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Topographical Location Has Little Effect on *Andropogon gerardii* and *Sorghastrum nutans*

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Abstract

Based on the logic that water can be found at lower elevations, we hypothesized that the dominant prairie plants Andropogon gerardii *and* Sorghastrum nutans *would grow larger and more abundantly at lower elevations. We analyzed soil samples and measured plant characteristics on three different slopes at the CERA prairie and cultivated specimens in a greenhouse from soil at different elevations. Using ANOVA we discovered that the only significant differences were that* Andropogon gerardii *grew taller at the base of hills than at the top, and that greenhouse cultivated* Andropogon gerardii *grew taller in soil from the bottom of slopes than in soil from the top. This may be explained by the flow of water and nutrients downhill.*

Introduction

Despite the stereotype of the prairie landscape as flat and level, this important ecosystem may have changes in topography that have an effect on the growth of organisms. Previous studies have concluded that as water flows downhill it creates erosion, which carries nutrients and moisture to the plants at lower topographical locations. This increased availability should lead to greater plant growth (Brands et al. 2000). As organisms such as *Andropogon gerardii* and *Sorghastrum nutans* dominate the non-woody populations of most tall-grass prairies (Howe 1994), we chose to study the effect of topography on the growth of these two species. In agreement with the previous research, we hypothesized that the species would grow larger and more abundantly at the bottom of slopes than the top. To determine differences in plant and soil characteristics, we measured plant height, stem width, and density, and soil moisture, organic content, and nitrogen content.

Methods

We sampled at three specifically selected slopes in CERA: the Big Basin, Wilson and Dam Prairies (Delong 1998) from October 6 to November 12, 2004 (http://www.grinnell.edu/academic/biology/cera). These slopes were chosen because of their relatively steep gradient (which should make any results easier to see), and because the same slopes were the subject of a similar study with which we could compare results (Brands et al. 2000). Six transects, 15 meters apart, were established going down each hill in a straight line. Two soil samples were taken from each of these transects: one to measure soil moisture, the other to measure nitrogen and organic content. We subtracted the mass of the soil moisture samples (after being dried for 48 hours) from the initial mass; obtaining the amount of moisture from the soil in grams. The nitrogen and carbon content of finely ground dry soil was determined with the Thermo Finnigan Elemental Analyzer.

Population density of Big Bluestem and Indian Grass was measured using an area with a two-meter radius around the highest, lowest, and middlemost points of each slope. Also within this circle, we measured three randomly selected individuals of each species for stem width and height.

We obtained a large soil sample from the top, middle, and bottom of each slope. These nine soil samples were used to plant Big Bluestem and Indian Grass samples, with the intention of isolating the effects of soil on plant growth from the weather and other factors. Eleven small growth cells were dedicated to each sample site for each plant species, creating 198 cells overall. After planting, they were placed in growth chambers with a constant 25 degrees Celsius temperature, 24-hour artificial sunlight, and daily water. After three weeks of development, we selected the tallest individual from each growth cell and took its height in cm. Once all of the data had been collected, we took the means of all the raw data, and organized all of the elevations into top, middle, and bottom. All of our statistics (such as height, density, or soil characteristics) were compared with

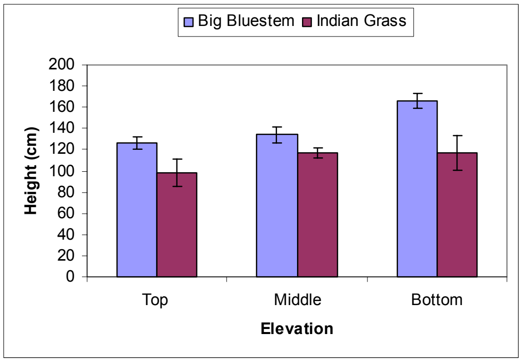

Figure 1: Mean Height (±SE) of *Andropogon gerardii* and *Sorghastrum nutans*.

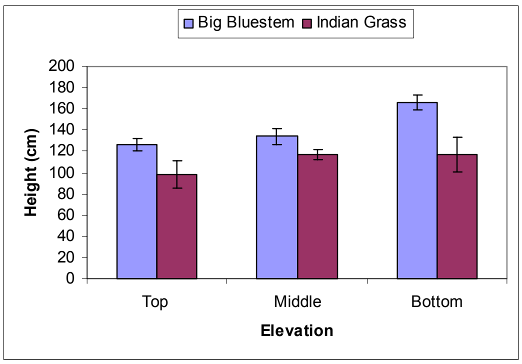

Figure 2: Mean Stem Width of *Andropogon gerardii* and *Sorghastrum nutans*.

elevation as the variable. We then used an ANOVA to test for effects of soil type on growth.

Results

When comparing the density, stem width and height of *Andropogon gerardii* and *Sorghastrum nutans* at the top of the hill, to the same data at the bottom and middle of the hills, the results were found to be mostly not significant. The only significant elevation effect found in the field data was in the height of *Andropogon gerardii* (p=0.030) (Fig. 1). Stem width (Fig. 2), plant density (Fig.3), the soil moisture (Fig. 4), organic content and nitrogen content (Fig. 5), were significantly variable across elevations. For the greenhouse data, the height of *Andropogon gerardii* at the bottom was significantly taller than at the top with a significant p-value (p=0.022), while the *Sorghastrum nutans* had no significant variation (p=0.200) (fig. 6).

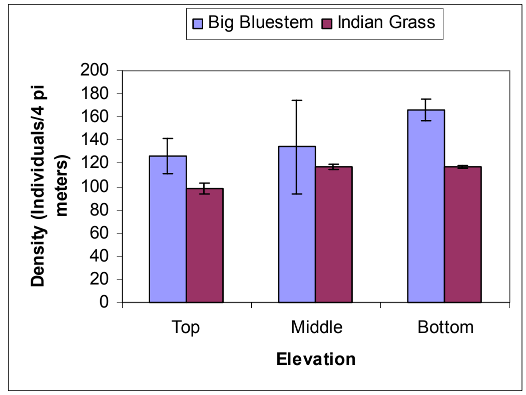

Figure 3: Density per 4PI Meters of *Andropogon gerardii* and *Sorghastrum nutans*.

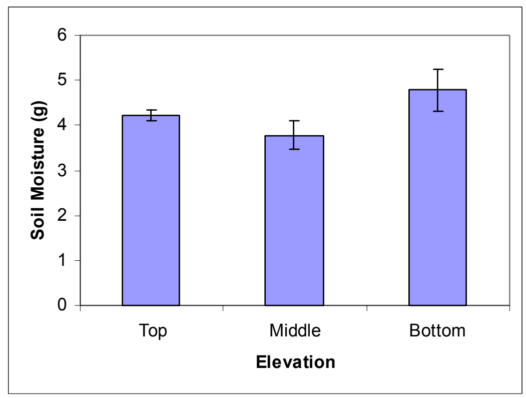

Figure 4: Prairie Soil Moisture by Elevation.

Discussion

The data does not support our hypothesis that there would be a significant difference in the plant characteristics at the top and bottom of the hills, except for height of *A. gerardii*. We believed this would be true because previous research claimed that as water flows downhill it will create erosion, which carries nutrients and moisture downhill, making moisture and nutrients more readily available to plants at the bottom as compared to the top (Brand, et al. 2000). This increased availability should lead to greater plant growth (Knapp et al. 1993). The previous study conducted at CERA on this subject showed results very different from ours. They did find a significant difference between top and bottom (Brand, et al. 2000). An interesting point to remember is that our greenhouse results proved that there was statistical difference between top and bottom with big bluestem.

There were many factors that could have led our results to be altered somehow. The occurrence of trampling could have led to results

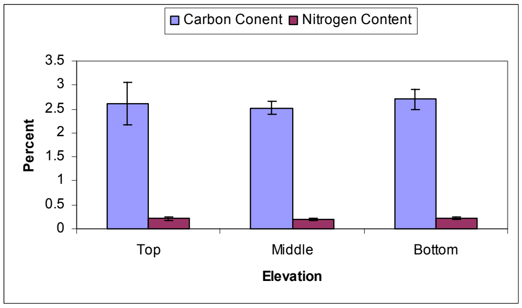

Figure 5: Percent Carbon Content and Nitrogen Content

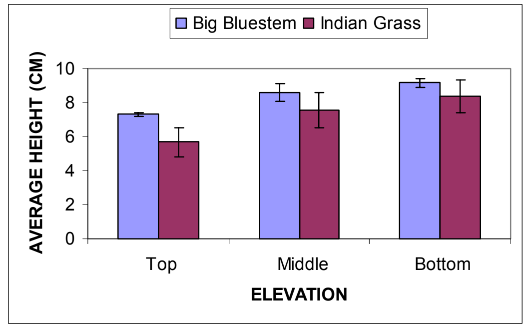

Figure 6: Average Height (±SE) of Greenhouse Grown *Andropogon gerardii* and *Sorghastrum nutans*.

somewhat different than those Brands et al. received. Changes in the weather also could have possibly altered our data. We collected data over a three week span, thus, it is possible that seasonal changes could have had an effect on plant growth. Resource availability throughout the prairie could also be a factor in the variability.

Acknowledgements

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