



Introduction

- Nitrogen often limits tree growth in the PNW.
- Nitrogen often limits fungal growth in dead wood/roots (decomposition).
- Most nitrogen added to forests results from nitrogen fixation and deposition.

Nitrogen Fixation

- Symbiotic vs. Asymbiotic.
- Very little known about N fixation in dead roots.
- Dead roots should be a favorable substrate for N fixation.

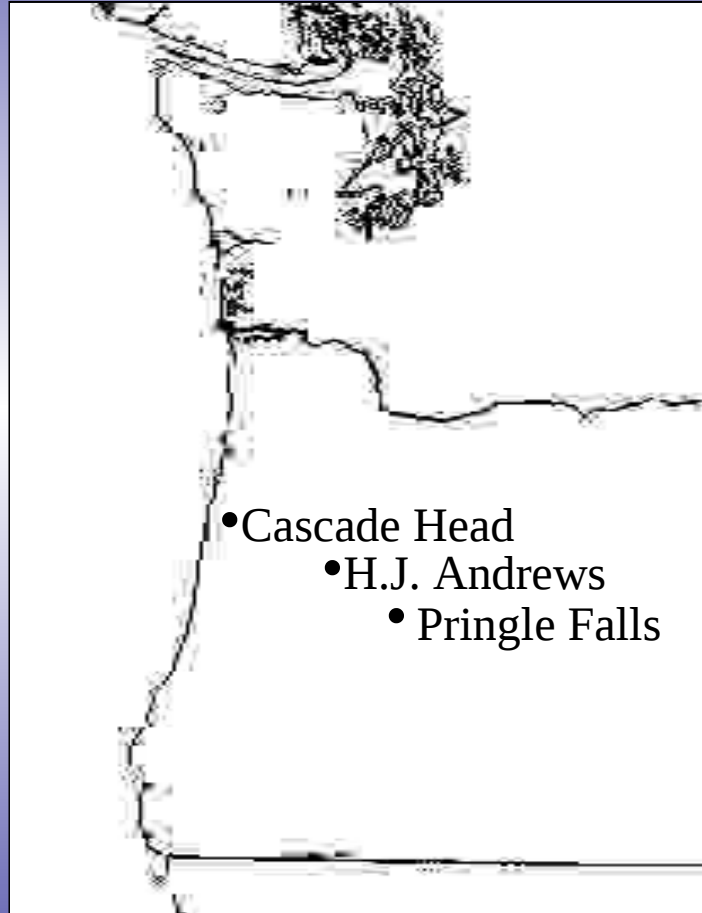
Objectives

- Explore possible controlling factors of N fixation in dead roots (e.g., species, size, site, temperature, oxygen, moisture etc.).
- Determine N fixation rates for dead roots from an experimental time series.
- Compare the rates in dead roots to other N inputs.

Root Decomposition Experiment

- Time-series started in 1995
- Three Sites (CH, HJ, PF)
- Three Species (PIPO, PSME, TSHE)
- Three Sizes (F, S, M)
- Four Years (2001-2004, 6-9 years of decomposition)

Sites





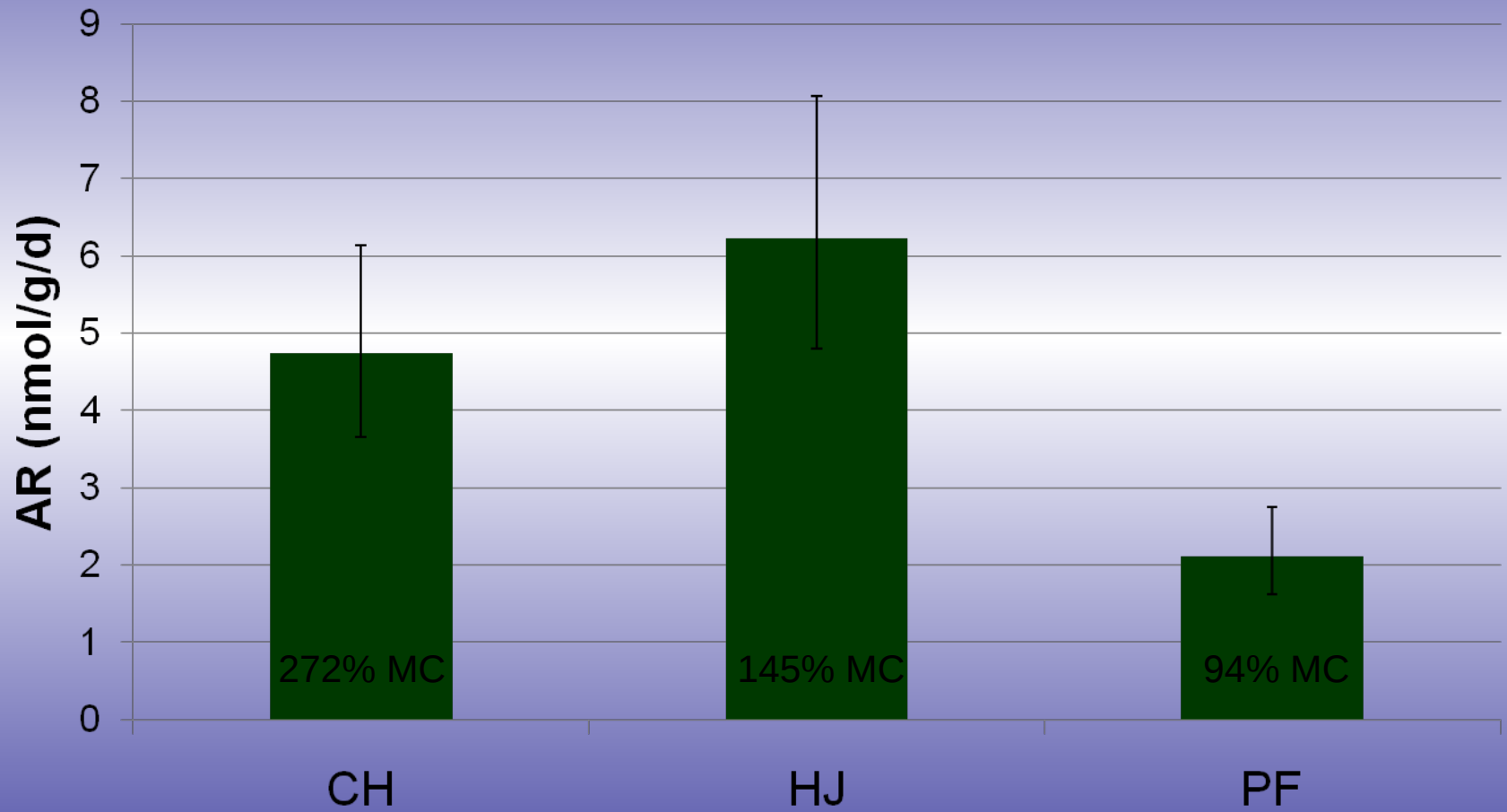
Four-way ANOVA

- Natural log of acetylene reduction
- Year
- Site
- Size
- Species
- All interactions (15 tests)
- P-value < 0.01

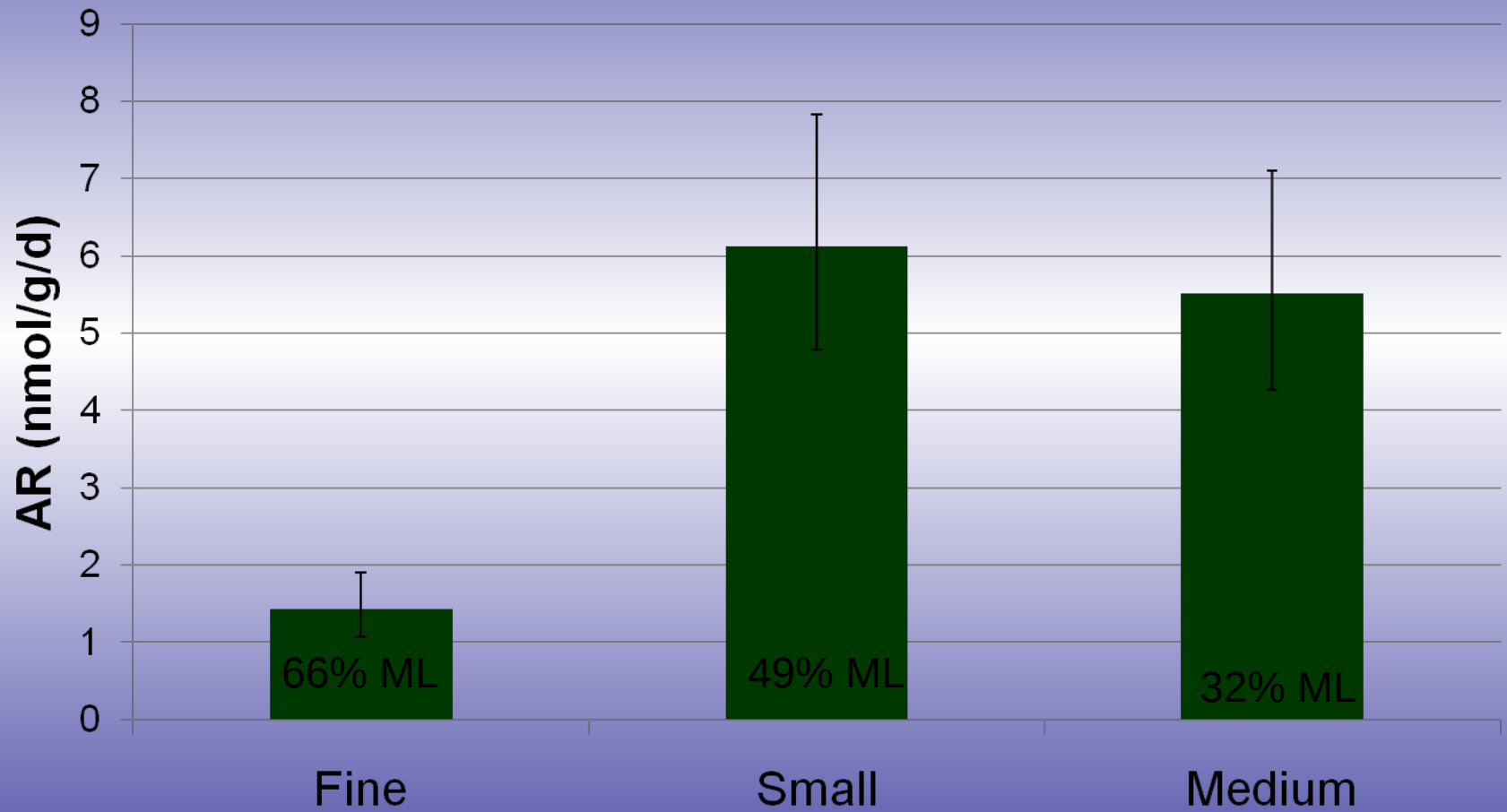
Four-way ANOVA

- Site ($p < 0.001$)
- Size ($p < 0.001$)
- Species ($p = 0.005$)
- Site x Year ($p < 0.001$)
- Site x Size ($p < 0.001$)

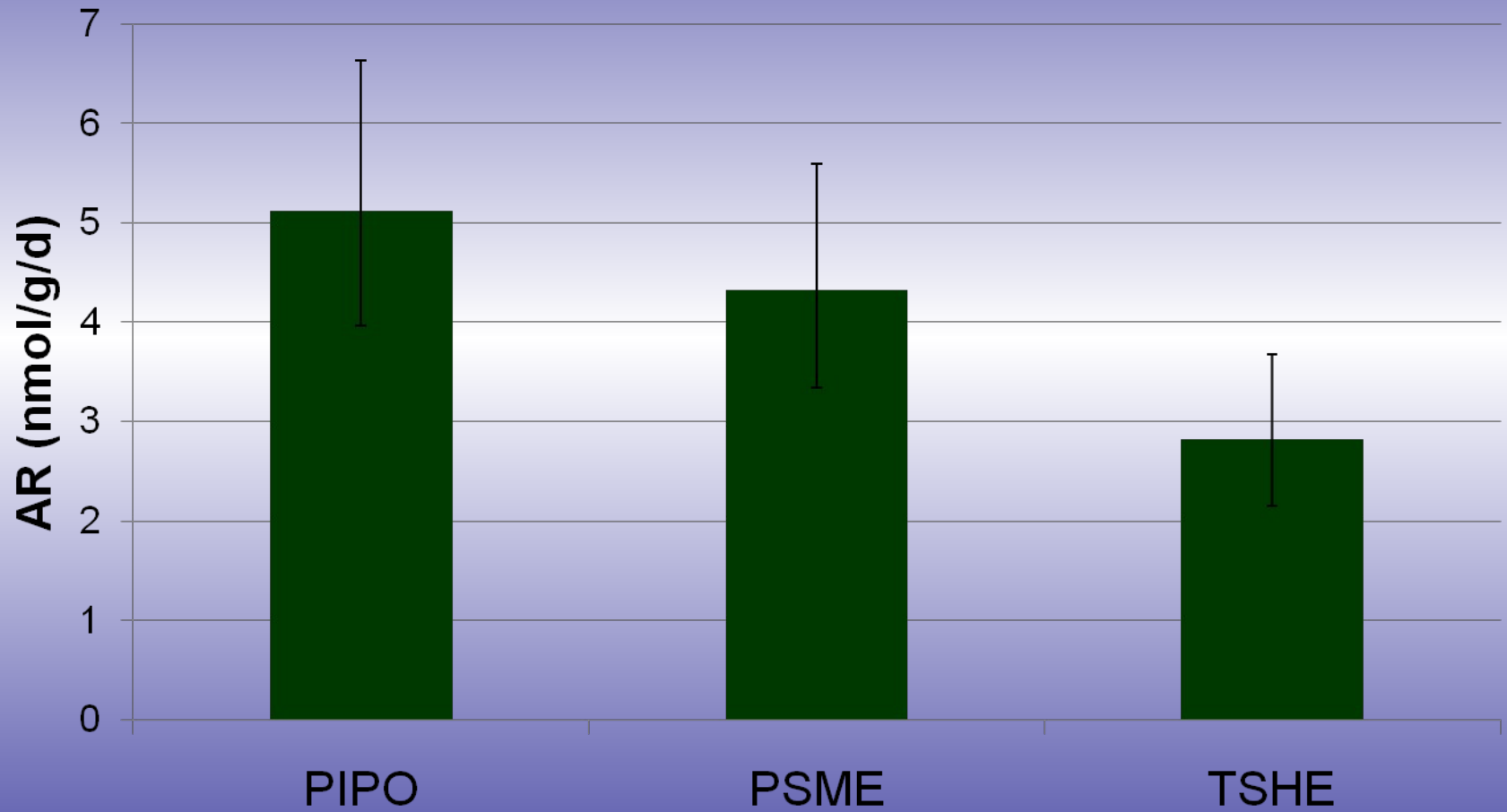
Site



Size



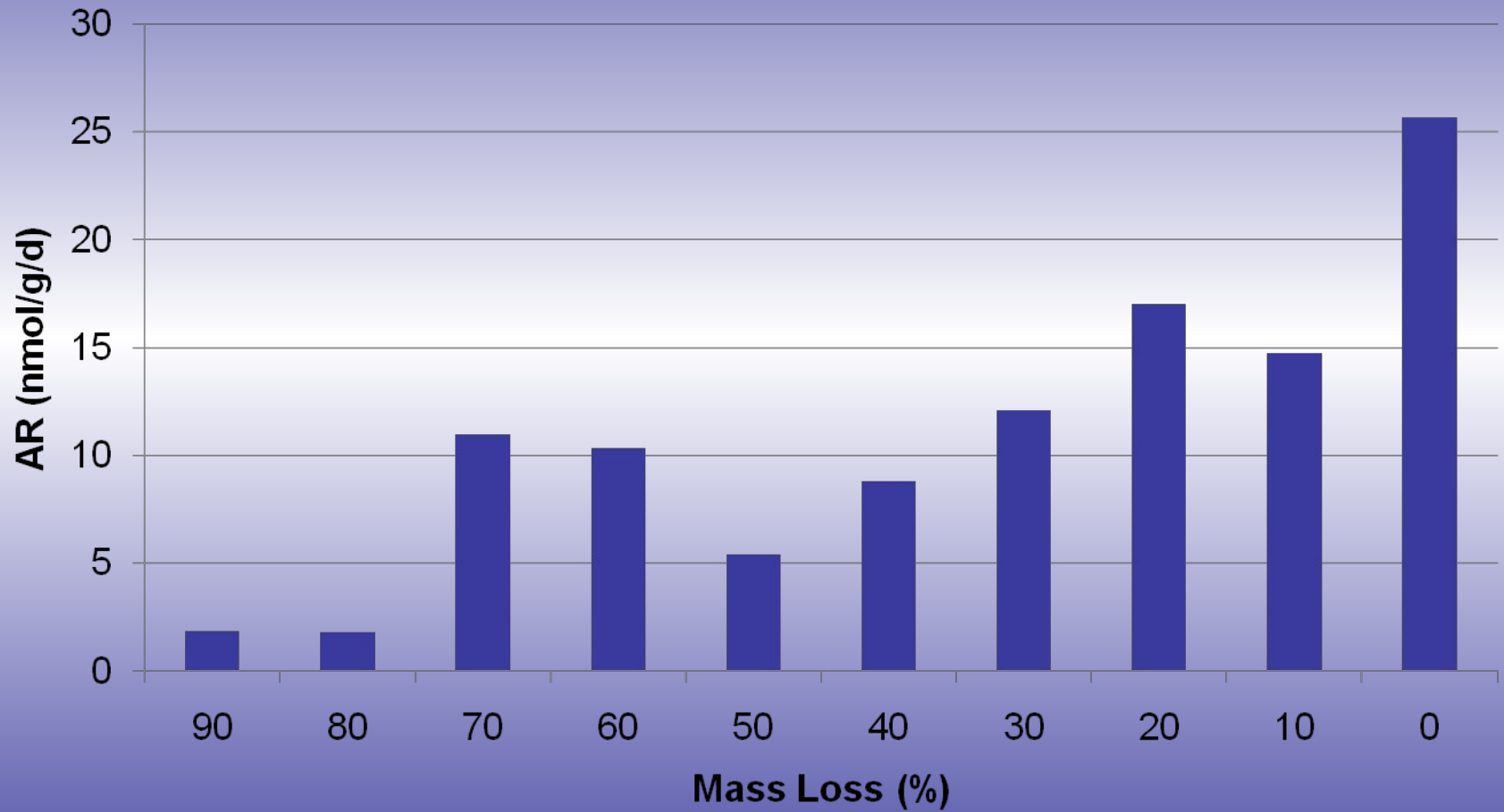
Species



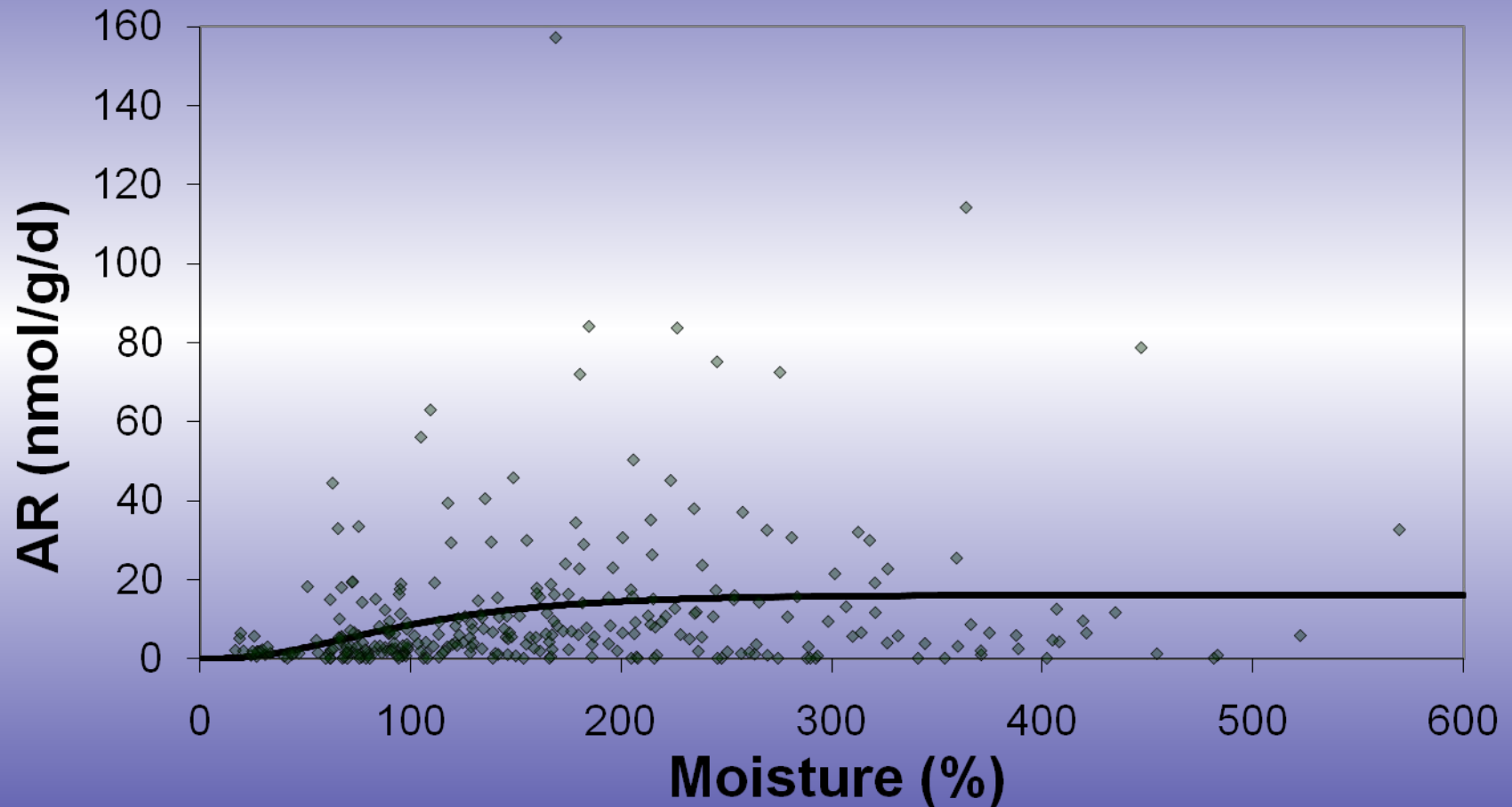
Interactions

- Site x Year
 - Pringle Falls low rates in 2001 (1.4 nmol/g/d, 76% MC) and 2004 (1.1 nmol/g/d, 115% MC)
- Site x Size
 - Low rate for Cascade Head, fine roots (0.8 nmol/g/d, 341% MC)
 - Low rates for Pringle Falls small (1.9 nmol/g/d, 95% MC) and medium roots (2.2 nmol/g/d, 105% MC)

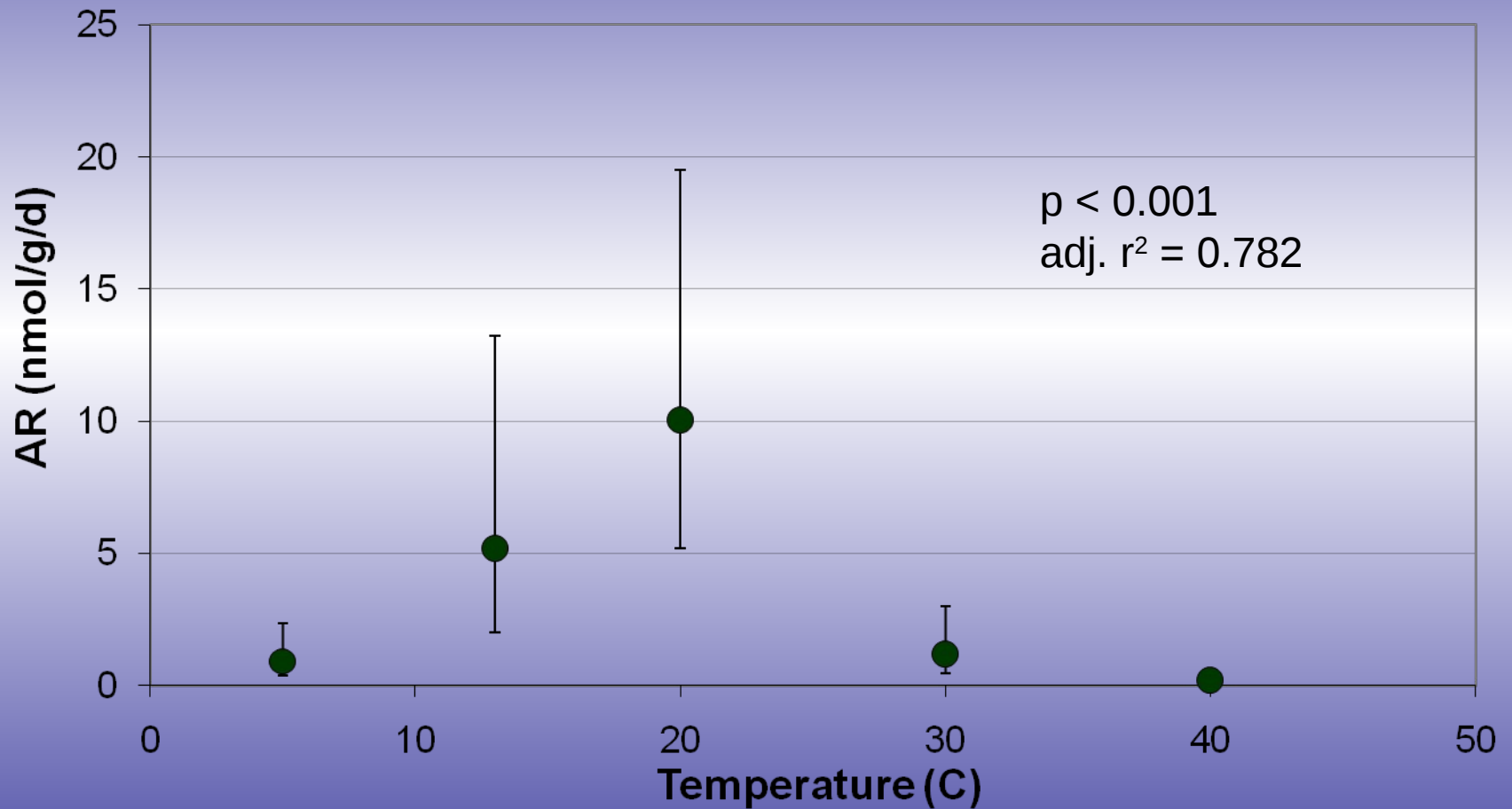
Mass Loss



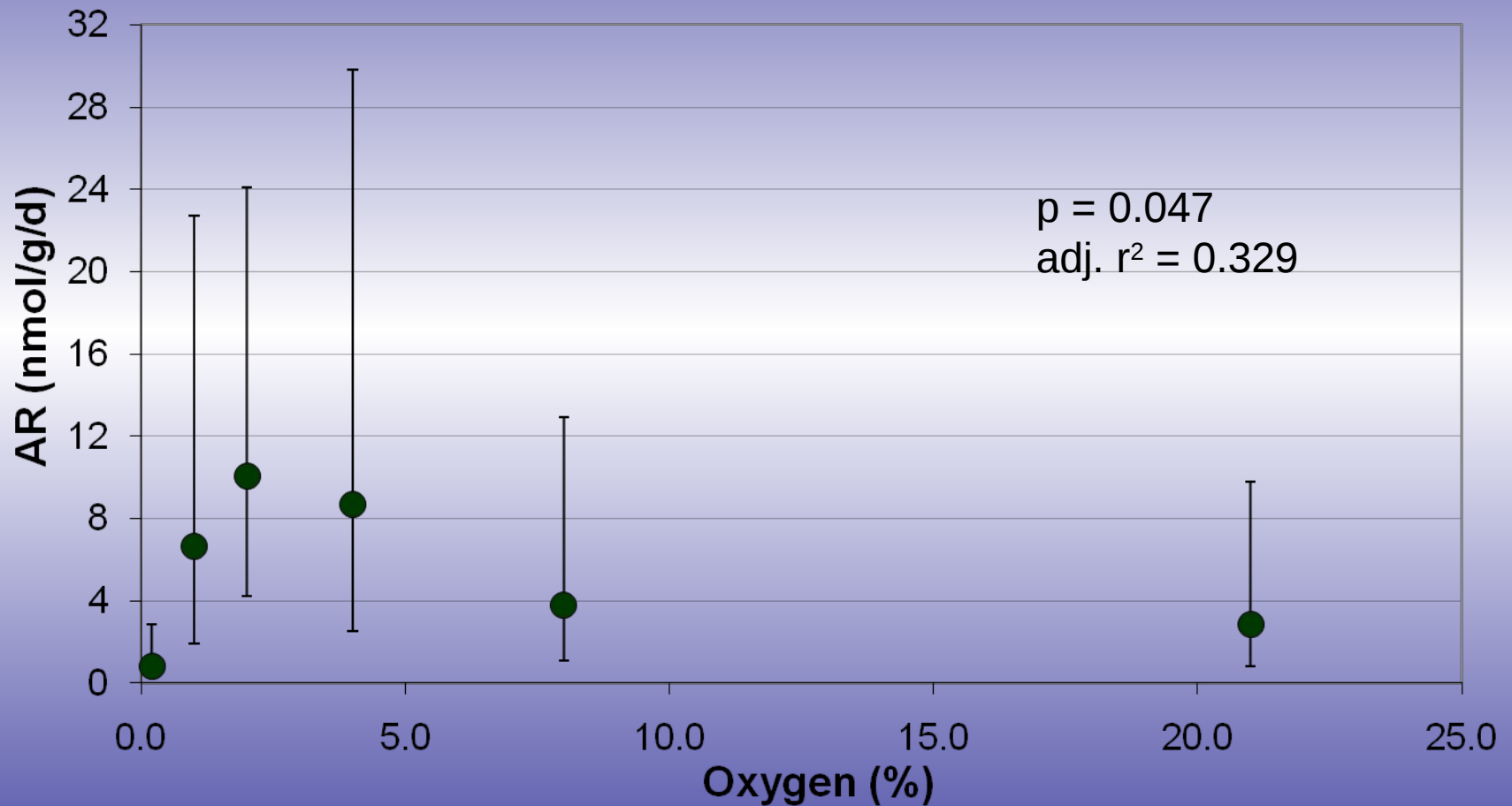
The effect of moisture content on acetylene reduction



The effect of temperature on acetylene reduction



The effect of oxygen concentration on acetylene reduction



Comparison of N Inputs

Substrate	N ₂ Fixed nmol/g/d (SE)	N	Conversion Ratio	Reference
Dead Roots	4.4 (1.01)	54	4.5:1	Chen and Hicks 2003
Dead Wood	1.3 (0.18)	93	4.4:1	Hicks et al. 2002
Soil	1.1 (0.15)	40	4:1	Jurgensen et al. 1992
Wood				
Litter	0.8 (0.16)	40	4:1	Jurgensen et al. 1992
Soil	0.2 (0.04)	40	4:1	Jurgensen et al. 1992

Conclusions

- Dead roots are a favorable substrate for N fixation with relatively high rates compared to other asymbiotic sources in the PNW.
- Explore deciduous roots, other systems.
- Oxygen levels in dead roots needed.
- Nutrient limitations, Mo and others.

Acknowledgements

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