response



Competition Thresholds

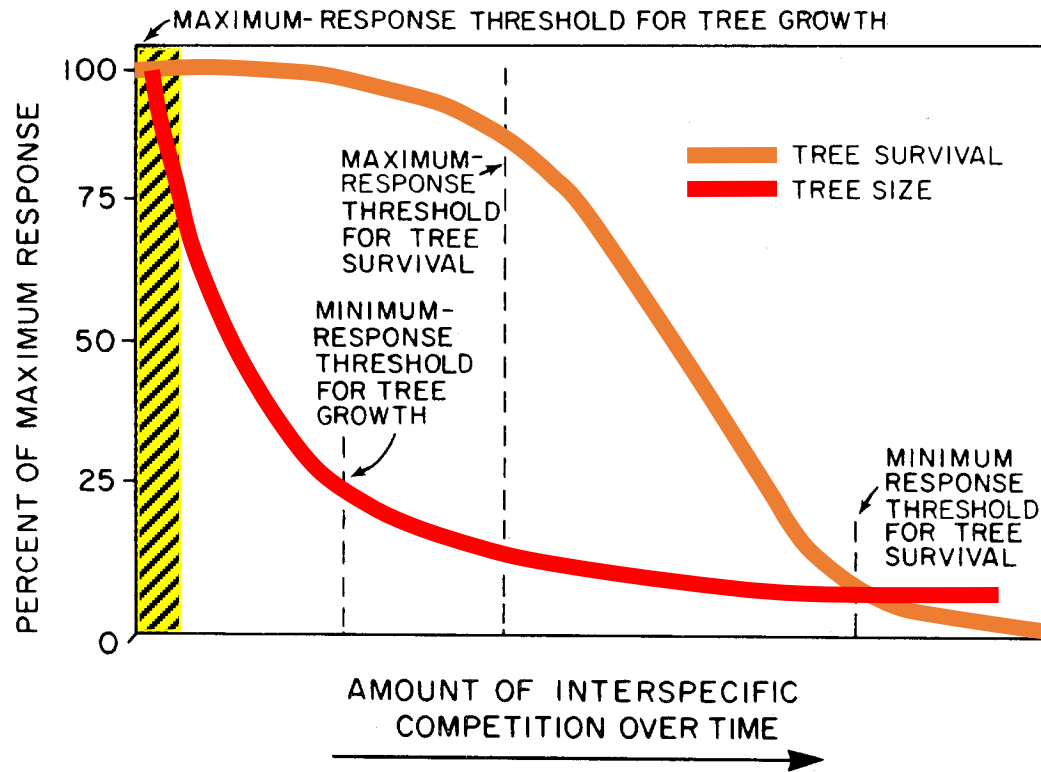


Fig. 3. Hypothetical relationship between interspecific competition, and tree survival and growth. The maximum- and minimum-response thresholds for tree survival and growth occur at different levels of interspecific competition. The maximum-response threshold for tree growth occurs in the shaded region under nearly vegetation-free conditions.

Competition Thresholds

- Most competition threshold research focused on Ponderosa pine and coastal Douglas-fir
- Rules of thumb for Ponderosa pine / dry habitat types:
 - Grass and forbs should be controlled where cover exceeds 40% at planting or expected shortly after
 - Shrubs should be controlled when cover exceeds or is expected to exceed 30% after planting

Research Needs

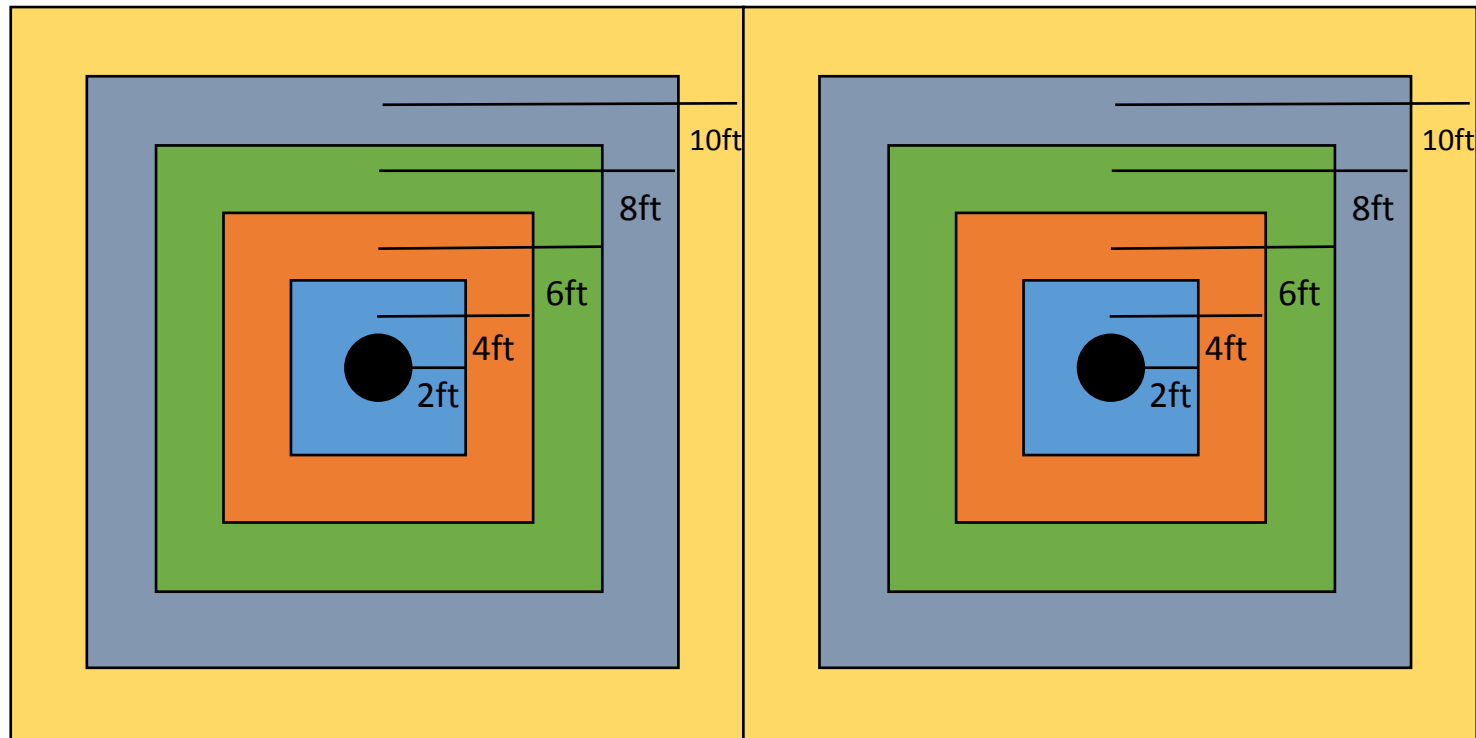
- Expansion of competition thresholds for important conifer species in INW: western larch, interior Douglas-fir, western white pine, lodgepole pine
- Competition thresholds across a range of habitat types from moderately dry to very moist (include competition of advance regeneration and post-planting natural regeneration)
- Decision support tool to predict effects of competing vegetation on individual tree survival and early growth

Proposed Study

- 3 habitat types
 - *Abies grandis*, *Thuja plicata*, *Tsuga heterophylla*
- 2 or 3 species
 - Western larch, interior Douglas-fir and/or western white pine
- 6 spot herbicide application sizes
 - Untreated, 2 x 2 ft, 4 x 4 ft, 6 x 6 ft, 8 x 8 ft, 10 x 10 ft

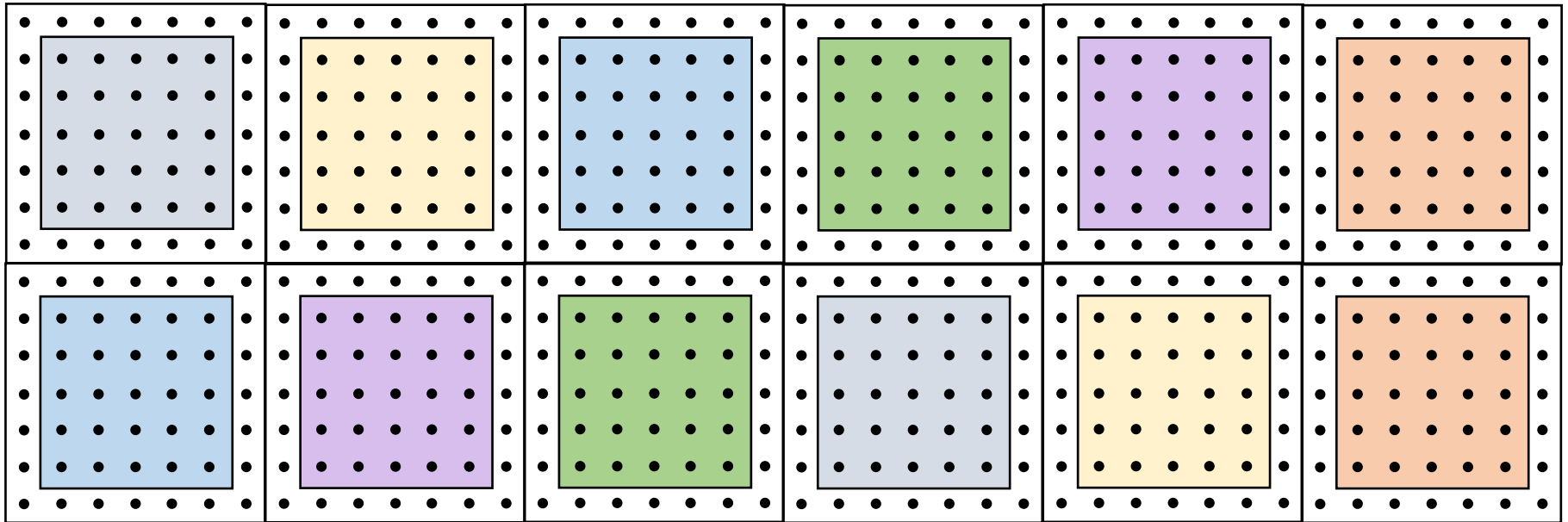
Proposed Study

Treatment plots will have one of six “areas of competition control” around each seedling and one of two or three species



Proposed Study

12 plots at each site, 3 sites per habitat type



Different colors refer to the areas of competition control. One for each species.

Proposed Study

- Start summer 2017
 - Locate sites
 - Quantify site vegetation abundance and composition
 - Layout plots, identify planting spots
 - Measure competition abundance around each planting spot
 - Treat vegetation around each planting spot
- Spring 2018
 - Plant trees
 - Measure competition abundance and composition
 - Measure tree survival and growth at end of the season



Questions?