



**SOUTHEAST RESEARCH  
AND EXTENSION CENTER  
AGRICULTURAL RESEARCH  
2022**

**K-STATE**  
Research and Extension



# SEREC

## AGRICULTURAL RESEARCH

### 2022

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# Bermudagrass Under Different Fertility and Harvest Management Practices

*B.C. Pedreira, D. Helwig, M. Haywood, J.K. Farney, and G. Sassenrath*

## Summary

A second year of a bermudagrass fertility study was conducted at the K-State Research and Experiment Station outside of Columbus, KS, in 2021. The purpose of the study was to simulate forage producers' practices of managing bermudagrass and determine how each practice affected forage production and quality.

## Introduction

Bermudagrass is a high-yielding summer perennial that is an efficient user of nitrogen. Under high fertility input, bermudagrass is capable of producing large amounts of high-quality forage. With ideal growing conditions, bermudagrass can be harvested multiple times a year.

Producers have many different management approaches for their forage production. Fertilizer management options include no fertilizer, differing amounts of fertilizer, and frequency of application. A second management decision is whether the producer allows the forage to grow during the season with no harvesting, or whether the forage is harvested at intervals during the growing season. Harvesting the forage returns it to a vegetative stage.

This research was conducted to test the impact of fertilizer rates, timing, and harvesting scenarios on bermudagrass production and quality. Treatments were selected to correspond with how producers manage their fields.

## Experimental Procedures

The site selected for the trial was a Wrangler bermudagrass stand at the Southeast Research and Extension Center field outside of Columbus, KS that was established more than 15 years ago. Plots were 60 × 30 ft and replicated 3 times. The soil at the field is a Parsons silt loam. Lack of management had allowed other grasses to enter the stand. In March of 2021, before the bermudagrass broke dormancy, the stand was sprayed with glyphosate at the rate of 32 oz/a to eliminate many of the cool-season grasses that had encroached on the stand.

Plots were sampled for forage production and quality on July 7, August 12, and September 29 using a 3-ft Carder Forage Harvester. A 15-ft length of each plot was sampled. The entire sample was weighed and a sub-sample was taken to determine moisture, dry weight, and quality. Measurements were converted to an area basis based on total harvested weight. Biomass was determined after drying samples at 120°F for 3 days. Samples were sent to a commercial laboratory for quality analysis: crude protein (CP) and total digestible nutrients (TDN) contents.

Treatments 1 and 3 were harvested and mowed on September 29. Treatments 2, 4, and 5 were completely mowed on July 7, August 12, and September 29 after forage sampling. The purpose of harvesting mid-season was to promote regrowth. The

remaining treatments were allowed to grow without mowing and were harvested at the end of the growing season (September 29; Table 1).

### **Conditions**

Fertilizer was first applied on May 24. Rainfall in 2021 was very close to average, with consistent rain received throughout the year (Figure 1). Soil moisture was plentiful at the time of first fertilization. Temperatures in 2021 were cool during the early and mid-growing season (Figure 2) but increased later in the season to near-normal conditions. The month of May was unseasonably cool with good moisture which may have slowed the initial growth of the bermudagrass. Weather conditions were monitored at the Mesonet station in Columbus, located 6 miles from the field (<https://mesonet.k-state.edu/weather/historical/>).

### **Results and Discussion**

Bermudagrass is a forage that responds well to added nitrogen. At the July 7 harvest, the control plot with no fertilizer produced 2010 lb/a, whereas treatments 3, 4, and 5 each produced 4065, 3480, and 4670 lb/a respectively (Table 2). Protein levels were significantly different in treatment 1 than in treatments 3, 4, and 5. Crude protein for treatment 1 was 8%, while treatments 3, 4, and 5 ranged from 9.95 to 11.38%.

After the July 7 harvest, treatment 5 received an additional 100 lb of N/a. When directly comparing treatments 4 and 5 with the same management, treatment 5 produced 3285 lb/a while treatment 4 produced 2264 lb/a. The additional N applied at the August 12 sampling in treatment 5 only added about 1000 lb/a but resulted in 45% more forage than treatment 4. This return on investment of N is comparable to that observed in 2020 in which Treatment 5 had 47% more forage produced with the additional N application. Moreover, the crude protein (CP) level of treatment 5 was 12.98% compared to treatment 4, which was 10.24% CP. In the control with no fertility or management, crude protein level was 7.25% and treatment 3 was 6.9% CP. In comparison, treatment 2 which had been mowed, had a CP value of 8.82%. It demonstrates that harvesting the forage, returning it to a vegetative stage, will increase CP values and overall CP accumulation for the field.

Management or mowing played a large role in the overall performance of all the plots. Comparing treatments 1 and 2, total forage accumulation was 5030 lb/a in treatment 1 and 5330 lb/a for treatment 2 (Figure 3). However, total CP production was significantly different. Treatment 1 produced 231 lb of CP/a while treatment 2 produced 434 lb of CP/a. That is an 88% increase in protein per acre by harvesting the forage throughout the year and keeping the grass in a vegetative phase. Similar results were observed when comparing treatments 3 and 4. Forage accumulations were similar between treatment 3 and 4 (6385 and 6680 lb/a). However, there was a significant difference in CP production with 272 lb/a in treatment 3 and 654 lb/a in treatment 4, a 140% increase in CP production.

When adding additional nitrogen throughout the year and managing the growth of the forage, CP production of bermudagrass was greatly improved. Treatment 5 produced an additional 2866 lb/a of forage and 547 lb/a of CP when compared to treatment 4. Adding a second and third application of nitrogen and keeping the forage in a vegetative stage by mowing improved the CP production by 84% over treatment 4.

The TDN values were similar among treatments in each harvest date. However, greater TDN values were observed from the August 12 sampling, after the plots being mowed in July, averaging 61%. After mowing, old tissues are removed and the new forage mass is mostly composed of new leaves, resulting in greater nutritive value.

### Recommendations

Management or mowing may play a larger role in forage quality than fertilization. Fertilization is extremely beneficial, but only if it is properly managed.

Effective fertility management practices will provide the highest production and quality of bermudagrass forage. Mowing bermudagrass when it heads out will increase forage quality regardless of nitrogen and contributes to resetting it to a vegetative phase. Adding nitrogen and mowing the grass throughout the year will give the best production and quality for bermudagrass.

If bermudagrass is used for summer grazing, when it matures it needs to return to a vegetative state. If not, the forage will fail to meet the animal’s nutritional requirements. Nitrogen application will also enhance forage production and protein value, helping to meet the animal’s nutritional needs.

### Acknowledgments

Farmers Co-op of Columbus and Baxter Springs, KS, provided the fertilizer for the experiment.

**Table 1. Treatments, mowing, and nutrient management in bermudagrass, Columbus, KS**

Treatment	Fertilizer (May 24)	Mowing	Fertilizer (July 9)	Mowing	Fertilizer (August 13)	Mowing
1	None		None		None	
2	None	July 7	None	Aug. 12	None	Sept. 29
3	100 lb N		None		None	
4	100 lb N	July 7	None	Aug. 12	None	Sept. 29
5	100 lb N	July 7	100 lb	Aug. 12	100 lb N	Sept. 29

## FORAGE CROPS

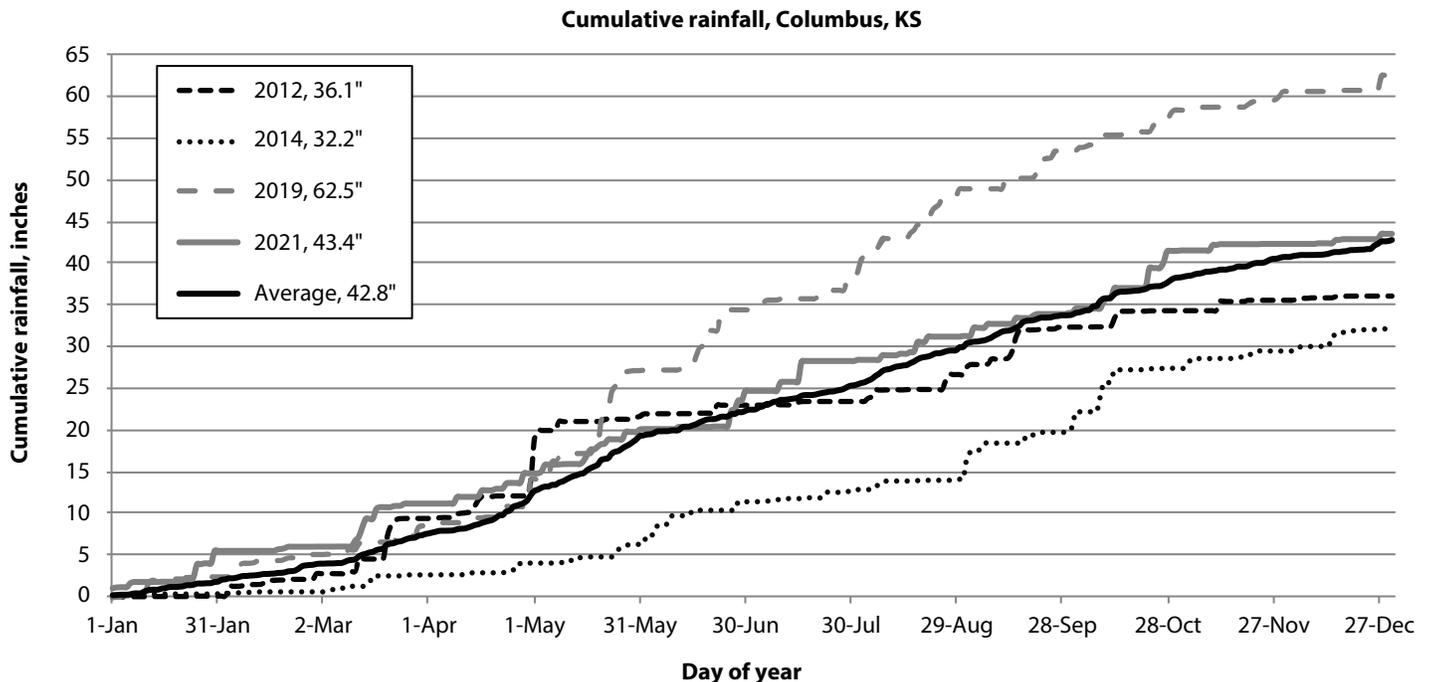
**Table 2. Forage accumulation (FA, lb/a), crude protein (CP, %), and total digestible nutrients (TDN, %) in bermudagrass, Columbus, KS**

	FA, lb/a	CP, %	TDN, %
July 7, 2021*			
Treatment 1**	2010	8.18	51.55
Treatment 3***	4065	10.0	52.45
Treatment 4	3480	9.95	51.79
Treatment 5	4670	11.38	49.61
August 12, 2021			
Treatment 1	2460	7.25	62.12
Treatment 2	2105	8.82	60.15
Treatment 3	4145	6.9	60.81
Treatment 4	2265	10.24	60.36
Treatment 5	3285	12.98	61.77
September 29, 2021			
Treatment 1	5030	4.59	50.69
Treatment 2	1220	6.93	49.2
Treatment 3	6385	4.25	47.12
Treatment 4	940	8.13	48.58
Treatment 5	1590	15.26	50.90

\*Sampling dates.

\*\*See Table 1 for the explanation of treatments.

\*\*\*At the July 7 harvest, treatment 1 and 2 are the same.



**Figure 1. Cumulative annual rainfall. Extreme years (2014 and 2019) are shown in comparison with the 12-year average.**

# FORAGE CROPS

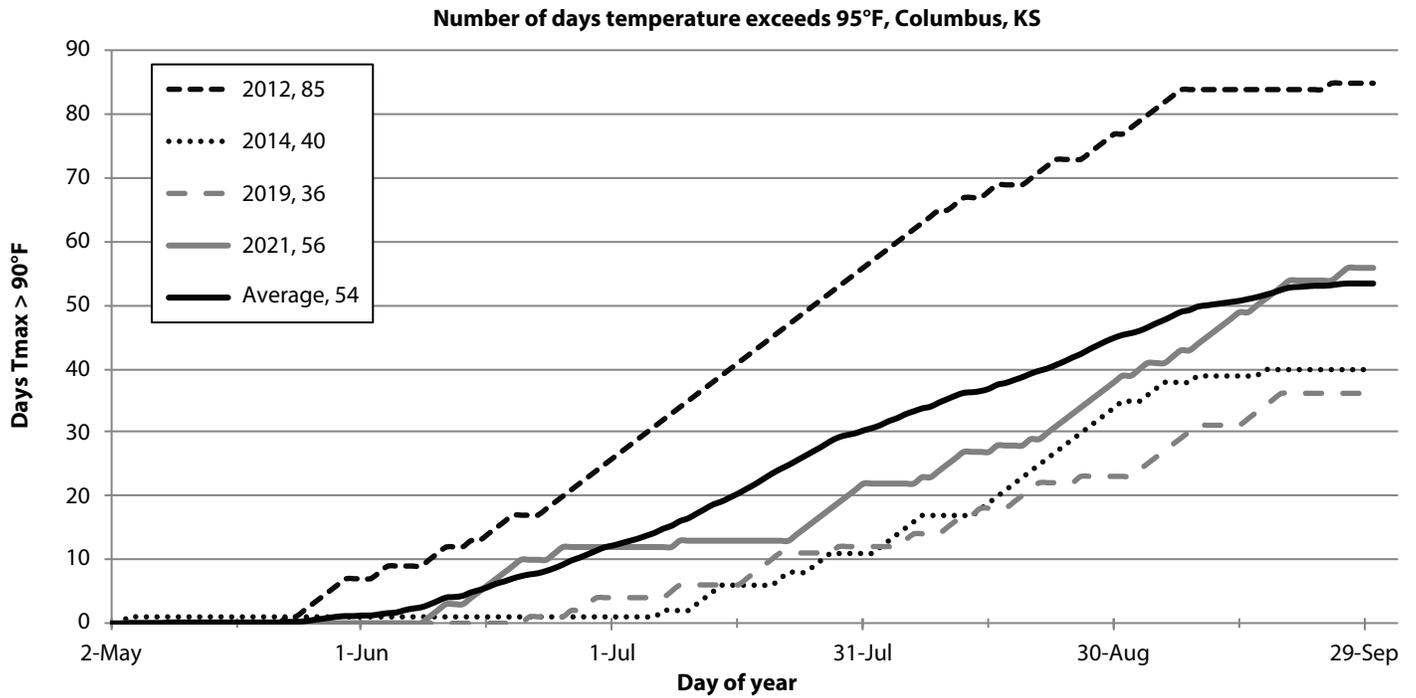


Figure 2. Cumulative number of high temperature days during the summer season.

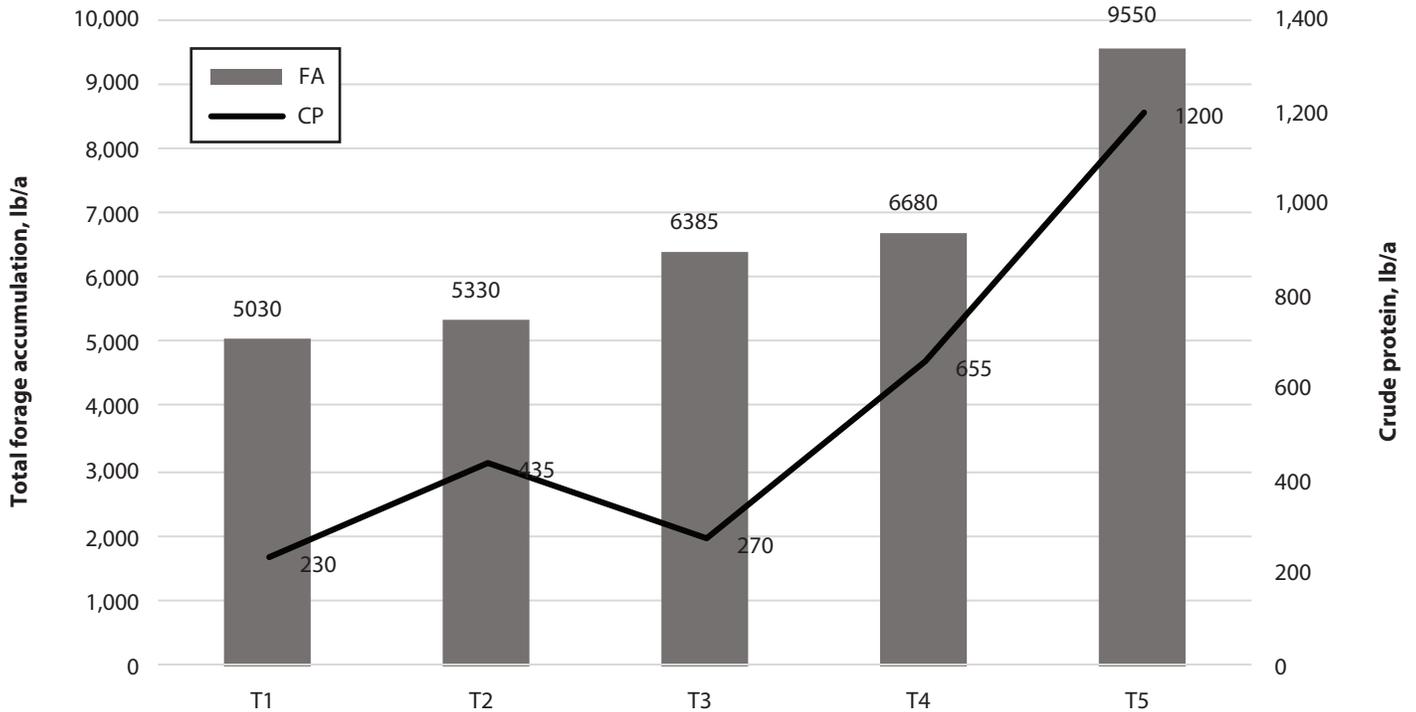


Figure 3. Total forage accumulation and crude protein production in bermudagrass, Columbus, KS.

# Impact of Fertility and Mowing on Crabgrass Quantity and Quality for Hay Production in Southeast Kansas

*B. Pedreira, D. Helwig, M. Haywood, J.K. Farney, and G.F. Sassenrath*

## Summary

A crabgrass variety trial comparing Quick-N-Big and Mojo crabgrasses was conducted in 2021 at the K-State Experiment Station outside of Columbus, KS. The trial evaluated forage quantity and quality under different fertilization and harvest management practices.

## Introduction

Forage is a major component of the livestock production system in southeast Kansas. Forage can be grazed, or harvested as hay to supplement cattle feeding during the winter. Crabgrass is a high-yielding summer annual that complements cool-season forages or can be used as a cover crop for summer forage. Mojo crabgrass is a blended seed variety with a large portion of the blend derived from Impact Crabgrass from the Noble Research Institute. Quick-N-Big is a commonly planted variety that has been shown to grow successfully in southeast Kansas and was chosen as a comparison.

In addition to new varieties, fertility management practices can be an alternative to increase forage production and quality. Producers have many different management approaches to forage production. Management choices range from no fertilization to different amounts and frequency of fertilization. However, there is a need to understand the impact of fertilization associated with harvest management. The main difference in production and quality has been reported when producers harvest the forage during the summer, putting the forage back in a vegetative stage. Our objective was to determine how fertilization and harvest management can be used as a tool to improve the production and quality of crabgrass hay. The treatments in the research trial varied fertilizer rates, timing, and harvesting scenarios corresponding with common production choices.

## Experimental Procedures

In 2020, plots were established in a field at the Southeast Research and Extension Center near Columbus, KS. Plots were 60 × 10 ft and replicated 3 times in a Parsons silt loam soil. Before planting, the field was disked and field cultivated. A cultipacker was used to provide a firm seedbed. The seed was planted using a Brillion seeder that dropped the seed in front of packing wheels to a scant ¼ inch depth at a rate of 6 lb/a. In 2021, plots were fertilized on May 24, sampled on July 7, and additional N was added to treatment 5 on July 9. Nitrogen was broadcast by hand as urea at the rate of 100 lb N/a as defined by the treatment. Treatments are summarized in Table 1.

Plots were sampled for forage production and quality on July 7 and August 12 using a 3-ft Carder Forage Harvester and sampled in a 15-ft length. The entire sample was weighed and a sub-sample was taken to determine moisture, dry weight, and quality. Measurements were converted to an area basis based on total harvested weight. Forage

production was determined after drying samples at 120°F for 3 days. Samples were sent to a commercial laboratory for quality analysis of crude protein (CP) and total digestible nutrients (TDN) contents. Crude protein production was calculated by multiplying the forage mass by the CP content. Nutritive value data presented in this report are from August 12.

Treatments 2, 4, and 5 were completely mowed on July 7 after forage sampling. This simulated harvesting of the forage for hay and stimulated regrowth. The remaining treatments were allowed to grow without mowing until the final harvest on August 12.

The weather during the growing season was recorded at the Mesonet station in Columbus, located 6 miles from the field (<https://mesonet.k-state.edu/weather/historical/>). Temperatures were cool and extremely wet through April and most of May, which may have slowed the initial growth of the crabgrass (Helwig et al., 2022). Weeds such as foxtail and barnyard grass were prevalent in the plots, largely due to wet and cool conditions late in the spring. No herbicide or weed control was used. Moisture was sporadic the rest of the summer, but overall growing conditions were favorable in the summer of 2021.

### Results and Discussion

The fertilization of crabgrass has a direct effect on total forage accumulation (TFA) and CP levels in the forage (Table 2). However, harvest management of the forage also plays a key role. When 100 pounds of N were added to Mojo and Quick-N-Big after the first sampling, TFA increased by 350 and 675% compared to control, respectively, demonstrating that crabgrass responds well to nitrogen application.

A key component of this trial was to show how management affects the quality of the grasses. Ideally, CP levels in hay should be from 9% (for dry cows) to 12% (for lactating cows). At first cutting, there was not a large difference in CP among treatments, but when considering FA, the application of nitrogen greatly increased the protein availability for the animal. In the Quick-N-Big treatments, the application of N increased CP from 8.5% in the control to between 9.5 and 11% in the other treatments.

Harvest management of the forage played a small role in the TFA. However, harvesting the forage and resetting the plant to a vegetative stage played a large role in the total CP produced throughout the growing season.

Different harvest management practices increased the total pounds of protein produced when similar fertilizer treatments were used. Comparing treatments 1 and 2, where no nitrogen was applied, there was a 75% increase (Mojo) and a 30% increase (Quick-N-Big) in total protein accumulation by harvesting the plant and returning it to a vegetative stage.

Between treatments 3 and 4, there was an increase of 77% (Mojo) and 17% (Quick-N-Big) in pounds of protein produced by harvesting and returning it to a vegetative phase. Applying additional N after the first harvest even further increased crude protein accumulation. Treatment 5 had an increase of 49% (Mojo) and 97% (Quick-N-Big) in CP production over treatment 4 which only had 100 pounds of nitrogen applied.

If the forage was not harvested during the season, crude protein levels of the plant dropped below 6% regardless of nitrogen application. This level of protein will not support a dry cow's protein requirement and the animals will lose weight and decrease performance.

The TDN values were similar among treatments, especially with Quick-N-Big. However, comparing Mojo treatments 4 and 5, the greatest value was observed in treatment 5, which was fertilized again in July. It highlighted Mojo's potential to maintain high CP and TDN values when a second nitrogen application was performed along with the harvest.

### Recommendations

Crabgrass responds very well to nitrogen. However, management is key to achieving greater performance. The increased CP production correlates to increased animal gains and performance. If crabgrass is used for summer grazing, when it matures it needs to return to a vegetative stage to maintain the forage quality.

Nitrogen application improved TFA but also increased CP production. Combining nitrogen application with timely harvest of the forage will increase the total pounds of crude protein harvested from the field. After crabgrass reaches maturity, it will continue to increase in TFA, but CP values will decrease unless it is harvested and returned to a vegetative stage.

Recommendations are to apply nitrogen early in the growing season to stimulate forage growth. Then an additional nitrogen application and harvest can be conducted to return the grass to a vegetative state to increase TFA and the total amount of CP produced, whether the grass is intended for haying or grazing throughout the growing season.

### Acknowledgments

Farmers Co-op of Columbus and Baxter Springs, KS, provided the fertilizer for the field trial.

### References

Helwig, D., Haywood, H., Farney, J., Sassenrath, G.F., Pedreira, B. 2022. Bermudagrass Under Different Fertility and Harvest Management Practices. *Kansas Agricultural Experiment Station Research Reports*: Vol. 8, Issue 3. <https://newprairiepress.org/kaesrr/vol8/iss3/>.

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## FORAGE CROPS

**Table 1. Fertility and mowing treatments for Mojo and Quick-N-Big crabgrass, Columbus, KS**

Treatment	Mowing		Fertilizer (May 24)	Fertilizer (July 7)
1	None	August 12	None	None
2	July 7	August 12	None	None
3	None	August 12	100 lb N	None
4	July 7	August 12	100 lb N	None
5	July 7	August 12	100 lb N	100 lb N

**Table 2. Total forage accumulation (FA, lb DM/a) during the growing season, and crude protein (CP, %), total digestible nutrients (TDN, %), and CP production (lb/a) from the August 12 harvest in Mojo and Quick-N-Big crabgrass, Columbus, KS**

Treatment*	TFA, lb DM/a	CP, %	TDN, %	CP production, lb/a
Mojo				
1	1797	5.05	58.01	91
2	1746	6.74	57.64	159
3	5086	4.98	57.74	253
4	6092	7.28	55.62	449
5	7037	9.37	60.84	667
Quick-N-Big				
1	1746	4.75	58.72	83
2	1406	7.24	58.90	108
3	7539	4.70	58.04	354
4	4662	7.91	56.87	413
5	7634	10.41	57.56	815

\*See Table 1 for treatment details.

# Fertilization Management to Improve Stockpiled Tall Fescue in the Fall

*B.C. Pedreira, D. Helwig, M. Haywood, J.K. Farney, and G. Sassenrath*

## Summary

In 2019 and 2021, a tall fescue fertility study was conducted at the K-State Experiment Station near Columbus, KS. The purpose of the study was to determine the effect of summer fertilization on forage quality and quantity in stockpiled fescue. If a producer can stockpile high-quality forage for late fall and early winter grazing, protein supplementation may not be necessary for fall calving cows.

## Introduction

Tall fescue is a cool-season perennial grass used in many parts of the United States. Fescue can be used for hay production but is more widely accepted as a grazing forage. Grazing endophyte-infected fescue in the summer can be problematic because of its effect on cattle, potentially causing long hair coat, elevated body temperature, and reduced blood flow. However, with cooler temperatures in the fall and winter, the symptoms are less severe, making fescue a more desirable forage at this time. By stockpiling fescue, producers can graze warm-season forages longer and reduce the amount of hay needed to feed cattle during the winter, decreasing overall expenses in the forage-livestock operation.

Additional fertilizer applied in the fall results in more grazable forage and plants with a higher crude protein value well into late fall and early winter, decreasing the need for expensive protein supplements. Fescue grass will actively grow as long as temperatures remain above freezing. Fescue does not mature in the fall as it will in late spring, making it a less fibrous foodstuff and maintaining its crude protein value. Additional techniques such as rotational grazing or strip grazing can further extend the grazing period. However, this study is designed to understand the effect of late-summer fertilization on forage quality. The research will identify if fescue will meet the cow's protein and energy requirements in December, and how much additional forage can be produced.

## Experimental Procedures

The site selected for the trial was tall fescue (Kentucky 31) stand at the Southeast Research and Extension Center field near Columbus, KS, that was established more than 15 years ago. Plots were 30 × 10 ft and replicated 3 times. The soil at the field is a Parsons silt loam soil. The treatments were 6 commercial fertilizer mixes (N at 0, 40, 60, 80, or 120 lb/a, P at 0 or 50 lb/a, and K at 0 or 30 lb/a) and the unfertilized control (Table 1). The plots were mowed (4-in. height) and treatments were applied in 2019, 2020, and 2021. However, 2020 was not evaluated due to a severe dry period.

Plots were sampled for forage production and quality on December 12, 2019, and December 15, 2021, using a 3-ft Carder Forage Harvester, and samples were collected in a 15-ft length. The entire sample was weighed and a sub-sample was taken to determine moisture, dry weight, and quality. Measurements were converted to an area basis based on total harvested weight. Forage mass (FM) was determined after drying samples at 120°F for 3 days. Samples were sent to a commercial laboratory for quality analysis:

crude protein (CP) and total digestible nutrients (TDN) contents. Crude protein production was calculated by multiplying the FM by the CP content.

### **Conditions**

Overall, 2019 was an extremely wet year (Figure 1A). Fertilizer treatments were applied on September 23, 2019. Moisture was adequate for September and October; however, November was significantly dryer and there was no precipitation in December prior to harvest. The first frost was also early that year, October 12, which may have slowed forage growth (Figure 1B).

In 2021, fertilizer treatments were applied on August 30. Moisture was adequate and the site received 0.98 inches of rain on September 3, which contributed to distribution of the fertilizer into the soil. Favorable conditions continued until harvest. The first frost was on November 4, and temperatures remained above normal through much of November and December, allowing for good growing conditions. The weather was monitored by the Mesonet station in Columbus, located 6 miles from the field (<https://mesonet.k-state.edu/weather/historical>).

### **Results and Discussion**

In 2019, the fertilizer was applied late in the growing season, thus not allowing the crop to fully utilize the nutrients. However, there was still a significant change in FM and CP produced in the different treatments over the control (Table 2).

In 2021, a more dramatic effect was seen in the plant's response to fertilization, specifically nitrogen. Treatment 2 was 59% higher in FM and 119% higher in weight of CP per acre than the control. A similar response was seen in 2019 as well. The 2021 results continued to show a linear increase in FM and CP produced per acre as an additional 40 pounds of nitrogen was added between treatments 2 and 3. There was an increase of FM (66%) and CP (40%) from treatment 2 to treatment 3. There was no difference in FM between treatments 3 and 4 but there was an increase in CP accumulation, especially in 2021, when an additional 40% increase in CP was measured. Treatment 4 had the cheapest cost of additional lb of crude protein produced (1.7 lb of DM per lb of N applied).

The addition of nitrogen in all treatments increased TDN values to the point that little energy supplementation would be needed for cattle feed, with the exception of treatment 2 in 2021. The TDN values in the fertilized treatments are typically higher than the values producers would have in their grass hays.

Adding additional P to the fertilization package had little effect on FM and CP but the addition of K in 2021 did show a response. The addition of P and K to the treatments would likely contribute to the forage production the following spring.

Overall, fall fertilization of tall fescue grass when used for grazing can be advantageous to producers. Lactating cows require a crude protein diet of about 12%, which was reached with fall nitrogen fertilization of the fescue. The larger the amount of nitrogen applied, the higher crude protein values in the hay.

## Recommendations

Fall fertilization of fescue will increase forage growth, CP, and TDN values of the forage. Higher CP values will decrease the producers' need to feed expensive protein supplements to lactating animals, saving supplementation expenses. Increased forage production will also reduce the need for feeding hay by prolonging the grazing season. Techniques such as stockpiling forage then strip grazing the pasture will further extend the grazing season.

Fertilization rates are recommended at 60 to 80 pounds of nitrogen for increased forage growth, higher crude protein, and TDN levels in the forage. It is uncertain if additional phosphorus or potassium fertilization leads to increased forage growth, but in 2021 treatment 6 presented higher values. Further research is needed, but the general recommendation is to apply phosphorus and potassium according to soil analysis.

## Acknowledgments

Farmers Co-op of Columbus and Baxter Springs, KS, provided the fertilizer for the experiment. The Columbus Unified High School 493 Chemistry II class assisted in applying fertilizer, taking measurements, and harvesting of the plots.

**Table 1. Commercial fertilizer applied in each treatment of fescue, Columbus, KS**

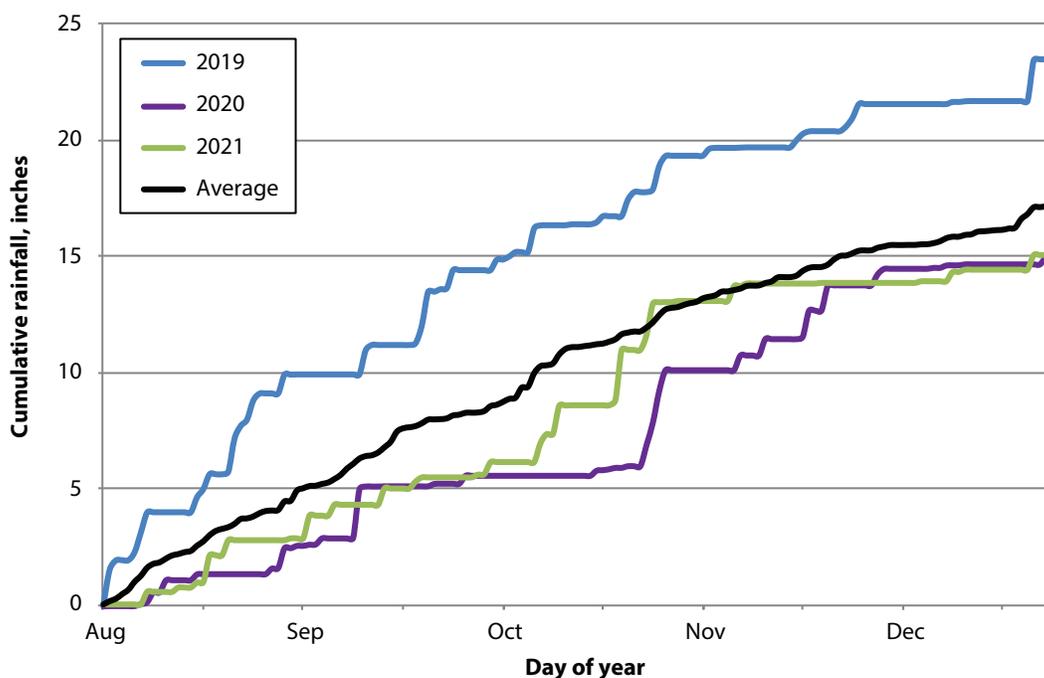
Treatment	Fertilizer
1	Control
2	40-0-0
3	80-0-0
4	120-0-0
5	120-50-0
6	120-50-30
7	60-50-30

## FORAGE CROPS

**Table 2. Forage mass (FM, lb DM/a), crude protein (CP, %), total digestible nutrients (TDN, %), and CP production (lb/a) in stockpiled fescue, Columbus, KS**

Treatment*	FM, lb DM/a	CP, %	TDN, %	CP production, lb/a
2019				
1	512	7.73	54.7	40
2	846	10.28	60.0	87
3	788	11.98	60.6	94
4	793	12.86	62.7	102
5	793	14.53	63.4	115
6	692	14.09	63.5	98
7	835	10.53	61.8	88
2021				
1	632	6.57	58.8	42
2	1007	9.11	52.2	92
3	1673	8.85	60.6	148
4	1630	12.53	64.1	204
5	1732	11.60	62.0	201
6	1915	12.22	67.1	234
7	1503	9.47	63.8	142

\*See Table 1 for treatment details.



**Figure 1. Cumulative rainfall during the fall season for 2019, 2020, and 2021. The 12-year average rainfall is shown for comparison (darkest line).**

# FORAGE CROPS

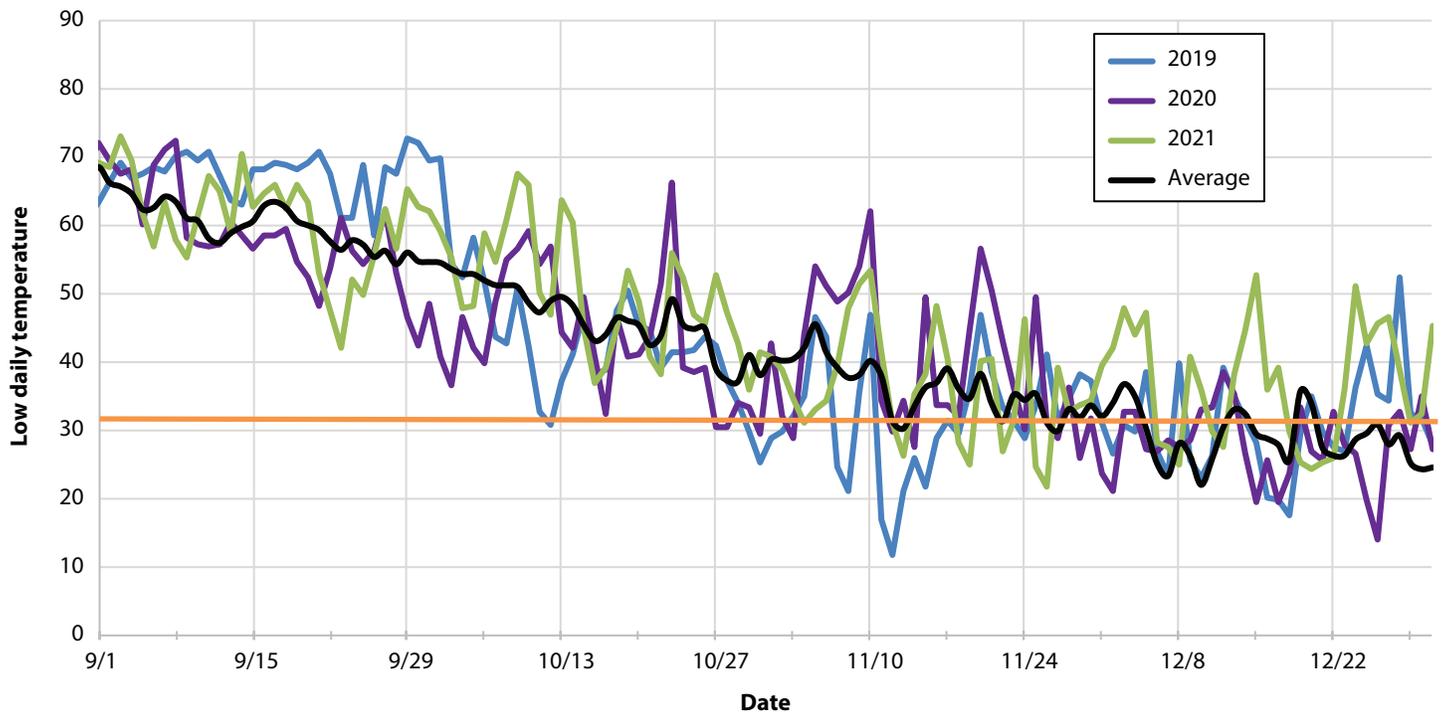


Figure 2. Low daily temperature for the study period and 11-year average (darkest line). Freezing temperature (32°F) is marked with a solid orange line.

# Crop Production Summary - 2021

*G.F. Sassenrath, L. Mengarelli, J. Lingenfelser, M. Knapp, and X. Lin*

## Summary

Soybean and corn varieties were tested in replicated field trials at the Southeast Research and Extension Center in Parsons through the Kansas State University variety testing program. In total, 26 corn varieties and 28 soybean varieties were tested. Weather during 2021 was near average for both rainfall and temperature, though there were periods of high rainfall and high temperatures. Corn and soybean production was also near average, both across the state and in the cultivar trials at Parsons.

## Introduction

Cultivar selection is an important determinant of potential yield. Kansas State University tests crop cultivars through the variety testing program. These tests establish a consistent baseline of common production practices, allowing comparison of variety performance under common growth conditions.

Other factors, including environmental conditions, soil, and management practices also impact crop production and yield. The temperature and precipitation conditions during the 2021 growing season are summarized and compared to previous years and the historical averages. Temperature plays a critical role in crop production. Early season soil temperatures are important for seed germination and stand establishment, while temperatures throughout the growing season regulate crop development and stages of development (vegetative, reproductive, and maturation). Temperatures that are too high or too low can negatively impact crop production and development. Cumulative Growing Degree Days (GDD) are a common measure of estimating crop growth and development. Rainfall is critical for crop establishment, growth, and development. Excessive rainfall can also contribute to crop disease development, especially in high-rainfall areas such as southeast Kansas.

This report summarizes results of the variety testing for soybeans and corn from 2021. Soybeans tested included 28 varieties from maturity groups 3-5. Corn varieties tested included 23 cultivars and 3 maturity checks (full, mid, and short season).

## Experimental Procedures

The Kansas State University Crop Performance Tests were conducted in replicated research fields throughout the state. This report summarizes crop production for southeast Kansas, focusing on crops grown at Parsons, and Columbus, KS. In 2021, all crop varieties were tested in upland fields (Parsons silt loam soil) at the Southeast Research and Extension Center in Parsons. All crop variety trials are managed with conventional tillage. Individual variety results are available at the K-State Crop Performance Test web site (<http://www.agronomy.k-state.edu/services/crop-performance-tests/>).

Full-season soybeans were planted in 30-in. rows on June 8, 2021, in Parsons, and harvested October 7, 2021. No fertilizer was applied. Weeds were controlled with glyphosate (1.5 qt/a), Dual II Magnum (2 pt/a), metribuzin (0.5 lb/a), and Authority XL (6 oz/a).

Corn varieties were planted on April 9, 2021, in 30 in. rows at a rate of 22,500 seed per acre. Plots were fertilized at a rate of 180-46-60 lb/a N-P-K. Weed control was glyphosate (2 qt/a), atrazine 4L (2 qt/a) and 2,4-D (2 qt/a). Plots were harvested on September 14, 2021. Sunflower and sorghum variety plots were abandoned due to technical difficulties.

Weather data were collected from the Kansas Mesonet website (<http://mesonet.k-state.edu/agriculture/degreedays/>) from a weather station located at SEREC in Parsons. Cumulative rainfall was calculated throughout the year and during the summer growing season (March – September). Cumulative growing degree days were calculated using a base of 50°F during the summer growing season. The number of days of high temperatures (greater than 90°F) were calculated during the summer growing season.

### Results and Discussion

Total rainfall received during 2021 (42.2 in.) exceeded the 12-year average (34.5 in.) (Figure 1A). Early season rainfall (March through May) was near average (Figure 1B). However, two substantial rainfalls in late June and early July contributed 16 in. of rain over a 22-day period. This time period is critical for double-cropped soybean establishment and corn pollination. Although total rainfall was above average because of these high rainfall amounts, the remainder of the growing season had near-normal precipitation.

Temperatures during 2021 were below average, as seen in the lower-than-average accumulation of GDD50 (Figure 2A). In early June, the number of high temperature days ( $T_{max} > 90^{\circ}\text{F}$ ) was above average (Figure 2B). After this 10-day warm period, cooler temperatures were experienced during the middle of the growing season. Total high-temperature days were normal by the end of the season.

Soybeans were planted on 4.85 million acres in 2021, a slight increase over the 4.8 million acres planted in 2020. Statewide average soybean yield (39.5 bu/a) was slightly less than in recent years but above the 10-year statewide average yield of 38.4 bu/a (Figure 3). Twenty-eight cultivars from maturity groups 3-5 were tested at Parsons. Average yield in the full-season test was 35.0 bu/a, with a range from 29 to 41, below the statewide average and well below yields observed in variety trials in recent years.

Corn was planted on 5.7 million acres in Kansas in 2021, a decrease in acreage from the 6.4 M acres in 2019 and 6.1 M acres in 2020. Statewide average yield in 2021 was 139 bu/a, slightly above the yields harvested recently, though well above the 10-year average statewide yield of 118 bu/a that includes the extreme drought years of 2012 and 2013 (Figure 4). Average yield in the corn variety trials was 131 bu/a, with a range from 109 bu/a to 154 bu/a, similar to yield trends in previous years.

### Conclusions

Weather in 2021 was fairly typical. Above-average rainfall was the result of two very heavy periods of rain in late June/early July. The rather dry period prior to that reduced double-cropped soybean establishment. Temperatures were also cooler than average, except for a period of high temperatures in early- to mid-June that coincided with the dry conditions, further reducing double-cropped stand establishment. Corn and

soybean yields reflected the average weather conditions, as both crops produced near average yields both statewide and in the variety trials.

### Acknowledgment

This report summary is part of the 2021 Soybean and Corn Performance Tests, SRP1158.

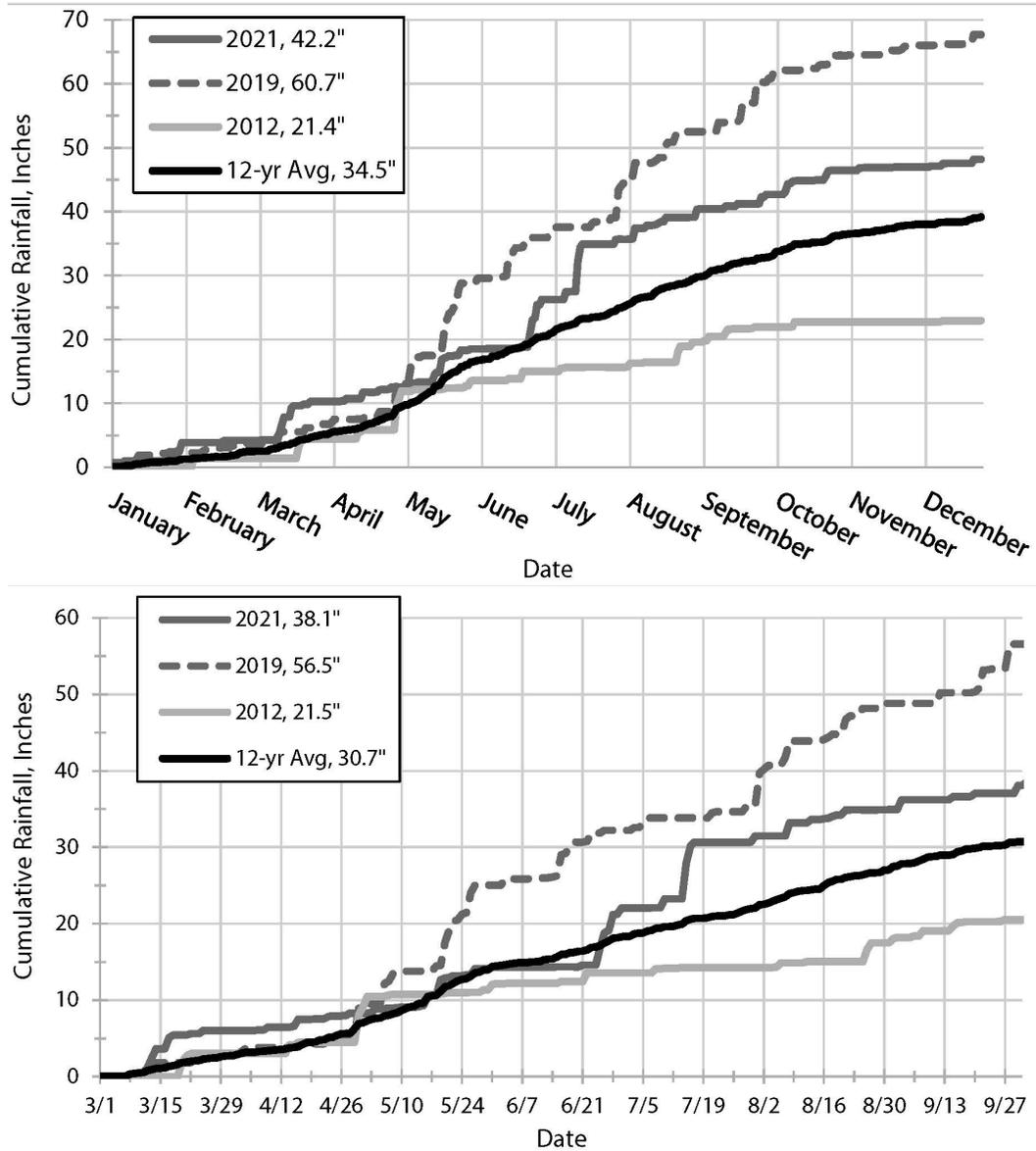


Figure 1. Cumulative rainfall during the calendar year (A) and summer growing season (March – September) for 2021. Extreme years (2012 and 2019) are shown in comparison with the 12-year average.

# CROPPING SYSTEMS RESEARCH

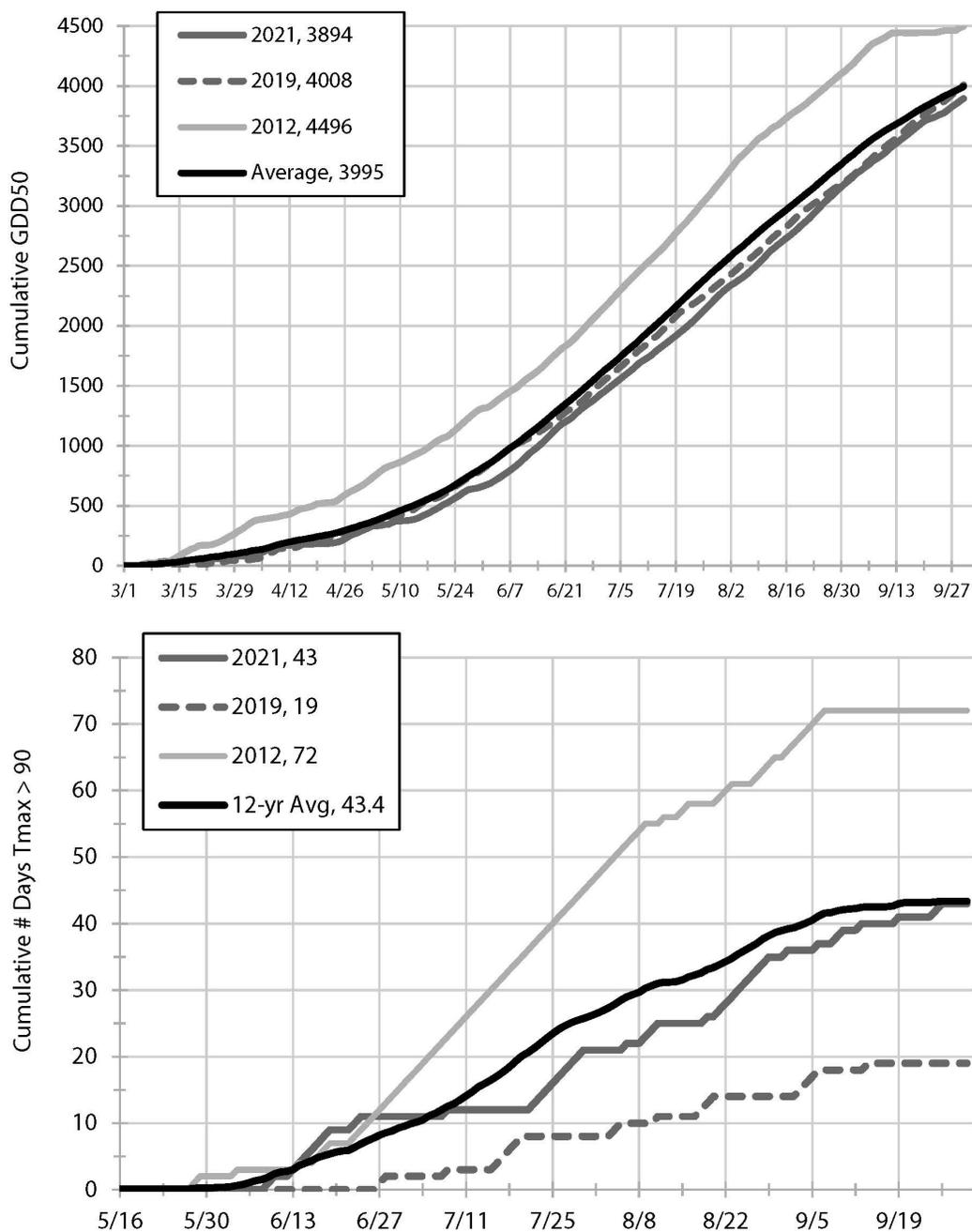


Figure 2. Cumulative growing degree days (50°F) (A) and cumulative number of high temperature (>90°F) days during the summer growing season (March – September) for 2021. Extreme years (2012 and 2019) are shown in comparison with the 12-year average.

Soybeans

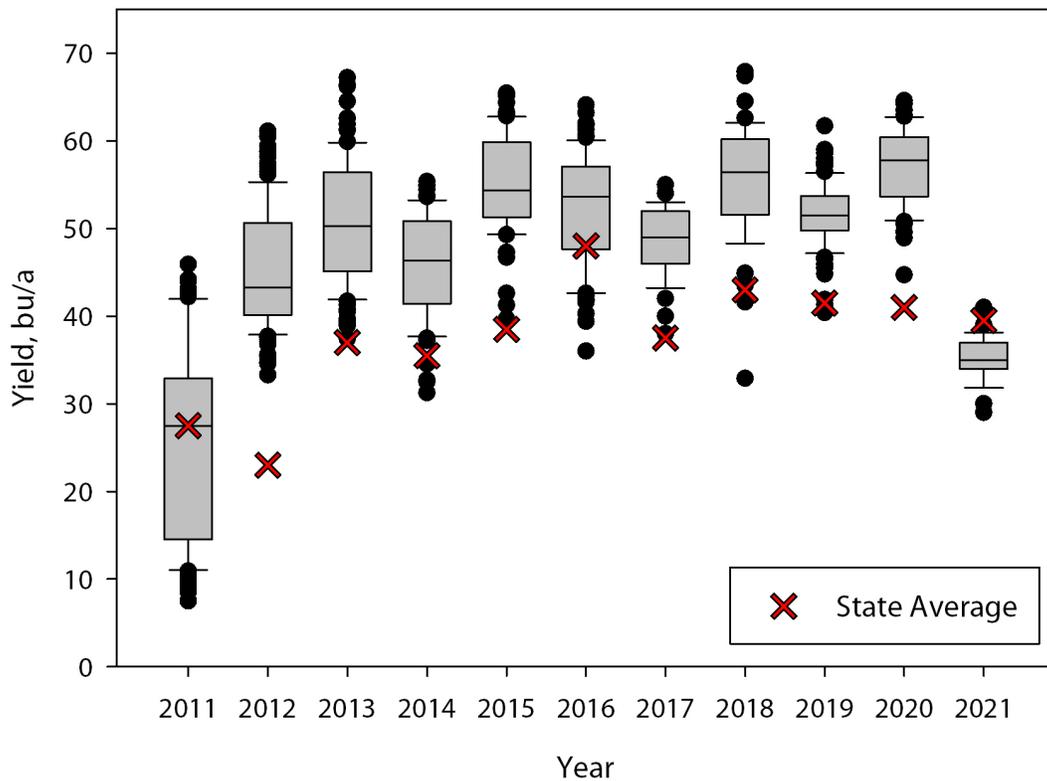
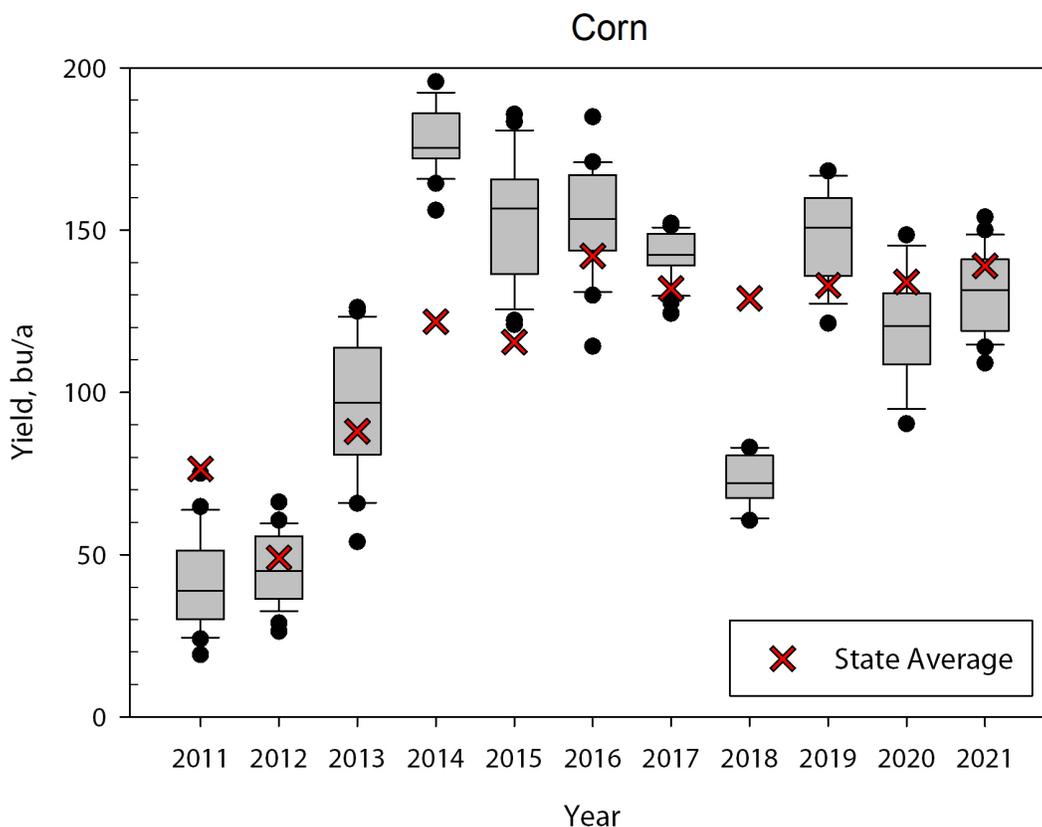


Figure 3. Comparison of soybean yield for full-season tests at Parsons. The line in the middle of the box plots is the median yield of all varieties. The upper and lower quartiles are given by the upper and lower edges of the boxes. The maximum and minimum values are given by the upper and lower “whiskers” extending from the box. Outliers are given as solid circles. For comparison, average reported yields from Kansas are highlighted as a red X.



**Figure 4.** Corn from variety trials grown at Parsons, KS from 2011 through 2021. For comparison, average reported Kansas state yields are highlighted as a red X. The upper and lower quartiles are given by the upper and lower edges of the boxes. The maximum and minimum values are given by the upper and lower “whiskers” extending from the box. Outliers are given as solid circles. For comparison, average reported yields from Kansas are highlighted as a red X.

# Using Cover Crops to Control Weeds and Improve Soil Health

*J. Dille, A. Hewitt, and G.F. Sassenrath*

## Summary

Herbicide-resistant weeds are challenging for producers to control in crop fields. This study explores the potential of cover crops to reduce weed pressure and improve soil health. Cover crops that had good canopy development, including grasses such as ryegrass and wheat, had the best weed control. Soybean yields were similar for all cover crops, though there was a trend towards lower yields for the brassica cover crops, Graza radish and forage collards. Soybeans grown after ryegrass had the highest yields.

## Introduction

Weed management is a critical component of good crop production. Increased use of herbicides has created development of herbicide resistance in many weed species, requiring development of alternative management practices to control these resistant weeds. Use of cover crops is an alternative management practice that has been reported to reduce weed pressure. Cover crops are also useful in increasing the diversity of plants grown in a field, potentially contributing to improved soil health. This study was designed to determine weed emergence and growth in crop fields in southeast Kansas.

## Experimental Procedures

Cover crops were planted in replicated blocks in the fall at the Southeast Research and Extension Center in Parsons, KS. Plots included: control (fallow with herbicide, no cover crop); wheat; Graza radish; annual ryegrass; winter oats; spring oats; forage collards; and a commercial cover crop mix. We also compared a mix of radish + ryegrass planted using both drilled and broadcast methods. Initially, there was a difference in cover crop emergence and stand establishment between the drilled and broadcast mixes. However, that difference disappeared by the spring due to winterkill of the radish.

Plant biomass samples were taken in the spring prior to cover crop termination. Total plant biomass was harvested from each plot, weighed, and dried. Soil samples were taken to a depth of 6 in. in the fall and in the spring and assayed for nutrients and biological activity.

In the spring, weed emergence was monitored across all cover crop plots using permanent PVC rings (Figure 1). Weed species were identified, counted, and pulled from each ring, until time of cover crop termination. Plant biomass samples of both cover crop and weed communities were taken in the spring prior to termination of the cover crops. Soybean was planted as the cash crop. Soybean yields were measured at harvest.

## Results and Discussion

Biomass samples of the cover crops and weeds were collected in mid-May of 2021, prior to termination of the cover crops. Some cover crops were poorly established (Graza radish and forage collards) or had strong winter kill (spring oats) and showed significantly reduced biomass. With more solid cover crop stand, weed counts were reduced

(Figure 2). Significantly more weed plants were observed with no cover crop, while an approximately 50% reduction in weed counts were observed in the presence of cover crops such as mixtures of radish and ryegrass, the commercial mixture, and winter wheat.

While results from previous years show excellent reduction in weed biomass with cover crops, this year the field had a strong foxtail infestation, increasing the weed biomass.

Cover crops do impact soybean yields (Figure 3). Data from harvest in fall 2020 indicated that soybean yields were 7.6 bu/acre higher than after fallow when grown after ryegrass, but 8.8 bu/acre lower when grown after Graza radish and nearly 7 bu/acre less with forage collards. This was particularly interesting, as the Graza radish and forage collards were winter-killed and did not have a large canopy in the spring. Conversely, the ryegrass had a very full canopy in the spring. The impaired yield from brassica species was somewhat alleviated when these cover crops were mixed with ryegrass. Other grass species (oats and wheat) also increased soybean yield slightly above the overall average across all treatments. Soil microbial composition also changed with cover crop (Figure 4). Bacterial percentage was the highest in all cover crop treatments, with a similar pattern in percentage of actinomycetes and fungi.

### Conclusions

Cover crops are a potentially good alternative to chemical use for weed management. Good establishment of the cover crop is important to ensure adequate weed control. Grass species, especially ryegrass and wheat, demonstrated good weed control this year, though additional weed pressure from a weedy grass species reduced their efficacy. In previous years, oats have also demonstrated good control. Additionally, ryegrass, wheat, and spring oats improved soybean yields. Under some conditions, radish or collards are difficult to establish and are winter-killed, providing inadequate weed control. Moreover, these species interfere with soybean production, reducing soybean yield.

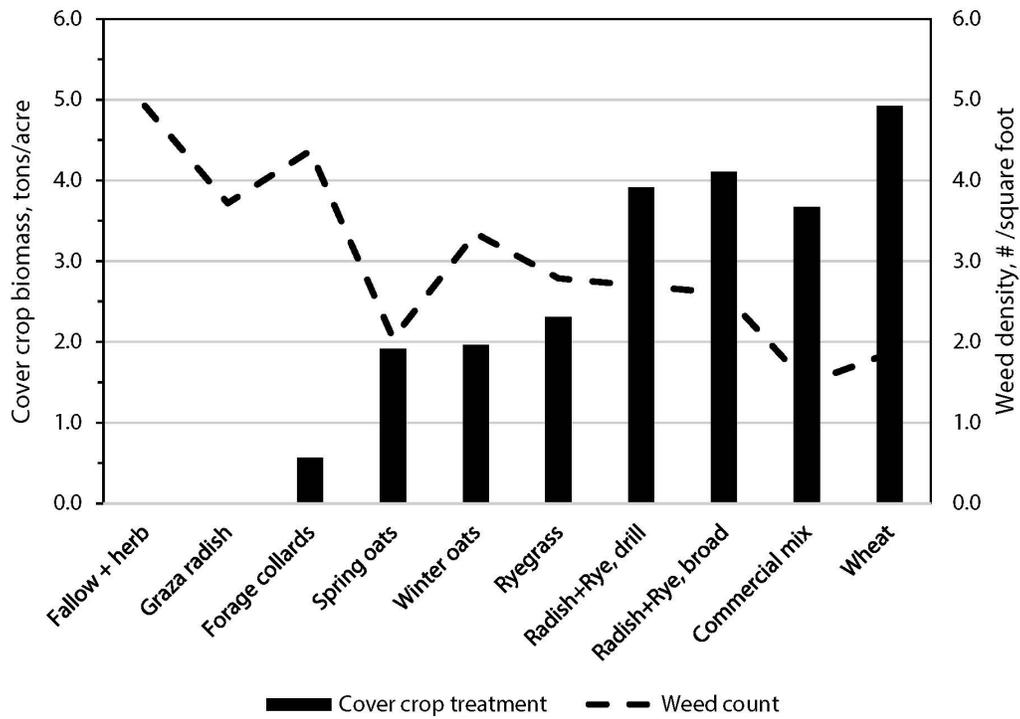
### Acknowledgments

This work is supported by the U.S. Department of Agriculture National Institute of Food and Agriculture, Hatch project 1018005 and the NRCS KS-CIG grant NR196215XXXXG003.

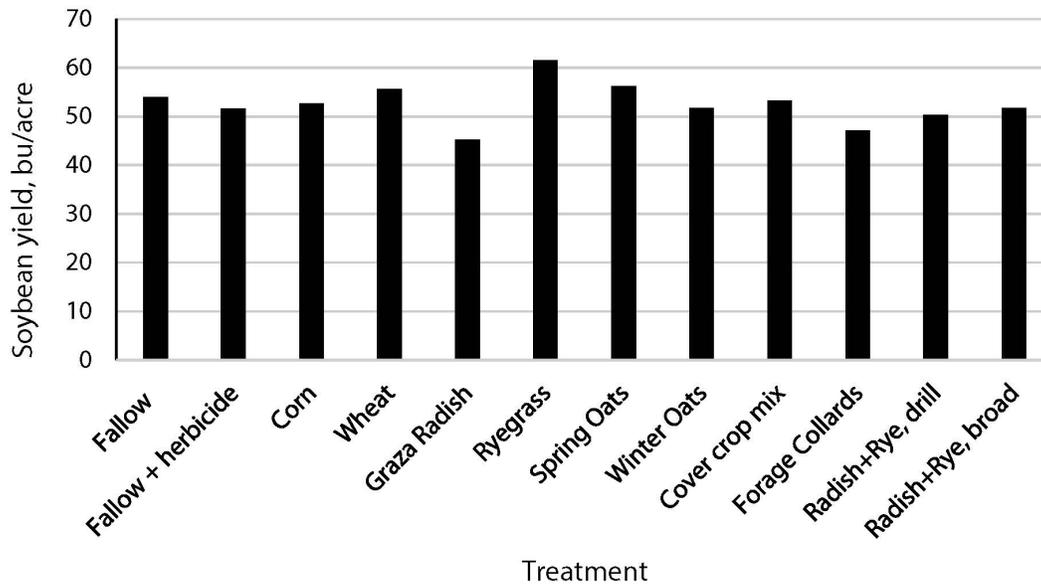


Figure 1. Rings installed in cover crop plots to track weed emergence and species.

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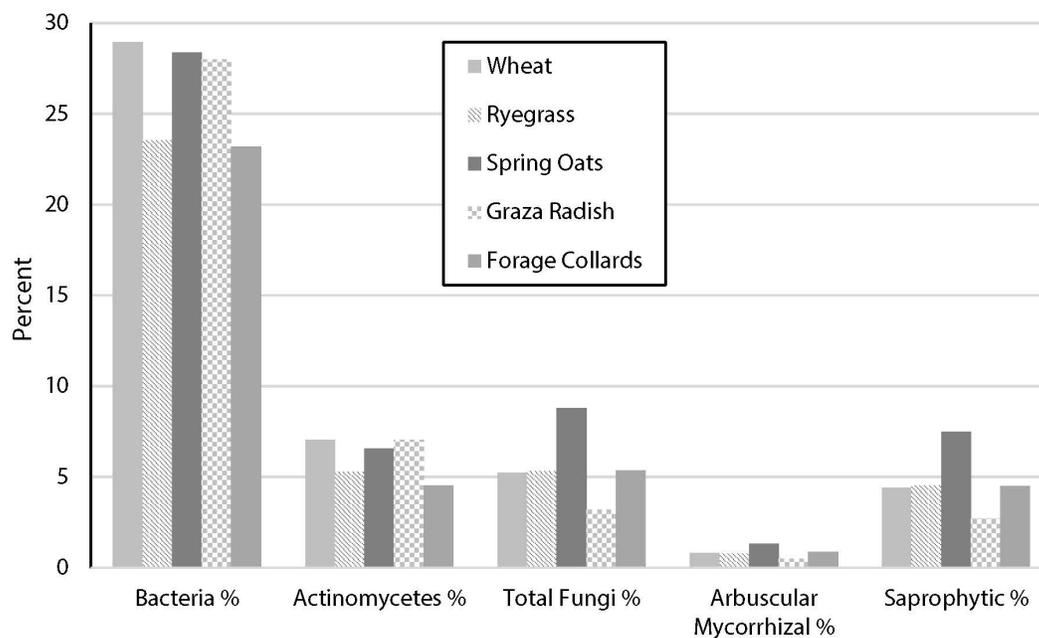


**Figure 2.** Change in cover crop biomass (tons/acre, left axis and bars) and weed count (number per square foot, right axis and dashed line) with different cover crop treatments.



**Figure 3.** Soybean yield after cover crop treatment in 2020.

# CROPPING SYSTEMS RESEARCH



**Figure 4. Differences in soil microbiome composition for five different cover crop treatments.**

# Comparison of Sensitivity to Fusarium Head Blight in Soft Red and Hard Red Winter Wheat Varieties

*G.F. Sassenrath, K. Andersen Onofre, J. Lingenfelter, and X. Lin*

## Summary

Fusarium head blight (scab) is a problem for wheat production in high rainfall areas. This is a report of research examining the response of wheat varieties on disease susceptibility and wheat yield and quality. Hard red wheat varieties had more disease than the soft red wheat varieties in 2021. Wheat yield was correlated with disease severity.

## Introduction

Fusarium head blight (FHB) is a problem for wheat that can result in severe reductions in yield and quality. Contamination of grain with FHB can result in formation of a mycotoxin, deoxynivalenol (DON), or vomitoxin, that can leave the wheat unfit for human consumption in extreme cases. Wheat contaminated with FHB must be segregated from non-contaminated loads, potentially making it practical to market as a feed grain.

High humidity or rainfall during the flowering period (anthesis) can lead to fungal infection of the wheat kernel. Southeast Kansas typically has high rainfall in the spring, leading to potentially challenging conditions for production of wheat due to fusarium infection. The best approach to control or limit infection is through a management system that integrates a multi-tiered approach: cultivar selection, fungicide application, residue management, and crop rotations (Wegulo et al., 2011, 2013). Farmers in southeast Kansas are considering soft wheat production because of its potential for greater resistance to disease, and the current price advantage. However, little is known about the relative resistance or susceptibility of soft wheat to FHB, or the correct fungicide control methods for soft wheat.

This report summarizes the results of FHB contamination in the wheat varieties grown in the wheat variety test (Sassenrath et al., 2022).

## Experimental Procedures

Wheat varieties are tested yearly for comparison of performance in the Kansas State University Crop Performance Test (<http://www.agronomy.k-state.edu/services/crop-performance-tests/>). Establishment of variety trials are described in Sassenrath et al., 2022. This year, 13 hard red and 27 soft red winter wheat cultivars were tested. After harvest, samples of each cultivar were collected and sent to the Kansas Grain Inspection Service in Topeka, KS, for determination of quality and presence of DON, an indicator of FHB infection.

## Results and Discussion

Rainfall during the 2020-2021 water year (WY21) from October 1, 2020, through September 30, 2021, was 11.6 in. above the 11-year average (Figure 1). Following an unusually dry early October in 2020, several high rainfall events increased total rainfall amounts to above average (Hoffstetter, 2021). Rainfall during wheat flowering in the spring can lead to Fusarium head blight (FHB) or scab infection.

High humidity conditions during anthesis in 2021 led to high levels of FHB in wheat. The average DON level measured in all the hard red wheat varieties was 7.71 ppm, exceeding the allowable maximum of 5 ppm\* (Figure 2). The most commonly planted cultivar in eastern Kansas, Everest, had levels very near 5 ppm. Two cultivars showed particularly high levels of DON, AM Eastwood and WB4699. The variety with the lowest levels of DON was Rockstar. Higher DON infection rates were correlated with reduced yield (Figure 3).

Soft wheat varieties had significantly lower DON levels, with an average across all cultivars of 3.4 ppm (Figure 4). Only 1 cultivar, the experimental variety from OCI, had DON levels that exceeded the allowable maximum. Because of the reduced disease load, the correlation between DON presence and yield was less (Figure 5). The one cultivar with high DON concentration had the lowest yield in the soft wheat variety test.

Although early spring rainfall increased the FHB in wheat in 2021, a dry period in late May/early June in 2021 helped with timely harvest of winter wheat, reducing vomitoxin levels in harvested wheat and limiting dockage at the elevators due to scab in 2021.

## Conclusions

Cultivar selection has been identified as an important first step in control of fungal diseases in wheat. This is especially important in a high-rainfall environment such as southeast Kansas. Differences in variety susceptibility to FHB can be significant. While soft red wheat seems to have more resistance to the disease, some cultivars can be very susceptible.

## Acknowledgments

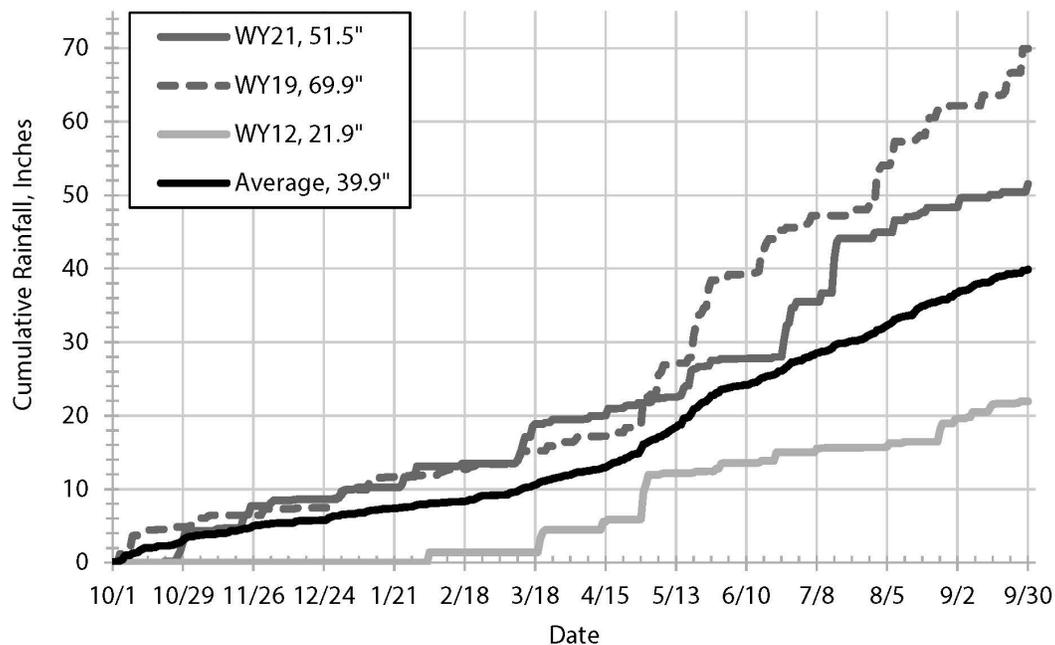
This work is supported by the U.S. Department of Agriculture National Institute of Food and Agriculture, Hatch project 1018005, with partial funding from the Kansas Crop Improvement Association.

\*Grain and grain products for poultry, beef, and feedlot cattle older than 4 months require a DOM level of 10 ppm or below. Grain and grain products for swine or other animals are limited to 5 ppm. Wheat products for human consumption must be below 1 ppm. From U.S. Food and Drug Administration. <https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-and-fda-advisory-levels-deoxynivalenol-don-finished-wheat-products-human>.

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**Figure 1. Cumulative rainfall on a water year (WY) basis for the 2021 winter wheat growing season (WY21) and the 11-year average cumulative rainfall. Excessive high (WY2019) and low (WY2012) rainfall amounts are shown for comparison.**

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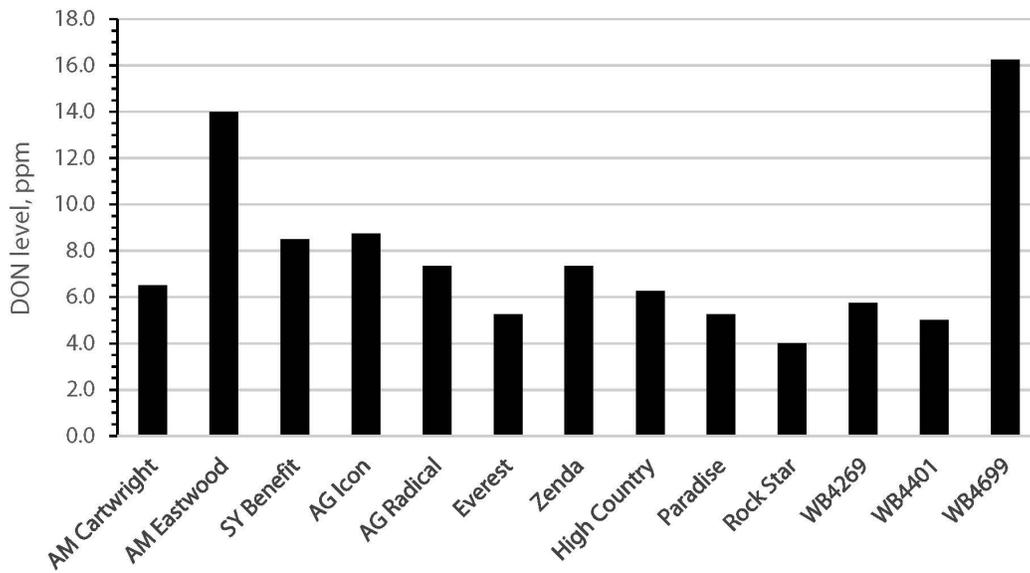


Figure 2. Deoxynivalenol (DON) levels in hard red wheat from the variety trials. Average levels across all hard red cultivars was 7.7 ppm.

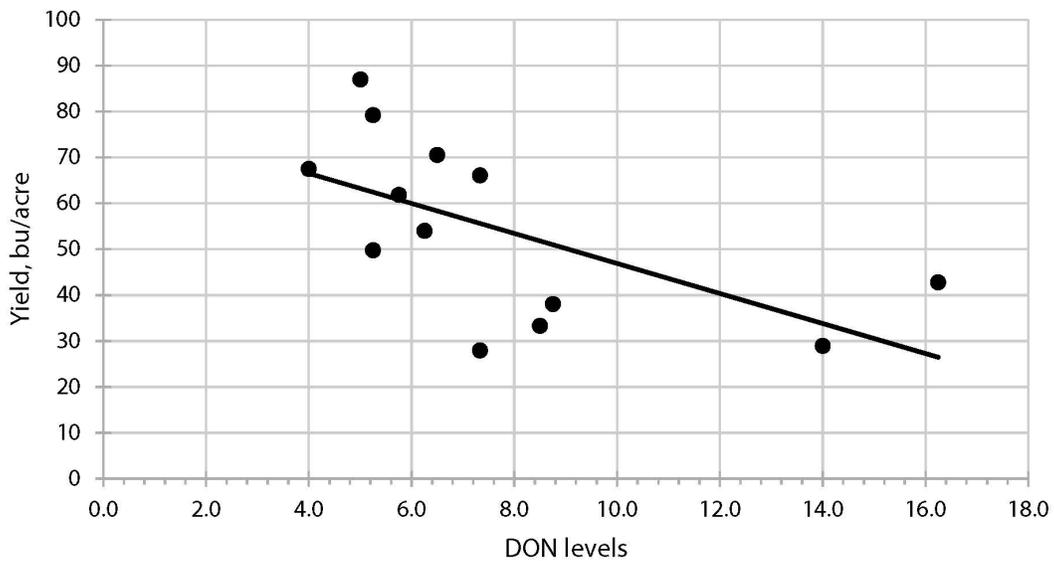


Figure 3. Correlation of deoxynivalenol (DON) levels in wheat to yield for the hard red varieties.

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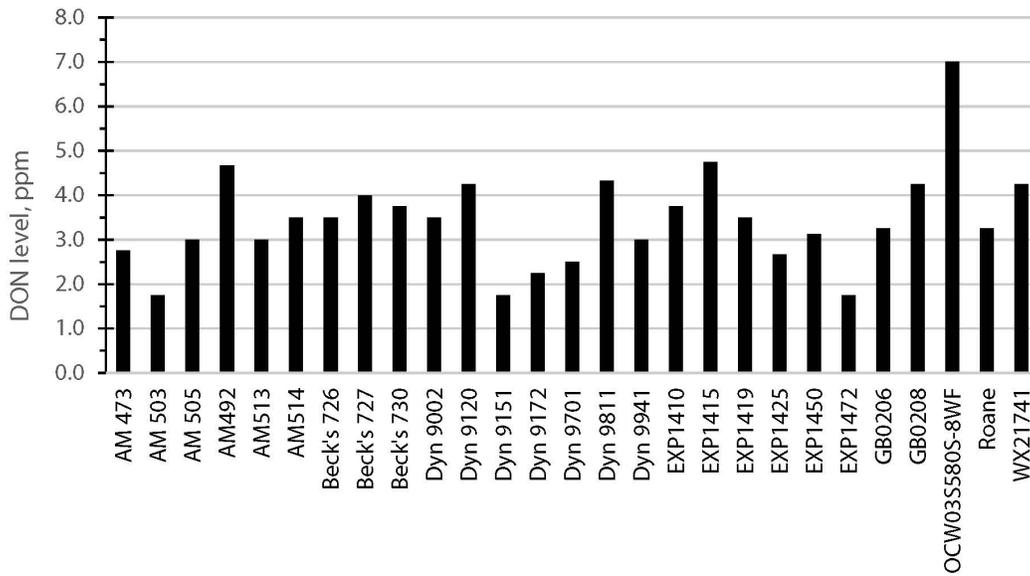


Figure 4. Deoxynivalenol (DON) levels in soft red wheat from the variety trials. Note change in y-axis range compared to hard red wheat.

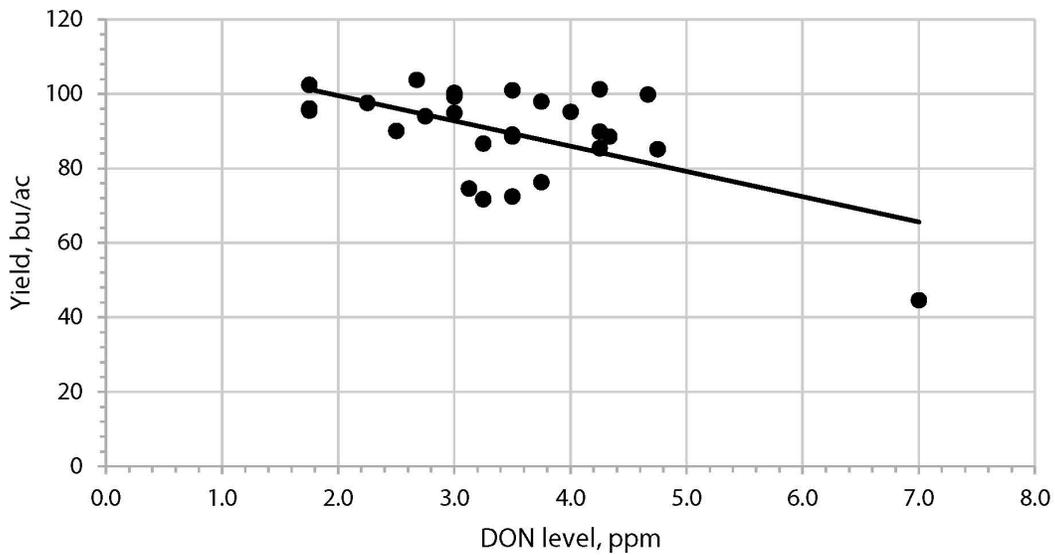


Figure 5. Correlation of deoxynivalenol (DON) levels in wheat to yield for the soft red varieties.

# Southeast Kansas Winter Wheat Variety Test Results - 2021

*G.F. Sassenrath, L. Mengarelli, J. Lingenfelter, and X. Lin*

## Summary

This is a summary of the winter wheat production conditions in southeast Kansas in 2020-2021 and the results of the winter wheat variety testing. Wheat production in 2021 benefited from dry conditions at planting and harvest. Overall yields were above multi-year averages. As in previous years, soft red winter wheat out-yielded hard red winter wheat varieties.

## Introduction

Crop production is dependent on many factors including cultivar selection, environmental conditions, soil, and management practices. This report summarizes the environmental conditions during the 2020-2021 winter wheat growing season in comparison to previous years and the historical averages. Thirteen hard red and 27 soft red wheat varieties were tested at Parsons.

## Experimental Procedures

The Kansas State University Crop Performance Tests were conducted in replicated research fields throughout the state. This report summarizes winter wheat production for Parsons, Kansas. Wheat varieties were tested in Parsons silt loam soil at the Southeast Research and Extension Center in Parsons. All crop variety trials are managed with conventional tillage. Individual variety results are available at the Kansas State University Crop Performance Test web site (<http://www.agronomy.k-state.edu/services/crop-performance-tests/>).

Wheat was drilled in 7-in. rows at 1.2 million seed/acre (approx. 90 lb/acre) in conventional tillage with an Almaco plot drill on September 29, 2020, in Parsons and harvested June 23, 2021. Plots were 7 ft wide × 27.5 ft long. Fertilizer was applied before planting at a rate of 50-46-30 lb/acre N-P-K (dry), with an additional 60-46-30 lb/acre N-P-K (dry) applied in February for both hard red and soft red cultivars. No fungicides or herbicides were applied. Historical weather data from the Parsons and Columbus Mesonet stations were used (<http://mesonet.k-state.edu/weather/historical/>).

## Results and Discussion

A very wet spring in 2021 (Sassenrath et al., 2022) resulted in some Fusarium head blight (FHB) infection in the wheat. However, the dry conditions after May preserved the wheat quality and limited the scab damage.

Winter wheat was planted on 7.3 million acres in Kansas in 2021, an increase from last year. Statewide average wheat yield was 52 bu/acre, more than the 14-year average of 43 bu/acre. The highest yield in the hard red wheat varieties was measured in WB4401 at 92.0 bu/acre (Figure 1A; Table 1). This is well above the 12-year average yield of 53.1 bu/acre in the variety trials, and the 12-year average yield of 40.7 bu/acre across the

state. Wheat yields in the hard red wheat variety trials showed much greater variability than in previous years, ranging from a low of 28.0 bu/acre to a high of 92 bu/acre. Overall, yields were much lower than last year. However, across all hard red varieties, the average yield of 55.5 bu/acre was near average (14-year hard red wheat yield average: 52.8 bu/acre).

Yields in the soft wheat varieties were very good this year (Figures 1 and Table 2). State-wide yields for soft red wheat are not reported, so hard red wheat variety yields for the KS state average are given as comparison. Soft red wheat yield of 90.4 bu/acre across all varieties in 2021 was much higher than the 12-year average of 68.3 bu/acre for soft red wheat in the variety trials. The highest yield of 103.8 bu/acre was measured in an experimental line, EXP1425, from Northern Star Seed. Five other varieties also had yields above 100 bu/acre (Table 2). In addition to greater yields, another potential advantage of soft red wheat is greater resistance to disease. This was observed in the FHB and reported in Sassenrath et al., 2022. Those varieties that had greater resistance to diseases tended to have higher yields.

Heading, defined as the date when 50% of the plot had heads emerged, was measured in the variety trials. Heading in the hard red varieties began April 25, 2021 and was complete by April 29. Heading in the soft red varieties occurred between April 27 and April 30, 2021.

### Conclusions

Wheat production was good in 2021. Dry planting conditions in the fall allowed timely planting. Adequate winter moisture allowed good stand establishment and tillering. Although high moisture during anthesis increased the FHB pressure, dry conditions during harvest allowed timely harvest prior to excessive vomitoxin production. Southeast Kansas has a high probability of rainfall during May and June, often limiting field access and timely wheat harvest, resulting in increasing disease damage.

Comparing variety performance across different growing seasons gives an understanding of how a variety responds under different growing conditions. For ease of comparison, variety testing results from the previous 4 years are provided for hard red (Table 1) and soft red (Table 2) varieties at Parsons. Note, no data were available from 2019 due to poor plant stand.

No herbicides or fungicides are normally used in the variety trials to provide an equal comparison based only on genetics. However, timely application of fungicide has been shown to be especially important in high rainfall areas such as southeast Kansas in order to control fungal diseases. Application of appropriate fungicides around flowering are especially important to control FHB (Onofre and De Wolf, 2020).

### Acknowledgments

This work is supported by the U.S. Department of Agriculture National Institute of Food and Agriculture, Hatch project 1018005. These data are part of the 2021 Winter Wheat Performance Tests, SRP 1165.

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Table 1. Multiyear comparison of hard red winter wheat yields from variety trials at Parsons, KS

Company	Variety	2017		2018		2020		Fusarium rating	Stripe rust rating	2021	
		Yield bu/a	Test weight lb/bu	Yield bu/a	Test weight lb/bu	Yield bu/a	Test weight lb/bu			Yield bu/a	Test weight lb/bu
AgriMAXX	AM Cartwright					<b>82.9</b>	60.8	1	1	<b>70.5</b>	55.3
AgriMAXX	AM Eastwood	47.2	55.5	<b>56.8</b>	58.5	67.2	57.9	3	8	33.9	51.7
Syngenta AgriPro	SY Benefit	56.9	57.7	45.2	57.4	77.5	59.5	1	7	37.5	50.3
Syngenta AgriPro	SY Grit			50	56.5	65.1	57.5	3	3		
AGSECO	AG Icon			47.4	57.2	80.5	60	2	4	42.2	75.9
AGSECO	AG Radical					76.1	56.6	0	3	28	50
AGSECO	TAM 205					<b>83.5</b>	60.2	5	1		
KWA Wildcat Genetics	Everest	60.5	58.1	48.6	59.3	78.9	60.8	1	8	49.8	54.1
KWA Wildcat Genetics	Zenda	60.7	58.4	43.5	59.7	<b>86.1</b>	60.8	1	2	<b>66.1</b>	55.2
OGI	Smith's Gold					<b>84.5</b>	60.1	2	1		
Polansky	High Country					79.2	58.3	3	2	54	52.7
Polansky	Paradise									<b>79.2</b>	54.2
Polansky	Rock Star									<b>67.5</b>	54.6
WestBred	WB4269	55	57	48.5	58.9	<b>86.8</b>	60.3	2	3	<b>61.8</b>	54.3
WestBred	WB4303					67.2	55.4	4	6		
WestBred	WB4401					<b>108.8</b>	61.5	1	1	<b>92</b>	57.8
WestBred	WB4699					<b>94.5</b>	58.7	2	2	39.5	50.7
Overall average, hard red winter wheat		57.1	57.4	51.7	58.1	81.1	59.2			55.5	55.1

Yields above average are highlighted in bold.

## CROPPING SYSTEMS RESEARCH

Table 2. Multiyear comparison of soft red winter wheat yields from variety trials at Parsons, KS

Company	Variety	2017		2018		2020		2021			
		Yield bu/a	Test weight lb/bu	Yield bu/a	Test weight lb/bu	Yield bu/a	Test weight lb/bu	Fusarium rating	Stripe rust rating	Yield bu/a	Test weight lb/bu
AgriMAXX	415	<b>91.9</b>	57.3	56.7	58.1	102.7	59.7	0	0		
AgriMAXX	473	<b>83.2</b>	57.9	<b>65.1</b>	57.5	<b>106.1</b>	59	0	1	<b>94.0</b>	55.2
AgriMAXX	492									<b>99.9</b>	56.3
AgriMAXX	503					<b>113.9</b>	60.1	0	1	<b>102.5</b>	56.2
AgriMAXX	505					<b>112.2</b>	60.7	2	5	<b>100.3</b>	57.2
AgriMAXX	513									<b>99.3</b>	55.0
AgriMAXX	514									<b>93.3</b>	54.4
Beachner	GB0206									<b>96.4</b>	53.7
Beachner	GB0208									89.9	55.1
Beachner	Roane									71.7	56.4
Becks	726									<b>101.0</b>	54.8
Becks	727									<b>95.2</b>	56.3
Becks	730									76.3	53.9
DuPont Pioneer	25R40	79.5	56.8	<b>66.1</b>	56.7	<b>105.8</b>	58.1	3	1		
DuPont Pioneer	25R50			57.1	57	97.5	59.3	0	1		
DuPont Pioneer	25R61	71.4	57.8	<b>61.6</b>	57.9	87.5	58.3	0	7		
DuPont Pioneer	25R74	80.8	57.6	<b>65.4</b>	56.3	<b>110.4</b>	61.6	0	1		
DuPont Pioneer	25R77	<b>84.4</b>	57.9	54.2	56.9	103	61.6	2	3		
Dyna-Gro	9002									76.4	53.4
Dyna-Gro	9120									<b>101.3</b>	57.4
Dyna-Gro	9151									<b>95.6</b>	56.6
Dyna-Gro	9172									<b>97.6</b>	55.6
Dyna-Gro	9701									90.1	55.4

Yields above average highlighted in bold.

Table 2 (cont'd). Multiyear comparison of soft red winter wheat yields from variety trials at Parsons, KS

Company	Variety	2017		2018		2020		2021			
		Yield bu/a	Test weight lb/bu	Yield bu/a	Test weight lb/bu	Yield bu/a	Test weight lb/bu	Fusarium rating	Stripe rust rating	Yield bu/a	Test weight lb/bu
Dyna-Gro	9811									<b>91.5</b>	54.4
Dyna-Gro	9941									<b>94.9</b>	55.2
Dyna-Gro	WX21741									85.4	54.6
NSS	EXP1410									<b>98.0</b>	54.8
NSS	EXP1415									85.2	54.7
NSS	EXP1419									88.6	53.6
NSS	EXP1425									<b>103.8</b>	53.9
NSS	EXP1450									78.6	54.0
NSS	EXP1472									<b>96.1</b>	56.8
OGI	OCW03S580S- 8WF					84.4	56.8	2	4.75	37.8	48.8
Average		78.2	57.5	59.9	57	102.4	59.5			90.4	54.9

Yields above average highlighted in bold.

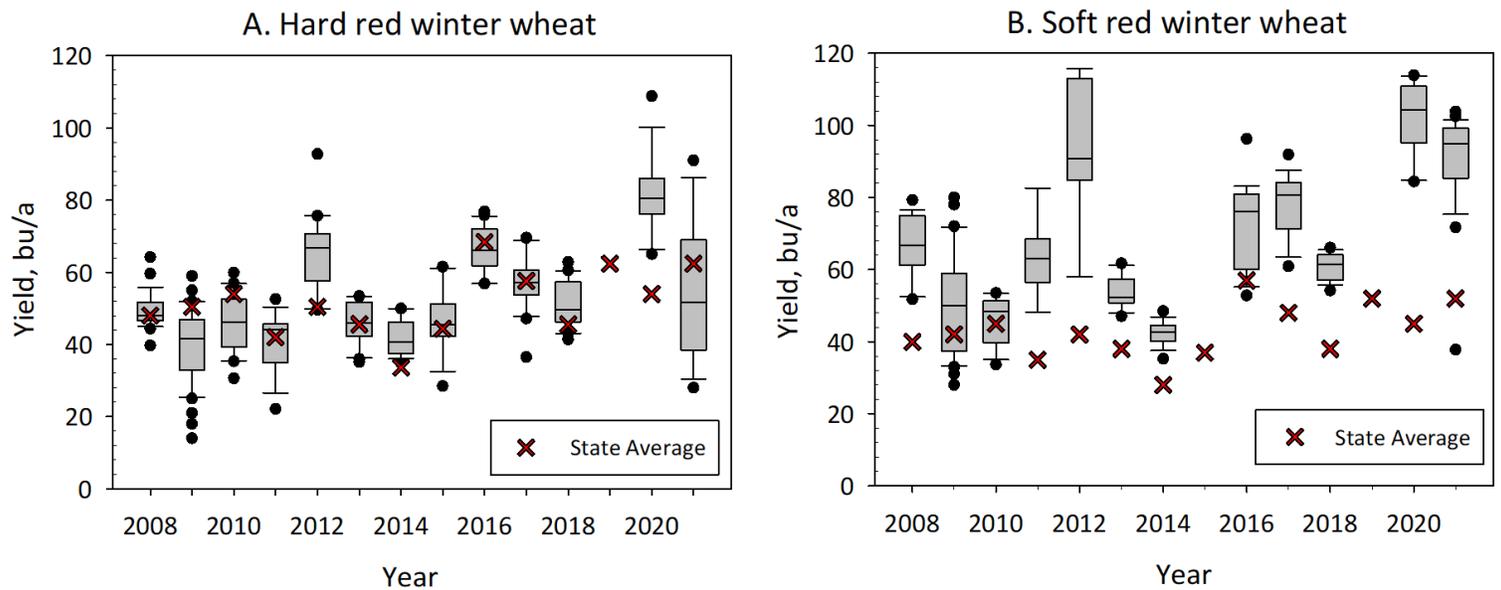


Figure 1. Winter wheat yield for (A) hard red wheat and (B) soft red wheat from variety trials in southeast and eastern Kansas from 2008 through 2021. In 2019, variety testing at both Ottawa and Parsons were abandoned due to flooding and poor stands. The line in the middle of the box plots is the median yield of all varieties. The upper and lower quartiles are given by the upper and lower edges of the boxes. The maximum and minimum values are given by the upper and lower “whiskers” extending from the box. Outliers are given as solid circles. For comparison, average reported state yields from Kansas are highlighted as a red X.

# Wheat Variety Test Results for South Central Kansas - 2021

*J. Seiler, R. Hein, R. Flaming, J. Carr, K. Nordyke, R. Lollato, and B. Pedreira*

## Summary

South central Kansas is an important winter wheat production area in the state. This report summarizes the results of winter wheat variety tests for 2020-2021 in five locations.

## Introduction

Variety selection is one of the most important steps in assuring the success of a wheat crop. In 2021, Kansas was again the highest producing wheat state in the country. The main wheat production region of the state, south central Kansas, experiences great weather variability (Lollato et al., 2020). For this reason, coupled with the different variety-specific agronomic and genetic traits and area of adaptation (Sciarresi et al., 2019), wheat varieties can yield differently in response to the environment (Jaenisch et al., 2021; Munaro et al., 2020) and soil characteristics (Lollato et al., 2019). This variability determines if, what, and/or when the crop will face yield-limiting factors such as drought, extreme temperatures, disease, weeds, insects, and nutrient issues, along with others. Thus, regional variety tests can be helpful in supporting growers' decision-making process. Data from these trials can help producers choose varieties that will perform well in their fields, as well as improve management and variety-selection recommendations (Munaro et al., 2020).

## Procedures

The South Central Kansas Extension Wheat Variety Tests were conducted in seven replicated trials in five locations in south central Kansas: Clearwater (Sedgwick Co.), Belle Plaine and Caldwell (Sumner Co.), Harper (Harper Co.), and Arkansas City (Cowley Co.). The same 30 varieties were tested at each location.

Tillage practices and chemical applications were consistent with the host field and managed by the cooperating grower. The trials in Clearwater and Belle Plaine were no-till; minimum tillage in Caldwell and Arkansas City; and conventional till in Harper. All five locations received a fungicide application and were non-irrigated.

Plots were six, 9-in. wide rows, about 30-ft long, and were sown using a Hege plot drill. The locations, planted in the first week of October, were drilled at 1.2 million seeds/a: Clearwater (10/5/20), Harper (10/5/20), Belle Plaine (10/6/20), and Arkansas City (10/6/20). Drilling in Caldwell was delayed due to a lack of soil moisture. This location was drilled on November 9. The seeding rate was increased to 1.4 million seeds/a to compensate for later planting which usually decreases yield environment (Bastos et al., 2020). All trial locations were harvested on June 18, 2021.

The study was established as a randomized complete block design with three replications and 30 varieties. All 30 varieties in a location were managed similarly and were recommended varieties for the area. Common management practices for the region

were used. The 30 varieties had a range of yield potentials, maturities, abiotic tolerances, disease resistances/susceptibilities, and other agronomic characteristics which one year of yield data, one planting date, and one fertilizer/fungicide/herbicide management system may not highlight.

Grain yield was analyzed for each individual location through one-way analysis of variance using PROC GLIMMIX of SAS v. 9.4. Varieties were considered fixed factors and replications were random effects. A combined analysis across locations was performed considering location and replication nested within location as random factors.

### Results and Discussion

The main weather events this crop experienced were dry planting conditions, an extreme cold period in February, a very dry April, and the growing season ended with a cooler, wetter period starting the second week of May that aided grain filling. None of the trials experienced heavy disease infestations.

All five sites presented good yield potential with an average yield of all locations of 57.9 bu/a. The highest yielding trials were at Belle Plaine (67 bu/a) and Clearwater (59.5 bu/a) (Table 1). Overall, wheat yield ranged from 32.5 to 76.4 bu/a. When evaluating the averages of all sites, the five highest yields varied from 62 to 67 bu/a.

Nineteen varieties yielded in the top statistical group in at least one of the five locations (Table 1). Varieties AP18 AX and Showdown both yielded in the highest statistical group in four locations. No varieties were in the top group at all five locations. Eleven varieties failed to reach the top yielding group at all locations. In the combined analysis, AP18 AX, Bob Dole, AG Radical, LCS Atomic AX, Gallagher, Showdown, Smith's Gold, Paradise, Rock Star, and WB4401 were in the highest yielding group.

### Conclusions

A number of varieties in the trial provided great yields in South Central Kansas. The variety test indicates variability among sites and highlights the importance of choosing several varieties to improve yield stability. Each year brings different wheat growing conditions. How the wheat crop responds to the differences is dependent on variety.

Farmers should look for consistent performers offering agronomic characteristics that fit their goals for a particular field. It is beneficial to utilize multiple varieties to minimize the risks that come with each cropping season. While the trials provide valuable information for local farmers, they should be utilized along with other variety selection resources. When selecting wheat varieties, it is vital to use multiple years of yield data, along with information provided by Extension Specialists and seed company representatives.

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## Acknowledgments

These data are part of the 2021 South Central Kansas Extension Wheat Plots, a collaboration of K-State Research and Extension County Agriculture Agents in Sedgwick, Sumner, Harvey, Harper, and Cowley County with the help of K-State Extension Specialists. Each trial is hosted by a local cooperating farmer who provides chemicals and tillage operations, if applicable. Our cooperating farmers for 2021 were Kohls Farm (Clearwater), Doug Hisken (Belle Plaine), Tim Turek (Caldwell), Davis Farms (Harper), Ken Bryant (Arkansas City), Greg Neville (Andale), and Stan Jost (Sedgwick).

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CROPPING SYSTEMS RESEARCH

Table 1. Wheat grain yield (bu/a) and test weight (TW; lb/bu) results for 2021 at Clearwater, Belle Plaine, Caldwell, Arkansas City, Harper, and the average for all sites

Variety	Yield Source	All sites		Clearwater		Belle Plaine		Caldwell		Arkansas City		Harper	
		TW	Yield	TW	Yield	TW	Yield	TW	Yield	TW	Yield	TW	Yield
Name	Source	bu/a	lb/bu	bu/a	lb/bu	bu/a	lb/bu	bu/a	lb/bu	bu/a	lb/bu	bu/a	lb/bu
AM Cartwright	AgriMaxx	55.8	59.2	57.3	59.3	64.4	57.9	52.7	58.8	47.9	62.0	56.9	57.9
AP EverRock	AgriPro	54.1	58.9	59.4	59.3	62.8	58.4	45.6	59.9	55.0	60.9	47.6	56.1
SY Achieve CL2	AgriPro	56.3	60.8	60.1	60.0	64.9	59.9	52.5	61.6	47.7	61.9	*	*
SY AP18 AX	AgriPro	<b>67.0</b>	59.5	<b>68.9</b>	58.6	<b>72.1</b>	58.8	53.4	59.9	<b>68.5</b>	61.3	<b>72.1</b>	58.7
SY Bob Dole	AgriPro	<b>62.0</b>	61.0	60.2	60.4	<b>69.1</b>	59.6	<b>62.5</b>	60.2	52.4	65.2	65.9	59.6
SY Monument	AgriPro	55.6	57.8	56.9	58.3	60.7	56.9	53.8	58.6	<b>57.6</b>	58.9	49.1	56.2
AG Icon	AGSECO	55.9	59.3	56.1	59.4	63.7	59.6	51.3	59.5	56.2	61.2	52.1	57.1
AG Radical	AGSECO	<b>60.7</b>	60.2	60.9	60.7	<b>70.7</b>	59.9	51.3	60.9	<b>69.4</b>	62.6	51.4	56.8
KS Hatchett	KWA	54.4	60.1	60.1	59.7	64.6	61.2	47.5	62.5	*	*	45.3	56.9
KS Western Star	KWA	52.2	59.0	55.1	60.2	65.0	59.1	49.4	58.2	52.6	61.4	38.9	56.0
Larry	KWA	58.1	58.9	<b>63.3</b>	59.6	66.9	58.0	50.1	59.4	<b>57.2</b>	60.6	53.0	57.1
Zenda	KWA	55.4	61.2	55.4	61.1	67.3	60.2	47.4	62.0	51.2	62.5	55.7	60.2
LCS Atomic AX	LCS	<b>60.6</b>	60.4	<b>65.9</b>	60.0	<b>69.2</b>	58.8	54.3	61.0	52.9	61.6	*	*
LCS Chrome	LCS	58.4	59.7	58.7	60.3	<b>69.3</b>	58.6	<b>57.2</b>	58.9	54.9	62.5	51.6	58.3
LCS Helix AX	LCS	57.8	59.4	59.0	60.3	<b>67.8</b>	59.5	56.0	59.5	54.8	61.1	51.2	56.5
LCS Julep	LCS	56.0	60.2	61.0	60.8	64.7	58.2	52.8	61.2	55.2	61.2	46.4	59.6
LCS Photon AX	LCS	56.6	61.7	56.8	62.1	<b>67.4</b>	61.8	47.9	61.0	50.6	62.6	60.3	61.1
Butler's Gold	OGI	49.5	60.2	51.8	59.0	59.2	59.3	44.2	61.5	32.5	61.0	59.7	60.4
Doublestop CL+	OGI	56.1	61.4	57.8	61.3	62.2	60.9	<b>56.4</b>	61.3	41.2	61.6	62.9	61.8
Gallagher	OGI	<b>61.7</b>	60.9	<b>67.7</b>	60.3	<b>67.6</b>	58.9	49.6	61.1	<b>61.8</b>	63.3	*	*
Green Hammer	OGI	57.5	60.1	55.9	59.3	63.2	59.6	53.6	59.9	47.6	61.8	67.1	59.8
Showdown	OGI	<b>64.2</b>	59.5	<b>66.1</b>	59.9	<b>76.4</b>	59.3	<b>62.1</b>	61.0	<b>58.8</b>	60.3	57.5	57.1
Smith's Gold	OGI	<b>61.1</b>	60.5	58.8	60.8	<b>74.6</b>	59.8	49.4	60.6	<b>62.3</b>	61.7	60.2	59.5
Strad CL+	OGI	57.2	60.2	59.7	61.0	66.8	60.3	<b>56.1</b>	60.4	38.2	59.8	65.3	59.5
Uncharted	OGI	56.7	59.5	55.8	58.9	<b>67.9</b>	59.0	49.6	59.6	52.7	61.5	57.3	58.3
Paradise	Polansky	<b>62.8</b>	60.1	59.8	59.9	66.1	60.6	<b>57.6</b>	59.3	55.4	60.5	<b>75.0</b>	60.3
Rockstar	Polansky	<b>64.9</b>	59.2	<b>63.8</b>	60.0	<b>76.2</b>	58.1	<b>63.4</b>	59.4	56.2	61.2	65.0	57.5
WB4269	WestBred	53.2	59.8	56.4	60.3	61.5	60.1	48.3	59.5	50.6	61.7	48.9	57.3
WB4401	WestBred	<b>61.9</b>	61.3	59.7	60.8	<b>72.2</b>	59.5	51.4	61.5	<b>57.0</b>	63.0	<b>69.3</b>	61.4
WB4699	WestBred	53.9	58.3	56.9	58.9	66.5	57.9	43.9	60.1	<b>58.2</b>	60.3	44.2	54.6
Average		57.9	59.9	59.5	60.0	67.0	59.3	52.4	60.3	53.7	61.6	56.7	58.3
Min		49.5	57.8	51.8	58.3	59.2	56.9	43.9	58.2	32.5	58.9	38.9	54.6
Max		67.0	61.7	68.9	62.1	76.4	61.8	63.4	62.5	69.4	65.2	75.0	61.8

Values, highlighted in **gray and bold**, belong statistically to the highest yielding group. We cannot say values within the group are different from each other.

\*Plots lost to planting or harvest errors.

# Effect of Corn Type and Form of Supplement on Grazing Steers

*J.K. Farney and T. Bottorff<sup>1</sup>*

## Summary

Eighty stocker steers were grazed on bromegrass from April to the beginning of November and were provided five different feeds while on grass during the summer. Treatments evaluated included (1) mineral only; (2) free-choice supplementation in the form of liquid feed (MIX30) or (3) block format (Mintrate 40 Red); and hand-fed supplements of 60% corn:40% dried distillers grains at 0.5% of body weight on a dry matter basis offered daily where the corn was either an (4) isoline corn (ISO; parent genetic line) or (5) Enogen feed corn (ENO; includes alpha-amylase gene). Steers were weighed every 28 days while on grass and were carcass quality measured by ultrasound prior to placement in the feedlot. Hand-fed steers had greater gain than self-fed supplemented steers and these steers also had more backfat and tended to have more muscle depth coming off grass than other supplemented steers. Steers that received free-choice mineral or self-fed supplements also had lower gains than steers being hand-fed supplement. Within the first 28 days of the study, the hand-fed steers began weighing more and weighed 125 pounds more than the free-choice supplemented and control steers. On average hand-fed steers had a 0.6 lb/d greater ADG than control steers and those consuming free-choice supplement. Cost of gain was the highest with hand-fed steers at \$0.27/pound, but even so profit was greatest with the hand-fed cattle.

## Introduction

Supplementation is important in cattle production because it could (1) fill the gap in a limiting nutrient; (2) allow an increase of gains on the same amount of acreage; (3) allow for an increased number of cattle on the same amount of acreage; (4) supply feed additives; (5) provide increased frequency of monitoring of animals from a husbandry perspective; and (6) stretch forage supply. Cattle management is different based on geographic location, access to labor, distance to cattle from feed source, forage types, and economic goals. A variety of supplements for grazing cattle have been developed to meet operational objectives. Determining which supplement best fits an operation can be daunting.

Enogen feed corn is a product that was developed for the ethanol industry as it contains the alpha-amylase gene which improves efficiency of ethanol production. The amylase trait helps convert starch to sugar more efficiently, which helps in the production of ethanol. In addition to ethanol production benefits, researchers have found this same benefit in cattle production so that feed efficiency can be increased by 5%.

The purpose of this study was to evaluate the effect of cattle gain of stocker steers grazing bromegrass during the summer (1) based on method of supplementation (hand-fed versus self-fed); and (2) type of corn (amylase gene included or not).

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<sup>1</sup> Undergraduate intern, Department of Animal Science, College of Agriculture, Kansas State University.

## Experimental Procedures

Twenty brome pastures were used in a completely randomized research project at the Southeast Research and Extension Center in Parsons, KS. Treatments consisted of one of five different supplementation feeds: (1) control treatment where calves received free-choice mineral (CON); (2) MIX30 (Agridyne, LLC; MIX30; MIX30); (3) Mint-rate 40 Red block (ADM Alliance Nutrition; BLOCK); (4) hand-fed supplement of 60% corn:40% DDG (DM-basis) daily where corn was Enogen feed corn (Syngenta, ENO); and (5) hand-fed supplement of 60% corn:40% DDG (DM-basis) daily where corn was an isoline corn (Syngenta, ISO). The isoline corn is the parent corn to the Enogen feed corn line that does not include the alpha-amylase gene. Enogen feed corn includes the alpha-amylase gene, which is involved in starch digestion. Hand-fed supplements were fed daily at 0.5% of body weight on DM-basis and adjusted every 28 days based on calf weights. The liquid feed supplement was fed in an open-topped tub. Blocks were fed free-choice to the steers and placed in bunks containing all pieces of the blocks. The loose mineral was fed in mineral feeders with weather guards to the cattle on the CON treatment and the hand-fed treatments (ENO and ISO). Mineral was supplied to the BLOCK and MIX30 through the free-choice supplements. Nutrient profiles of treatments are found in Table 1.

The blocks and liquid tubs were weighed weekly to estimate intake. A new block was added when less than  $\frac{1}{4}$  of the old block was remaining in the feed tub. New liquid was added weekly after agitation in storage tote and agitation in the feeding tubs was done with a paint stirrer.

Pastures were fertilized in March 2021, based on recommendations from soil test for phosphorus and potassium and all pastures had 100 lb of nitrogen applied in 46-0-0 form.

### *Cattle Specifics*

Weaned and vaccinated steers ( $568 \pm 17$  lb) were used and stocked at 4 head per pasture on 5-acre pastures. There were four pastures of each treatment. Steers were weighed on two consecutive days and placed on brome pastures (April 19, 2021). Steers were wormed prior to turnout with a white wormer (Valbazen, Zoetis Inc.).

Steers were ultrasounded (Aloka 500 with CPEC feedlot software) to detect any differences in ribeye area, backfat, and marbling on the last day of the grazing period (November 7, 2021; 200 days on grass).

## Results and Discussion

Supplement offered during the summer did impact cattle gains ( $P < 0.001$ ; Table 2). Steers on the hand-fed diet (ISO and ENO) had greater ADG and final weight off grass than CON, MIX30, and BLOCK treatments. There was no difference in ADG between ENO and ISO treatments ( $P = 0.62$ , Table 2). Supplemented cattle did gain more than CON calves ( $P < 0.01$ ; Table 2); however, this difference was driven by the much greater gains found with ISO and ENO fed cattle as MIX30 and BLOCK had similar gains as CON cattle.

## BEEF CATTLE MANAGEMENT

Beginning at the 28-day weigh date (Figure 1), the hand-fed treatments (ISO and ENO) had cattle that had greater gains and they maintained this advantage through the entire grazing period. Some of the most distinct periods where the hand-fed supplement resulted in greater gains were the last 56 days of the study (Figure 1) when the brome was fully dormant and total forage biomass was decreasing (data not presented). During this period the steers on ENO and ISO maintained between a 0.5 to 1 lb/d greater average daily gain than either CON or self-fed supplements and during the final 28-day period were the only ones that gained weight (Figure 1).

Ultrasound data at the end of the grazing period indicated very few differences between the feeding systems. Backfat was statistically increased with the hand-fed steers as compared to other treatments, however, visual appraisal would not have resulted in a “dock” in price at the sale barn (Table 2). Marbling was not different by any treatment. Loin muscle depth tended to increase with the hand-fed treatments as compared to the other treatments. There were no differences in ISO or ENO in carcass measures following a grazing period.

Costs of gain were different for each treatment group and were \$0.05, \$0.08, \$0.25, and \$0.27 per pound of gain for control, MIX30, block, and hand-fed treatments, respectively. These values were based on 2021 costs for products and delivery costs for each treatment. Intake was determined based on actual intake of feed ingredients for the steers during 2021. Delivery costs were determined based on feeding 100 head of stockers and traveling 20 miles round trip to feeding location and based on 2021 costs. The cost of production was high in 2021 (i.e., \$6/bu corn; \$3.25/gallon diesel cost). On average the hand-fed calves sold for \$1525 whereas the control and free-choice supplements averaged \$1357 (<https://usda.library.cornell.edu/concern/publications/gb19f584t?locale=en&page=2#release-items>). Even though the cost of gain was greatest for hand-fed calves, the extra weight and total sale price resulted in a greater net profit for hand-fed calves as compared to all other treatments. On average it cost \$41, \$95, and \$86 more per head to hand-feed supplement as compared to block, mineral, and MIX30, respectively. Even so, net profit was \$127, \$73, and \$82 more for hand-fed steers than block, mineral, and MIX30, respectively. All these values were based on 2021 costs of production and sale prices.

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## BEEF CATTLE MANAGEMENT

**Table 1. Nutrient profiles of supplements fed to steers**

<b>Item on dry matter basis</b>	<b>Free-choice mineral (CON)</b>	<b>MIX30 (MIX30)</b>	<b>Mintrate 40 Red Block (BLOCK)</b>	<b>60% corn: 40% DDG (ENO or ISO)</b>
Crude protein, %	5.69	38.35	40	18.3
NPN, %	--	18.98	12	--
Fat, %	--	24.52	1.5	6.66
TDN, %	--	109.5	--	90
Calcium, %	16.67	0.21	3	0.09
Phosphorus, %	3.33	1.33	1.5	0.55
Salt, %	22.54	2.77	12.5	--
Magnesium, %	2.51 <sup>1</sup>	2.23	0.3	0.20
Potassium, %	0.89	1.79	1.0	0.83
Iron, ppm	5,546	--	--	75
Copper, ppm	1,153 <sup>2</sup>	7.75 <sup>2</sup>	250 <sup>3</sup>	2.48
Zinc, ppm	3,471 <sup>2</sup>	115.08 <sup>2</sup>	1,000 <sup>4</sup>	25.6
Manganese, ppm	1,817 <sup>2</sup>	29.6 <sup>2</sup>	750 <sup>4</sup>	7.86
Selenium, ppm	22	0.34	6.6	--
Iodine, ppm	333	--	20	--
Cobalt, ppm	13	--	20 <sup>5</sup>	--
Vitamin A, IU	141,667	17,451	50,000	--
Vitamin D, IU	14,167	3,854	5,000	--
Vitamin E, IU	172	101	50	--

Free-choice mineral formulated for stocker cattle (Wildcat Feeds, LLC) to be consumed at 4 oz/hd/d; 60% corn:40% DDG nutrient profiles are based on average book values for each ingredient. Steers on the hand-fed supplement were also given the same free-choice mineral as control.

<sup>1</sup>Nuplex Mg/K, Nutech Biosciences, Inc. (Oneida, NY), contributed 25% of the magnesium in the minerals.

<sup>2</sup>Nuplex 3-chelate blend, Nutech Biosciences, Inc. (Oneida, NY), contributed 25% of the copper, zinc, and manganese of the total trace mineral supplied in the minerals.

<sup>3</sup>IntelliBond hydroxy copper.

<sup>4</sup>Zinpro zinc methionine.

<sup>5</sup>CoMax patented form of cobalt from ADM.

## BEEF CATTLE MANAGEMENT

**Table 2. Steer gain and carcass measures during the grazing period**

	Treatment					SEM <sup>5</sup>	P-value			
	CON <sup>1</sup>	MIX30	Block <sup>2</sup>	ISO <sup>3</sup>	ENO <sup>4</sup>		Trt <sup>6</sup>	Hand vs. Self <sup>7</sup>	Supple. vs. No <sup>8</sup>	ISO vs. ENO <sup>9</sup>
Start weight, lb	568	568	568	568	568	17.5	1.00	1.00	1.00	1.00
Final grazing weight, lb	854	841	844	980	967	19.1	<0.0001	<0.0001	0.01	0.62
Grazing ADG, lb/d	1.43	1.36	1.38	2.06	2.00	0.06	<0.0001	<0.0001	<0.001	0.43
<i>Period average daily gain (ADG), lb/d</i>										
d 28	4.35	3.86	4.52	4.91	4.85	0.17	<0.001	0.001	0.36	0.79
d 56	1.08	1.23	1.14	1.33	1.78	0.21	0.19	0.10	0.24	0.15
d 84	1.16	0.80	1.22	2.06	1.75	0.23	0.01	0.001	0.26	0.35
d 112	1.79	2.10	1.14	1.83	1.63	0.29	0.25	0.70	0.72	0.63
d 140	0.61	0.21	1.01	1.57	1.44	0.28	0.02	0.006	0.18	0.74
d 168	2.05	1.53	1.15	1.82	2.33	0.34	0.17	0.05	0.38	0.30
d 200	-0.84	0.01	-0.34	1.19	0.44	0.22	0.0001	0.0005	0.0003	0.03
<i>Cumulative ADG grazing period, lb/d</i>										
d 56	2.72	2.53	2.83	3.12	3.31	0.12	<0.0001	<0.0001	0.08	0.24
d 84	2.20	1.95	2.29	2.77	2.79	0.11	<0.0001	<0.0001	0.04	0.87
d 112	2.10	1.99	2.00	2.53	2.51	0.09	0.001	<0.0001	0.14	0.82
d 140	1.80	1.64	1.80	2.34	2.29	0.08	<0.0001	<0.0001	0.02	0.66
d 168	1.84	1.62	1.69	2.25	2.30	0.08	<0.0001	<0.0001	0.18	0.71
<i>Ultrasound carcass measures: grazing phase</i>										
Back fat, in.	0.16	0.17	0.16	0.21	0.23	0.02	0.04	0.007	0.11	0.50
Marbling <sup>9,10</sup>	5.01	4.99	4.93	4.93	4.81	0.17	0.92	0.58	0.64	0.63
Loin depth, mm	50.6	50.0	52.1	53.7	54.2	1.49	0.26	0.07	0.28	0.83

<sup>1</sup>CON: control treatment received free choice mineral (Wildcat Feed, LLC).

<sup>2</sup>Block: Mintrate 40 block (ADM Alliance Nutrition).

<sup>3</sup>ISO: 40:60 blend of dried distillers grains (DDG) and cracked corn offered at 0.5% of body weight (DM-basis) daily. Corn is isoline variety that is parent genetic line to the Enogen feed corn (Syngenta).

<sup>4</sup>ENO: Enogen feed corn (Syngenta) fed daily at 0.5% of body weight (DM-basis) in a 60%:40% of corn and DDG.

<sup>5</sup>SEM: standard error of means.

<sup>6</sup>Trt: P-value comparison between all 5 treatments.

<sup>7</sup>Hand vs. Self: P-value comparison between free-choice treatments (MIX30 and Block) and hand-fed treatments (ISO and ENO).

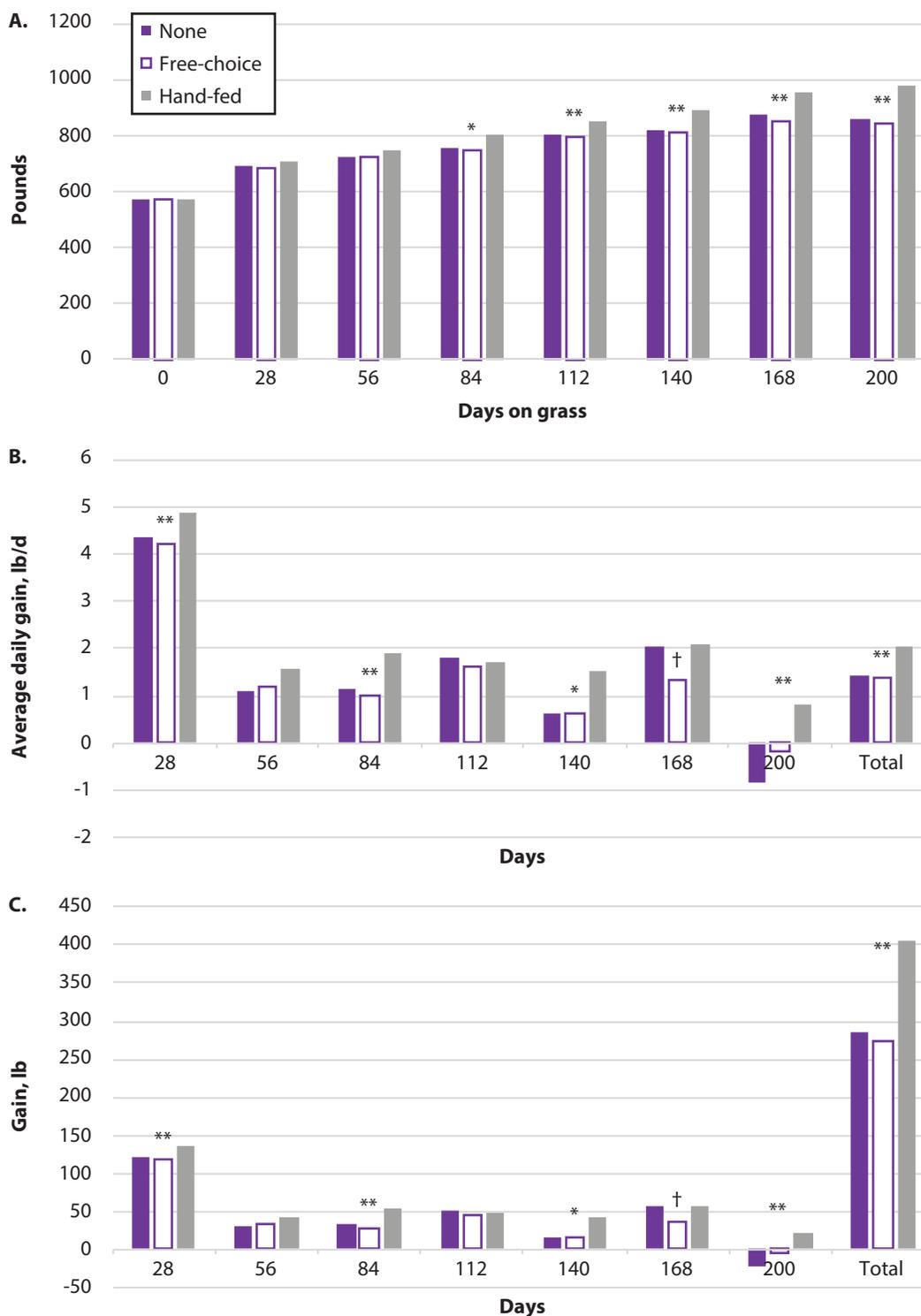
<sup>8</sup>Supple. vs. No: P-value comparison non-supplemented (CON) and supplemented (MIX30, Block, ISO, and ENO).

<sup>9</sup>ISO vs. ENO.: P-value comparison between corn variety treatments (isoline or Enogen-feed corn).

<sup>9</sup>Ultrasound marbling score: 5.0–5.9 is Small 00–90 (CUP labs, 2007; <https://www.cuplab.com/Files/content/V.%201%20IMF%20or%20Marbling%207-1-07.pdf>).

<sup>10</sup>U.S. Department of Agriculture marbling scores: 300–399: Slight 0–90; 400–499: Small 0–90; and 500–599: Modest 0–90.

# BEEF CATTLE MANAGEMENT



**Figure 1. Steer weight, ADG, and total gains categorized by type of supplement; measured every 28 days.**

\*  $P < 0.01$ ; \*\*  $P < 0.001$ ; †  $P < 0.10$

Panel A: Steer weights by type of supplement, measured every 28 days.

Panel B: Average daily gain calculated every 28 days and total average daily gain based on type of supplement.

Panel C: Gain in each 28-day period based on type of supplement.

None: control treatment where steers received free-choice mineral.

Free-choice: steers received supplemental energy and protein from liquid feed (MIX30, AgriDyne) or block form (Mintrate 40 Red Block, ADM Nutrition).

Hand-fed: steers were supplemented at 0.5% of body weight on DM-basis with a blend of 60% corn and 40% dried distillers grains (DDGs) daily. Corn was an isoline genetic line or Enogen feed corn (Syngenta).

# Stocker Steer Gains and Fly Numbers as Impacted by Burn Date and Type of Mineral on Tallgrass Native Range – Year 3

*J.K. Farney and M. Frahm<sup>1</sup>*

## Summary

This study aims to evaluate effectiveness of two operational management systems for steer gains and fly control. The first strategy evaluated was pasture burn date of March (MAR) or April (APR). The second management strategy was free-choice mineral with spices (SPICE) or without spices (CON). Eight pastures ( $n = 281$  steers; initial weight  $572 \pm 75$  lb) were used in a  $2 \times 2$  factorial treatment structure. Steers were weighed individually, randomly assigned to treatment, and grazed for 87 days. Weekly, 33% of steers were photographed to count flies and evaluated for hair coat score. Neither the date of pasture burning nor the mineral type impacted cattle gains for all treatments. Cattle consuming mineral with spices had less flies through a majority of the grazing period. Even though SPICE cattle had less flies, the spice treatment did not result in improvements in gain as during the weeks where spice cattle had less flies than control, both treatments were over the economic threshold for horn flies (200 flies per steer). Additional years on this project will be completed to determine the effects of pasture burn date and addition of spices in mineral.

## Introduction

Essential oils/spices have been offered as a potential method to control insects in cattle (Showler, 2017; Massariol et al., 2009), alter rumen microbial population (Elcoso et al., 2019), and replace feed antibiotics, all of which may improve production responses in beef as well as dairy cattle. In feedlot studies, cattle consuming a blend of essential oils had similar average daily gain, final body weight, gain to feed ratios, and carcass characteristics as steers fed monensin with or without tylosin (Araujo et al., 2019). Grazing stocker cattle on cool-season annual grass pasture or summer pasture did not show improvements in gains when cattle received a cinnamon and garlic essential oil product by either free-choice or hand-feeding (Beck et al., 2017). However, other studies at Kansas State University have found that feeding supplements of spices in mineral have increased gain in growing cattle on grass (Farney, 2020a; Farney, 2020b).

Burning pasture in April results in about 20 pounds more gain in grazing cattle than burning a pasture in March (Owensby, 2010). Smoke management plans are important for the state of Kansas as high smoke production in April creates smoky conditions that drift to large metropolitan areas. If weight gains and plant population changes are not too different when burning in March instead of April, earlier burning would provide the opportunity to develop a smoke management plan that allows for an increased burning season to dilute a single month's smoke.

The overall objective of this study is to evaluate management practices that may impact stocker steer gains on a 90-day double-stocking grazing system in tallgrass native range. Specific objectives are to evaluate the time of burning, and the inclusion of spices in the

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<sup>1</sup> Undergraduate intern, Department of Animal Science, College of Agriculture, Kansas State University.

mineral supplement, and to determine whether the effects of both treatments are additive.

## Experimental Procedures

The study was conducted at the Bressner Research unit in Yates Center, KS. The unit consists of eight pastures on 625 acres of tallgrass native prairie. Two management strategies were evaluated to determine effects on stocker steer gains in a  $2 \times 2$  factorial arrangement. The two management strategies were timing of pasture burning and free-choice mineral supplementation. Within each management strategy there were two treatments being evaluated, thus a total of four treatments were applied to the cattle at the unit. The pasture burning management strategies evaluated were burning in March or burning in April. The pastures for the March burn treatment were burned on March 3, 2021, while the April burned pastures were burned on April 11, 2021.

The free-choice mineral supplementation strategies consisted of two treatments: (1) free-choice complete mineral (CON) where 25% of magnesium (Nuplex Mg/K, Nutech Biosciences, Inc., Oneida, NY), copper, zinc, and manganese came from chelated organic sources (Nuplex Chelate-3 blend, Nutech Biosciences); and (2) the same base mineral with the addition of spices (SPICE). The spices included were powdered forms of oils from garlic and the product Solace (proprietary blend of four spices; Wildcat Feeds Inc., Topeka, KS). The mineral analysis is listed in Table 1. The minerals were formulated for a 4 ounce/head/day intake and were offered free choice. Every week, 125% of that week's formulated mineral consumption for each pasture was placed into feeders and weighed. Any remaining mineral from the previous week was also weighed.

### *Gain Measures*

Two hundred eighty-one steers ( $572 \pm 75$  lb) were weighed individually on April 19, 2021, and assigned to pasture randomly based on order through the chute. Cattle were weighed at the end of the study on July 16, 2021, for a total of 87 days of grazing. Two steers were not weighed on the final weigh date so only 279 head were included in the analyses. Data collected included initial and final weights, and then average daily gain and total gain were calculated.

### *Fly Counts and Hair Coat Score*

Weekly, 33% of the steers in each pasture were photographed with a Nikon digital camera with a 300 mm zoom lens, with the photographer's back to the sun. The steers were photographed with their entire side filling the viewfinder. Then photos were processed with ImageJ and flies counted (Figure 1). Additionally, hair coat score was recorded from the photos with a score of 1–5, where a 1 was a 100% slick haired animal; 2 had 25% of body with long hair; 3 had 50% of body covered in long hair; 4 had 75% of body covered in long hair; and 5 was 100% long haired. Data collected included number of flies and hair coat scores for each week.

## Results and Discussion

### *Performance of Steers*

In contrast to previous years (Farney et al., 2020; Farney and Reeb, 2021) there was no effect of burn date or mineral type on average daily gain, total gain, or final weight (Table 2). Burn date probably did not impact gains as 2021 had a cooler than average

spring and the grasses were slow to begin growing. In fact, the day of turnout, there was a light misting of snow on the pastures.

### *Fly Counts*

Flies increased through the summer until week 8 where there was a reduction in fly numbers until week 11 when there was an increase in the number of flies (Figure 2). During the 2021, grazing season, steers on the SPICE mineral had less flies than CON, especially during weeks 4–7, and 9–12 (Figure 3). In contrast to previous years, SPICE mineral intake was more consistent in 2021 and was closer to 4 ounce/head/day for which it was formulated. This level of intake may be why in 2021 the spice mineral reduced fly populations, whereas in other years there was no difference in fly numbers (Farney et al., 2020; Farney and Reeb, 2021).

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## BEEF CATTLE MANAGEMENT

**Table 1. Analysis of minerals**

<b>Item (on dry matter basis)</b>	<b>Control mineral</b>	<b>Spice mineral<sup>1</sup></b>
Crude protein, %	5.69	5.50
Calcium, %	16.67	16.17
Phosphorus, %	3.33	3.44
Salt, %	22.54	22.53
Magnesium, % <sup>2</sup>	2.51	2.48
Potassium, %	0.89	0.88
Iron, ppm	5,546	5,529
Copper, ppm <sup>3</sup>	1,153	1,153
Zinc, ppm <sup>3</sup>	3,471	3,471
Manganese, ppm <sup>3</sup>	1,817	1,818
Selenium, ppm	22	22
Iodine, ppm	333	333
Cobalt, ppm	13	13
Vitamin A, IU	141,667	141,667
Vitamin D, IU	14,167	14,167
Vitamin E, IU	172	172

<sup>1</sup>Spice mineral with similar base as control mineral with the addition of 3 pounds per ton garlic oil and 18 pounds per ton of Solace (Wildcat Feeds Inc., Topeka, KS) that replaced dried distillers grains and limestone in control mineral.

<sup>2</sup>Nuplex Mg/K (Nutech Biosciences Inc., Oneida, NY) contributed 25% of the magnesium in the minerals.

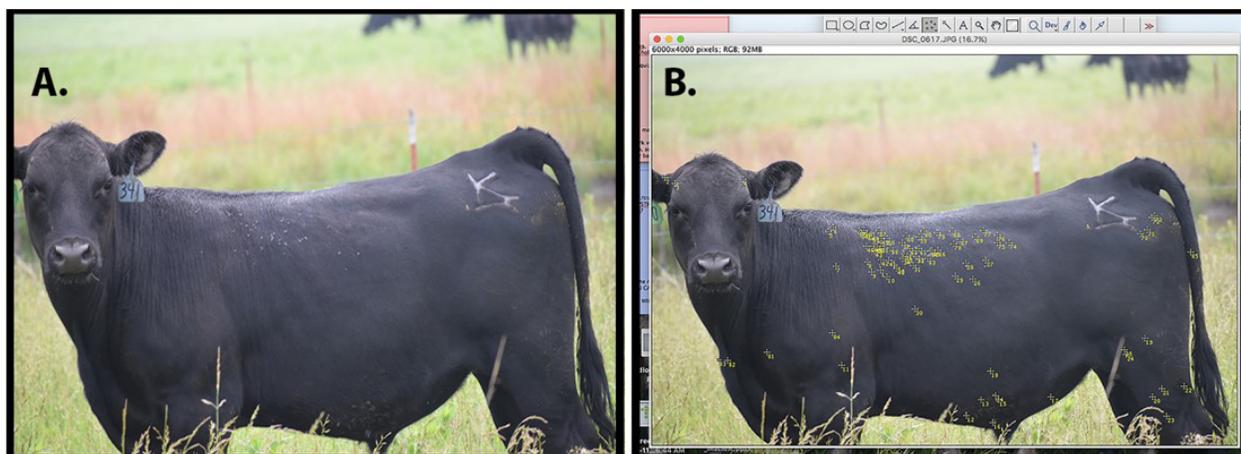
<sup>3</sup>Nuplex 3-chelate blend (Nutech Biosciences Inc., Oneida, NY) contributed 25% of the copper, zinc, and manganese of the total trace mineral supplied in the minerals.

## BEEF CATTLE MANAGEMENT

**Table 2. Performance measures and fly counts based on mineral and burn dates**

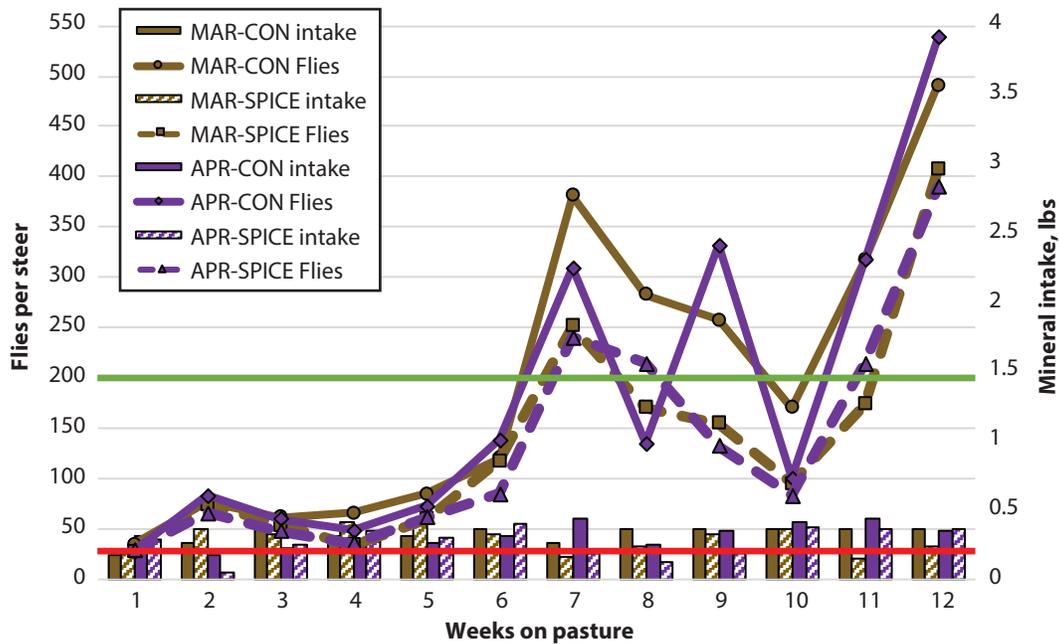
Item	March		April		SEM	P-value		
	Control	Spice	Control	Spice		Burn	Mineral	Burn × mineral
In wt., lb	571	572	570	580	9.2	0.75	0.63	0.50
Out wt., lb	725	751	741	726	12.1	0.69	0.68	0.16
Gain, lb	152	177	168	145	11.5	0.51	0.93	0.11
ADG, lb/d	1.78	2.06	1.95	1.70	0.13	0.51	0.93	0.11
Fly counts, n	72	51	63	49	1	0.04	<0.001	0.23
Score coat score	3.35	3.36	3.39	3.84	0.03	0.35	0.92	0.68

SEM = standard error of the mean.



**Figure 1. Illustration of the photos taken and fly count method. A. Original photo taken with Nikon camera with 300 mm zoom lens. B. Same image in ImageJ with flies highlighted in yellow.**

## BEEF CATTLE MANAGEMENT



**Figure 2. Average number of flies per steer per week and average weekly intake of mineral by treatments.**

Average number of flies per steer per week ( $P = 0.02$ ) are represented in the line chart while weekly average mineral intake is the bar charts. The green line at 200 indicates economic threshold for horn flies. The red line at 0.25 indicates the formulated mineral intake of 4 oz/head/day.

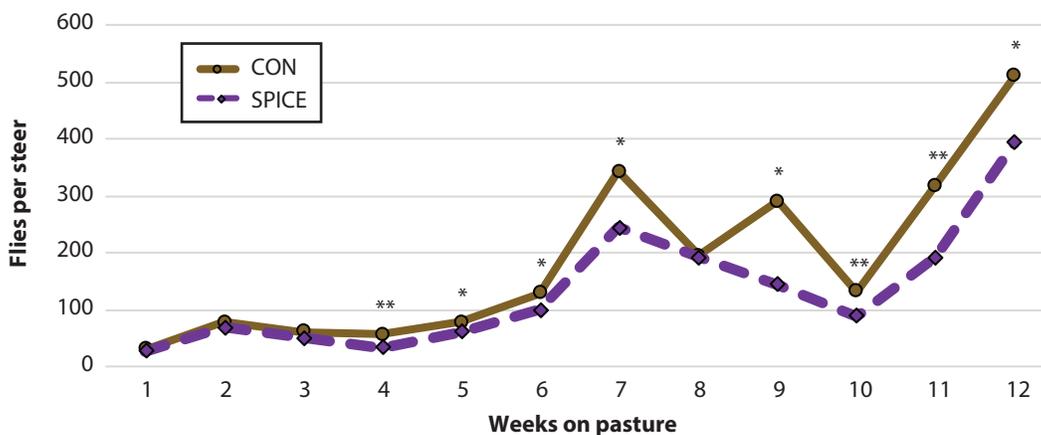
MAR-CON: Fly numbers are represented in brown solid line with circle markers. Mineral intake is represented by solid brown bars.

MAR-SPICE: Fly numbers are in dashed brown line with square markers. Mineral intake is represented by brown striped bars.

APR-CON: Fly numbers are in solid purple line with diamond markers. Mineral intake is represented by solid purple bars.

APR-SPICE: Fly numbers are in dashed purple line with triangle marker. Mineral intake is represented by purple striped bars.

## BEEF CATTLE MANAGEMENT



**Figure 3. Average number of flies per steer per week by mineral treatments.**

Average number of flies per steer per week ( $P = 0.01$ ) are represented in the line chart.

CON: control mineral is represented by the solid brown line with circle markers.

SPICE: spice mineral is the same base mineral as control with 3 pounds/ton of garlic oil and 18 pounds/ton of Solus (Wildcat Feeds LLC).

\* indicates for that week  $P < 0.01$ .

\*\* indicates for that week  $P < 0.10$ .

# Evaluation of Grazing Options During Summer for Growing Heifers – Year 2

*J.K. Farney*

## Summary

Developing methods to provide high quality forage through most of the year is important for cattle operations. The purpose of this study was to determine forage management options to offset the summer “slump” with fescue. Four grass pasture treatments (10 pastures total; 4 acres each) were used in a completely randomized design and stocked with growing heifers ( $n = 49$ ; initial wt  $473 \pm 60$  lb). Pasture treatments consisted of novel fescue (FES), crabgrass (CRAB), bermudagrass (BERM), and sorghum-sudan interseeded into novel fescue (SS-FES). Heifers were weighed and grazed on pastures from April to September (153 d). Heifers on FES were continuously grazed. All other pastures were rotationally grazed. Sorghum-sudan was interseeded into fescue pastures in May. Average daily gain (ADG) for the entire grazing period was not different between pasture systems. In contrast to the previous year, there were no differences in heifer gain, ADG, or gain per acre for any of the grazing treatments.

## Introduction

Fescue is a cool-season hardy grass that can withstand intensive grazing. Approximately 60% of the annual forage production occurs from March-May. Then fescue has a “slump” during the summer when production is stopped, the plant goes into reproductive phase, and animal performance can be negatively impacted. In an ideal production system, high quality forage needs to be provided to cattle year-round to maximize overall production. One method to offset the “summer slump” with fescue is for producers to provide warm-season pastures and cool-season pastures and rotate cattle between the two during their respective growing season. However, that requires at least doubling the acreage or reducing the cow herd by half. Another opportunity to improve fescue forage quality during the summer would be an addition of warm-season perennials such as clovers. Biomass production increase may be small, even though forage quality is improved. Therefore, producers are interested in adding warm-season annual grasses which produce substantial biomass into cool-season perennial pastures to maximize land usage.

The purpose of this study was to evaluate different grazing options for summer for growing replacement heifers.

## Experimental Procedures

Ten, 4-acre pastures were used in this study. Three pastures of crabgrass (CRAB), three pastures of bermudagrass (BERM), two pastures of Max-Q fescue (FES), and two pastures of Max-Q fescue interseeded with sorghum-sudan (SS-FES) were stocked with weaned heifers. Heifers on the FES were stocked with 4 head per pasture through the entire grazing period and allowed to graze the pasture continuously. The FES pastures were fertilized with 60 lb of nitrogen (N) per acre in February and 40 lb N/acre in September. Heifers on the SS-FES pastures were stocked with 7 head per pasture from April to July, and rotationally grazed the pasture in 3 paddocks. Heifers on SS-FES grazed for 14 days on each paddock to try to keep the swath height close to 2 inches.

## BEEF CATTLE MANAGEMENT

At the end of May, the paddock that was just grazed (paddock 1) was also mowed to 2-inch height, and 25 lb/acre of sorghum-sudan was drilled into the standing fescue. Then 14 days later when heifers were removed from paddock 2, the paddock was swathed to 2 inches and drilled with sorghum-sudan. After sorghum-sudan was interseeded, 46 lb N/acre was applied. Once the sorghum-sudan was 2 feet tall, 4 heifers were rotated to the paddock and allowed to graze for 10 days before being rotated to the next paddock. The SS-FES pastures were fertilized with 40 lb N/acre in September. Heifers on the BERM pastures were stocked at 5 head per pasture and rotationally grazed between 2 paddocks with 28 days between rotations. The BERM pastures were fertilized with 50 lb N/acre in mid-April. Heifers on the CRAB were stocked at 4 head per pasture and rotationally grazed between 2 paddocks with 28 days of grazing per paddock. Five pounds of crabgrass seed was broadcast onto the pastures in April with 50 lb N/acre. The CRAB and BERM pastures were also fertilized with 50 lb N/acre in mid-June.

Heifers were placed on pasture on April 26, 2021. Heifers were weighed going to pasture after a 3-day rumen equivalence diet consisting of 50:50 blend of DDG:wheat middlings at 2% of body weight, and weighed on two consecutive days. All heifers were weighed July 26, 2021, and September 29, 2021.

Heifer average daily gain, total gain, and gain per acre were determined for each grazing period.

### Results and Discussion

In contrast to previous years and in contrast to hypothesis, grazing the heifers on warm season forages during the summer of 2021 did not result in changes of measures of gain as compared to grazing a novel endophyte fescue pasture. Potentially the similarities in gains can be explained by the weather patterns of 2021. In general it was quite a bit cooler than normal in early summer, which hampered the growth of the crabgrass and bermudagrass pastures. For the sorghum-sudan interseeded pastures, one pasture had particularly good growth of the sorghum-sudan, whereas the other pasture had limited to no growth. Weather variability highly influences forage systems production and thus this project will need to be continued for several more years before making recommendations about grazing systems.

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## BEEF CATTLE MANAGEMENT

**Table 1. Gains for cattle based on type of pasture**

Item	Pasture type				SEM	<i>P</i> -value
	FES	BERM	CRAB	SS-FES		
Initial weight (April), lb	490	489	490	431	19	0.07
July weight, lb	622	630	623	554	19	0.01
Gain/acre April-July, lb	132	140	132	122	8	0.55
ADG, April-July, lb/d	1.48	1.58	1.49	1.37	0.10	0.55
September weight, lb	699	695	737	696	20	0.41
Gain/acre July-September, lb	76	65	114	90	13	0.13
ADG July-September, lb/d	1.21	1.04	1.81	1.43	0.22	0.13

FES = novel fescue. CRAB = crabgrass. BERM = bermudagrass. SS-FES = sorghum-sudan interseeded into novel fescue.

# Evaluation of Implants, Clover, and Fescue Variety on Stocker Steers – Year 2

*J.K. Farney, M. Frahm,<sup>1</sup> S. Strnad,<sup>1</sup> and T. Bottorff<sup>1</sup>*

## Summary

Sixty-four growing steers were used in a split-plot experiment, where the whole plot was pasture, and the split-plot was the implant level. Whole plot treatment was a  $4 \times 2$  factorial with four levels of fescue (High Endophyte, Low Endophyte, Novel, or Endophyte Free) and two levels of legume (Legumes or No Legumes). The split-plot included four implant levels (No Implant, Synovex One Grass, Revalor-G, or Ralgro). Data collected were weights, hair coat scores, hair length, rectal temperature (every 28 days), and ultrasound carcass characteristics when steers were coming off grass. Steers on High Endophyte had the lowest average daily gain (ADG) and final weight and smallest loin muscle as compared to steers on all other fescue types. The gain differentiation was observed beginning at day 56 through the end of the study. Overall, ADG was not impacted by the addition of legume. Steers that were implanted with Synovex One Grass had a greater gain, final weight, and lower hair score as compared to non-implanted steers. For many of the other measures, steers implanted with Ralgro or Revalor-G resulted in changes between non-implanted steers and those receiving Synovex One Grass. Steers on high endophyte fescue had greater final weight and ADG than non-implanted steers or those receiving Ralgro, with Synovex One Grass being intermediate. Gains for steers on endophyte free pastures were also impacted by the type of implant where Synovex One Grass steers had greater gains than non-implanted and Revalor-G steers, with Ralgro being intermediate. In this second year of research, the use of low to no endophyte fescue and the addition of implants increased gains.

## Introduction

Fescue makes up a large portion of pastureland in the United States. Kentucky 31 (K31) is the most commonly-planted fescue type due to its hardiness and easy stand maintenance. Kentucky 31 is hardy due to the symbiotic relationship with a fungus commonly known as endophyte. The endophyte allows the fescue to be less susceptible to flood, drought, pests, and other environmental impacts. However, the endophyte produces ergot toxins that can cause metabolic issues and possibly vasoconstriction. Vasoconstriction can lead to increased respiration rates, sloughing of hoof wall and/or tails, pregnancy loss, breeding issues, and reductions in stocker calf gains.

A variety of options have been discovered and tested to help combat the issues pertaining to cattle performance, including fescue development, the addition of clover, or implants. The other fescue varieties have shown improvements to cattle gains, but may come at the cost of stocking rates, pasture persistence, grazing days, or grazing management. Legumes often improve cattle gains but may impose a problem with return on investment. Implants have been proposed as a way to control the fescue toxicity issues. The use of implants in cattle during grazing has shown improved gains compared to cattle grazing without implants.

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<sup>1</sup> Undergraduate intern, Department of Animal Science, College of Agriculture, Kansas State University.

The purpose of this study is to identify management practices that result in the greatest economic return to the stocker operation and determine which management techniques reduce toxicity issues.

### Experimental Procedures

Sixty-four growing steers were weighed on two consecutive days and allotted to one of sixteen fescue pastures. Four levels of fescue pastures were used: K31, high endophyte (HIGH); K31, low endophyte (LOW); endophyte free fescue (FREE); and novel endophyte fescue (NOVEL). Eight of the pastures also had ladino clover (6 lb/acre) to serve as an interseeded legume (two pastures per fescue type). Four steers were assigned to each pasture. The steers in each pasture were assigned to one of four implant treatments. The implant treatments included no implant, Ralgro (Merck Animal Health), Revalor-G (Merck Animal Health), and Synovex One Grass (Zoetis).

Steers were turned out on April 1, 2021, and grazed until November 11, 2021. Pastures were fertilized according to recommendations of soil test results in February 2021. Legumes were interseeded into pastures in 2014. Seedheads were clipped in all pastures June 2021.

On day zero of the trial, calves were implanted and wormed, and rectal temperature, hair coat length, and score were recorded. Hair length was measured over the 10th rib in the upper 1/3 of the body using a hemming tape measure. Hair scoring was completed by three individual scorers about every 28 days and based on a scale of 1-5, where a value of 1 is a steer that is completely slick haired; 2 has 25% of body with long hair; 3 has 50% of body with long hair; 4 has 75% of body with long hair; and 5 has 100% of body with long hair coat. Steer weight, hair measurement, and rectal temperature were recorded every 28 days until the pastures no longer supported the steers.

At the end of the grazing period, steers were weighed off grass, scanned with ultrasound for body composition, hair was measured and scored, and rectal temperature read.

### Results and Discussion

In this second year of data collection, there was one interaction between grass type and implant where final weights and ADG were different ( $P < 0.10$ ). Steers on novel and low endophyte fescue pastures did not have different final weights or ADG when combining pasture type and implant type (Figure 1). However, steers grazing endophyte free fescue pastures and receiving the Synovex One Grass implant had greater gains, final weight, and ADG than those implanted with Rev-G or receiving no implant. Steers receiving Ralgro while grazing endophyte free fescue had intermediate gains (Figure 1). Steers grazing high endophyte fescue and being implanted with Rev-G had greater gains, final weight, and ADG as compared to non-implanted and Ralgro steers, with Synovex One Grass implanted steers being intermediate (Figure 1).

Rectal temperature and measured hair length were not different on any dates based on grass type, addition of legume, nor implant type ( $P > 0.10$ ; data not shown).

#### *Steer Performance: Fescue Types*

Fescue type had an impact on the overall steer performance. Similar to past studies, High Endophyte Kentucky 31 Fescue resulted in the poorest performance by the steers.

These steers had the lowest ADG, when compared to the steers grazing other types of fescue (Table 1). By 56 days on the fescue, the High Endophyte treatment steers had the lowest gain and were the lowest through the entire period.

Steers grazing high endophyte fescue had smaller loin muscle depth than endophyte free and novel variety of fescues, with low endophyte concentrations being intermediate (Table 1). There were no differences in marbling score or backfat when measured by ultrasound.

### ***Steer Performance: Legumes***

The addition of legumes did not impact the steers' performance. Legumes had no impact on the ADG of the steers throughout the course of the grazing period (Table 2). The addition of legumes and effects on gain and mitigation of fescue toxicity may have been diluted as some of the high endophyte pastures with legumes had a very low stand count of legumes (< 5% of plant population was legume). The average legume percentage for endophyte free fescue pastures was 23.75%; novel endophyte pastures was 24.25%; low endophyte was 12.25%; and high endophyte was 7.5%.

### ***Steer Performance: Implants***

Steers implanted with Synovex One Grass had greater total gains than non-implanted steers and steers implanted with Ralgro, with Rev-G being intermediate (Table 3). The type of implant started showing differences in ADG at day 112 where non-implanted steers had lower cumulative ADG than Ralgro and Synovex One Grass, with Rev-G being intermediate (Figure 2).

Even though there was no measured difference in hair length by implant type, when the three trained observers scored the steers, they found that beginning on day 140 of the study the steers implanted with Rev-G and Synovex One Grass had a lower hair score than non-implanted steers, with Ralgro being intermediate (Figure 3). This advantage was found through the end of the grazing period.

This study found that there were two management strategies for fescue toxicity. Use of non-endophyte or non-toxic varieties of fescue pasture improves cattle gain. Additionally, in the second year of the study the long-duration implant of Synovex One Grass did increase gains for the steers. Legumes did not improve steer gains.

*Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned. Persons using such products assume responsibility for their use in accordance with current label directions of the manufacturer.*

## BEEF CATTLE MANAGEMENT

**Table 1. Steer performance measures based on fescue type**

Item	Endophyte Free	Novel Endophyte	Low Endophyte	High Endophyte	SEM	P-value
Initial wt, lb	672	675	672	670	19	0.99
Final wt, lb	1025 <sup>a</sup>	1016 <sup>a</sup>	1060 <sup>a</sup>	889 <sup>b</sup>	16.5	< 0.001
Grazing ADG, lb/d	1.77 <sup>a</sup>	1.73 <sup>a</sup>	1.93 <sup>a</sup>	1.14 <sup>b</sup>	0.08	< 0.001
Loin muscle depth, mm	55 <sup>a</sup>	56 <sup>a</sup>	53 <sup>ab</sup>	50 <sup>b</sup>	1.5	0.07
Marbling score <sup>1</sup>	4.72	4.79	4.86	4.89	0.11	0.75
Backfat, in.	0.16	0.16	0.16	0.15	0.01	0.68

SEM = standard error of the mean. ADG = average daily gain.

<sup>ab</sup> Different letters indicate  $P < 0.05$ .

<sup>1</sup>Ultrasound marbling score: 4.5–4.9 is Slight 50–90; 5.0–5.9 is Small 00–90 (CUP labs, 2007; <https://www.cuplab.com/Files/content/V.%201%20IMF%20or%20Marbling%207-1-07.pdf>).

**Table 2. Steer performance measures based on legume presence**

Item	No legume	Legume	SEM	P-value
Initial wt, lb	672	675	13.5	0.96
Final wt, lb	1001	995	11.8	0.71
Grazing ADG, lb/d	1.66	1.63	0.05	0.71
Loin muscle depth, mm	52	55	1.1	0.14
Marbling score <sup>1</sup>	4.89	4.75	0.08	0.25
Backfat, in.	0.16	0.15	0.006	0.86

SEM = standard error of the mean. ADG = average daily gain. Legume = ladino clover seeded at 6 lb/acre.

<sup>1</sup>Ultrasound marbling score: 4.5–4.9 is Slight 50–90; 5.0–5.9 is Small 00–90 (CUP labs, 2007; <https://www.cuplab.com/Files/content/V.%201%20IMF%20or%20Marbling%207-1-07.pdf>).

## BEEF CATTLE MANAGEMENT

**Table 3. Steer performance measures based on implant**

Item	Synovex				SEM	P-value
	No Implant	Ralgro <sup>1</sup>	Revelor-G <sup>2</sup>	One Grass <sup>3</sup>		
Initial wt, lb	672	675	670	673	11.5	0.95
Final wt, lb	970 <sup>b</sup>	988 <sup>b</sup>	1006 <sup>ab</sup>	1027 <sup>a</sup>	13.7	0.02
Grazing ADG, lb/d	1.52 <sup>b</sup>	1.60 <sup>b</sup>	1.68 <sup>ab</sup>	1.78 <sup>a</sup>	0.06	0.03
Loin muscle depth, mm	55	52	53	55	1.6	0.67
Marbling score <sup>4</sup>	4.86	4.94	4.70	4.76	0.09	0.20
Backfat, in.	0.16	0.16	0.15	0.16	0.01	0.28

<sup>1</sup> Merck Animal Health, Madison, NJ.

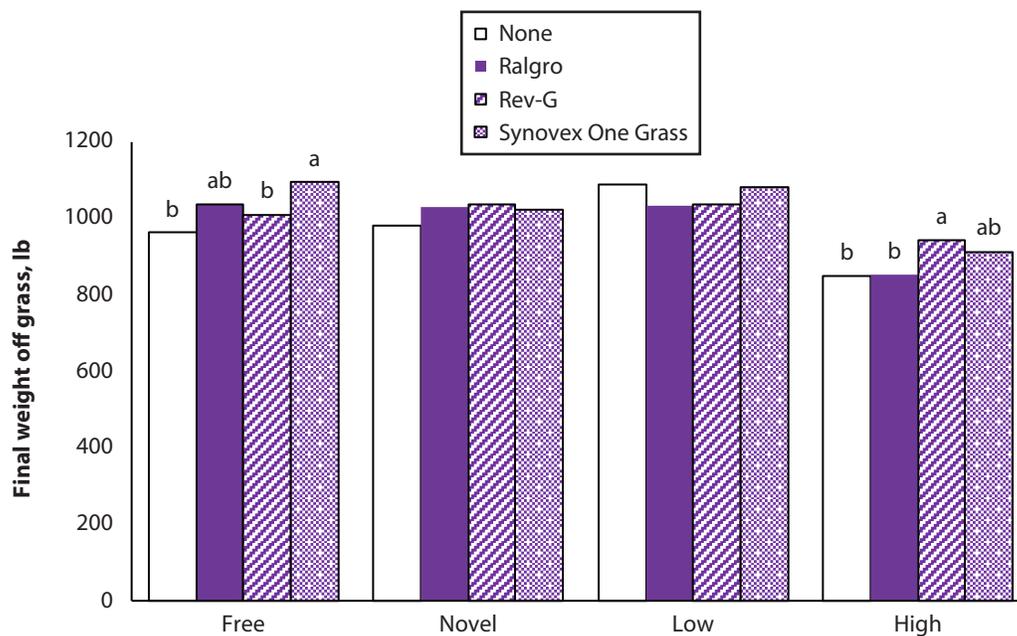
<sup>2</sup> Merck Animal Health, Madison, NJ.

<sup>3</sup> Zoetis, Parsippany, NJ.

SEM = standard error of means. ADG = average daily gain.

<sup>ab</sup> Different letters indicate  $P < 0.05$ .

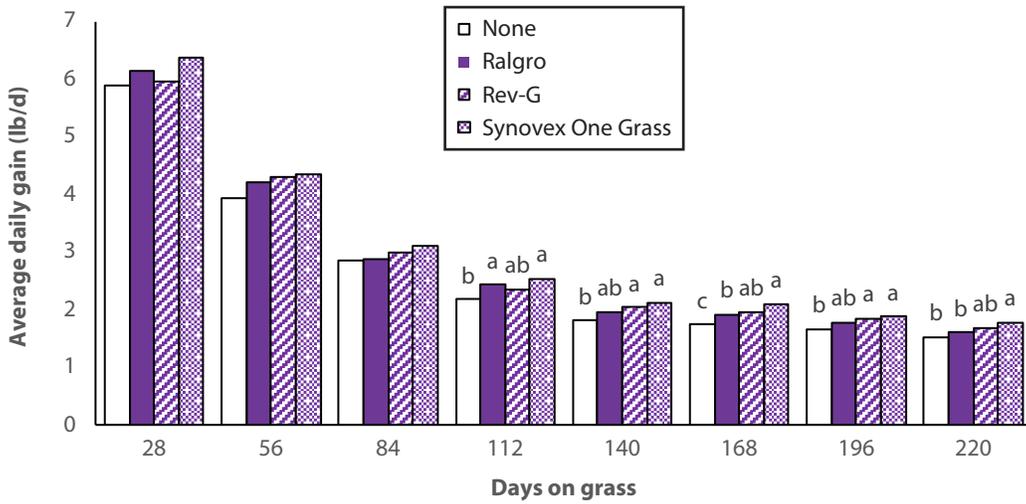
<sup>4</sup>Ultrasound marbling score: 4.5–4.9 is Slight 50–90; 5.0–5.9 is Small 00–90 (CUP labs, 2007; <https://www.cuplab.com/Files/content/V.%201%20IMF%20or%20Marbling%207-1-07.pdf>).



**Figure 1. Final weight of steers based on pasture type and type of implant.**

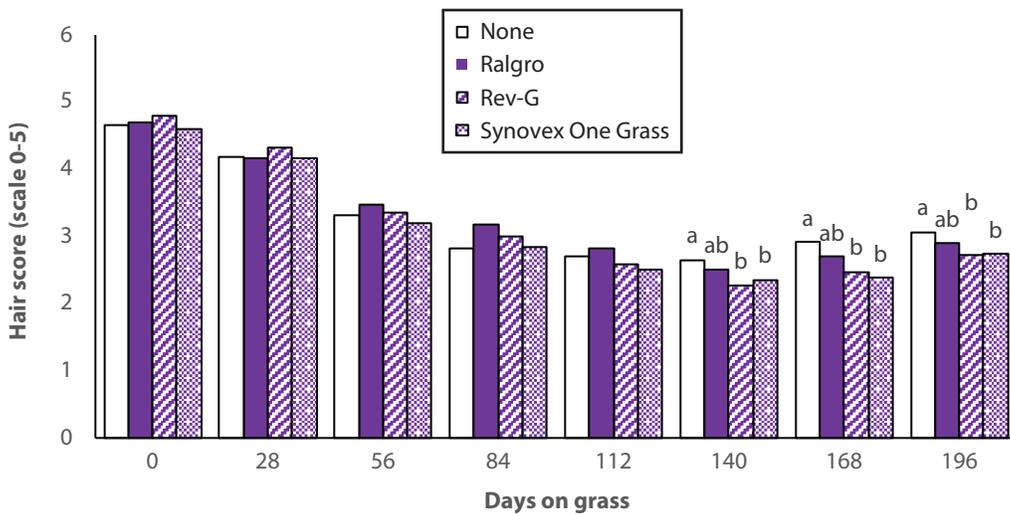
<sup>ab</sup> Different letters within forage type indicate differences at  $P < 0.05$ .

## BEEF CATTLE MANAGEMENT



**Figure 2. Average daily gain for steers based on implant type across days on grass.**

<sup>abc</sup> Different letters within forage type indicate differences at  $P < 0.05$ .



**Figure 3. Average hair score for steers based on implant type across days on grass.**

<sup>ab</sup> Different letters within forage type indicate differences at  $P < 0.05$ .

Hair scoring was completed by three individual scorers about every 28 days and based on a scale of 1-5 where a value of 1 is a steer that is completely slick haired; 2 has 25% of body with long hair; 3 has 50% of body with long hair; 4 has 75% of body with long hair; and 5 has 100% of body with long hair coat.

# Comparison of Finishing Cattle on Self-Feeder or Total-Mixed Ration

*J.K. Farney*

## Summary

Corn-finished cattle are the backbone of the US beef production system. Traditionally cattle are fed a total-mixed ration (TMR) where all feed ingredients are mixed together, delivered, and fed daily to cattle. Previous research evaluated complete self-fed finishing rations where the diet is placed into a self-feeder. With advancements in technology and varieties of corn, the purpose of this study was to determine the differences in finishing cattle gains, feed efficiency, carcass merit, and cost of production on a TMR ration as compared to a self-fed finishing ration. Thirty-five steers and heifers were sorted into 8 pens and assigned to one of two finishing diet treatments: traditional TMR or self-fed finishing ration. There were 3 pens of heifers and 1 pen of steers per treatment group. There were no differences based on the sex of the cattle. Calves on the self-fed finishing diet had a greater ADG and total gain. Self-fed calves also tended to have a heavier hot carcass weight, greater marbling score, and greater average carcass value than calves on TMR. There was no difference in yield grade. Calves on the self-fed ration had a greater average daily intake and tended to have a higher feed:gain conversion ratio. Cost of gain was \$0.36 more for self-fed calves.

## Introduction

Feeding corn to beef cattle improves the flavor of beef in the United States. To produce the high quality and flavorful beef, the cattle must be finished on a high-corn diet. Feedlots have been developed to make the cost of producing beef most efficient. This feeding method has been found to have a greater efficiency of feed conversion to produce pounds of beef. There are lots of infrastructure, equipment, labor, and time commitments to make this system work. This is why economies of scale are so important in feedlot finishing systems.

Cattle geneticist have been working on improving marbling and carcass characteristics. However, many cow-calf producers have not been able to capture revenue from the improvements in carcass genetics they have been implementing. It has been proposed that a low-input finishing system is an option for cow-calf producers to be able to feed their own calves to finished market weight and be able to capture premiums on the rail. One method that does not include lots of pen and feeding equipment infrastructure is a complete ration fed through a self-feeder (creep feeder).

Older studies have been conducted examining self-fed rations as compared to total mixed rations (TMR). In a 2002 report from North Dakota there was no difference in cattle performance or carcass characteristics in a self-fed or TMR feeding system. Also, based on 2002 prices it was economically feasible to feed cattle with a self-fed ration.

The purpose of this study is to evaluate current feed ingredients and costs associated with production based on either a self-fed ration or as a total mixed ration.

## Experimental Procedures

Thirty-five heifers and steers (29 heifers and 6 steers) were weighed and assigned to one of 8 pens. There were 6 pens of heifers (4–5 head per pen) and 2 pens of steers (3 head per pen). Half of the pens were assigned to a totally mixed ration (TMR) diet that consisted of a dry matter basis including 80% whole shelled corn, 15% corn silage, and 5% supplement containing Tylan and Rumensin. Calves on the TMR ration were offered step-up rations over 3 weeks by increasing the amount of corn and decreasing amount of corn silage. The other half of the pens were provided a complete feed in a self-feeder that consisted of 62% whole shelled corn, 14% wheat midds (pelleted), 10% dried distillers grains, 8% cottonseed hulls (loose), and 6% supplement (contained limestone, salt, mineral pack, vitamin E, urea, MGA, copper sulfate, and 35 lb/ton of molasses). To prepare calves to be completely on the self-fed finishing diet, in the first week calves had free-choice prairie hay and were fed the finishing ration at 1% of body weight on a dry matter basis. The next week feed was increased up to 1.5% of body weight, and the third week they were fed the finisher diet at 2% of body weight. On the fourth week the calves were placed on the self feeders and all the hay was removed.

Calves were started on trial January 6, 2021, and were sent to Creekstone Farms (Arkansas City, KS) packing plant on June 6, 2021 (143 days on feed). Initial weight of calves were 707 lb  $\pm$  41 lb. Heifers were implanted at start of feeding with Revalor XH and steers with Revalor XS.

## Results and Discussion

There was no difference in performance of calves based on whether they were steers or heifers, so gains and carcass characteristics are reported based on finishing diets. No digestive problems were observed in the cattle on these diets.

Calves that were consuming the self-fed finishing ration tended to weigh 50 lb more at harvest than TMR-fed calves. This corresponded to 45 pounds more gain during the feeding period and a 0.33 lb/d advantage in average daily gain. Calves on the self-fed finishing ration also had a greater marbling score, 26 lb more hot carcass weight, and had carcasses that sold for an average of \$62.94 more than calves on the TMR. Yield grades were not different between the two feeding methods. Calves on the TMR were more efficient as they had a much better feed to gain ratio. They also had a lower dry matter intake. Overall, calves on the TMR had a more appealing cost of gain (\$0.92 versus \$1.28 for the self-fed calves).

Even though gains were better with the self-fed ration and actual carcass sale prices were higher, the calves on the self-fed ration lost money, using 2021 values, whereas calves on the TMR made a \$100 profit. Based on 2021 prices and the diet formulated, it was not cost effective to use a self-fed ration for finishing calves. Providing self-fed rations could be an option for producers, but producers need to develop a budget before determining if their options for feed ingredients and final marketing plans allow for profit. The self-fed ration that was developed focused on trying to develop a ration that would maximize gains and be very “safe” from digestive issues. We successfully met those goals, however, the poor efficiency (conversion of grain to weight) was less than desirable. Another thing that would have made the self-fed supplement more attractive was if we could have locked in the January prices for the commodities. This would have saved \$20 per ton or \$47.20 per head on feed cost for the self-fed ration. Another thing

that makes the self-fed feeding option attractive is that smaller producers may have the chance to feed out their own cattle. In the calculations used, a yardage of \$0.45/hd/d was included that was supposed to account for feed truck and infrastructure charges. That value is the feedlot industry standard value, and as previously mentioned, economies of scale probably make that number much lower than the cost for a small farmer-feeder. That is another operational specific cost that needs to be evaluated to determine if the cost, spread out over time, is economical to purchase feeding equipment. An easily made complete feed that is delivered and deposited into feeding pens may be more beneficial for smaller producers.

More self-fed diet options would need to be evaluated if a producer is interested in using this method. The 2002 study from North Dakota used free-choice hay as an option to minimize digestive issues in calves on the self-fed diet, however, their average daily gains were only 3.6 lb/d whereas the gains in this current study were 4.10 pounds. The calves used in the North Dakota study were also all steers and in all other studies steers are more efficient and have faster gains than heifers. The complete self-fed ration developed for this study was excellent at gains, but there are still adjustments needed to make it more financially feasible for cattle producers.

## References

Kreft, B., R. Cargo, J. Kreft, and D. Schmidt. 2002. Low input cattle finishing. North Dakota Beef Report 2002.

**Table 1. Cattle performance and cost of production comparing total mixed ration (TMR) versus a self-fed ration**

Item	TMR	Self-fed	SEM	<i>P</i> -value
Initial weight, lb	707	707	10	0.96
Final weight, lb	1248	1292	20	0.14
Total gain, lb	540	585	12.9	0.02
Total ADG, lb/d	3.77	4.10	0.09	0.02
Marbling score	375	390	6.0	0.09
Yield grade	2.98	3.10	0.12	0.50
Hot carcass weight, lb	753	779	12	0.14
Average intake, lb DM	24.9	28.3	0.5	0.01
Feed:gain (DM-basis)	5.97	7.03	0.32	0.06
Cost of gain (\$/lb) <sup>1</sup>	\$0.92	\$1.28	--	--
Average carcass value, \$	\$1484.51	\$1547.45	26	0.10
Cost/ton of feed, \$/lb	\$168.78	\$294.90	--	--
Net profit, \$/hd <sup>2</sup>	\$99.38	\$-110.08	--	--

<sup>1</sup>Feeding cost of gain. Includes actual feed and delivery costs during study period with \$0.45/hd/d and \$0.05/hd/d yardage for the total-mixed ration (TMR) and self-fed diets respectively.

<sup>2</sup>Cattle purchase price was based on Pratt Livestock Market price average for heifers January 2021 (\$122.80). The TMR ration costs included corn valued based on monthly USDA corn value report ([https://www.nass.usda.gov/Charts\\_and\\_Maps/graphics/data/pricecn.txt](https://www.nass.usda.gov/Charts_and_Maps/graphics/data/pricecn.txt)) with a \$0.20/bu storage and handling cost; corn silage valued at 8× the cost of average corn cost for the month and included harvesting costs, handling and storage fees (range was \$59.61 to \$72.28 per ton); supplement at \$700/ton, and yardage at \$0.45/hd/d. Self-fed ration costs included actual receipts from Bartlett COOP (Bartlett, KS) for the time frame, including delivery and mixing charges (23-mile delivery). Other costs included in profit analysis include cattle trucking, vaccines, and implants.

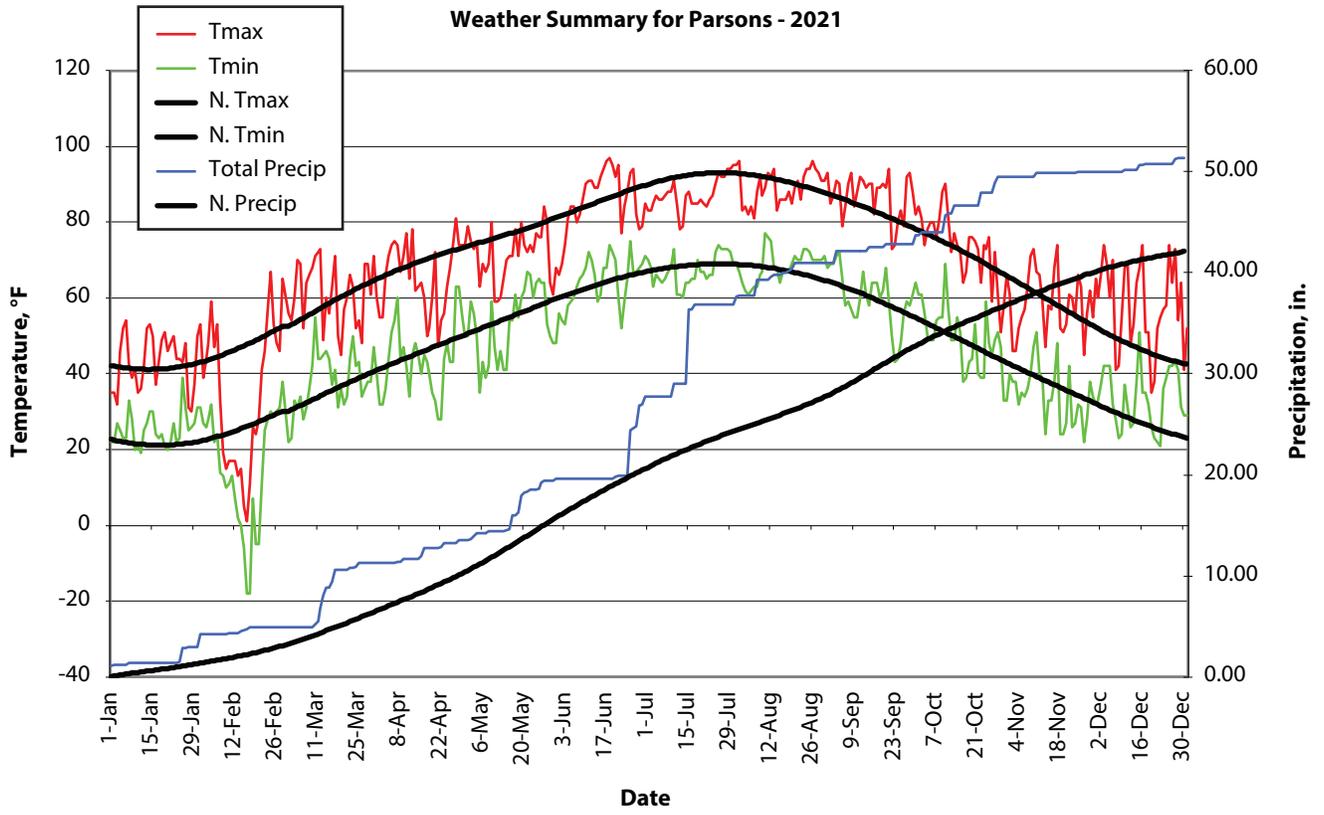
# Annual Summary of Weather Data for Parsons - 2021

2021 Data													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Avg. Max	43.5	34.8	61.2	66.7	70.9	86.5	87.8	88.8	86.6	72.6	58.8	58.0	68.0
Avg. Min	25.5	14.8	38.4	44.5	53.2	65.0	67.2	68.5	59.7	48.4	34.2	33.5	46.1
Avg. Mean	34.5	24.8	49.8	55.6	62.1	75.7	77.5	78.6	73.2	60.5	46.5	45.8	57.0
Precip	4.29	0.65	6.33	2.3	6.03	8.15	9.9	3.29	2.68	5.77	0.51	1.37	51.29
Snow	0.9	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.4
Heat DD*	946	1166	471	296	147	6	0	0	13	176	556	577	4351
Cool DD*	0	0	0	13	56	327	387	423	259	35	0	0	1499
Rain Days	10	6	13	10	19	10	7	11	5	10	3	5	109
Min < 10	0	9	0	0	0	0	0	0	0	0	0	0	9
Min < 32	29	27	5	2	0	0	0	0	0	0	9	13	85
Max > 90	0	0	0	0	0	11	9	14	7	0	0	0	41

Normal values (1981–2010)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Avg. Max	42.0	47.6	57.1	67.1	75.7	84.4	90.0	90.3	81.3	69.6	56.6	44.2	67.2
Avg. Min	21.8	26.0	35.0	44.5	55.0	64.1	68.5	66.6	57.6	45.5	35.3	24.6	45.5
Avg. Mean	31.9	36.8	46.1	55.8	65.3	74.2	79.3	78.5	69.4	57.6	46.0	34.4	56.4
Precip	1.41	1.77	3.19	4.38	5.93	5.53	3.92	3.29	4.69	3.86	2.94	2.06	42.97
Snow	2.8	1.7	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.7	8.7
Heat DD	1026	790	590	299	85	8	1	1	52	260	574	948	4632
Cool DD	0	0	2	23	96	285	442	418	186	29	2	0	1483

Departure from normal													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Avg. Max	1.5	-12.8	4.1	-0.4	-4.8	2.1	-2.2	-1.5	5.3	3.0	2.2	13.8	0.9
Avg. Min	3.7	-11.2	3.4	0.0	-1.8	0.9	-1.3	1.9	2.1	2.9	-1.1	8.9	0.7
Avg. Mean	2.6	-12.0	3.7	-0.2	-3.2	1.5	-1.8	0.1	3.8	2.9	0.5	11.4	0.8
Precip	2.88	-1.12	3.14	-2.06	0.1	2.62	5.98	0	-2.01	1.91	-2.43	-0.69	8.32
Snow	-1.9	5.8	-1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-2.7	-0.3
Heat DD	-81	376	-120	-4	62	-3	-1	-1	-39	-85	-19	-371	-283
Cool DD	0	0	-2	-11	-40	42	-55	5	73	6	-2	0	16

\* Daily values were computed from mean temperatures. Each degree that a day's mean is below (or above) 65°F is counted for one heating (or cooling degree day).



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AgriMAXX Wheat Co., Mascoutah, IL  
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Bartlett Co-op Association, Bartlett, KS  
Beachner Grain, St. Paul, KS  
Beason Farm, Elk City, KS  
Columbus Chamber of Commerce,  
Columbus, KS  
Commercial Bank, Parsons, KS  
Community National Bank & Trust,  
Parsons, KS  
CONICYT, Chile  
Corner Post Crop Insurance,  
Independence, KS  
Deere and Company, Moline, IL  
DeLange Seed, Inc., Girard, KS  
Ernie and Sharon Draeger, Columbus, KS  
Dyna-Gro Seed, Richmond, CA  
East Kansas Agri-Energy, Garnett, KS  
Elanco Animal Health, Indianapolis, IN  
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Fastenal, Parsons, KS  
Faulkner Grain, Chetopa, KS  
FRMS Crop Insurance, Columbus, KS  
Frontier Farm Credit, Parsons, KS  
Greenbush Southeast Kansas Education  
Service Center, Girard, KS  
Joe Harris, St. Paul, KS  
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Independence, KS  
Kansas Center for Sustainable Ag &  
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Kansas Crop Improvement Association,  
Manhattan, KS  
Kansas Department of Agriculture,  
Manhattan, KS  
Kansas Forage & Grassland Council,  
Manhattan, KS  
Kansas Soybean Commission, Topeka, KS  
Kansas Wheat Alliance, Manhattan, KS  
Indigo Ag., Boston, MA  
Labette Bank, Altamont, KS  
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Altamont, KS  
Limagrain Cereal Seeds, Ft. Collins, CO  
McCune Farmers Union Coop,  
McCune, KS  
Merck Animal Health, Summit, NJ  
MFA Incorporated, Columbia, MO  
Midwest Fertilizer, Oswego, KS  
Mix 30, Springfield, IL  
Montgomery Conservation District,  
Independence, KS  
Jeff Murphy, Murphy Generations Farms,  
Girard, KS  
National Science Foundation,  
Arlington, VA  
Parsons Livestock Market, Parsons, KS  
Pioneer Hi-Bred International,  
Johnston, IA  
PrairieLand Partners, John Deere,  
Independence, KS  
Producers Coop, Girard, KS  
R&F Farm Supply, Erie, KS  
Syngenta/AgriPro, Berthoud, CO  
T&T Agronomy, LLC, Coffeyville, KS  
Emmet and Virginia Terril, Catoosa, OK  
Thomas Implement, Inc., Altamont, KS  
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Westbred, LLC, Bozeman, MT

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Wilson County Conservation District,  
Fredonia, KS

W-L Alfalfa, Hill City, KS

Zoetis, Madison, NJ

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# SEREC

## AGRICULTURAL RESEARCH

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