Ecophysiological evidence for superior soil water acquisition in Centaurea maculosa compared to competing rangeland grasses

Judson Hill¹, Matthew Germino¹, Jon Wraith², Bret Olson²
Idaho State University¹; Montana State University²
Research Objectives

• Why is *C. maculosa* (CEMA) such a successful invader?
• Do the photosynthetic and water relation properties of CEMA differ from its co-occurring species?
• Does CEMA differ in its resource use and acquisition?
Pseudoregneria spicata (Bluebunch wheatgrass)

Agropyron smithii (Western wheatgrass)

Centaurea maculosa (Knapweed)

Bromus inermis (Smooth brome)

http://plants.usda.gov/
http://www.usask.ca/agriculture/plantsci/classes/range/pseudoregneria.html
Greenhouse Photosynthesis

Photosynthesis (μmol CO₂ m⁻² s⁻¹)

- CEMA (sk)
- AGSM (ww)
- PSSP (bb)

Dry, Mesic, Wet conditions.
Greenhouse Water Use Efficiency

Water Use Efficiency (μmol CO₂/mmol H₂O)

- CEMA (sk)
- AGSM (ww)
- PSSP (bb)

[Graph showing water use efficiency for different conditions and treatments]
Midday Photosynthesis of Naturally Occurring Plants

Helena

Leverich

Photosynthesis (μmol CO₂ m⁻² s⁻¹)

- CEMA (sk)
- PSSP (bb)
- BRIN (sb)

Jun   Jul   Aug           Jun     Jul  Aug           Jun     Jul   Aug
Midday Water Use Efficiency of Naturally Occurring Plants

![Graph showing water use efficiency for Helena and Leverich locations over June, July, and August of 2002 and 2003.]
Predawn and Afternoon Water Potential ($\Psi$)

- CEMA (sk)
- BRIN (sb)
- PSSP (bb)
Diurnal Change in Water Potential ($\Psi$)

- CEMA
- PSSP
- BRIN
- RUHI

Daily % Change in Water Potential ($\Psi$)
Summary

- **Greenhouse**
  - CEMA did not have greater $A$ or WUE

- **Field**
  - CEMA had greater $A$ and stomatal conductance, therefore greater transpiration
  - CEMA better able to sustain $\Psi$

- *Must be pulling more moisture from soil.....How?*

Sperber et al. 2003
Possible Cause of Success for *C. maculosa*

- Photosynthesis of CEMA was enhanced by greater soil water extraction
  - Maintains $\Psi$ throughout the day

- High water acquisition, and flexibility in WUE, allows increased carbon assimilation throughout the growth season

- Lower water availability for competitors, along with increased $A$, may lead to the increased ecological success of *C. maculosa*
  - *Research possible through grants from USDA/NRI and NASA*