

Lessons learned from carbon addition experiments in the Willamette Valley

Matt A. Bahm, Denise E.L. Giles-Johnson, Erin C. Gray, and
Thomas N. Kaye



Carbon sources

- Sugar
 - Increases microbial activity
 - Effects nutrient cycling; creates nutrient deficient system
 - *Myosotis, Sonchus, Taraxacum, Valerianella, Vulpia*
- Activated carbon
 - Can inhibit plant-microbe interaction and allelopathy
 - Binding organic molecules
 - *Bromus tectorum, Centaurea diffusa*
- Biochar
 - Increase N, release P, increase pH
 - Ineffective of *Serecia lespedeza*

Background

- Other researchers have reported:
 - reduced weed growth and/or greater growth of desired species following the addition of labile carbon to the soil.¹
 - no effect of C additions on the growth of weeds or desired species.²
 - C additions reduced the growth of desired species more than that of weed species.³

¹Rashid and Reshi 2010, Mitchell and Bakker 2011, Grygiel 2012

²Kardol et al. 2008, Mangold and Sheley 2008

³Averett et al. 2004

Fern Ridge Natural Area

Purpose: To test for effects of carbon addition, in the form of sucrose, on native and invasive species abundance in upland prairies at Fern Ridge Natural Area

Big Spires



West Shore



Active restoration at both sites

Big Spires: Dominated by exotic grasses

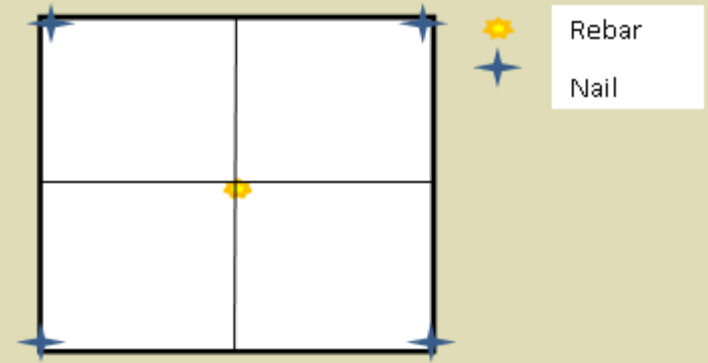
West Shore: Dominated by exotic grasses but with native forbs

Methods

Treatments:

1. Control
2. Carbon added **spring 2012** only
3. Carbon added **spring 2012 + fall 2012**
4. Carbon added **spring 2012 + fall 2012 + spring 2013**

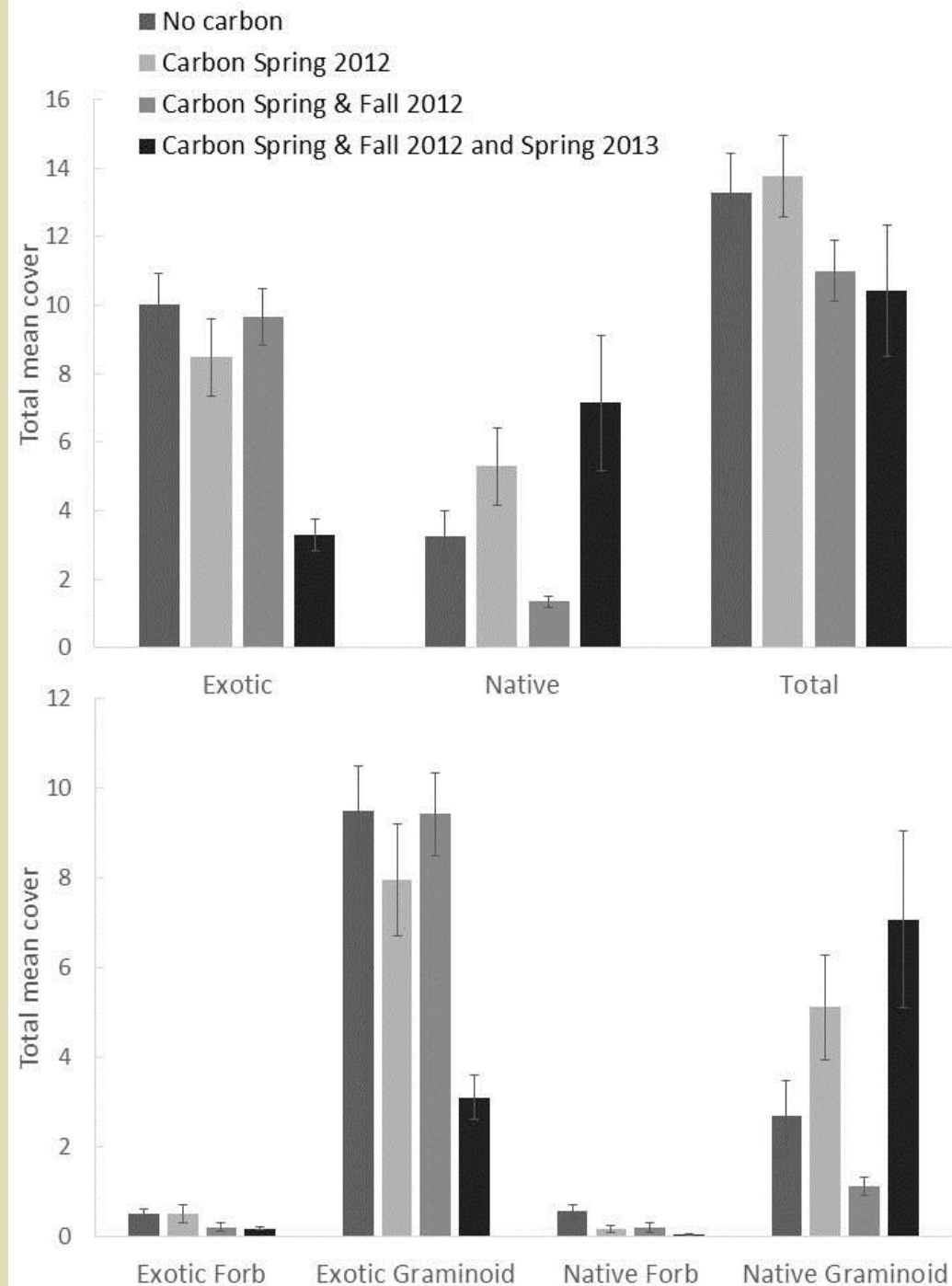
Applied 4 lb (1.81 kg per m²) sucrose to each randomly selected treatment plot



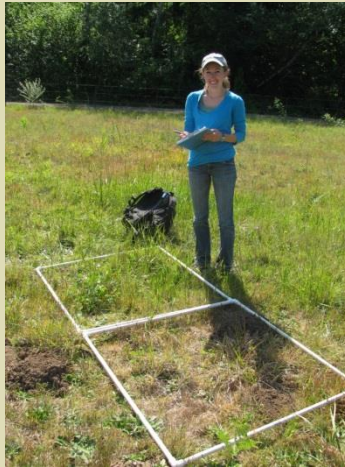
Big Spires: Graminoid dominated with higher cover of exotics

Results

- Decrease in total mean exotic cover ($P = 0.03$)
- Increase in total mean native cover (3 treatments)
- Exotic graminoid cover declined with 3 treatments
- Native graminoid cover higher with 3 treatments

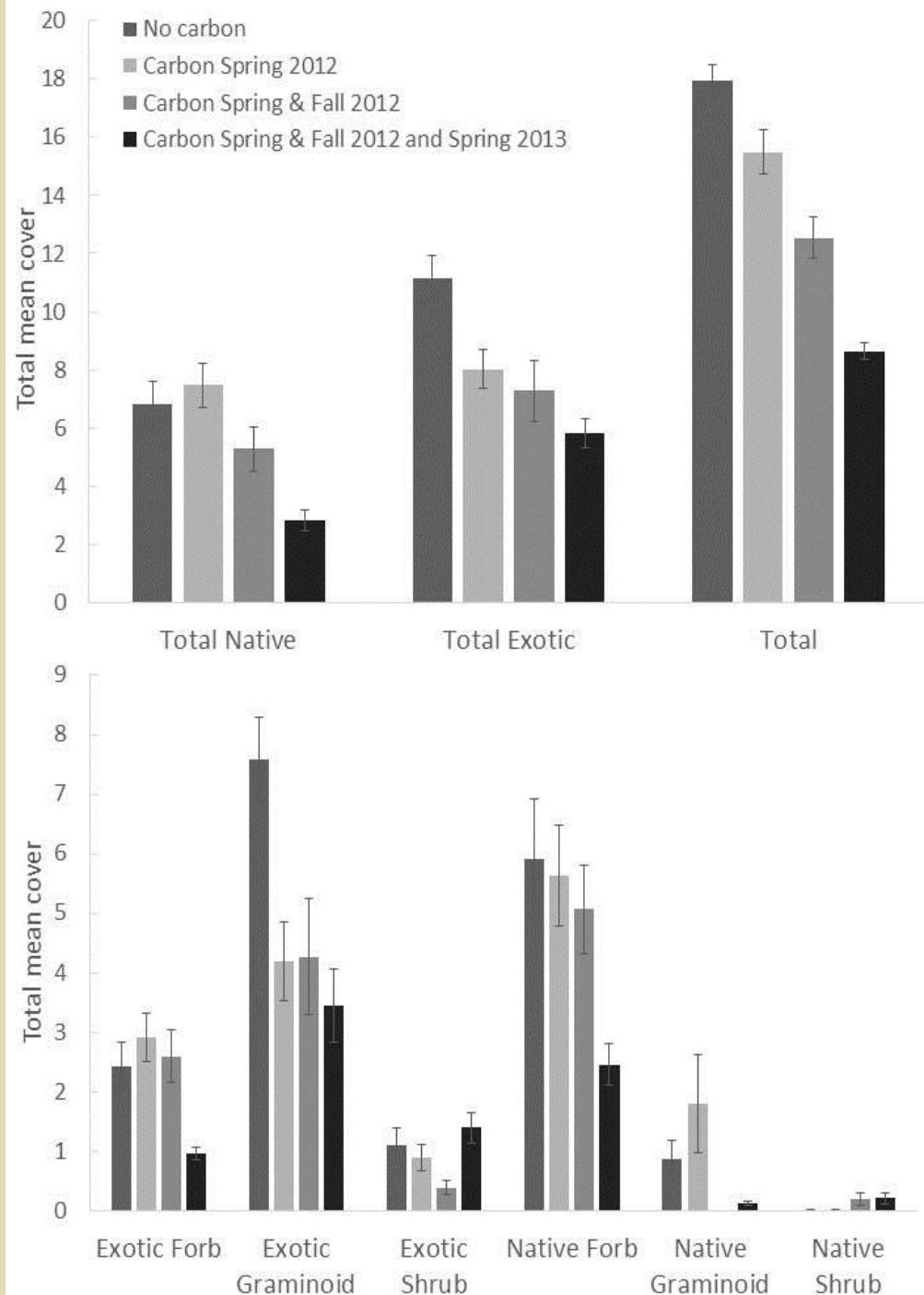


West Shore: Dominated by exotic grasses but native forbs



Results

- Decrease in total native, total exotic, and total cover ($P = 0.02, 0.001, 0.03$, respectively)
- Fewer carbon treatments might be more effective for maintaining native forb cover



Willamette daisy research

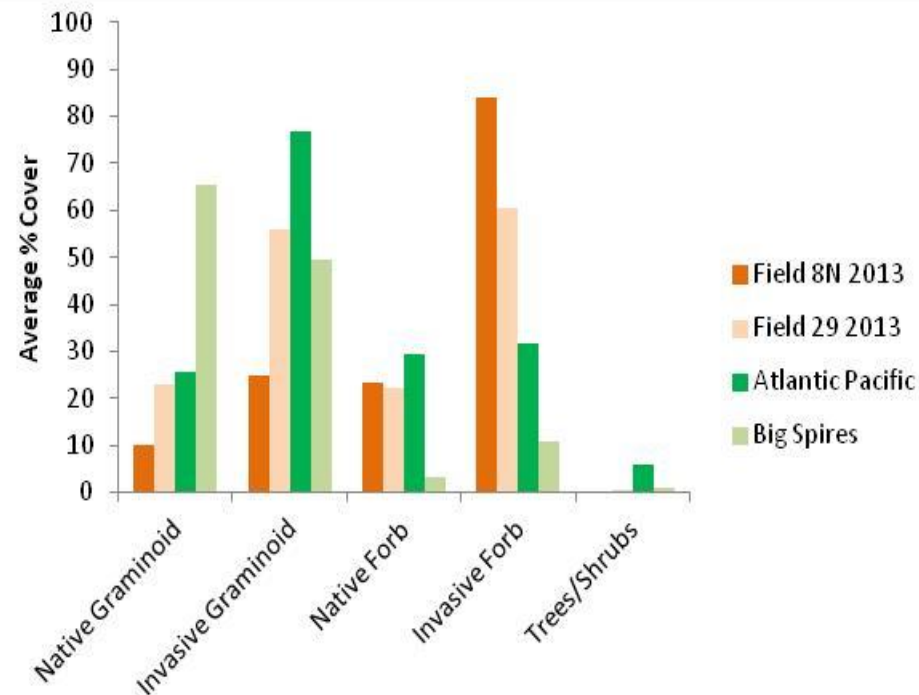
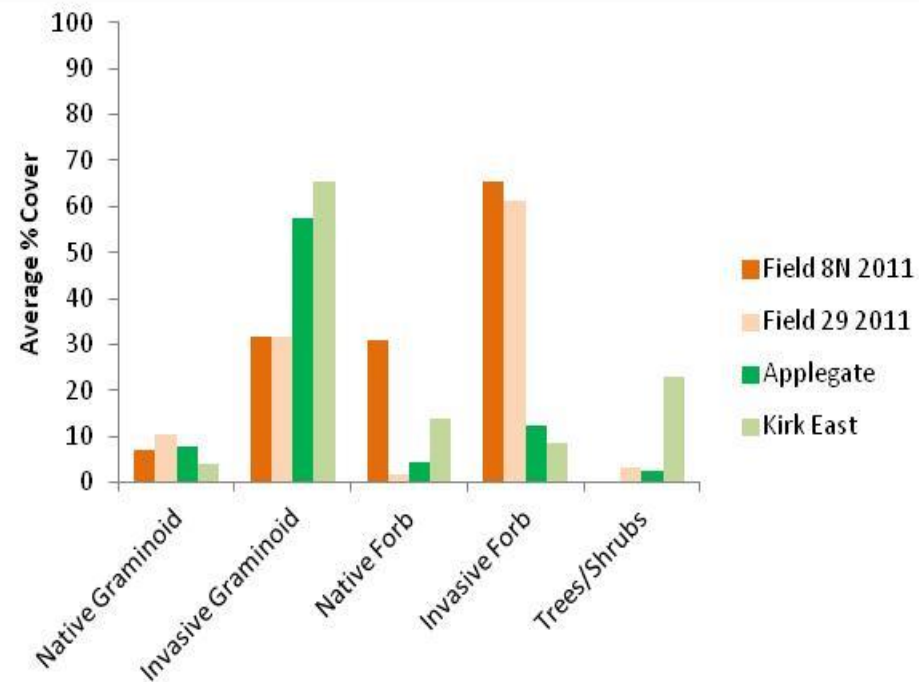
Purpose: To test for effects of management actions on Willamette daisy and plant community in Willamette Valley

- Willamette daisy outplanted in 2011 and 2013
 - Established before treated
 - Monitored survival, growth, reproduction
- Habitat management treatments tested include:
 - Mowing
 - Prescribed fire + glyphosate
 - Glyphosate only (Finley only)
 - Sheep grazing (Fern Ridge only)
 - Grass-specific herbicide (Fusilade)
 - Carbon addition



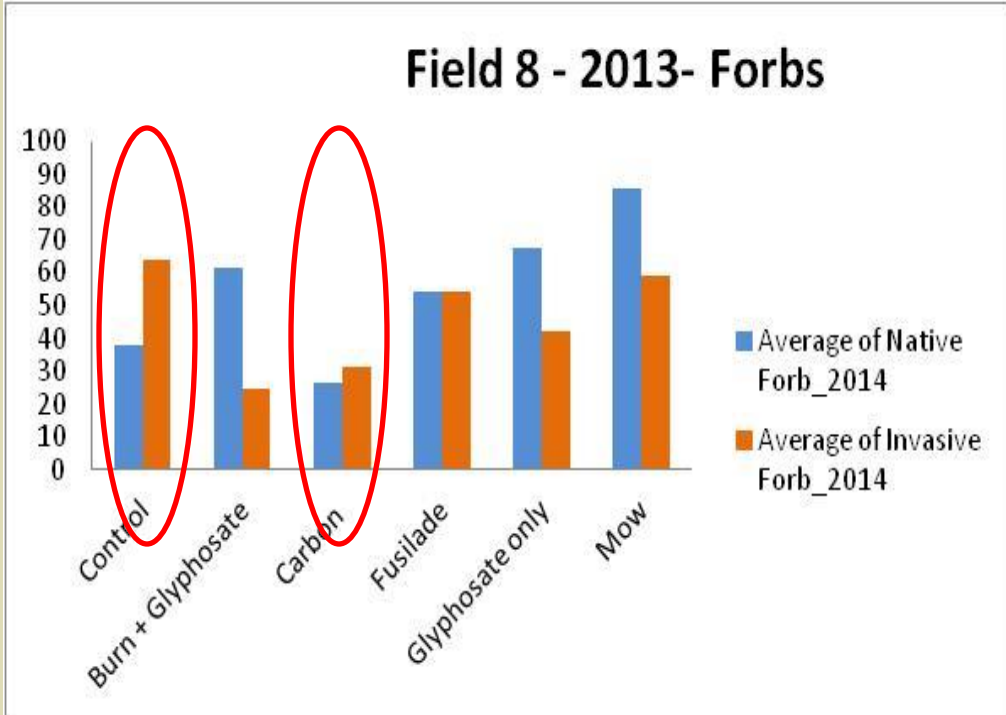
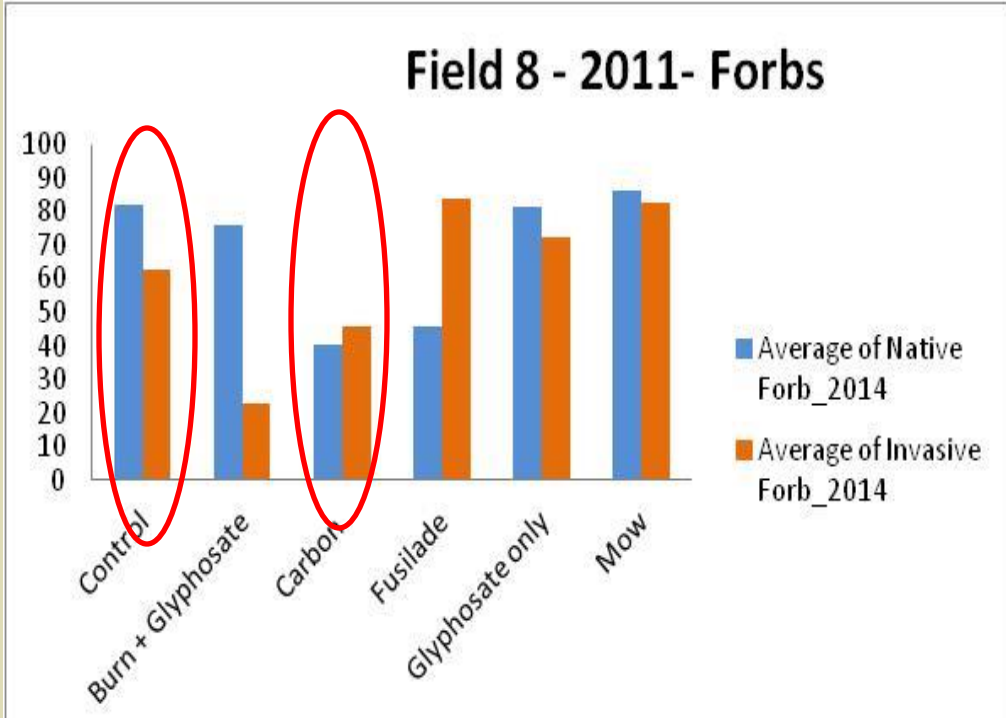
Community

- High variability in plant community
- Carbon treatments in 2012 and 2014
- Field 8N and 29
 - Findley NWR
 - High invasive forb cover
 - Moderate invasive grass cover
 - Moderate native grass and forb cover (except 29 in 2011)



Field 8N

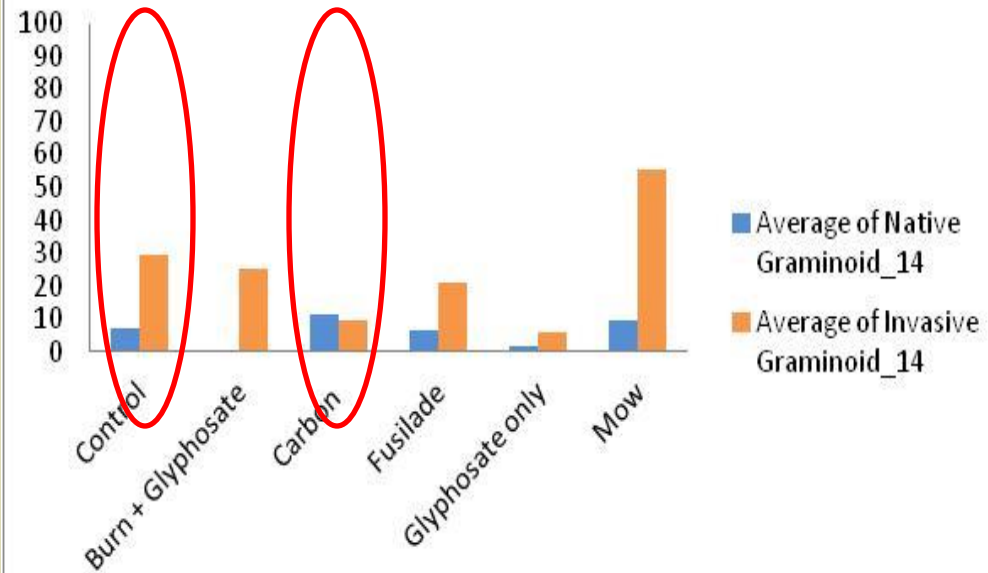
- 2011
 - Decreased forbs compared to control
- 2013
 - Native forbs similar to control
 - Decrease invasive forbs



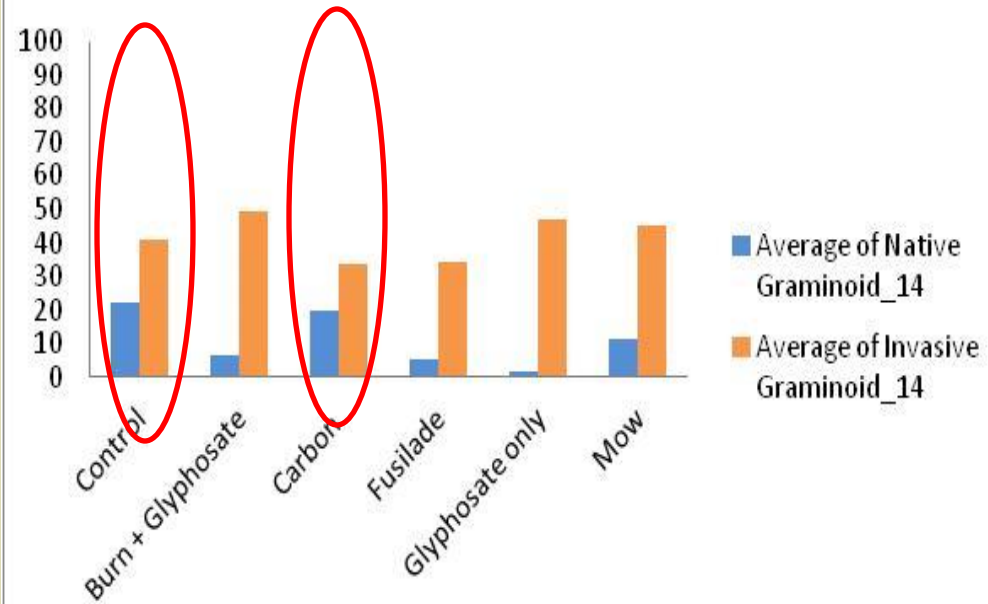
Field 8N

- Variable between years
- 2011
 - Decreased invasive grass cover compared to control
- 2013
 - No difference

Field 8 - 2011 - Graminoid



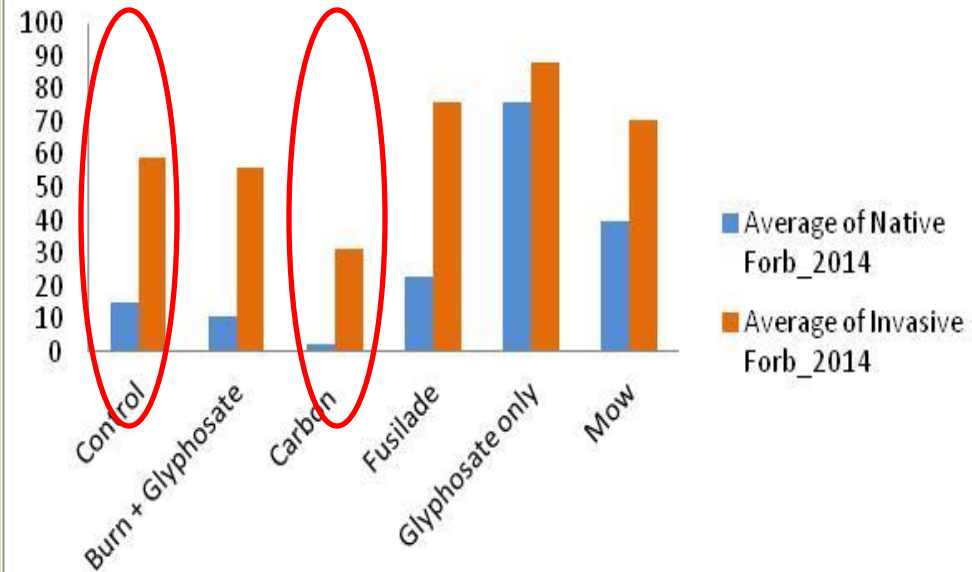
Field 8 - 2013 - Graminoid



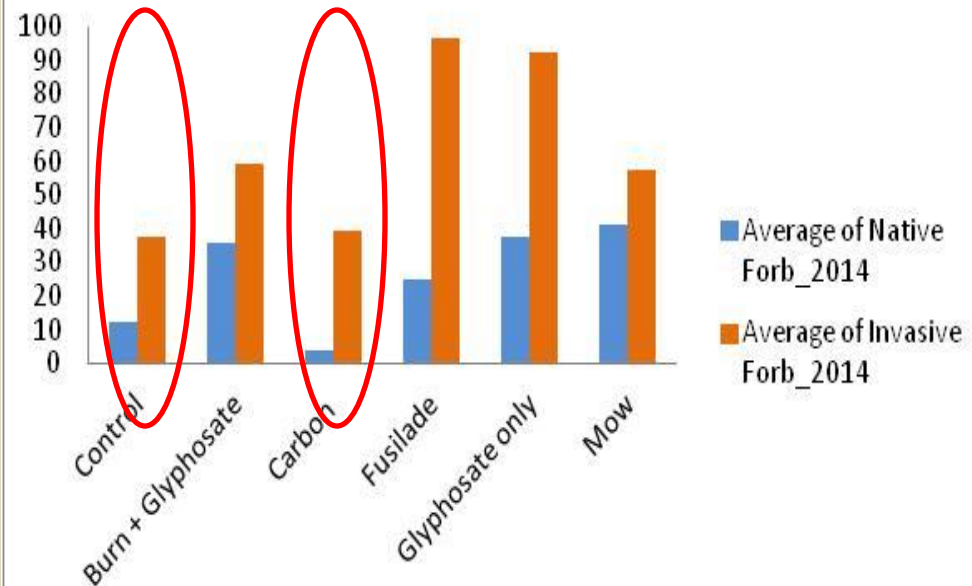
Field 29

- Variable between years
- 2011
 - Lower invasive forbs than control
- 2013
 - Similar to control

Field 29 - 2011- Forbs



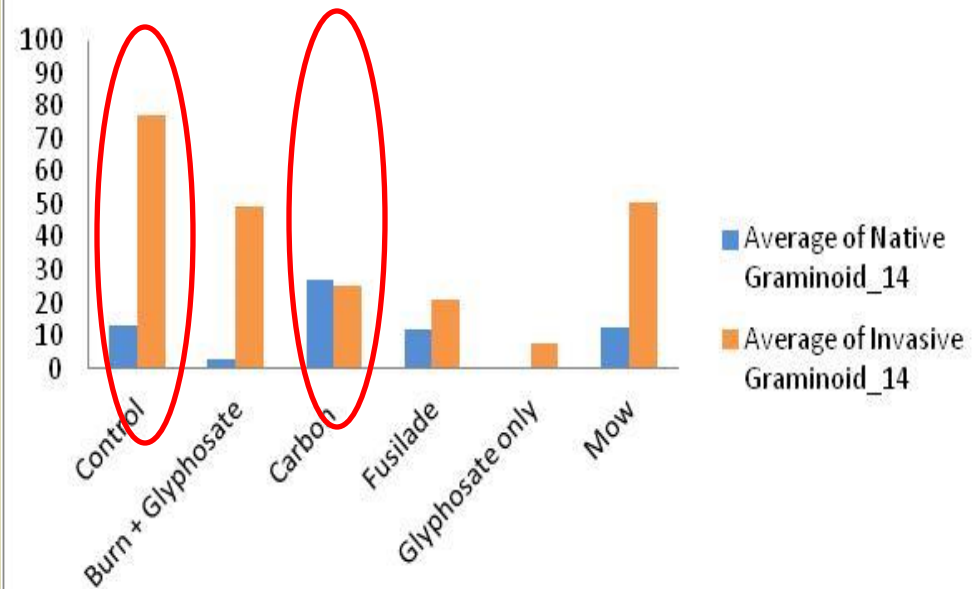
Field 29 - 2013- Forbs



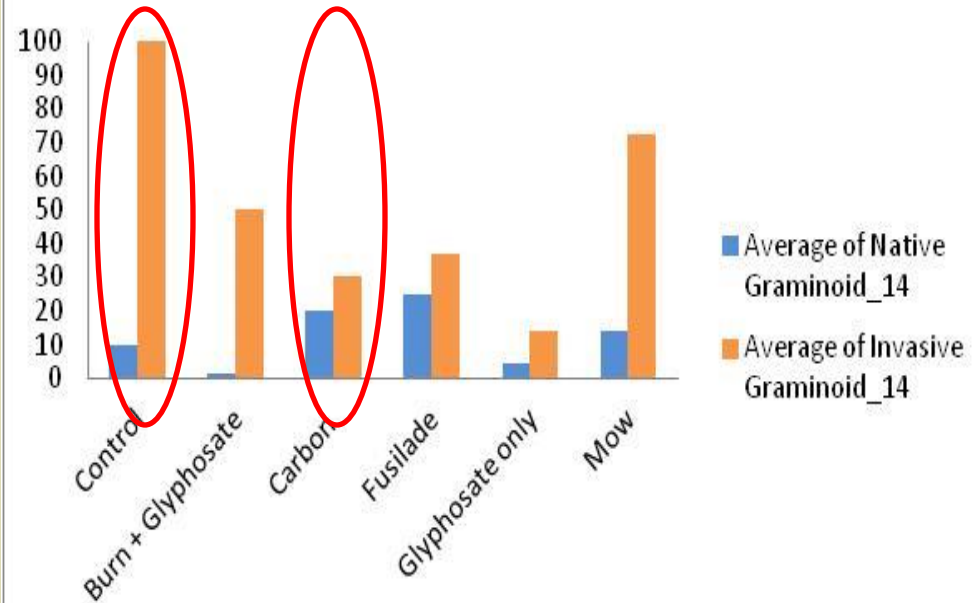
Field 29

- 2011 and 2013
 - Decrease in invasive grasses compared to control
 - Higher native grass cover than several treatments

Field 29 - 2011 - Graminoid



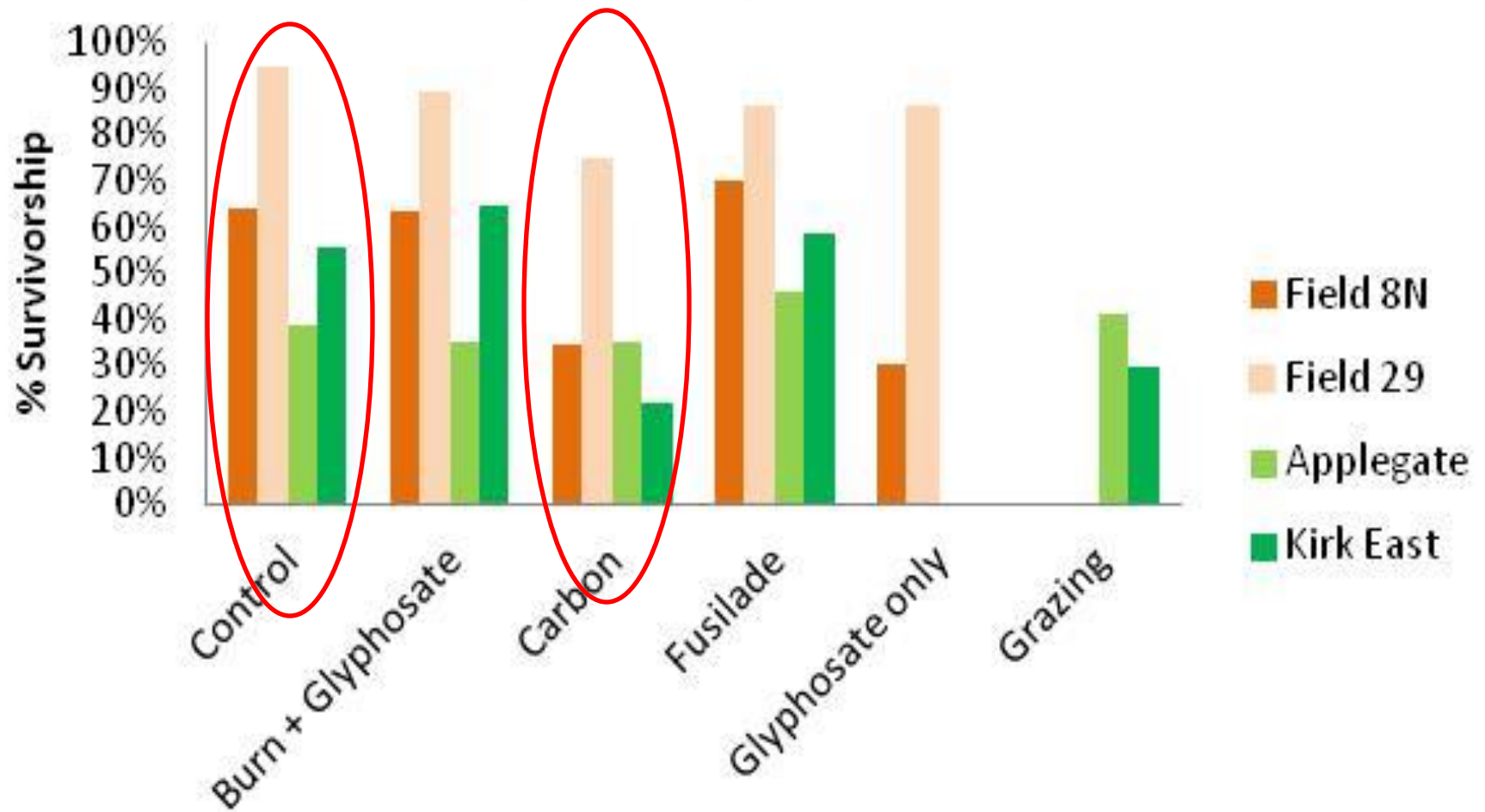
Field 29 - 2013 - Graminoid





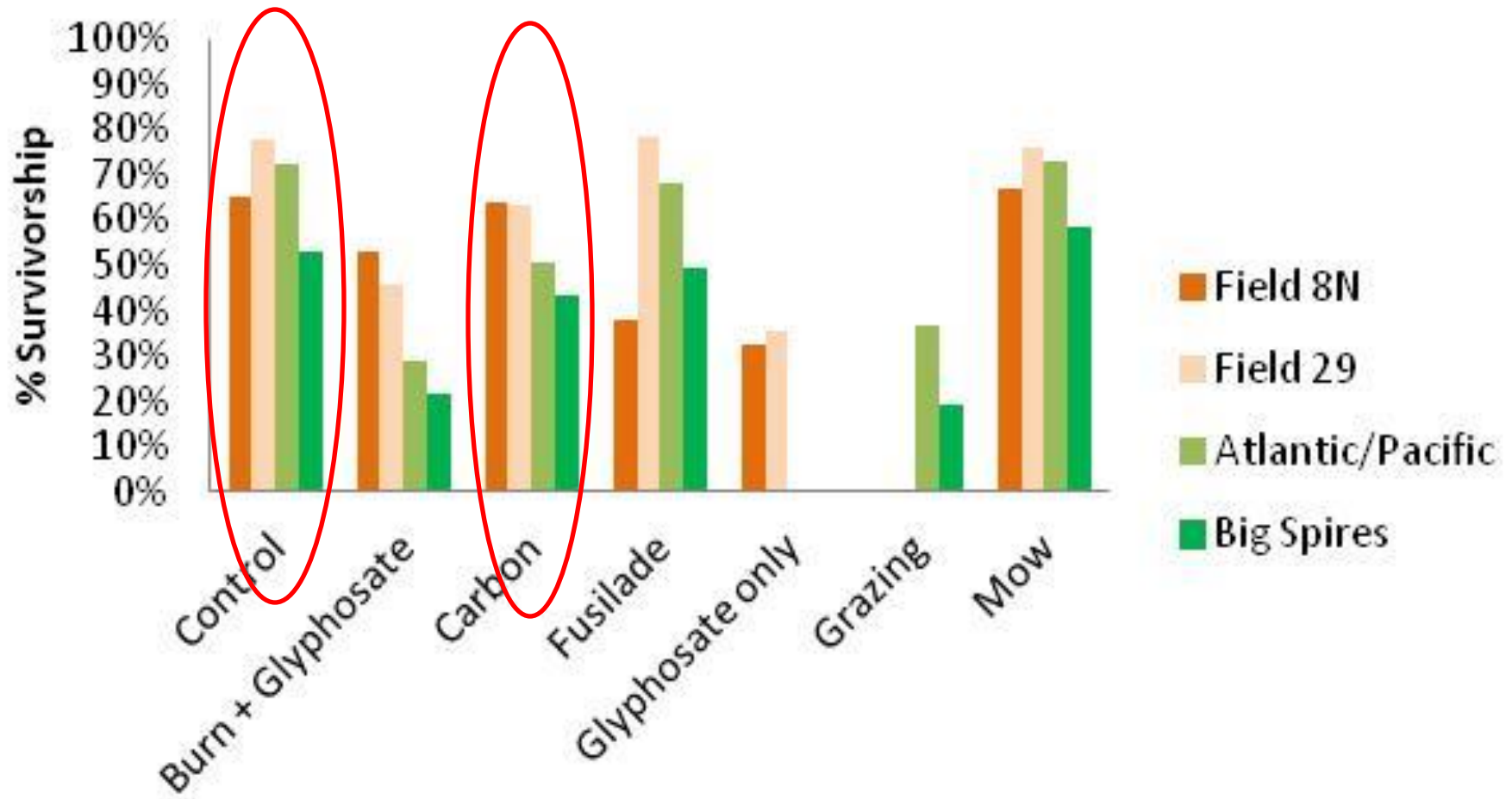
Willamette daisy

2011 Outplanting - Survivorship



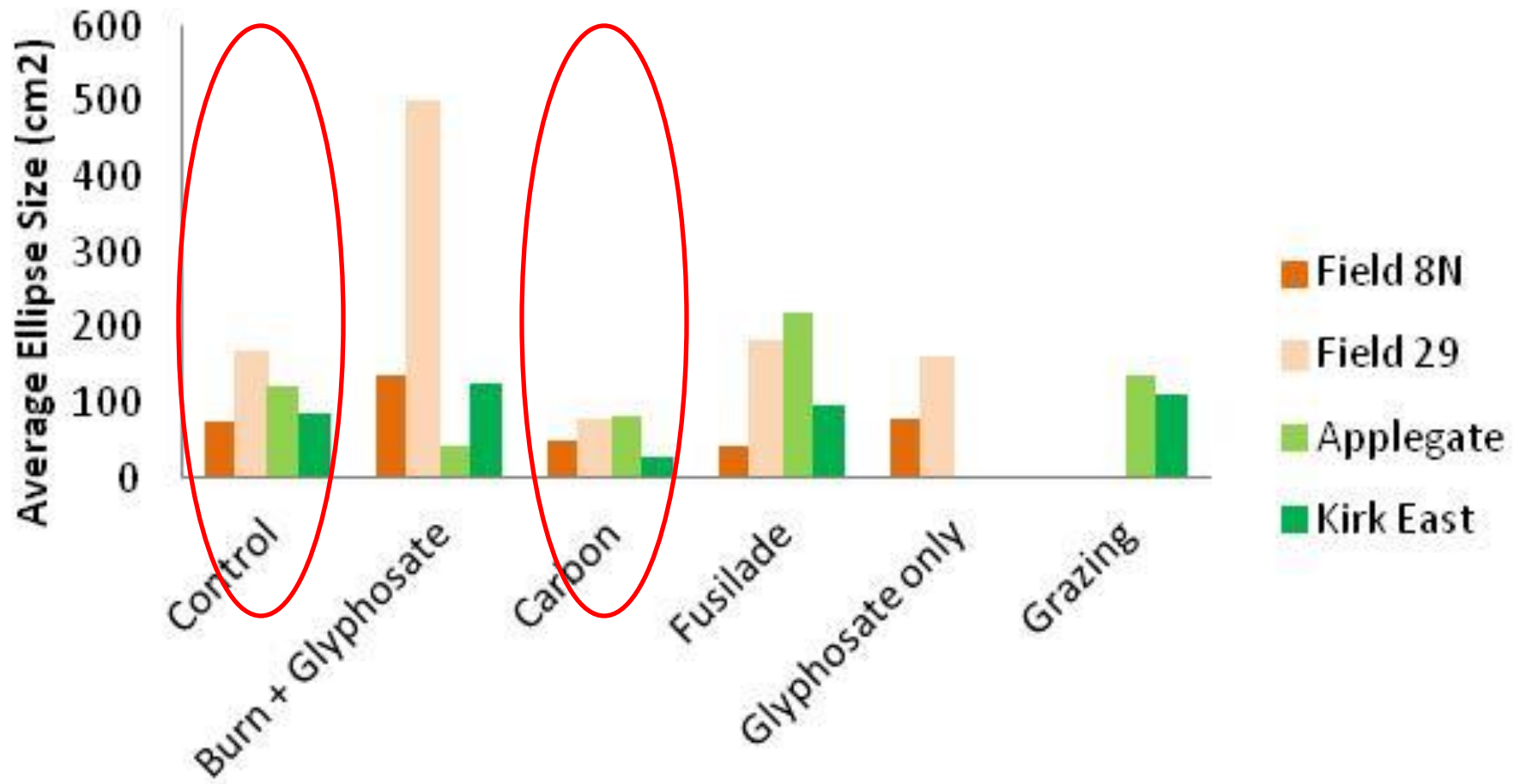
Willamette daisy

2013 Planting - Survivorship

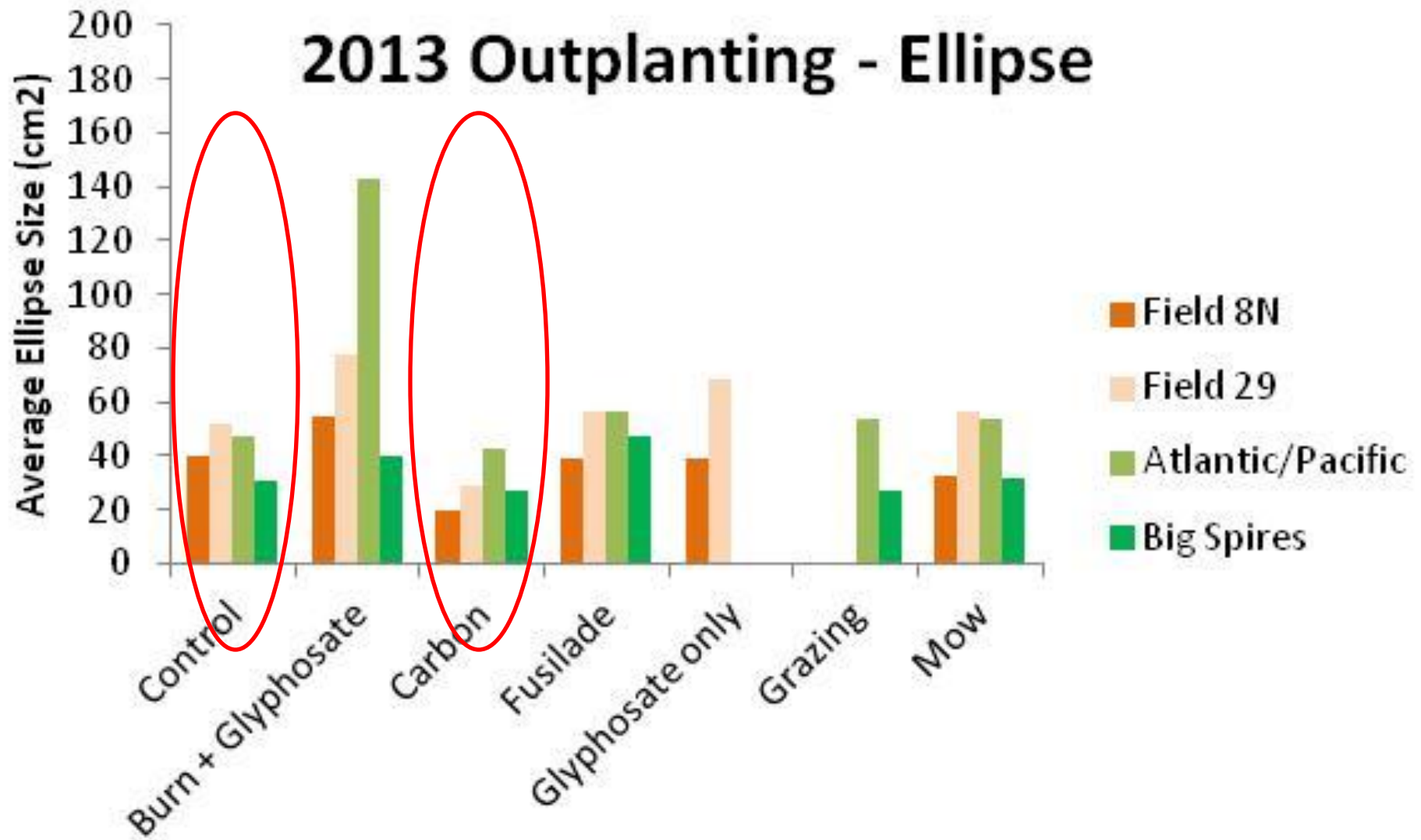


Willamette daisy

2011 Outplanting - Ellipse



Willamette Daisy



Conclusions???

- Little selectivity
 - Similar to broad spectrum herbicide, but less “collateral” damage
- Carbon addition (sucrose) tends to decrease plant cover
- Results differ by site/year
- Useful tool where other methods aren't possible
 - Minimal damage to Willamette daisy

Future Directions

- More sites, with variable plant composition
 - Possible tease apart differences?
 - Work showing minimal effect on *Agrostis*
- Seeding with carbon addition
- How feasible is it to treat with carbon?
 - Issues with large scale treatment

Acknowledgements

- Fern Ridge NWR
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