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Plant-Soil Microbiome Feedback Impacts on Native and Non-native Grasses Throughout Kansas

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History of Old World Bluestem :
Beginning in 1917, a group of perennial warm-season bunchgrasses collectively called Old World Bluestems (OWBs) were introduced from the countries of Europe, Asia, Russia, and Australia. These grasses were brought in to reduce soil erosion and increase hay and forage production, as they can produce up to four times more biomass than native grasses. However, the forage quality of OWBs is reduced as the plant matures and must therefore be harvested prior to maturation. Furthermore, OWBs have become problematic in the southern and central Great Plains, invading and then dominating native warm-season rangelands causing a reduction in ecosystem services.

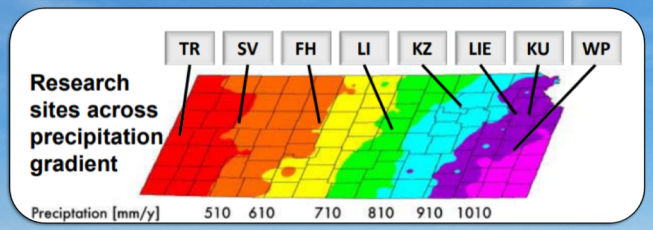

Fig. 1 Kansas is shown with the gradient of average annual precipitation in mm. Proposed study sites Tribune (TR), Smoky Valley Ranch (SV), Konza Prairie (KZ), The Land Institute (LI), the Land Institute-East (LIE), KU Field Station (KU), and Welda Prairie (WP) are denoted with their respective acronyms.

Study Design:
Soil samples will be taken from several locations across the precipitation gradient in Kansas. The core sites will consist of Fort Hays State University, Konza Prairie, and Welda Prairie. We will also be collecting samples at satellite sites which may include Tribune, The Land Institute, the Land Institute-East, the KU Field Station, Smoky Valley Ranch, and private lands. Samples will be collected beginning in August of 2018. Soil samples will be collected from below monospecific stands of the two invasive species yellow bluestem (*Bothriochloa ishaemum*) and Caucasian bluestem (*Bothriochloa bladhii*), as well as below the two native species little bluestem (*Schizachyrium scoparium*), and big bluestem (*Andropogon gerardii*).

Genetic data will be extracted from non-animal soil microbial communities. This will include small subunit ribosomal (SSU) ITS region of DNA for fungi, bacterial 16S rRNA, and algal chloroplast DNA. Data will be analyzed for variation using an ANOVA. Variation of richness and community structure will be analyzed between the grass species and across the precipitation gradient.

Microbes and Plant Growth:
Several studies have shown the importance of soil microorganisms in regulating plant growth, reproduction, diversity, and population and community dynamics. These microbe mediators include organisms such as arbuscular mycorrhizal fungi (AMF), nematodes, and bacteria. These organisms can act as facilitators by increasing soil mineral solubilization, nitrogen fixation, and increased access to other soil resources. They can also inhibit plants by being parasitic or pathogenic. It has been shown that some organisms, such as AMF, can act as ecosystem regulators in native systems by promoting the growth of some plants while inhibiting the growth of others through plant-soil feedbacks.

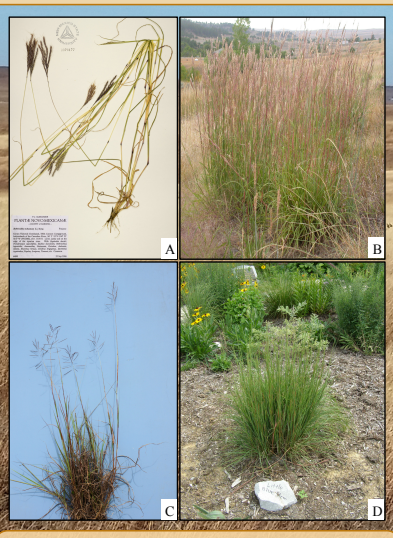

Fig. 2 The two invasive *B. ischeamum* (A) and *B. bladhii* (C), and two native *A. gerardii* (B) and *S. scoparium* (D) study species of grasses.

Hypotheses:
We expect (1) lower species richness in soils surrounding OWBs than the native grasses, and (2) lower species richness moving west across the precipitation gradient. We also anticipate (3) a higher proportion of generalist microbes associating with OWBs than native grasses.

Consequences of Old World Bluestem Growth:
The ability of OWBs to create mono-specific stands threatens more than just the diversity of native prairie grasses. Studies have shown that changes from native grassland prairies to exotic monospecific stands cause declines in small mammal diversity, richness, and relative abundance. Additionally, it has been shown that monospecific stands of OWB cause decreases in arthropod biomass compared to native grasslands, negatively impacting avian abundance and species richness.

Acknowledgements:
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Study Objectives:
Determine how soil microbial community structure and composition varies:
- Across the precipitation gradient
- Among native and non-native study grasses

Fig. 3 The above photo demonstrates a native grass prairie (right) compared to a monospecific stand of Old World Bluestem (left).

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