Ecophysiological Responses of Tall Fescue Genotypes to Endophyte Infection and Climate Change

Marie Bourguignon1,2, Rebecca L. McCulley2, Randy D. Dinkins2, Tim D. Phillips2, Dennis B. Egli2, Jim A. Nelson2, Elizabeth Carlisle2 and Huihua Ji2
1 Dept of Agronomy, Iowa State University
2 Dept of Plant and Soil Sciences, University of Kentucky

1 Background

Tall fescue (Schedonorus arundinaceus) can form a symbiosis with the fungal endophyte, Epichloë coenophialum, whose presence can benefit the plant, depending on plant and fungal genetics and prevailing environmental conditions. Despite having agricultural, economic and ecological importance, relatively little is known regarding how the symbiosis will respond to predicted climate change. We evaluated how plant genetics and endophyte presence altered fescue response to predicted changes in climate.

2 Methods

Genetic clones of four KY-31 derived tall fescue individuals infected with different common toxic (CTE14, CTE45) or novel endophyte (NE16, NE19) strains were developed. Half of the material was treated with Folicur 3.6F to produce genetically identical endophyte-free individuals. Endophyte-infected (+) and -free (-) genetic clones were transplanted into an existing 2 x 2 factorial climate change experiment: Control, +Heat (+3°C), +Precip (+30%), +Heat+Precip (+3°C, +30%). The study was a randomized complete block design with five replications. Photosynthesis, leaf water potential, tiller number, aboveground biomass and ergot and loline alkaloid concentrations were measured from March to November 2012.

3 Results

In 2012, environmental conditions were much hotter and drier than usual, affecting water availability. All measured fescue responses, except alkaloid concentrations, were negatively impacted by additional heat, especially in the summer.

Fescue Genotype Variability:
Endophyte infection greatly stimulated aboveground biomass production in CTE14, but had no significant effect on the other genotypes (Fig. 5-A).
For tiller production, the same endophyte-associated stimulation was observed for both symbiotic genotypes CTE14 & NE19 (Fig. 5-B).

4 Conclusion

We hypothesized that fescue ecophysiological responses to climate change factors would vary across plant genotypes and depend on Epichloë presence. We predicted that endophyte infection would not confer the same degree of environmental stress tolerance to all fescue genotypes. Our results support these suppositions.

When averaged across the growing season, photosynthesis rates were significantly impacted by elevated heat and increased precipitation but in contrasting ways depending on the fescue genotype and endophyte status. Often, +E+ individuals performed better than E-, except for leaf water potential, which was never influenced by endophyte presence. Endophyte infection conferred different levels of environmental stress tolerance to the different fescue genotypes.

Overall, this study suggests that choice of plant and endophyte genetic material will be important in determining the productivity and resilience of fescue pastures under future climate conditions.

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