Determining threshold responses of plant-soil feedbacks to nitrogen deposition

The project developed infrastructure and baseline data to study the effect of chronic, low-level nitrogen addition in grassland ecosystems, such as tall grass prairie.

What was done and why?

The long-term goal for the project is to understand how N deposition impacts the stability of coupled plant-soil (CPS) interactions, as these interactions contribute to diversity maintenance and ecosystem function. The overall objective of this project is to determine threshold responses to nutrient enrichment in mesic perennial grasslands of the type that are being proposed 1) to mitigate agricultural nutrient and soil loss and 2) as candidates for biofuel cropping systems.

The central hypothesis of the project is that nutrient enrichment decouples plant-soil interactions, and results in non-linear changes in ecosystem functioning. The proposed experiment leverages the data and infrastructure of an established global experimental network, the Nutrient Network (NutNet: www.nutnet.org) to establish a new gradient experiment that complements and follows NutNet’s established protocols and design: NitNet (for Nitrogen Network). To provide a firm foundation for NitNet, there were three project objectives:

1. Establish three NitNet sites along an east-west gradient across Iowa;
2. Deploy monitoring stations throughout the state to quantify both wet N-deposition and gaseous N-levels; and
3. Quantify coupled-plant-soil indicators of N deposition thresholds.

The working hypothesis for the third objective is that the specificity of organisms in the rhizosphere declines with nutrient enrichment. Also, that those plant species that increase in dominance following N-enrichment are relatively less dependent on CPS specificity than those species that decrease in dominance.

What did we learn?

Plant interactions with organisms in the soil surrounding their roots can regulate C sequestration and contribute to diversity-driven patterns in productivity that are critical for continued ecosystem health. With this series of experiments, the PIs tried to identify the threshold effects of N deposition on plant-soil interaction although data on this point remains inconclusive. However, by linking nutrient-driven changes in plant-soil interactions with C storage, the research addresses a critical gap in understanding of the “black box” belowground processes that regulate plant productivity in general as well as diversity responses to global climate change.