FACT SHEET:

Rainfall **M**anipulation **P**lot**s** (RaMPs)

Purpose of the Research:

Experimentally manipulate rainfall amounts to simulate conditions predicted by global climate change models and evaluate plant and soil responses to these manipulations.

Background:

- Constructed in 1998
- Built to allow experimental manipulation of rainfall amounts and timing of the rain events to simulate predicted climate changes for tallgrass prairie.
- Climate change models predict:
  - Warmer temperatures (= increased water stress on plants)
  - Fewer, but more intense rainfall events
  - More frequent and severe growing season droughts and fewer storms with heavier rainfall
- 12 “rainout shelters” created from modified greenhouse structures (30’ x 46’) covered with 6 mil, UV-transparent polyethylene greenhouse film. Plastic installed in April and removed in October.
- There are 6 shelters that are assigned an “**altered rainfall timing treatment**” and 6 shelters with ambient (control) rainfall timing.
- The native prairie plots under all shelters receive the same amount of rain as the prairie outside. The difference in the altered timing treatment is that the **growing season rain is repackaged to create longer dry periods between natural rain events (prolonged growing season droughts) and larger rain events when they occur (fewer but larger rain events without changing in total growing season rainfall amounts).**
- Specifically – the rain is applied at an interval that is 50% longer than the actual interval between natural rain events. E.g. If the natural rain interval was 14 days between events, the altered timing shelters wouldn’t have any rain for 21 days.

- To control the amount of rain the vegetation receives the rain is collected in gutters along the sides of the plastic roofs. The rain drains into the large black drums (capacity = 2,200 gallons) on the end of the plot. This water is then reapplied over the vegetation at the specific intervals dictated by the two treatments.
- Areas under each frame are designated for specific measurements, e.g: soil and plant biomass sampling ("destructive sampling") and plant species composition sampling ("non-destructive sampling").

Hypotheses:

- Alterations in the timing of rain events, amounts of water in each event, and the depth of soil moisture with the altered rainfall timing will trigger a broad range of responses in plans and soil processes.
- Roots will be stimulated to grow deeper into the substrate and soil microbial processes will be altered.
- Plant species found in the treated area will change to species more capable of tolerating longer dry periods.
- Invasive species may thrive with the **pulses of water and nutrients**.

Results-to-Date:

- The altered rainfall treatment plots showed lowered plant growth – lowered "annual net primary product (ANPP)". The plants produce 11-22% less plant material under altered rainfall timing.
- There was a lower release of CO_2 from the soil in the treatment plots – this means there is a lower level of bacterial and fungal action (less decomposition) and less growth of the plant roots
- Although changes in the plant community were relatively small, there were changes in the genetic composition of the dominant grasses (Big Bluestem and Indiangrass) within 10 years, with fewer and more different genotypes in the altered rainfall timing treatment.

Next Steps:

- Starting in 2014, all shelters (both treatments) are being exposed to a two-year severe drought, followed by a year of normal rainfall and recovery. This will allow researchers to understand how the effects of long-term climate changes alter the sensitivity of grasslands to more extreme droughts, and their ability to recover from drought.

Note: From 2003 – 2013 the shelters included plots heated with infrared lamps to study effects of elevated temperatures. The heaters were removed in 2013 because: heating effects were relatively minor and mostly linked to changes in water stress, and the cost incurred to run the heaters was prohibitively high.