Identifying Optimal Alfalfa Germplasm Types and Characteristics for Compatibility and Performance in Mixed Cropping Systems

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RATIONALE & OBJECTIVES

- Trials were conducted in Kansas, Minnesota, and Wisconsin in 2019 to evaluate yield Kernza® grain yield and intermediate wheatgrass (IWG) summer forage yield and quality when planted in mixtures with alfalfa.
- Multiple alfalfa varieties were evaluated in mixtures with IWG to explore the genetic variability for alfalfa performance and compatibility with IWG in the system.

STUDY DESCRIPTION

Plot layout:
Randomized complete block design.

Locations:
Salina, KS; Rosemount, MN; Arlington, WI; and West Salem, WI.

Treatments:
- IWG monocultures planted in 30 cm rows (IWGn).
- IWG monocultures planted in 30 cm rows with 80 kg ha^{-1} nitrogen fertilizer (urea) in spring (IWGn+).
- IWG monocultures planted in 60 cm rows (IWGw).
- IWG monocultures planted in 60 cm rows with 80 kg ha^{-1} nitrogen fertilizer (urea) in spring (IWGw+).
- IWG planted in alternating 30 cm rows with a hybrid alfalfa variety (IWG + HYB1).
- IWG planted in alternating 30 cm rows with a grazing type alfalfa variety (IWG + GRZ1).
- Up to 23 other treatments per location of IWG planted in alternating 30 cm rows with alfalfa varieties of various genetic backgrounds.

Analysis:
Summer Kernza grain yields and IWG straw and IWG straw + alfalfa forage yields and quality were measured at all locations. Additional spring and fall forage yield and quality data were collected for the treatments at the Kansas location.

RESULTS

- Kernza perennial grain yields did not differ between monoculture IWG and alfalfa + IWG mixtures.
- Including alfalfa in IWG mixtures improved crude protein (CP) content and yield of summer straw/forage yields in some but not all locations.
- We did not observe significant genetic variance for IWG straw + alfalfa forage yield or alfalfa forage yield among diverse alfalfa varieties in the four test locations.
- We observed a small amount of genetic variance in alfalfa for Kernza grain yield and CP of IWG straw + alfalfa summer forage and greater levels of genetic variance and genotype x environment variance in alfalfa CP, ADF, and NDF.
- There were no differences in Kernza grain yield, summer IWG straw + alfalfa forage yield, or summer alfalfa forage yield or CP between alfalfa germplasm types in mixtures with IWG.
- Alfalfa improved fall biomass yield and gross forage value in IWG + alfalfa mixtures in Kansas.
- IWG + alfalfa mixtures had higher relative forage values than IWG monocultures in the spring and fall but did not improve total annual forage yield or total gross forage value.

Figure 1. Spring forage in an IWG + alfalfa plot in KS as part of this study. Intermediate wheatgrass and alfalfa are planted in alternating 30 cm rows.

Figure 2. Spring and fall hay/forage and summer straw yields in KS harvested from IWG monocultures spaced in 30 cm rows with (IWGn+) and without (IWGn) spring nitrogen fertilizer application; monoculture IWG spaced in 60 cm rows with (IWGw+) and without (IWGw) spring nitrogen fertilizer application; and IWG planted in alternating 30 cm rows with a grazing type alfalfa hybrid (HYB1) alfalfa variety. Means followed by a common letter are not significantly different at the alpha = 0.05% level after Bonferroni correction.

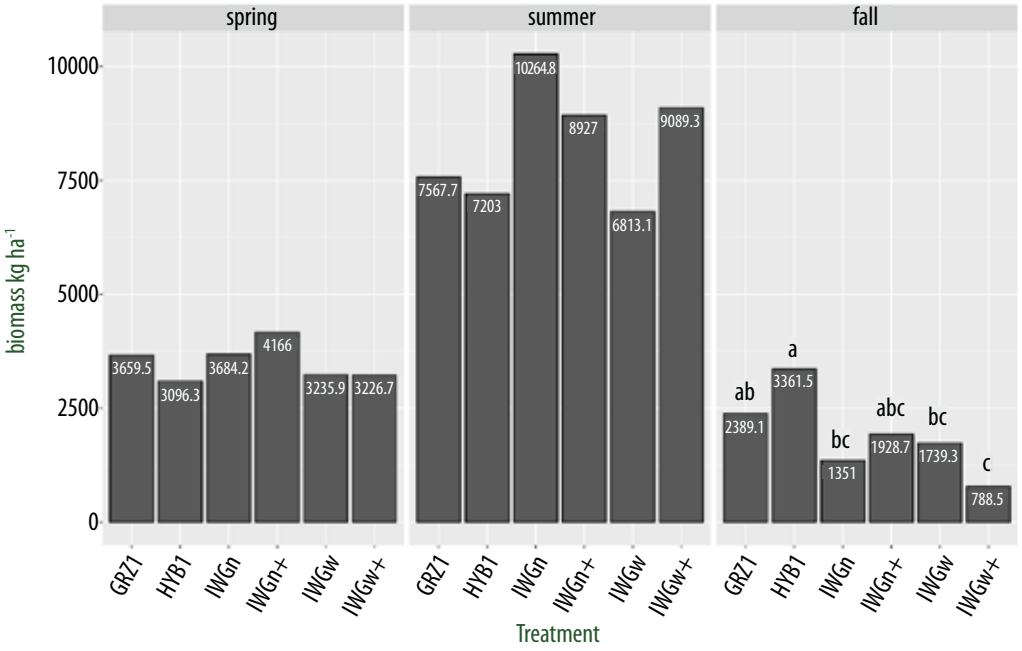
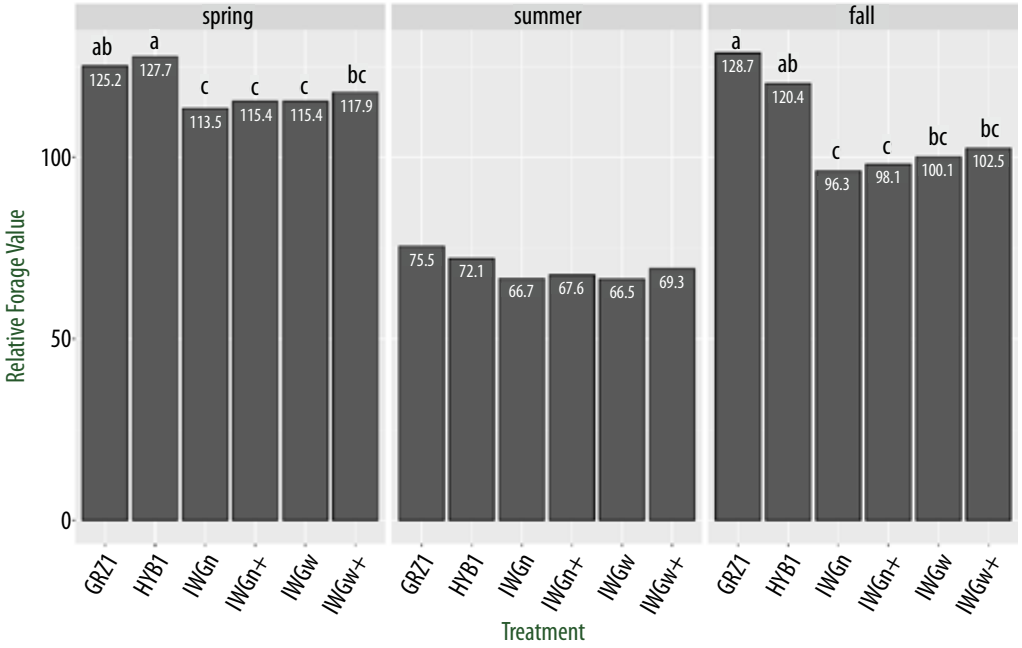


Figure 3. Relative forage value of spring and fall hay/forage and summer straw in KS harvested from IWG monocultures spaced in 30 cm rows with (IWGn+) and without (IWGn) spring nitrogen fertilizer application; monoculture IWG spaced in 60 cm rows with (IWGw+) and without (IWGw) spring nitrogen fertilizer application; and IWG planted in alternating 30 cm rows with a grazing type alfalfa hybrid (HYB1) alfalfa variety. Means followed by a common letter are not significantly different at the alpha = 0.05% level after Bonferroni correction.



CONCLUSIONS

- Although IWG + alfalfa mixtures improved summer IWG straw + alfalfa forage total CP, other management practices (e.g., increased alfalfa populations) should be tested to further increase CP (CP > 7) to increase palatability and nutritive value.
- Lack of observed alfalfa genetic variance for summer forage yield and quality in IWG + alfalfa mixtures suggests that follow-up research should focus on other aspects of the cropping system, besides improving summer straw yield or quality, where alfalfa can contribute additional ecological or economic benefits and where genetic variance in alfalfa may more likely be observed.
- While higher fall yields and forage values were observed in KS for IWG + alfalfa mixtures, management decisions need to consider the economics of haying vs. grazing forage.

Alfalfa
U.S. Alfalfa Farmer Research Initiative

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