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Effects of Supplementing Corn Silage to Fall-Calving Heifers and Cows Grazing Tall Fescue on Cow Performance

J.W.L. Banks, J.K. Farney, K.E. Fike, J.M. Warner

Summary

The objective was to test the effect of fescue cultivars and supplemental feeding of cows grazing fescue pastures on cow performance and pasture management. Primiparous and multiparous Angus-based crossed cows (n = 45) averaging 151 ± 7 d of gestation at turnout, were randomly allocated and stratified to pasture treatment by parity. Each pasture contained 3 cows of different ages, consisting of a young (first-calf heifer), middle-aged (3-5 yrs.), and old (≥ 6 yrs.) cow. Treatment was a 2 by 2 factorial design with two types of pasture (toxin producing or non-toxin producing fescue) and two levels of supplemental feeding (non-supplemented or supplemented at 1% of body weight on a DM basis of corn silage). Toxic fescue pastures consisted of K-31 endophyte infected tall fescue (n = 8) tested at 507 ppm ± 0.82 SEM for ergot alkaloids with a 92.5% infection rate. Non-toxic pastures consisted of novel (MaxQ) and endophyte free varieties (n = 7). Cows were fed silage (32-42% DM and 7.83% CP) daily in fence-line bunks, with feeding amount being adjusted at each weigh date. Cows were weighed on 2 consecutive days prior to turnout (middle of the second trimester), midpoint (beginning of the third trimester), and at about 2 weeks prior to the estimated calving date for herd. Body weight, body condition score, hair score, and rump fat measurements were taken at each weigh date. Supplementation tended ($P = 0.07$) to increase body weight gain and rump fat ($P = 0.06$) regardless of fescue type. Cattle grazing toxic fescue tended to have longer hair ($P = 0.09$) and did not "slick" off as quickly as those that were supplemented ($P = 0.08$). Cattle grazing toxic fescue exhibited classic fescue toxicosis symptoms, and supplementation improved cow performance regardless of fescue cultivar.

Introduction

Notably, fescue toxicosis is known for its signature negative impacts on livestock, with some of the most prominent visual symptoms being an inability to shed summer hair coats, fat necrosis, and fescue foot (Hemken et al., 1984; Stuedemann and Hoveland, 1988). The endophyte fungus that works cohesively with toxic fescue to ensure drought and predation resistance is also infamous for producing ergot alkaloids known to have vasoconstricting properties, which hinder proper circulatory function (Aiken and Strickland, 2013). Cattle grazing endophyte infected fescue tend to pant, excessively salivate, and spend more time in either shade, mud, or water sources (Stuedemann and Hoveland, 1988; Rottinghaus et al, 1991; Beck et al., 2008; Evans et al., 2012). As far as feeder calves are concerned, their "unthrifty" appearance has been well documented, along with decreased feed intake and altered posture, which results in a lesser price at auction (Paterson et al., 1995). Compromised reproductive efficiency in heifers and cows has also been associated with grazing toxic fescue, accompanied by delayed puberty and increased respiration rates (Schmidt and Osborn, 1993; Paterson et al., 1995; Strickland et al., 2011).

The cattle industry has investigated mitigation strategies with hopes of eliminating the more than one-billion-dollar price tag that comes with grazing fescue pasture across the United States (Strickland et al., 2011). Supplemental feeding has been proven to assist in alleviating tall fescue toxicosis by means of substitution in the diet (Roberts and Andrae, 2004). Grain, oil seeds, milling byproducts, silage, and non-toxic hay have been deemed solutions in the fight against fescue toxicity (Roberts and Andrae, 2004). As the cattle select the alternatives previously mentioned, they decrease the intake of fescue and thus reduce the amount of toxin being ingested, resulting in improved animal performance (Elizalde et al., 1998).

The focus of this study was to examine how the inclusion of corn silage would impact function and performance of cattle grazing non-toxic fescue and if this supplemental feeding would reduce the effect of grazing toxic tall fescue during the late gestation period of fall calving cows.

Experimental Procedures

The study was conducted at the Mound Valley Branch of the Southeast Research and Extension Center in Mound Valley, Kansas. The facility consisted of 8 non-toxin producing fescue and 8 toxin producing fescue pastures. Due to drought conditions and lack of regrowth, one non-toxic pasture was unable to be utilized in this experiment. The experiment was a 2 by 2 factorial design. The two fescue types were toxin producing and non-toxin producing, with the two levels of supplemental feeding being either non-supplemented or supplemented at 1% of BW corn silage on a DM basis in fence-line bunks. Both groups were offered access to free choice mineral. Following a two-day weigh period to adjust for feed allocation, cattle were turned out on May 8, 2023, gathered for a single day of midpoint measurements on June 21, 2023, and for a final two-day weigh period on August 29-30, 2023. The initial weight measurement corresponded to cows in mid-gestation, the mid-point measurement was at the beginning of the third trimester, and the end measurement was about 2 weeks prior to calving. Following the calving period, pairs were gathered and sorted for calf weigh-suckle-weigh on December 3, 2023.

Corn silage consisted of 32-42% DM and 7.83% CP content respectively.

Weight Measures

Cattle were restrained in an Arrowquip Q-Power 107 Series hydraulic squeeze chute (Arrowquip, Woodlands, MB), with weights being recorded by a Gallagher TWR chute scale head (Gallagher Group Limited, Riverside, MO). Average weights at the beginning and middle of the experiment were used to adjust feed allocation. Initial, middle, and ending weights were used to determine total body weight change. Calf birthweight was also collected via the hanging calf scale. Weights were recorded in pounds (lbs).

Body Condition Score and Rump Fat

Three blind, independent evaluators recorded body condition scores at each measurement period using the standard 1-9 scale. Rump fat was recorded using an ALOKA 500 ultrasound machine (Hitachi, LTD., Wallingford, CT) with a 3.5-megahertz short probe capturing the image in Cattle Performance Enhancement Company (CPEC). Measurement was taken over the rump by a trained technician and recorded in millimeters (mm).

Hair Score and Hair Length

One independent tech evaluated hair scores at each measurement period using the standard 1-5 scale. Hair length was measured chute-side using a slide ruler and recorded in millimeters (mm).

Results and Discussion

Weight Measures

Body weight gains measured during second trimester and third trimester measurements were not statistically significant between treatments. However, the duration of the 209-d grazing period allowed for a tendency ($P = 0.09$, Table 1) for supplemental feeding to increase total weight gain for cows on supplemented pastures compared to their non-supplemented contemporaries, regardless of fescue cultivar. There was no difference in calf birth weight based on fescue type, supplementation, nor the interactions ($P > 0.10$; Table 1).

Body Condition Score and Rump Fat

Cattle did not show a significant change in BCS during the second trimester, but during the third trimester there was an interaction tendency ($P = 0.06$, Table 1) for supplemented cattle, regardless of fescue cultivar, to more effectively increased body condition when compared to their counterparts that grazing toxin producing fescue. Ironically, there was not a significant effect on total BCS change from the middle of the second trimester to about 2 weeks prior to calving. Total rump fat change from the middle of the second trimester to about 2 weeks prior to calving tended ($P = 0.06$, Table 1) to increase the rump fat deposition for cows that were supplementally fed. Supplementation increased external fat content in cows regardless of fescue type as evidenced by numerical improvements in both visually appraised BCS and ultrasound rump fat measurements.

Hair Score and Hair Length

Cattle grazing toxic fescue without supplementation showed classic symptoms of fescue toxicosis by having a handicapped ability to shed their winter hair coat with an interaction tendency ($P = 0.08$, Table 2). The cows on toxic pastures that were supplementally fed had "slicker" hair coats than those not consuming the silage. Supplementation did not Supplementation did not improve hair measurements in a non-toxic pasture. Total hair length change tended to be impacted by fescue cultivar ($P = 0.09$, Table 2.).

Conclusions

Supplemental feeding, regardless of fescue cultivar, tends to increase rump fat and weight gain over time. Non-supplemented cattle on toxic fescue exhibit hallmark signs of toxicosis, including longer hair and subsequently poorer hair scores, along with a decreased ability to gain weight. Supplemental feeding aids in cow performance, but more research is needed to provide a deeper understanding of how ergot alkaloids biologically disrupt other physiological pathways.

References

Aiken, G. E., and J. R. Strickland. 2013. Forages and Pastures Symposium: Managing the tall fescue–fungal endophyte symbiosis for optimum forage-animal production. Journal of Animal Science. 91:2369–2378. doi:10.2527/jas.2012-5948.

Beck, P. A., S. A. Gunter, K. S. Lusby, C. P. West, K. B. Watkins, and D. S. Hubbell. 2008. Animal performance and economic comparison of novel and toxic endophyte tall fescues to cool-season annuals1. Journal of Animal Science. 86:2043–2055. doi:10.2527/jas.2007-0522.

Elizalde, J. C., J. D. Cremin, D. B. Faulkner, and N. R. Merchen. 1998. Performance and digestion by steers grazing tall fescue and supplemented with energy and protein. Journal of Animal Science. 76:1691. doi:10.2527/1998.7661691x.

Evans, T. J., D. J. Blodgett, and G. E. Rottinghaus. 2012. Fescue toxicosis. In: Veterinary Toxicology. Elsevier. p. 1166–1177. Available from: *https://linkinghub.elsevier.com/retrieve/pii/B9780123859266001150*

Hemken, R. W., J. A. Jackson, and J. A. Boling. 1984. Toxic Factors in Tall Fescue. Journal of Animal Science. 58:1011–1016. doi:10.2527/jas1984.5841011x.

Paterson, J., C. Forcherio, B. Larson, M. Samford, and M. Kerley. 1995. The effects of fescue toxicosis on beef cattle productivity. Journal of Animal Science. 73:889–898. doi:10.2527/1995.733889x.

Roberts, C., and J. Andrae. 2004. Tall Fescue Toxicosis and Management. Crop Management. 3:1–18. doi:10.1094/CM-2004-0427-01-MG.

Rottinghaus, G. E., G. B. Garner, C. N. Cornell, and J. L. Ellis. 1991. HPLC method for quantitating ergovaline in endophyte-infested tall fescue: seasonal variation of ergovaline levels in stems with leaf sheaths, leaf blades, and seed heads. J. Agric. Food Chem. 39:112–115. doi:10.1021/jf00001a022.

Schmidt, S. P., and T. G. Osborn. 1993. Effects of endophyte-infected tall fescue on animal performance. Agriculture, Ecosystems & Environment. 44:233–262. doi:10.1016/0167-8809(93)90049-U.

Strickland, J. R., M. L. Looper, J. C. Matthews, C. F. Rosenkrans, M. D. Flythe, and K. R. Brown. 2011. Board-Invited Review: St. Anthony's Fire in livestock: Causes, mechanisms, and potential solutions1,2. Journal of Animal Science. 89:1603–1626. doi:10.2527/jas.2010-3478.

Stuedemann, J. A., and C. S. Hoveland. 1988. Fescue Endophyte: History and Impact on Animal Agriculture. J. Prod. Agric. 1:39–44. doi:10.2134/jpa1988.0039.

Table 1. Body condition score (BCS), rump fat (RF), and body weight (BW) change

	Non-toxic		Toxic			*P*-value		
	No supplement	Supplement	No supplement	Supplement	SEM	Fescue	Supp.	Fescue by Supp
BCS change during second trimester	0.39	0.73	0.44	0.52	0.24	0.74	0.40	0.58
BCS Change during third trimester	1.08[a]	0.96[ab]	0.39[b]	1.06[a]	0.24	0.16	0.18	0.06
Total BCS change	1.47	1.67	0.83	1.57	0.34	0.27	0.17	0.41
Total rump fat change, mm	5.56	8.77	6.62	9.22	1.33	0.59	0.06	0.83
BW change during second trimester, lb	130	138	87	125	18.5	0.14	0.22	0.42
BW Change during third trimester, lb	61	91	47	78	18.0	0.46	0.12	0.99
Total BW change, lb	191	227	134	203	28.2	0.18	0.09	0.58

Table 2. Hair score (HS) and hair length (HL) change

	Non-toxic		Toxic			P-value		
	No supplement	Supplement	No supplement	Supplement	SEM	Fescue	Supp.	Fescue by Supp
Total HS change	-1.78[b]	-0.79[ab]	0.25[a]	-0.42[ab]	0.43	0.02	0.72	0.08
Total HL change	-11.11	-7.10	-1.17	-5.83	3.00	0.09	0.92	0.18

Effects of Supplementing Corn Silage to Fall-Calving Heifers and Cows Grazing Bermudagrass and Calf Performance and Physiology

J.W.L. Banks, J.K. Farney, K.E. Fike, J.M. Warner

Summary
The objective was to test the effect of supplemental feeding on cows grazing bermudagrass pastures on cow-calf performance and pasture management. In a completely randomized design, (n = 24) primiparous and multiparous Angus-based cross cows were allocated to bermudagrass pasture with one of two levels of supplemental feeding (non-supplemented or supplemented at 1% of BW on a DM basis of corn silage). Each treatment consisted of (n = 4) pastures stocked with three cows of different ages, a young (first-calf heifer), middle-aged (3-5 yrs.), and old (≥ 6 yrs.) cow, each averaging 155 ± 14 d of gestation at turnout. Cows were fed silage (32-42% DM and 7.83% CP) daily in fence-line bunks, with feeding amount being adjusted at each weigh date. Cows were weighed on 2 consecutive days prior to turnout (middle of the second trimester), midpoint (beginning of the third trimester), and at about 2 weeks prior to the estimated calving date for the herd. Body weight, body condition score, hair score, hair length, and rump fat measurements were taken at each weigh date. Following the final measurement day, cows were relocated to calving pastures consisting of a mixture of bermudagrass, tall fescue, and prairie grass. Supplemental feeding of late gestation fall-calving cows on bermudagrass pasture did not have an effect on cow-calf performance, calf birth weights, and milk output. However, supplemental feeding of cows with corn silage during the summer resulted in 31% more available forage in the pastures. Overall, there were minimal differences in cow performance while grazing bermudagrass pastures during the summer and with supplemental feeding of corn silage. The greatest advantage comes from a greater amount of forage available, which may offset periods of drought or allow producers to increase stocking rates on their property.

Introduction
Bermudagrass (*Cynodon dactylon*) is revered as the go-to warm season perennial for pasture and hay production in the southern U.S. (Hill et al., 2001). Bermudagrass has multiple different hybrids, but the most prevalent cultivar is Coastal bermudagrass, which occupies more than 4×10^6 acres nationwide and was developed by Glenn Burton, USDA-ARS, Tifton, GA. This cultivar gained popularity for its notable adaptability, stability, yield, and quality (Hill et al., 2001). Though bermudagrass is usually known to inhabit the deep southeastern sectors of the U.S. (Aiken, 2002). Bermudagrass can also be used in conjunction with cool season forages like fescue (Stokes et al., 1988), ryegrass, and/or clover (Rouquette, 2017) to extend the grazing season in the central plains (Peel, 2003; Mullenix and Rouquette, 2018). According to Kallenbach (2015), 50% or less of available dry matter (DM) in a mixed-species pasture is credited to fescue, especially in the summer months. This percentage relies heavily on annual precipitation, fertilization, grazing management, and the interspecies competition that can be expected in the dynamic of pairing cool- and warm-season grass growth (Kallenbach, 2015).

A two-year study by (Aiken, 2002) investigated the impact of supplemental feeding of yearling steers grazing bermudagrass with different amounts of ground corn on their average daily gain (ADG) and feed cost. The researchers concluded that feeding steers at 0.99 and 2.97 lb per calf per day increased ADG, with the 2.97 lb per calf per day treatment having the lowest cost per additional ADG unit for the grain and cattle prices during the time of the experiment (1998-1999; Aiken, 2002). Wheeler, et al., (2002) looked at how the supplemental feeding of protein (soybean meal) in increasing amounts to beef cows on stockpiled bermudagrass pasture affected performance. Cows being supplemented lost more weight and body condition during the first year of the study than their non-supplemented contemporaries. But in year two, supplemented cows gained more weight and lost less body condition. Additionally, forage intake tended to increase in supplemented cows, though the amount of protein supplementation did not have an effect (Wheeler et al., 2002). In a digestion trial with (n = 4) steers, forage intake increased 16% and OM intake increased 30% in supplemented steers compared to non-supplemented steers (Wheeler et al., 2002). Diet OM digestibility also increased 14.5% and total digestible OM intake increased 49% in supplemented compared to non-supplemented steers.

The goal of this study was to explore how the inclusion of corn silage would affect the physiology and performance of cattle grazing bermudagrass pasture, with a secondary objective of increasing forage savings in an intense drought environment.

Experimental Procedures

Cow and Calf Measurements

The study was conducted at the Mound Valley Branch of the Southeast Research and Extension Center in Mound Valley, Kansas. Cows were allocated to one of eight bermudagrass pastures, with four pastures being non-supplemented and four pastures being supplemented at 1% of BW corn silage on a DM basis in fence-line bunks. Both treatments had access to free choice mineral. Following a two-day weigh period, cattle were turned out on June 1, 2023, then weighed again on June 21, 2023, and at end of the study for two consecutive weights on October 2-3, 2023. These time points corresponded with mid-gestation, beginning of third trimester, and about 2 weeks prior to the start of calving. Following turnout to calving pastures, pairs were gathered and sorted for a calf weigh-suckle-weigh on December 7, 2023.

Weight measures: Cattle were restrained in an Arrowquip Q-Power 107 Series hydraulic squeeze chute (Arrowquip, Woodlands, MB), with weights being recorded by a Gallagher TWR chute scale head (Gallagher Group Limited, Riverside, MO). Average weights at the beginning and middle of the experiment were used to adjust feed allocation. Initial, middle, and ending weights were used to determine the total body weight change. Calf birthweight was also collected via hanging scale. Weights were recorded in pounds (lbs).

Body condition score and rump fat: Three blind, independent evaluators recorded body condition scores at each measurement period using the standard 0-9 scale. Rump fat was recorded using an ALOKA 500 ultrasound machine (Hitachi, LTD., Wallingford, CT) with a 3.5-megahertz short probe capturing the image in Cattle Performance Enhancement Company software. Measurement was taken over the rump by a trained technician and recorded in millimeters (mm).

Hair score and hair length: One independent technician evaluated hair scores at each measurement period using the standard 1-5 scale. Hair length was taken chute side using a slide ruler and recorded in millimeters (mm).

Calf weigh-suckle-weigh: Pairs were gathered and sorted, with calves being separated from dam overnight. Calves were then weighed empty. After empty weight was recorded, calves were turned back in with their dams to nurse until full. Then calves were sorted once more and weighed to get a "full" weight and separated from dams for 8 hours. Then calves were weighed "empty," allowed to nurse, and then weighed again. The empty weight was then subtracted from the full weight to determine the change in calf body weight due to milk.

Pasture Measurements

Forage mass: Forage mass per square foot was collected every 28 days by sampling a 1 by 1 ft area that was being grazed by the cows. This measurement was used to determine the amount of available forage for the cows. These samples were clipped with about one inch of stem remaining.

Forage accumulation: This was used to determine the amount of forage that was growing and was measured using the pair-cage method. Within each pasture there were 4 exclusion cages that were sampled via clipping a sample every 28 days. Then the cages were moved to another location within the pasture. To calculate forage accumulation the amount of forage measured within the exclusion cage was used and then the amount of forage measured from outside the cage during the previous 28 days was subtracted.

Nutritional quality: Hand-grab samples were taken at the beginning of grazing, middle of grazing, and end of grazing. This technique was used to more accurately determine the consumed nutritional quality of the pastures the cows were grazing.

Results

Cow Performance

There was no statistical difference in body weight change between treatment groups from the middle of second trimester to about 2 weeks prior to calving (Table 1). There was also no difference regarding supplemental feeding on calf birthweight, and there was no difference in estimated milk production of the cows via the weigh-suckle-weigh measurement methods. Additionally, cow body condition score and rump fat thickness were not impacted by supplementation methods. Cows all had slick hair coats and were not impacted by the feeding regimen.

Pasture Measurements

Forage mass was increased by 31% with supplemental feeding of cows with 1% of body weight on a dry matter basis of corn silage. Forage accumulation was the same for both feeding groups. The pastures where cows were grazing bermudagrass without supplemental feed bermudagrass had greater total digestible nutrients (TDN) and lower acid detergent fiber (ADF). All other measures of pasture nutritional quality were the same.

Conclusions

Supplementally feeding the late gestation, fall-calving cows grazing bermudagrass pasture did not impact cow or calf performance. There was a 31% increase in forage savings due to supplemental feeding. When estimating forage intake, forage quality, and silage quality the estimated calories and pounds of protein consumed for each set of cows were the same, which led to observations of similar performance results for these cows. There was about a 1:1 substitution on a dry matter basis when feeding the silage; for each pound (dry matter) of silage the cows consumed, they ate a pound (dry matter) less of the pasture. This feeding practice could be used in years of good precipitation to increase your pasture's carrying capacity or possibly in drought years it could be used to reduce grazing pressure on the pasture. Based on 2023 costs of production, supplemental feeding of cows with corn silage on pasture did make economic sense.

References

Aiken, G. E. 2002. Cost of Steer Weight Gain to Rate of Supplementation with Ground Corn on Bermudagrass Pasture. Agronomy Journal. 94:1387–1392. doi:10.2134/agronj2002.1387.

Hill, G. M., R. N. Gates, and J. W. West. 2001. Advances in bermudagrass research involving new cultivars for beef and dairy production. Journal of Animal Science. 79:E48. doi:10.2527/jas2001.79E-SupplE48x.

Kallenbach, R. L. 2015. Bill E. Kunkle Interdisciplinary Beef Symposium: Coping with tall fescue toxicosis: Solutions and realities. Journal of Animal Science. 93:5487–5495. doi:10.2527/jas.2015-9229.

Mullenix, M. K., and F. M. Rouquette. 2018. Review: Cool-season annual grasses or grass–clover management options for extending the fall–winter–early spring grazing season for beef cattle. The Professional Animal Scientist. 34:231–239. doi:10.15232/pas.2017-01714.

Peel, D. S. 2003. Beef cattle growing and backgrounding programs. Veterinary Clinics of North America: Food Animal Practice. 19:365–385. doi:10.1016/S0749-0720(03)00032-X.

Rouquette, F. M. 2017. Invited Review: Management Strategies for Intensive, Sustainable Cow-Calf Production Systems in the Southeastern United States: Bermudagrass pastures overseeded with cool-season annual grasses and legumes. Professional Animal Scientist. 33:297–309. doi:10.15232/pas.2016-01591.

Stokes, S. R., A. L. Goetsch, H. H. Nejad, G. Murphy, A. L. Jones, S. Mashburn, K. W. Beers, Z. B. Johnson, and E. L. Piper. 1988. Effects of Supplemental Bermuda Grass Hay or Corn on Intake, Digestion and Performance of Cattle Consuming Endophyte-Infected Fescue. Journal of Animal Science. 66:204–212. doi:10.2527/jas1988.661204x.

Wheeler, J. S., D. L. Lalman, G. W. Horn, L. A. Redmon, and C. A. Lents. 2002. Effects of supplementation on intake, digestion, and performance of beef cattle consuming fertilized, stockpiled bermudagrass forage. Journal of Animal Science. 80:780–789. doi:10.2527/2002.803780x.

Table 1. Cow and calf performance results

Item	Treatment: Non-Supplemented	Treatment: Supplemented	SEM	*P*-value
Initial weight, lb	1205	1214	48	0.89
Mid-point weight, lb	1358	1418	49	0.39
Final weight, lb	1433	1498	50	0.37
Total weight gain, lb	228	269	31	0.37
Initial body condition score (scale 1-9)	5.25	5.15	0.16	0.69
Mid-point body condition score	5.44	5.72	0.16	0.23
Final body condition score	6.18	6.36	0.16	0.44
Change in body condition score	0.95	1.21	0.26	0.50
Initial rump fat, mm	6.86	7.61	0.81	0.51
Final rump fat, mm	10.36	13.81	1.52	0.12
Calf birth weight, lb	79	74	4	0.43
Calf weight due to milk, lb[1]	7.8	8.8	1.7	1.00

Initial time point is the beginning of the study when cows are in mid-gestation. Mid-point is the middle of the grazing period when cows are at the beginning of their third trimester. Final points are about 2 weeks prior to calving and the end of the grazing period on bermudagrass.

[1]Calf weight gain from empty is used to estimate a cows' milk production.

Table 2. Pasture production based on treatments (results are on a dry matter basis)

Item	Treatment: Non-Supplemented	Treatment: Supplemented	SEM	*P*-value
Forage mass, lb/a	2190	2879	231	0.09
Forage accumulation, lb/a	1497	1472	105	0.88
Crude protein, %	12.8	11.6	0.49	0.15
Total digestible nutrients (TDN), %	55.9	54.6	0.33	0.01
Acid detergent fiber (ADF), %	30.1	31.2	0.27	0.01
Neutral detergent fiber (NDF), %	53.4	55.4	1.09	0.25
Calcium, %	0.49	0.46	0.03	0.38
Phosphorus, %	0.24	0.22	0.01	0.24
Potassium, %	1.89	1.78	0.11	0.63
Magnesium, %	0.23	0.20	0.02	0.33

Table 3. Estimated operational cost and returns based on traditional method or supplementally feeding cows with corn silage on bermudagrass (based on 2023 cost of production)

Item	Traditional	Supplemental feeding
Carrying capacity, hd[1]	89	131
Fertilizer costs, 300 acres[2]	$23,259	$23,259
Cow costs for herd[3]	$17,723	$26,087
Grazing cost for herd remaining 240 day[4]	$29,459	$43,453
Silage cost, 100 days	--	$17,292
TOTAL COSTS	**$70,441**	**$110,091**
Calf sale price[5]	$120,630	$177,557
REVENUE	**$50,189**	**$67,466**
Difference		*$17,277*

[1]Carrying capacity specs: 300 acres of bermudagrass using forage mass numbers at 50% utilization for 120 days
[2]Urea $573/ton used $61.34/acre by 300 acres; DAP $745/ton used on average $16.19/acre by 300 acres
[3]Cow costs (yearly) not including feed or pasture based on Kansas Farm Management Association of $597.42/cow. Divided by 1/3 since bermudagrass is grazed for only 1/3 of production year.
[4]Feed and pasture costs (yearly) based on KFMA = $502 times 2/3 (remainder of year on bermudagrass we have accounted for) = $331/cow.
[5]Calf sale price assumes 90% of calf crop is sold for $251/cwt, and 600 lbs split into 1/3 based on 1/3 of cow life on bermudagrass.
[6]Silage $55/ton as-received. Fed average of 40 lbs as-is silage/day/cow.

Evaluation of Grazing Options During Summer for Growing Heifers – Year 3

J.K. Farney, K. Rash,[1] N. Collins,[1] E. Black,[2] and H. Gillespie[1]

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. Three grass pasture treatments (8 pastures total; 4 acres each) were used in a completely randomized design and stocked with growing heifers (n = 32; initial weight 559 ± 20 lb). Pasture treatments consisted of crabgrass (CRAB), bermudagrass (BERM), and sorghum-sudan interseeded into novel fescue (SS-FES). Novel fescue is fescue variety that has endophyte organism but does not produce toxin. Heifers were weighed and grazed pastures from May to October (150 d). All other pastures were rotationally grazed with two paddocks for CRAB and BERM and 3 paddocks for SS-FES. Sorghum-sudan was interseeded into fescue pastures in late May and June. Average daily gain (ADG) for the entire grazing period was not different between pasture systems. Bermudagrass pastures produced the greatest average biomass. Crabgrass pastures produced one of the lowest biomass early in the grazing period, then one of the highest at the end of grazing period. Biomass production results for the SS-FES pastures were very low, except for July when the sorghum-sudan had the greatest forage production.

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 the 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 have designated warm-season pastures and cool-season pastures and rotate cattle between the two during their respective growing seasons. However, that requires using at least double 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 that 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
Eight, 4-acre pastures were used in this study. Study consisted of three pastures of crabgrass (CRAB), three pastures of bermudagrass (BERM), two pastures of Max-Q fescue (SS-FES) that were drilled with sorghum-sudan. Heifers were stocked on the

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SS-FES pastures with 4 head per pasture from April to July and they rotationally grazed the pasture in 3 paddocks. Heifers on SS-FES were grazed for 14 days on each paddock to try to keep the swath height close to 2 inches. At the end of May, the paddock that was just grazed was also mowed to a 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 of fertilizer 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. Heifers on the BERM pastures were stocked at 4 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 and fertilized with 50 lb N/acre. The CRAB and BERM pastures were also fertilized with 50 lb N/acre in mid-June.

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. Heifers were placed on pasture on May 3, 2023. All heifers were weighed on June 27, 2023, and October 4, 2023.

Pastures were clipped before heifers were placed into paddocks and then at the end of the grazing period for each rotation. Forage mass was measured from these clippings and the measurements represent the available forage.

Heifers' average daily gain, total gain, and gain per acre (gain per acre = heifer gain since grazed for 1 heifer per acre) were determined for each grazing period. Average forage mass was calculated by month.

Results and Discussion

The summer of 2023 was very dry and so forage production was limited, primarily in the SS-FES pastures. Rotational grazing of bermudagrass and crabgrass pastures appeared to support moderate growth for the heifers during this summer. Overall, there was no difference in heifer gains for 2023.

Bermudagrass pasture overall averaged greater available forage ($P = 0.02$) as compared to crabgrass and sorghum-sudan interseeded into fescue. This advantage began in May when bermudagrass pastures had the greatest biomass and this advantage continued through June (Figure 1). However, in July, when all the paddocks had sorghum-sudan growing in the fescue pastures, that treatment had a drastic increase in biomass. Even with that increase in biomass, it did not produce more than bermudagrass or crabgrass pastures at that time. From August through October, the sorghum-sudan-fescue pastures had a lower biomass than bermudagrass, with crabgrass being intermediate (Figure 1). Crabgrass pastures started with a low biomass, but by the end of the grazing period had as much production as bermudagrass. Even though statistically, there was no differences in ADG based on these different grasses, the available forage almost matched the performance measured when the low biomass and slow growth of crabgrass had the numerically lowest gains from May through June. Then when the crabgrass pastures grew rapidly and produced more tonnage, the heifers grazing crabgrass had the highest numerical gains.

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Table 1. Gains for cattle based on type of pasture

	Treatments				
Item	**BERM**	**CRAB**	**SS-FES**	**SEM**	***P* - value**
Initial weight (May), lbs	558	559	561	20	0.99
June 27 weight, lbs	594	559	626	38	0.47
Gain/acre May-June, lbs	36	0.38	64	32	0.41
ADG, May-June, lbs/d	0.69	0.01	1.20	0.58	0.41
October weight, lbs	737	722	731	23.2	0.89
Gain/acre July-October, lbs	143	163	106	32	0.52
ADG July-October, lbs/d	1.47	1.68	1.09	0.35	0.52
Total gain for summer, lbs	179	163	170	12.1	0.61
Total ADG for summer, lbs/d	1.19	1.09	1.13	0.07	0.61
Average forage mass, lb DM/acre	5392[a]	4379[b]	3610[b]	294	0.02

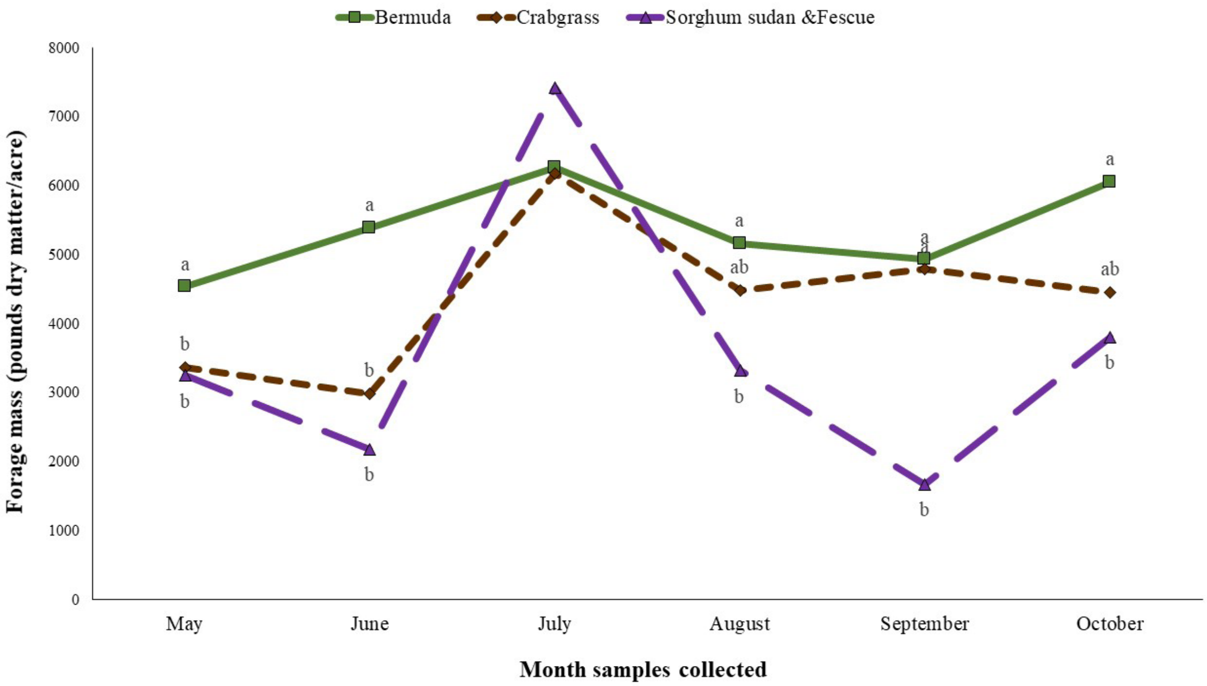

Figure 1. Forage mass by month for each grass type (in pounds dry matter per acre).
[ab] Within month, different letters between treatments indicate differences at $P < 0.05$.
Bermuda: bermudagrass pastures rotationally grazed in 2 paddocks every 28 days. Represented in solid (green) line with square markers.
Crabgrass: Big and Quick crabgrass that was newly seeded and volunteer from previous years. Represented in short dashed (brown) line with diamond markers.
Sorghum sudan & fescue: sorghum sudan was drilled into standing novel fescue (fescue with endophyte but does not produce toxins) pastures in mid-June. Represented as long dashed (purple) line with triangle markers.

Effect of Corn Type and Form of Supplement on Grazing Steers – Year 3

J.K. Farney, K. Rash,[1] N. Collins,[1] E. Black,[2] and H. Gillespie[1]

Summary
Eighty stocker steers were grazed on bromegrass from the middle of May 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 the alpha-amylase gene). Steers were weighed every 28 days while on grass and were measured for carcass quality by ultrasound prior to being placed in feedlot. Hand-fed steers had greater gain than self-fed supplemented steers and these hand-fed steers tended to have more muscle depth coming off grass than other supplemented steers. There was no difference in backfat nor marbling scores off grass for any treatments evaluated. Loin muscle depth was greater for supplemented steers as compared to non-supplemented. Overall, if a steer was supplementally fed, it had 64 pounds more weight than if fed a mineral only, and this advantage was driven primarily by hand-fed supplements. However, each operation needs to calculate cost of production and ease of feeding daily over the convenience of self-fed supplements.

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 the forage supply. Cattle management is different based on geographic location, access to labor, distance to cattle from a 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 was developed for the ethanol industry as it contains the alpha-amylase gene that 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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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) Mintrate 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 by 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 treatment groups 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 ¼ of the old block remained 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 2023, based on recommendations from soil test for phosphorus and potassium and all pastures had 100 lb of nitrogen per acre applied in 46-0-0 form.

Cattle Specifics

Weaned and vaccinated steers (587 ± 15.3 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 (May 10 and 11, 2023). Steers were wormed prior to turnout with a white wormer (Valbazen, Zoetis Inc.).

Steers were tested by ultrasound (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 1; 170 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, total gain, and final weight off grass than those on the CON, MIX30, and BLOCK treatments. There was no difference in ADG between ENO and ISO treatments at any measurement point ($P > 0.37$, Table 2). Supplemented cattle did gain more than CON steers ($P = 0.04$; Table 2); however, this difference was driven by the much greater gains found with ISO and ENO fed cattle as the MIX30 and BLOCK treatment groups had similar gains as CON cattle.

There were variable average daily gain responses through the entire grazing and supplementation feeding period. For the time between days 28 and 56 on grass, steers that were supplemented outgained non-supplemented steers (mineral only steers; Table 2). Again, between the days of 140 and 170 on grass the supplemented steers outperformed non-supplemented steers (Table 2). Hand feeding resulted in greater gains as compared to cattle that received self-fed supplements in measurements between days 56 and 84, and days 130 to 170 on grass (Table 2).

For actual steer weights, the steers had to be on grass for 112 days with their respective supplements before there were differences in treatments (Figure 1). At this point the ISO steers had greater body weights than MIX30, CON, and BLOCK. This same advantage continued through the grazing period, when by the end of the grazing period, both the hand-fed treatments (ISO and ENO) had heavier body weights than all the other treatments. The supplemented steers averaged 64 pounds more weight off grass as compared to those that received mineral only.

Ultrasound data at the end of the grazing period showed a tendency for loin muscle to be greater for ISO fed steers as compared to CON steers ($P = 0.10$; Table 2). Steers that were supplemented had greater muscle than non-supplemented steers ($P = 0.05$). Hand-fed steers tended ($P = 0.08$) to have more muscle than self-supplemented steers. There were not differences in marbling score nor backfat.

Conclusions

Comparable to what has been found in the 3 other years of data collection (Farney et al., 2021; 2022; 2023), the hand-fed supplementation results in greatest cattle gains while on grass as compared to free-choice products. Even though statistically there was no difference in gains with other free-choice supplements as compared to mineral only, overall if a steer was supplemented on bromegrass in 2023 and allowed to graze for 170 days, it averaged 64 more pounds than a steer provided with only a mineral. Before implementing a hand-fed supplementation strategy a producer must calculate all the costs of production that go into the additional labor, fuel, equipment, and infrastructure to complete this management practice as compared to self-fed supplements.

References

Farney, J. K. and Malone, K. (2021) "Form of Supplement and Addition of Ionophore Effects on Steer Performance while Grazing Bromegrass and Subsequent Effects in Feedlot and Carcass Measures," *Kansas Agricultural Experiment Station Research Reports*: Vol. 7: Iss. 2. *https://doi.org/10.4148/2378-5977.8041*

Farney, J. K. and Bottorff, T. (2022) "Effect of Corn Type and Form of Supplement on Grazing Steers," *Kansas Agricultural Experiment Station Research Reports*: Vol. 8: Iss. 3. *https://doi.org/10.4148/2378-5977.8288*

Farney, Jaymelynn K.; Allen, Harley; and Muniz, Larissa (2023) "Effect of Corn Type and Form of Supplement on Grazing Steers – Year 2," *Kansas Agricultural Experiment Station Research Reports*: Vol. 9: Iss. 2. *https://doi.org/10.4148/2378-5977.8435*

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Table 1. Nutrient profiles of supplements fed to steers

Item on dry matter basis	Free-choice mineral (CON)	MIX30 (MIX30)	Mintrate 40 Red Block (BLOCK)	60% corn: 40% DDG (ENO or ISO)
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[1]	2.23	0.3	0.20
Potassium, %	0.89	1.79	1.0	0.83
Iron, ppm	5,546	--	--	75
Copper, ppm	1,153[2]	7.75[2]	250[3]	2.48
Zinc, ppm	3,471[2]	115.08[2]	1,000[4]	25.6
Manganese, ppm	1,817[2]	29.6[2]	750[4]	7.86
Selenium, ppm	22	0.34	6.6	--
Iodine, ppm	333	--	20	--
Cobalt, ppm	13	--	20[5]	--
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.

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

[2]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.

[3] Zinpro zinc methionine.

[4] CoMax patented form of cobalt from ADM.

[5] IntelliBond hydroxy copper.

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

	Treatment						*P* - value			
Item	**CON[1]**	**MIX30**	**Block[2]**	**ISO[3]**	**ENO[4]**	**SEM[5]**	**Trt[6]**	**Hand vs. Self[7]**	**Supple. vs. No[8]**	**ISO vs. ENO[9]**
Start weight, lb	588	585	589	592	582	15.2	0.99	0.99	0.95	0.68
Final grazing weight, lb	838[b]	856[b]	865[b]	952[a]	935[a]	19.8	**0.001**	**<0.0001**	**0.01**	0.54
Grazing ADG, lb/d	1.47[b]	1.59[b]	1.64[b]	2.11[a]	2.07[a]	0.11	**0.002**	**0.01**	**0.01**	0.77
Total gain, lb	249[b]	271[b]	276[b]	360[a]	352[a]	19.0	**0.001**	**0.01**	**0.01**	0.77
Period average daily gain (ADG), lb/d										
d 28	1.99	2.29	2.13	2.49	2.56	0.45	0.88	0.49	0.46	0.91
d 56	1.64	2.12	2.03	2.53	2.15	0.25	0.23	0.29	**0.07**	0.33
d 84	1.38[ab]	1.55[ab]	1.27[b]	2.11[a]	2.05[a]	0.25	**0.08**	**0.02**	0.20	0.86
d 112	1.27	0.38	1.08	1.19	1.44	0.36	0.31	0.12	0.55	0.63
d 140	2.47	2.75	2.16	2.84	2.98	0.28	0.30	0.13	0.52	0.72
d 170	0.14[c]	0.54[bc]	1.11[ab]	1.36[a]	1.50[a]	0.23	**0.004**	**0.02**	**0.002**	0.67
Ultrasound carcass measures: grazing phase										
Back fat, in.	0.15	0.16	0.16	0.18	0.20	0.01	0.42	0.12	0.20	0.71
Marbling[10,11]	5.04	4.99	4.93	4.93	4.79	0.18	0.90	0.58	0.50	0.64
Loin depth, mm	49.7[b]	51.6[ab]	52.0[ab]	55.7[a]	54.3[ab]	1.65	**0.10**	**0.07**	**0.05**	0.58

[abc]Values indicate treatment differences within row with $P < 0.05$.
[1]CON: control treatment received free choice mineral (Wildcat Feed, LLC).
[2]Block: Mintrate 40 block (ADM Alliance Nutrition).
[3]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).
[4]ENO: Enogen feed corn (Syngenta) fed daily at 0.5% of body weight (DM-basis) in a 60%:40% of corn and DDG.
[5]SEM: standard error of means.
[6]Trt: *P*-value comparison between all 5 treatments.
[7]Hand vs. Self: *P*-value comparison between free-choice treatments (MIX30 and Block) and hand-fed treatments (ISO and ENO).
[8]Supple. vs. No: *P*-value comparison non-supplemented (CON) and supplemented (MIX30, Block, ISO, and ENO).
[9]ISO vs. ENO.: *P*-value comparison between corn variety treatments (isoline or Enogen-feed corn).
[10]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*).
[11]U.S. Department of Agriculture marbling scores: 300–399: Slight 0–90; 400–499: Small 0–90; and 500–599: Modest 0–90.

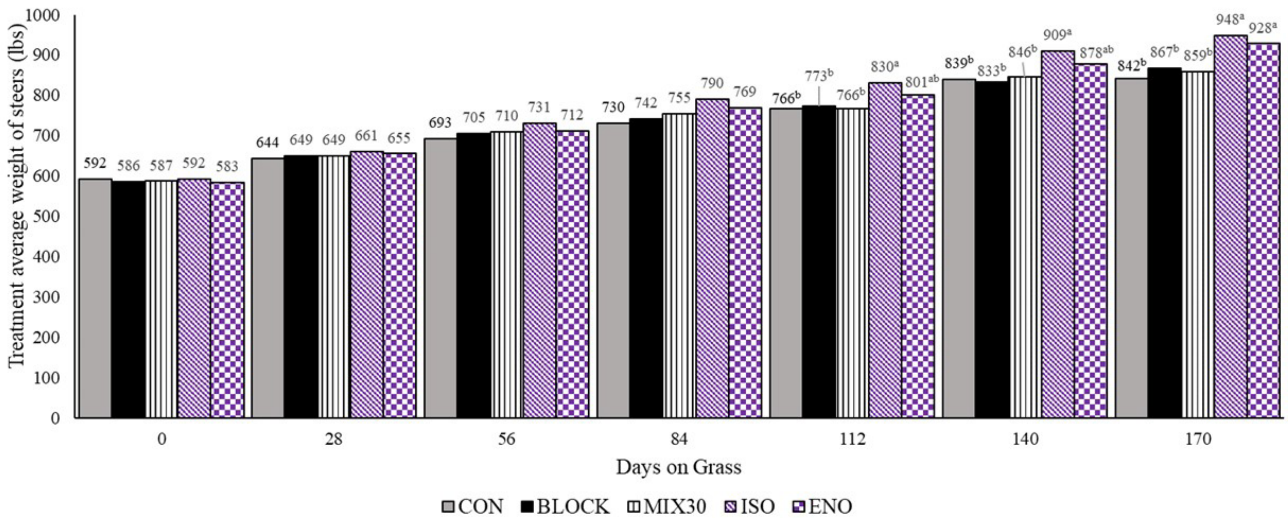

Figure 1: Average treatment weight of steers based on days of grazing bromegrass.
[ab] Letters within period are different at $P < 0.05$.
CON: control treatment received free choice mineral (Wildcat Feed, LLC) in a gray solid bar.
Block: Mintrate40 block (ADM Alliance Nutrition) in a black solid bar.
MIX30: Mix30 (Agridyne) is a bar with white and black upright lines.
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 the parent genetic line to the Enogen feed corn (Syngenta). This treatment is represented by a bar with white and purple diagonal lines.
ENO: Enogen feed corn (Syngenta) fed daily at 0.5% of body weight (DM-basis) in a 60%:40% of corn and DDG. This treatment is represented by bars with purple and white checks.

Stocker Steer Gains and Fly Numbers as Impacted by Burn Date and Type of Mineral on Tallgrass Native Range – Year 5

J. K. Farney, K. Rash, H. Gillespie, E. Black, and N. Collins[1]

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 566 lb) were used in a 2 × 2 factorial treatment structure. Steers were weighed individually, randomly assigned to treatment, and grazed for 89 days. Weekly, 33% of steers were photographed to count flies and evaluated for hair coat score. Steers that grazed pastures that were burned in March had a greater average daily gain than those grazing pastures that were burned in April and March resulted in nearly 30 pounds more gain per calf during the grazing season. Steers that consumed the mineral that contained the spices/essential oils had a 0.10 pound per day advantage as compared to steers on the control mineral. There was an interaction between pasture burn date and mineral type where steers gained the most on March burned pastures (with no difference in mineral type), had the second greatest gains on the April burned pastures with SPICE mineral, and had the lowest gains on the April burned pastures with CON mineral. Weather plays a very important role in cattle performance following a complete pasture burn, and in a year with excessive spring moisture and extreme drought beginning in June, a March burn was the better management practice.

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 resulted 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 could provide the opportunity to develop a smoke management plan that allows for an increased burning

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season to dilute smoke by burning some pastures across multiple months rather than primarily in one.

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 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 × 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 14, 2022, while the April burned pastures were burned on April 12, 2022.

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 (average initial weight 566 lb) were weighed individually on April 24, 2022, and assigned to pasture randomly based on order through the chute. Cattle were weighed at the end of the study on July 24, 2022, for a total of 90 days of grazing. 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. 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 has 50% of body covered in long hair; 4 has 75% of body covered in long hair; and 5 is 100% long haired. Data collected included number of flies and hair coat scores for each week.

Results and Discussion

Performance of Steers

Steers that were on March burned pastures gained on average 0.14 more pounds per day (ADG), which resulted in around 12 pounds more total gain per steer over the 90-day grazing period than those that were on April burned pastures ($P = 0.04$; Table 2). Steers that were consuming the spice mineral had a 0.13 pound/day increase in ADG, which resulted in, on average 12 pounds more weight at the end of the grazing period ($P = 0.04$; Table 2). There was an interaction ($P = 0.03$) between burn date and mineral where the steers that were grazed on March burned pastures regardless of mineral type, and April burned pastures with steers consuming spice mineral had a greater gain than steers that grazed April burned pastures where steers were on a control mineral, with no difference in gain based on mineral type (Table 2).

The spice mineral, averaged over the 5 years, has resulted in 0.10 pounds increase in ADG ($P = 0.003$) and that has been fairly consistent (2021 was the exception). Each of the 5 years of this study have had drastically different weather patterns, and weather seems to drive the most substantial differences in gains for 90-day stocker calves. Over the 5 years of the study, gains for the steers have not been different based on burn dates ($P = 0.75$), but within year gains have shown differences that were driven by weather events (Farney et al., 2020; Farney and Reeb, 2021; Farney et al., 2022; Farney et al., 2023).

Fly Counts

Flies increased through the summer ($P < 0.001$). There were no differences in fly numbers based on whether cattle consumed the mineral or based on pasture burn date ($P > 0.10$; Table 2). There were some interactions of week by mineral and week by burn date that were detected based on $P < 0.01$. During the first 4 weeks the steers were on pasture, those grazing March burned pastures had greater fly numbers than those on April burned pastures (Figure 1). At weeks 5 and 11 on pasture, April burned pastures had steers with more flies on them. This makes sense when looking at the life cycle of flies in relation to burning. When pastures are burned, that set of fly larvae are destroyed and it takes time for new flies to become introduced. With this set of data, about a month seems to be necessary for flies to become active after burning. The time from turnout date to March burn date was about 6 weeks, whereas there were only two weeks between turnout and the April burn date. For mineral type and fly numbers, contrary to the hypothesis, there were greater number of flies on steers that were consuming the spice mineral as compared to control, especially later in the season (specifically weeks 6, 8, 12; Figure 2). Hair coat scores were not different for any measures ($P > 0.10$, Table 2).

Conclusions

Weather plays a large role in how stocker steers will gain weight following a pasture fire. With early precipitation before a drought in the middle of a grazing period, a March burn seems to result in greater stocker steer gains than an April burn. Addition of spices/essential oils in a free-choice mineral increases average daily gain by ~0.1 pounds per day, and that has been repeatable, regardless of pasture conditions.

References

Araujo, R. C., D. R. Daley, S. R. Goodall, S. Jalali, O. A. G. Bisneto, A. M. Budde, J. J. Wagner, and T. E. Engle. 2019. Effects of a microencapsulated blend of essential oils supplemented alone or in combination with monensin on performance and carcass characteristics of growing and finishing beef steers. App. Anim. Sci. 35:177-184.

Beck, P. A., M. S. Gadberry, C. B. Stewart, H. C. Gray, T. J. Wistuba, M. D. Cravey, and S. A. Gunter. 2017. Effects of blended garlic and cinnamon essential oil extract with and without monensium sodium on the performance of grazing steers. Prof. Anim. Sci. 33:176-185.

Elcoso, G., B. Zweifel, and A. Bach. 2019. Effects of blend of essential oils on milk yield and feed efficiency of lactating dairy cows. App. Anim. Sci. 35:304-311.

Farney, J. K. 2020a. Spices fed to growing heifers on bromegrass result in increased gains with some effects on tick populations. Kansas Ag. Exp. Stat. Res. Report. Vol. 6: Issue 4. *https://doi.org/10.4148/2378-5977-7907*.

Farney, J. K. 2020b. Evaluating stocker steer gains on tallgrass native range with two burn dates and spices in mineral. Kansas Ag. Exp. Stat. Res. Report. Vol 6: Iss. 2. *https://doi.org/10.4148/2378-5977.7885*.

Farney, J. K. and M.E. Reeb. 2021. Stocker steer gains and fly numbers as impacted by burn date and type of mineral on tallgrass native range. *Kansas Agricultural Experiment Station Research Reports*: Vol. 7: Iss. 2. *https://doi.org/10.4148/2378-5977.8043*

Farney, J. K. and M. Frahm. 2022. Stocker steer gains and fly numbers as impacted by burn date and type of mineral on tallgrass native range – Year 3. *Kansas Agricultural Experiment Station Research Reports*: Vol. 8: Iss. 3. *https://doi.org/10.4148/2378-5977.8289*

Farney, J. K., H. Allen, and L. Muniz. 2023. Stocker steer gains and fly numbers as impacted by burn date and type of mineral on tallgrass native range – Year 4. *Kansas Agricultural Experiment Station Repor*ts: Vol. 9: Iss. 2. *https://doi.org/10.4148/2378-5977.8434*

Massariol, P.B., C. J. Olivo, N. Richards, C. A. Agnolin, G. R. Meinerz, J. F. Both, L. Faccio, F. Hohenreuther, and S. Martinelli. 2009. Ectoparasite load alteration in Holstein cows fed with different garlic (*Allium sativum* L.) levels. Revista Brasileira de Plantas Medicinais. 11:37-42.

Ownesby, C. 2010. Managing Kansas Flint Hills grasslands. Symphony in the Flint Hills Field Journal. *http://newprariepress.org/sfh*. Accessed 9/13/19.

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Table 1. Analysis of minerals

Item (on dry matter basis)	Control mineral	Spice mineral[1]
Crude protein, %	5.69	5.50
Calcium, %	16.67	16.17
Phosphorus, %	3.33	3.44
Salt, %	22.54	22.53
Magnesium, %[2]	2.51	2.48
Potassium, %	0.89	0.88
Iron, ppm	5,546	5,529
Copper, ppm[3]	1,153	1,153
Zinc, ppm[3]	3,471	3,471
Manganese, ppm[3]	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

[1]Spice mineral with similar base as control mineral with the addition of 3 pounds per ton of garlic oil and 18 pounds per ton of Solace (proprietary spice blend; Wildcat Feeds Inc., Topeka, KS) that replaced dried distillers grains and limestone in control mineral.
[2]Nuplex Mg/K (Nutech Biosciences Inc., Oneida, NY) contributed 25% of the magnesium in the minerals.
[3]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.

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

	March		April			*P*-value		
Item	Control	Spice	Control	Spice	SEM	Burn	Mineral	Burn × mineral
In wt., lb	618	619	618	616	8.7	0.85	0.97	0.87
Out wt., lb	822	820	796	820	9.5	0.13	0.19	0.16
Gain, lb	204[a]	202[a]	178[b]	204[a]	4.3	0.05	0.05	0.03
ADG, lb/d	2.37[a]	2.34[a]	2.07[b]	2.37[a]	0.04	0.05	0.05	0.03
Fly counts, n	51	59	62	53	1.08	0.52	0.93	0.11
Hair coat score	2.77	2.85	2.96	2.86	0.09	0.32	0.91	0.40

SEM = standard error of the mean.

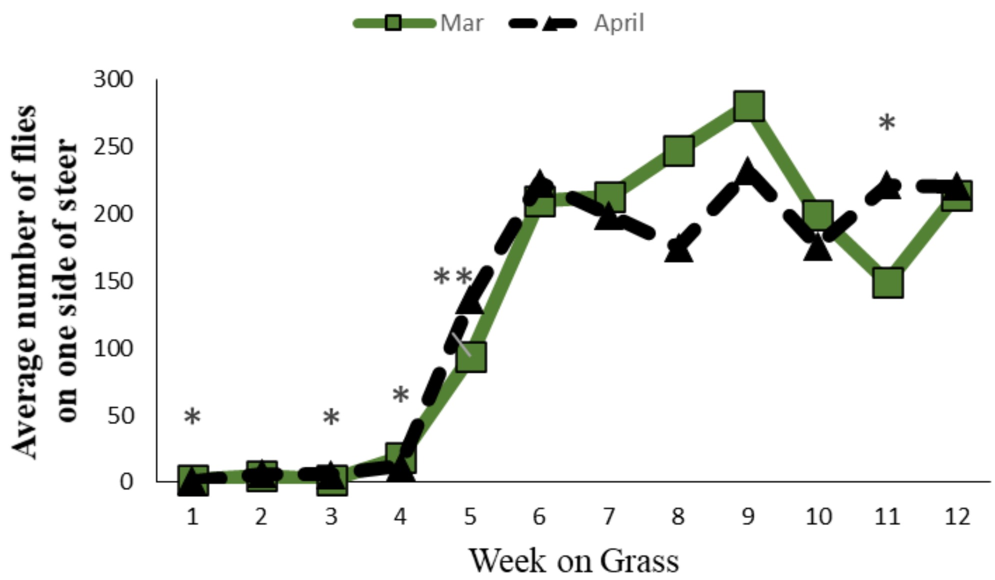

Figure 1. Average number of flies per steer per week by pasture burn date.
Average number of flies per steer per week based on burning in March or in April ($P < 0.01$) are represented in the line chart.
March: March 15, 2022 was burn date represented by the solid green line with square markers.
April: April 19, 2022 was burn date represented by dashed black line with triangle markers.
* Indicates difference $P < 0.05$ for that week between treatments.
** Indicates difference $0.05 < P < 0.10$ for that week between treatments.

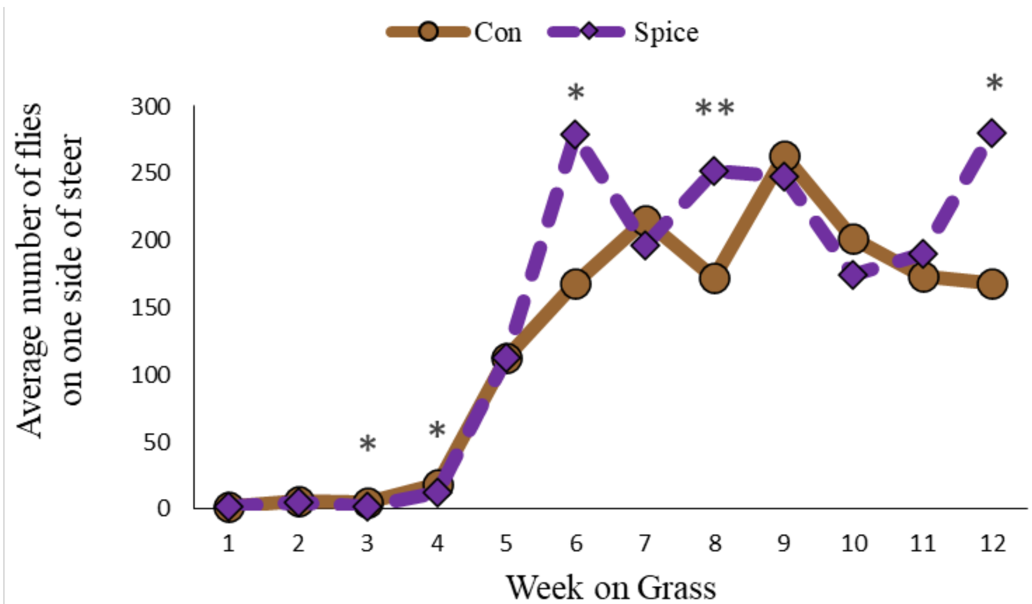

Figure 2: Average number of flies per steer per week by mineral treatments.
Average number of flies per steer per week ($P < 0.01$) are represented in the line chart.
CON: control mineral is represented by the solid brown line with circle markers.
SPICE: spice mineral is the same base mineral as control with 3 pounds/ton of garlic oil and 18 pounds/ton of Solace (proprietary spice blend; Wildcat Feeds LLC).
* Indicates difference $P < 0.05$ for that week between treatments.
** Indicates difference $0.05 < P < 0.10$ for that week between treatments.

Corn and Soybean Production – 2023 Summary

G.F. Sassenrath, J. Lingenfelser[1], and X. Lin[1]

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, 21 corn varieties and full-, mid-, and short-season maturity checks were tested. Fifteen full-season and nine double-cropped soybean varieties were tested, with three maturity checks ranging in maturity from 3.1 to 5.2. Fourteen sunflower varieties were also tested. The 2023 summer crop growing season was nearly average for both temperature and rainfall. Yields from the variety tests were slightly lower than the 13-year average.

Introduction
Kansas State University performs crop variety testing annually at several locations throughout the state. The Southeast Research and Extension Center tests crop varieties of corn, soybeans, and sunflowers. Variety selection is an important determinant of potential yield. Variety selection is also an important factor in disease and insect management. The crop variety tests performed through the Kansas State University variety testing program allow a comparison of variety performances under common growth conditions and management practices in multiple regions throughout the state.

Environmental conditions are key factors in determining crop success, together with soil characteristics, fertility, and management practices. Of the environmental factors, temperature and moisture (rainfall) are primary determinants of crop performance. Temperature is critical at certain crop developmental stages and plays a role in yield potential. Cumulative Growing Degree Days (GDD) are commonly used to estimate crop growth and developmental stage. Extreme Degree Days (EDD) are an indication of the high-temperature exposure during the growing season and can negatively affect crop growth, development, and yield (Zhang et al., 2015; Zhang and Lin, 2016).

This report summarizes corn, double-cropped soybean, and sunflower variety performance in Parsons, KS, for 2023. Full-season soybean varieties were abandoned because of a planting error.

Experimental Procedures
The Kansas State University Crop Performance Tests were conducted in replicated research fields throughout the state. Individual variety results are available at the K-State Crop Performance Test webpage (*http://www.agronomy.k-state.edu/services/crop-performance-tests/*). This report summarizes crop production for southeast Kansas, focusing on crops grown at Parsons and southeast Kansas. In 2023, crop varieties of corn, soybeans, and sunflowers were planted in 30-in. rows in upland fields (Parsons silt loam soil) at the Southeast Research and Extension Center in Parsons using conven-

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tional management and fertility. All crop variety trials are managed with conventional tillage. All crops germinated and appeared healthy.

Twenty-one corn varieties were planted on April 18, 2023 in 30-in. rows at a rate of 22,500 seed per acre and harvested on October 30, 2023,. Plots were fertilized at a rate of 125-30-50 lb/acre N-P-K. Weed control was atrazine 4l (74 oz/acre), Charger Max (24 oz/acre), glyphosate (24 oz/acre) and 2-4D (24 oz/acre).

Full-season soybeans were planted in 30-in. rows but abandoned because of a planting error. Double-cropped soybeans were planted on June 26, 2023, in 30-in. rows after wheat harvest. No fertilizer was applied. Weeds were controlled with glyphosate (1 qt/acre), 2-4D lv6 (1.5 pt/acre), metribuzin (8 oz/acre), and Authority XL (6 oz/acre). Double-cropped beans were harvested on November 3, 2023.

Double-crop oilseed sunflowers were planted in 30-in. rows following wheat harvest on April 28, 2023. Plots were fertilized at a rate of 110-46-60 lb/acre N-P-K. Weeds were controlled with glyphosate (1 qt/acre), 2-4D lv6 (1.5 pt/acre), Prowl (50 oz/acre), Brawl 2 (1 qt/acre), Spartan charge (8 oz/acre), and Clethodium (10 oz/acre). Sunflowers were harvested on Nov. 1, 2023

State reported crop yield data were downloaded from the National Agricultural Statistic Service Crop database (*https://quickstats.nass.usda.gov/*). Weather data were collected from the Kansas Mesonet website (*http://mesonet.k-state.edu/agriculture/degreedays/*) for a weather station located at SEREC in Parsons. Cumulative rainfall was calculated throughout the year and during the summer growing season (March – Sept.). Cumulative growing degree days were calculated using 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. Extreme degree days were calculated as temperatures above 86°F.

Results and Discussion

Rainfall during the 2023 summer growing season (beginning with corn planting in March through the end of September) was 27.2 in., slightly below the 13-year average of 33.1 in. (Figure 1). Rainfall was unevenly distributed, with two major rain events separated by long dry periods. The first major rainy period occurred from May 4 – May 18, a 16-day period that received 7.3 in. of rain. The subsequent 77-day period from May 19 through August 4 received only an additional 6.65 in. of rain. The second major rainy period from Aug. 5 – Aug. 14 brought an additional 6.67 in. of moisture over the 10-day period, bringing the total growing-season rainfall to near-normal levels. The summer growing season had total precipitation above that received during the very dry 2012 and 2022 growing seasons (Figure 1).

Temperature during the 2023 summer growing season was average. The cumulative growing degree days (GDD, base 50) were well-below 2012, and slightly above the 13-year average (Figure 2). The extent of high temperatures during the growing season can be seen by the number of days with temperatures above 90°F (Figure 3). The total of high-temperature days (43) in 2023 was slightly less than average (46), and much less than the number of days recorded in 2012 (72) and 2022 (71). Similarly, the number of Extreme Degree Days (EDD, base 86°F) were just slightly above normal (Figure 4).

The area planted to corn has been increasing steadily in Kansas over the past 50 years. In 2023, 5.75 million acres of corn were planted in Kansas, a slight increase from 2022, with 89% harvested for grain. Grain yield statewide (Figure 5; 119 bu/acre) was below the 50-year average (125 bu/acre). Yield of corn in the variety trials was lower than the state average, and lower than in previous years (Figure 5).

Soybean acreage was less in 2023 than in 2022, with 4.43 million acres planted compared to 5.05 million acres planted in 2022. Planted soybean acres are more consistently harvested, with an average of 97% of planted acres harvested. This year saw an increase in abandoned soybean acres, as only 91% of planted acres were harvested. The average statewide yield in 2023 was also reduced, with an average of 26 bu/acre, significantly less than the previous 10 years. Soybean yields in the double-cropped test were lower than the previous years at Parsons, but slightly above the statewide average (Figure 6).

Sunflower acreage has declined steadily over the past few years. In 2023, only 34,000 acres of oilseed sunflowers were planted in Kansas, with 91% of those acres harvested. Yields statewide were also lower than in previous years, with 917 lb/acre, below the 13-year average of 1322 lb/acre. Yields from the variety trials at Parsons were at the state average (Figure 7).

Conclusions

2023 was a more moderate growing season than 2022, which was reflected in the crop yields.

Acknowledgements

This data is part of the 2023 Kansas Performance Tests with Corn Hybrids (*https://bookstore.ksre.ksu.edu/pubs/SRP1181.pdf)* , 2023 Kansas Performance Tests with Soybean Varieties (*https://bookstore.ksre.ksu.edu/pubs/SRP1180.pdf*), and 2023 Kansas Performance Tests with Sunflower Hybrids (*https://bookstore.ksre.ksu.edu/pubs/SRP1184.pdf*).

References

Zhang, T., Lin, X. and Sassenrath, G.F., 2015. Current irrigation practices in the central United States reduce drought and extreme heat impacts for maize and soybean, but not for wheat. Science of the Total Environment, 508, pp.331-342.

Zhang, T. and Lin, X., 2016. Assessing future drought impacts on yields based on historical irrigation reaction to drought for four major crops in Kansas. *Science of the Total Environment*, *550*, pp.851-860.

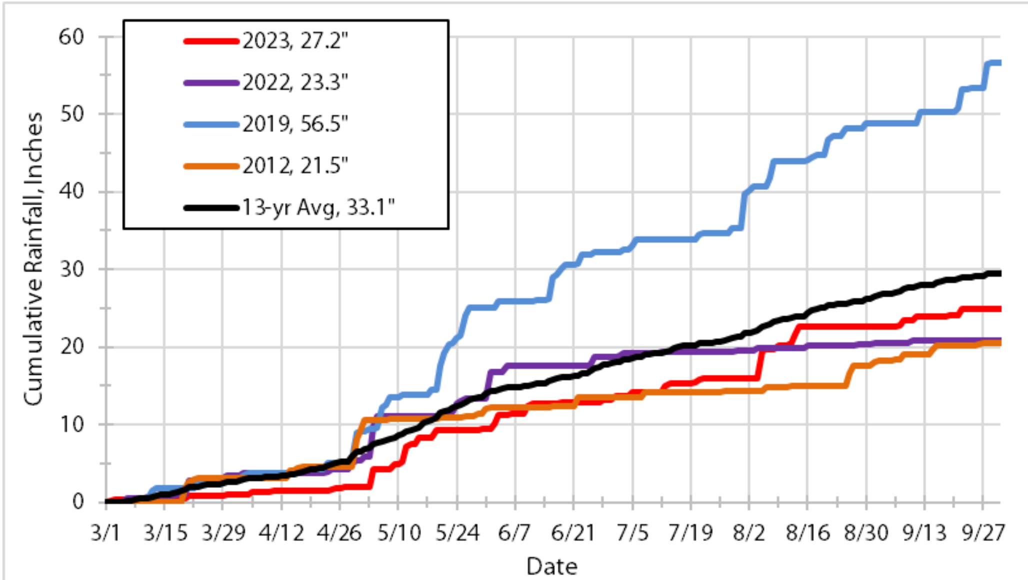

Figure 1. Cumulative rainfall during the summer growing season (March – September) for 2023. Extreme years (2012 and 2019) and previous year (2022) are shown in comparison with the 13-year average. Total rainfall in inches is given after each year.

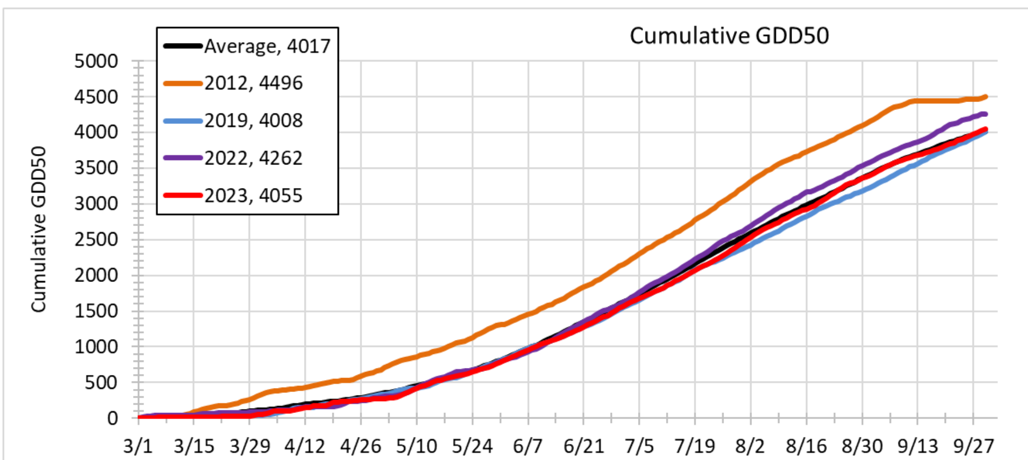

Figure 2. Cumulative growing degree days (GDD, base 50) during the summer growing season (March – September) for 2023. Extreme years (2012 and 2019) and previous year (2022) are shown in comparison with the 13-year average. Cumulative GDD is given for each year.

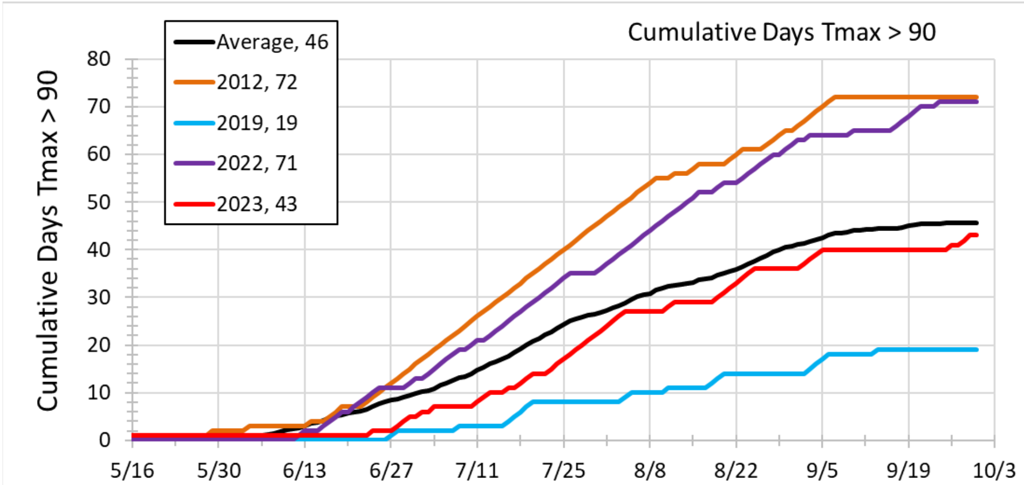

Figure 3. Cumulative number of days with high temperature exceeding 90°F during the summer growing season (March – September) for 2023. Extreme years (2012 and 2019) and previous year (2022) are shown in comparison with the 13-year average. Total number of days is given after each year.

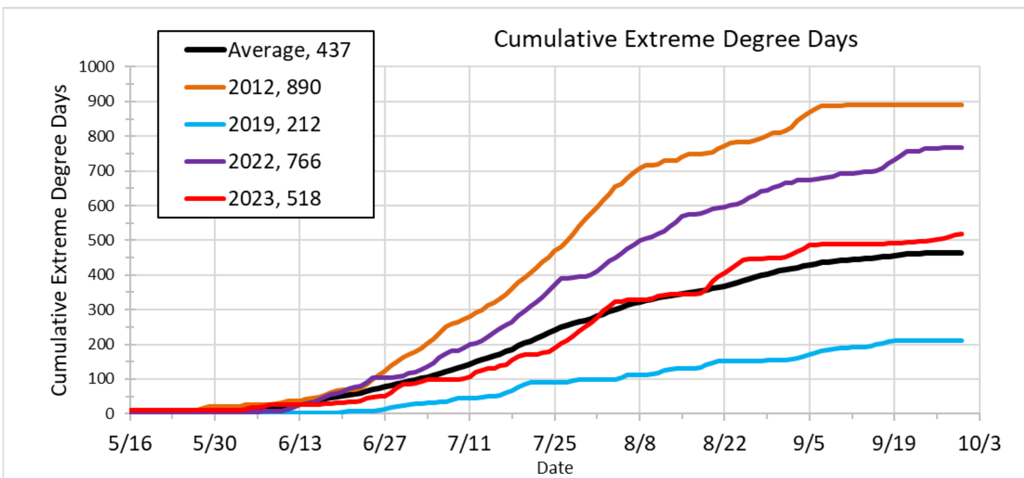

Figure 4. Cumulative extreme degree days (EDD, base 86°F) during the summer growing season (March – September) for 2023. Extreme years (2012 and 2019) and previous year (2022) are shown in comparison with the 13-year average. EDD are given after each year.

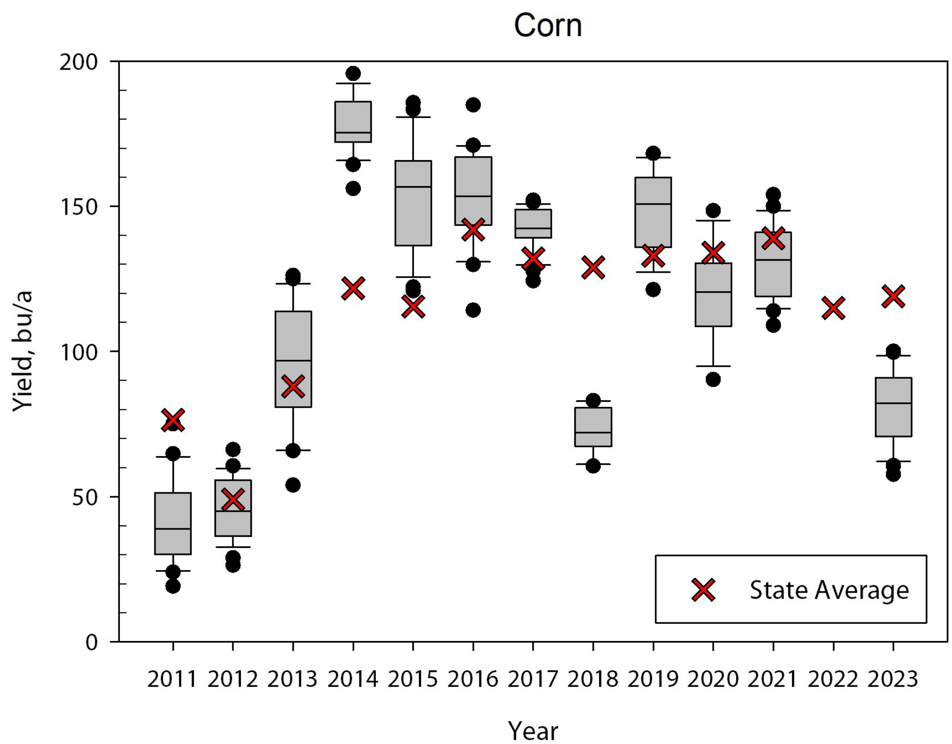

Figure 5. Corn variety test results at Parsons, KS, from 2011 – 2023. The line in the middle of the box plots is the median yield of all varieties. The upper and lower quartiles are given by the upper and lower edges of the boxes. The maximum and minimum values are given by the upper and lower "whiskers" extending from the box. Outliers are given as solid circles. For comparison, average reported yields from Kansas are highlighted as a red X. Corn variety tests were abandoned at Parsons in 2022 because of insufficient rainfall.

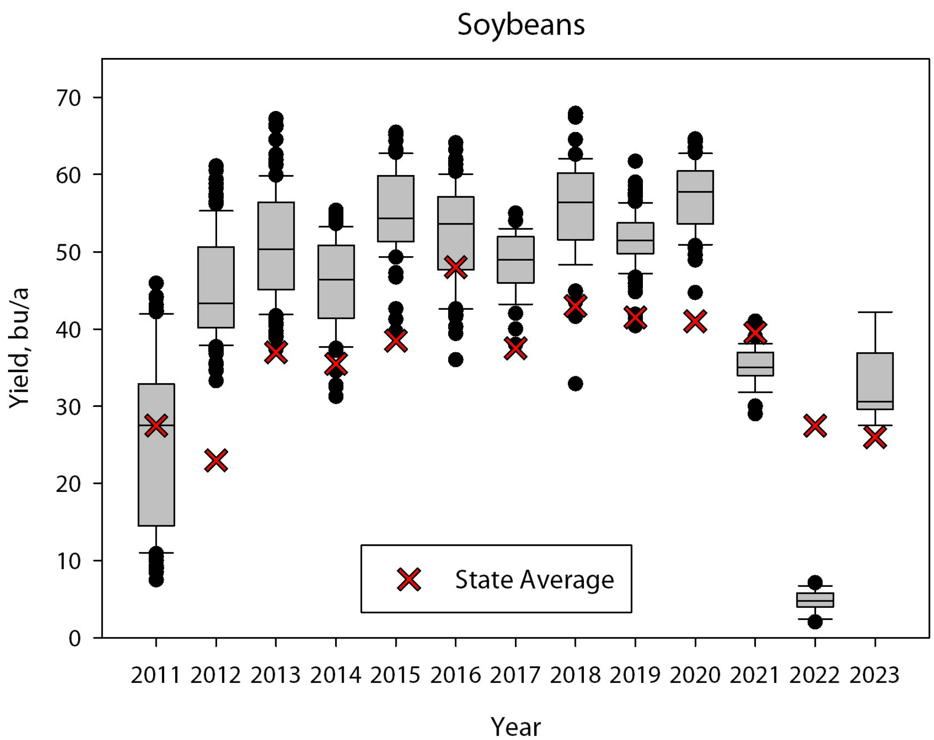

Figure 6. Soybean variety test results at Parsons, KS, from 2011 – 2023. Yields before 2023 are from full-season tests; soybean yields from 2023 are from double-cropped tests. For comparison, average reported Kansas state yields are highlighted as a red X.

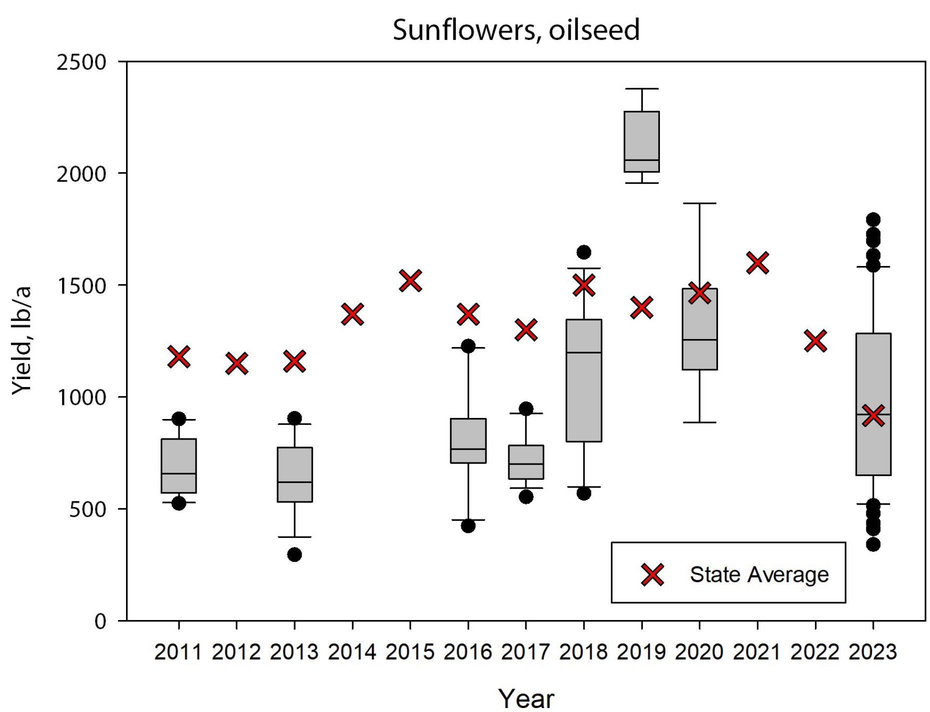

Figure 7. Oilseed sunflower variety test results from Parsons, KS from 2011 – 2023. For years with no bars, the variety tests failed. For comparison, average reported Kansas state yields are highlighted as a red X.

Hard Red and Soft Red Winter Wheat Variety Testing - 2023

G.F. Sassenrath, J. Lingenfelser,[1] and X. Lin [1]

Summary
This is a summary of the winter wheat production conditions in Kansas, with particular emphasis on the variety trial results from southeast Kansas in 2023. After the dry conditions of 2022, adequate rain for wheat establishment and growth in the fall in southeast Kansas was received, although drought conditions were observed in central and western Kansas. The growing season had slightly below average rainfall, with adequate soil moisture in the fall for good stand establishment. Overall yields of hard and soft red wheat varieties were above multi-year averages, but slightly below the yields from 2022. As in previous years, soft red winter wheat out-yielded hard red winter wheat varieties, but the extent was not as dramatic as in previous years.

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 2022-2023 winter wheat growing season in comparison to previous years and the historical averages for the state of Kansas. Fifteen hard red and 19 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, KS. Wheat varieties were tested in Parsons silt loam soil at the Southeast Research and Extension Center (SEREC) in Parsons. All crop variety trials are managed with conventional tillage. Individual variety results are available at the K-State Crop Performance Test webpage (http://www.agronomy.k-state.edu/outreach-and-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 in Parsons and harvested in June. Plots were 7-ft wide by 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 fungicide or herbicides were applied in the wheat crop.

State reported crop yield data were downloaded from the National Agricultural Statistic Service Crop database (*https://quickstats.nass.usda.gov/*). Weather data were collected from the Kansas Mesonet website (*http://mesonet.k-state.edu/agriculture/degreedays/*) for a weather station located at the SEREC in Parsons. Cumulative rainfall was calculated on a water year basis from October 1, 2022, through June 30, 2023.

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Results and Discussion

After the very dry summer of 2022, rainfall during autumn and early winter (water year 2023 (WY23)) was slightly (2.8 in.) above average through February (Figure 1). March and April had very little rain, reducing totals to slightly below average. Although dry spring conditions can make establishment of summer crops challenging, wheat production usually benefits from dry conditions in southeast Kansas due to lower disease pressure. Winter wheat heading in the variety trials began on April 24 in the hard red and April 26 in the soft red varieties and ended May 3 and May 5 in the hard and soft varieties, respectively. During this 11-day period, Parsons received 2.6 in. of rain, increasing the likelihood of diseases, especially Fusarium head blight (scab). Rain increased during the spring of 2023, bringing the wheat growing season total rainfall for 2023 to just below average and very similar to 2022.

Acreage planted to winter wheat in Kansas increased slightly in 2023 to 8.1 million acres (Figure 2). This is below the long-term average of 11.5 million acres, and down from the peak of 17.1 million acres planted in 1937. However, of those acres planted, an estimated 70% of those acres were harvested. This is below the 102-year average of 88% harvested; the lowest harvested acres occurred in 1935, with only 51% of planted acres harvested. Average statewide yield was 35 bu/acres.

Yields for hard and soft winter wheat varieties in Parsons were very similar to those harvested in 2022 (Figure 3), with a slight increase in yield variability. The average hard red winter wheat yield in 2023 in Parsons was 73.1 bu/acre with a test weight of 60.8 lb/bu. (Table 1). Soft red wheat yield was 83.8 bu/acre, with a test weight of 59.3 lb/bu. While the soft red wheat yielded better than the hard red wheat, the difference was not as great as measured in previous years.

Conclusions

Winter wheat did well in 2023 in southeast Kansas. This was an exception for the state, as other regions of Kansas experienced exceptional drought conditions throughout much of the year (https://droughtmonitor.unl.edu/CurrentMap.aspx). Although rain was received during wheat bloom, disease was not a significant problem this year.

Acknowledgements

These data are part of the 2023 Kansas Performance Tests with Winter Wheat Varieties and will be available online.

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

		2017		2018		2020		2021		2022		2023	
Company	**Variety**	**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**	**Yield, bu/a**	**Test weight, lb/bu**	**Yield, bu/a**	**Test weight, lb/bu**
AgriMAXX	AM Cartwright					**82.9**	60.8	**70.5**	55.3	65.5	55.9	65.4	60.2
AgriMAXX	AM Eastwood	47.2	55.5	**56.8**	58.5	67.2	57.9	33.9	51.7				
Syngenta AgriPro	SY Benefit	56.9	57.7	45.2	57.4	77.5	59.5	37.5	50.3				
Syngenta AgriPro	Prolific									**82.2**	57.6	69.6	61.0
AGSECO	AG Icon			47.4	57.2	80.5	60	42.2	75.9				
AGSECO	AG Radical					76.1	56.6	28	50	**75.2**	56	**86.9**	60.7
KWA Wildcat Gen	KS16DH0010-17											71.1	61.1
KWA Wildcat Gen	Everest	**60.5**	58.1	48.6	59.3	78.9	60.8	49.8	54.1	64	57.8	65.5	61.0
KWA Wildcat Gen	Providence									66.5	56.5	77.2	61.4
KWA Wildcat Gen	Zenda	**60.7**	58.4	43.5	59.7	**86.1**	60.8	**66.1**	55.2	**75.3**	58.2	58.0	61.5
Polansky	High Country											64.7	60.4
Polansky	Paradise							**79.2**	54.2	73.7	56.2		
Polansky	Rock Star							**67.5**	54.6	**78.2**	55.6	71.4	60.9
WestBred	WB4269	55	57	48.5	58.9	**86.8**	60.3	**61.8**	54.3	67.1	55.7	**75.3**	60.4
WestBred	WB4401					**108.8**	61.5	**92**	57.8	73	53.8	**84.4**	60.4
WestBred	WB4422									**85**	58	**80.2**	61.7
WestBred	WB4523									72.3	54.1	**80.7**	61.0
WESTBRED	WB4632	**61.5**										61.5	60.5
WestBred	WB4699					**94.5**	58.7	39.5	50.7	**82.6**	56	**76.4**	60.0
Overall average, hard red winter wheat		57.1	57.4	51.7	58.1	81.1	59.2	55.5	55.1	74.6	56.3	72.5	60.8

Yields above average are highlighted in bold.

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

		2017		2018		2020		2021		2022		2023	
Company	Variety	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	Yield, bu/a	Test weight, lb/bu	Yield, bu/a	Test weight, lb/bu
AgriMAXX	473	**83.2**	57.9	**65.1**	57.5	**106.1**	59	**94**	55.2				
AgriMAXX	492							**99.9**	56.3	81	57.5		
AgriMAXX	503					**113.9**	60.1	**102.5**	56.2	80.6	55.7	77	58.8
AgriMAXX	505					**112.2**	60.7	**100.3**	57.2	**88.9**	57.7	**85.7**	60.2
AgriMAXX	513							**99.3**	55	**86.9**	56.7	81.4	59.5
AgriMAXX	514							**93.3**	54.4	**87.5**	55.3	**84.6**	58.8
AgriMAXX	516									83.8	55.9	**92.3**	59.4
AgriMAXX	525											80.1	58.7
AgriMAXX	535											84.2	60.2
AgriMAXX	EXP 2105									**87.1**	55.1		
Beachner	GB0206							**96.4**	53.7	**86.2**	55.8	**90.7**	58.4
Beachner	GB0208							89.9	55.1	**88.7**	56.2	83.4	59.6
Beachner	Roane							71.7	56.4				
Becks	726							**101**	54.8				
Becks	727							**95.2**	56.3				
Becks	730							76.3	53.9				
Becks	720											81.9	59.6
Becks	722											83.3	58.9
Becks	724											**88.1**	60.1
Becks	725											81.2	59.2
Becks	732											**90.9**	59.4

Yields above average highlighted in bold.

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

		2017		2018		2020		2021		2022		2023	
Company	Variety	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	Yield, bu/a	Test weight, lb/bu	Yield, bu/a	Test weight, lb/bu
DuPont Pioneer	25R40	79.5	56.8	**66.1**	56.7	**105.8**	58.1						
DuPont Pioneer	25R50			57.1	57	97.5	59.3			81.8	54.6		
DuPont Pioneer	25R61	71.4	57.8	**61.6**	57.9	87.5	58.3						
DuPont Pioneer	25R74	80.8	57.6	**65.4**	56.3	**110.4**	61.6			**92.6**	54.8		
DuPont Pioneer	25R76									79.1	55.8		
Dupont Pioneer	25R77	**84.4**	57.9	54.2	56.9	103	61.6						
NSS	EXP1410							**98.0**	54.8				
NSS	EXP1415							85.2	54.7				
NSS	EXP1419							88.6	53.6			81.1	60.1
NSS	EXP1425							**103.8**	53.9				
NSS	EXP1450							78.6	54.0				
NSS	EXP1472							**96.1**	56.8				
NSS	EXP15											**89.4**	58.5
NSS	EXP24											82.7	59.7
NSS	EXP94											80.7	58.8
WestBred	WB2606									82.8	56.3	72.8	58.8
Overall average, soft red winter wheat		78.2	57.5	59.9	57	102.4	59.5	90.4	54.9	85.2	56	83.8	59.3

Yields above average highlighted in bold.

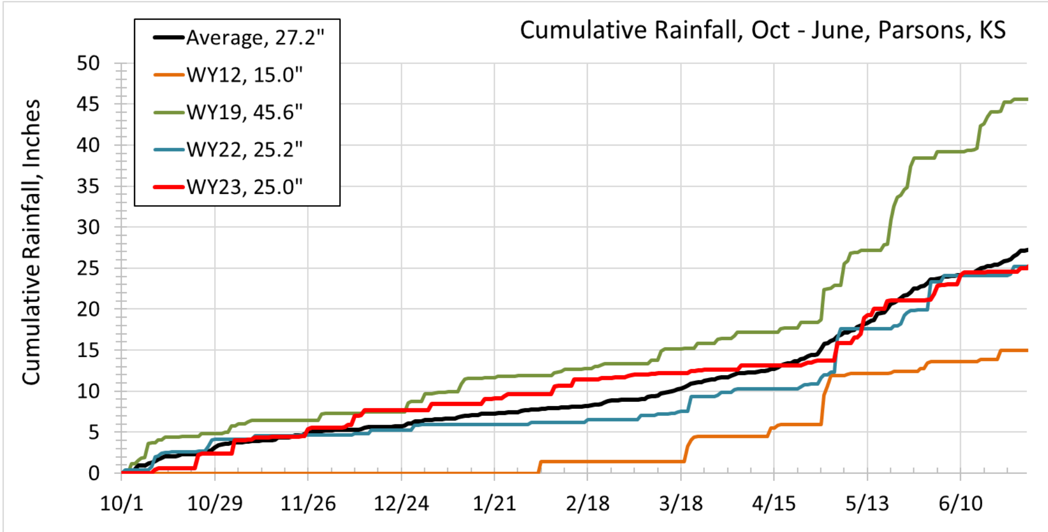

Figure 1. Cumulative rainfall during the winter wheat growing season (October 1 - June 30). Rainfall totals during this period are given for each year.

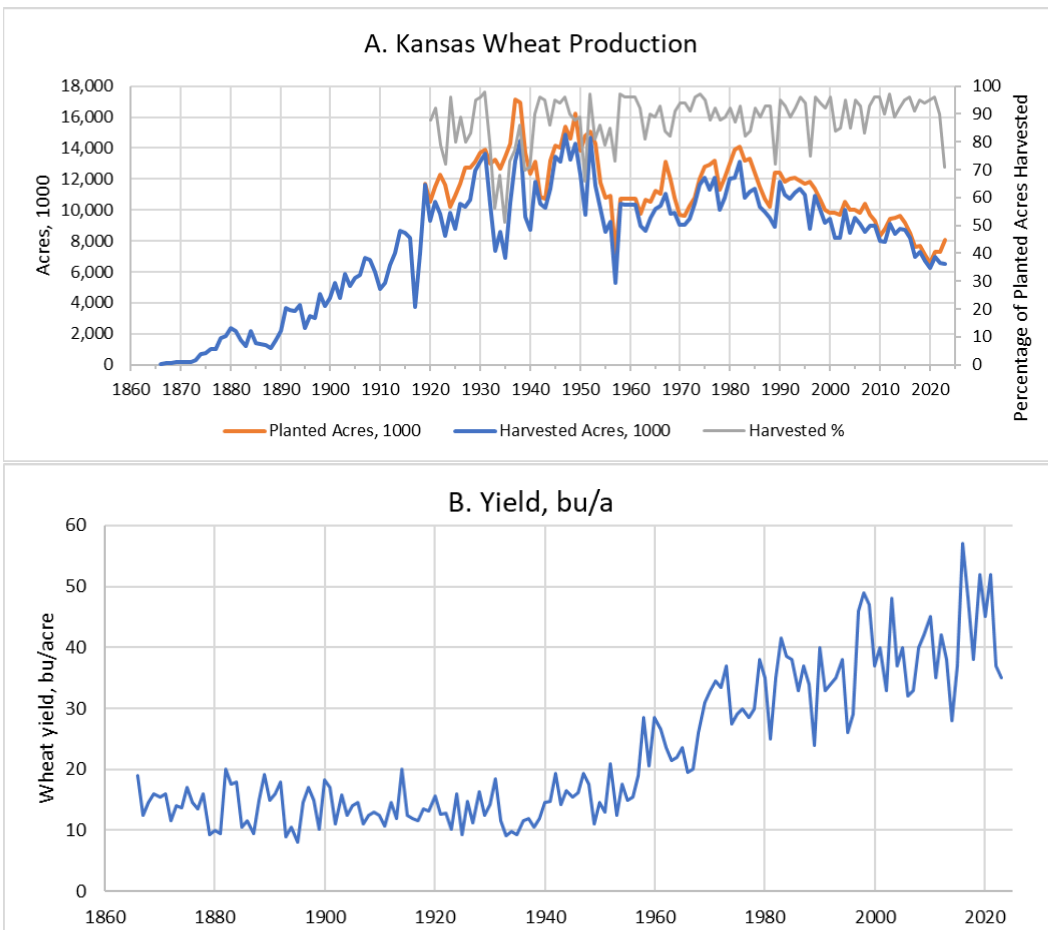

Figure 2. A. Statewide historical wheat production, (left axis) acres planted (1,000), acres harvested (1,000), and (right axis) percent of planted acres harvested. B. Average statewide winter wheat yields bu/acre for Kansas.

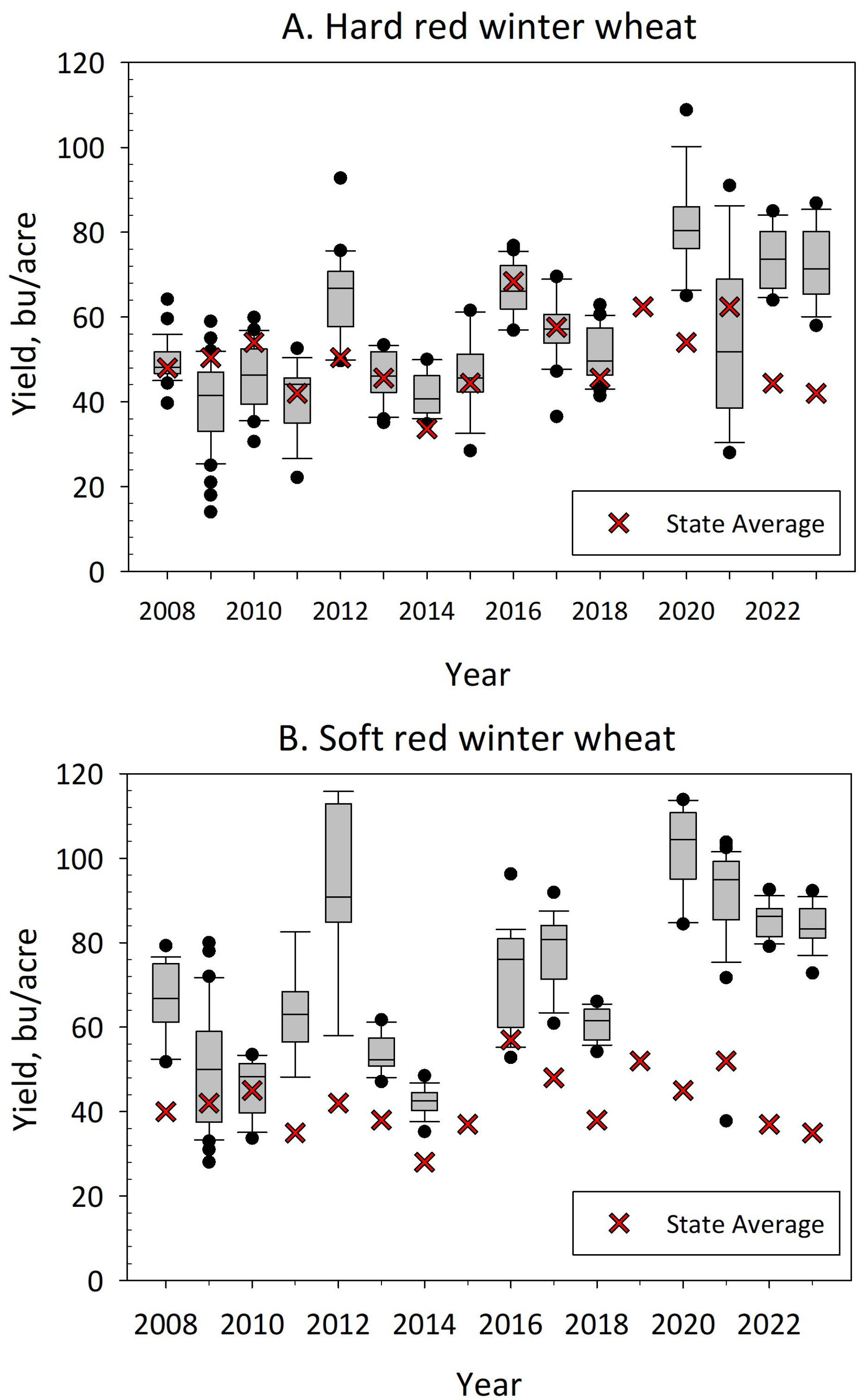

Figure 3. Winter wheat yield for (A) hard-red wheat and (B) soft-red wheat from variety trials in southeast Kansas from 2008 through 2023. In 2019, variety testing was abandoned due to flooding and poor stands. The line in the middle of the box plots is the median yield of all varieties. The upper and 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 statewide yields for hard red winter wheat from Kansas are highlighted as a red X in both graphs.

Role of Soil Management in Control of Soil-Borne Diseases

G.F. Sassenrath, C. Little,[1] and X. Lin[2]

Summary

Soil-borne diseases are a significant cause of crop yield reduction. Alternative soil-management methods can enhance the soil's natural disease-controlling organisms. This study explores the effect of alternative production methods on a primary soybean disease, charcoal rot, caused by the fungus *Macrophomina phaseolina*. Treatments that could potentially enhance or reduce the disease pressure were implemented, and soil tests were conducted for nutrients, soil properties, and disease presence. Manure increased the nutrient levels in the soil, as expected, but did not influence disease control. Solarization increased the temperature within the plots and increased the number of colony-forming units (CFUs) of *M. phaseolina*.

Introduction

Suppressive soils have been defined as soils that can inhibit the growth of naturally occurring soil-borne diseases. These soils can suppress or control disease-causing organisms, including fungi (e.g., *Fusarium virguliforme* (cause of sudden death syndrome, SDS), *Macrophomina phaseolina* (cause of charcoal rot), Phytophthora root rot (*Phytophthora sojae*), and nematodes (e.g., soybean cyst nematode, *Heterodera glycines*)). How the native soil microbial communities reduce disease is not known. Knowledge of factors that contribute to and support these beneficial microbial communities is also unknown.

One example of this natural improvement in the soil microbial community reducing disease was demonstrated in previous research (Sassenrath et al., 2017, 2019), which demonstrated that a high-glucosinolate mustard (*Brassica juncea*) reduced fungal populations that caused charcoal rot in both soil and soybean plants. Here, those results are expanded on by exploring the interaction between soil health and disease pressure. Management practices that increase, decrease, or maintain disease pressure were tested in field studies to determine the influence of those practices on soil health, fungal pathogen presence, and soybean growth and yield.

Impact of Soil Health on Soybean Disease

Crop plants that are disease hosts increase the number of disease-causing organisms in the soil. The increase in colony forming units (CFU) of *M. phaseolina* in the soil after soybean production has been shown previously (Sassenrath et al., 2019). Other factors that reduce soil-borne diseases include high-glucosinolate mustard as a cover crop (Sassenrath et al., 2017, 2019) and increasing the soil temperature (e.g., "solarization"). Use of animal manures greatly increases the diversity of the soil microbial community, and beneficial microorganisms in particular. In addition to improving the nutrient balance of the soil, manure may contribute to reduced disease pressure (Graham et al., 2014) and soybean cyst nematode populations (Bao et al., 2013).

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Diseases are primary factors that reduce the yield and quality of soybeans in Kansas and throughout the world. Soil-borne diseases are prevalent in eastern Kansas crop fields. Certain plants have been shown to produce chemicals that act as biofumigants that control or reduce harmful soil fungi. Animal manures have also been used to alter the soil microbiome to improve control of disease organisms. The working hypothesis of this research is that improving the overall soil health by supporting healthy soil microbial communities can reduce disease pressure, i.e., creating suppressive soils by altering management practices will reduce disease pressure. This research explores the relationship between soil health and disease pressure. The research tests the ability of cover crops, animal manure, and solarization to control or reduce charcoal rot in soybean production through improved soil microbial communities.

Experimental Procedures

Replicated plots were established at the Southeast Research and Extension Center in Parsons in the spring, 2023. Plots included: fallow, mustard cover crop, soybean, corn stubble, cow manure, and plastic sheets. Temperature and moisture sensors (HOBO, Onset, Inc., Bourne, MA) were installed at 2-in. depth in the soil, and temperature and moisture were recorded continuously. Plastic sheets provide a "solarization" treatment, increasing soil temperature and potentially reducing soil microbes. Plastic sheets were placed on plots and held in place with concrete blocks. Corn stubble was spread to about a 2-in. layer; corn stubble provides more carbon for soil microbes, increasing their abundance, but is also a host for *M. phaseolina*, potentially increasing the disease prevalence. Animal manure provides an additional food source for the microbes and adds additional microbes to the soil; manure has been shown to reduce some pathogens in soil. Cow manure was spread to about a 2-in. layer on the plots. The use of a mustard cover crop has been shown to reduce the number of CFUs of *M. phaseolina*, while soybeans are a host and increase the CFUs of *M. phaseolina*. The high-glucosinolate mustard, Might Mustard Pacific Gold (Johnny's Selected Seeds, Winslow, ME) was broadcast in plots in early April. The fallow treatment was left unplanted and served as a control. Five cultivars of soybeans, ranging from maturity group (MG) 3.2 to 5.2, were also planted to test for variation in charcoal rot sensitivity.

Soil samples to a depth of 6 in. were collected in spring prior to implemented treatments, mid-season, and after harvest. Soils were analyzed for nutrients and microbial activity, and for the number of CFUs of *M. phaseolina*. Soil microbial activity was measured with the CO_2-burst test (Solvita, Woods End, ME).

Results and Discussion

Nutrients changed in response to treatments (Table 1). As anticipated, the cow manure treatment had the highest levels of organic matter (OM), potassium (K), and phosphorus (P). Surprisingly, the solarization treatment (plastic film) had the highest total nitrogen (N) and microbiologically active carbon.

Interesting differences were observed in the environment within the soil in the different treatments (Figure 1). The soil with animal manure retained the most moisture (Figure 1), most likely due to the coverage of the soil, reducing evaporation from the soil surface. Similarly, corn stalks and plastic reduced evaporative losses and retained soil moisture. Mustard seed and soybeans removed soil moisture, resulting in soil moisture levels that were lower that those measured in the fallow treatment. The solarization treatment (plastic) increased soil temperature an average of 15°F above that of bare soil (fallow) (Figure 2). Cow manure and corn stubble kept the soil an average 8°F cooler. Plants (soybeans and mustard seed cover crop) also kept the soil cooler, but not as cool as the corn stubble and manure treatments.

The soil microbial activity, as measured by the Solvita CO_2-burst test, was very high in the corn stubble and manure, as would be expected from the high carbon content of those materials (Figure 3). The soil treated with cow manure also had much higher microbial activity, but the activity under the corn stubble was less than that planted to soybeans. Microbial activity with the mustard seed cover crop was also low. The fallow and solarization treatments had the lowest microbial activity at mid-season.

Conclusions

The soil microbiome controls many of the functions of the soil. It is possible, through alternative management practices, to alter the soil microbiome to support helpful organisms, such as arbuscular mycorrhizae, while controlling disease-causing organisms. Preliminary evidence from this study showed a minor change in microbial composition and activity with treatments. However, the unusually hot and dry weather may have compromised the results, as soybean yields were greatly reduced.

Acknowledgements

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References

Bao, y., Chen, S., Vetsch, J., Randall, G. 2013. Soybean yield and Heterodera glycines responses to liquid swine manure in nematode suppressive soil and conducive soil. J. Nematology. 45(1):21-29.

Graham, E., Grandy, S., Thelen, M. 2014. Manure effects on soil organisms and soil quality. Michigan State Extension. *https://www.canr.msu.edu*

Sassenrath, G.F., Lingenfelser, J., Lin, X. 2023. Corn and soybean production – 2022 summary. *Kansas Agricultural Experiment Station Research Reports:* Vol. 9: Iss. 2.

Sassenrath, G.F., Little, C., Roozeboom, K., Lin, X., Jardine, D. 2019. Controlling soil-borne disease in soybean with a mustard cover crop. *Kansas Agricultural Experiment Station Research Reports*: Vol. 5: Iss. 2. *https://doi.org/10.4148/2378-5977.7740*

Sassenrath, G.F., Little, C.R., Hsiao, C.-J., Shoup, D.E., Lin, X. 2017. Cover crop system to control charcoal rot in soybeans. *Kansas Agricultural Experiment Station Research Reports*: Vol. 3: Iss. 2. *https://doi.org/10.4148/2378-5977.1383*

Table 1. Changes in soil nutrients with treatment

	Organic matter	Potassium	Mehlich P	Total N
	%	ppm		
Mid-season				
Corn stubble	1.9	74.5	23.0	13.4
Cow manure	2.4	150.5	47.3	16.1
Fallow	2.0	66.8	18.5	13.2
Mustard seed	2.1	78.5	23.0	15.6
Plastic film	2.0	62.3	19.5	21.2
Soybeans	2.0	73.8	20.3	12.9
At harvest				
Corn stubble	2.0	80.3	27.3	19.6
Cow manure	2.2	160.3	53.0	27.8
Fallow	2.0	60.8	25.8	20.1
Mustard seed	2.0	74.5	29.0	21.8
Plastic film	2.0	60.3	29.0	33.3
Soybeans	2.0	71.8	25.5	19.2

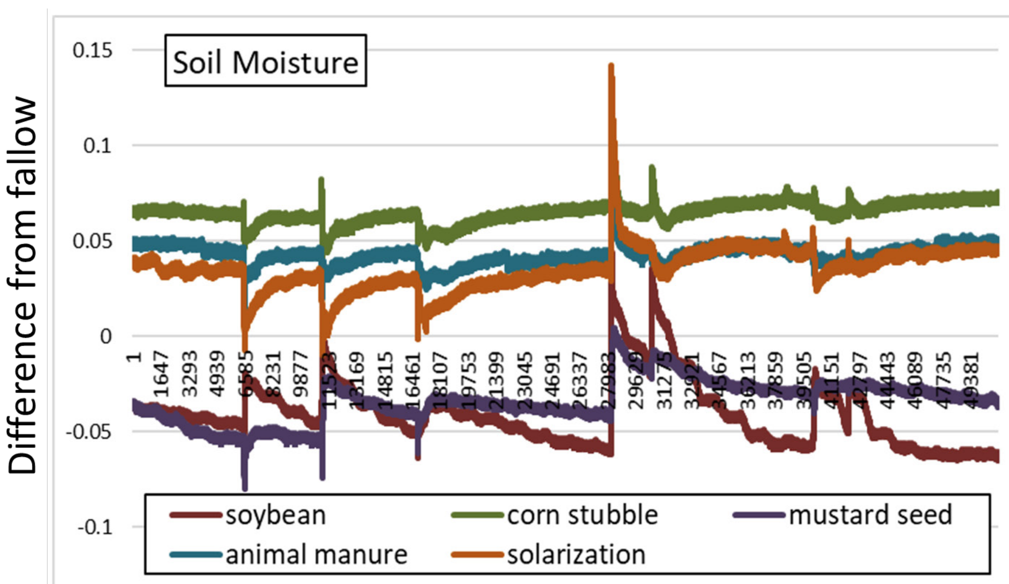


Figure 1. Difference in soil moisture at 2-in. soil depth between fallow and different treatments.

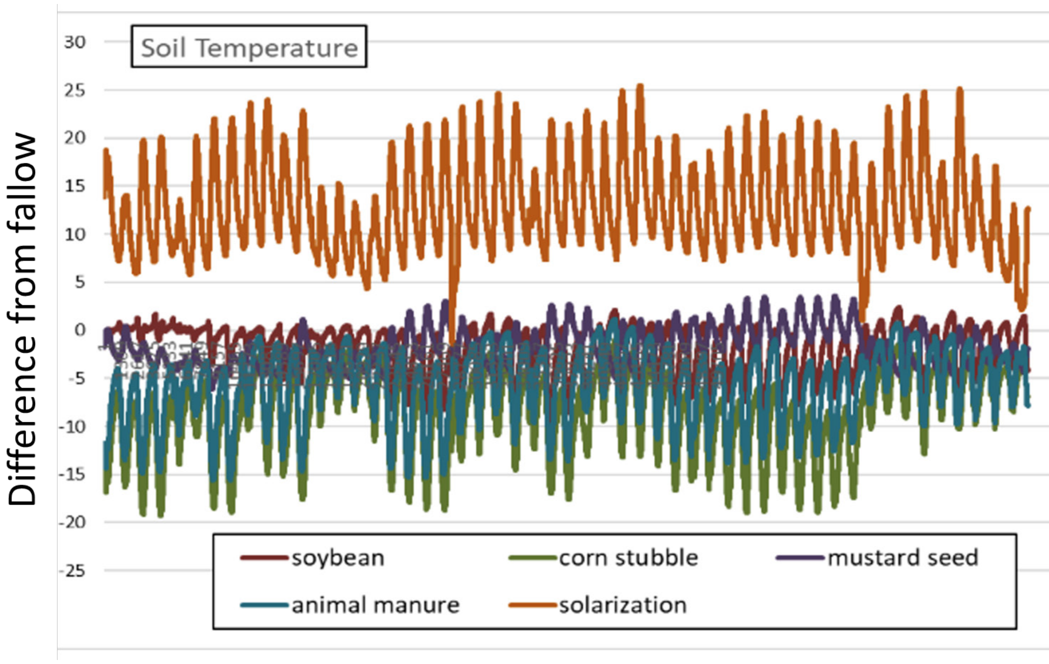


Figure 2. Difference in soil temperature (°F) at 2-in. soil depth between fallow and treatments.

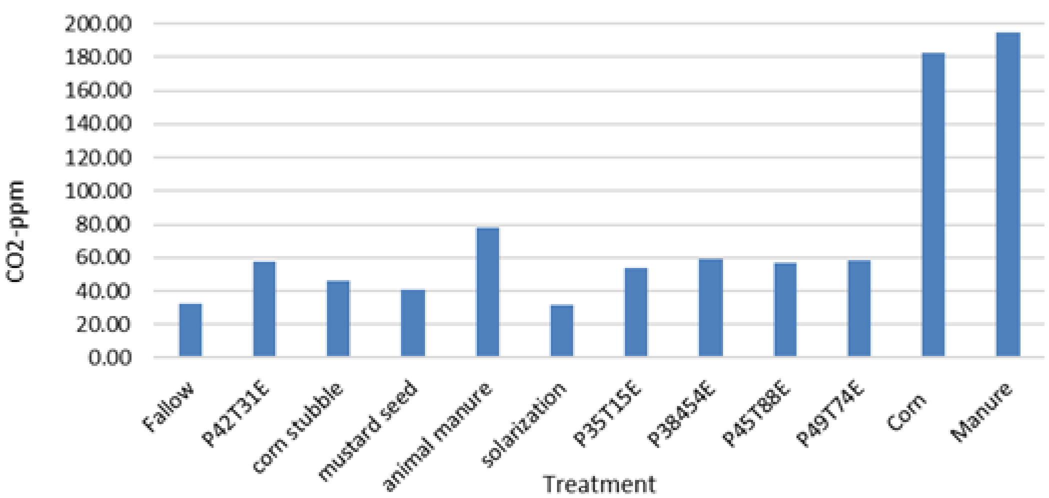


Figure 3. CO_2 burst test for different treatments.

Southeast Kansas Climate Summary for 2023

Matthew Sittel, Assistant State Climatologist

Summary

Temperature and rainfall are important factors influencing agricultural performance. This report summarizes weather conditions in southeast Kansas. Comparisons to long-term records are used to indicate deviations from historical averages. Overall, in 2023 the southeast region had below average precipitation and above normal temperatures.

Introduction

Temperature and precipitation are primary determinants of crop growth and yield. In addition to contributing to the physical comfort of human inhabitants, these weather parameters also determine the health and performance of livestock. Climatic trends are determined by a range of complex interactions across the globe.

Humans have tracked weather parameters for decades. Improvements in instrumentation, frequency, and coverage of measurements have improved the accuracy and reliability of reported values, allowing crop and animal scientists to better track changes in climate.

Here, weather conditions (temperature and rainfall) over the 14-county region of Kansas designated as the Southeast Region (Figure 1) are examined. Historical data are used to build trends and comparative information across multiple years.

Experimental Procedures

The divisional precipitation and temperature data were downloaded from the National Centers for Environmental Information (NCEI; *https://www.ncei.noaa.gov/*). NCEI generated monthly divisional averages based on individual station data from observers within the 14 counties that comprise southeast Kansas. The observations were collected from official reporting sites, such as airports as well as co-operative and citizen observers who measure both temperature and precipitation. These observations expand the number of observations in an area, and are different than the automated weather stations reported in the Kansas Mesonet site (*https://mesonet.k-state.edu/*).

Results and Discussion

Precipitation was below normal in 2023 (Figure 2). 2023 ranked as the 20th driest year on record in southeast Kansas dating back to the beginning of NCEI records in 1895 and was the driest year since 2012. Temperatures averaged above normal as well. 2023 was the 11th warmest year on record in this division and was the warmest year since 2016.

In terms of percent of normal and departure from normal, southeast Kansas (Figure 1) was the driest division in the state in 2023. Last year's annual precipitation across southeast Kansas averaged 29.49 in., or 72% of normal. This total was 11.27 in. below the 30-year normal of 40.76 in. (Table 2). Despite the dry year, drought conditions improved somewhat during the past 12 months. At the beginning of 2023, all of southeast Kansas' counties were in drought status on the U.S. Drought Monitor conditions map (Figure 2a, Table 1). Parts of eight counties were in D4, the most severe drought category. The D4 area included all of Elk and Chautauqua Counties, as well as portions of Butler, Cowley, Greenwood, Woodson, Wilson, and Montgomery Counties. By the end of 2023, the worst drought category in southeast Kansas was only D2 across parts of Elk, Chautauqua, Wilson, and Montgomery Counties (Figure 2b). Cherokee County was drought free, as were portions of Bourbon, Crawford, and Labette Counties. The improvements in drought conditions across southeast Kansas happened primarily within the last few weeks of the year. December had 160% of normal precipitation (1.06 in. above normal) in southeast Kansas, the highest percent of normal of any month in 2023 and the wettest December since 2015 (Table 2).

Despite these improvements, precipitation in 2024 will need to be much greater than average to fully erase the drought deficits from 2023. The likelihood of an annual surplus of precipitation of the same magnitude or larger than 2023's deficit is historically rare. During the previous 129 years, only four years had more than 11.27 in. above normal precipitation (i.e., 52.03 in. of total precipitation, the normal 40.76 in. plus the 2023 deficit of 11.27 in.). It last happened just five years ago in 2019 (Table 3), when an average of 57.60 in. of precipitation fell across southeast Kansas, the wettest year on record.

The 2023 average annual temperature in southeast Kansas was 59.0°F, or a departure of +1.9°F (Table 2). All months were above normal except March. December (+6.3°F), January (+4.8°F) and September (+3.4°F) were the three months most above normal. The number of 90-degree and 100-degree days in 2023 were much above normal across the division (Table 4). All three summer months (June, July, and August) had average temperatures that were much above normal, primarily driven by very warm days. The average low temperatures during both June and July were slightly below normal (Table 5), and the counts of days with lows at or above 70 degrees were mostly below normal across the division, suggestive of drier than normal conditions that allowed temperatures to cool more easily at night than on very humid days. At the Kansas Mesonet site in Parsons, the average dew point for summer 2023 was 66.1°F, lower than the normal dew point for June 1 – August 31 of 67.2°F (based on 1991 – 2020 hourly data). During the summers of 1991 through 2020, Parsons had a dew point at or above 70°F, indicating very humid conditions 35.6% of the time. In 2023 this threshold was exceeded only 23.1% of the time, further evidence of lower humidities during the past summer in southeast Kansas.

Conclusions

Although the drought conditions in southeast Kansas were somewhat alleviated by precipitation received at the end of the year, the substantial deficit will take time to recover. The probability of getting sufficient rain to fully relieve the deficit and refill the soil profile is low. Current conditions in the region are primarily still listed as abnormally dry to moderate drought.

Temperatures across the region were consistently above average, except during March. This resulted in the number of days of temperatures above 90°F and 100°F being above average for 2023. Conversely, the low humidity due to drought resulted in fewer high nighttime lows.

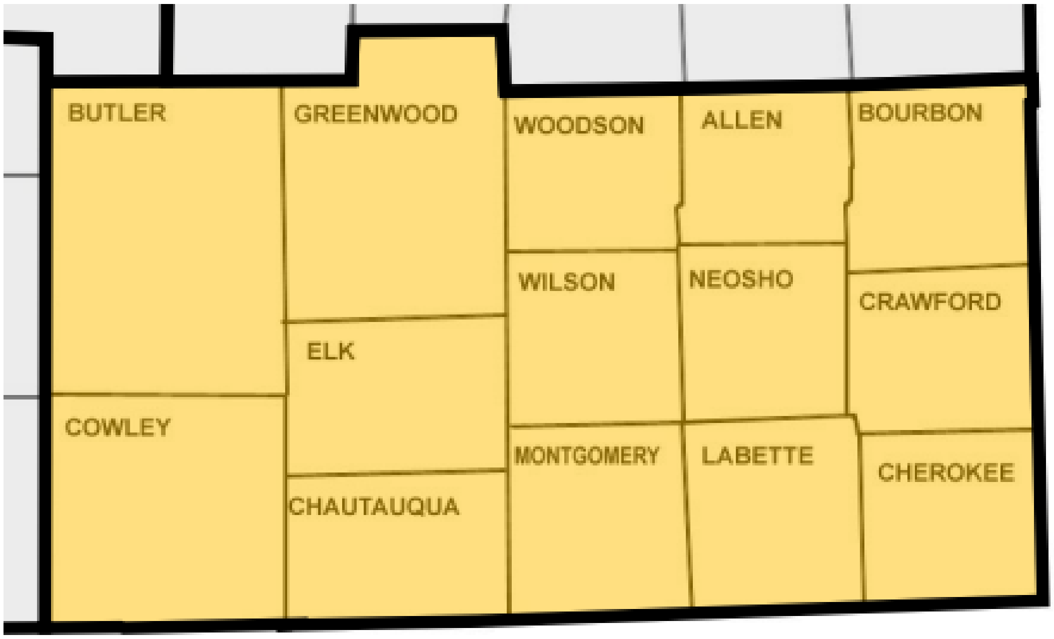
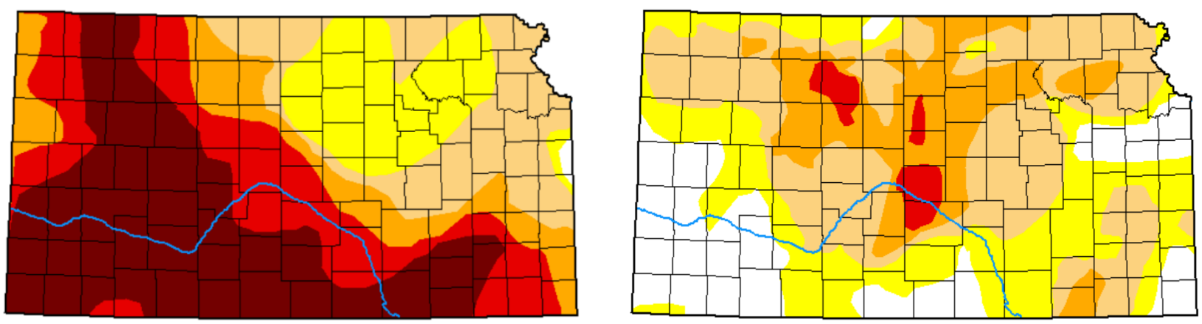


Figure 1. Map of the 14 counties comprising NCEI's southeast Kansas climate division.



Date	None	D0	D1	D2	D3	D4	DSCI
12/27/2022	0.25	14.15	16.74	11.83	20.18	36.85	348
12/26/2023	20.25	26.32	34.00	16.56	2.88	0.00	156

Figures 2a-b, Table 1. U.S. Drought Monitor map for Kansas on December 27, 2022 (left) and December 26, 2023 (right), as well as categorical percentages of the amount of Kansas in each of the drought categories. D4 is the most severe category, while D0 is the least severe. None refers to drought-free conditions. DSCI is the Drought Severity Coverage Index, a composite index of overall drought conditions. Higher DSCI values indicate worse drought. The DSCI can range from a minimum of 0 (entire state drought-free) to 500 (entire state in D4).

Table 2. Total precipitation and daily temperature averages for each month across the southeast Kansas climate division (Source: NCEI).

	Precipitation (in.)			Temperature (°F)		
	Total	Norm.	Dep.	Avg.	Norm.	Dep.
Jan	1.32	1.22	+0.10	37.9	33.1	+4.8
Feb	1.90	1.59	+0.31	39.4	37.6	+1.8
Mar	1.04	2.75	-1.71	45.9	47.3	-1.4
Apr	1.25	4.14	-2.89	57.0	56.7	+0.3
May	3.98	5.96	-1.98	66.9	65.7	+1.2
Jun	2.82	5.45	-2.63	75.6	75.1	+0.5
Jul	4.23	4.23	+0.00	80.1	79.7	+0.4
Aug	3.20	3.92	-0.72	81.1	78.5	+2.6
Sep	2.12	3.93	-1.81	73.7	70.3	+3.4
Oct	3.39	3.48	-0.09	60.4	58.5	+1.9
Nov	1.41	2.13	-0.92	47.6	46.3	+1.3
Dec	2.83	1.77	+1.06	42.4	36.1	+6.3
YEAR	29.49	40.76	-11.27	59.0	57.1	+1.9

Table 3. The five wettest, driest, warmest and coldest years in southeast Kansas since 1895 (Source: NCEI). Years marked with an asterisk (*) indicate the last of multiple occurrences.

Precipitation					Temperature			
Wettest		Driest			Warmest		Coldest	
Amount (in.)	Year	Amount (in.)	Year	Rank	Value (°F)	Year	Value (°F)	Year
57.60	2019	21.93	1963	1	60.7	2012	54.0	1979
54.09	2008	22.28	1956	2	59.9	1954	54.2	1895
53.62	1961	22.60	1952	3	59.5	1946	54.3	1917
52.36	1985	23.06	1980	4	59.4	1921	54.4	1903
51.95	1973	23.40	1917	5	59.3	2016*	54.5	1993*

Table 4. Number of days in 2023 on which high temperatures were at least 90°F and 100°F, and the number of days on which low temperatures were at least 70°F, at selected locations across southeast Kansas. The average annual counts are based on 1991–2020 data. BOLD numbers in the 2023 column indicate above-normal totals.

	90°F Highs		100°F Highs		70°F Lows	
Location	**2023**	**Avg.**	**2023**	**Avg.**	**2023**	**Avg.**
Chanute	**80**	49	**14**	5	**43**	40
El Dorado	**82**	53	**20**	6	32	38
Eureka	**78**	50	**19**	7	**29**	27
Fort Scott	**56**	53	**8**	6	29	42
Girard	**59**	52	**10**	4	31	40
Independence	**72**	54	**16**	6	30	43
Iola	**42**	40	**6**	2	27	38
Parsons	**52**	47	**8**	5	33	35
Sedan	**92**	58	**16**	9	34	40
Winfield	**84**	55	**23**	9	**43**	35
Yates Center	**56**	41	**13**	4	29	30

Table 5. Departures from normal for average daily maximum and minimum temperature as well as average monthly temperatures for the three months of meteorological summer 2023. Departures from normal are based on average temperatures for the period 1991–2020 (Source: NCEI).

	Average Temperature (°F)		Maximum Temperature (°F)		Minimum Temperature (°F)	
Month	2023	Dep.	2023	Dep.	2023	Dep.
June	75.6	+0.5	87.6	+2.1	63.7	-1.0
July	80.1	+0.4	91.6	+1.1	68.5	-0.5
August	81.1	+2.6	93.8	+4.1	68.5	+1.2

Variety Trial and Fertility of Fescue Cultivars in Southeast Kansas

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Summary

In fall 2021, five varieties of fescue were planted at the K-State Research station outside of Columbus, Kansas. The varieties included two endophyte free (E-) varieties, two novel endophyte (NE) varieties, and one endophyte (E+) variety. The varieties were Atlas (E-), Cajun (E-), Bar Optima (NE), Estancia (NE), and K-31 (E+). Three rates of nitrogen were applied in the spring to each variety; 0, 50, and 100 units and each treatment was replicated three times. Due to the drought, measurements were not taken in 2022 but samples were obtained in 2023. The only stress the plots received was lack of moisture as the drought persisted in 2023. These plots were not grazed. Overall, addition of nitrogen increased biomass production in all cultivars evaluated. There was no difference in biomass produced in K-31 fescue between 50 or 100 units of nitrogen. Bar Optima had the greatest response to the additional nitrogen in regard to biomass production. However, as nitrogen increased, the crude protein increased for each variety. When biomass was measured in May, Cajun at both 50 and 100 units of nitrogen had the greatest yield, followed closely by yields with 100 units of nitrogen on Bar Optima and Estancia. Atlas and K-31 fescue varieties at both 50 and 100 units of nitrogen had similar biomass and had the lowest yields of the fertilized treatments. However, for total accumulation through the growing year, varieties fertilized with 100 units of N varieties out-yielded K-31. At 50 units of N the Bar Optima had the lowest total yield.

Introduction

Fescue is a cool season perennial forage that has many uses, primarily in the Southeast United States. This grass was first identified as a “wonder” grass that remained green in Kentucky during the winter. After many producers utilized this forage, they started observing signs of toxicity such as cattle that spent more time in ponds, gains were reduced, cattle had more hair, and pregnancy rates were reduced. Researchers then found the endophyte organism, which is a fungus that has a symbiotic relationship with the fescue plant that makes it very hardy. This fungus can produce toxins called ergot alkaloids, and these lead to symptoms of fescue toxicity. After this fungus was found to be leading to reductions in animal performance, plant breeders worked on removing the fungi from the plant and developed endophyte-free varieties of fescue. When grazing endophyte-free fescue pastures, the cattle performance was enhanced; however, the stand persistence was not as good as with Kentucky-31 fescue. Then plant breeders worked on developing varieties of fescue that had the endophyte organism as it made the plant hardier, but the varieties had an endophyte that did not produce toxins. That is where the name Novel came from. It indicates a fescue plant that has the fungi but does not produce toxins. In general, this variety results in better cattle performance than endophyte-free pastures but the fescue has close to the same stand persistence as endophyte-positive pastures. The balanced goals of stand persistence and cattle performance measures are important, and thus the purpose of this field trial was to determine performance of different varieties of fescue in Southeast Kansas.

Methods

In fall 2021, five varieties of fescue were planted at the Southeast Research and Extension Center Columbus branch. The varieties included two endophyte free (E-) varieties, two novel endophyte (NE) varieties, and one endophyte (E+) variety. The varieties were Atlas (E-), Cajun (E-), Bar Optima (NE), Estancia (NE), and K-31 (E+). Three rates of nitrogen were applied in the spring to each variety; 0, 50, and 100 units and each treatment was replicated three times. Due to the drought, measurements were not taken in 2022 but samples were obtained in 2023. The only stress the plots received was lack of moisture as the drought persisted in 2023. These plots were not grazed. No additional nitrogen was added after the initial spring application. The plots were harvested in May and again in September and measured for forage accumulation.

Results and Discussion

Forage accumulation for each variety that was collected in May is illustrated in Figure 1. There were few quality differences between varieties when sampled in May, but as nitrogen application increased, crude protein values increased across treatments, demonstrating that nitrogen application to fescue directly affects the crude protein value of the plant (Figure 2). Forage accumulation in September is illustrated in Figure 3. Total forage accumulation through the 2023 year is illustrated in Figure 4.

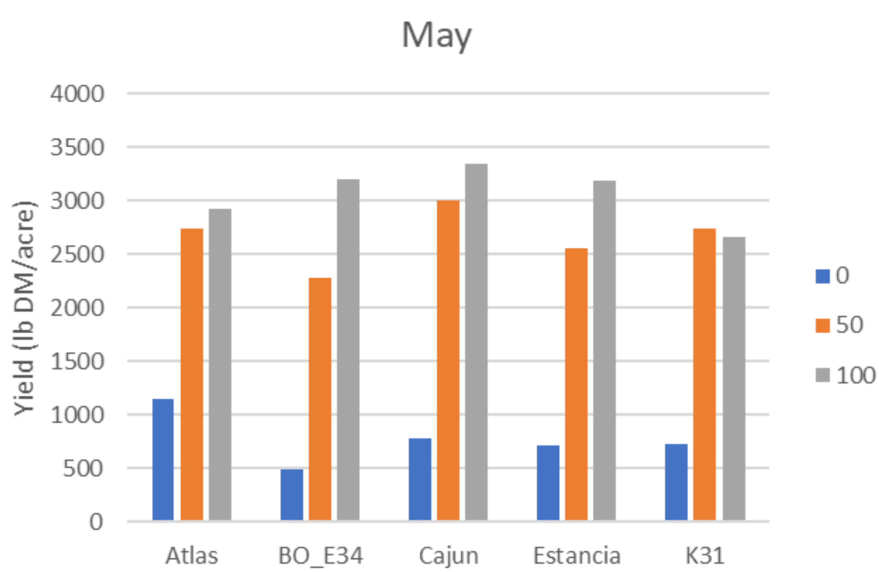

Figure 1. Forage accumulation of 5 varieties of fescue collected in May.
Atlas: endophyte free fescue.
BO_E34: Bar Optima is a novel endophyte fescue.
Cajun: endophyte free variety.
Estancia: novel endophyte fescue variety.
K-31: Kentucky-31 fescue contains the endophyte and often produces ergot alkaloids.
Blue bars are no nitrogen; Orange bars are 50 units nitrogen; Grey bars are 100 units of nitrogen.

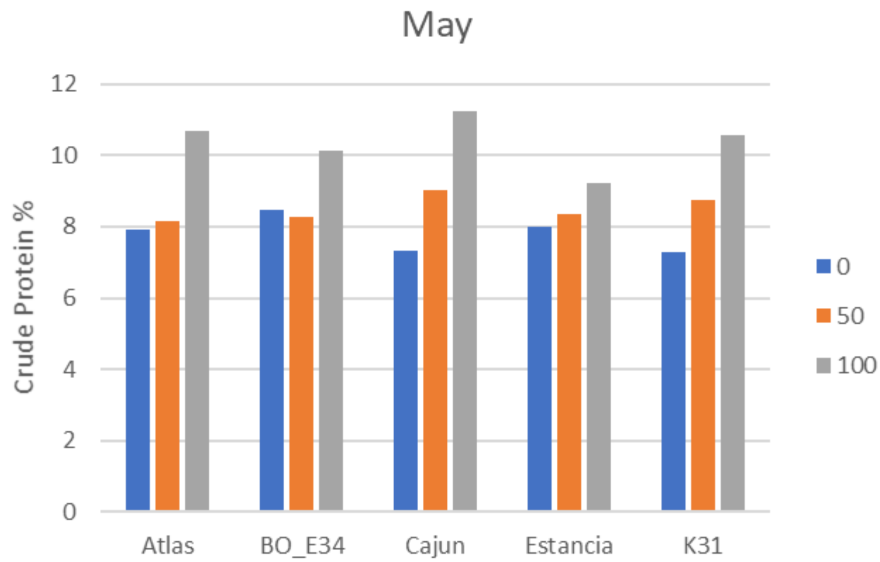

Figure 2. Crude protein of 5 varieties of fescue collected in May.
Atlas: endophyte free fescue.
BO_E34: Bar Optima is a novel endophyte fescue.
Cajun: endophyte free fescue.
Estancia: novel endophyte fescue variety.
K-31: Kentucky-31 fescue contains the endophyte and often produces ergot alkaloids.
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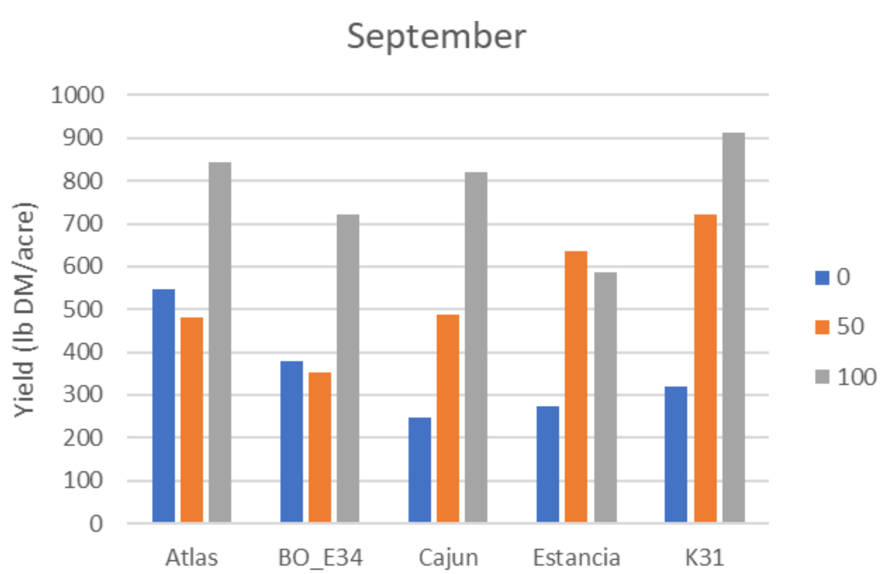

Figure 3. Forage accumulation of 5 varieties of fescue collected in September.
Atlas: endophyte free fescue
BO_E34: Bar Optima is a novel endophyte fescue.
Cajun: endophyte free.
Estancia: novel endophyte fescue variety.
K-31: Kentucky-31 fescue contains the endophyte and often produces ergot alkaloids.
Blue bars are no nitrogen; Orange bars are 50 units nitrogen; Grey bars are 100 units of nitrogen.

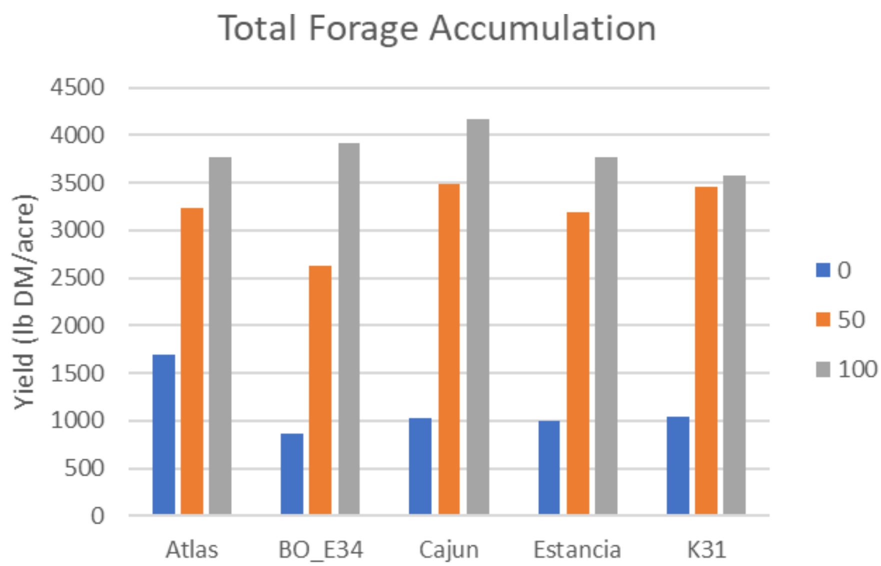

Figure 4. Forage accumulation of 5 varieties of fescue accumulated through a May and September collection.
Atlas: endophyte free fescue
BO_E34: Bar Optima is a novel endophyte fescue.
Cajun: endophyte free.
Estancia: novel endophyte fescue variety.
K-31: Kentucky-31 fescue contains the endophyte and often produces ergot alkaloids.
Blue bars are no nitrogen; Orange bars are 50 units nitrogen; Grey bars are 100 units of nitrogen.

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