Grazing Kernza® as a Dual-Use Crop for Forage and Grain Production: Results

Kernza® is a novel perennial grain harvested from new varieties of intermediate wheatgrass developed by The Land Institute, the University of Minnesota, and others. It can be managed for both grain and forage, providing hay or grazing opportunities. With deep roots that stay in the ground for three years or more, it has lower requirements for fertilizer and tillage, and reduces nutrient leaching that contaminates drinking water sources. Data and recommendations on optimal management are key to supporting adoption.

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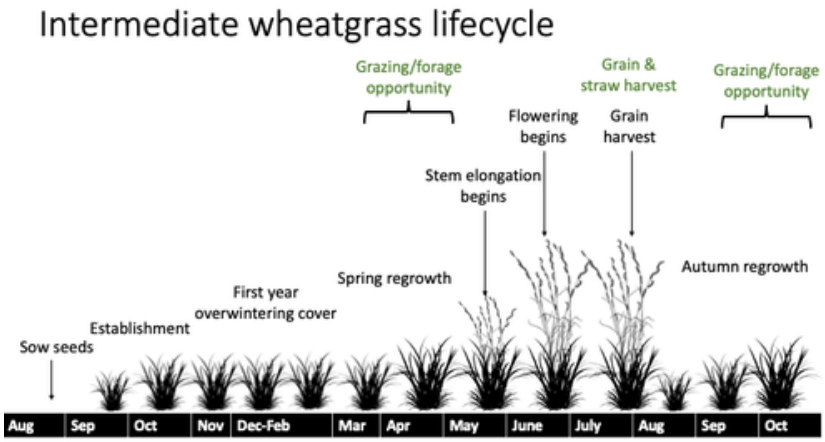


The Kernza Grazing Trials were led by Alan Kraus of Clean River Partners in cooperation with Jake Jungers, Nicole Tautges, and Mitch Hunter of the University of Minnesota and farmers Kaleb Anderson and Dan Honken. Field activities were carried out primarily by Anderson and Honken. Data analysis was carried out by Jungers and Hunter. The project aimed to address the needs of crop and livestock producers in the Cannon River Watershed who are interested in grazing Kernza for biomass production and crop diversification, with findings applicable for others in the Upper Midwest.

Kernza offers both new market opportunities and improved soil and water outcomes. Economic viability of the system is key to adoption, and research on optimal management strategies can help ensure maximum returns. This project examined the impacts of grazing Kernza biomass in the spring and fall, along with grain and straw harvest in the summer. The figure above represents the Kernza lifecycle and the potential grazing opportunities.

After only harvesting grain the first year, Kernza was harvested for grain and grazed in both spring and fall for two consecutive years. The research team measured grain, forage, and straw and calculated net returns for grazed and ungrazed paddocks. Grazing reduced grain yield by 29% in Year 2. However, grain yield was not impacted by grazing in Year 3, and by Year 4 grazing increased grain yield. Grazing reduced summer straw yield but had no effect on spring or fall forage yield. Grazing did not impact the nutritional value of the forage. Results show that grazing Kernza forage is feasible and could increase the profitability of the system compared to solely harvesting grain.

Field Sites: Anderson and Honken Farms

This research was carried out on two livestock and grain farms in SE Minnesota, both with six to seven acres of Kernza: Kaleb Anderson's farm in Goodhue County and Dan Honken's farm in Rice County.

Data is presented from the Anderson farm only. Kernza did not establish well on the Honken farm, which required re-seeding the following year. With the combination of a lost year of revenue and the added expense of re-planting, the yield and economic data do not reflect a typical Kernza production system. The Kernza established well on Kaleb Anderson's operation and better reflects real-world production and economic potential.

Kernza on the Anderson Farm was swathed and windrowed, then combined on August 8, 2020

Methods

Kaleb Anderson's farm is located on Knox silt loam and receives a historical average of 30.6" of precipitation annually. Precipitation during the four years of the study, measured from October to the following September, was 45.3", 32.2", 26.4", and 25.6" for seasons beginning October 2018, 2019, 2020, and 2021, respectively.

Kernza was no-till planted in mid-September 2018. The plot established well by Spring 2019 and was sprayed with 2,4-D on July 3. Five thousand gallons of liquid dairy manure were applied in Summer 2019; 5000 gallons were also applied in spring and summer 2020 and 2021. (The total of 10,000 lbs/ac/year provided about 100 lbs N, 50 lbs P and 100 lbs K per year of available nutrients.)

Grain was combine harvested and straw was baled in August 2019, 2020, and 2021. Fall regrowth was grazed in late October or early November of 2019, 2020 and 2021, and spring regrowth was grazed in May of 2020, 2021, and 2022. Grain and straw were not harvested in 2022: very dry conditions and forage needs led Kaleb Anderson to graze in spring and summer, and forgo grain harvest and fall grazing. Stocking rates and duration were based on sampled forage availability and paddock rotation was managed to leave less than 2 inches of stubble. Fencing was used to exclude cattle from some areas of the field.

Grain samples were hand-collected from grazed and ungrazed portions of the field before the combine harvest. They were threshed and weighed to estimate grain yields. Forage biomass samples were hand-collected, dried, and weighed to determine yield. Samples were also analyzed for forage quality. Forage biomass was sampled again post-grazing to estimate forage utilization.

Straw was baled into 25 - 1,100 lb rounds after grain harvest in August 2020. It was used as winter cattle feed but can also be used as bedding or sold for additional revenue.

Anderson Farm Kernza grain harvest in August 2019.

Kaleb Anderson with his harvest of 3,600 pounds of Kernza® grain, which was sold to Perennial Pantry.

Grazing in October 2019 on the Anderson farm.
All photos courtesy of Alan Kraus, Clean River Partners

Results and Discussion

Note: The stand was planted in 2018; Year 1 refers to the first full year, 2019, which included the first grain harvest. Years 2, 3, and 4 refer to 2020, 2021, and 2022, respectively.

Kernza Grain Yields

Fig. 1 shows grain yields from Years 2-4 (at the time of the Year 1 grain harvest, plots had not yet been grazed). Year 2 grain yield declined by 29% in grazed compared to ungrazed stands, but grain yields were similar between treatments in Year 3, and higher in the grazed stands in Year 4. This study used a high forage utilization rate to test the regenerative capacity of Kernza; it is possible that lighter grazing would have a smaller impact on Year 2 grain yields.

Year 2 grain yields in this study were similar to those from other Year 2 research stands, but greater than typical production-scale yields. This is consistent with previous observations, and indicates that research is needed to optimize field-scale harvest timing and techniques to maximize yield and profitability. Grain yields did not decline as much in later years of this study as is typically observed, providing an interesting avenue for future research.

Forage Yield and Quality

Averaged over years, grazing had no effect on subsequent forage yield, so grazed and ungrazed forage yields are shown as averages. As shown in Figure 2, fall forage yields (blue bars) were higher than spring forage yields (red bars), except in Year 4 where fall forage yields were especially low because of a drought. The relatively low yield in fall of Year 1 was possibly due to lower plant populations in the establishment year. Forage yields increased from fall of Year 1 to their peak in Year 2, perhaps due to increased stand density as the stand aged. The higher fall forage yields in Years 2 and 3 were expected, since previous research has shown more forage availability in fall than spring.

Summer straw yields were 41% lower in grazed compared to ungrazed stands in Year 2, but were similar in Year 3 (green bars, Fig. 2, shown as averages). Straw yields were comparable to previous studies.

Averaged over years, there was no effect of grazing on forage quality, so values are shown as averages. The Relative Feed Value (RFV), which takes into account acid detergent fiber, and neutral detergent fiber content, varied by season. On average, RFV was greater than 100 in the spring and slightly less than 100 in the fall.

Fig. 1 Kernza Grain Yield, Years 2 - 4

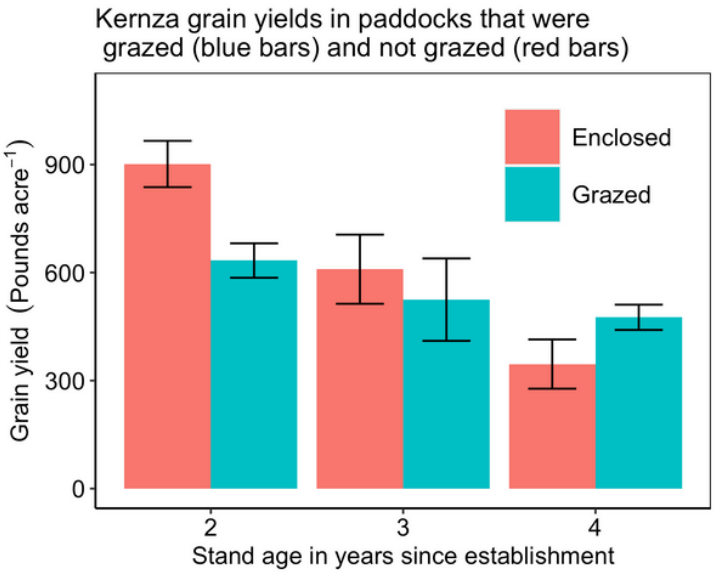


Fig. 2. Kernza Forage Yield, Years 1 - 4

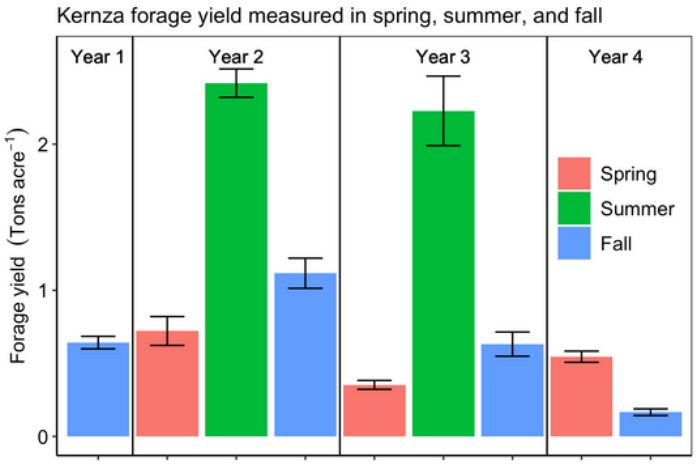
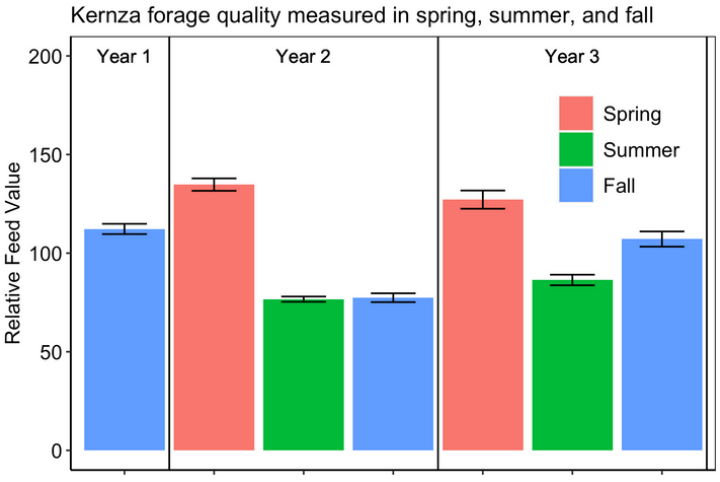


Fig. 3. Kernza Forage Quality, Years 1 - 3

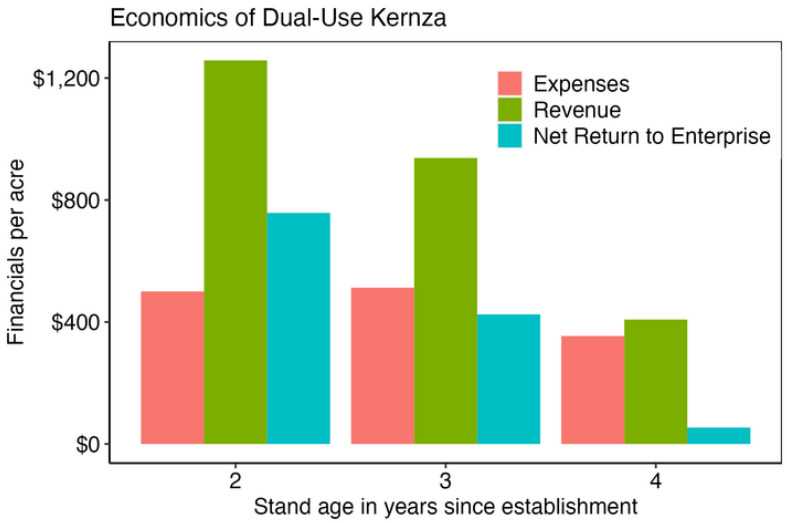


Financial Outcomes

Financial outcomes are based on actual expenses and revenues from grain, straw, and grazed forage from August 2018 to August 2022, with one exception: 2021 and 2022 (Year 3 and 4) straw yields were estimated based on the average of previous years' yields (straw yield does not typically vary significantly across years, and this estimate is likely to be conservative). Grain was not harvested in Year 4. Prices received were $1.00/lb in 2019 and $1.50/lb in 2020-21 for uncleaned Kernza grain. Dry matter basis values for grazed forage was valued at $0.07/lb and $0.05/lb for straw.

Net Return to Enterprise (total revenues less total expenses including management and labor) for Years 2 - 4 was $758/acre in 2020, $425/acre in 2021, and $54/acre in 2022 (note that there was no grain harvest or fall grazing in 2022), as shown in Figure 4. As demand grows, grain prices are likely to be higher, resulting in more favorable financial outcomes.

Fig. 4 Kernza Expenses, Revenues, and Returns



Management Tips for Dual-Use Kernza Production

1. Consult the 2023 Kernza Grower Guide, available at Kernza.org (linked here)
2. Plant prior to September – preferably mid-August for the Upper Midwest, following seeding rate recommendations.
3. Avoid soils that tend to be wet or have poor subsoil drainage.
4. Direct combine if the straw will be utilized on farm, in which case delay harvest until seed heads are brown and dry. Swath to maximize grain yields and provide flexibility in harvest timing, but expect potentially lower straw yields. Graze or mechanically harvest vegetative regrowth in late October.
5. Grain should be less than 20% moisture for direct combining and 35% or less for swathing. If swathed, use a draper head. Store grain at ~13% moisture: grain drying may be needed.
6. Kernza sown in late summer helps control spring-germinating weeds the next year, though in subsequent years, perennial weeds can be an issue. Research has shown an 88% overall reduction of weeds over 3 years.
7. Test soil to determine nutrient needs for the following crop, since Kernza effectively scavenges soil nutrients.
8. Wait until after the first grain harvest to graze or cut forage. Then, if the stand is well established, it can be grazed in the fall (6-8 weeks after grain harvest) and in the spring (before stem elongation to avoid damaging the seed head). Current recommendations are to graze only in the fall to optimize forage and grain yields.

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Green Lands Blue Waters is a vision for productive, profitable agriculture in the Upper Midwest based on the straightforward concept of getting as much value as possible from farmlands by growing crops that keep the soil covered year-round—what we call farming with Continuous Living Cover. The values from the crops we promote can be measured in yields and farm profits; but also as reduced risk, improved outlook for long-term productivity from the soil, more jobs, more wildlife, cleaner water and resiliency in the face of a changing climate.

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