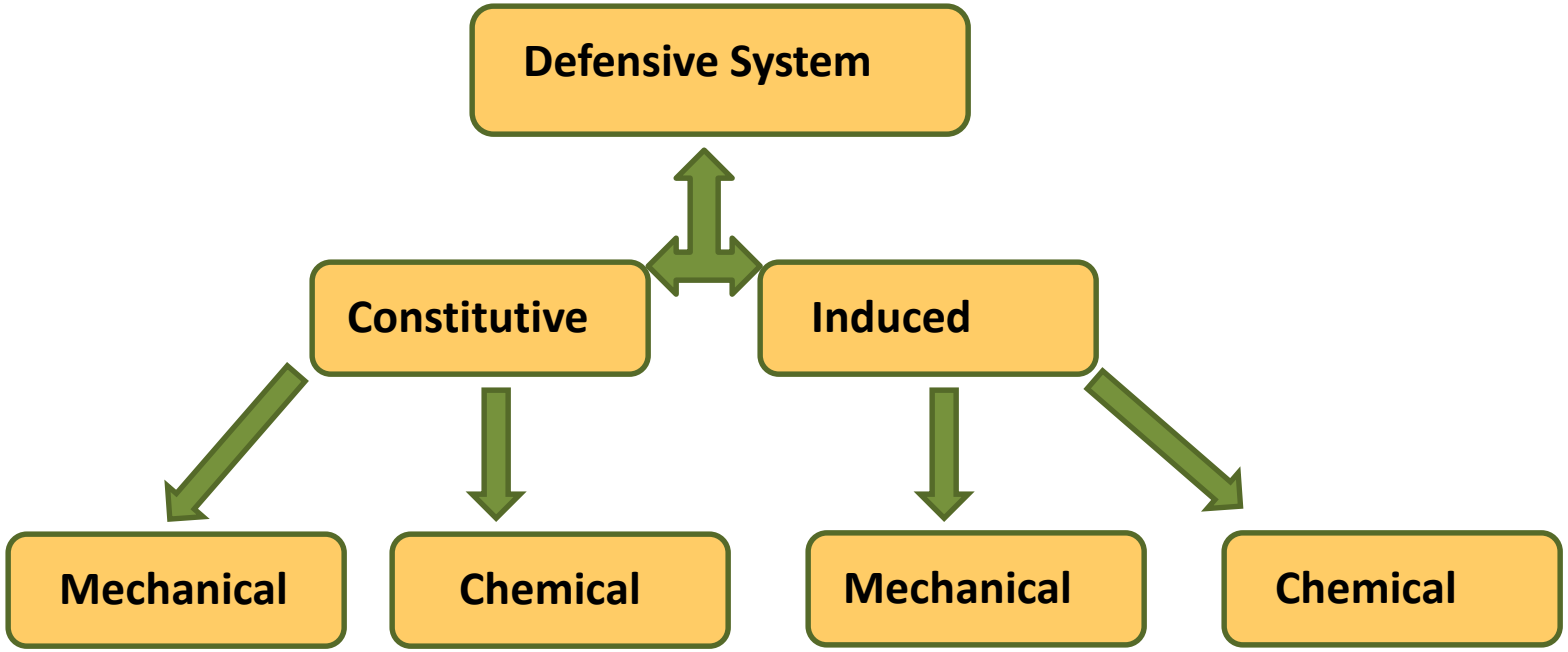
Chemical defensive reaction of *Pinus taeda* to *Leptographium terebrantis* invasion

John K. Mensah[1], Ryan L. Nadel[1], George Matusick[2], Zhaofei Fan[1], Mary A. Sword Sayer[3] and Lori G. Eckhardt[1]

[1]School of Forestry and Wildlife Sciences, Auburn University, Auburn, Alabama; [2]The Nature Conservancy, Fort Benning, Georgia; [3]USDA Forest Service, Southern Research Station, Pineville, Louisiana

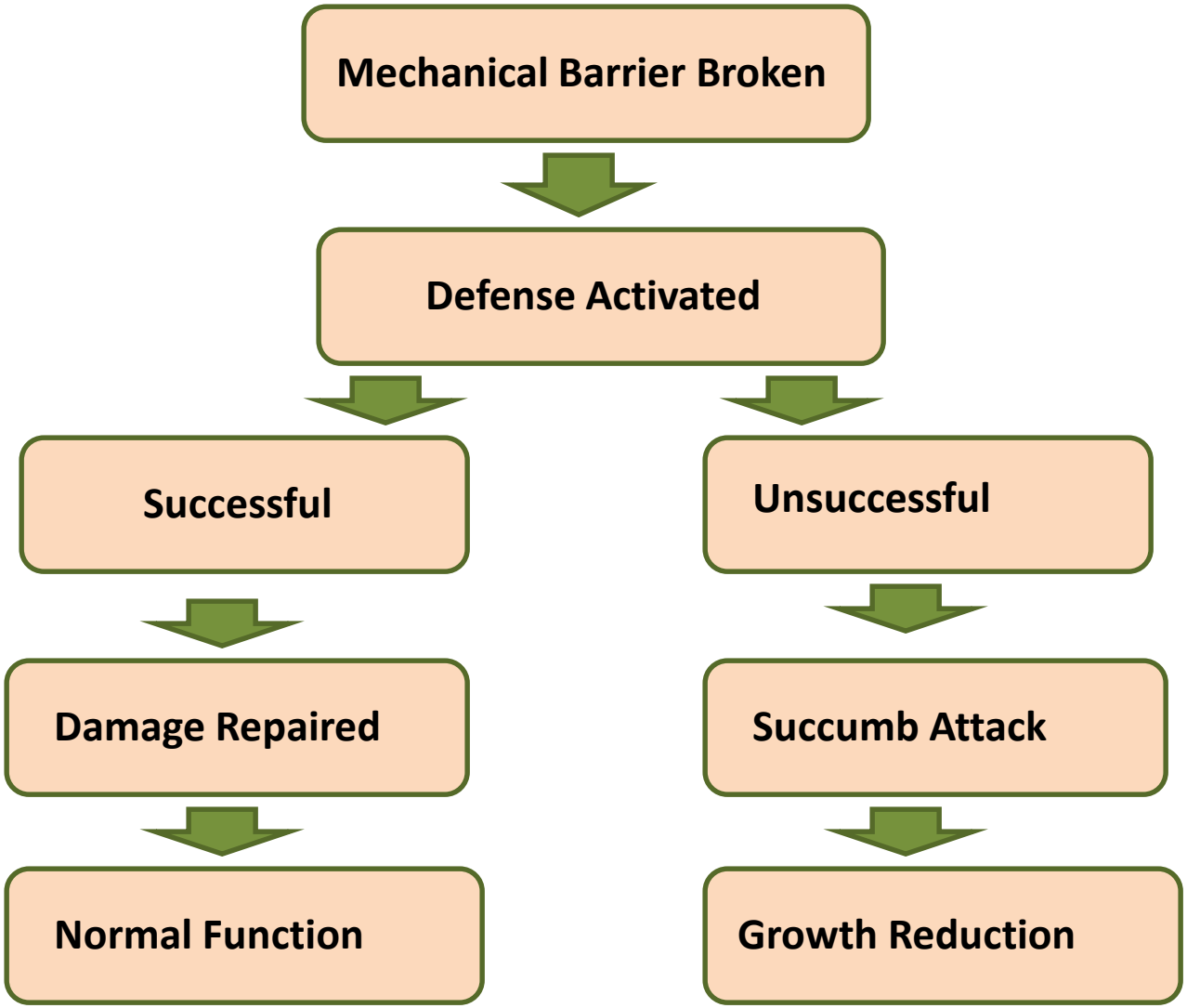
Background


Defensive System
Constitutive
Induced
Mechanical
Chemical
Mechanical
Chemical

Background

- Chemical defensive responses
  - Constitutive
  - Induced
- Induced chemical responses
  - Protein based
  - Non-protein based
- Specific and toxic
- Bind hydrolytic enzymes
- Bind amino acids and proteins

Background


Mechanical Barrier Broken
Defense Activated
Successful
Unsuccessful
Damage Repaired
Succumb Attack
Normal Function
Growth Reduction

Background

- Soil nutrients - Essential for plant growth
- Deficiency - Inhibit growth
- Nutrients - Translocated
- Immobile - Ca, Cu, B, S, Fe
  - Accumulation - leaf area reduction
- Remobilized - N, P, K, Mg, Cl, Mo, Zn

Objectives

- Assess the chemical defensive response and mineral nutrient dynamics to pathogen invasion
- Determine the relationship between the multiple defensive chemicals produced

Hypotheses

- A significant reduction of resins and phenolics in loblolly pine trees following fungal invasion
- Nutrient accessibility and supply to growing tissues will decrease with increased fungal inoculum

Approach - Resins

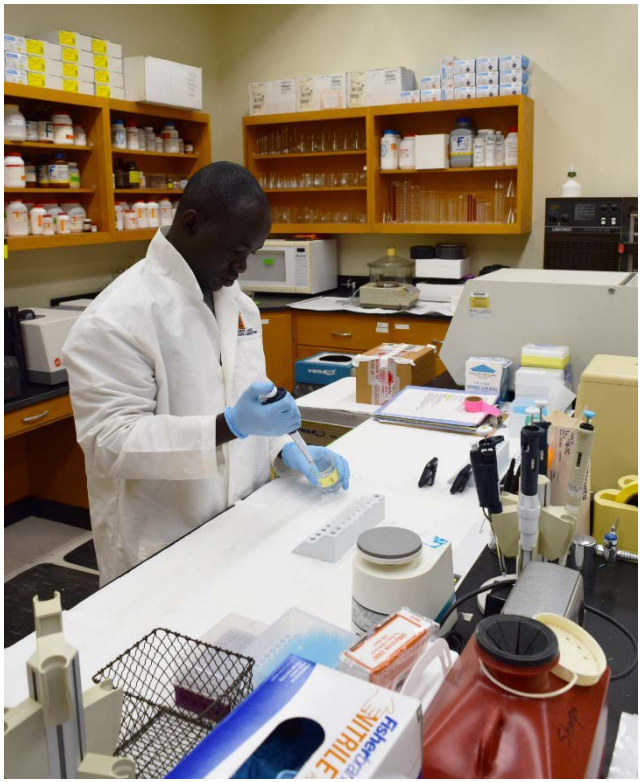
- North-south sides of each tree were sampled by punching a hole with 1.9 cm diameter arch punch at DBH
- A plastic connector was screwed into the tree to direct resin into a pre-weighed plastic tube attached to the connector
- Tubes were removed after 24hrs and transported
- Average resin weights were determined

Approach - Phenolics

- Upper crown branch tissue was shot
- Fascicles on branches were ripped off
- 10cm portion of the woody branches were excised
- The samples were freeze dried for about 24 hrs
- Milled into powder
- 50 mg of the powdered branch sample was extracted - 70% acetone

Approach - Phenolics

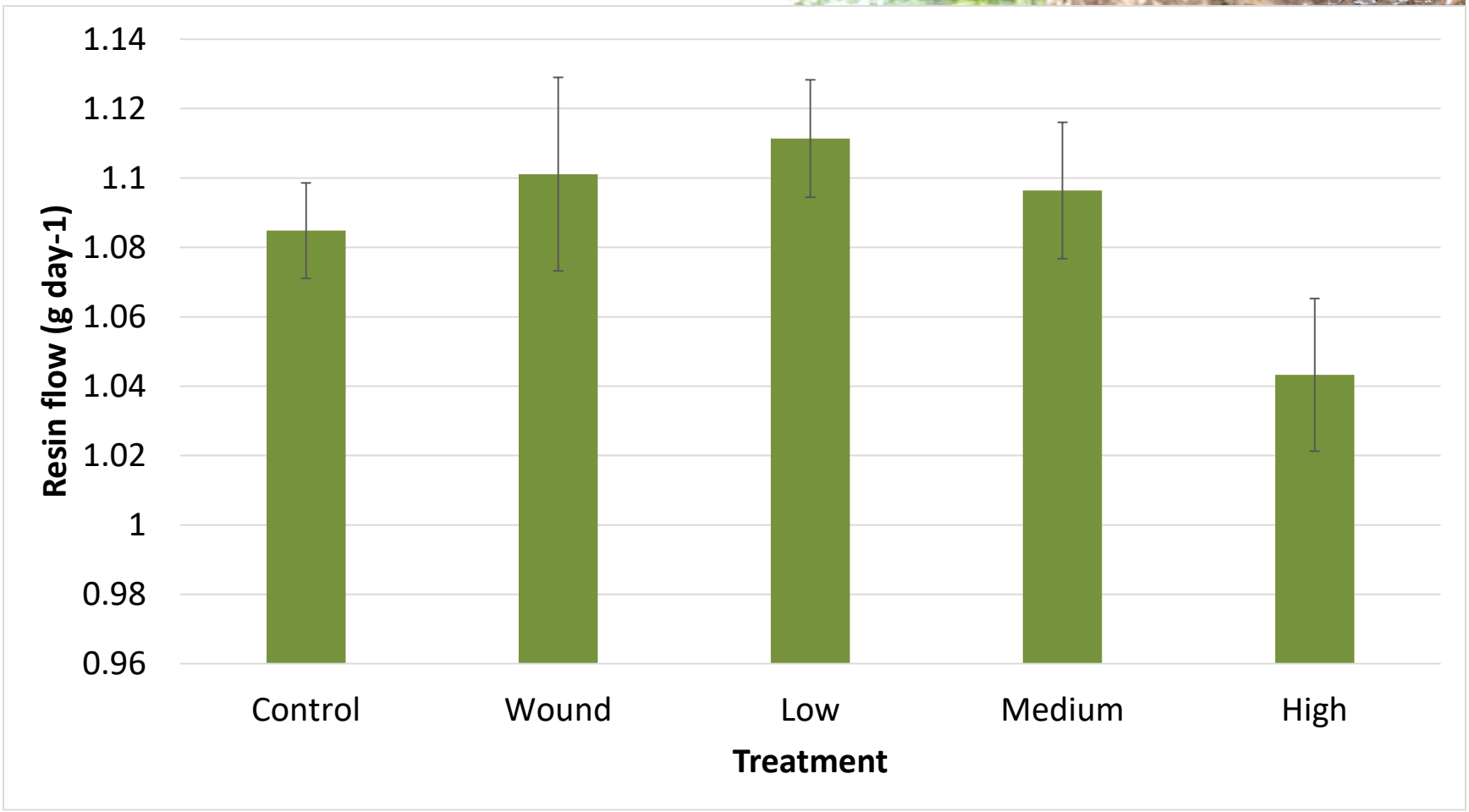
- Extraction - 70% acetone
- Development - Na_2CO_3
- Absorbance - Spectrophotometry



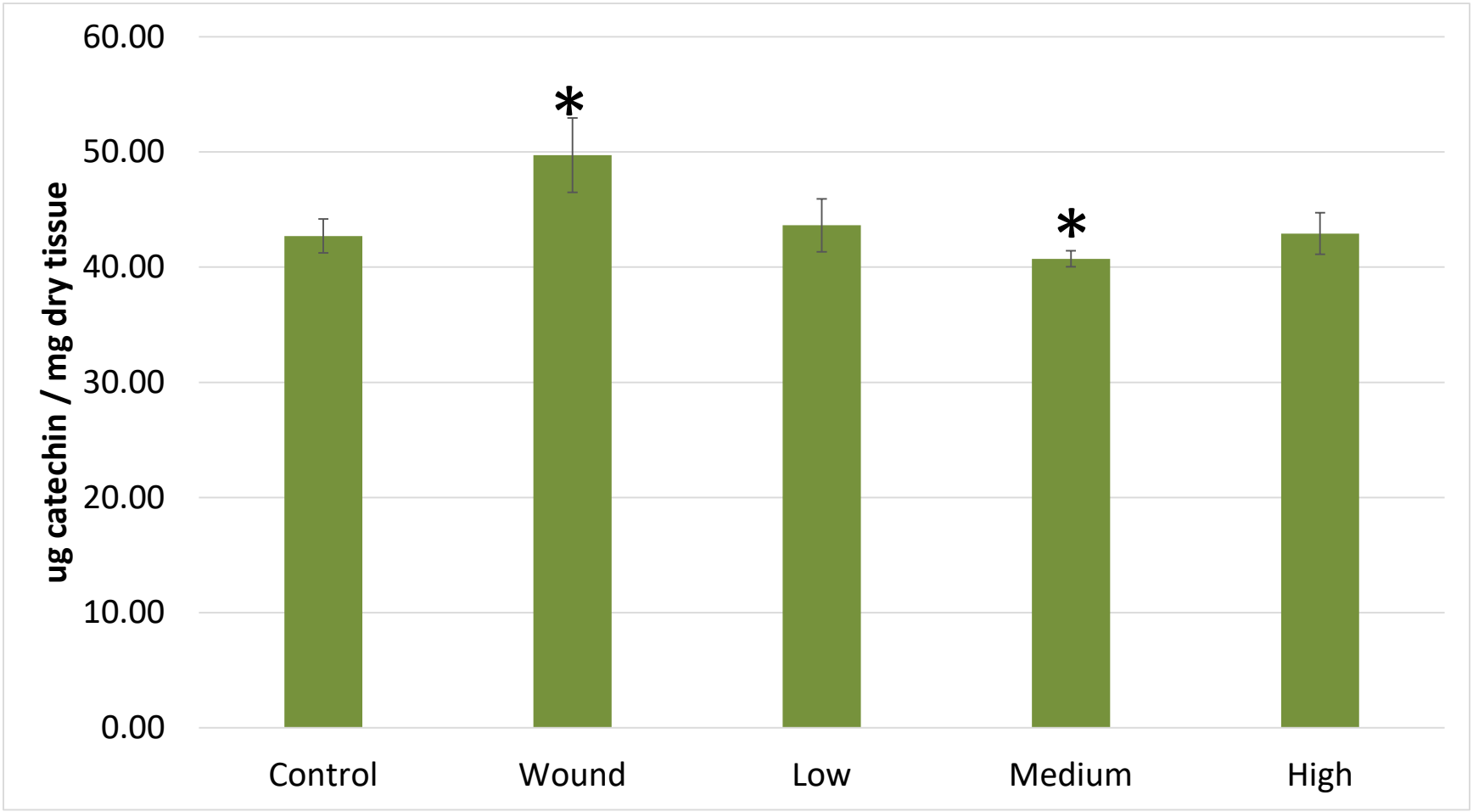
Approach - Foliar nutrients

- About 25 fascicles
- The samples were forced-air oven dried at $70^{O}C$
- Foliar nutrients - Waypoint Analytical (Memphis, TN)

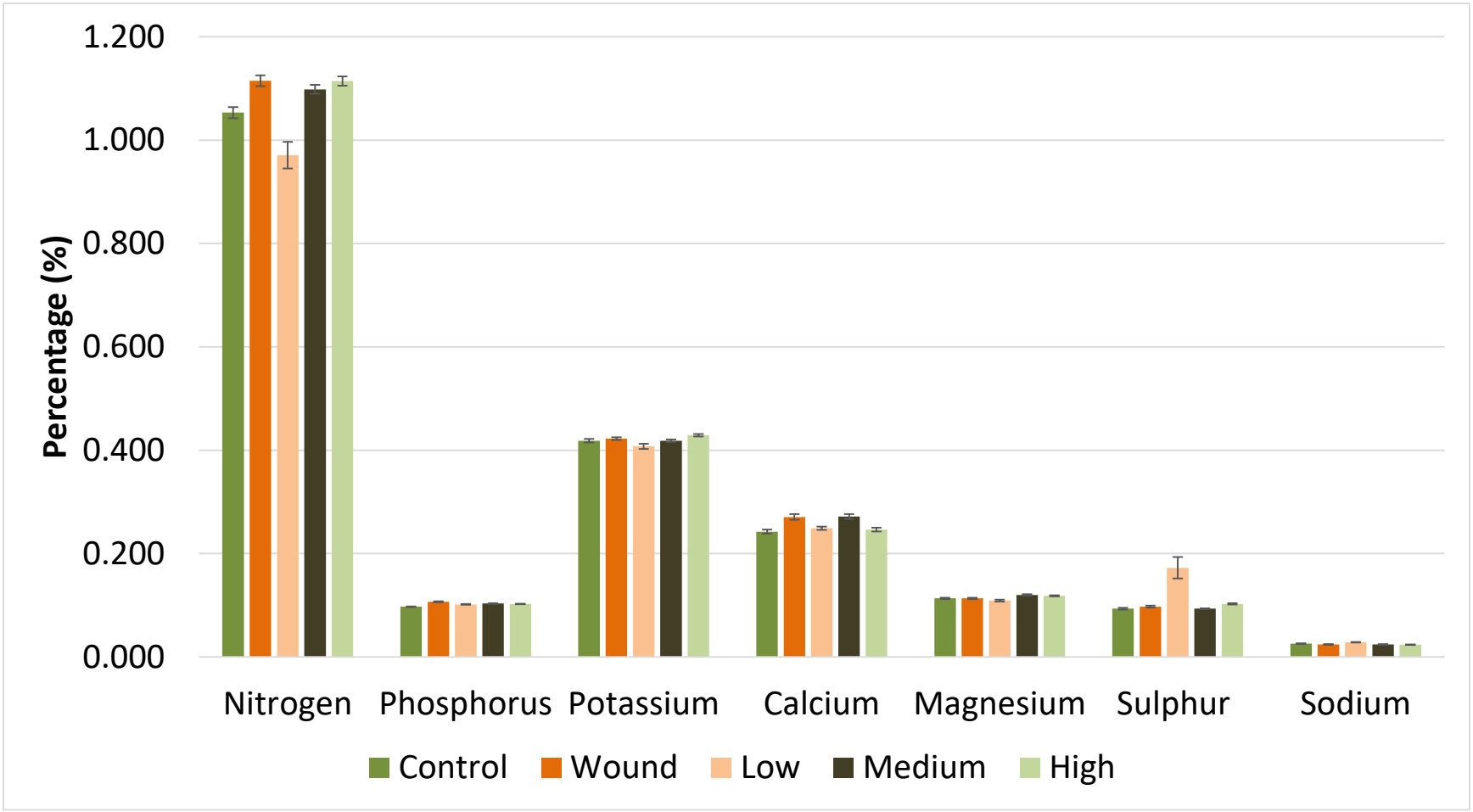
Results - Resins



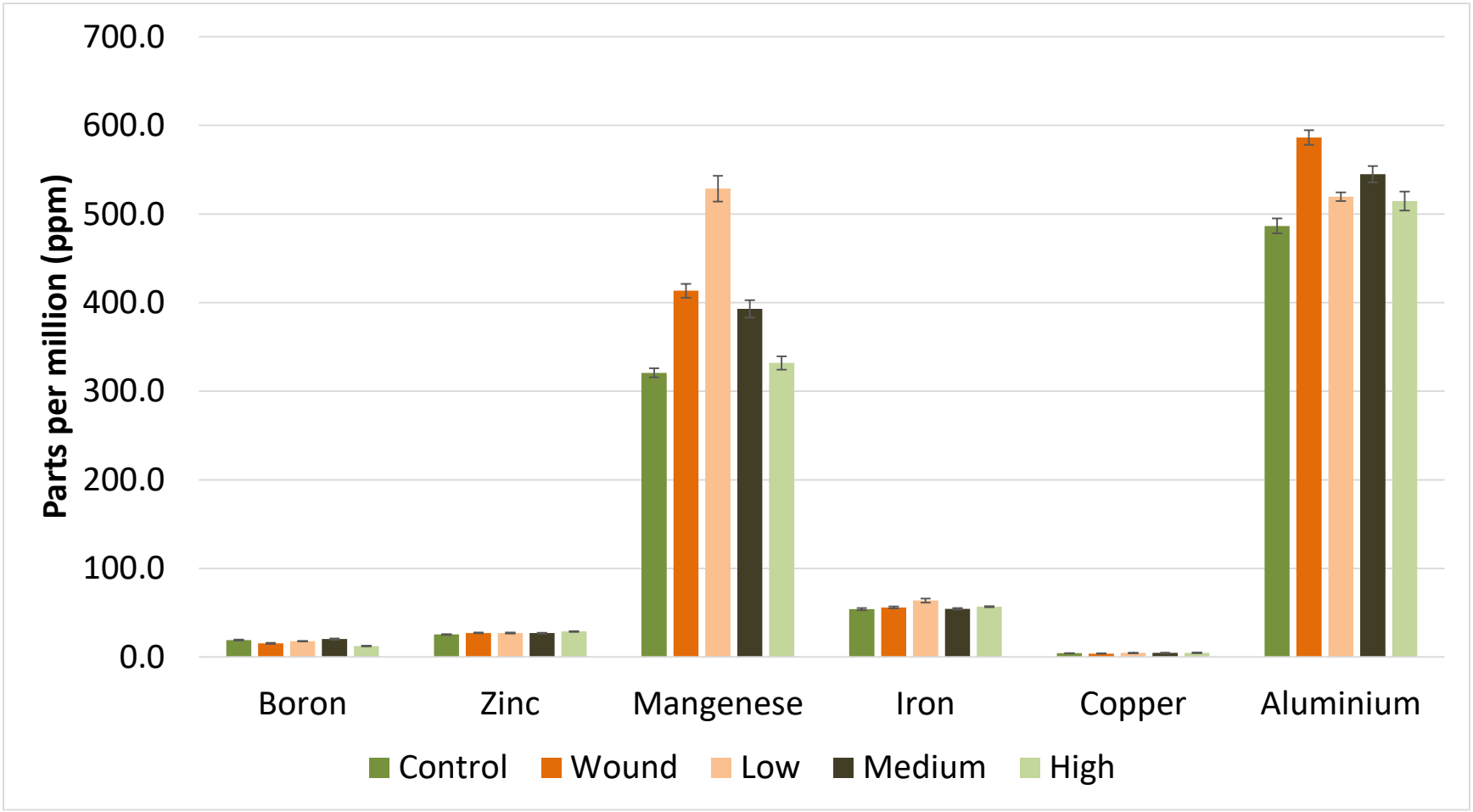
Results - Total phenolics



Results - Foliar macronutrients



Results - Foliar micronutrients



Post Inoculation Reaction

Wound

High

High

Conclusions

- Macro- and micronutrients were adequate except Cu
- Resin flow rate - 1.0 g/day and no significant difference prior treatment
- Phenolic content was highest and lowest in wound and medium treatments respectively
- High innoculum trees were characterized by pitch tubes and resinosis
- Inducible defensive system activated
- What happens next…….?

Acknowledgements

- Luis Mendez
- Dalton Smith
- Andrea Cole
- Shrijana Duwadi
- Jessica Ahl
- Charles Essien
- Pratima Devkota
- Kristi Wharton
- Dr. Susana Sung
- Undergraduates