

Relative Efficacy of Chemical, Mechanical, and Combination Treatments for Oriental Bittersweet Removal



Jennifer Rhode Ward

H. David Clarke

Jonathan Horton



UNIVERSITY of NORTH CAROLINA
ASHEVILLE

Oriental Bittersweet (*Celastrus orbiculatus*)

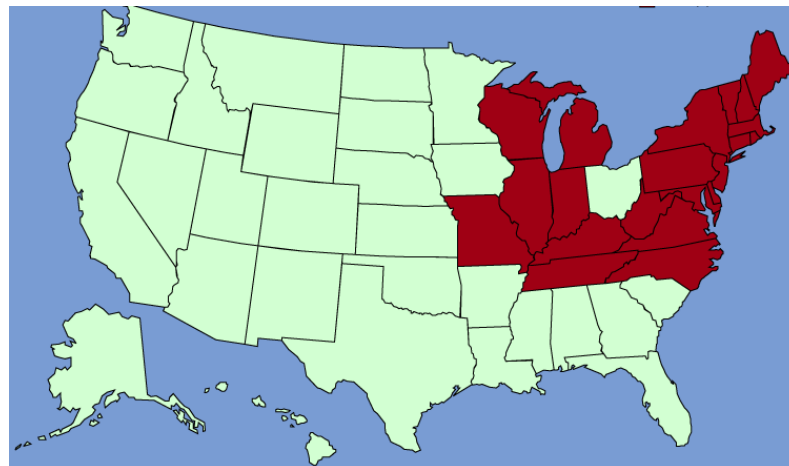
- polygamous, deciduous, long-lived liana; Celastraceae
- fruits mature in fall / winter
 - *bird / mammal dispersal; seeds germinate in spring*
 - *can also spread by root suckering*



- native to China, Japan, Korea
- introduced to U.S. in 1860s as an ornamental
 - *Connecticut; Buncombe County, NC (Albright et al. 2009)*

Oriental Bittersweet (*Celastrus orbiculatus*)

- invades disturbed, undisturbed habitats (Leicht-Young et al. 2009)
- naturalized in 21 states
 - *14 national parks*
 - *oldest vines here: 35 years old (Bent Creek), 36 years old (Fontana), 41 years old (Baldwin Gap)*
- spreading across NC, Southern Appalachians (Merriam 2003)



<http://www.nps.gov/plants/alien/map/ceor1.htm>

Oriental Bittersweet: Threats

- smothers native vegetation (Patterson 1974)
- makes trees more susceptible to weather-induced falls; affects timber quality (McNab and Meeker 1987)
- hybridizes with American bittersweet (*Celastrus scandens*) (Pooler et al. 2002)
- outcompetes American bittersweet (Leicht-Young et al. 2007, 2011)
- changes soil chemistry (Leicht-Young et al. 2009)





Techniques for Controlling or Eradicating Oriental Bittersweet?

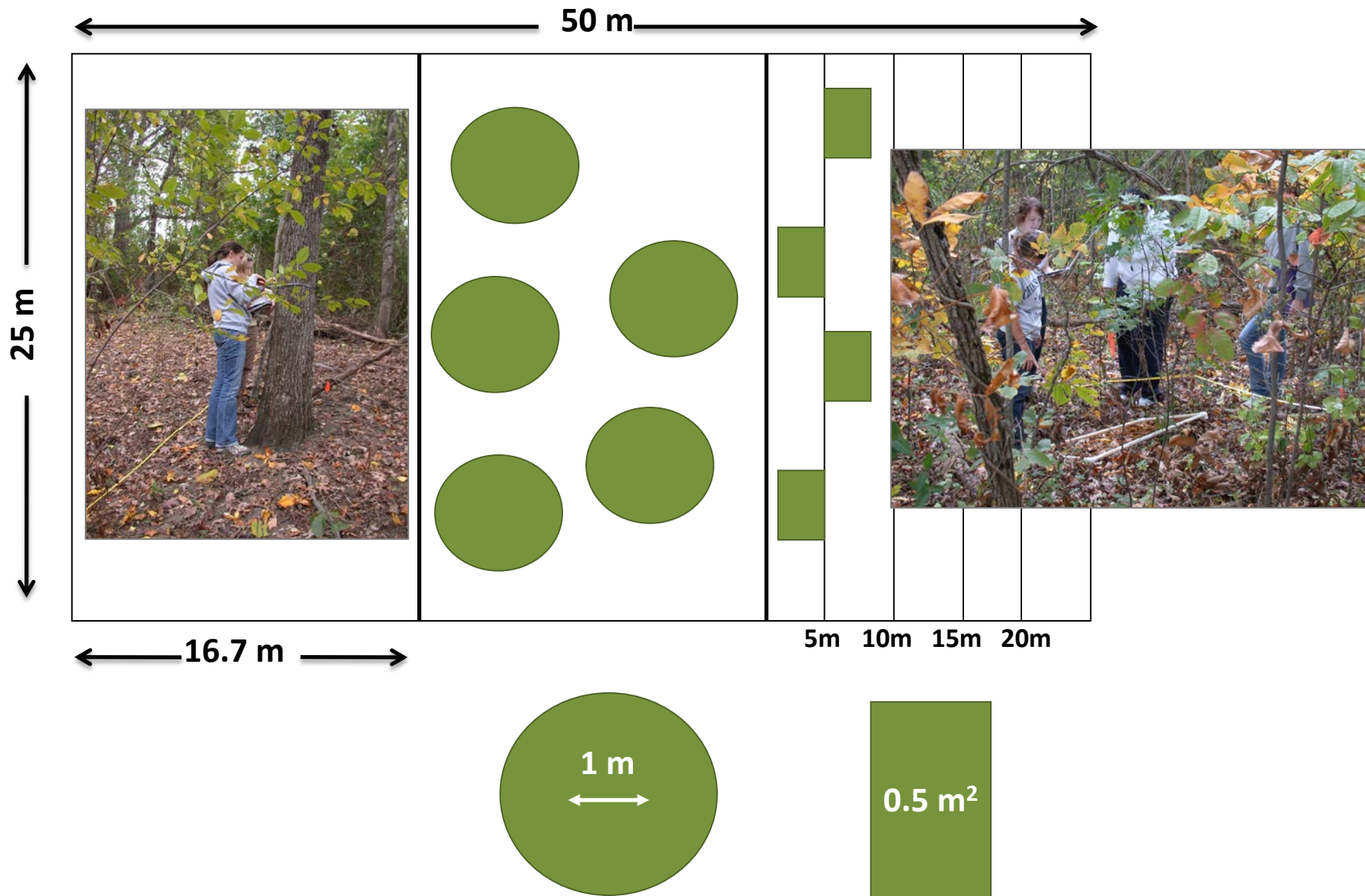
- vary in their efficacy
- must be applied repeatedly
 - *season?*
- must treat all life stages
 - *adults, juveniles, seedlings, seeds*
- might affect native species, plant communities, and ecosystems (Zavaleta et al. 2001, Flory & Clay 2009)

Oriental Bittersweet Removal Experiments

- UNC Asheville campus in Buncombe County, NC
- 2 forested sites on campus
 - *Chestnut Ridge: oak hickory forest*
 - *Pisgah Forest: formerly grazed oak-hickory forest*
- block design
 - *3 blocks / site*
 - *4 treatment plots / block*

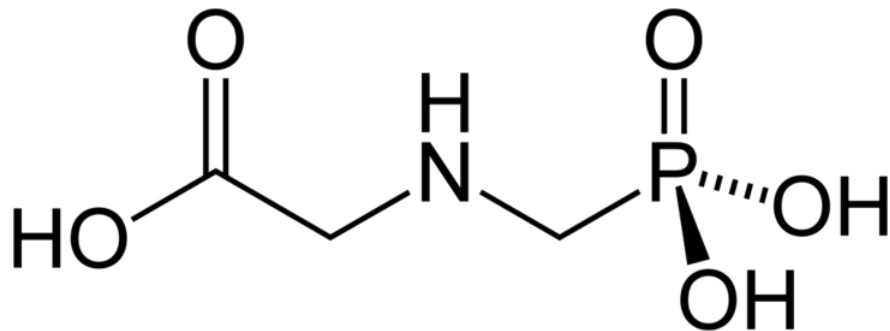


Oriental Bittersweet Removal

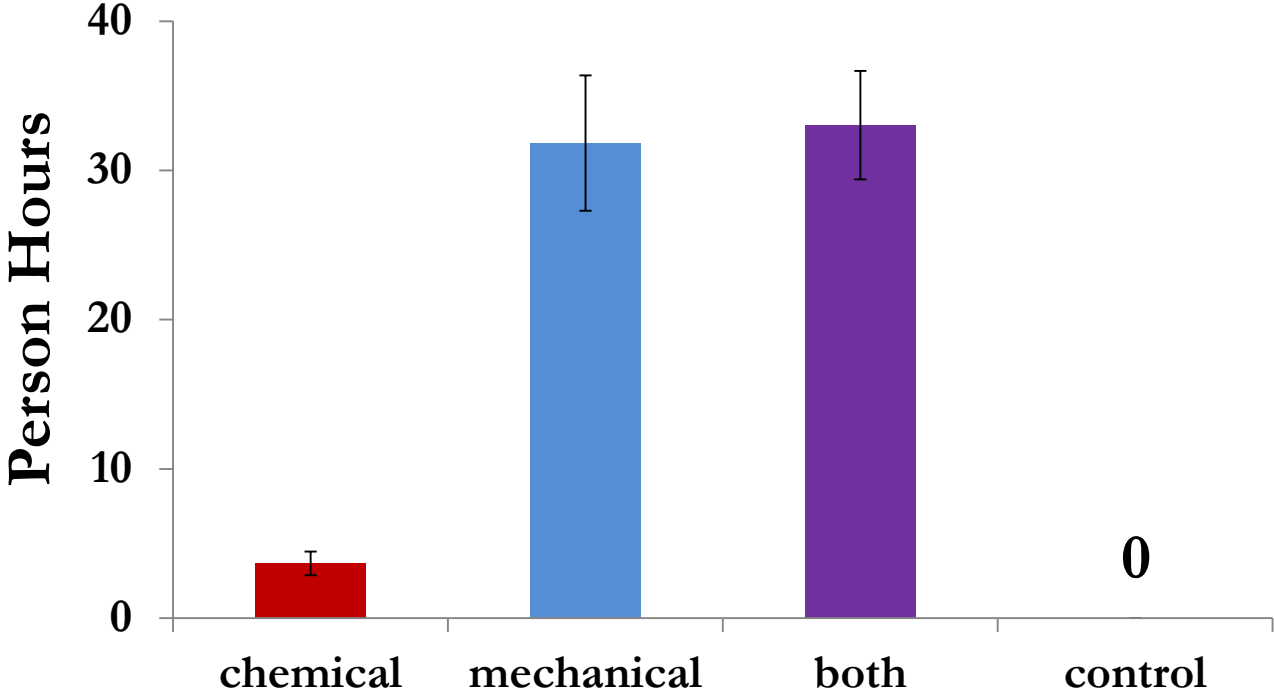


Oriental Bittersweet Removal

- treated each summer (2008 - 2011) to remove all exotics
 - *chemical: spot spraying with glyphosate*
 - *mechanical: hand-pulling, weed wrenches, mattocks, girdling*
 - *both: mechanical then chemical*



Person-Hours Spent on Initial Treatment

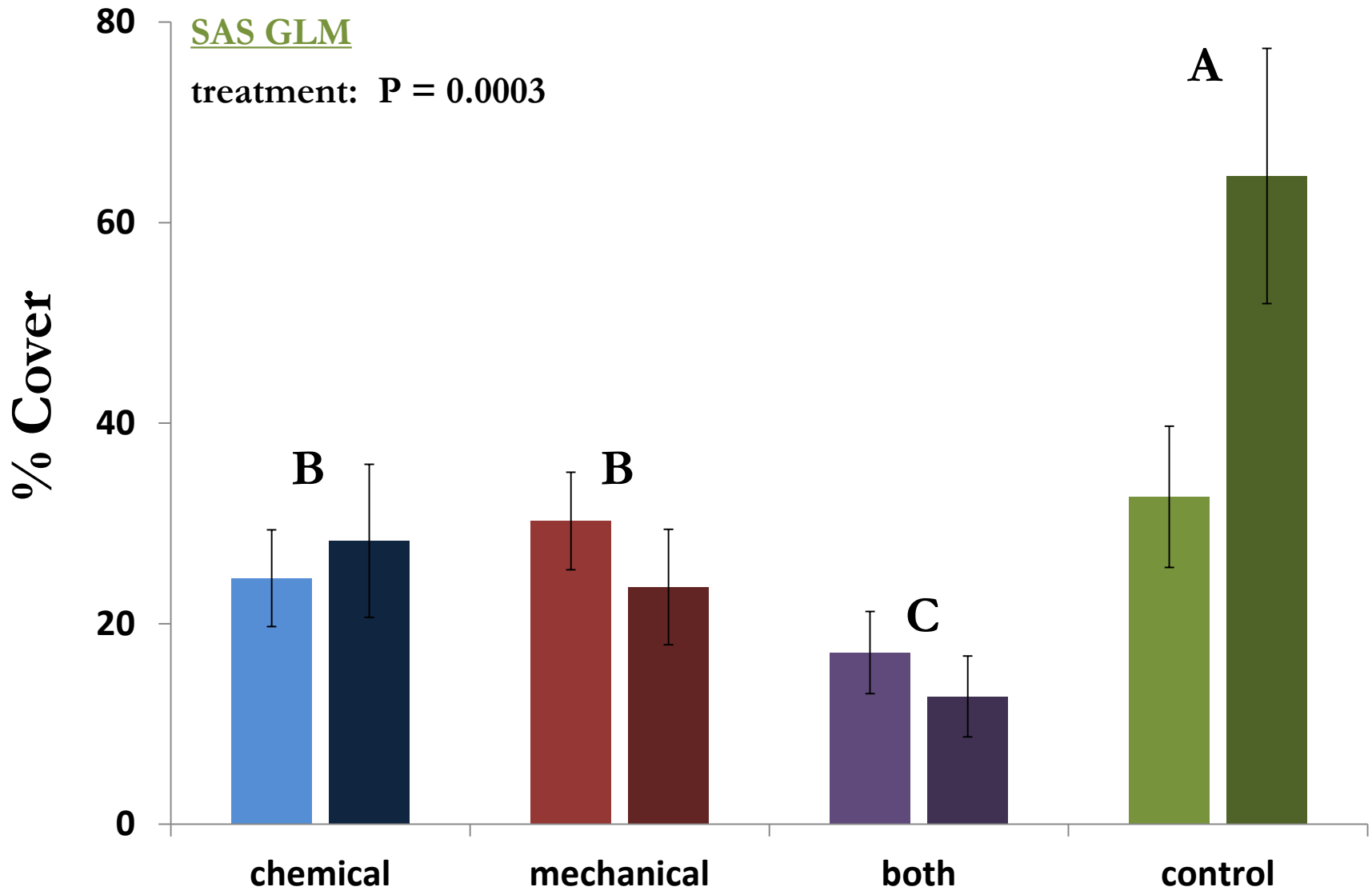


Oriental Bittersweet Removal

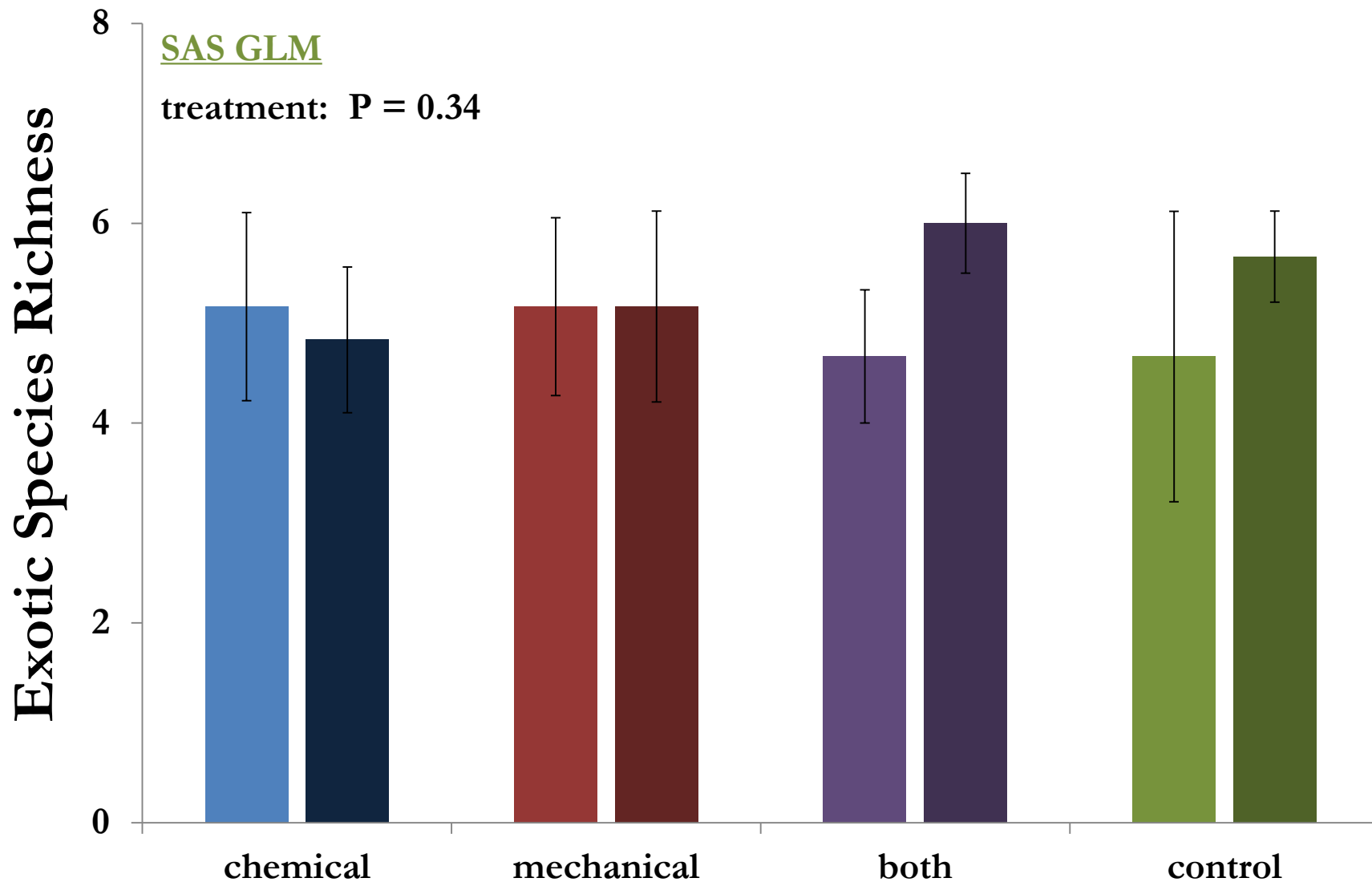
- monitored plots (beginning in 2008)
 - *summer*
 - *undergraduate research students*
 - *faculty*
 - *fall*
 - *sophomore-level classroom students*
 - *undergraduate research students*
 - *faculty*



Exotic Herbs, % Cover: Years 2, 4



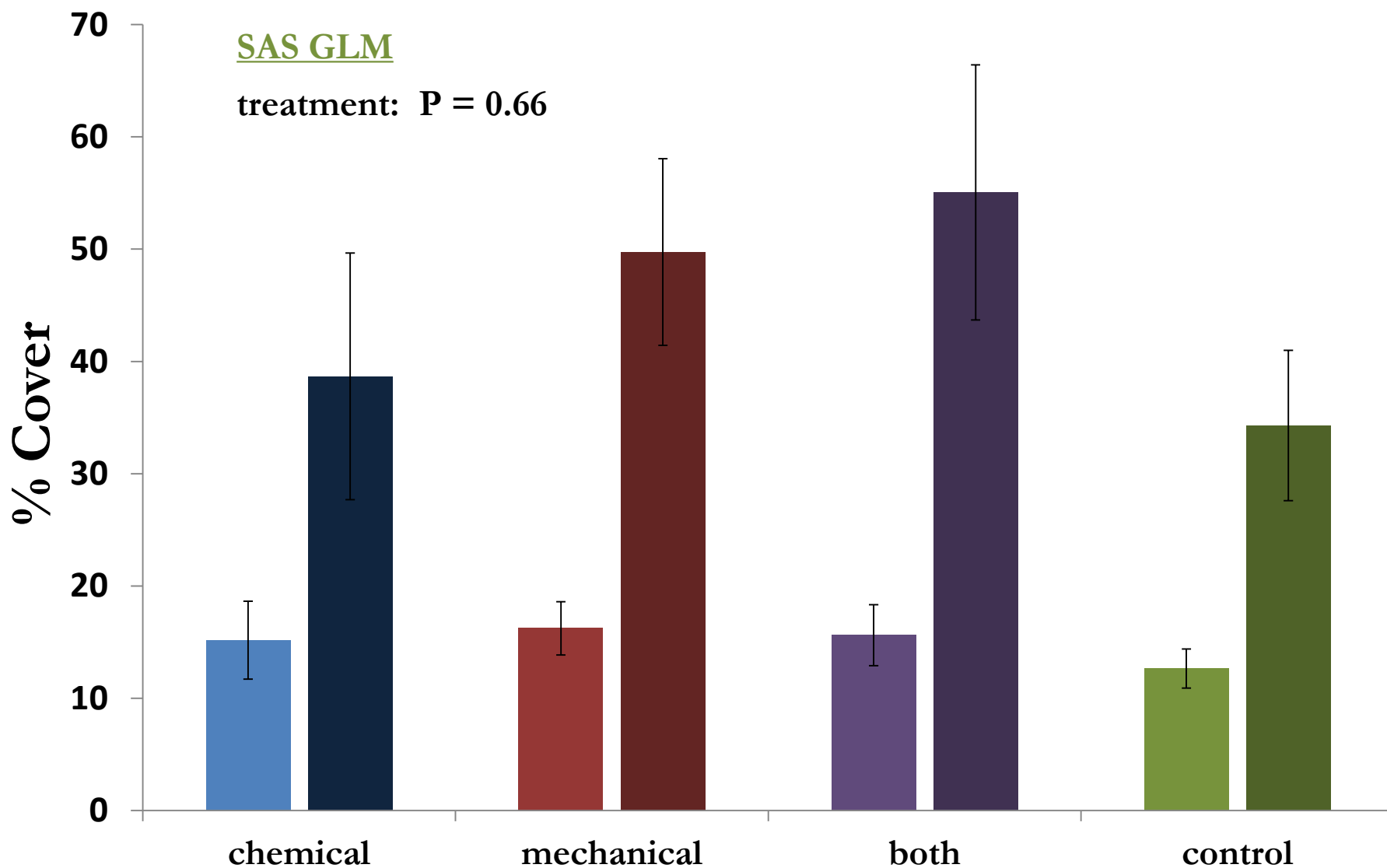
Exotic Herbs, Species Richness: Years 2, 4



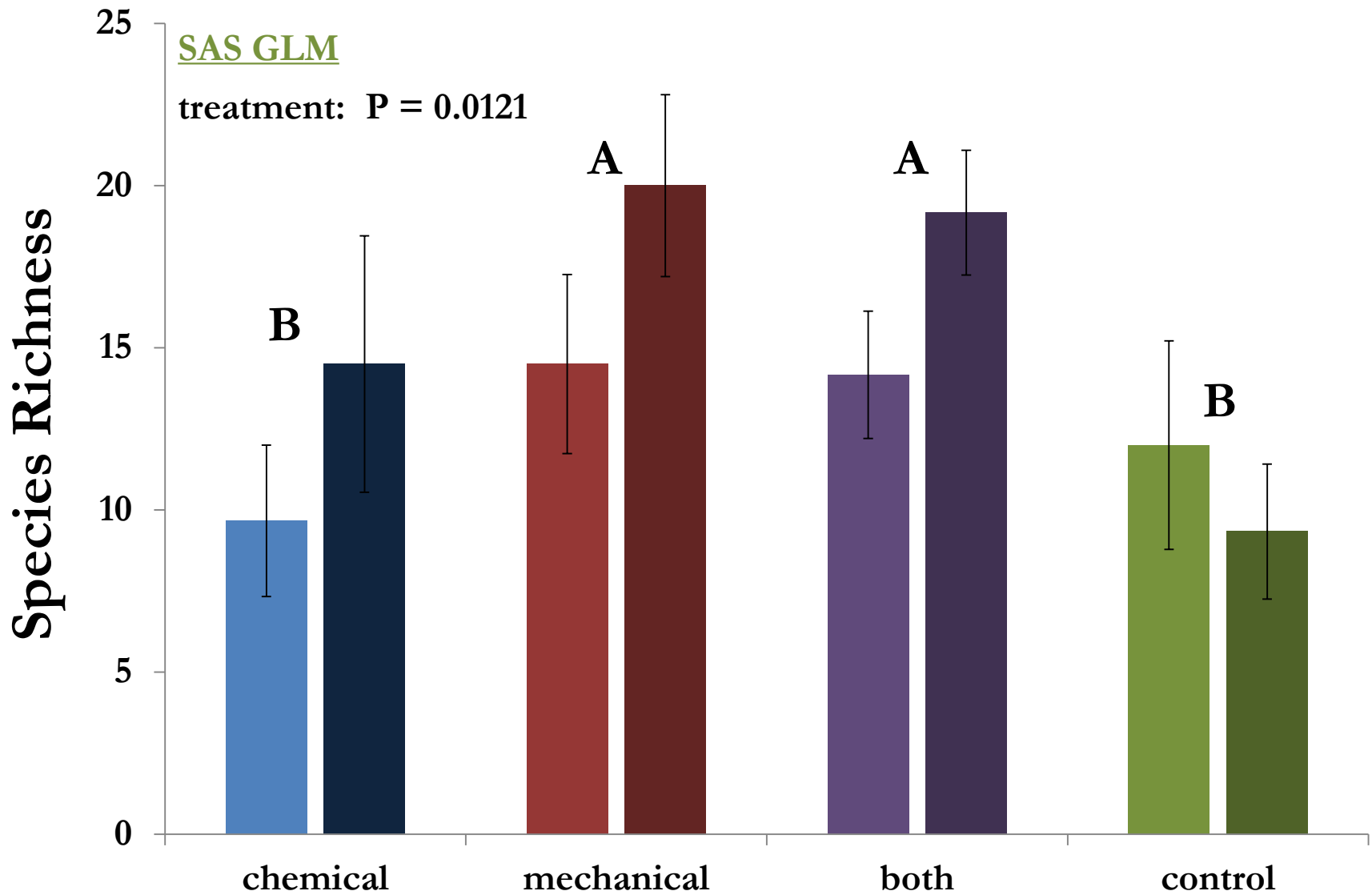
Native Herbs, % Cover: Years 2, 4

SAS GLM

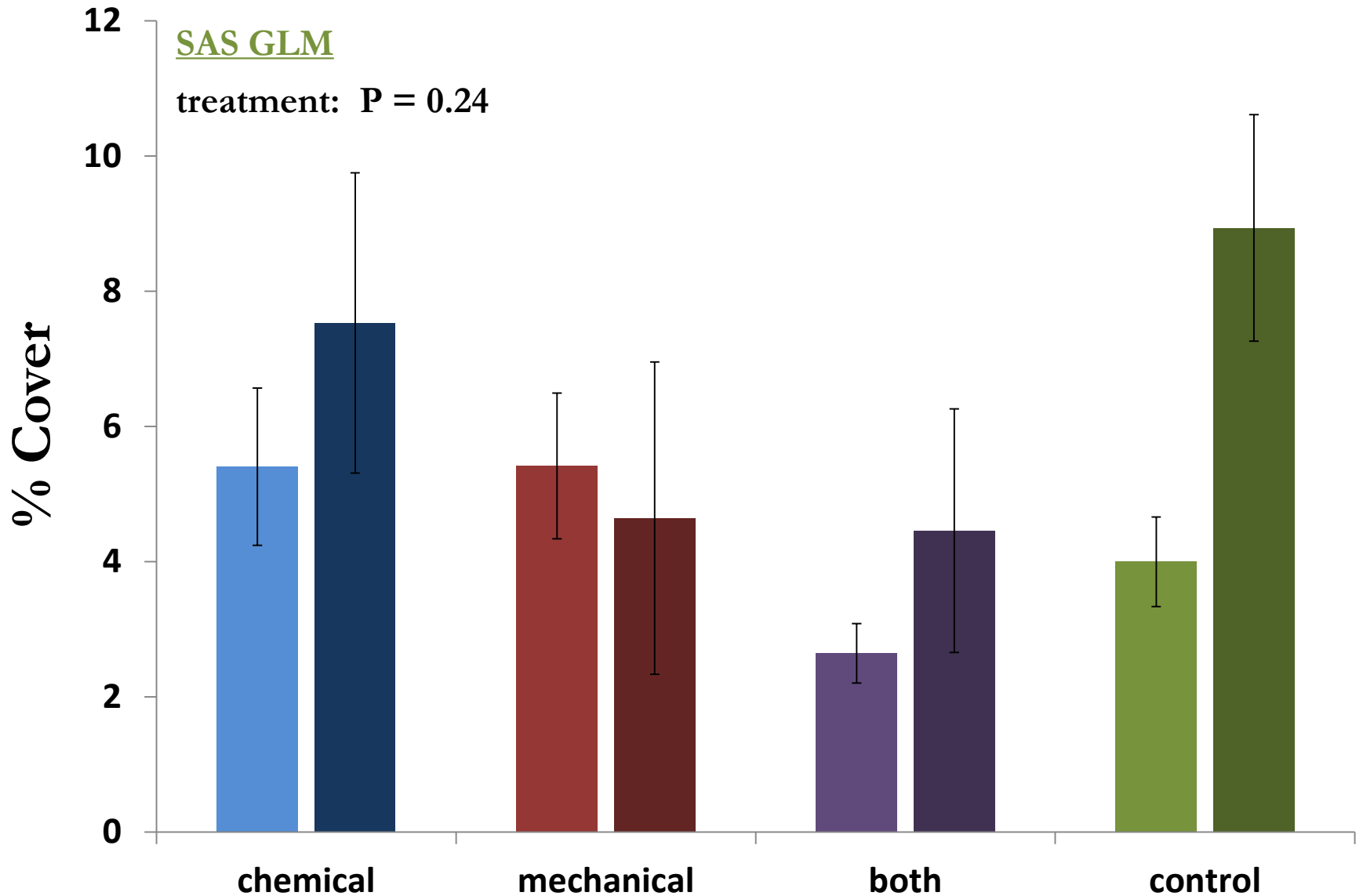
treatment: $P = 0.66$



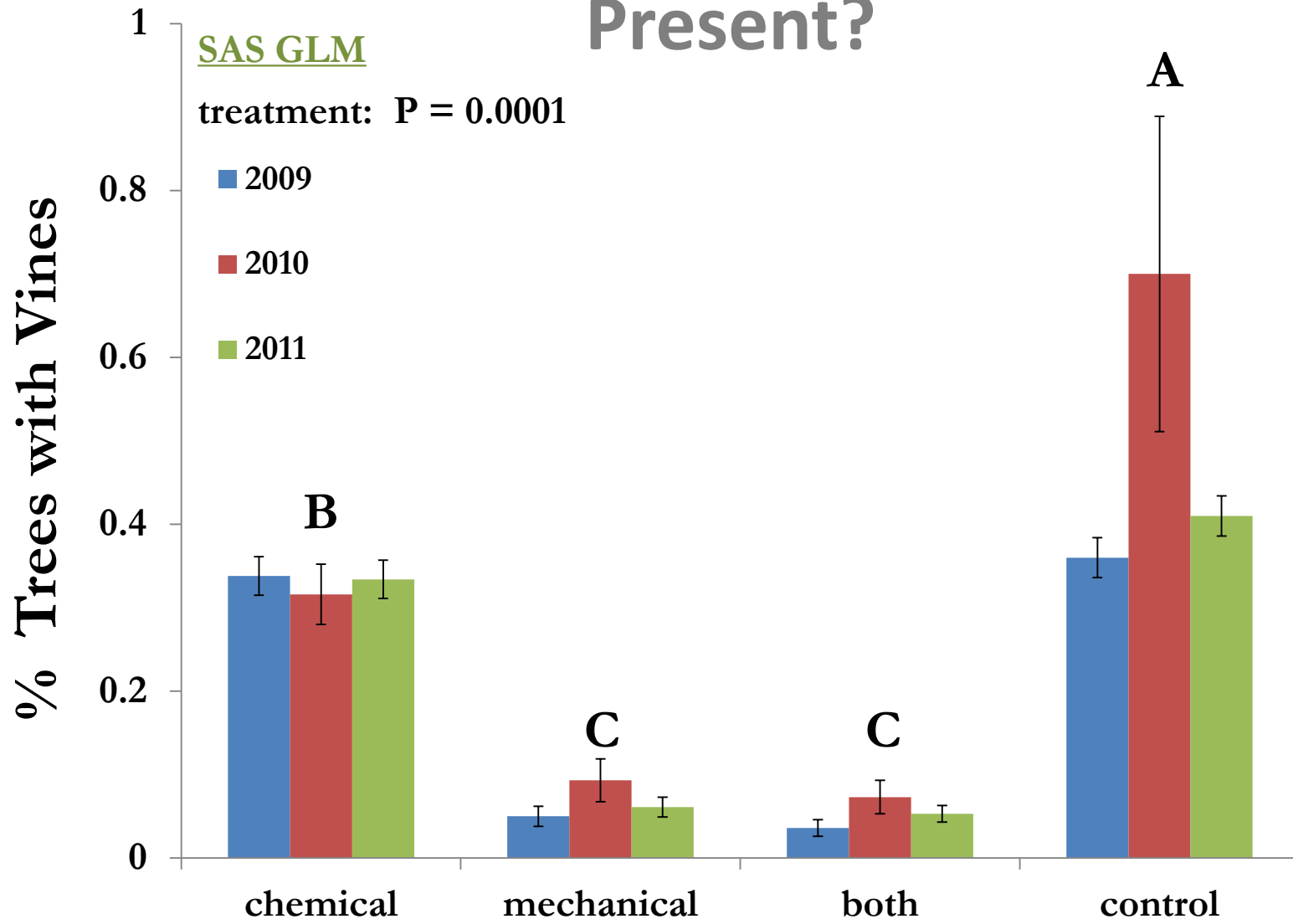
Native Herbs, Species Richness: Years 2, 4



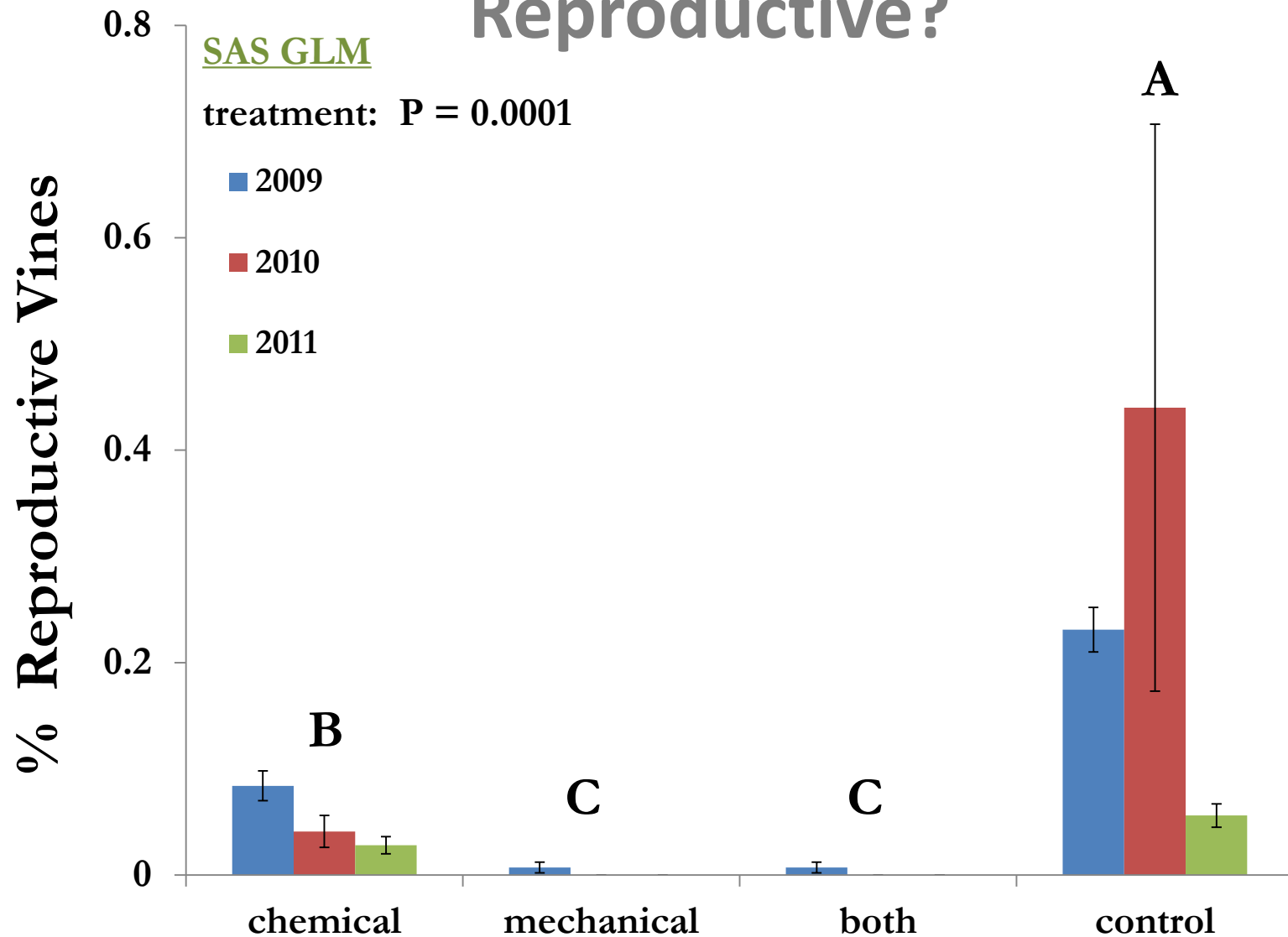
Herbaceous Oriental Bittersweet: Years 2, 4



Tree-Bound Oriental Bittersweet: Present?



Tree-Bound Oriental Bittersweet: Reproductive?



Summary of Eradication Results

- all treatments reduced % cover of exotic herbs
 - *combined treatment most effective*
 - *no treatment reduced exotic species richness*
- no treatment affected % cover of native herbs
 - *% increased over time*
 - *mechanical, combined had higher species richness*
- no treatment was effective in removing herbaceous oriental bittersweet
- mechanical, combined treatments effective in removing twining oriental bittersweet



Oriental Bittersweet Plasticity: A Predictor of Invasiveness?

- cuttings, seeds
 - *from 3 Buncombe County populations: Baldwin Gap, Chestnut Ridge, Glenn's Bald*
- grown under 3 light levels
- growth, morphology, mass, physiology, plasticity



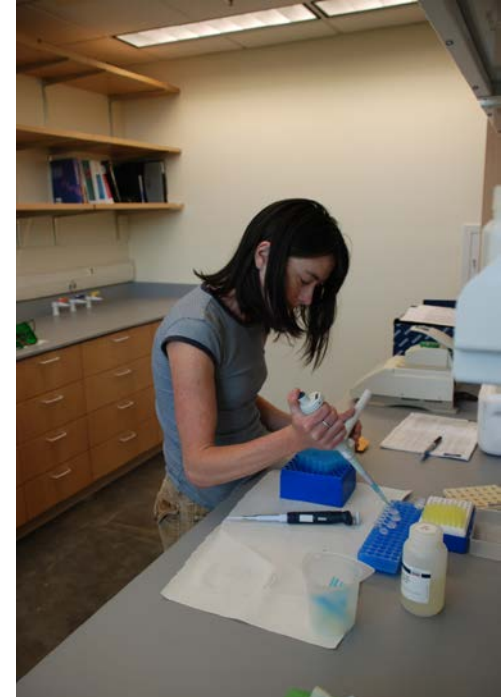
Oriental Bittersweet Performance, Plasticity

- population-level differences in leaf area, biomass, photosynthetic rates
- % germination, seedling height varied among treatments
 - *intermediate light treatment produced greatest values*
- total height was plastic
 - *most plastic in plants from Chestnut Ridge*



Oriental Bittersweet Genetics: Effects on Invasiveness?

- concentric sampling circles from Asheville, NC
- sampled every 10 km for 100 km
- 10 randomly-selected points along each circle
- leaf samples from adults, seedlings
 - *3 per point from each stage*
- DNA extracted
- 6 microsatellite loci



Overall Conclusions

- herbaceous oriental bittersweet not removed
 - *timing of removal?*
 - *propagule pressure?*
 - *seed bank*
- twining oriental bittersweet removed
 - *chemical treatments ineffective*
- populations differ in responses, plasticity
 - *faster growth, photosynthesis = more invasive?*
 - *target eradication efforts?*



Future Directions

- continue annual removal, semiannual monitoring
- additional
 - *sites*
 - *management methods*
- propagule pressure / seed bank exhaustion?
- bittersweet genetics
 - *biogeographic patterns*



Acknowledgements



- UNC Asheville botany students
- research students (2008 – present)
 - *Scott Arico, Kayla Bott, Randy Cockerell, David Greene, Jenna Hamlin, Ashley Hanes, Karissa Keen, Sam Maser, Joe McKenna, Megan Rayfield, Matt Searels, Kat Selm, Anna Sitko, Alice Smithlund, Alyssa Teat, Margot Walston, Aaron Whiting, Andrew Wilson*
- University of North Carolina at Asheville Faculty / Student Partnership
- UNCA Undergraduate Research Program
- NSF MRI (DBI-0420295)
- NSF MRI (DBI-0821062)
- NSF CCLI (DUE-0942776)



jrward@unca.edu