Cover Your Acres

Winter Conference

January 18 & 19, 2022

Gateway Civic Center
Oberlin, KS

K·STATE
Research and Extension

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Proceedings from prior years of the Cover Your Acres
Winter Conference can be found online:
www.northwest.ksu.edu/coveryouracres

Presenters

Cody Creech - Dr. Cody Creech is an Associate Professor in the Department of Agronomy and Horticulture and Dryland Cropping Systems Specialist at the University of Nebraska's Panhandle R&E Center in Scottsbluff, NE. He received his B.S. and M.S. degrees from Utah State University and Ph.D. from the University of Nebraska. His research and Extension efforts focus on enhancing agronomic practices to increase profitability, optimizing soil water conservation, and delivering weed management solutions. He serves as the faculty supervisor for the High Plains Ag Lab near Sidney, NE and conducts the majority of his research at that site. He also oversees the statewide variety testing program.

Lucas Haag - Dr. Lucas Haag was raised on a diversified dryland farming and ranching operation near Lebanon, Nebraska along the Kansas/Nebraska line. He received his B.S. in Agricultural Technology Management in 2005 and a M.S. in Agronomy in 2008 from K-State. Lucas completed his Ph.D. in Agronomy in 2013. He is an associate professor of agronomy and Northwest Area Agronomist stationed at the Northwest Research-Extension Center in Colby, Kansas. He has extension agronomy responsibilities for 29 counties in northwest and north-central Kansas and is interim head of the Tribune Experiment Station. He conducts research and extension activities in a variety of areas but specializes in precision ag and intensification of dryland cropping systems.

John Holman - Cropping Systems Agronomist at Kansas State University. John received his B.S. degree in plant science and agriculture business and his M.S. degree in weed science from Montana State University. His Ph.D. is from the University of Idaho. He joined Kansas State University in 2006 and is currently an Associate Professor with a 70% Research and 30% Extension appointment. His research is primarily on dryland cropping systems of western Kansas, with an emphasis in soil-water, crop rotations, integrated weed management, and annual forages. He manages the state-wide forage variety testing program. In addition, he and his wife Marcella, operate a 4th generation cow/calf and farming enterprise near Dodge City, KS.

Jeff Hutton - Jeff Hutton is the Warning Coordination Meteorologist for the National Weather Service office in Dodge City. Mr. Hutton received a Bachelor of Science degree in Meteorology from the University of Oklahoma in 1983 and began his professional career in weather during that same year working for a private firm in Oklahoma City. He joined the National Weather Service in Des Moines, Iowa in 1989. A native of Dodge City, Mr. Hutton was selected as one of the first forecasters at the modernized weather office in Dodge City in early 1992. He was selected as the Warning Coordination Meteorologist at the Dodge City office in 1994, a position he has held since.

Sarah Lancaster - Sarah Lancaster began as an Assistant Professor and Extension Specialist in the Kansas State University Agronomy Department in November 2019. Sarah was raised on an integrated crop and livestock farm in east central Missouri and earned a BS in Plant Science from the University of Missouri. Sarah completed her graduate studies at North Carolina State University and Texas A&M University, then held teaching, research, and extension positions at Oklahoma State University, University of Florida, and Missouri State University prior to joining the faculty at Kansas State University. Sarah is responsible for Extension programming in agronomic crops in Kansas and leads a team that conducts research in corn, cotton, grain sorghum, soybean, sesame, and wheat.

Dorivar Ruiz-Diaz– Dr. Dorivar Ruiz Diaz is a soil fertility and nutrient management specialist at Kansas State University. He holds a Ph.D. in soil fertility from Iowa State University and MS in soil fertility from the University of Illinois at Urbana-Champaign. He does research and extension work on the efficient use of fertilizers, phosphorus and micronutrient management, and land application of by-products with an emphasis on crop–available nitrogen. He also oversees the K-State soil testing laboratory which provides analysis services for farmers, homeowners, and research-extension personnel.

Presenters

Matalyn E. Stark - Matalyn E. Stark is an Area Resource Soil Scientist for Kansas NRCS. She is stationed in Hays and provides technical soil services to 27 counties in Western Kansas. Matalyn's assistance includes topics such as soil conservation, soil health, soil investigations, and wetland conservation. She is passionate about soil health and soil outreach, and she is available to present to a diverse range of audiences. She is a graduate from Cornell University with a B.S. in Agricultural Science with minors in soil science, crop production and management, and education.

Jordan Steele- Jordan Steele is an Extension Agricultural Economist with Kansas Farm Management Association, NW assisting members with accurate record keeping and financial analysis. Jordan grew up on a Wyoming cattle ranch then attended the University of Wyoming to obtain a Bachelor's Degree in Agricultural Business in 2010 and a Master's Degree in Agricultural Economics in 2012. Steele enjoys working with NW Kansas farm families to develop and maintain profitable agri-businesses.

Peter Tomlinson- Peter Tomlinson - Peter Tomlinson is an Assistant Professor and Extension Environmental Quality Specialist for Kansas State University. He received B.S. degrees in Animal Science and Agronomy from the University of Connecticut and M.S and Ph.D. degrees in Crop, Soil and Environmental Sciences from the University of Arkansas. Peter's passion for agriculture began as a 4-Her and motivates his current research and extension programs addressing the complex environmental challenges facing agriculture. Drawing on his diverse background in animal science, manure management, agronomy, soil science and ecology Peter conducts applied research and extension programing in the areas of soil biology, nutrient management, and soil, water and air quality.

Mark Wood - Mark Wood is an Extension Agricultural Economist with the Farm Management Association in Northwest Kansas. He has been assisting Association member families with record keeping, analysis, management and generational transfer issues in Northwest Kansas for over 28 years. He graduated from North Dakota State University with a Master's degree in Agriculture Economics in 1986 and Kansas State University with a Bachelor's degree in Agricultural Economics in 1982. Mark grew up on a farm near Wakefield, Kansas.

Dale Younker - Dale grew up on a diversified farm near Hays, Kansas and received his Bachelors of Science degree in Agriculture from Fort Hays State University. He has worked for Kansas NRCS in Western Kansas for the last 34 years has been in his current position as the Soil Health Specialist since 2014. His primary responsibility is to provide technical assistance on cropping systems that improve overall soil health to NRCS field staff and producers across western Kansas. Dale also owns and operates a farm in Ellis and Rush County, Kansas where he uses a diverse and intensive no-till cropping system that includes several different cash crops along with cover crops. He and his two sons also operate a custom farming business in Ellis and surrounding counties.

Anthony Zukoff - Anthony is the Entomology Extension Associate at the Southwest Research and Extension Center in Garden City, Kansas. He is a graduate of Georgia Southern University and holds an M.S. degree in Biology. Anthony began his agricultural entomology career in 2009 at the University of Missouri and subsequently with the USDA Agricultural Research Service. He joined the staff at Garden City in 2013 working on insect resistance management of spider mites and western corn rootworm. His extension programming is focused on all things insect-related with an emphasis on current and emerging pest issues facing crop production in western Kansas.

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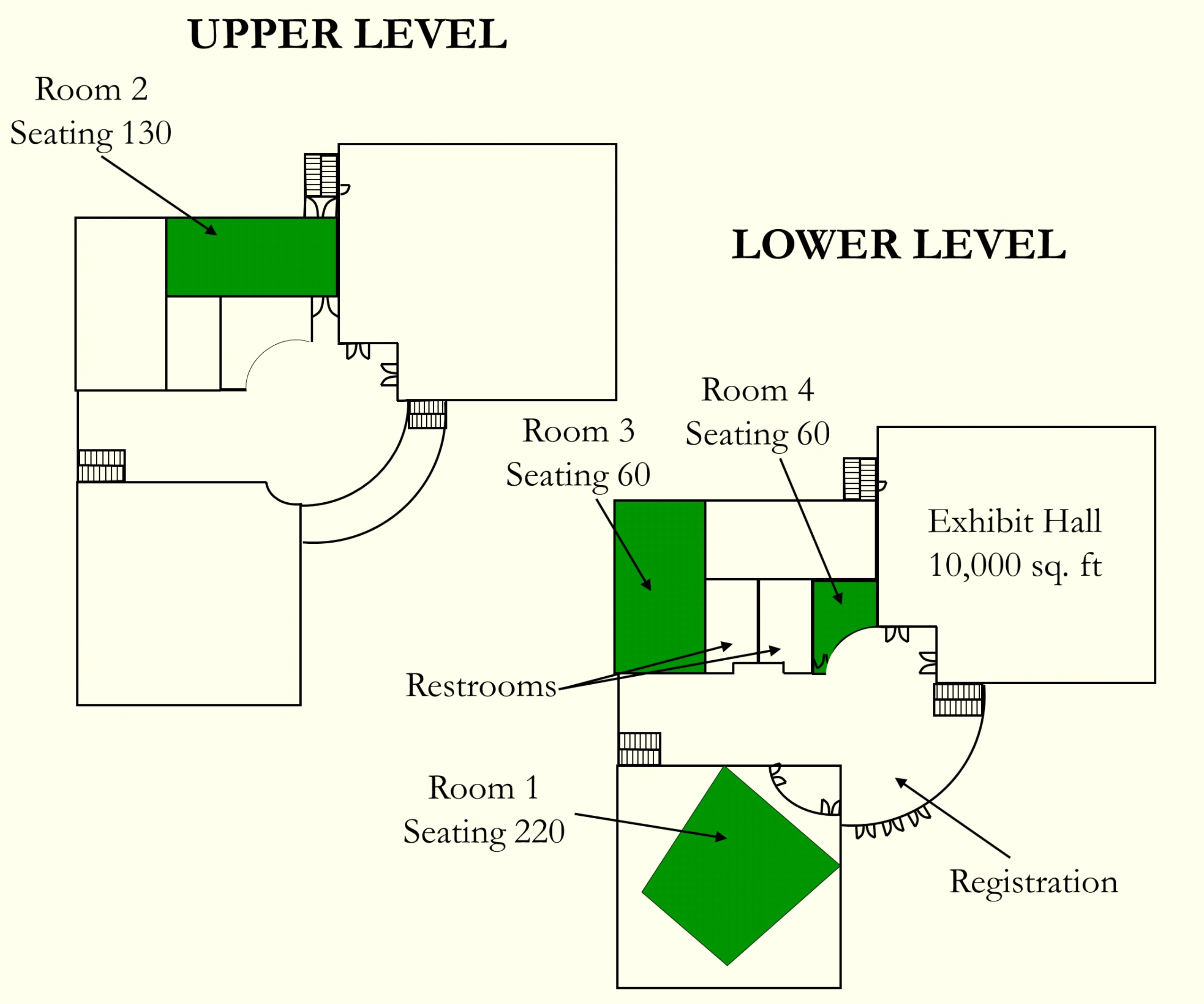

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Changing Strategies in Insect Management

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A variety of ongoing resistance issues are necessitating new management approaches and regulation changes in the corn growing regions of the United States, including Kansas. Meanwhile, new resistance issues are on the horizon for Kansas alfalfa production. A combination of new technology, modified regulations and strategic IPM may help to combat these problems in the new year and moving forward.

A need for diversified corn rootworm management

Genetically modified corn has been a valuable tool for managing corn rootworm losses in continuous corn operations throughout the country since the mid 1990's. These modified corn plants produce insecticidal toxins from the bacterium *Bacillus thuringiensis* (Bt) which kill corn rootworm larvae as they feed on root tissue. Field-evolved resistance to Bt corn was first documented in Iowa in 2009 to one particular Bt toxin. To date, resistance has expanded to other areas of the corn belt and resistance to all commercially available Bt toxins has been documented. A combination of strategies including crop rotation, Bt hybrid rotation and planting non-Bt corn with soil applied insecticides will be important for preserving the efficacy of Bt toxins in areas where they are still working. The introduction of a new insecticidal trait in 2022, RNA interference (RNAi) will provide another approach for corn rootworm management across the corn belt (Figure 1), while emerging data from long term studies in multiple regions show promise for the use of entomopathogenic nematodes (EPNs) as effective tools to manage corn rootworm larvae and reduce root damage (Figure 2).

EPA proposes changes to Bt regulations to combat resistance in various lepidopteran pests

Since the introduction of Bt traits to control lepidopteran pests of corn, resistance has been documented in corn earworm, fall armyworm and western bean cutworm in various regions of the United States. Working with researchers from academia and industry, the EPA has proposed changes to current Bt regulations that are intended to help slow the spread of resistance in these pests. Modifications to current refuge-in-a-bag (RIB) blends, phasing out certain Bt corn hybrids and establishing unexpected injury thresholds for the rapid detection of resistance are expected to be implemented in the future. Some highlights of the proposal are explained below.

1. Unexpected injury (UXI) threshold established for Bt corn.

For corn expressing Vip3A traits, a resistance investigation will be triggered when 10% of ears (30 ear sample) have second instar larvae (corn earworm or western bean cutworm) or an exit hole and 60 damaged kernels (2 kernels/ear). For corn expressing the Cry2 trait, an investigation will be triggered when, 50% of ears (30 ear sample) have second instar corn earworm larvae or an exit hole and 600 damaged kernels (20 kernels/ear).

2. Sentinel plots and rapid resistance detection.

In an effort to rapidly detect resistance issues, corn sentinel plots will be established and monitored for unexpected injury in high risk regions of the corn belt. Additionally, industry must report unexpected injury to the EPA for each state within 1 year of occurrence.

3. Increased refuge in seed blends

The currently registered 5% RIB products will be allowed to expire at the end of their registration time frame and then be transitioned to a 10% RIB blend when re-registered.

4. Phasing down Bt traited corn

Single trait corn hybrids used in the corn belt will be phased out over 3 years once proposals are implemented. Pyramid corn hybrids will have registration times shortened to 3 or 5 years depending on the combination of traits.

Pyrethroid resistance in Kansas Alfalfa Weevils

Alfalfa weevil control issues and field failures have been common in states west of the Rocky Mountains since 2015. These problems have been attributed to the appearance of resistance to lambda-cyhalothrin, a commonly used pyrethroid. This resistance was documented in northeast Colorado in 2019 and subsequently verified in Oklahoma and western Kansas in 2020. The most recent data from Oklahoma indicates continued reduced efficacy of lambda-cyhalothrin in 2021, however other commonly used pyrethroids as well as indoxacarb (Steward) continue to be effective for alfalfa weevil control. Reports of repeated use of indoxacarb in Kansas alfalfa fields raise concerns for the eventual reduced efficacy of that product. Producers should be vigilant for alfalfa weevil control issues and practice proper IPM strategies, including proper rotation of products to maintain their usefulness for as long as possible.

An end to chlorpyrifos (Lorsban) in 2022

A final ruling made by the EPA in August will remove the organophosphate insecticide chlorpyrifos as an option for agricultural pest control nationwide. This final rule was effective as of October 29, 2021 and the tolerances for all commodities expire on February 28, 2022.

After the tolerances are revoked, sale and distribution of chlorpyrifos products labeled for use on food crops would be considered mislabeled, making it a violation of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) to sell and distribute those products. Additionally, new applications of chlorpyrifos will result in any food or feed that is treated to be considered adulterated and unfit to be distributed.

Chlorpyrifos, known to many as Lorsban, is a broad-spectrum insecticide which kills insects upon contact by disrupting the function of the nervous system. Nationally, the use of this pesticide has been declining for the last decade and in 2020, Corteva Agriscience announced it would end production of the chemical. In Kansas, chlorpyrifos has been used to control insect pests in all major agricultural commodities.

Aside from various pyrethroid insecticides, there are other effective chemicals with different modes of action that will be available to control the pests that chlorpyrifos once did (Table 1). Chlorantraniliprole (Vantacor, previously Prevathon), indoxacarb (Steward), flupyradifurone (Sivanto), sulfoxaflor (Transform) and afidopyropen (Sefina) are more selective and have less impact on beneficial insects such as pollinators and those that are important for keeping pest populations in check. Please refer to the most recent Insect Management Guides for specific control information. Most importantly, in order to maintain the efficacy of these products, be sure to practice proper rotation, as repeated use of one product or the same mode of action will ultimately lead to the evolution of resistance in our pest populations.

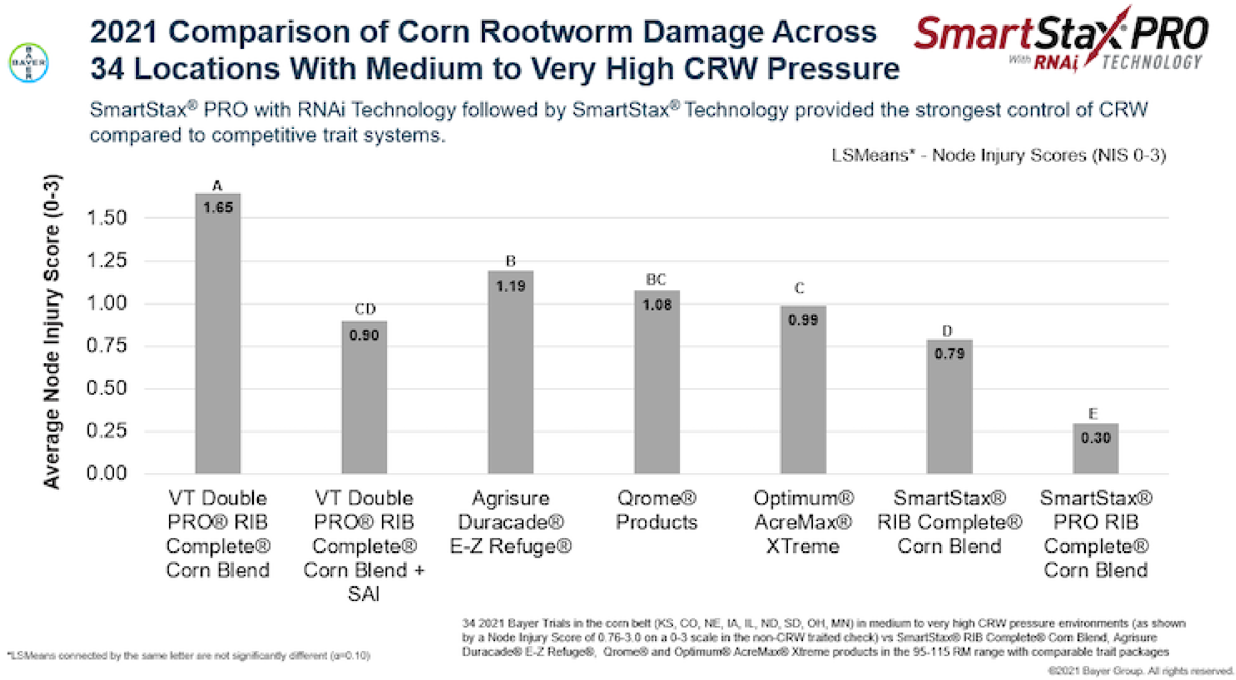

Figure 1. Data provided by Bayer illustrates a significant increase in root protection provided by the new RNA interference trait in areas of medium to high rootworm pressure.

EPN - CRW efficacy since 2016
34/35 Traited Corn (Herculex) (NY)

Year	No EPNs (0-3 Root Ratings)	+ EPNs (2014) (0-3 Root Ratings)	Damage Reduced
2016	0.2	0.2	0%
2017	No CRW	Pressure	
2018	0.7	0.1	86%
2019	1.1	0.2	82%
(Drier Soil)	1.9	1.0	47%
2020	1.1	0.2	81%
(Drier Soil)	1.4	0.3	79%

Figure 2. Long term studies have shown the ability of persistent entomopathogenic nematodes (EPNs) to significantly reduce corn rootworm damage in Bt corn. Data courtesy of Dr. Elson Shields, Cornell University.

Table 1. Additional registered products to include in rotations with existing organophosphate and pyrethroid insecticides for pest control in Kansas crops. For more specific information relative to any insecticide, always refer to the actual label on the product. *FIFRA 2(ee) valid until 2026 or until withdrawn. **supplemental label expires July 1, 2022 ***supplemental label expires October 31, 2023

Chemical Name	Trade Name	Mode of Action Class	Crop	Pests Controlled (see labels for details)
chlorantraniliprole	Vantacor	28	alfalfa	army cutworm, grasshoppers
				alfalfa caterpillar, beet armyworm, fall armyworm*
				true armyworm, European corn borer, southwestern corn
			corn	borer, fall armyworm, western bean cutworm
				grasshoppers
				bollworm
				corn earworm, fall armyworm
			cotton	sorghum webworm, grasshoppers
			sorghum	corn earworm, green cloverworm
				saltmarsh caterpillar, grasshoppers
			soybean	sunflower moth, grasshoppers
				true armyworm, fall armyworm
			sunflower	grasshoppers
			wheat	
indoxacarb	Steward	22	alfalfa	alfalfa weevil, alfalfa caterpillar, beet armyworm,
				grasshoppers
			corn	true armyworm, corn rootworm adults, European corn borer,
				southwestern corn borer, fall armyworm, western bean
				cutworm, grasshoppers
				fleahopper, bollworm
			cotton	corn earworm, green cloverworm, grasshoppers
			soybean	
flupyradifurone	Sivanto	4D	alfalfa	aphids, potato leafhopper
			sorghum	sugarcane aphid, greenbug
			soybean	soybean aphid
sulfoxaflor	Transform	4C	alfalfa	aphids**
			sorghum	sugarcane aphid
			soybean	soybean aphid
			wheat	greenbug, Russian wheat aphid
afidopyropen	Sefina	9D	cotton	whitefly, aphids
			sorghum	aphids***
			soybean	soybean aphid

References:

Gassmann, A.J. Resistance to Bt Maize by Western Corn Rootworm: Effects of Pest Biology, the Pest–Crop Interaction and the Agricultural Landscape on Resistance. Insects 2021, 12, 136.

Memorandum: EPA's Response to Comments Received on the September 9, 2020 Draft Proposal to Address Resistance Risks to Lepidopteran Pests of Corn and Cotton Containing the *Bacillus thuringiensis* (Bt) Plant-Incorporated Protectant (PIP) and Revised Framework for Industry Negotiations. November 2021

Elson, Shields Persistent Entomopathogenic Nematodes for Corn Rootworm Control. 2021. Cornell University

Rethwisch, M.D. et al. Insecticide Resistance in Alfalfa Weevil and Related Implications in other Alfalfa Insect Pests. Proceedings, 2019 Western Alfalfa and Forage Symposium, Reno, NV, Nov.19 – 21, 2019. UC Cooperative Extension, Plant Sciences Department, UC, Davis.

Seuhs, Kelly. Update on Alfalfa Weevil Insecticide Resistance Study. Oklahoma State University EPP-20-24. July 2021.

Current Financial Status of Northwest Kansas Farms and Comparison of Land Lease Options

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Current Financial Status of NW Kansas Farms written by Jordan Steele

Using Kansas Farm Management Association NW data, we portray net farm incomes from 2000-2020 then attempt projecting 2021 and 2022 data. There have been several peaks and valleys in the past twenty years, but the past four years have been fairly steady all with $100,000+ net farm income for the average farm. However, looking forward is a different story thanks to rising crop prices the end of 2020 and into 2021; the accrual change in inventory prices should have a large positive effect on net farm income for 2021. The rising input prices in the second half of 2021 may eat away those profits in 2022. There are several reasons for input costs rising which we will not discuss, just the price impacts on our local farmer's bottom line.

Figure 1 below shows the value of farm production components for KFMA farms since 2000, notice how the crop income has moved to the majority.

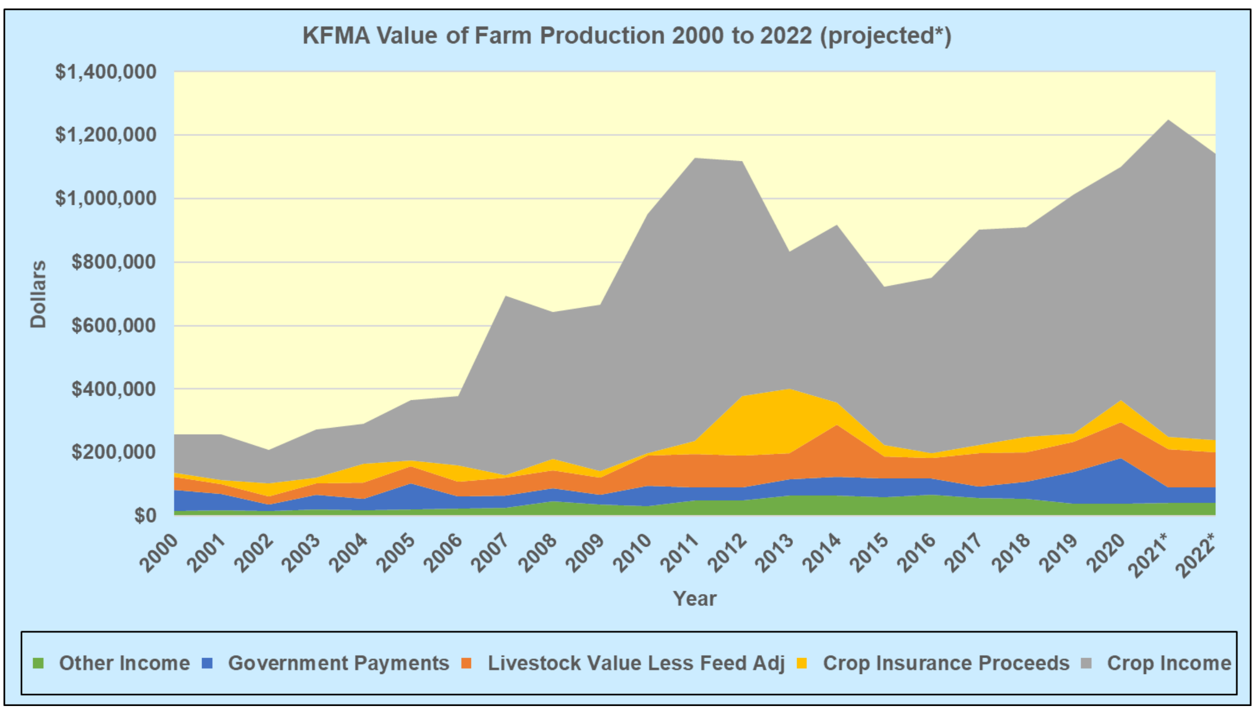
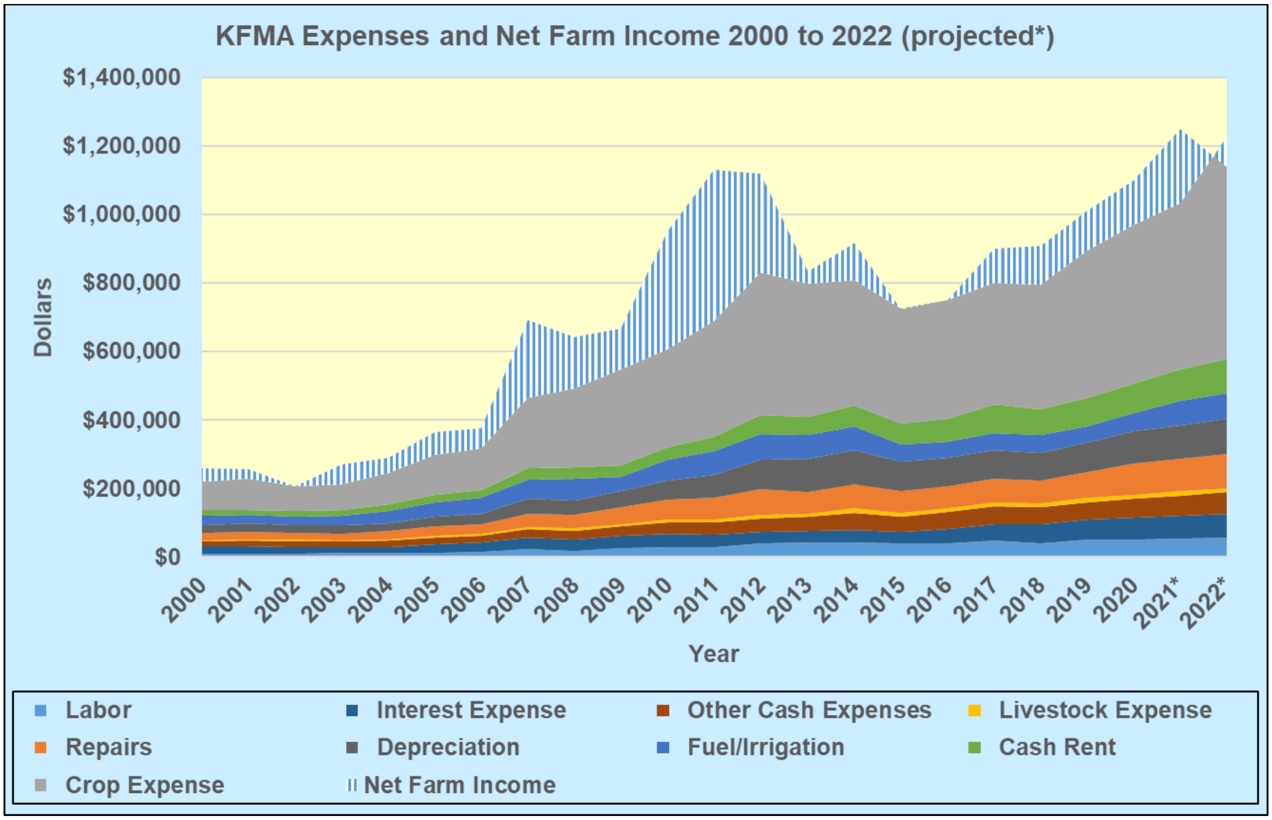


Figure 2 below displays the expense components for KFMA farms since 2000. Once again notice there is a general increase in all expense groups over time but crop expenses have assumed the majority. The shaded area on top represents net farm income, which will then show the same area chart as the previous figure because value of farm production minus expenses will equal net farm income (or loss!?).



Family living expense for the average KFMA farm was $91,403 in 2020 and averages $104,044 for the prior ten years. It is important to understand net farm income is reported before unpaid operator labor so farm profits need to meet these demands before business reinvestment and debt payments. It will be important for producers to know every expense, on and off the farm, in the upcoming years to make sound decisions to ensure profitability even with inflated input costs.

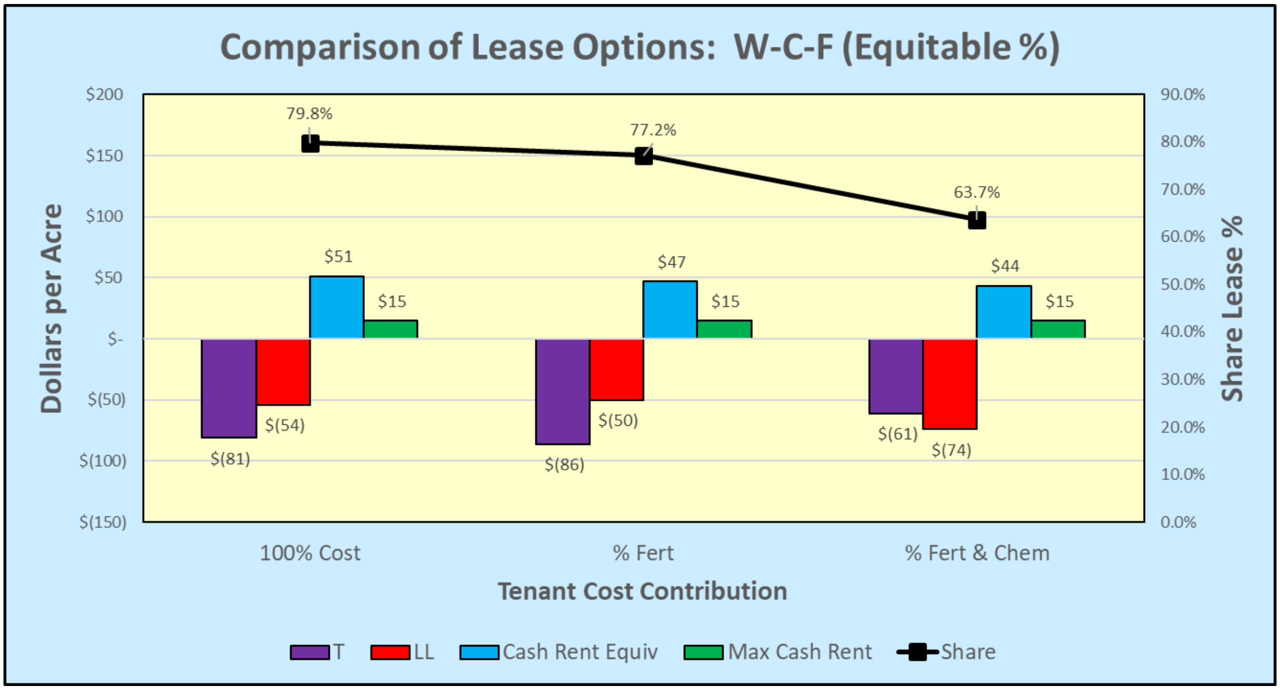
Comparison of Lease Options written by Mark Wood

The relationship between landlord and tenant should be an equitable, profit or (loss) sharing arrangement. The actual arrangement can vary greatly, but the results should be equitable. This presentation utilizes the KSU-Lease spreadsheet available on AgManager web site (https://www.agmanager.info/land-leasing/land-rental-rates/ksu-lease) to evaluate different crop rotations and cash lease equivalents using estimated cost of production facing producers in 2022. Seed, crop insurance, and equipment costs were increased 10%, over the 2020 KFMA, NW enterprise analysis. There will be increases in 2021, but those results are not available yet. In general, these increases reflect those found in the KSU crop budgets. Fertilizer is increased in the budgets by 250% and chemicals are increased by 200% for our analysis. Irrigation fuel also increased from 2020, but the change should be limited from 2021 to 2022. Natural gas prices/cost increased nearly 200% in 2021 as compared with 2020.

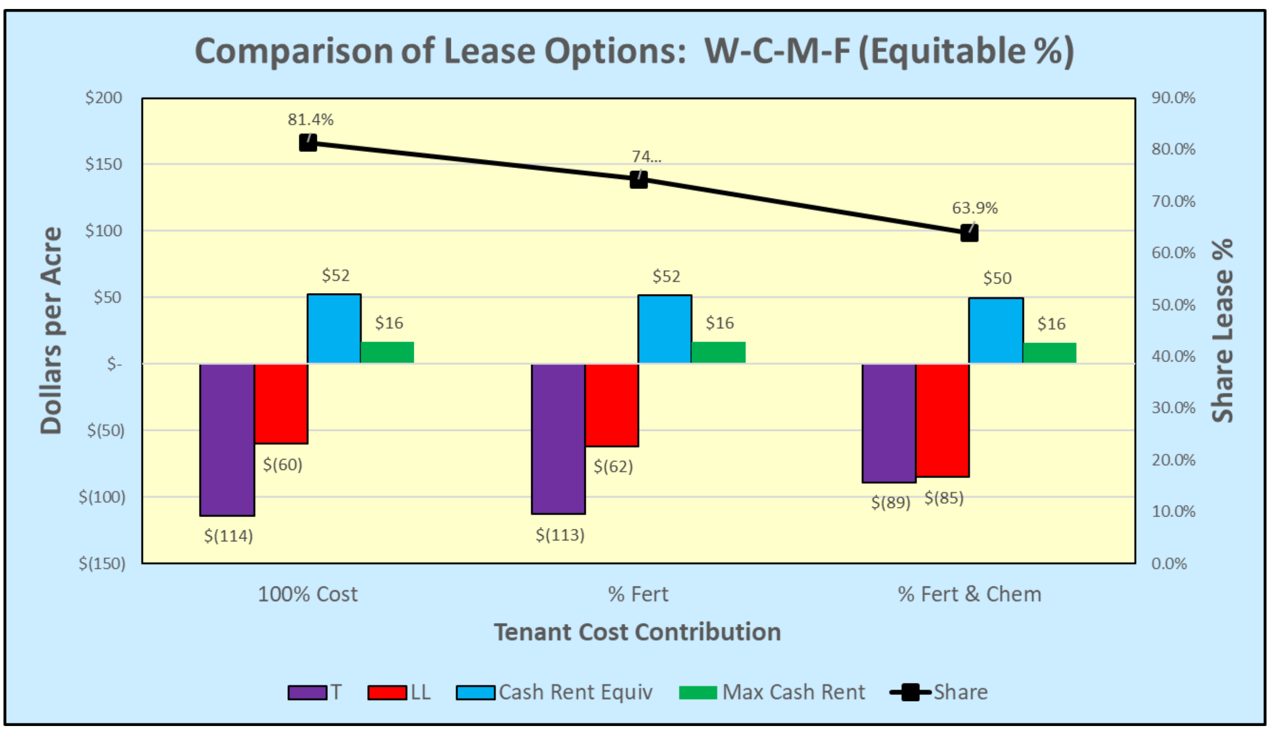
There are varieties of scenarios presented for discussion at Cover Your Acres. These include non-irrigated rotations: Wheat-Corn-Fallow (W-C-F), Wheat-Corn-Milo-Fallow (W-C-M-F), Wheat-Corn-Milo-Beans (W-C-M-B) for areas further east in Kansas, such as Phillips and Smith Counties. Irrigated enterprise rotation is limited to a Corn-Corn-Soybean (C-C-B) sequence. There is a comparison of lease rates if the Landlord or the Tenant owns the sprinkler system. This would represent a more of a full irrigation program. Limited water rotations are not included this presentation, but could be run through a KSU-Lease spreadsheet for your farm using your projections. These are only examples for discussion purposes and your specific farm operation will have different rotations and costs from these budgets. It is wise to evaluate your own farm situation yourself.

The charts displayed on the following pages show an "equitable" share lease percentage based on shared expenses. Each scenario had three options: 1) Tenant pays all expenses, 2) Tenant and Landlord share fertilizer on equitable share rate, and 3) Tenant and Landlord share both fertilizer and chemicals at the equitable share rate. Obviously, when the tenant pays a larger share of the input costs, the tenant should receive a larger share of the crop income. Casual observation indicates that "traditional" lease arrangement frequently are unwilling to "flex" the shares to reflect the real cost sharing structure and equitable sharing in profits. These issues will be discussed at our meeting.

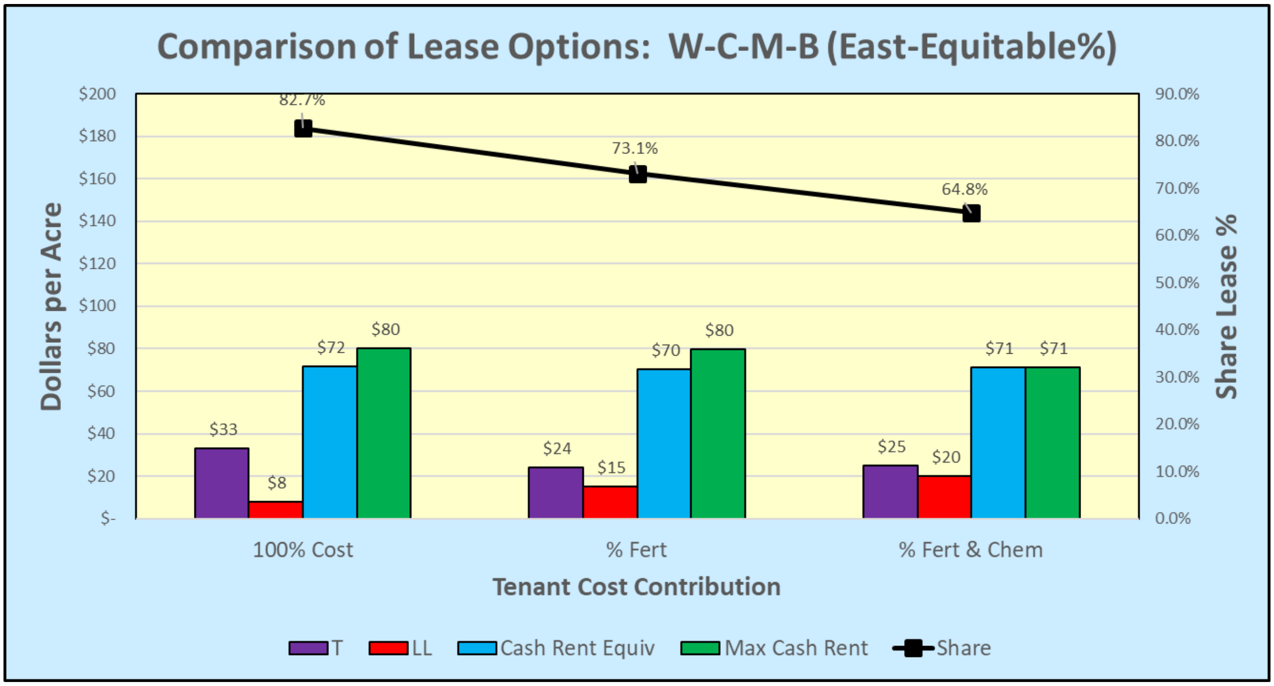
Wheat – Corn – Fallow (W-C-F)



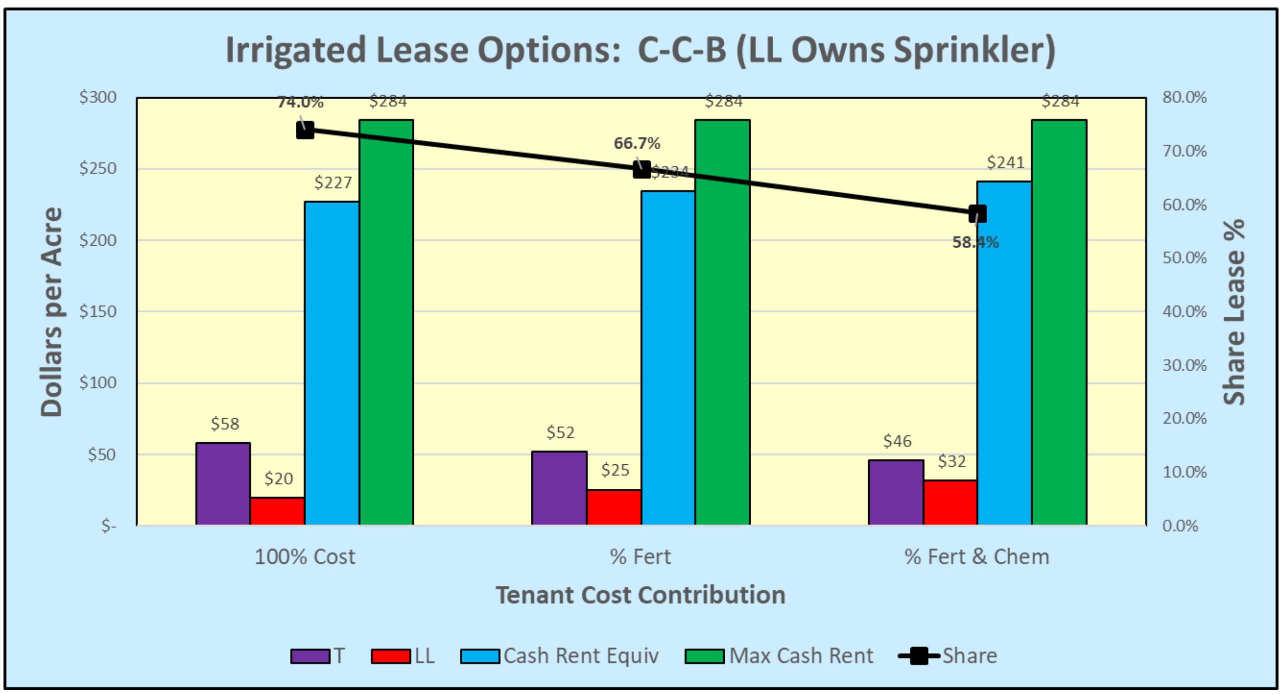
Wheat-Corn-Sorghum-Fallow (W-C-M-F)



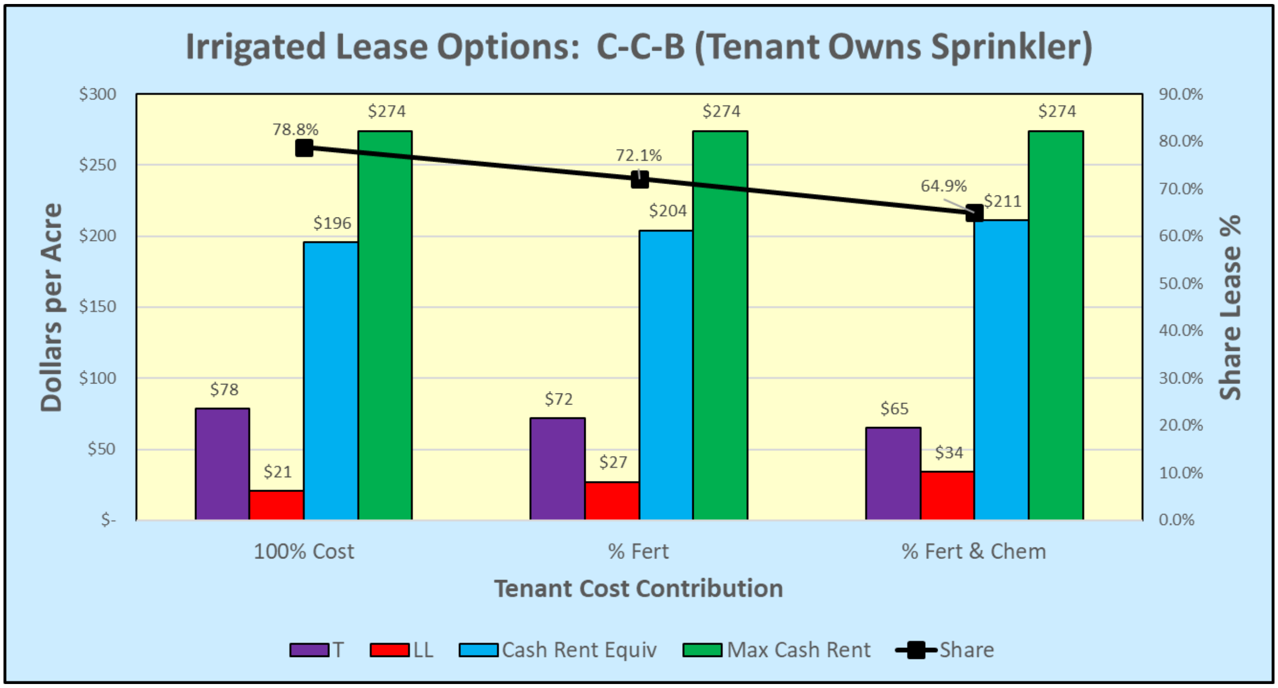
Wheat-Corn-Sorghum-Soybean (W-C-M-B)



Corn-Corn-Soybean (C-C-B), landlord owns the sprinkler system



Corn-Corn-Soybean (C-C-B), tenant owns sprinkler



Economics of Soil Fertility Management and Soil Testing

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Current Situation

Crop nutrient recommendations over the years have generally not included crop and fertilizer price as explicit inputs into the decision. Relatively stable relationships of the price ratio of grain to plant nutrients have not necessitated a need until recent years. Grain:nutrient price ratios for nitrogen and phosphorus on a monthly time step since December, 1985 are presented in Figures 1 and 2 for corn and wheat, respectively. The most notable feature in both figures is the grain:phosphorus ratio during the time period of March through September of 2008 when DAP at the Gulf of Mexico was trading near or above $1,000/ton.

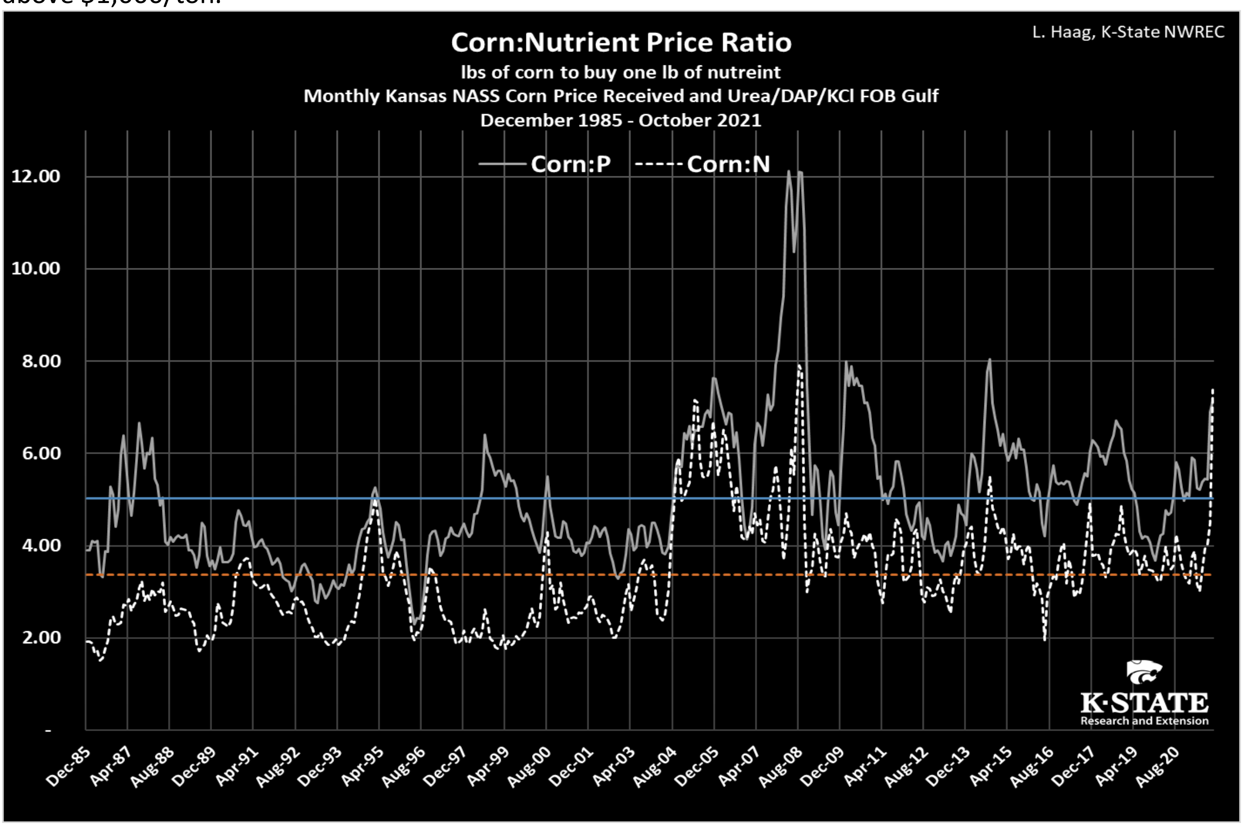


Figure 1. Corn:Nutrient price ratios for nitrogen and phosphorus, December 1985-November 2015.

In late 2016 we saw another peak in phosphorus prices relative to grains. Today, we are seeing the highest wheat:nitrogen price ratios 2008. The average wheat:phosphorus ratio since December of 1985 has been 4.05, while in November of 2021 that ratio was 5.43. The average corn:phosphorus ratio has been 5.02, while in November of 2021 that ratio was 7.26. The grain to nitrogen ratio for corn and wheat are significantly above their long-term averages with corn at 8.99 compared to an average of 3.36 and wheat at 6.73, compared to a long-term average of 2.70.

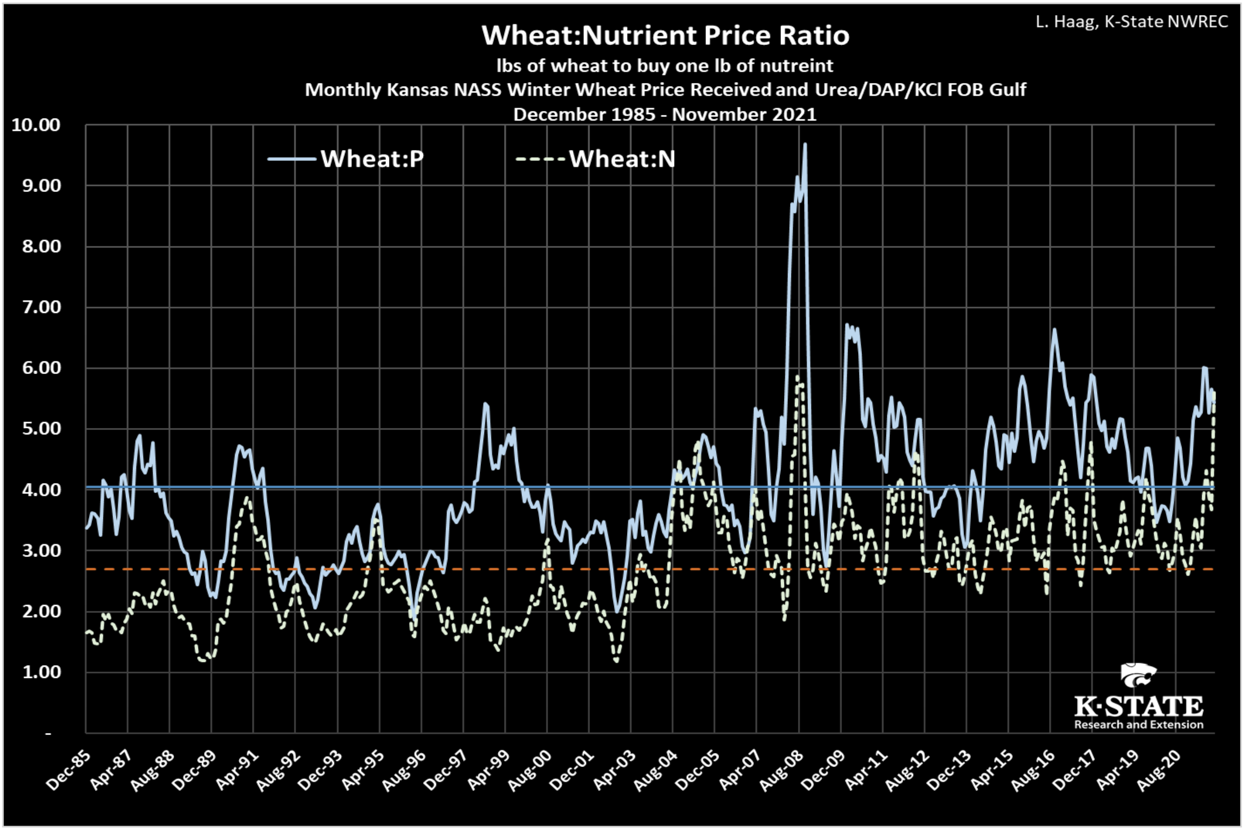


Figure 2. Wheat:Nutrient price ratios for nitrogen and phosphorus, December 1985-November 2015.

The current grain:nutrient price ratios and logistical limitations on fertilizer availability pose significant challenges for the 2022 growing season. Farmers cannot afford to use nutrients inefficiently. Determining appropriate application rates and selecting application methods that minimize loss and maximize effectiveness is essential.

Understanding Crop Response

Crop yield response to the addition of fertilizer is determined in large part by the previously existing soil nutrient supply. Murrell and Bruulsema (Figure 3) show the response to fertilizer additions for A) low, B) medium, and C) high soil test levels of a given nutrient (could be N, P, K, S, etc.). At low soil test levels, panel A, one would expect low yields without additional fertilizer. Note that under low soil test conditions, the range of economically optimal rates is relatively narrow, i.e. the optimum rate is minimally affected by grain:nutrient price ratio. Under medium soil test levels, panel B, the expected yield without fertilizer is higher than in low soil test conditions and the range of potentially optimal fertilizer rates is wider. In other words, on medium soil testing soils, in a single-year decision framework, the optimal rate is much more sensitive to grain:nutrient price ratios. As the price ratio increases, the optimal rate declines to the lower end of the range, as the price ratio decreases, the optimal rate increases to the upper end of the range. Under high soil test conditions, where nutrient levels in the soil are sufficient for maximum attainable yields, we would not expect to see a response to added fertilizer as shown in panel C.

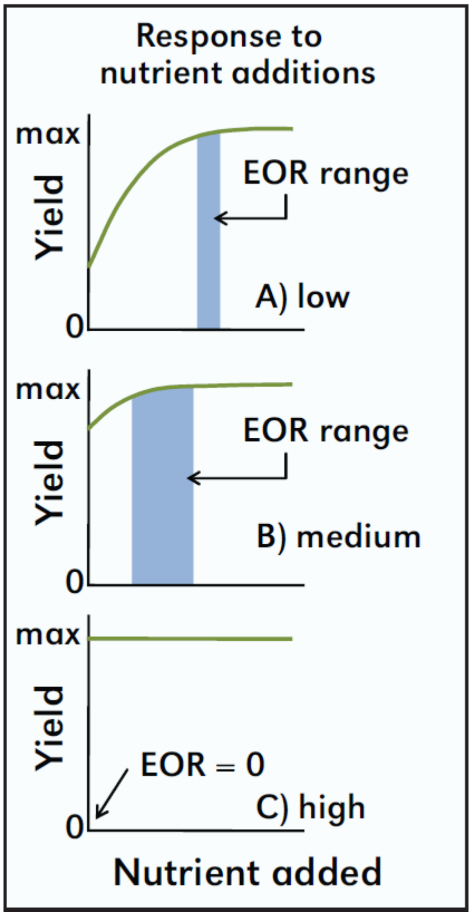


Figure 3. Conceptual model of crop response to soil nutrient supply for A) low, B) medium, and C) high soil test levels. The shaded areas below the curves represent the range of short-term economically optimum rates based on grain:nutrient price ratios. (Murrell and Bruulsema, 2008)

Economics of Soil Testing

Higher price ratios increase the potential profits from soil testing at the field or subfield level. In the absence of soil test information some assumption must be made on the nutrient status of the soil. For example, in K-State's nitrogen recommendations, if a producer doesn't know the nitrate nitrogen in the 24" profile, a default value of 30 lbs/ac is assumed. Many producers likely apply the "usual" fertilizer rates from a combination of occasional soil tests and experience. Kastens and Dhuyvetter (2005) used data collected in Northwest Kansas to develop a simulation of 10,000 fields in a typical wheat-corn-fallow rotation. A portion of that analysis was to evaluate the change in profit as actual soil test nitrate and soil test phosphorus varied in comparison to an assumed value. Updating this analysis with current prices produces Figures 4 and 5. As shown in Figure 4, as actual soil test nitrate drops below the assumed value of 40 lb/ac, profits in wheat and corn are reduced by approximately $2.50/ac when there is actually 20 lb/ac in the profile and $13/ac when there is essentially no nitrate in the profile. These reductions in profit would be attributed to nitrogen deficiency induced yield reductions. As soil test nitrate values exceed the 40 lb/ac assumption, again, profits are reduced due to the cost of applying unneeded nitrogen.

Similar results are shown for soil test phosphorus (Figure 5). As actual soil test level drops below the assumed value of 16 ppm Bray1P or Mehlich III, profit for wheat and corn is reduced due to phosphorus deficiency induced yield reductions. Conversely, as actual soil test levels rise above the assumed value of 16 ppm, profits are reduced due to the cost of unneeded phosphorus application. The above scenarios give some indication on the potential profitability of soil sampling to identify fields and areas within fields that are both greater than and less than the soil test value for N and P that might otherwise be assumed for making nutrient recommendations.

Soil Testing Data Quality

Investing in a soil testing program requires expense in the forms of sampling equipment, sampling labor, and laboratory fees. The largest challenges to obtaining high quality soil testing data are within the process of physically obtaining the soil sample in the field. Maintaining a consistent and appropriate sampling depth is critical to obtaining a lab result that is consistent with its intended use in nutrient recommendations, i.e. if the recommendations are based off a 6" sample, it's important to have a lab result representative of cores taken to a depth of 6". In long-term no-till this becomes especially important as nutrient stratification, especially with respect to phosphorus and soil pH, creates a strong gradient across the shallow depths of the soil profile. In a highly stratified field, collecting a soil core that is 1" short or 1" long can affect lab results and nutrient recommendations.

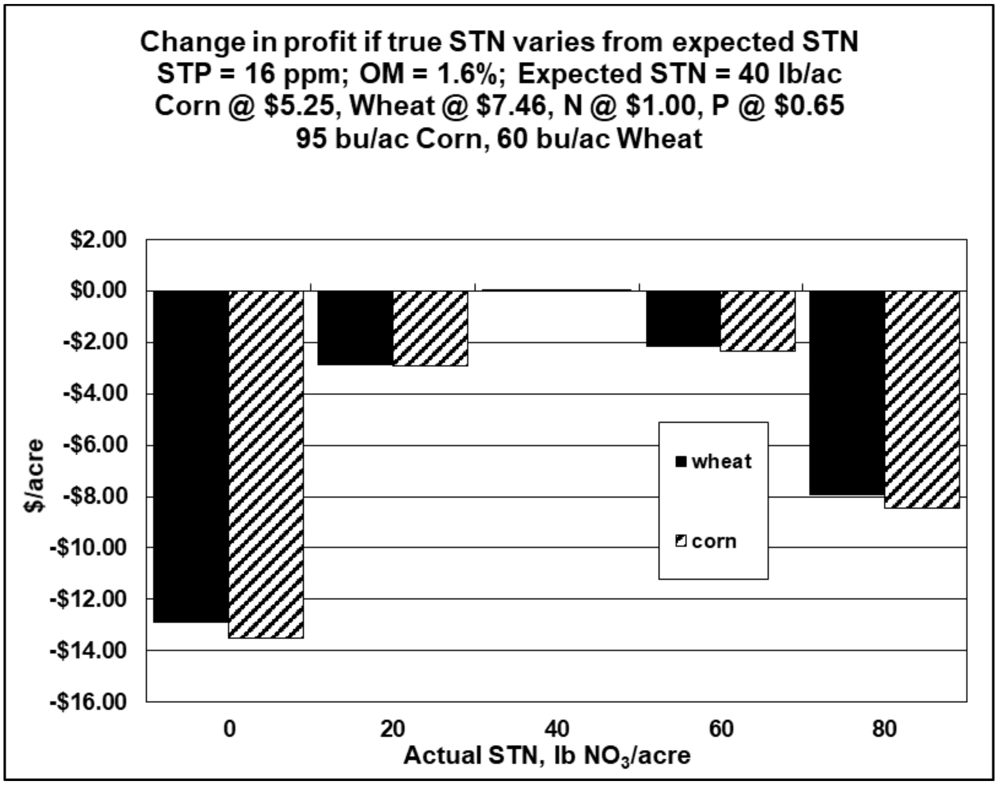


Figure 4. Change in profit if true soil test nitrate (STN) varies from expected STN in a NW Kansas W-C-F rotation.

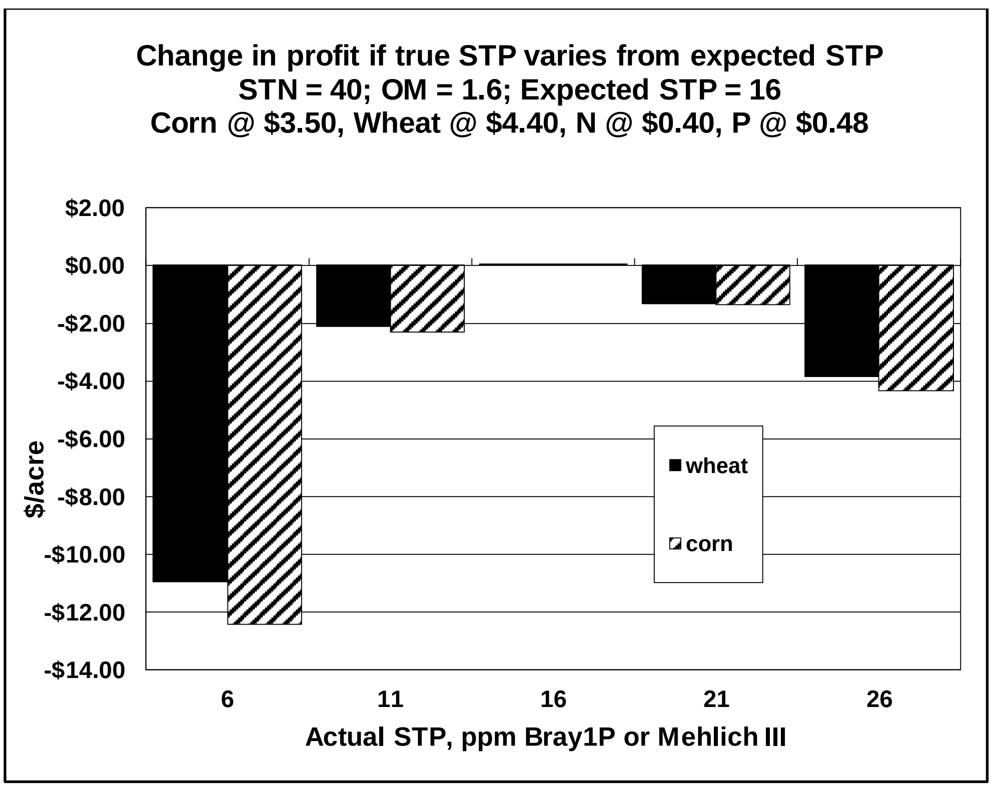


Figure 5.Change in profit if true soil test phosphorus (STP) varies from expected STP in a NW Kansas W-C-F rotation.

The second main consideration is obtaining a sample consisting of an adequate number of cores to minimize the variability induced by small scale spatial variability in the field. The more cores used to comprise a sample the less influence any one core has on the overall mean. This is important to counteract the effects of small scale spatial variability both from natural soil processes as well as manmade variability, such as that created by banding fertilizer or grazing livestock. Previous work in phosphorus sampling has shown that a minimum of 15 cores is a reasonable number to minimize sample error without dramatically affecting labor requirements (Figure 6). The marginal costs of collecting 15 cores vs. 10 appears to be relatively minor for the increase in data quality.

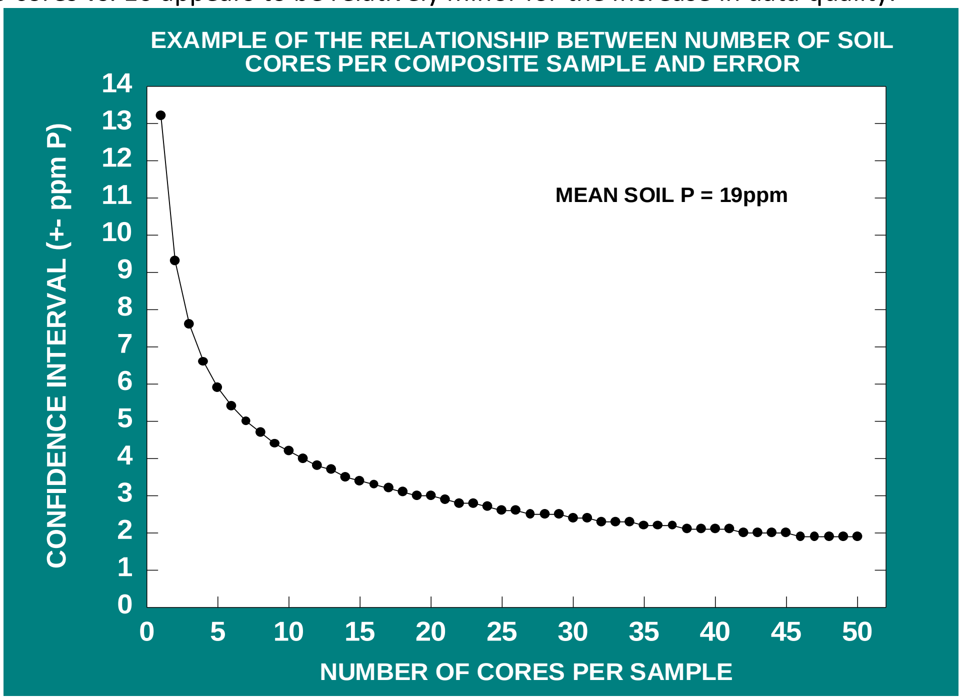


Figure 6. Confidence interval around a lab result for STP as a function of cores comprising the sample.

Economics of Nitrogen Timing and Placement

The new K-State corn and sorghum nitrogen recommendations make the fertilizer efficiency factor more explicit. This allows us to do some economic comparisons of different levels of fertilizer efficiency. In general, for the practices used in Kansas, we would expect fertilizer efficiency (the percentage of N applied that is taken up by the plant) to range from 55 to 70%. The lower end of that range would be typically be associated with fall applications done in a way that is more subject to loss, e.g. surface application of urea, or application of NH_3 in dry, poor sealing conditions. The upper end of the range would be associated with planting time applications that are injected below the soil surface, or split-applications where some of the nitrogen is applied in-season via side-dress or fertigation. Differences in fertilizer efficiency can substantially affect fertilizer costs to achieve the same yield. When less efficient application methods are used, it takes more lbs of fertilizer to attain the same grain yield. This is illustrated in Figure 6, a limited-irrigation corn example using current prices.

In this example, broadcast fall-applied urea, with a fertilizer efficiency of around 55% Figure 7. Nitrogen cost differences as affected by fertilizer efficiency factor for a limited-irrigation corn example would require 250 lbs of applied N to meet a 235 bu/ac yield goal resulting in a cost of $243/ac. Using injected UAN, or split-applying through fertigation, would increase the fertilizer efficiency factor to 70%, resulting in a N recommendation of 195 lb/ac at a cost of $189/ac. The economic difference between these two methods comes to $53/ac.

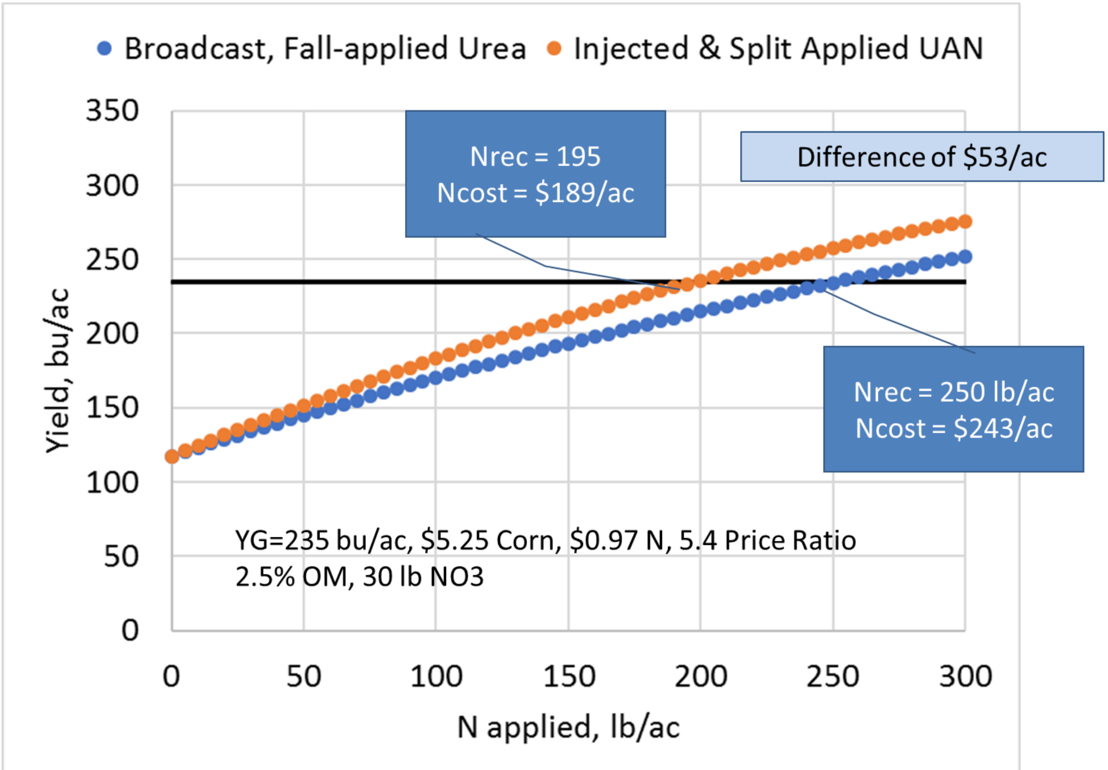


Figure 8. Nitrogen cost differences as affected by fertilizer efficiency factor for a limited irrigation corn example.

Nutrient Sources

Under the current economic conditions, it's important that producers compare all available forms of plant nutrients on a pound for pound basis. Liquid and dry forms of plant nutrients are equivalent as long as their application method accuracies and efficiencies are comparable. There can be a tendency to consider nutrient products advertised has having "enhanced efficiency" or "plant availability" whereby the producer can cut back on rates of actual nutrient applied due to these characteristics. Producers should always do the math on the nutrient analysis and weight/acre application rate of the product to compare the product on a pound for pound basis. Ortho vs. polyphosphate fertilizers are often a topic of discussion in this regard. While most orthophosphate fertilizers allow higher concentrations to be placed near the seed due to their lower salt concentration, there is effectively no difference in plant availability as polyphosphates convert to orthophosphates (the form absorbed by plants) within a matter of days depending upon soil moisture and temperature conditions.

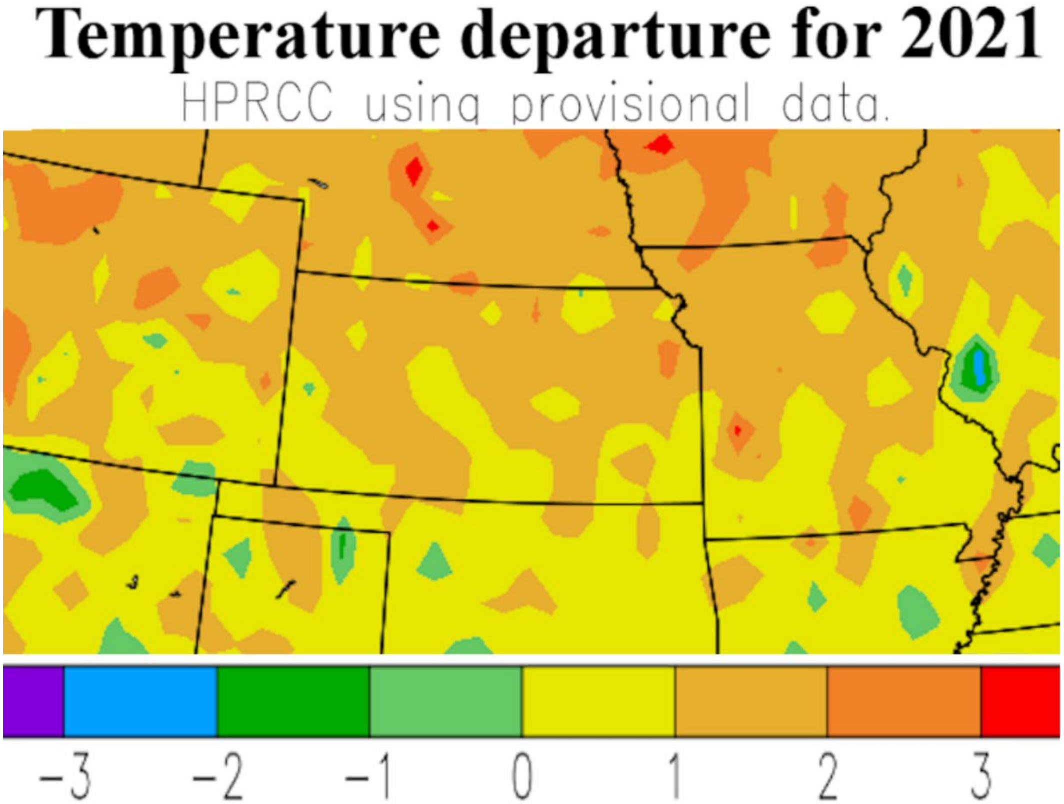
Summary:

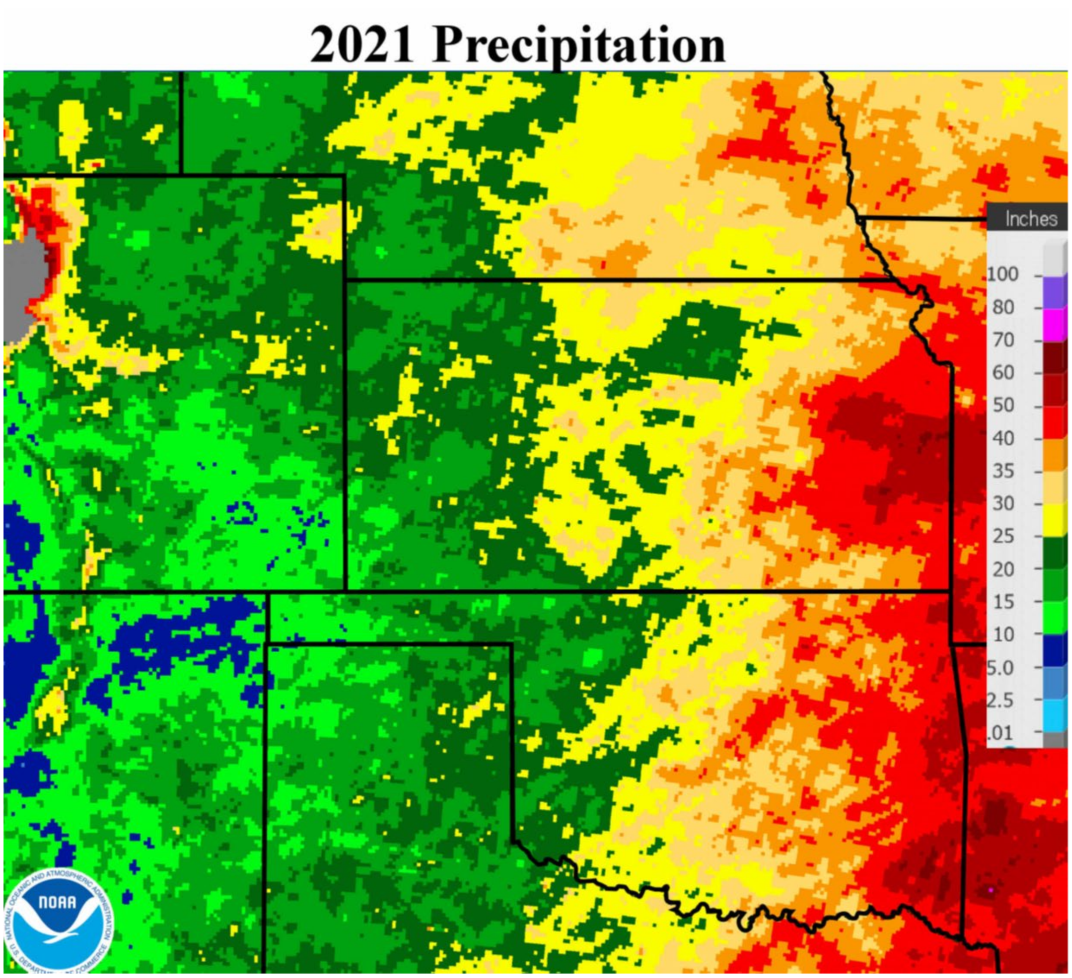
It's important to remember that higher grain:nutrient price ratios do not change the amount of N or P removed by a crop from the soil. Higher price ratios do however increase the potential profitability of adopting more efficient methods of fertilizer application and/or implementing a soil sampling program for determining optimum fertility rates, provided that the sampling program collects data of good quality.

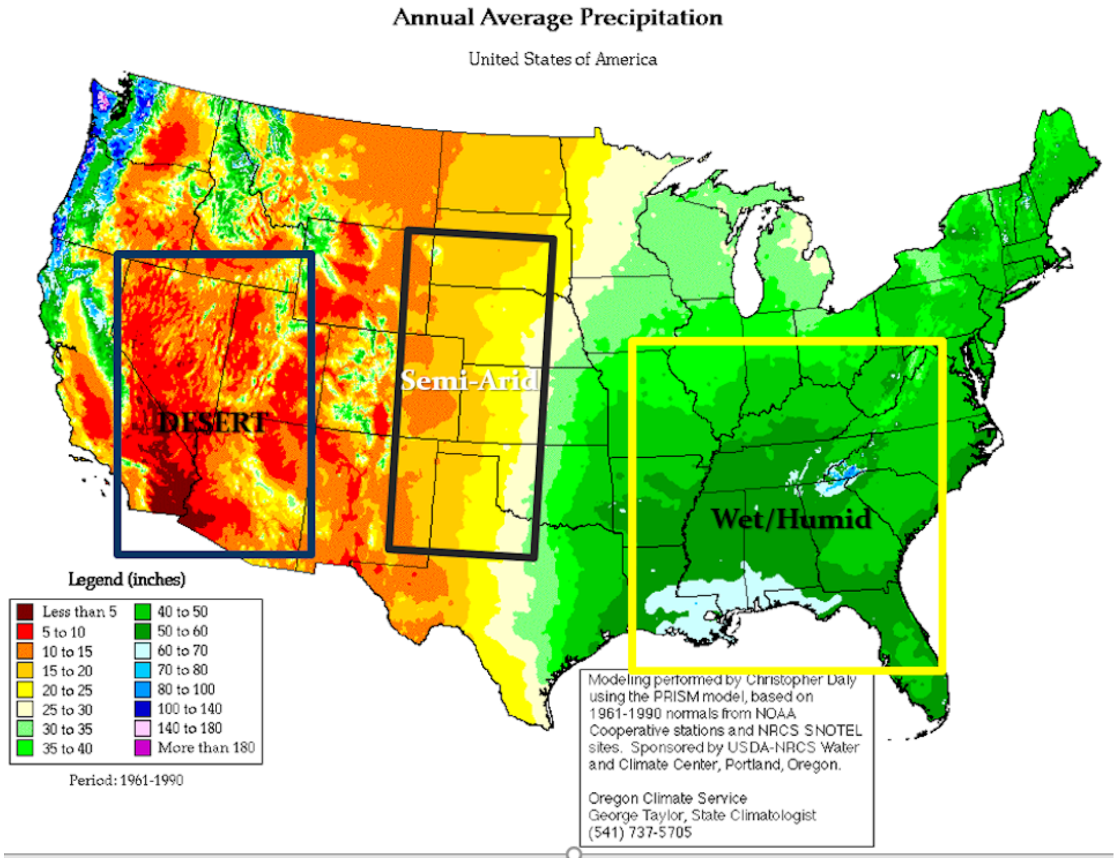
Meteorologist Jeff Hutton will be discussing the weather and climate of the high plains. The weather pattern of 2021 has little to do with what may happen this year (2022), specifically what will occur during the growing season. He will discuss the why not.

What goes up must come down. Similarly, wet periods will be offset by dry periods. It is a case of "laws of average". Will there be beneficial growing weather this season? Are we due for a very dry year? How about extreme heat? In this presentation, the following will be discussed:

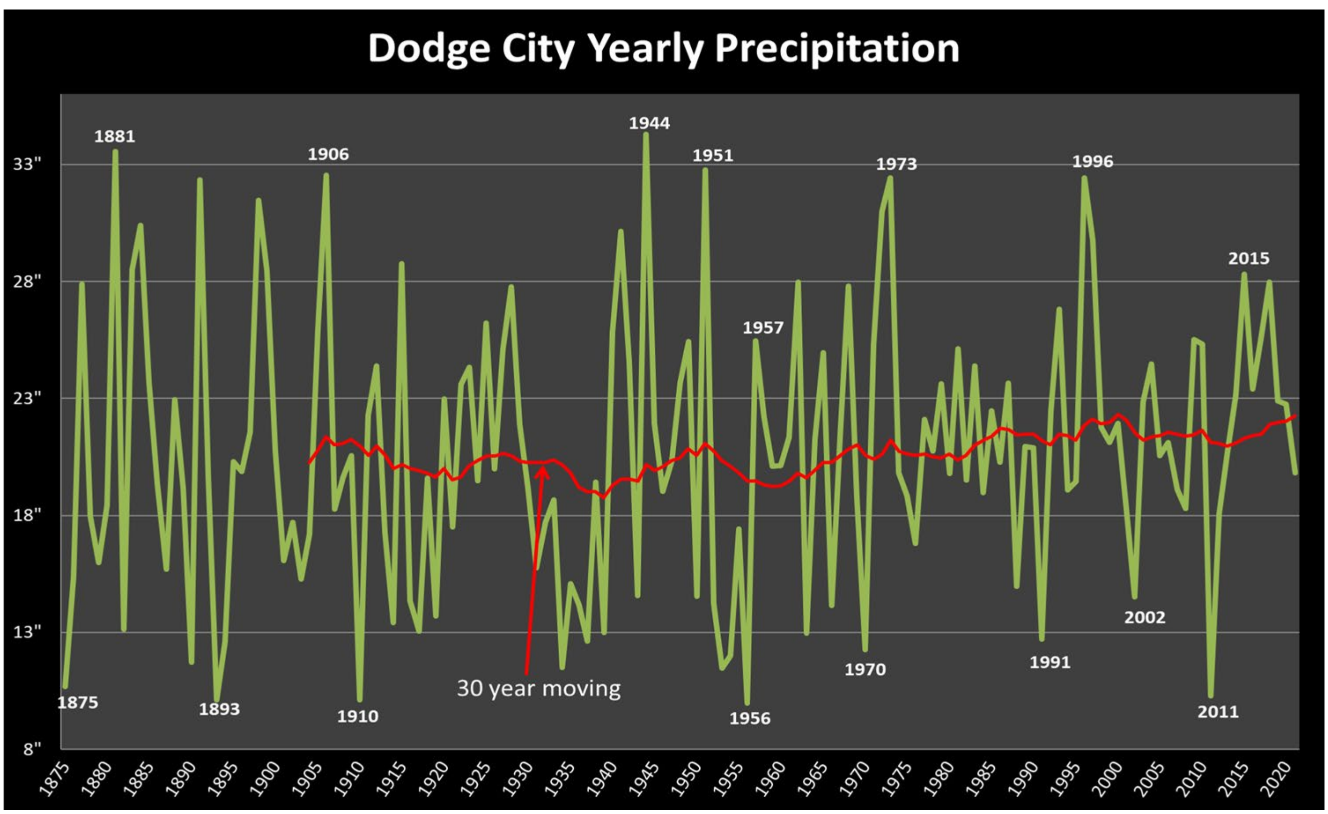
- Past weather for 2021
- Discussion on Kansas Climate
- Weather and Climate Variability
- Dynamic Weather Prediction
- Weather and Climate Mis-information
- The Outlook for 2022


Temperature departure for 2021
HPRCC using provisional data.
-3
-2
-1
0
1
2
3


2021 Precipitation
Inches
100
80
70
60
50
40
35
30
25
20
15
10
5.0
2.5
.01
NOAA



Annual Average Precipitation
United States of America
DESERT
Semi-Arid
Wet/Humid
Legend (inches)
Less than 5
5 to 10
10 to 15
15 to 20
20 to 25
25 to 30
30 to 35
35 to 40
40 to 50
50 to 60
60 to 70
70 to 80
80 to 100
100 to 140
140 to 180
More than 180
Period: 1961-1990
Modeling performed by Christopher Daly using the PRISM model, based on 1961-1990 normals from NOAA Cooperative stations and NRCS SNOTEL sites. Sponsored by USDA-NRCS Water and Climate Center, Portland, Oregon.
Oregon Climate Service
George Taylor, State Climatologist
(541) 737-5705



Dodge City Yearly Precipitation
33"
28"
23"
18"
13"
8"
1881
1906
1944
1951
1973
1996
2015
1957
2002
1875
1893
1910
1956
1970
1991
2011
30 year moving
1875 1880 1885 1890 1895 1900 1905 1910 1915 1920 1925 1930 1935 1940 1945 1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020

Dynamic Weather Prediction

- Theoretically, the laws that govern the physics of weather are fairly simple.
    - Every particle in the atmosphere should be predictable as long as we know the position of all those particles and how fast they are moving.
- Unfortunately, the number of molecules in the atmosphere is around <u>100</u> tredecillion or 1 with 44 zeros following.
- To make perfect weather predications, we would have to account for all those molecules, plus solve equations for all 100 tredecillion of them at once.

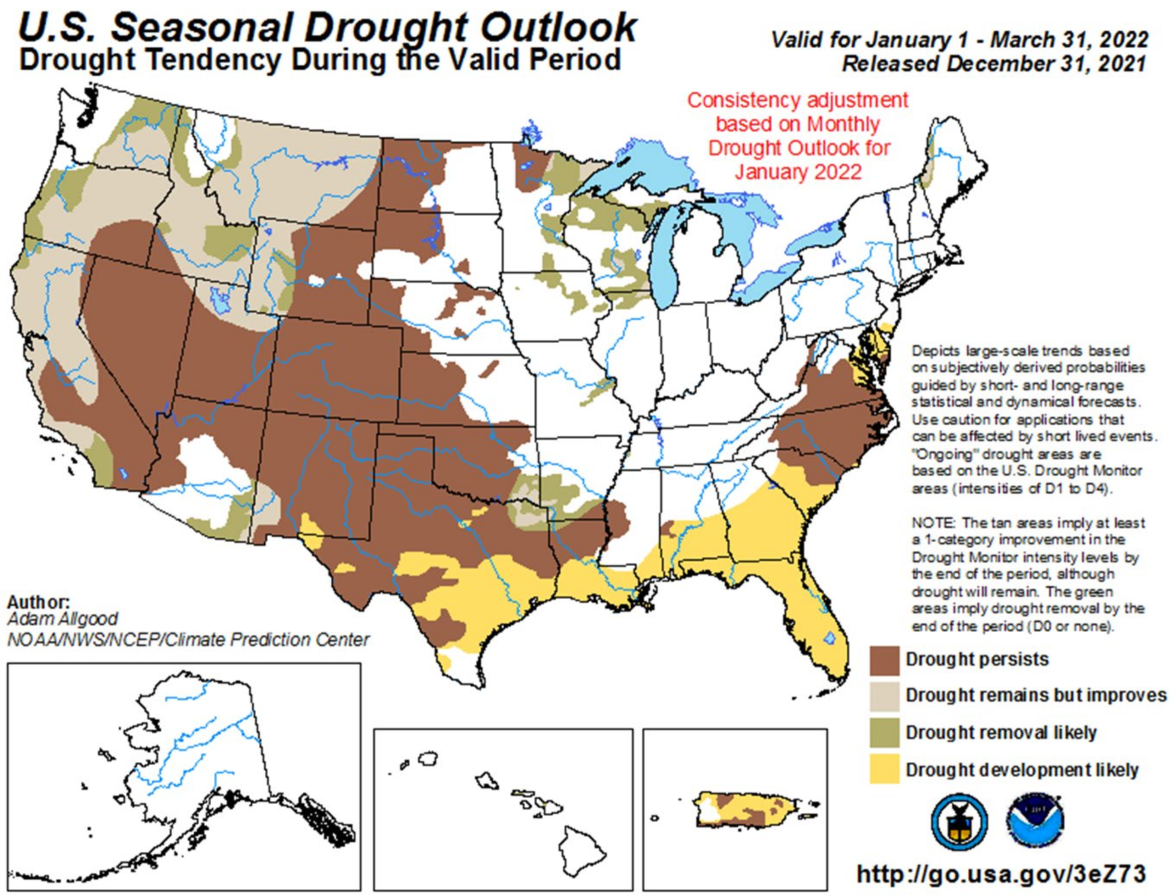
The Mis-information train – Especially thru Social Media

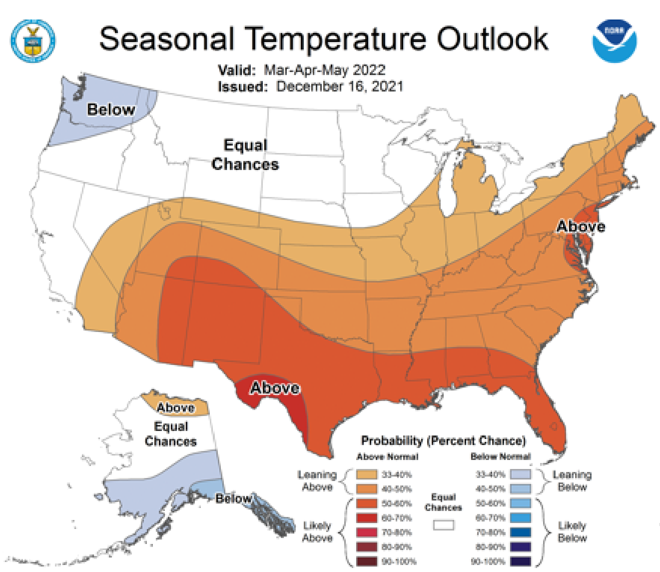
What should you believe? Any of it?

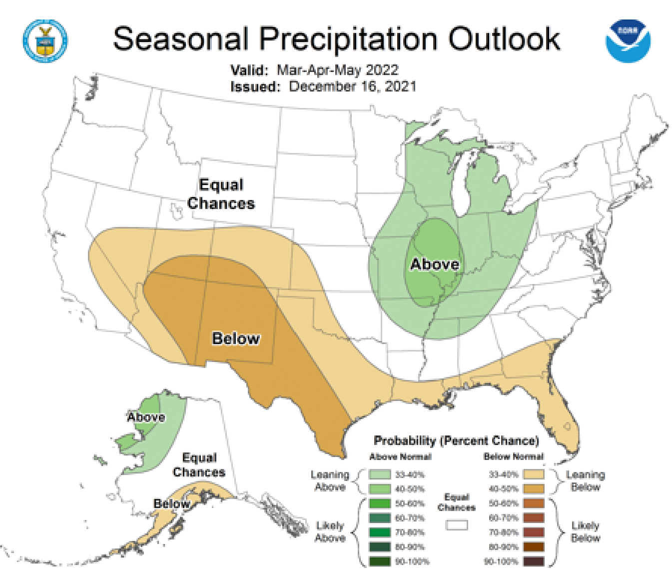
Sharing of computer forecast model data and maps could lead to confusion of what is to be expected - factual or fiction. Computer model output can be vastly different each time forecast elements are derived.

What might be the best source? Trust your source.

The outlook for 2022







What Jeff Hutton will be looking for…

- The "new" pattern set up this fall around October 5
  - Weather features repeat on a specific time period
- Orientation of the Jetstream has been important
- Location of troughs and ridges have been important
  - Will those locations benefit the region or be detrimental?
- Where will amplification continue to take place (geographical)
- Most importantly, where will the location(s) of atmospheric "forcing" continue to be located at?
- Cycle length and impacts have been hard to discern this year.

The source :

swkswx.blogspot.com

YIELD AND PROFIT MAXIMIZING ANNUAL FORAGE ROTATIONS IN THE CENTRAL GREAT PLAINS

J.D. Holman[1], A.K. Obour[2], Y. Assefa[1], Logan Simon[2], and P.S. Mauler[1]

Abstract

Forage-based rotations with greater forage nutritive values and efficient resource utilization are needed to increase forage availability in the central Great Plains. The objectives of the current study were to quantify forage yield, nutritive value and net return from individual crops and overall crop rotation sequence of winter triticale [×*Triticosecale Wittm*. ex A. Camus (Secale ×Triticum)], forage sorghum [*Sorghum bicolor* (L.) Moench], and spring oat (*Avena sativa* L.). The study was conducted near Garden City, KS from 2013 - 2020. There were six treatments including; continuous sorghum (S-S) no-till (NT), triticale sorghum-sorghum-oat (T/S-S-O) reduced till (RT) and NT, triticale/sorghum-sorghum-sorghum-oat (T/S-S-S-O) RT and NT, and triticale-sorghum-oat (T-S-O) NT. Results showed crude protein concentration was 23-31% greater for T-S-O and T/S-S-O compared with S-S. The S-S treatment had greater fiber content and least digestibility, Ca, and P concentrations compared with the remaining forage rotations. Annualized cost of production was 9-32% greater for forage sorghum dominated NT systems [T/S-S-S-O, S-S (NT)] compared with T-S-O and T/S-S-O (RT) rotation. T/S-S-S-O (RT) was among the top in net return and nutritive value due to greater forage sorghum biomass production. We concluded forage producers should consider productivity and market value, in addition to nutritive value and cost of production in selecting crops for a profitable forage-based rotation system.

Introduction:

Integrating annual forages into traditional grain crop rotations increased productivity, weed control, water use efficiency, and soil health. A forage-based cropping system can lower cost of production and provide more stable net return than continuous grain cropping. Even though forage rotation systems are advantageous compared with grain-only based systems; forage productivity, nutritive value, and cost of production varies by forage species and information is limited for which forage crop and crop rotation sequence optimizes nutritive value and net return in the central Great Plains.

Forage sorghum, oat, and triticale are among the most adapted annual forages in the central Great Plains. Forage sorghum is an annual warm-season crop, drought- and heat-tolerant, and adapted to semi-arid regions of the world. Triticale is an annual cool season crop with winter hardiness and high forage nutritive value, and it is a better alternative to wheat grown for forage in the Great Plains (Holman et al., 2010, 2021). Like triticale, oat is a cool-season crop grown for forage and it is highly nutritious as livestock feed. A rotation of warm-season and cool-season forage crops contributes to improved use of precipitation and resources available across different seasons in the year compared with a continuous cropping of either of these crops (Holman et al., 2020). Furthermore, growing forages during different periods of the year in semi-arid environments with variable precipitation can help reduce forage yield variability and ensure availability of sufficient forage resources to meet livestock demand. Forage nutrient value and biomass production from cool-season and warm-season forages are different. For example, warm-

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[2]Agricultural Research Center-Hays, Kansas State University, Hays, KS.

season grasses tend to have high biomass productivity and cool season grasses have better forage nutrient value, and therefore they might become complementary when grown in rotation.

For a forage rotation system to be sustainable, it has to be productive, efficient in resource use, provide nutritious forage and, overall, it has to be profitable (Holman et al., 2020). Often, a productive and resource use efficient rotation system may be profitable at the enterprise level, but if the forage nutritive value is low, purchased (often expensive) supplemental feed may be needed to meet animal production goals. The objectives of the current study were to quantify forage yield, nutritive value and net return from individual crops (winter triticale, forage sorghum, and spring oat) and crop rotation sequences of that same study.

Material and Methods:

Forage yield, nutrient analysis and economic data presented herein were from a study conducted at the Southwest Research-Extension Center near Garden City, KS from 2013 through 2020. The experimental design was a randomized complete block. Crops in the rotation were winter triticale (T), forage sorghum (S), and spring oat (O). An incomplete factorial combination of four rotations of these crops (S-S, T/S-S-O, T/S-S-S-O, and T-S-O) and two tillage [(no-tillage (NT), reduced tillage (RT)] practices formed the six treatments of the study. These were (1) continuous forage sorghum rotation with no-tillage (S-S NT); (2) winter triticale/double crop forage sorghum-forage sorghum-spring oat rotation with no-tillage (T/S-S-O NT); (3) winter triticale/double crop forage sorghum-forage sorghum-spring oat rotation with single tillage after spring oat (T/S-S-O RT); (4) winter triticale/double-crop forage sorghum- forage sorghum-forage sorghum-spring oat rotation with no-tillage (T/S-S-S-O NT); (5) winter triticale/double-crop forage sorghum- forage sorghum- forage sorghum-spring oat with single tillage after spring oat (T/S-S-S-O RT); and (6) a winter triticale-forage sorghum-spring oat with no-tillage (T-S-O). There were four replications for each treatment and plot size was 9.1 m x 9.1 m.

Data analysis was conducted in SAS 9.4 (SAS Institute). Crop and rotation treatment effects on response variables (forage yield, nutritive value, cost of production, and return) were analyzed using PROC MIXED procedure. For each response variable, a type 3 test of fixed effects was conducted, with each response variable modeled against fixed variable crop or treatment, and year and replication were random effect variables. For a significant ($\alpha = .05$) main effect, a mean separation test was conducted using Tukey's honest significant difference.

Two of the crop rotations in this study, T/S-S-O and T/S-S-S-O, have multiple sorghum crops at different rotation order. For that reason, we conducted a separate analysis to identify if sorghum at different rotation sequences had similar nutritive value and net return. Before analysis, we grouped each of these different sorghum groups as the sorghum in double crop (T/S), and the sorghum after sorghum (-S-S-).

Results and Discussion:

Averaged over the years, there was no significant treatment effect on oat forage yield due to tillage and crop rotation treatments. Forage sorghum yield was 26% greater in the S–S compared with T/S–S–O (NT) treatment. Triticale forage yield was 41% more in the T/S-S-S-O (RT) compared with T/S–S-S–O (NT) or T/S-S-O (RT) treatments. Overall, annualized forage yield was greatest for S–S and T/S–S–S–O (NT and RT) and was the least for T/S–S–O (NT) and T–S–O treatments (Table 1).

Nutritive value of the three forage crops in the study varied as expected. Triticale had the greatest CP, forage sorghum had the greatest ADF and NDF, and oat had the greatest Ca, K, P, and IVTDMD compared with the other forage species. The higher nutritive value of oat and triticale combined with the higher yield of forage sorghum integrated into one crop rotation is a benefit of the forage rotation, i.e., to supply all necessary nutrients and biomass yield to meet livestock demand. Crude protein is an essential nutrient for livestock and is positively correlated with both dry matter digestibility and organic matter digestibility where as ADF and NDF are negatively correlated with forage digestibility. Crude protein content decreases with maturity and plants were harvested at heading in this study to optimize both yield and nutritive value. Legumes (that were not included in our study) have much higher CP than grasses, however, in semi-arid regions, legumes tend to produce less dry matter and often not enough to cover the cost of production (Holman et al. 2018, 2022).

Among treatments, there was a 23-31% greater CP for T-S-O and T/S-S-O compared with S-S (Table 2). The differences in CP among rotation treatments is consistent with individual crop CP. The presence of forage sorghum in the rotation tended to decrease CP concentration because forage sorghum had less CP than triticale or oat. The nutritive value differences were minimal among rotation treatments with the exception that S-S tended to have greater ADF and NDF, and lower CP, IVTDMD, Ca, and P concentrations compared with other treatments. Of the treatments, S-S was among the top in net return due to greater forage sorghum yields. However, the T/S-S-S-O (RT) treatment was among the greatest in all four measures, i.e., productivity, stability (based on prior report), nutritive value, and net return (based on this report). Our findings also showed raising forage sorghum and triticale may be more economical compared to some purchased alternatives. We concluded forage producers should consider growing a rotation of forages throughout the year to reduce production variability and weather risk, while increasing forage yield, nutritive value, and market value in designing profitable forage systems.

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Holman, J. D., Schlegel, A., Obour, A. K., Assefa, Y., 2020. Dryland cropping system impact on forage accumulation, nutritive value, and rainfall use efficiency. Crop Sci. 60, 3395–3409.

Holman, J. A., Obour, A. K., Assefa, Y., 2021. Rotation and tillage effects on forage cropping systems productivity and resource use. Crop Sci. 61, 3830-3843.

Table 1. Forage accumulation in oat, forage sorghum, and triticale for six rotation by tillage treatments at Garden City, KS, average for years 2013 – 2020.

Treatments	Oat	Forage sorghum	Triticale	Treatment	
				Total	Annualized
	………………kg ha^{-1}		…………………	kg (ha 1-cycle)$^{-1}$	kg ha^{-1}
S-S (NT)	-	6932a	-	6932c	6932a
T/S-S-O (NT)	1895	5480b	3107bc	14938b	5171b
T/S-S-O (RT)	1865	5985ab	4261ab	17457b	5966ab
T/S-S-S-O (NT)	1935	6646ab	3113c	24371a	6797a
T/S-S-S-O (RT)	1788	6338ab	4409a	24214a	6958a
T-S-O (NT)	1884	6182ab	3902abc	13169b	4390b
HSD[2]	NS	1072	1165	4231	966
Pr > F	0.896	0.019	0.001	<.0001	<0.0001

[1]Mean values within a column followed by the same letter or with no letter are not significantly different (P<0.05).

[2] HSD is minimum difference between two treatments used to declare they are significantly different using Tukey's Honest Significant Difference Test at p<0.05.

Table 2. Crude protein concentration in oat, forage sorghum, and triticale for six rotation x tillage treatments or double and single crop at Garden City, KS, average for years 2013 – 2020.

Treatments	Oat	Forage sorghum	Triticale	Composite
				Weighted average
	………….……………..Crude Protein (g kg^{-1})……………………………..			
S-S (NT)	-	120b[1]	-	113c
T/S-S-O (NT)	167	129a	181	132ab
T/S-S-O (RT)	168	126ab	179	130abc
T/S-S-S-O (NT)	169	124ab	183	125bc
T/S-S-S-O (RT)	165	127ab	178	129abc
T-S-O (NT)	169	126ab	182	139a
HSD[2]	NS	7	NS	14
Pr > F	0.855	0.042	0.615	0.002
Double crop sorghum (T/**S**)		133a		
Single crop sorghum (S-**S**)		122b		
HSD		2.87		
Pr > F		<0.001		

[1]Mean values within a column followed by the same letter or with no letter are not significantly different (P<0.05).

[2] HSD is minimum difference between two treatments used to declare they are significantly different using Tukey's Honest Significant Difference Test at p<0.05.

Table 3. Gross return for each crop by treatment and average gross return and net return for each treatment in the forage rotation system study at Garden City, KS.

Treatments	Oat	Forage sorghum	Triticale	Treatment	
				Total for complete rotation	Annualized
	……………..Gross Return ($ ha^{-1})……………………				Net Return $ $(ha)^{-1}$
S-S (NT)	-	501a	-	501c	50a
T/S-S-O (NT)	207	407b	312bc	1333b	-52b
T/S-S-O (RT)	211	445ab	419ab	1519ab	43a
T/S-S-S-O (NT)	222	463ab	307c	1917a	-12ab
T/S-S-S-O (RT)	206	448ab	441a	1991a	51a
T-S-O (NT)	219	474ab	330abc	1023b	-34b
HSD[2]	NS	75	116	363	88
Pr > F	0.895	0.018	0.001	<0.001	0.001
Double crop sorghum (T/**S**)		368b			13b
Single crop sorghum (S-**S**)		491a			60a
HSD		25			17
Pr > F		<0.001			<0.001

Rolling with the punches: Weed Management in 2022

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Herbicide availability and prices, as well as potential regulatory changes are likely to make weed management in 2022 especially challenging. Success is possible, but it is likely to require extra planning and diligence. The following information is intended of offer suggestions and guidance for weed management in 2022.

Start with the basics. Limited supplies of glyphosate and glufosinate means re-sprays are not an option in 2022. It will be important to be extra diligent about basic weed management.

1. Start with clean fields, either through a burndown herbicide application that includes multiple effective herbicides or through tillage.
2. Apply full rates of herbicides. The one exception to this is to consider applying the 'grass rate' of glyphosate products, which is typically 22 fl oz per acre.
3. Apply in the best conditions possible. If possible, avoid applications when temperatures are too hot or too cold for active weed growth.
4. Target small, actively growing weeds. Most herbicides are labeled for application to weeds that are 4 inches in height or less. Identifying weeds this size requires thorough scouting.

Take product delivery as soon as possible. But make sure storage conditions are adequate.

Table 1. Storage temperatures for selected herbicides.

Condition	Herbicides
Above 32 F	Authority Assist, Flexstar, **Gramoxone 2.0**, Poast Plus, Pursuit, Raptor, Ultra Blazer
Above 14 F	Balance Flexx, Huskie formulations, Starane NXT*
Above 10 F	Flexstar GT, Starane Ultra*
Above -10 F	Callisto GT, Halex GT, Lumax
Above -20 F	Callisto, Callisto Xtra
Above -30 F	Dual formulations
Below freezing	2,4-D amine and ester, Aatrex 4L, Flexstar, Impact, Impact Z, **Liberty*,** Prowl H2O
No restrictions	Dry formulations, Aim, Armezon PRO, Assure II, Bicep formulations, Capreno, Engenia, Enlist One, Fusilade DX, **Gramoxone 3.0,** Harness formulations, Impact Core, Laudis, Lexar EZ, Outlook, Resource, **Roundup PowerMax formulations, Roundup Ultra,** SelectMax, Spartan 4F, Valor, Verdict, XtendiMax

Table 1 lists storage temperatures for some common products. When you are ready to use products that have been stored over winter, extra care must be taken to ensure products have been remixed. This will involve using an air wand to lift settled components of the bottom of mini-bulk containers. Use low pressure and make sure the container is vented to avoid damage that could cause leaks.

Look for alternate sources of active ingredients. Be familiar with generic options for the products you use most. Also, consider premixes that include the products you use most.

Look for alternate active ingredients. Consider replacing glyphosate in your burndown applications, as there are more options when compared to in-crop applications. Paraquat is one choice, but does have considerable human health risks for acute exposures. It can only be handled by certified applicators with extra training. A link to the training can be found at https://npsec.us/paraquat . Paraquat activity can be enhanced by tankmixing with atrazine or metribuzin, which will also provide some residual activity. Other options for pre-plant applications include Group 1 herbicides such as clethodim (Select Max, others) or quizalofop (Assure II, others) for grass control and Group 4 herbicides like 2,4-D and dicamba for broadleaf control. Remember the control spectrum for these products varies slightly, so the best active ingredient(s) will depend on the weed species present. Also, combining Group 1 herbicides with Group 4 herbicides can result in poor grass control, especially when 2,4-D amine formulations are used (Figure 1). If you intend to use these products in combination, be sure to use high rates and the correct adjuvants for the Group 1 herbicide.

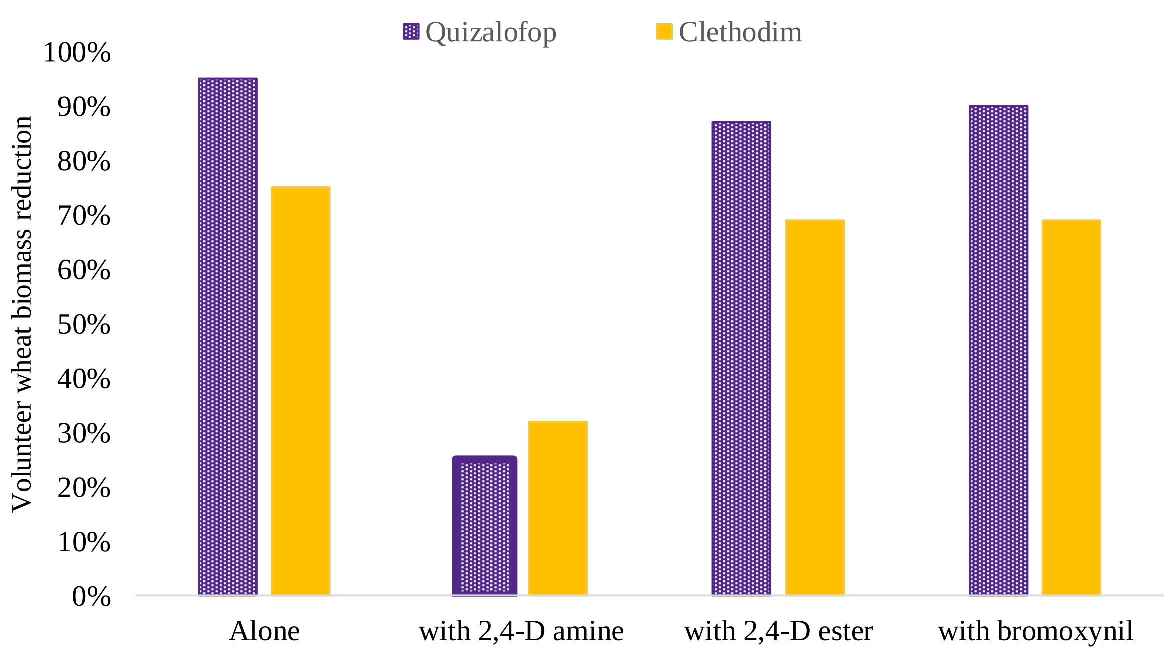

Figure 1. Control of volunteer wheat and other grass species is reduced when applied with other herbicides, especially 2,4-D amine. Data from Blackshaw et al. 2006.

Increase residual herbicide use. Residual herbicides are usually a good investment for weed management, however, keeping effective concentrations of residual herbicides present through crop canopy will make postemergence applications of glyphosate or glufosinate more successful by reducing the number of plants that must be controlled. When selecting residual herbicides, consider the water solubility and other properties that affect how long you can expect effective concentrations to be present. Some properties of selected residual herbicides are listed in Table 2. Herbicides with orange- or red-shaded cells in the solubility column have low water solubility, so will generally take more water to be made available for plant uptake and are less likely to be leached out of the effective zone by rainfall or irrigation.

Table 2. Properties of some residual herbicides that may affect product selection.

	Solubility (mg/L)	Half-life (d)	Crops	Pigweeds	Morning-glories	Fall panicum	Crab-grass
Acetochlor	282	12	Cn Sg Sy	G	--	E	E
S-metolachlor	480	23	Cn Sg Sy	G	--	E	E
Dimethenamid	1499	16	Cn Sg Sy	G	--	E	E
Pyroxasulfone	3.5	22	Cn Sy	E	F	G	G
Isoxaflutole	6.2 L	1.3	Cn	E	G	G	G
Mesotrione	1500	5	Cn Sg	E	--	--	F
Flumioxazin	0.8	18	Cn Sy	E	G	F	F
Sulfentrazone	780	547	Sy	E	E	--	--
Metribuzin	10,700	19	Sy	G	G	F	F

Optimize application variables to ensure herbicide efficacy. This includes utilizing adjuvants to increase herbicide uptake, as well as AMS to offset the minerals in hard water. Other factors include using the optimum spray volume. In general, 15 to 20 gallons per acre will result in maximum coverage and control of emerged weeds. Recent research suggests that tank mix partners also affect spray coverage (Figure 2).

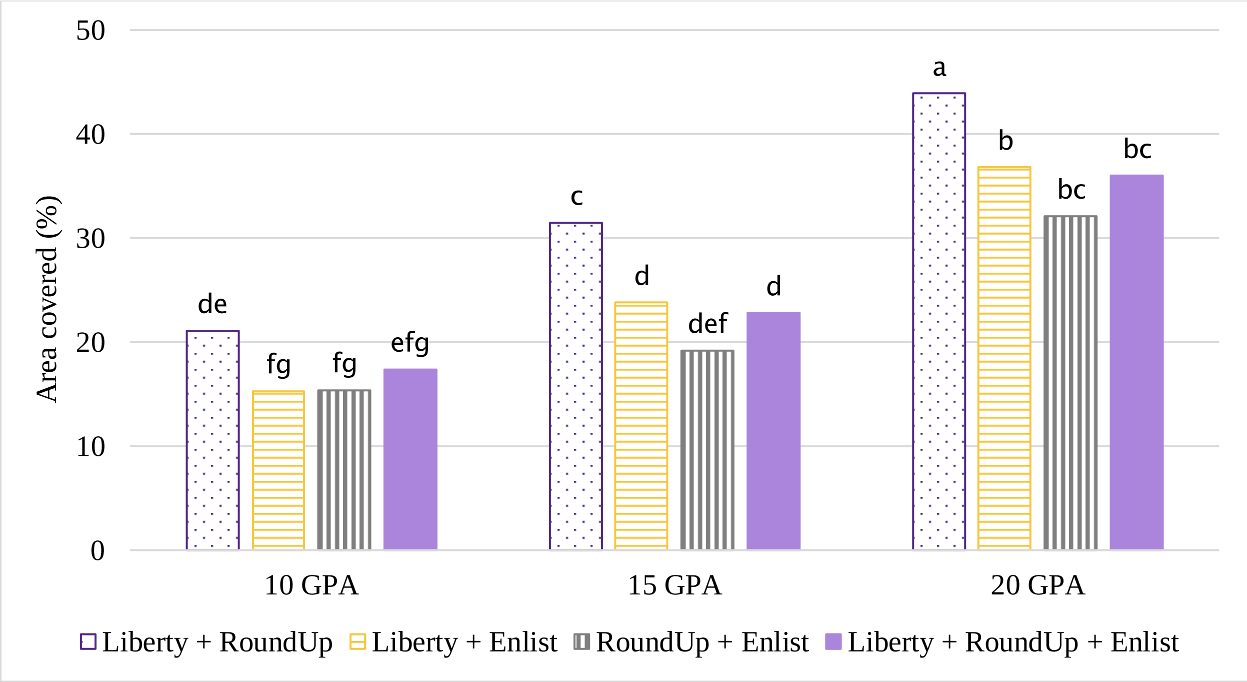

Figure 2. At typical spray volumes, tank-mixtures that included Enlist One resulted in less spray coverage than mixtures without Enlist One. Data from Lammers et al. 2021.

Maintain equipment. Having machinery, including spray nozzles in good working condition will also help achieve maximum effectiveness of herbicide applications. Make sure you are using the type and size of nozzle that is most appropriate for the products being applied. Evaluate spray nozzles to ensure proper output and spray patterns (Figure 3).

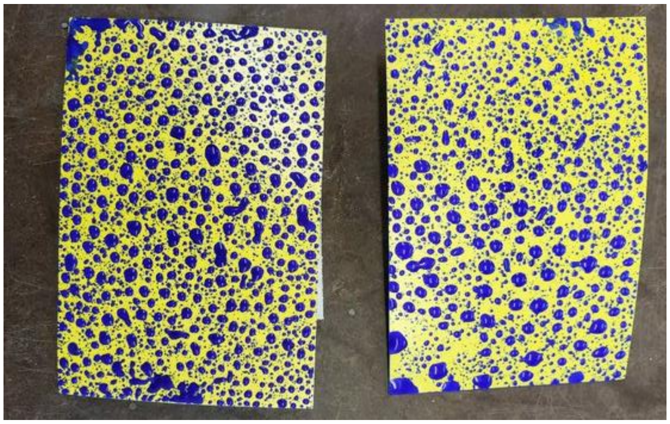

Figure 3. Spray coverage resulting from application with a new (left) and used (right) nozzle. Replacing worn nozzles will result in more uniform coverage.

Take advantage of non-chemical weed control. Cultural practices, like greater plant populations or narrow row spacings will make crops more competitive against weeds. Other practices, like strategic tillage or cover crops may be beneficial for some operations. If cover crops are used, termination may be more challenging if glyphosate is saved for in-crop applications. The herbicide alternatives discussed for burndown situations will also be helpful for cover crop termination.

Soil Carbon: What You Need to Know

Peter Tomlinson and DeAnn Presley

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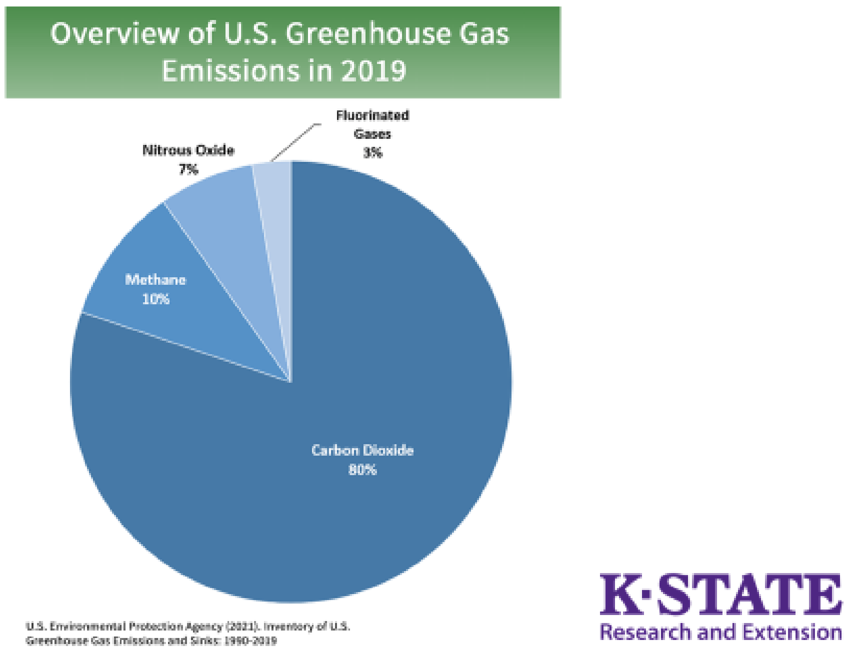

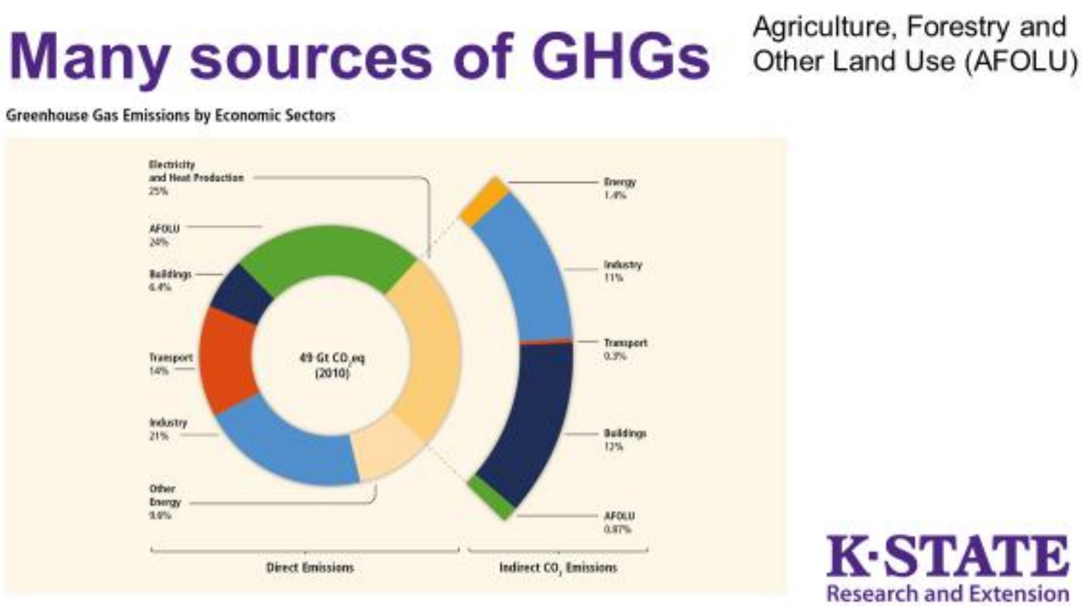

STRATEGIES

- The most cost-effective mitigation options in forestry are afforestation, sustainable forest management and reducing deforestation
- In agriculture, the most cost-effective mitigation options are cropland management, grazing land management, and restoration of organic soils (ex: Histosols in MN, WI, MI, and FL)

https://www.uidaho.edu/cals/soil-orders/histosols

FORMS OF C IN SOIL

- Total C = Soil organic C + Soil inorganic C
- Where soil organic C is in soil organic matter
- And soil inorganic C is in the calcium carbonate

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C: traded in tons per acre

- Or megagrams per hectare (Mg/ha)
- Need to know:
- Percent soil organic C (SOC)
- Bulk density (g/cm^3)
- And depth

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Bulk density

- Excavate a known volume of soil and determine dry mass
- Volume of a cylinder: pi*r^2*h
- Where h is the length of the core
- r is half the diameter

Table 1. Average minimum bulk densities that restrict root penetration in soils of various textures.

Texture	Bulk Density g/cc
Coarse, medium, and fine sand	1.80
Loamy sand and sandy loam	1.75
Loam and sandy clay loam	1.70
Clay loam	1.65
Sandy clay	1.60
Silt and silt loam	1.55
Silty clay loam	1.50
Clay	1.40

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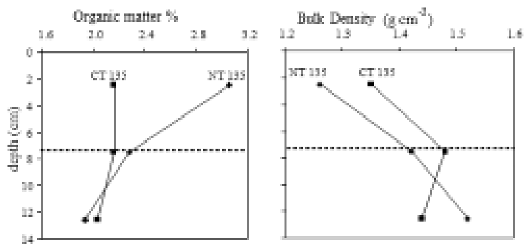
Converting C

- Soil organic matter contains C, N, S, H, O and lots of other elements
- On average, SOM is a little over half C by weight (58%)
- So the number 1.72 is used to convert
- SOM = SOC*1.72

LONG-TERM SORGHUM

- Established 1982
- Soil sampled 2008
- Continuous grain sorghum, CT and NT, 4 N rates (0, 30, 60, 90, 120 lbs/ac)
- Sampled 0-2, 2-4, and 4-6 inch increments (sectioned cores)
- SOC determined with a LECO analyzer (if your soil contains carbonates, you'll have to get those removed)

Relationships: Organic matter is key



Both soils received the same N rate for 30 years

One tilled, other not tilled

- Averaged across all the N rates, NT contained 15.6 tons per acre (34.9 Mg/ha) SOC and CT contained 14.1 tons per acre (31.7 Mg/ha) SOC

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Carbon market basics

- Two types of markets:
  - Compliance (CA Cap and Trade Program)
  - Voluntary (Corporate Sustainability)
- Current carbon market trend
  - Voluntary, incentive-based markets
  - Companies (third-party aggregators) linking sellers and buyers
  - Carbon program criteria very by Aggregator
    - Minimum acres to enroll
    - Payment structure
    - Length of contract
- Ask questions, read the fine print and seek legal advice

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Actions that generate carbon credits (offsets)

- Emission removal:
  - Cabon taken out of the atmosphere and stored
  - Changing tillage practices
  - Growing forests
  - Managing grasslands

- Emission reduction:
  - Change in activities/practices that emit fewer gases
  - Reduced N fertilizer application
  - Changing from fall to spring N application

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Questions a farmer should ask

- What management changes does the company pay for?
- How do they measure carbon stored? Will they collect the initial and follow-up soil samples or do you? What is their fee to collect the samples?
- Understand the payments and the costs. Do they pay by acre or by carbon credit? What is the payment schedule? Some companies use holdbacks or a percent taken off of the top to cover their role in the process. What are their fees? Are they in line with other companies?
- Can you stack carbon market payments with cost-share payments from local or federal governments?
- What is the contract length, terms, and exit clauses? If you rent the farmland, is your landowner required to consent? If your rental contract ends, the landlord may assume responsibility for the contract.
- What management data and verification are you required to provide? Most programs will require annual documentation of practices in a web-based portal. Some may be able to incorporate data collected by other software. Make sure you're prepared to provide data at an appropriate level of detail, on the timeline required by the contract.
- What happens if you are not able to implement the new practice due to the weather? Due to other circumstances? What happens if soil carbon doesn't increase even when you do implement the new practices?
- Does the company sell other services or products? Are any of these services/products required to be purchased in order to participate?
- Are any other ecosystem services brokered by the company, such as water quality credits?

- Source: https://blog-crop-news.extension.umn.edu/2021/04/how-to-approach-carbon-market.html

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Soil Health Strategies in Dryland Production

Matalyn E. Stark—NRCS, Resource Soil Scientist
Dale Younker—NRCS, Soil Health Specialist

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Definition of Soil Health

The continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals, and humans.

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Common Soil Heath Terms

- Aggregation—The process whereby primary soil particles (sand, silt, clay) are bound together, usually by natural forces and substances derived from root exudates and microbial activity.
- Available Water Capacity—The amount of water released between in situ field capacity and the permanent wilting point. It is not the portion of water that can be absorbed by plant roots.
- Infiltration—The entry of water into soil.

Term Definitions by the Soil Science Society of America

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General Symptoms of Cultivated Soils

Above Ground

- ↓ H_2O Infiltration & Storage
- ↑ Erosion Potential
- ↓ Aggregation
- ↑ Summer Temperatures

Below Ground

- ↓ Biological Activity
- ↓ Biological Diversity
- ↓ Efficient Nutrient Cycling
- ↓ Contribution to Vigor

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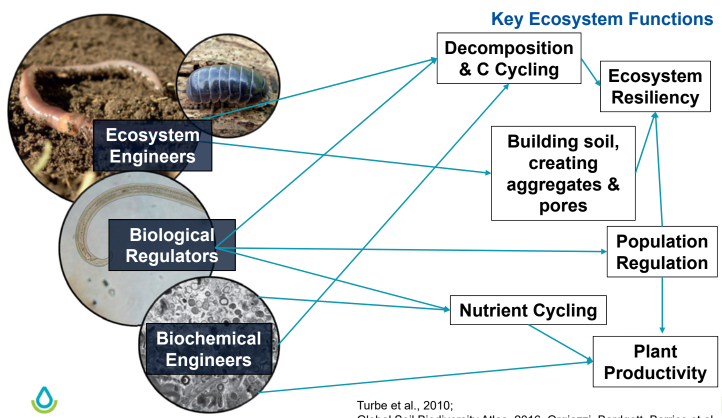
Soil Biology Drives Soil Health



Turbe et al., 2010;
Global Soil Biodiversity Atlas. 2016. Orgiazzi, Bardgett, Barrios et al.

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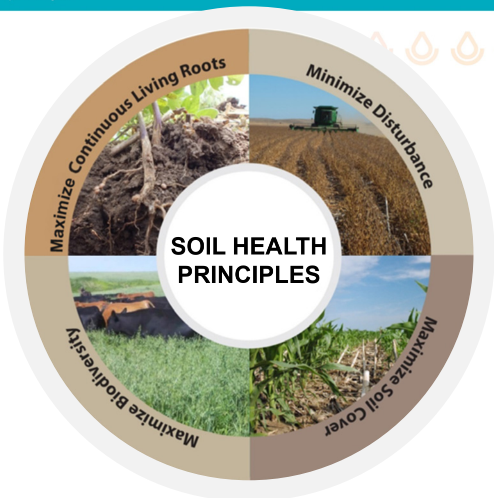

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Protect Principles

- Maintain stable aggregates
- Manage erosion
- Buffer temperature
- Reduce evaporation
- Maintain soil organic matter

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Protect—Minimize Disturbance

- Symptoms of Disturbance
  - ↓ Habitat for Soil Organisms
  - Degraded Soil Structure & Aggregation
- 3 Types of Disturbance
  - Physical—Tillage
  - Chemical—Fertilizer, Pesticides, Soil Amendments
  - Biological—Fallow Systems, Monoculture Communities, Grazing

Dr. Don Reicosky

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Ways to Minimize Disturbance

- Residue & Tillage Management
  - Reduce Till → No-Till
- Nutrient Management—4 Rs
  - Right Source, Right Rate, Right Time, Right Place
- Grazing Management
  - Preventing Overgrazing of Crop Residue or Cover Crops
- Integrated Pest Management (IPM)

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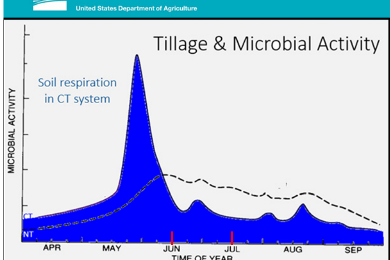
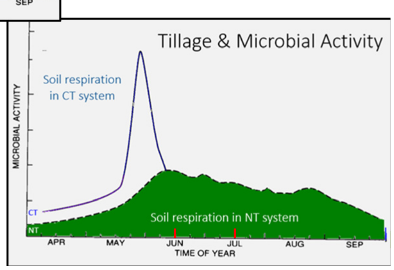


Suggested Corn Planting Dates*
- April 20 to May 20

Estimated Dates for V6 Stage
- Month of June



*Information is from K-State L818 Kansas Crop Planting Guide

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Protect—Maximize Soil Cover

Above Ground
- ↓ Erosion
- ↑ Infiltration
- ↓ Evaporation
- Mitigate Compaction from Machines & Livestock

Below Ground
- Moderate Soil Temp
- ↑ Habitat for Soil Organisms
- ↑ Food for Biota

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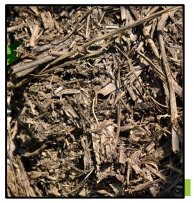
Ways to Maximize Soil Cover

- Reducing Tillage
- Implement Diverse Crop Rotations
- Replace Fallow with Cover Crop
- Planting High Biomass Cover Crops
- Maximize Crop Residue
- Planned Grazing System

Photo: Washington State University



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Feed Principals

- Stimulate below-ground diversity
- Increase SOM
- Improve nutrient cycling
- Enhance plant growth
- Break pest cycles
- Increase predator & pollinator populations

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Feed—Maximize Living Roots

- Replace Fallow with Cover Crops
- Plant Cover Crops in the Off-Season
  - Spring Cover Crops prior to Corn/Milo
  - Summer Covers following Wheat
  - Fall/Winter Covers fo
- ↓ Re-Cropping Intervals
- ↑ Time in Perennial Crops
- Planned Grazing System
- Manage Forage Height

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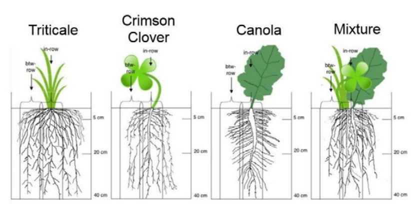
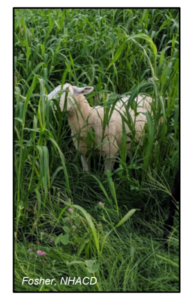
Feed—Maximize Biodiversity

- Diverse Cover Crops
  - Grasses, Legumes, Brassicas, Non-Legumes
  - Plant & Root Architecture
- Diverse Crop Rotations
  - Adding in a Perennial Crop
- Integrate Livestock
  - Grazing Covers & Residues





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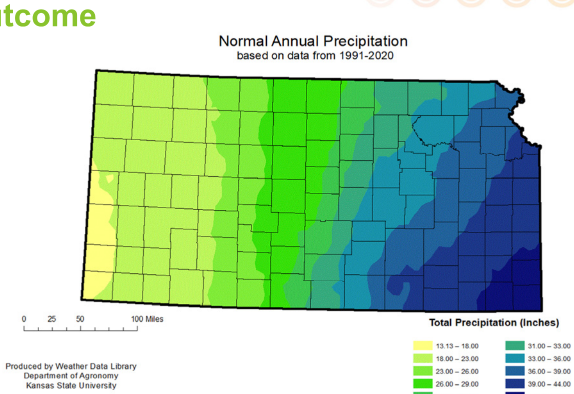
Climate still determines a lot of the outcome



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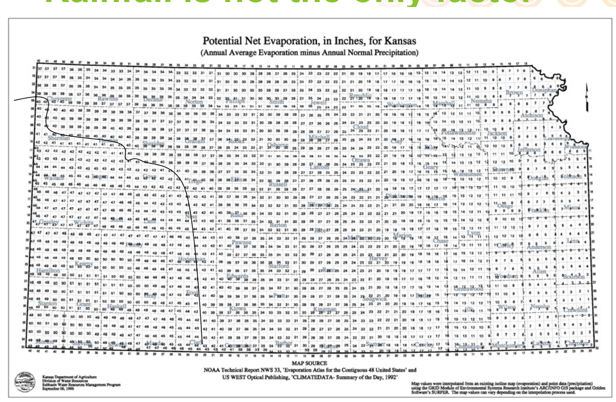
Rainfall is not the only factor



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The Basic Soil Health Strategies

- Diverse and flexible crop rotations
- No-till, or some variation of it
- Cover crops
- Nutrient management (4R principles)
- Pest management
- Maintain and improve profitability

Diverse and Flexible Crop Rotation

- Have as much diversity as possible in the rotation based on the soils, climate, field topography and marketing opportunities.
- Place an emphasis on high carbon crops being in the rotation.
- Keep the rotation flexible to adjust for weather conditions, crop prices and pest management issues.
- The rotation needs to be as intense as the climate allows. The goal is to keep a living root in the soil and keep it covered as much as possible.

No-Till

- Minimize disturbance with no-till as much as possible.
- There may be times when tillage is the “lesser of the two evils” where it may be the proper tool to address weed and compaction issues, etc.

Cover Crops

- Cover crops can be used to fill in gaps between cash crops in fallow systems.
- The key to making cover crops work in a dry environment is to only use the moisture to grow the cover that would have been loss during a fallow period anyway.
- Planting and termination timing is critical.
- Use high carbon multi species mixes to add diversity to the system.

Cover Crops

- Maintain flexibility in the system. In dry years it may make more sense to maintain the cover you have rather than plant a cover crop that will not come up.
- Seed cost needs to be economical based on what your goals are.
- Grazing livestock can increase the economic returns on growing covers.
- Cover crops can be used as a tool to manage hard to control weeds.

Nutrient Management (4R Principles)

- Use the **right source**. Match fertilizer type to the crop needs.
- Use the **right rate**. Match rates based on soil analysis and projected crop removal rates.
- Provide nutrients at the **right time**. Time nutrient application and availability on when it is most beneficial to the crop.
- Apply nutrient in the **right place** so it is available to the crop when it is needed.
- Consider the impact on soil biology when applying fertilizers and other soil amendments.

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Pest Management

- In the past using a pesticide was a simple and economical approach to weed and insect management.
- Herbicide weed resistance and chemical costs has forced us to consider and use other methods, including crop rotations, cover crops, companion crops, relay cropping, other biological, mechanical (tillage and shovel), and other effective methods.
- “An ounce of prevention is worth a pound of cure”. It is much easier to prevent a weed from coming up then it is to control it once it is three feet tall.

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Pest Management

- Cover crops can be used as an effective management tool to suppress herbicide resistant/hard to control weeds.
- Many small seeded weed seedlings (palmer amaranth, kochia) need sunlight to survive. Shading the soil with crop residue and/or crop canopy goes a long way in weed management.
- When applying pesticides mitigate the impacts to the soil biology and other beneficial fauna to the extent possible.

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Maintain and Enhance Profitability

- A system is only considered “sustainable” if it is profitable.
- Run scenarios and develop budgets before making significant changes. Look at both short-term and long-term returns.
- Developing carbon markets may be a way to generate additional revenue.
- Financial assistance programs like EQIP and CSP can help offset the initial cost when transitioning to a soil health system.

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Soil Health System Examples

1. Replace traditional fallow with cover crops to graze.
2. Plant cover crops continuously and utilize the cover strictly for livestock forage.
3. Intensify the cash crop rotation and use cover crops between cash crops.

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Replace Fallow With Cover Crops to Graze

- Diverse cover crop mixes are planted during the typical fallow periods.
- The amount of forage available is highly variable and dependent on the weather conditions of the season.
- Short duration, high intensity grazing utilizes more forage and provides more soil health benefits.

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Replace Fallow With Cover Crops to Graze

- KSU Research at HB Ranch in Trego County indicates that this is an economically viable replacement to traditional fallow in most years.
- This system works well where a livestock enterprise is part of the operation and crop fields are contiguous and adjacent to grass areas.
- A readily available water source is needed. With some species adequate fencing could be an issue.

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Plant Cover Crops Continuously for Forage

- Crop fields are planted to cover crops “back-to-back” and are used as livestock forage.
- This system works well where livestock is the main enterprise.
- Cash crops are occasionally used to breakup the cover crop cycle and provide some additional income.
- Typically, permanent water and some fencing is developed in the crop fields to facilitate short term intensive grazing.
- Provides needed rest to native pastures.

Intensify the Cash Crop Rotation

- A diverse mix of cash crops are grown on a continuous basis, at least one crop per year.
- Fallow is only used during short periods between cash crops and during drought conditions.
- The rotation is flexible depending on weather conditions, pest issues and marketing opportunities.

Intensify the Cash Crop Rotation

- Cover crops are planted between cash crops when practical and are part of the weed control strategy.
- The goal is to have 100% ground cover and to have living root in the soil as much as possible.
- This is a “high risk-high reward” system and can fail. The theory is to take advantage of the good years to get through the bad ones.

Summary

- Soil health is a journey and not a race. Don’t expect many immediate results. It takes time for the soil to adjust to a new system.
- Soil health is not a “one size its all”. Systems must be tailored to each individual farmer, the local climate and the field itself.
- Profitability is still the driving factor. In order to make a significant change you need to make as much, or more money than you were before.

Questions?

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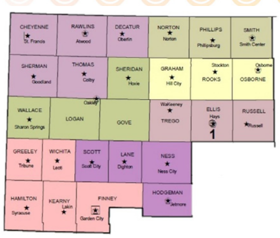

Taking Weed Control to the Next Level

Cody Creech
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Herbicide applications are the leading method of weed control in U.S. agricultural production due to their ease of application and effectiveness. It has been estimated that nearly 6 billion pounds of pesticides were applied in the U.S. in 2011. However, only a fraction of the amount applied reaches its intended target. With herbicide resistance increasing around the world and the costs associated with herbicide applications, it is imperative that steps are taken to get the most out of our weed control plan and the herbicides we use.

Know Your Weeds

Sun Tzu, a Chinese general and author of *The Art of War* wrote, "It is said that if you know your enemies and know yourself, you will not be imperiled in a hundred battles." All fields have a diverse population of annual and some perennial weeds. Some annual weeds germinate in the fall, some in the spring, and others throughout the year. Understanding the lifecycles of weeds, how they propagate, and their desired growing conditions can aid in their control. For example, glyphosate-resistant marestail can be difficult to control in-season. In Nebraska, marestail germinates primarily in the fall and is readily controlled with a fall application of 2,4-D or dicamba tank-mixed with glyphosate. If a weed species emerges early in the spring and has a short emergence period, it could be managed after most seedlings have emerged but prior to crop planting. Other species may emerge throughout the growing season and will require many control methods such as delayed planting of the crop to allow for mechanical or non-selective chemical burndown control, in crop applications of PRE and POST herbicides, inter-row cultivation, and/or narrow rows to achieve canopy closure earlier in the growing season. Regularly scout your fields to identify when weeds are germinating so weeds can be controlled in a timely manner.

Complex System

The application of herbicides involves complex processes that begin in the tank of the sprayer and end when the herbicide enters a plant. A change that occurs at any stage of the process impacts other stages and may impact the performance of the herbicide. Researchers have estimated that up to 50% of herbicides applied are lost to the environment due to volatilization and drift (Figure 1). The reduced amount of herbicide that reaches the weed target may not fully control it. Weeds that survive a herbicide application may require a second application that can be costly, impact crop yield, and/or mature and set seed. Herbicide resistance also becomes a greater risk if the weeds continue to survive herbicide applications and no alternative mode-of-action or method is used to control the weed escapes. The ideal herbicide application delivers the appropriate rate of chemical to effectively control the weed species while mitigating injury to the crop and drift. Herbicide spray applicators should understand the following five principles to maximize herbicide efficacy.

Nozzle Selection

Nozzles could be considered the most important part of a sprayer. Nozzles convert the spray-mixture into spray droplets for delivery to the soil or plant. They also have the greatest influence on the size and uniformity of the droplets. In a survey of Nebraska applicators, it was found that more than a third were still using the nozzles that came with the sprayer when it was originally purchased. This is disconcerting because no one nozzle is suitable for all applications. The nozzle needed for an application can vary based on the targeted weed, chemical used, or goal of the application. The size of the spray droplets generated by nozzles has a direct effect on spray coverage, herbicide efficacy, and potential drift. In general, the larger the spray droplet the less coverage and less risk that it will drift. Glyphosate, for example, performs better when applied using course or larger droplets (Table 1). Contact herbicides often require medium droplets or smaller to achieve the coverage needed to be effective. Air-induction nozzles have dramatically increased droplet size and are popular with applicators when coverage is not required to achieve satisfactory control. The large droplets created by these nozzles are not only recommended for glyphosate applications, but are recommended for other systemic herbicides, namely the plant growth regulators 2,4-D and dicamba, because of their propensity to move off-target and cause damage to sensitive neighboring plants. However, it is more difficult for a large droplet to remain on a leaf surface. A final consideration when selecting a nozzle is the orifice size. Selecting a larger or smaller orifice size should be the primary way to achieve the desired gallons per acre (GPA) of the application. Increasing or decreasing the application pressure should only be used to fine tune the GPA. Nozzles have a wide range operating pressures. However, too high or too low of a pressure may negatively impact the spray pattern of the nozzle.

What's in the Tank?

There are many products available on the market and selecting what is appropriate for your situation depends on the weeds present in your field, the crop, and your strategy. However, not all products are created equal. A recent study conducted at North Dakota State University evaluated different non-ionic surfactants available on the market and found some enhanced herbicide efficacy more than others. One option to decide what will work best for your application would be to use a product on one part of a field and another product of the other part and compare.

Many applicators are accustomed to the low carrier volume rates used in glyphosate applications. This results in more acres sprayed per tank and less water being hauled to the sprayer. However, many herbicides require higher carrier volumes. Liberty, Cobra, and Flexstar all require carrier volumes of 15 GPA or greater. Making applications with these products using less than 15 GPA will result in reduced herbicide efficacy. Even systemic herbicides can benefit from increased carrier volumes.

Calibrate

The most recent generation of sprayers use a variety of technologies to apply herbicides evenly and precisely. However, no sprayer, no matter how new, can perform as desired without being appropriately calibrated. A Nebraska study reported that two-thirds of applicators had application rate errors greater than 5%. Some of these errors were attributed to inaccurate tank measuring. The majority of the errors were due to improper calibration and worn nozzles. Sprayer calibration is covered in greater depth in the extension publication NebGuide G1756 of the University of Nebraska. Inaccurate herbicide applications can be due to nozzle wear. Nozzle wear depends on the product being sprayed, hours of use, and the material of the nozzle. Materials such as stainless steel or ceramic last longer than plastic or brass. For example, after 50 hours of spraying, a brass nozzle may have an increased flow rate of 10 to 15% whereas a stainless steel nozzle may increase 2%. For as important as nozzles are to the application of herbicides, they are relatively inexpensive. The increased cost of nozzles made from durable materials will easily pay for itself many times by reducing over-application.

Zero Tolerance

Before herbicide-resistant weeds were a major problem in U.S. agricultural production systems, weed control decisions were often based on the economic threshold approach. This approach defined the density of a weed population at which control is economically justified because of the potential for yield reduction, quality loss, harvesting difficulties, or other problems that weeds may cause. This approach is no longer sufficient for sustaining glyphosate-resistant (GR) cropping systems. A recent study illustrated that if a single GR Palmer amaranth is allowed to set seed in a previously clean field, and no other weed control method other than glyphosate was used, the field would be un-harvestable three years later. Thus, weed escapes need to be quickly identified and eliminated to prevent seed from replenishing the soil seed bank. Weeds that set seed this year will be next year’s problem.

Conclusion

Although many of the previous suggestions relate to herbicide spray applications, it is only one of the tools available to growers to control weeds. Successful weed control programs begin with having an open mind to the various options available to control the existing weed problem. Preventative, cultural, chemical, mechanical, and biological methods should all be considered and utilized to achieve your desired outcomes. Never rely on a single tool or approach. Use a well-designed plan to integrate the various tools into an effective weed control system based on the crop, the surrounding environment, and goals of the farm. Such an approach will allow the grower to obtain the best weed control results from an integrated approach.

Table 1.

Category	Symbol	Color Code	Approximate VMD Range (microns)
Extremely Fine	XF	Purple	~50
Very Fine	VF	Red	<136
Fine	F	Orange	136-177
Medium	M	Yellow	177-218
Course	C	Blue	218-349
Very Course	VC	Green	349-428
Extremely Coarse	EC	White	428-622
Ultra Course	UC	Black	>622

Table 1. Nozzle classification with color coding according to droplet size measured in microns. Based on ANSI/ASAE Standards 572.1.

Figure 1. A spray application in 15 mph winds with nozzles producing fine droplets using a red dye to aid in visualization of the herbicide loss due to drift.

Which corners can I cut? Maximizing Fertilizer Value

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With a well-planned nutrient-management program and based on accurate and current information, we can minimize input costs without adverse effects on yield potential. In some cases, fertilizer rates should be maintained or increased considering the potential economic return and based on specific soils, fields, and production conditions. Evaluation of the potential yield response to each pound of fertilizer and given the current price of grain and fertilizer becomes a critical factor that should be evaluated on a field-by-field basis.

In some cases, growers take advantage of nutrients stored in the soil and reduce fertilizer application this year. For example, in the case of phosphorus, soil test above the responsive range resulting from a prior build-maintenance program may not need any P application (or just a starter P application) (Fig 1). Utilizing P stored in the soil can be done for a few growing seasons depending on the current soil test P level and removal with yield; however, soil test P will decrease in the medium-long term.

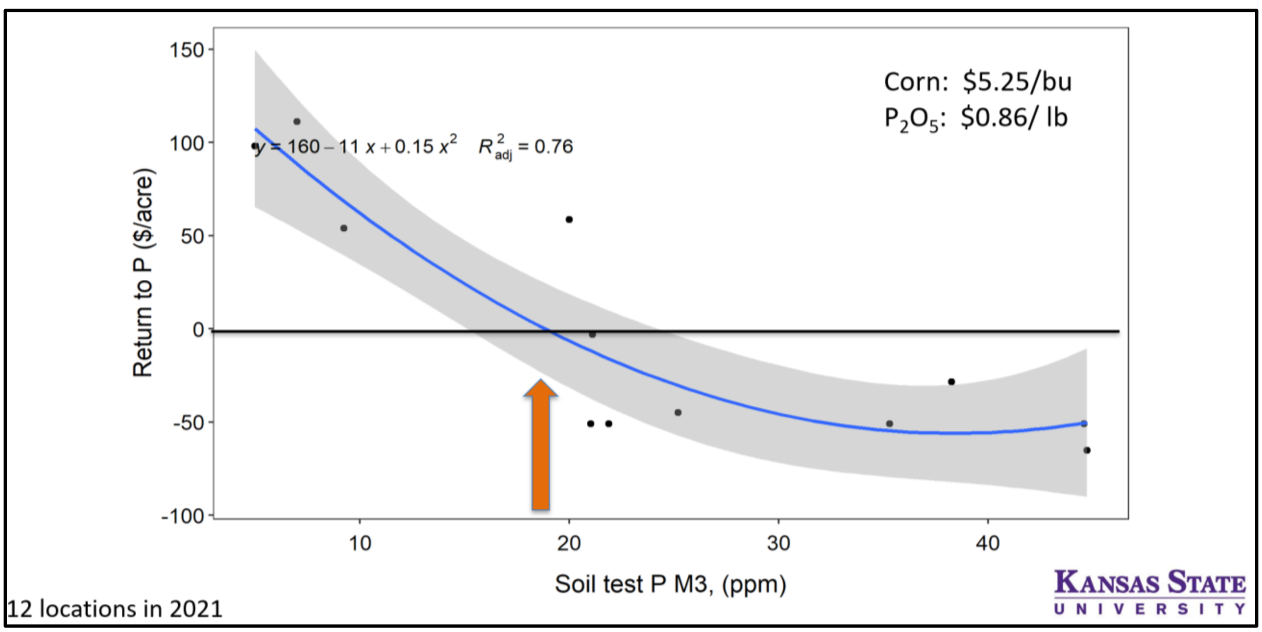

Figure 1. Return ($/acre) to 60 lbs of P2O5 in the year of application in corn, based on crop yield response. Soil test values based on Mehlich-3 at the 0-6 inch sampling depth.

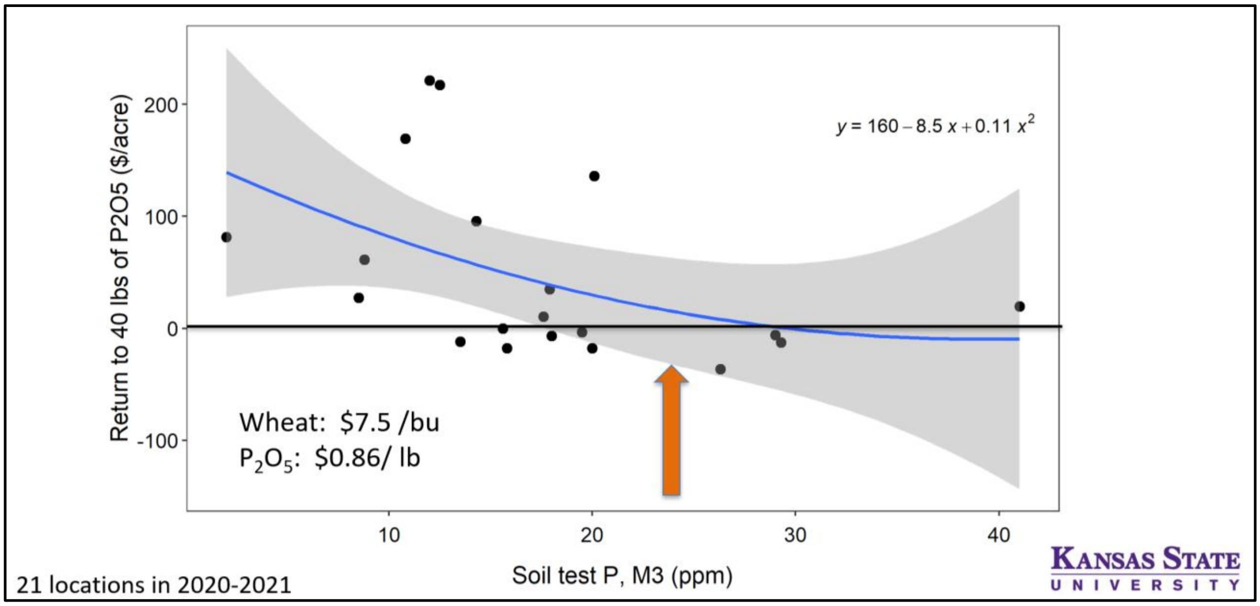

Figure 2. Return ($/acre) to 40 lbs of P2O5 in the year of application in wheat, based on crop yield response (broadcast fall pre-plan). Soil test values based on Mehlich-3 at the 0-6 inch sampling depth.

Phosphorus management can provide more flexibility than other nutrients such as nitrogen; and P "stored" in the soil (non-responsive soil test range) can skip applications without adverse effects on yields. Soil test information for such a decision should be recent and using recommended guidelines for analysis methods and proper sampling in the field.

Corn, sorghum, and wheat are highly responsive to nitrogen, and the needs should be supplied by fertilizer and ideally accounting for other important sources such as residual profile nitrogen. The economic optimum N rate (EONR) considers the typical response to N fertilizer but adjusted to the corn: N fertilizer prices ratio. The EONR seeks to maximize N fertilizer's net return (Figure 3). The EONR is lower than the agronomic maximum N rate, but how much lower it is dependent on the ratio of corn: N price.

Under the scenario of expensive N fertilizer (low corn: N price ratio), the economic optimum N rate is lower; under this scenario, the return to N is very sensitive to the over application of N fertilizer. While under a high corn: N price ratio (cheaper N fertilizer), the return is less sensitive to the over-application of N (Fig 3). However, it is important to emphasize that under-application of N (below the EONR) will reduce the net return. Therefore substantial reductions in N fertilizer rates are generally not recommended even under current price scenarios.

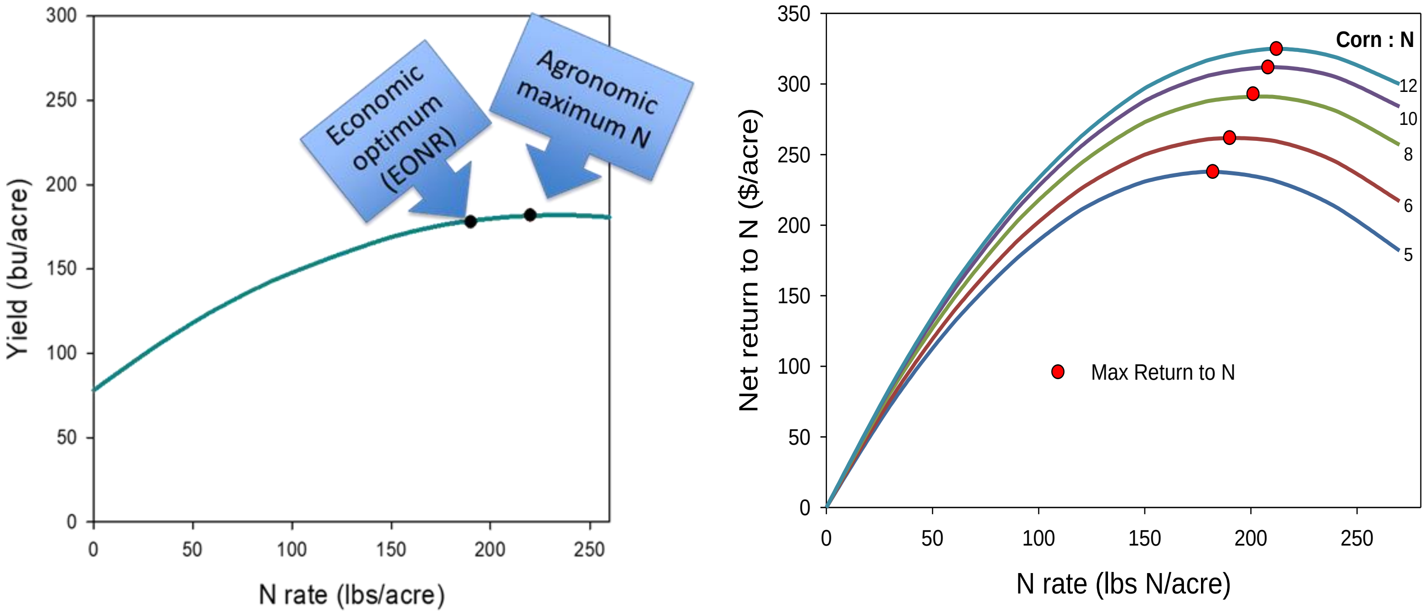

Figure 3. Economic optimum N rate (EONR) and return to N decrease with decreasing corn:N price ratio (expensive N fertilizer).

One key factor that should be considered is the efficiency associated with N fertilizer use by the crop. Figure 4 shows one irrigated location in 2021, with N response using broadcast urea at planting. Other N fertilizer management options (such as UAN coulter injected) show higher efficiency and yields with the same rate of N fertilizer. The most efficient application of N fertilizer will directly affect the economic return, and real opportunities exist to improve efficiency for some production systems.

The use of N additives and other fertilizer technologies can provide benefits under specific situations; however, to ensure a return to investment, these should be used when the likelihood of response is high and avoid them when they are unnecessary based on soils, environment, and fertilizer management. In addition, the relevant research should be examined, and in some cases, in-field evaluations should be done at the farm level.

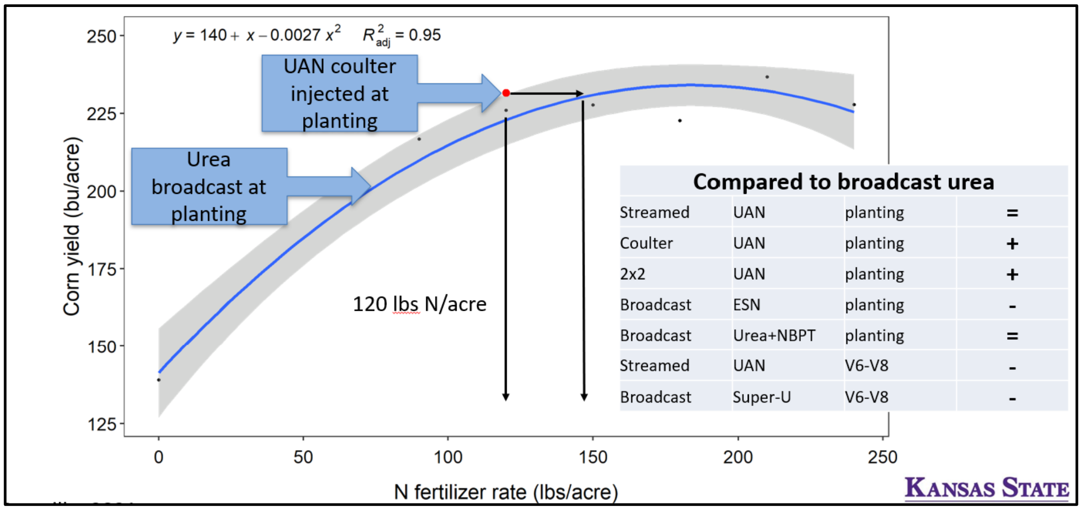

Figure 4. Nitrogen fertilizer efficiency with improved management in corn

In summary, the use of good soil test information to make the right decision becomes critical during high fertilizer prices. Don't reduce P in low testing fields; profits are very likely. But return to fertilizer in high testing soils may be limited with current conditions and "reserve soil nutrients" can be used in the short term. It is also critical to identify the limiting nutrients (or other factors) examining the overall fertility program; in some cases, significant gains can be made with one nutrient, while keeping other nutrients at the same rate (Figure 5).

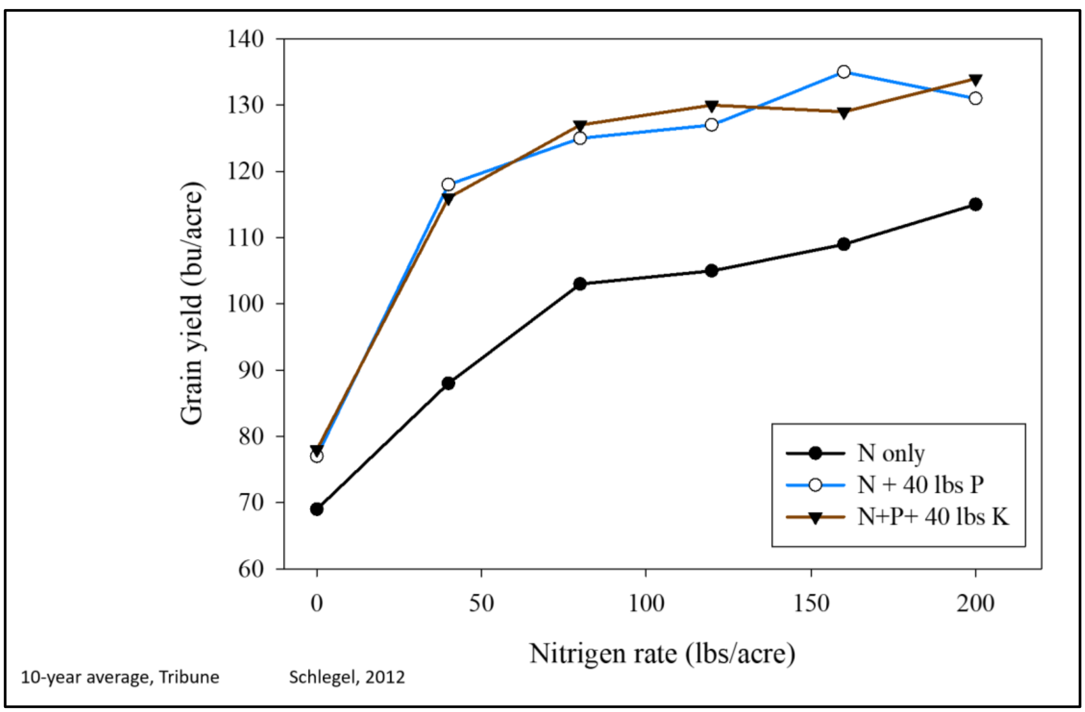

Figure 5. Yield response to N fertilizer as affected by adding 40 lbs of P2O5 (or K2O). Providing P (limiting factor in this case), yields are significantly increased while N rates are maintained.


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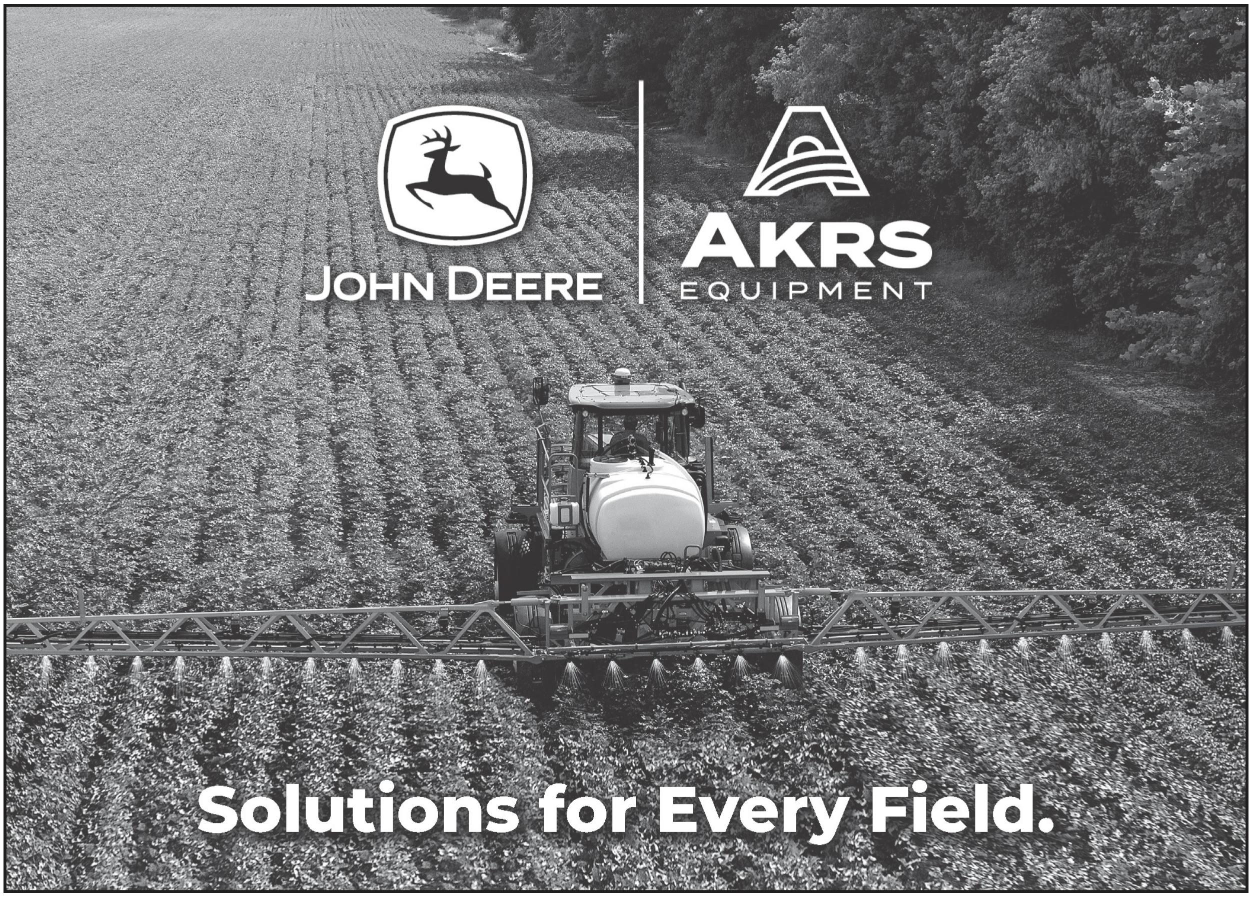

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The plan for the day...

		Room 1	Room 2	Room 3	Room 4
7:45	8:15	Registration			
8:15	8:20	Welcome			
8:30	9:20	Current Financial Status of NW KS Farms[1] *(J. Steele / M. Wood)*	Changing Strategies in Insect Management [1,2] *(A. Zukoff)*	Economics of Soil Fertility and Soil Testing?[1] *(L. Haag)*	
9:30	10:20	Which corners can I cut? Maximizing Fertilizer Value[1] *(D. Ruiz-Diaz)*	High Plains Weather: Review and Outlook[1] *(J.Hutton)*	Soil Carbon: What You Need to Know[1] *(P. Tomlinson)*	*The Importance of Adjuvants (EGE Bio) (I)*
10:20	10:50	View Exhibits			
10:50	11:40	Taking Weed Control to the Next Level [1,2] *(C. Creech)*	Soil Health Strategies in Dry-land Production[1] *(D. Younker / M. Stark)*	Managing Hayed and Grazed Forages for Profit[1] *(J. Holman)*	*Understanding Biologicals and Bacteria (PathwayAg) (I)*
11:50	12:40	Rolling with the Punches: Weed Management 2022 [1,2] *(S. Lancaster)*	Which corners can I cut? Maximizing Fertilizer Value[1] *(D. Ruiz-Diaz)*	Lunch	
12:50	1:40	Economics of Soil Fertility and Soil Testing?[1] *(L. Haag)*	Taking Weed Control to the Next Level [1,2] *(C. Creech)*		
1:50	2:40	Soil Health Strategies in Dryland Production[1] *(D. Younker / M. Stark)*	Soil Carbon: What you need to know[1] *(P. Tomlinson)*	Rolling with the Punches: Weed Management 2022 [1,2] *(S. Lancaster)*	*Corn Nematodes, More Common Than you Think (Pioneer) (I)*
2:40	3:10	View Exhibits			
3:10	4:00	Panel Discussion: Successes and Failures in Herbicide Efficacy	Managing Hayed and Grazed Forages for Profit[1] *(J. Holman)*	Changing Strategies in Insect Management [1,2] *(A. Zukoff)*	
4:10	5:00	High Plains Weather: Review and Outlook[1] *(J.Hutton)*	Current Financial Status of NW KS Farms[1] *(J. Steele / M. Wood)*		

(I) indicate industry sponsored sessions.

[1] Indicate Certified Crop Advisor CEUs applied for.

[2] Indicate Commercial Applicator CEUs applied for.

This conference is organized by a committee of producers and K-State Research & Extensionpersonnel. Lucas Haag, K-State Northwest Area Agronomist is the conference coordinator and proceedings editor. Please send your feedback to LHaag@ksu.edu

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