

Abstract: Interactions among Water, CO₂, and N in a Perennial Grassland Ecosystem

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(1) Objectives. Our goal is to enhance understanding of how potential changes in rainfall will influence grassland community composition and ecosystem processes, and in particular whether and how these effects will be offset, augmented or influenced by other global change factors such as elevated atmospheric CO₂ and nitrogen (N). To achieve this objective, we will continue for two additional years a manipulation of summer precipitation x CO₂ x N in a perennial grassland system, and assess the effects on ecophysiology, soil water, primary production, community composition, and the potential for woody seedling colonization.

(2) Scientific Questions and Hypotheses. Our experiment is designed to address questions about multiple resource interactions (among water, CO₂ and N) on ecosystem structure and function, including leaf level gas exchange and tissue nutrient status, community composition and dynamics, and a variety of ecosystem scale metrics, such as leaf area index, soil water status, total root and aboveground biomass, and soil CO₂ flux. Based on current theory there are a variety of ways in which variation in each of the three main factors can influence responses to the other factors. A series of specific hypotheses will be tested in the study regarding such interactions and how they may vary with time and with intra- and inter-annual precipitation variability.

(3) Location. Cedar Creek Ecosystem Science Center, East Bethel, MN

(4) Approach. We will use free-air CO₂ enrichment, soil N additions, and precipitation manipulation (using portable rain-out shelters) to expose open-grown established experimental grassland plots to all combinations of two levels of each factor. This represents a continuation of a current NICCR-funded experiment that tests water x CO₂ x N interactions (six replicates per unique treatment) using 48 2 m x 2 m plots planted with nine species in 1997 and each having 7-8 species on average at present. We will assess hypotheses about the interactions among these three factors by measuring a suite of responses. These include well-developed protocols for measures of leaf level gas exchange, soil water, soil CO₂ flux, root and total biomass, and of compositional change, including both the established grassland species and experimentally added tree seedlings.

(5) Intended accomplishments (including deliverables). We intend to effectively conduct the experiment, test the hypotheses, analyze, interpret and synthesize the data, and publish peer-reviewed scientific articles that disseminate our findings.