Effects of Nitrogen & Gibberellin on *Setaria viridis* Growth

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Introduction

Nitrogen fertilizers have traditionally been applied to crops to maximize yields. This has been a very proven and effective method (Sadava et al., 2014). In the past Gibberellin's effect on growth has been shown to increase pasture yields; however due to its relatively high price it was not proven to be an economical form of fertilization (Matthew et. al., 2009). In recent years, the price of gibberellin has decreased, making it a more economical option for fertilization and creating a renewed interest in the possibility of using hormone based fertilizers (Matthew et. al., 2009). We were especially interested in crops like corn that have traditionally been heavily dependent on nitrogen fertilizers. Gibberellin has been shown to increase plant growth and stimulate flowering and is needed in much smaller amounts relative to nitrogen (Matthew et. al., 2009). This led us to question if adding a growth hormone would change plant growth when paired with nitrogen fertilizer, therefore reducing the amount of nitrogen needed to grow C4 grass crops such as corn. We decided to test this method to determine a possible alternative to the standard application of nitrogen. We hypothesized that plants given both nitrogen and gibberellin would show increased growth in all areas measured.

Results

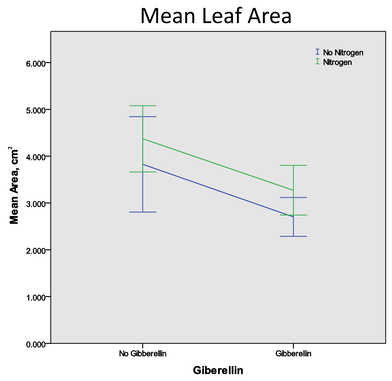


Figure 1: This figure shows the means and confidence intervals of leaf area for each treatment group, with a p-value for Nitrogen of p= 0.00612, and for Gibberellin of p= 0.00022

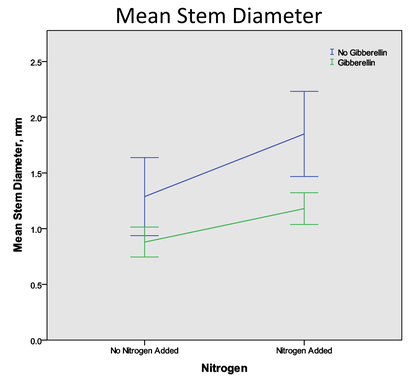


Figure 2: This figure shows the means and confidence intervals of stem diameter for each treatment group, with a p value for Nitrogen of p= 0.00003, and for Gibberellin of p= 0.00049

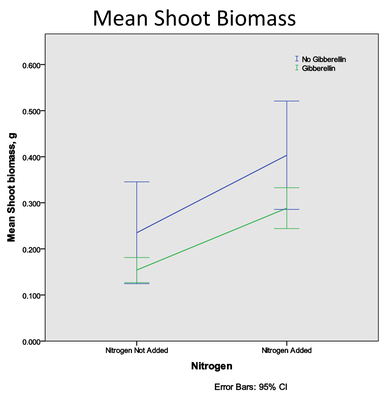


Figure 3: This figure shows the means and confidence intervals of shoot biomass for each treatment group, with a p-value for Nitrogen of p= 0.00503, and for Gibberellin of p= 0.00012

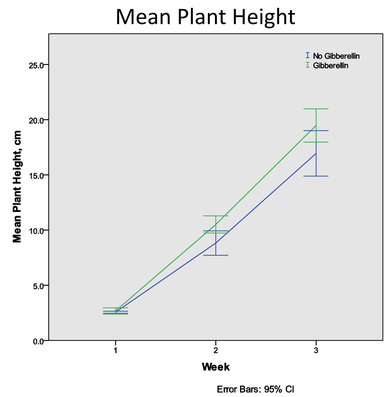


Figure 4: This figure shows the means and confidence intervals of plant height for the plants with and without Gibberellin measured each week, with a p-value for Gibberellin of p= 0.2816

Discussion and Data Analysis

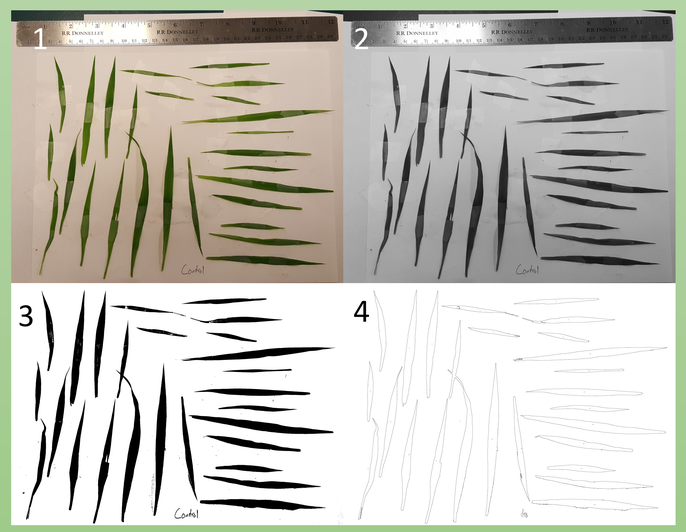
One of the most striking responses observed was the difference in stem diameter between plants with added gibberellin and those without. As is shown in **Figure 2** plants with gibberellin showed a significantly smaller stem diameter than those without added gibberellin. Overall, the presence of nitrogen significantly increased stem diameter but was not successful in completely negating the effects of the gibberellin. Leaf surface area was greatest for the group given a complete nitrogen fertilizer and no gibberellin as can be seen in **Figure 1**. There was a significant correlation between nitrogen and larger leaf surface area as well as between gibberellin and smaller leaf surface area. In addition to decreasing leaf surface area and stem diameter, added gibberellin correlated with a significant decrease in shoot biomass when compared to the two groups with no gibberellin. As is shown in **Figure 3** nitrogen produced a significant increase in shoot biomass. Although the data was not significant, gibberellin did appear to increase overall plant height as shown in **Figure 4**. The difference in height became more pronounced from week 2 to week 3 although the difference was still statistically insignificant. Overall, plants given gibberellin were taller and thinner as compared to their shorter, stouter nitrogen counterparts. This general difference can be seen in **Figure 5**.

Figure 5: This figure shows one representative plant from each treatment group

Similar to the results found in a study done by Tsai et al. gibberellin somewhat increased growth rate in our experiment; however our results showed that overall gibberellin did not produce a desirable effect on growth, even when paired with a nitrogen fertilizer.

Materials and Methods

- *Setaria viridis* was chosen due to its small size, quick growth, and comparability to C4 grass crops such as corn.
- Plants were grown in a homogenous environment with equal light intensity/quantity/quality, water availability, temperature, soil composition, etc.
- 10 plants were given nitrogen deficient fertilizer (control), 10 were given complete nitrogen fertilizer (N), 10 were given nitrogen deficient fertilizer and gibberellin (G), and 10 were given complete nitrogen fertilizer and gibberellin (NG)
- Plants were allowed to grow for 3 weeks.
- After the first week of growth each plant was given 10 mL of their assigned liquid fertilizer (Gibberellin concentration was 100 ppm).
- Plant height was measured each week after planting.
- Leaf count, shoot biomass, root biomass, stem diameter, and leaf area were measured at the 3 week mark.
- Data was analyzed using PAST
- Leaf surface area was measured using FIJI (steps are shown to the right)



References

Matthew , W. A. Hofmann & M. A. Osborne (2009) Pasture response to gibberellins: A review and recommendations, New Zealand Journal of Agricultural Research, 52:2, 213-225, DOI: 10.1080/00288230909510506

Sadava, D., Hillis, D. M., Heller, H. C., Berenbaum, M. R. (2014). Life: The science of biology tenth edition. U.S.A.: The Courier Companies, Inc.

Tsai, DS. & Arteca, R.N. Photosynth Res (1985) 6: 147. doi:10.1007/BF00032789