Potential for Perennial Grasses as an Organic Dual Forage-Grain Crop in Michigan

Sienna Tinsley[1], Sieglinde S. Snapp[1], Steve Culman[1], Santiago Utsumi[2], Nikhil Jaikumar[1], and John Green[1]
[1]Kellogg Biological Station, Department of Crop and Soil Sciences, Michigan State University
[2]Kellogg Biological Station, Department of Animal Science, Michigan State University

Abstract

The adoption of perennial grains presents farmers with environmental, economic, and agronomic opportunities and risks. If these plants can be used as dual-purpose forage-grain crops, many risks will be alleviated. In order to evaluate potential for perennial wheat (*Triticum aestivum* x *Thinopyrum elongatum*; pwheat) and intermediate wheatgrass (*Thinopyrum intermedium*; IWG), two novel perennial grain species, to thrive as dual-purpose crops, a field experiment is in progress at Kellogg Biological Station (KBS) in which robustness of plant growth and perennial regrowth, as well as quality and quantity of harvested grain and forage is under investigation for two planting dates and two cutting regimes. Preliminary data presented here indicate apparent tradeoffs between high first-year yields and ability to initiate late-season regrowth.


Figure 1: P-Cut Experiment on May 5, 2011


Figure 2: P-Cut Experiment on June 30, 2011

Introduction

Annual winter wheat (*Triticum aestivum* L.) is a successful dual purpose forage-grain crop in the southern Great Plains region of North America (Redmon et al., 1995). Intermediate wheatgrass is a highly successful perennial forage grass. Wheat breeding programs at Washington State University (WSU) and The Land Institute (TLI) are currently working to establish lines of perennial wheat by crossbreeding these two species and to breed a variety of IWG with improved levels of grain production, while maintaining forage yield. We are currently exploring the possibility of using these perennial grasses as dual forage-grain crops in organic systems in Michigan.

Objectives


Figure 3: Perennial Wheat Before and After Cutting


Figure 4: IWG Before and After Cutting

- To investigate effect of:
  - -species (perennial wheat vs. IWG)
  - -planting time (spring vs. fall planting)
  - -cutting regime (cut vs. no cut)
- To evaluate:
  - -initial stand establishment
  - -early growth
  - -regrowth after cutting
  - -biomass and grain harvest
- To determine robustness of perenniality based on:
  - -second year regrowth
  - -winter survival rates

Methods

The treatments used to achieve the objectives listed above are genotype, planting date, and cutting management. 16 plots were planted on Oct 13, 2010 and 16 were planted on May 3, 2011. Half of the plots in each of these planting groups were sown with perennial wheat and half with IWG. A forage crop was harvested from half of the perennial wheat plots on May 11, 2011 and from half of the IWG plots on May 24, 2011. The rest of the plots remained uncut until the fall grain harvest. Figure 5, shown below, depicts one of the four replicates included in this experiment.

We are using estimates of specific leaf area, leaf area index (LAI), tiller density, and tiller recruitment rate to evaluate the vigor, ability to compete with weeds, and overall health of the plants under various treatments. We are also comparing the quality and quantity of grain and forage produced under each treatment.

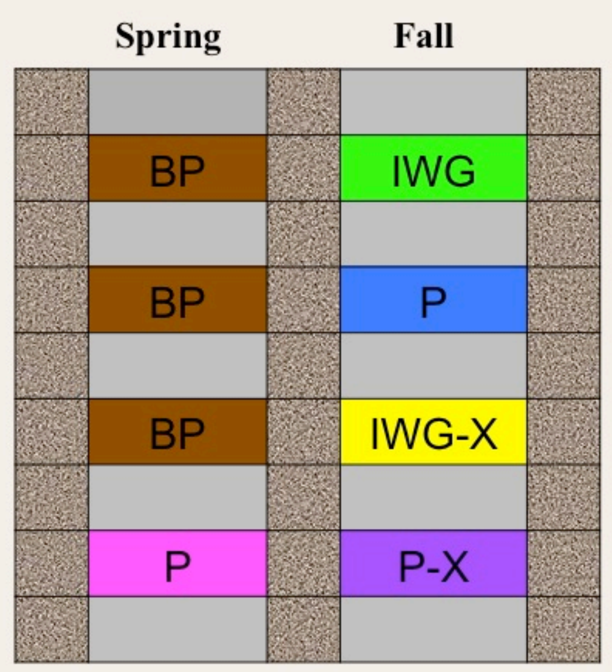

Figure 5: Planting Map. Block 1 Only.
Key: IWG=Intermediate Wheatgrass, No Cut
IWG-X=Intermediate Wheatgrass, Cut
P=Perennial Wheat, No Cut
P-X=Perennial Wheat, Cut
BP=Border Plot

Preliminary Results

Preliminary analyses of first-year data indicate that fall-planted perennial wheat has the ability to yield greater amounts of grain and forage in the first year of production than fall-planted intermediate wheatgrass in its first year of production (fig. 6 and 7).

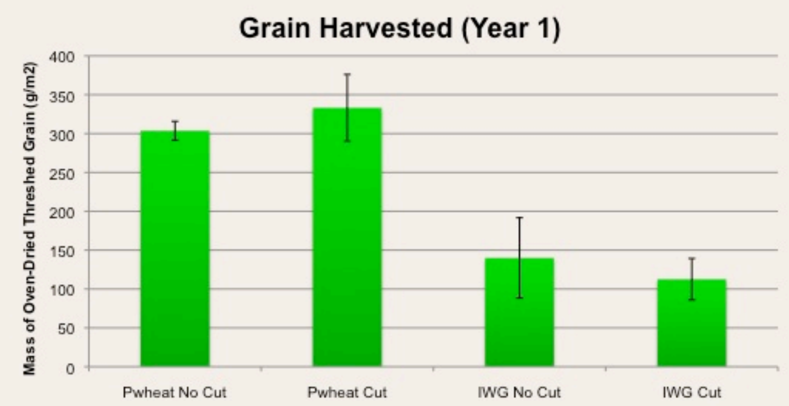

Figure 6: Pwheat and IWG Grain Harvested in 2011

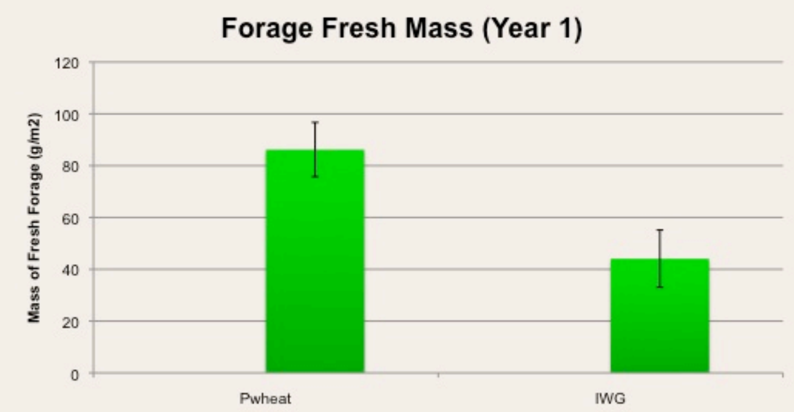

Figure 7: Pwheat and IWG Forage Harvested in 2011

In addition, cutting has only a temporary effect on height (fig. 8) and does not appear to affect grain production in the first year for either species (fig. 6).

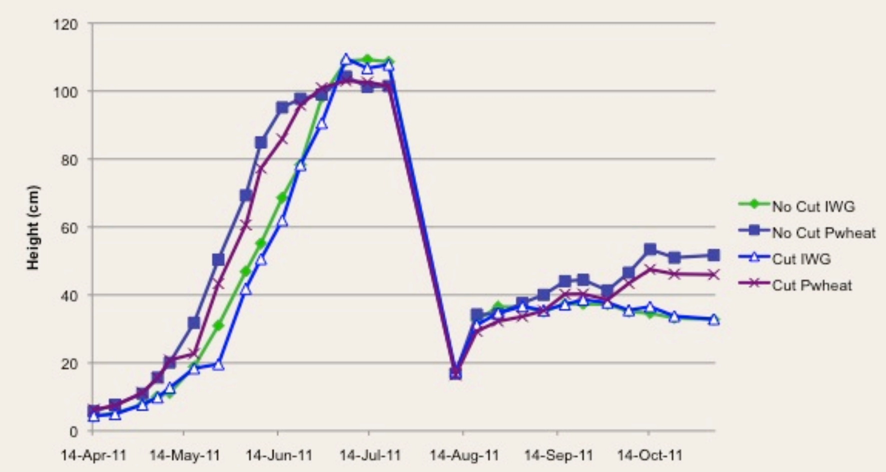

Figure 8: Height of Fall-Planted Pwheat and IWG Over Time

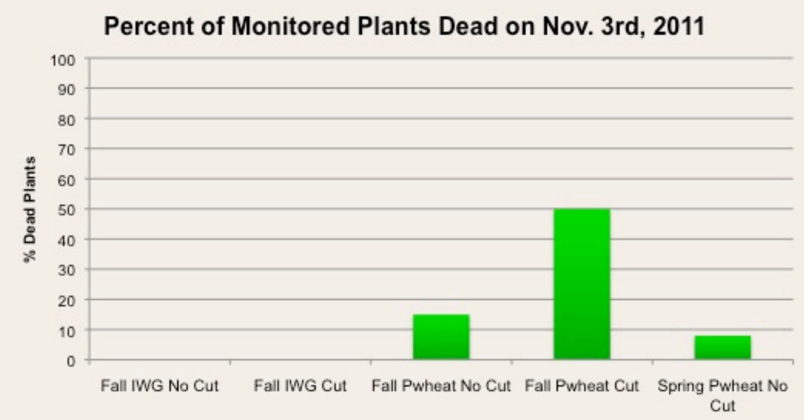

Figure 9: Percentage of Pwheat and IWG Plants that Died after Harvest

However, the post-harvest regrowth, and thus the potential for second year regrowth, of perennial wheat does appear to be negatively affected by cutting (fig. 9). While cutting does not appear to induce plant death in IWG, it can decrease the number of tillers per plant (fig. 10 and 11), which or may not have implications for second-year forage and grain production.

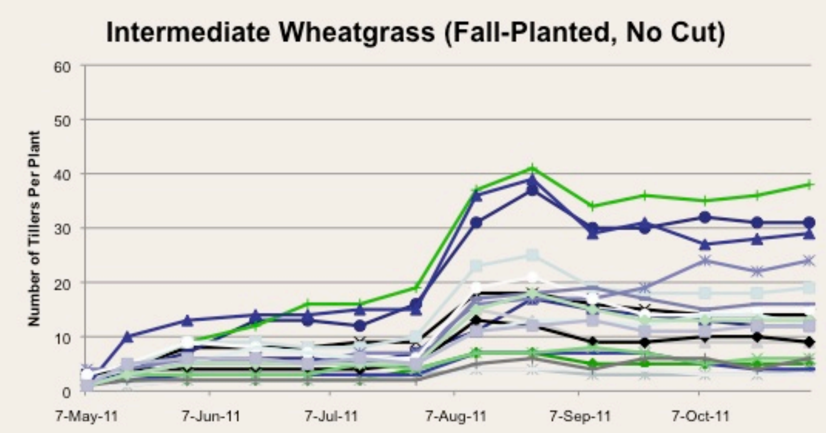

Figure 10: Number of Tillers per Plant for Uncut IWG

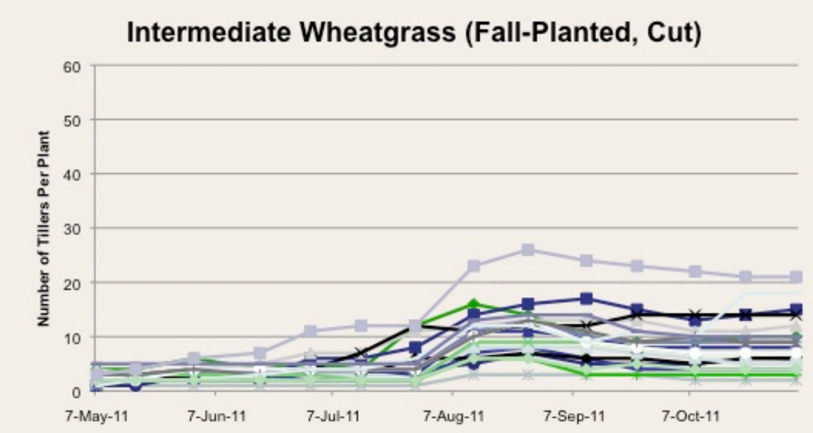

Figure 11: Number of Tillers per Plant for Cut IWG

Support for this research was provided by USDA/NIFA, The Ceres Trust, the NSF Long-Term Ecological Research Program at the Kellogg Biological Station and by Michigan State University AgBioResearch.

Source Cited:
1.Redmon, L.A., et al.. 1995. A Review of Livestock and Wheat Grain Yield: Boom or Bust?. Agronomy Journal. 87: 137-147.