When should rain fall?

How the timing of large storms impacts arid grasslands

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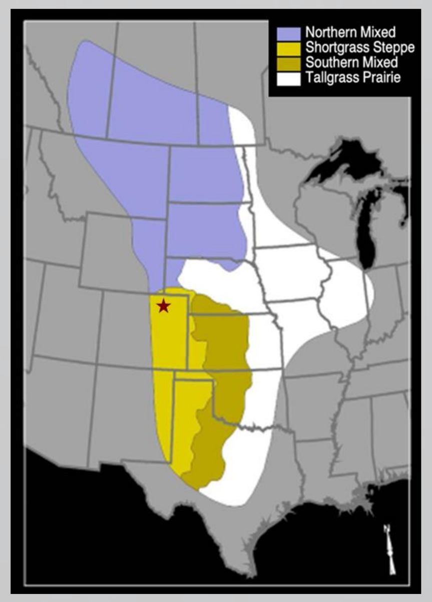
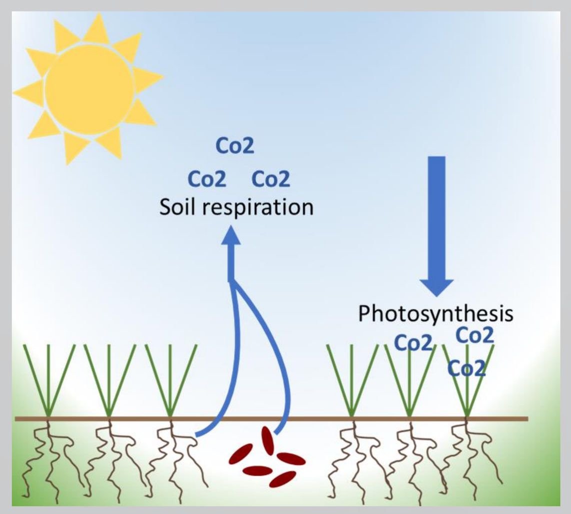
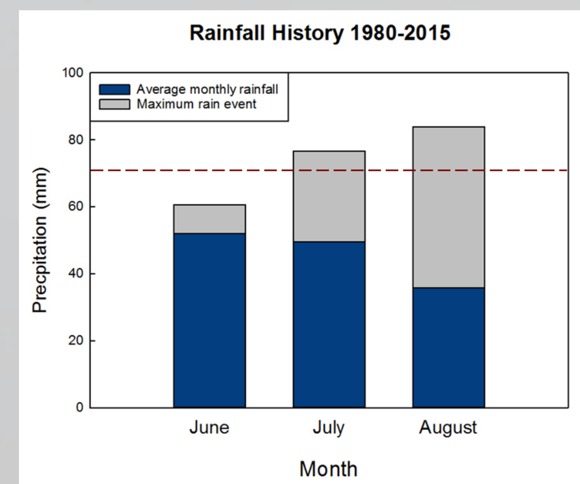
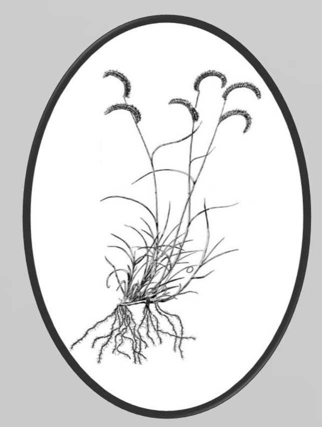
Introduction







- Climate models predict an increase in large rainstorms for Eastern Colorado
- The shortgrass prairie is a large carbon "sink"= removes CO^2 from air
- **Objective:** Determine how the timing of large rain events affects carbon cycling in the shortgrass prairie
  - When does a large rainstorm promote the most carbon storage?



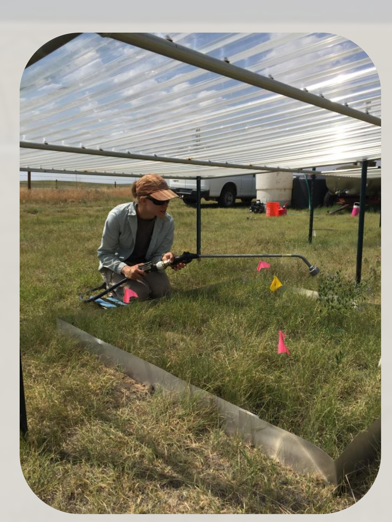
Blue Grama
(Bouteloua gracilis)

Methods

Watering Treatments:

3 Treatments
Add rain either:
June
July
August

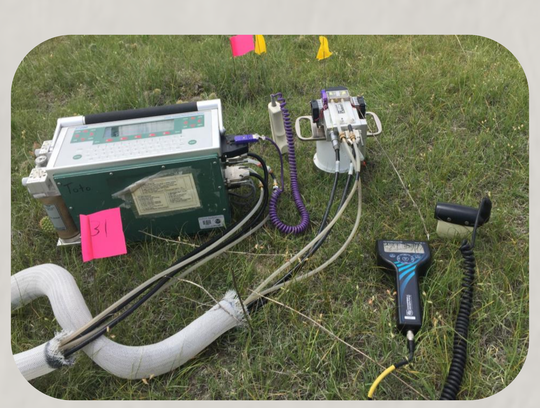
1. Erect roofs to block ambient rainfall



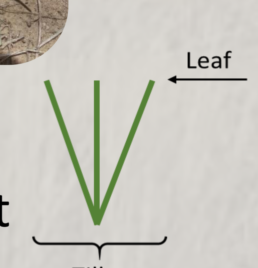
2. Apply large rain event (70 mm over 3 days)

3. After 10-12 days, remove roofs to allow ambient rainfall

Measurements:



1. Measure soil moisture & soil respiration

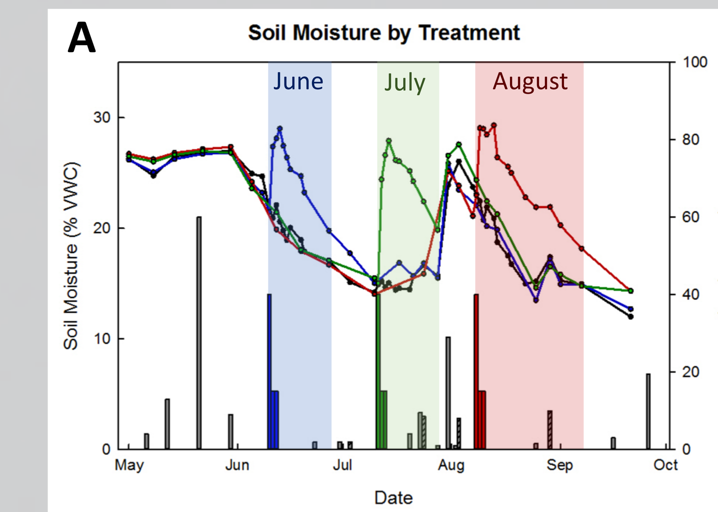


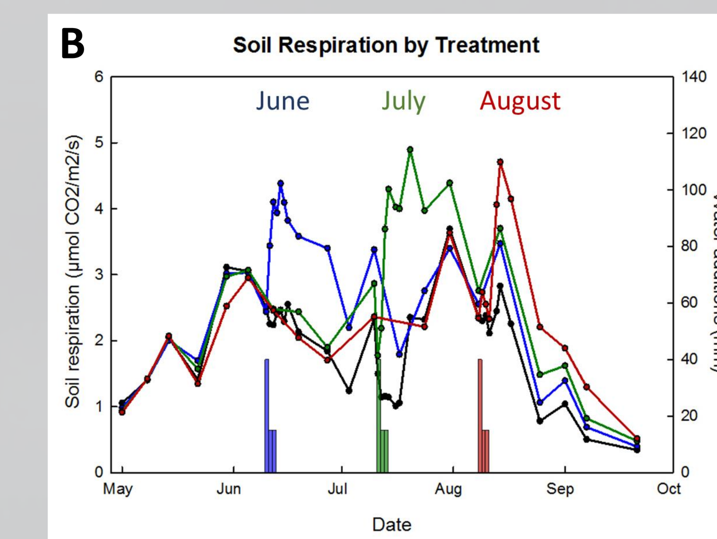
2. Measure Blue Grama tiller height

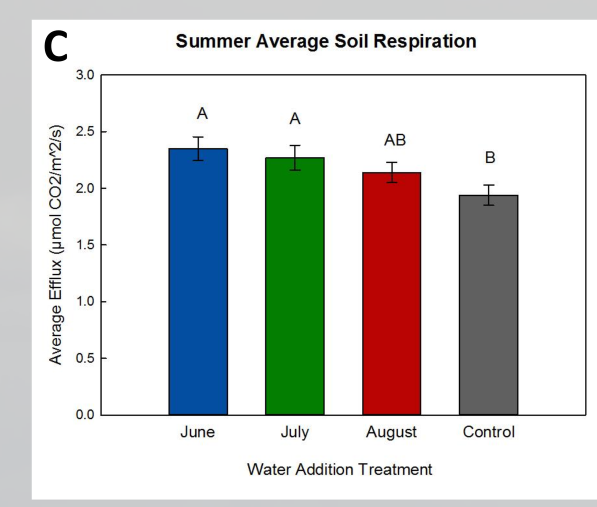
3. Count Blue Grama seedheads

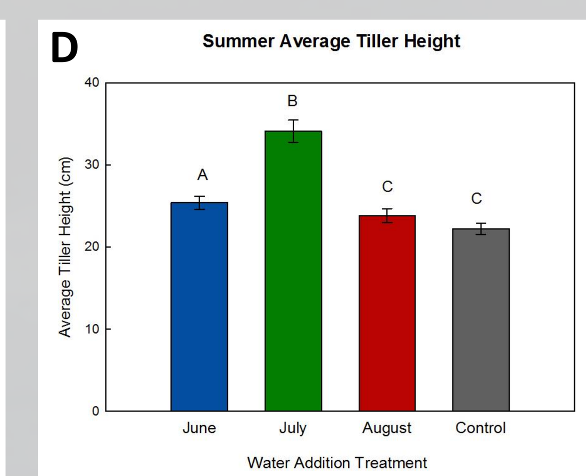
Results

- Watering treatments significantly increased soil moisture for an extended period of time (A)
- Soil respiration closely tracked soil moisture (B)
- Average summer soil respiration was the same across treatments (C)
- Blue Grama tiller height increased the most with July rainfall, increased slightly with June rainfall, and showed no increase with August rainfall (D)
- Ratio of tiller height / soil respiration shows that only July rainfall increased relative carbon uptake (E)
- July rainfall caused the most seedhead production (F)



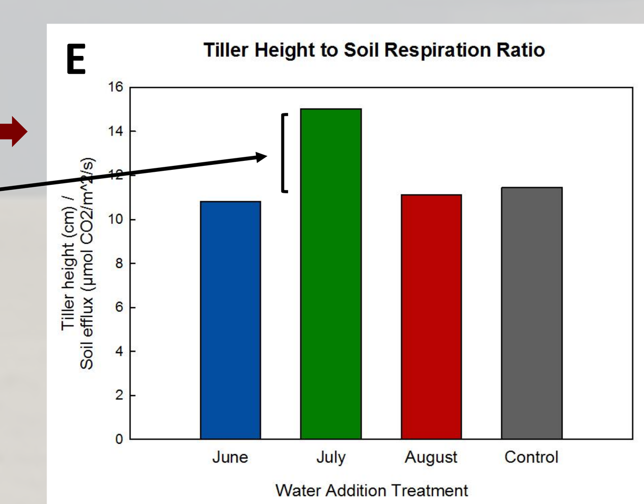


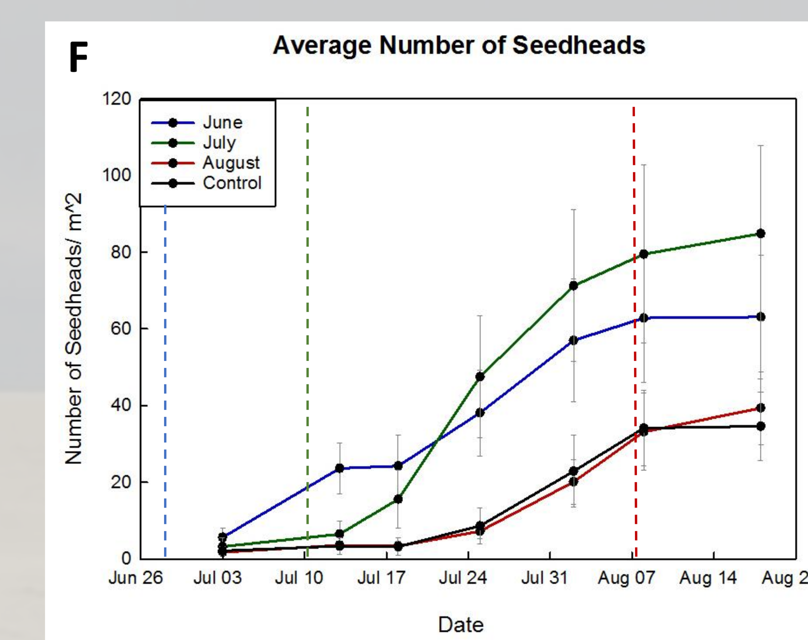




4-5 cm more growth/µmol of CO^2 released

$\frac{CO^2 \text{ uptake}}{CO^2 \text{ release}}$





Conclusions

- Soil respiration responded the same no matter when large rain events occurred (same amount of CO^2 release), but Blue Grama grew the most with July rainfall (taller tillers = more photosynthesis = more CO^2 uptake).
- **July rainfall caused the most relative carbon uptake.**
- Seedhead production indicates that Blue Grama had sufficient carbon reserves to allocate towards reproductive structures.

Implications

- **Mid-summer rainstorms are most beneficial to grass growth and carbon uptake in the shortgrass prairie.**
- This knowledge can help ranchers predict forage availability for their livestock based on rainfall patterns.