Cover Your Acres Winter Conference

7th Annual

January 19 and 20, 2010

Gateway in Oberlin, KS

Discussing Conservation Crop Production Practices

for the High Plains

K-State Research and Extension &

Northwest Kansas Crop Residue Alliance

Schedule for Conference

Time	Room 1	Room 2	Room 3	Room 4	Exhibit Hall
7:45 - 8:15 a.m.	Registration				
8:20 – 8:27	Welcome in Exhibit Hall				
8:32 – 9:20	Weed control in fallow[1,2]	I – State of fertilizer	Fertilizing for no-till[1]	I – Bayer CropScience innovations update	
9:20 – 9:50	View Exhibits				Sponsor Displays
9:57 – 10:45	Implementing forages in no-till rotations	I – Plant nutrition	Micronutrients and major crops[1]	I – New sunflower production strategies	
10:52– 11:40	Efficiency of band vs. broadcast N and N-stabilizers[1]	Minimize your risk through marketing[1]	Soil quality: impacts of no-till[1]	I – USCP and new sorghum technologies	
11:47 – 12:35	Fertilizing for no-till[1]	I – Cover your acres for less	Lunch		
12:43 – 1:31	Cover crops for western Kansas[1]	A guide to setting up on farm research			
1:38 – 2:26	Aggressive no-till crop rotations: farmer panel	I – Corn leaf diseases	Common production problems[1]	I – Grain marketing strategies to enhance profitability	
2:33 – 3:21	Micronutrients and major crops[1]	Does stacked corn pay on dryland?[1]	Implementing forages in no-till rotations	I – Getting started in agriculture	
3:21 – 3:51	View Exhibits				Sponsor Displays
3:58 – 4:46	CRP conversion to production[1]	I – Monsanto trait and pipeline update	Does stacked corn pay on dryland?[1]	I – Livestock risk protection	
4:53 – 5:41	Soil quality: impacts of no-till[1]	Long-term crop rotation results[1]	Cover crops for western Kansas[1]	Common production problems[1]	
	Bull Session				

[1]CEU credits for CCAs have been applied for.

[2]CEU credits for 1A for Commercial Pesticide Applicators have been approved.

I - Industry sponsored sessions will have no CEU credits offered.

Coordinated by:
Brian Olson, K-State Extension Agronomist – Northwest
Please send comments or suggestions to bolson@ksu.edu
To become a member of the Northwest Kansas Crop Residue Alliance,
please call Brooks Brenn 785-443-1273

PLEASE TURN ALL CELL PHONES OFF OR TO VIBRATE. If you need to talk on your phone, please leave the meeting room. THANK YOU

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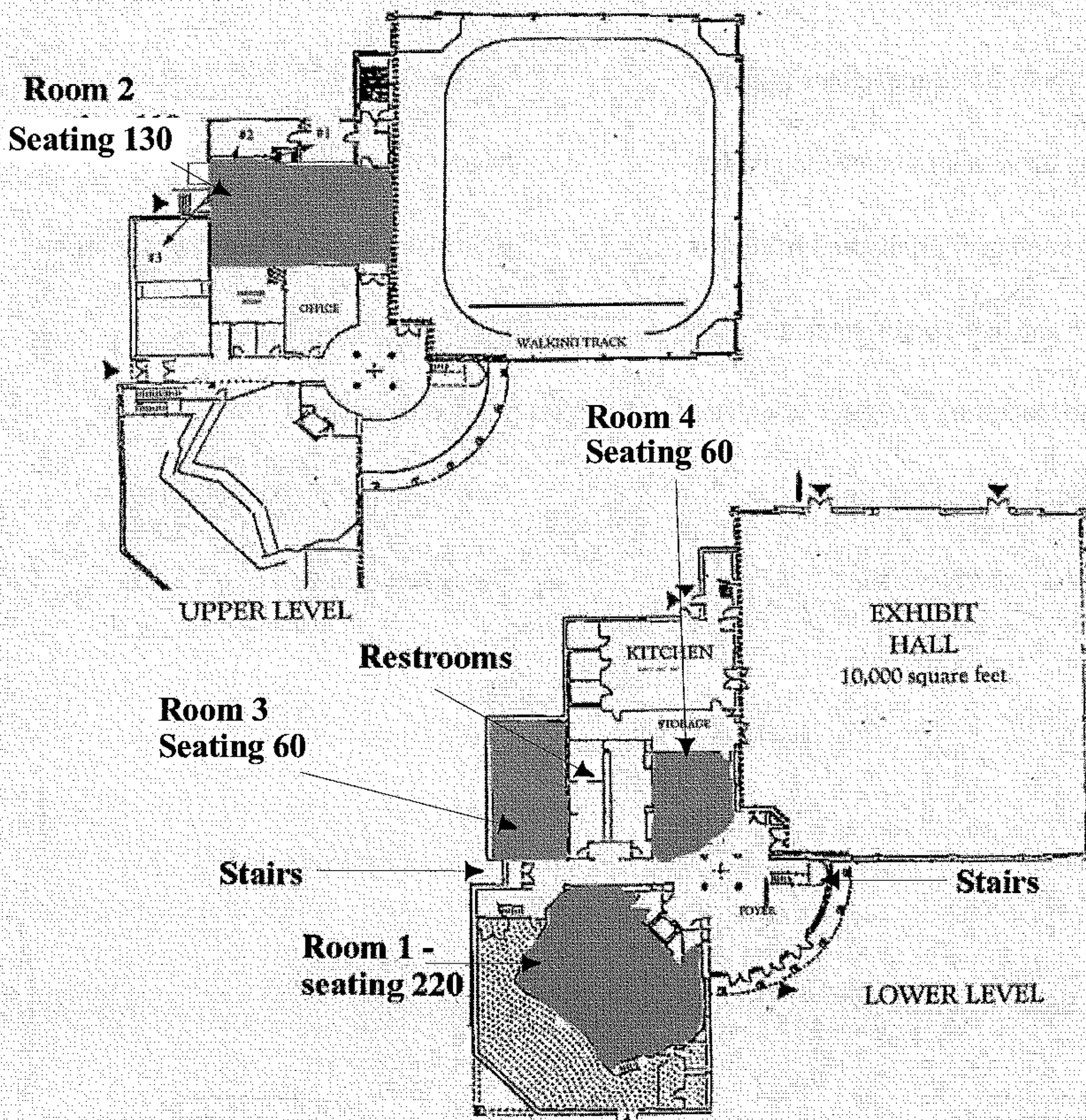
GATEWAY Oberlin, Kansas

The Premiere Exhibition, Meeting & Conference Center for the Tri-State Area



#1 Morgan Drive, Oberlin, Kansas 67749 785.475.2400 Fax 785.475.2925

Industry Sessions	Company Presenter
State of fertilizer	Cargill AgHorizons
Plant nutrition	Crop Production Services
Cover your acres for less	Sims Fertilizer
Corn leaf diseases	Pioneer
Monsanto trait and pipeline update	Monsanto
Bayer CropScience innovation update	Bayer CropScience
New sunflower production strategies	High Plains National Sunflower Assoc.
USCP and new sorghum technologies	United Sorghum Checkoff
Grain marketing strategies to enhance profitability	Market Data Inc.
Getting started in agriculture	Farm Credit of Western Kansas
Livestock risk protection	The Home Agency

Weed Control in Summer Fallow (Prewheat Fallow)

Drew Lyon, Extension Dryland Cropping Systems Specialist

University of Nebraska-Lincoln Panhandle Research and Extension Center, Scottsbluff

The primary role of summer fallow (a.k.a prewheat fallow) in dryland cropping systems is to store precipitation received during the spring and summer in the soil for use by the following crop, typically winter wheat. This is critical to the successful establishment of the winter wheat crop in the fall and it reduces crop failure rates and stabilizes winter wheat yields compared to systems without fallow. The amount of precipitation stored in the soil is reduced by factors such as runoff, deep percolation, evaporation, and weed use. Larger uncontrolled weeds can use up to 0.3 of an inch of soil water per day and can extract this water from deeper soil depths. Effective weed control is critical to the goal of storing as much precipitation as possible for the succeeding crop.

An effective fallow weed control program begins with the preceding crop. A good stand of vigorously growing plants and effective weed control in the preceding crop reduces the chance of weeds becoming a problem after harvest. Uniformly spreading crop residues at harvest allows for more effective weed control during fallow.

Weed Control After Wheat Harvest

Controlling weed growth after harvest reduces soil water use and prevents seed production that can contribute to weed populations during the subsequent summer fallow period. Tillage should be avoided after harvest in order to maintain standing stubble to catch snow and reduce stubble degradation over the winter and spring.

Wheat streak mosaic and its associated viruses (High Plains and *Triticum* mosaic) are transmitted by the tiny wheat curl mite. The most important summer host for the curl mite is volunteer wheat. By far, the greatest risk for developing serious wheat streak mosaic is from volunteer wheat that results from hail occurring within about three weeks prior to harvest. This volunteer allows for a continuous 'green bridge' to carry mites and virus to the next wheat crop. The most effective way to manage this disease is to break the over-summering 'green bridge' and thus avoid the buildup of mites and virus before winter wheat is seeded in the fall. Volunteer wheat can be effectively controlled by tillage or chemical means. Weather conditions will influence the effectiveness of the method that is used. If conditions following harvest are warm and dry, shallow tillage can provide rapid and effective control of volunteer wheat. Tillage is less effective at providing control when soils are wet or cool conditions exist. When plants are growing well, glyphosate will provide excellent control of volunteer. If plants are stressed, glyphosate efficacy is reduced and growers should consider tillage or an herbicide containing paraquat, for example, Gramoxone Inteon™. Paraquat effectively controls seedling volunteer wheat and other weeds in the seedling stage of growth if thorough plant coverage is achieved. Increased plant coverage is achieved by increasing the spray volume applied and/or increasing spray pressure to produce more fine droplets. This also increases the risk of spray drift.

A residual herbicide such as atrazine may be used after winter wheat harvest, but at least 12 months prior to seeding winter wheat. It is usually best to delay the application of atrazine until late August or early September to reduce degradation loss caused by soil microbes, which thrive in warm, moist soils. Atrazine rates at this time of year range from 0.6 to 1.1 lb of 90 DF per acre depending on soil type and climate. Use the lower rates in the drier portions of western Kansas and Nebraska and/or where soil pH is above 7.5, organic matter is less than 1%, or clay content is high.

Valor™ herbicide may be added to glyphosate at a rate of 2 to 3 ounces/acre, depending on soil type, to provide enhanced burndown and residual control of certain weeds such as kochia, pigweeds, purslane, and puncturevine. Valor should not be applied prior to October 15 if residual control is to be maintained into the spring.

Glyphosate, paraquat, 2,4-D, and/or dicamba may be used to control emerged weeds after harvest (Table 1). Glyphosate provides excellent control of non-stressed grass weeds while the other herbicides provide effective control of broadleaf weeds. Although higher rates of glyphosate may be effective against some broadleaf weed species, with the increase incidence of glyphosate tolerance and resistance in weed populations, it is wise to tank mix glyphosate with paraquat, 2,4-D, and/or dicamba for broadleaf weed control.

Table 1. Effect of herbicides applied after winter wheat harvest on weed control.

Herbicide treatment	Fields surveyed	Weed control
	---------- % ----------	
Paraquat + atrazine + 2,4-D	20	85
Glyphosate + 2,4-D	23	94
Glyphosate + 2,4-D + atrazine	27	89
Glyphosate + atrazine	2	100
Glyphosate	7	91
Glyphosate + dicamba	5	95
Atrazine + 2,4-D	3	30
Sprayed twice	14	96

Adapted from Wicks et al. 2003. Weed Technol. 17:475-484.

For the purposes of this paper, I am going to define summer fallow as beginning in the early spring in the year in which the winter crop, typically winter wheat, is to be seeded and ending at the time of winter wheat seeding. This is also referred to as prewheat fallow. About 75% of the average annual precipitation is received during this period of time, which makes it a critical period to store and conserve soil water.

March-April-May

At this time of year, air temperatures tend to be lower than later in the summer and rainfall tends to be more frequent. Precipitation is most efficiently stored during this time when residue remains undisturbed by tillage. These same weather conditions also reduce the effectiveness of tillage for weed control compared to the use of herbicides such as glyphosate.

Winter annual weeds

It is important to control winter annual weeds early enough to prevent seed production. Blue mustard is usually the first common winter annual to flower. It may begin to bolt in February or early March. Other mustard species and winter annual broadleaf weeds begin to flower two to four weeks after blue mustard. Prior to bolting, these species are easily and economically controlled with 2,4-D. However, once they begin to bolt, control becomes more difficult. The addition of a sulfonylurea herbicide such as Ally® XP or Amber® can improve the control obtained by 2,4-D alone, but these products work more slowly and may not prevent all seed production if applied after flowering. If a sulfonylurea herbicide is used during summer fallow, do not use a sulfonylurea herbicide or other ALS-inhibitor herbicides in the following winter wheat crop.

Winter annual grass weeds including volunteer wheat, downy brome, jointed goatgrass, or feral rye should also be controlled early enough to prevent seed production, but these species generally flower after the winter annual broadleaf weeds. Like winter wheat, these winter annual species require vernalization (cold treatment) in order to produce a seed head in a timely manner. In most years, seedlings that emerge after the first of April will not experience sufficient cold to be vernalized. Therefore, a glyphosate treatment made in mid April will kill any winter annual grass plants that are likely to produce seed. Don't delay treatment of winter annual grass weeds until late April or May in the hopes of getting more seedlings up prior to spraying. These late emerging plants are unlikely to produce seed and to delay may risk seed development by plants that emerged the previous fall or over winter. Once you observe seed heads on these plants, some weed seed development is possible.

Winter annual grass weeds are easily controlled with glyphosate unless they are suffering from drought or some other stress that slows plant growth. Typically 16 to 20 ounces of a 4 lb ai/gallon formulation of glyphosate will provide good control of non-stressed winter annual grass weeds. Be sure to add nonionic surfactant if needed. Ammonium sulfate may also be added to improve control.

Warm season annual weeds

Warm season annual weeds begin to emerge in late March and early April and peak flushes often occur in late April and May. Tank mixes of glyphosate and 2,4-D and/or dicamba can provide effective control of many of these weeds. The addition of 2,4-D and/or dicamba to glyphosate also helps in the control of glyphosate-tolerant and resistant weeds such as marestail.

Valor herbicide may be added to glyphosate at a rate of 1 or 2 ounces/acre in the spring to enhance burndown and provide 30 to 60 days of residual weed control.

June-July-August

Dry, warm conditions at this time of year frequently result in drought-stressed weeds that may be difficult to control with herbicides, especially glyphosate. However, these same conditions result in rapid wilting and death of plants disturbed by shallow tillage. Non-inversion tillage maintains crop residues at the soil surface for greater protection against soil erosion. Deep tillage is not recommended at his time of year because it can be very difficult to firm the soil and prepare a good seedbed if adequate rainfall is not received.

Herbicides can provide effective weed control during this phase of the fallow period, but it may require higher use rates, less reliance on glyphosate, or both. Herbicides with long soil residuals should be avoided. Herbicides such as glyphosate and 2,4-D will be the mainstay of weed control during this time period. If grass weeds are showing signs of significant drought stress, consider substituting paraquat for glyphosate. Be sure to add spray-grade ammonium sulfate at 17 pounds/100 gallons of spray solution to improve glyphosate activity on stressed plants.

Do not plant winter wheat for 15 days following an application of 2,4-D. If 2,4-D is applied when the air temperature is 80°F or higher, consider using the amine formulation if vapor spray drift could be a problem in the area.

Weed growth at this time of year will be rapid and water use will be high, so do not allow weeds to grow for very long before controlling them .

September

In tilled systems, a rodweeder should be used just prior to wheat seeding to control small emerged weeds and create a firm seedbed. In no-till systems, glyphosate should be used just prior to seeding to ensure a weed-free seedbed. Sharpen ™ herbicide, a new product from BASF, can be tank mixed with glyphosate at a rate of 1 to 2 ounces/acre to enhance burndown and provide residual control in winter wheat of fall emerging broadleaf weeds such as the mustards, field pennycress, and marestail (Table 2). Residual control is improved by using the 2 ounce/acre rate.

Table 2. Tumble mustard control with Sharpen applied preplant to winter wheat.

		Tumble mustard control	
Treatment*	Rate	10/28/08	4/29/09
	oz/acre	------------ %	------------
Check		0	0
Sharpen	0.72	99	93
COC	1% v/v		
Roundup	32	83	64
NIS	0.25% v/v		
Sharpen	0.72	95	86
Roundup	32		
COC	1% v/v		
Sharpen	1.52	100	99
Roundup	32		
COC	1% v/v		
2,4-D amine	16	99	88
Roundup	32		
NIS	0.25% v/v		
LSD (5%)		5	13

*AMS was added to all herbicide treatments at the rate of 17 pounds/100 gallons of spray solution.

Perennial Weed Control

Summer fallow is an excellent time to concentrate on perennial weed control such as Canada thistle. Herbicides and herbicide rates can be used during fallow that would cause significant crop injury if used during a cropping season. For example, Curtail® herbicide can be applied at a rate of 4 pints/acre during fallow. The maximum use rate in winter wheat is 2 pints/acre. It is also easier to time the application for maximum performance during fallow. The majority of basal leaves should be emerged before application and this is not always possible in winter wheat because Curtail must be applied prior to winter wheat jointing. Tordon 22K may also be used at a rate of 0.5 to 1 pint/acre with 1 to 2 pints/acre of 2,4-D ester (4L) in the fall one year before seeding wheat.

Field bindweed is another common perennial weed that should be worked on during fallow. Apply 1 quart/acre of 2,4-D ester (4L) with or without dicamba at 0.5 to 1 pint/acre in the late summer or fall to vigorously growing plants or in the following spring at the flower bud stage. As with Canada thistle, Tordon 22K may be used at a rate of 0.5 to 1 pint/acre with 1 to 2 pints/acre of 2,4-D ester (4L) in the fall one year before seeding winter wheat. Paramount® herbicide may be applied in the fall, just prior to the first killing frost at a rate of 5.3 to 8.0 ounces/acre. Paramount may also be applied at a rate of 5.3 ounces/acre preplant to winter wheat. Winter wheat should be seeded at least 1 inch deep or crop injury could occur.

Weed control in fallow – Part II

Effect of Volunteer Roundup Ready Corn on Winter Wheat
J. Holman, A. Schlegel, B. Olson[2], S. Maxwell, and T. Dumler

Overview

In a wheat-corn-fallow rotation, volunteer corn can be a problem when Roundup Ready hybrids are used. During the fallow period between corn harvest in the fall and wheat planting the following fall, producers often control weeds with glyphosate or tank mixes of glyphosate and 2,4-D or dicamba. None of those herbicide treatments will control Roundup Ready volunteer corn. To control volunteer Roundup Ready corn, a postemergence grass herbicide such as Select, Assure II, or Poast Plus must be used.

It is believed that volunteer corn will reduce the amount of soil moisture during the fallow period and subsequently affect the following winter wheat crop. In years with average precipitation and growing conditions, wheat yield was reduced 1 bu A^{-1} for every 200 volunteer corn plants A^{-1} at Colby, KS, and at Tribune, KS, the first bushel of wheat yield was lost when volunteer corn density was 75 plants A^{-1}. Producer fields averaged 455 volunteer corn plants A^{-1}. On the basis of the test results in Colby and Tribune from 2008, a density of 455 plants A^{-1} would cause an estimated wheat yield loss of 4.3 bu A^{-1}. The estimated breakeven cost to apply a selective postemergence herbicide, like Select, to volunteer corn would be approximately 250 plants A^{-1} with the price of wheat at \$5.00 bu^{-1} and the cost of herbicide plus application at \$14.00 A^{-1} .

Conclusion

1. In very dry years and low yield environments such as Tribune in 2009 volunteer corn did not affect wheat tiller density, grain yield or test weight due to already very poor crop performance. In very wet years and high yield environments such as Garden City in 2009 volunteer corn did not affect wheat tiller density, and had no effect to a slight increase in wheat grain yield and test weight. The positive affect of volunteer corn on wheat were likely some of the same positive benefits observed with cover crops in non moisture limiting environments. In "average" years volunteer corn negatively impacted wheat tiller density and grain yield, and had minimal affect on grain test weight.
2. Production fields averaged 500 volunteer corn plants per acre across the three years. In a year with average precipitation, this would result in a wheat yield loss of 4.6 bu A^{-1}.
3. The herbicide cost to treat the entire field for volunteer corn with Select during the fallow period is about \$10 A^{-1} (for the product only, excluding application cost). A volunteer corn density of 250 plants A^{-1} would cause an estimated 2.7 bu A^{-1} wheat yield loss. The price of wheat and herbicide will influence the amount that can be spent to control volunteer corn. With wheat at about \$5.00 bu A^{-1}, a yield loss of 2.7 bu A^{-1} would result in a loss of about \$13.50 A^{-1}. That would be near the breakeven cost to apply herbicide to the entire field with a volunteer corn density of 250 plants A^{-1}. A field could be spot sprayed to reduce the cost of inputs or Select, Assure, or Poast Plus could be used in place of Roundup for sequential herbicide applications in fallow.

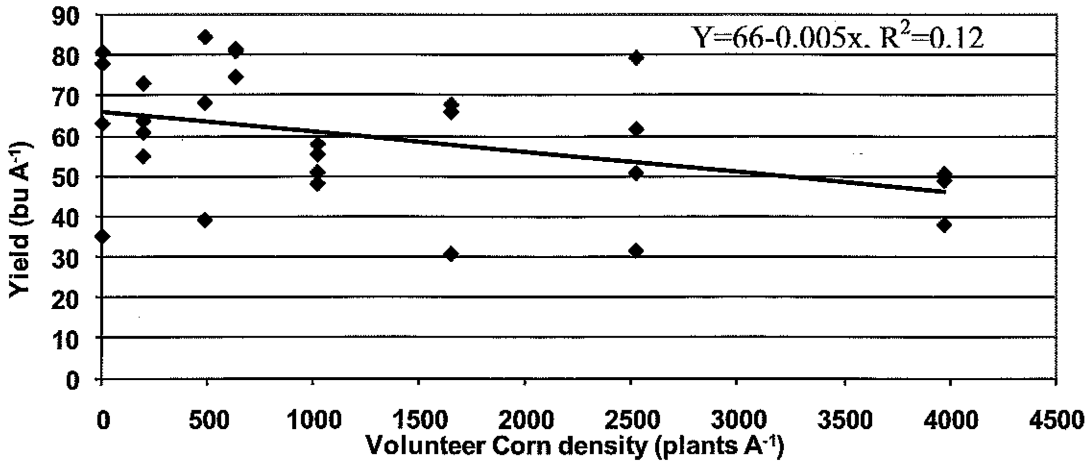


Figure 1. Wheat yield response to 2007 volunteer corn density at Colby, 2008.

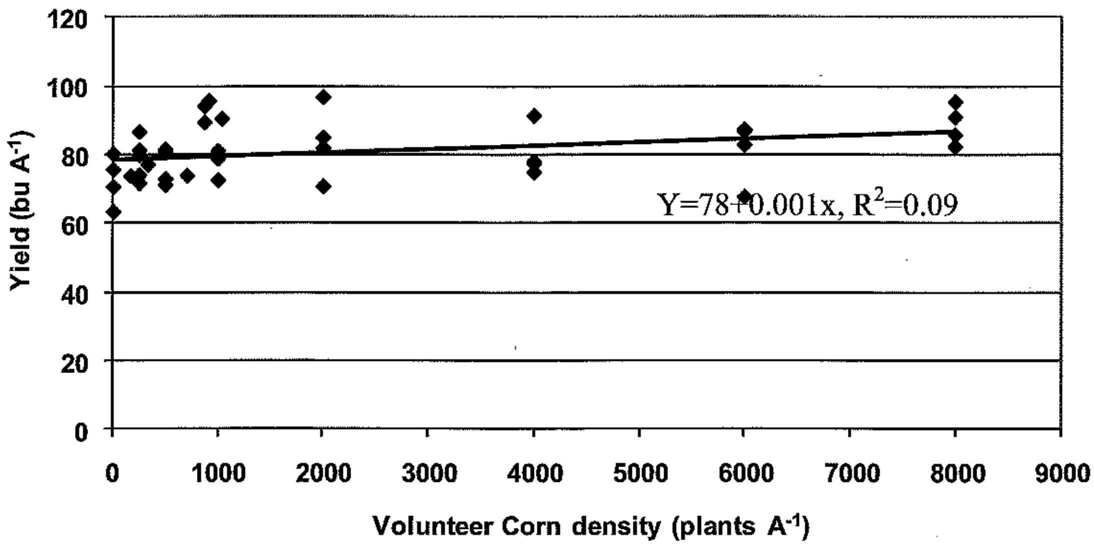


Figure 2. Wheat yield response to 2008 volunteer corn density at Garden City, 2009.

Implementing forages in no-till rotations – Mark Watson

Watson Brothers Partnership is a family farming operation consisting of Bruce and Mark Watson. Bruce's son John also works for us when not attending college. Our farm was homesteaded by our great grandparents in 1891 and has been a family farm for four generations.

We began no till crop production in the late 1980's and moved to a complete continuous no till farming system on our dry land and irrigated acres in 1994. During this time we have experimented with several alternative crops looking for the most profitable crop rotation.

The soil types on our farm range from Valient fine sand to an Alliance silt loam. Our silt loam soils are shallow, with a couple of feet of silt loam and underneath a while calcareous rock type soil. Our soils have moisture holding capacities of 4-6 inches in a four foot soil profile. Another challenge we have is our semi-arid climate with an annual precipitation of 15.12 inches.

Over the years we have used several crop rotations on our dry land acres in an attempt to develop the most profitable crop rotation. The problem we ran into was finding a rotation which gave us the best opportunity to produce winter wheat. Our feeling is that winter wheat is the most consistent and profitable crop in our rotation and we wanted to give the winter wheat the best opportunity for success.

The problem we ran into with most rotations was the crop before wheat, such as proso millet, edible beans, chickpeas and sunflower put our winter wheat crop at a distinct disadvantage. We then began looking at field peas as or crop before winter wheat.

The crop rotation that we have settled on is winter wheat, followed by corn or proso millet, field peas, and back to winter wheat. The challenge with the field peas is developing a market for the crop. There have been numerous studies done by several universities around the region, particularly North Dakota, showing the benefit of including field peas in cattle receiving and finishing rations. Field peas have also proven to be an excellent binder in the production of cake for cow/calf operators.

Field peas proved to be an excellent crop for rotating back to winter wheat. Once you have produced your own seed the peas are relatively inexpensive to raise and mature in early July which allows for a fallow period before winter wheat planting. The peas are also excellent producers of nitrogen which is utilized by the following crops.

The other alternative for cattle grazing is the planting of forage cocktails on dry land acres. This system of spring, summer, and fall forages provides high quality grazing for producers who have cattle in their operation. The forages improve the quality of the soil; provide nitrogen for grain crops, and excellent grazing for cattle.

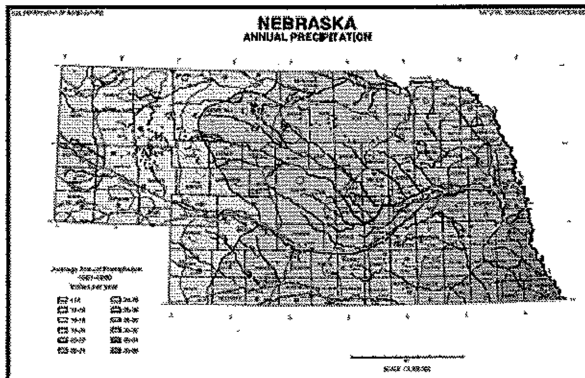
We planted forages for a neighbor since we don't have cattle in our operation. A 40 acre field was divided in half, with a spring forage mix planted on 20 acres and a summer forage mix planted on the other 20 acres. Each 20 acre pasture was divided into 3 separate paddocks for grazing. 40 bred heifers grazed a total of 11 weeks on the 40 acres of land.

Problems with the grazing that occurred were too few cattle to keep up with the growth of the forage. The other problem we saw was our timing of grazing. We should have begun grazing sooner with more rotational grazing. Had we timed the grazing properly, we felt we could have gained an additional 4-5 weeks of grazing off these forages.

We still have a lot to learn as far as managing these forages. The benefit we see in this type of grazing rotation is providing high quality forage for the cattle, giving the pastures a rest during the season to improve the quality of the pastures, and being able to incorporate grain production into this rotation at any time. The forages will also break up persistent weed and disease cycles, and provide nitrogen for the following grain crop.

Watson Brother's Partnership

- 3,000 acres total
- [illegible] center pivots
- [illegible] acres dry land
- [illegible] crop no till



Alliance –15.12 Inches Annual Precipitation

Soil Types

- Valent Fine Sand
- Water Holding Capacity- .96 inches/foot
- [illegible] and Alliance Silt Loam
- [illegible]

Moisture and Cropping Intensity

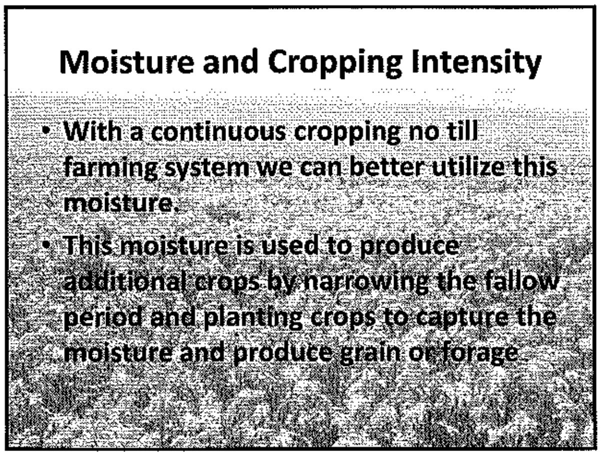
- We receive 15.12 inches of precipitation on average.
- In a Conventional wheat/fallow farming system: Wheat is harvested in July
- 14 month fallow period
- July- September of following year
- **Average rainfall 18.99 inches**

Moisture and Cropping Intensity

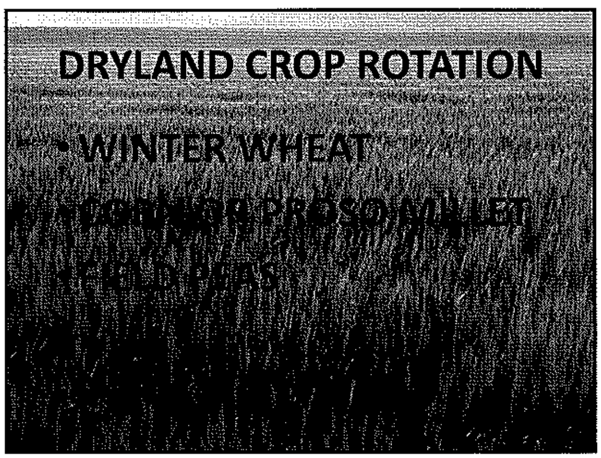
- Our soils store .96 inches (sand) - 2.16 inches (silt loam) of moisture/foot of soil
- In a 4 foot soil profile we can store only 3.84 - 8.64 inches of moisture
- Most soils aren't this deep!
- **We are losing 10.35- 15.15 inches of moisture during the fallow period**

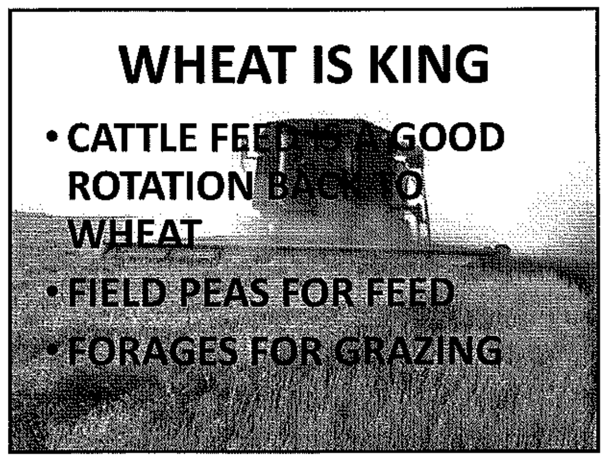
Moisture and Cropping Intensity

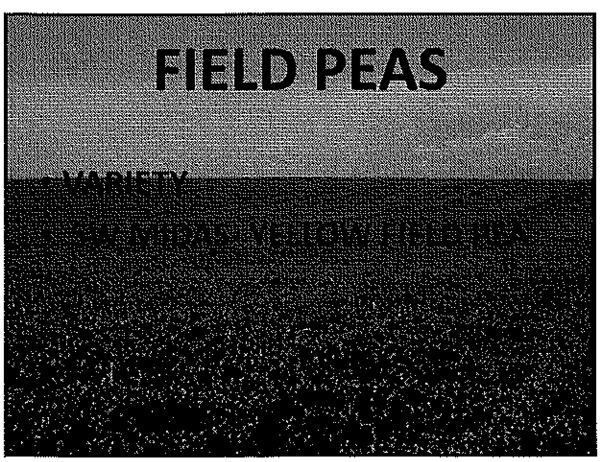
- WHEAT FALLOW SYSTEM FROM HARVEST TO HARVEST:
- 30.3 INCHES OF PRECIPITATION TO RAISE 35 BUSHELS OF WHEAT!

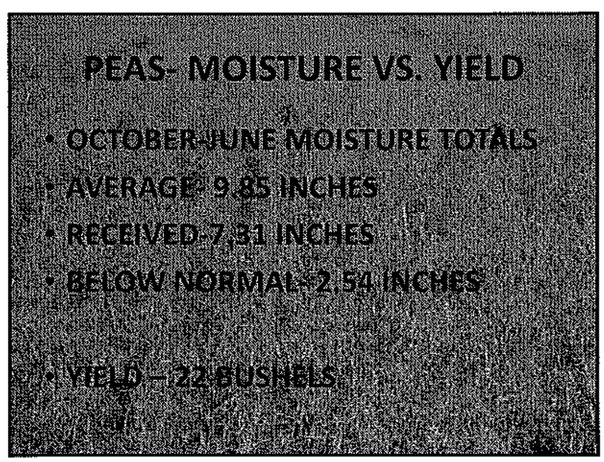

Moisture and Cropping Intensity
• With a continuous cropping no till farming system we can better utilize this moisture.
• This moisture is used to produce additional crops by narrowing the fallow period and planting crops to capture the moisture and produce grain or forage.

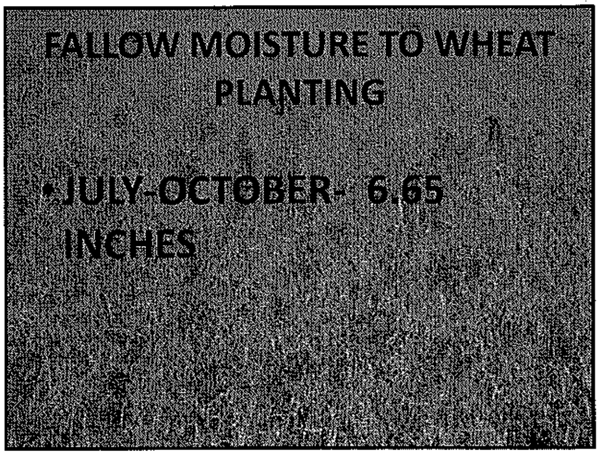

ALTERNATIVE CROPS-WHEAT
• PROSO MILLET
• CORN
• EDIBLE BEANS

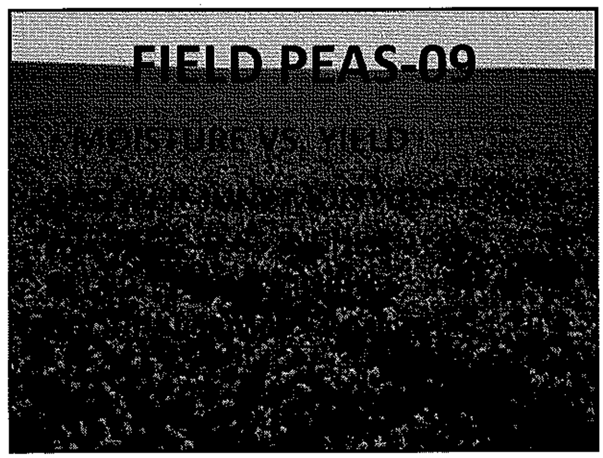

DRYLAND CROP ROTATION
• WINTER WHEAT
• CORN OR PROSO MILLET

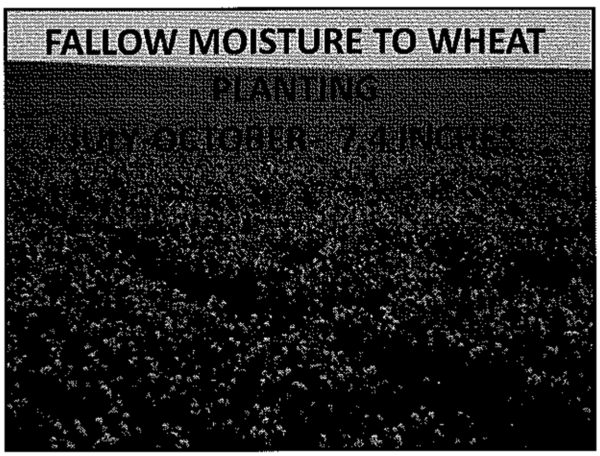

WHEAT IS KING
• FIELD PEAS FOR FEED
• FORAGES FOR GRAZING

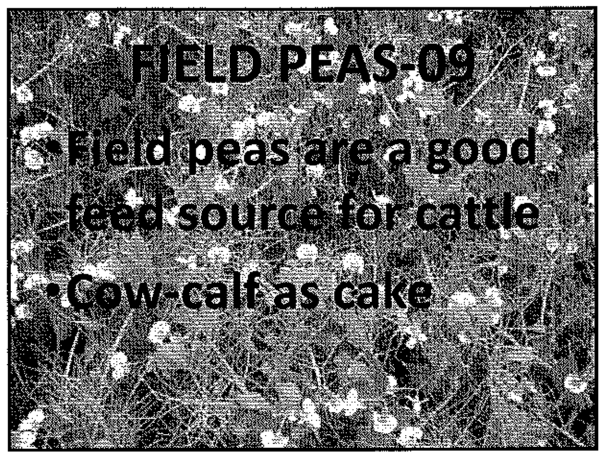

FIELD PEAS
• VARIETY

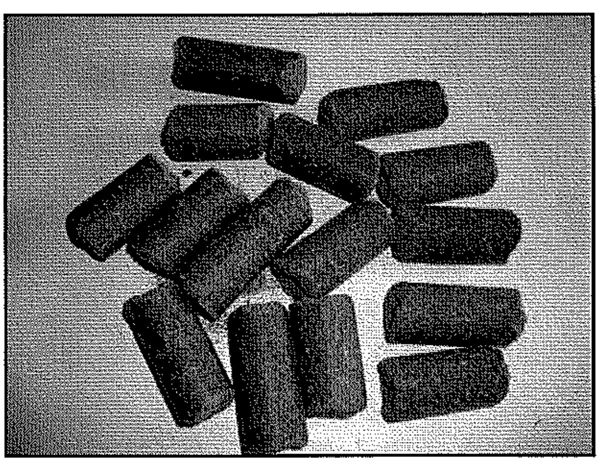

PEAS- MOISTURE VS. YIELD
• OCTOBER-JUNE MOISTURE TOTALS
• AVERAGE 9.85 INCHES
• RECEIVED 7.31 INCHES
• BELOW NORMAL 2.54 INCHES
• YIELD – 22 BUSHELS

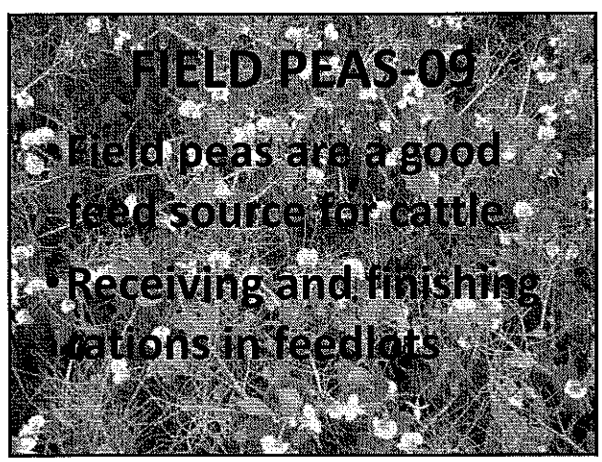

FALLOW MOISTURE TO WHEAT
PLANTING
•JULY-OCTOBER- 6.65
INCHES

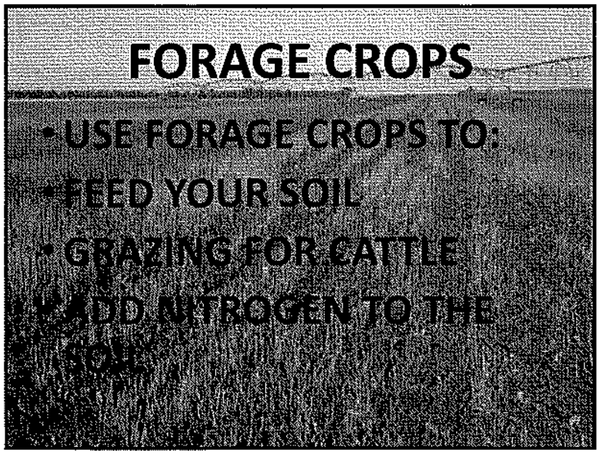

FIELD PEAS-09
•MOISTURE VS. YIELD

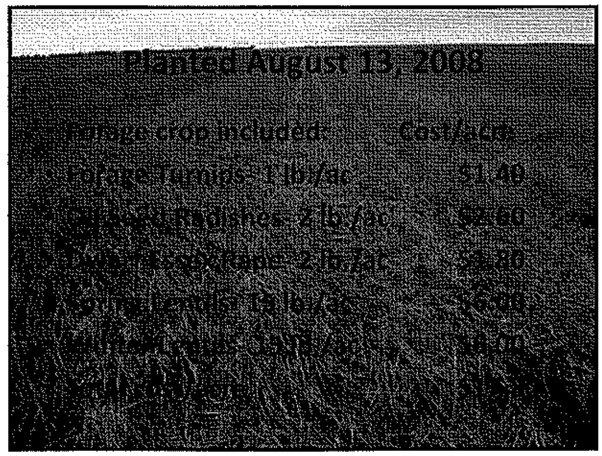

FALLOW MOISTURE TO WHEAT
PLANTING

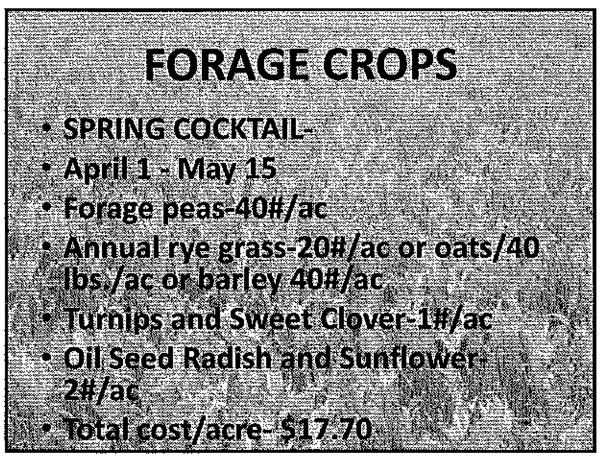

FIELD PEAS-09
•Field peas are a good feed source for cattle
•Cow-calf as cake

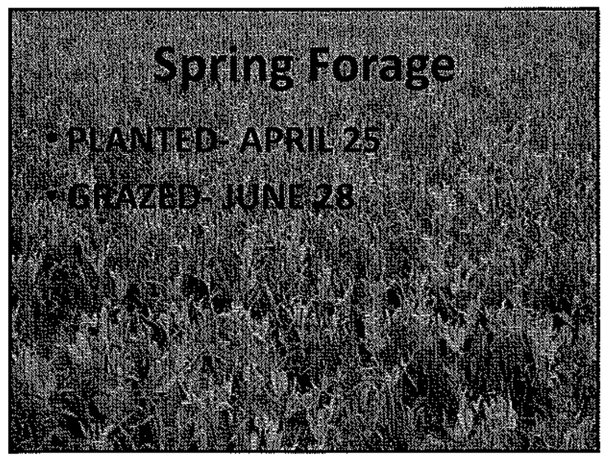


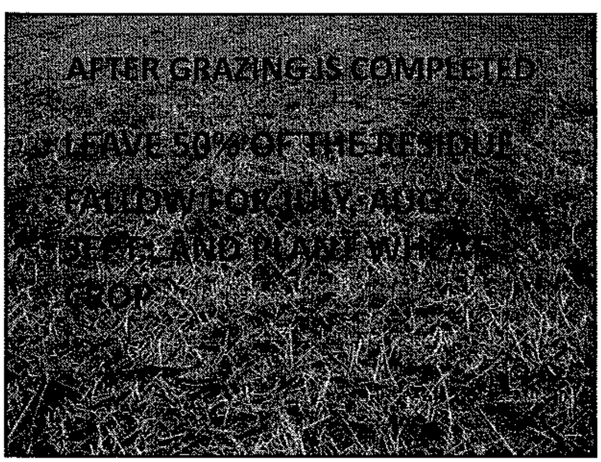

FIELD PEAS-09
•Field peas are a good feed source for cattle
•Receiving and finishing rations in feedlots

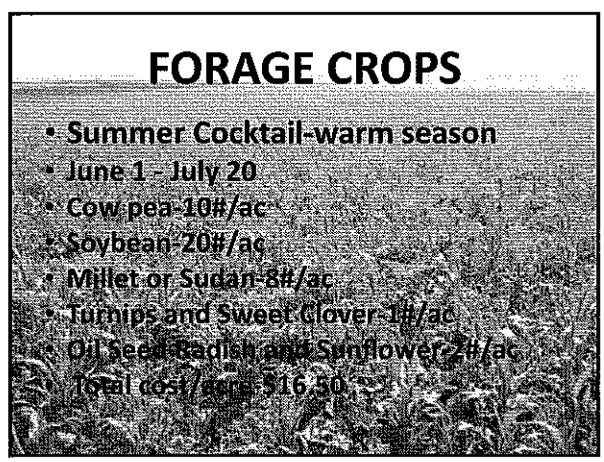

FORAGE CROPS
• USE FORAGE CROPS TO:
• FEED YOUR SOIL
• GRAZING FOR CATTLE
• ADD NITROGEN TO THE SOIL

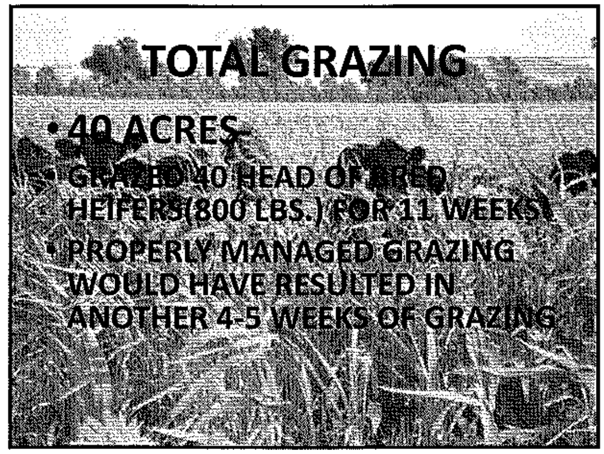

Planted August 13, 2008
Forage crop included: Cost/acre
Forage Turnips- 1 lb/ac $1.40


FORAGE CROPS
• SPRING COCKTAIL-
• April 1 - May 15
• Forage peas-40#/ac
• Annual rye grass-20#/ac or oats/40 lbs./ac or barley 40#/ac
• Turnips and Sweet Clover-1#/ac
• Oil Seed Radish and Sunflower-2#/ac
• Total cost/acre- $17.70


Spring Forage
• PLANTED- APRIL 25
• GRAZED- JUNE 28


AFTER GRAZING IS COMPLETED


FORAGE CROPS
• Summer Cocktail-warm season
• June 1 - July 20
• Cow pea-10#/ac
• Soybean-20#/ac
• Millet or Sudan-8#/ac
• Turnips and Sweet Clover-1#/ac
• Oil Seed Radish and Sunflower-2#/ac
• Total cost/acre-$16.50


TOTAL GRAZING
• 40 ACRES
• GRAZED 40 HEAD OF BRED HEIFERS(800 LBS.) FOR 11 WEEKS
• PROPERLY MANAGED GRAZING WOULD HAVE RESULTED IN ANOTHER 4-5 WEEKS OF GRAZING


FORAGE CROPS
• Fall Cocktail-cool season
• July 20-Sept.10
• Winter Wheat or Triticale-75#/ac
• Hairy Vetch-8#/ac
• Turnip, Red Clover, Sweet Clover 1#/ac
• Oil Seed Radish 2#/ac
• Possibly Buckwheat in September 6-8#/ac
• Total cost/acre-$24.00

NITROGEN MANAGEMENT FOR NO-TILLAGE CORN AND GRAIN SORGHUM PRODUCTION

W.B. Gordon

SUMMARY

No-tillage production systems are being used by an increasing number of producers in the central Great Plains because of several advantages that include reduction of soil erosion, increased soil water use-efficiency, and improved soil quality. However, the large amount of residue left on the soil surface can make nitrogen management difficult. Surface applications of urea containing fertilizers are subject to volatilization losses. Leaching can also be a problem on course textured soils when N is applied in one preplant application. Slow-release polymer coated urea products are beginning to become available for agricultural use. The polymer coating allows the urea to be released at a slower rate than uncoated urea. The use of urease inhititors applied with urea-containing fertilizers can reduce volatilization losses. Recently, a new product that is a co-polymer of maleic and itaconic acids has become available (Nutrisphere-N) and has shown potential in reducing urea-N losses. A three-year irrigated corn study compared urea (46% N), UAN (28%) a controlled release polymer coated urea (ESN), Agrotain, Agrotain Plus+, Nutrisphere –N[1] and ammonium nitrate at 3 nitrogen (N) rates (80, 160, and 240 lbs/a). A no n check plot also was included. The study was conducted on Crete silt loam soil. The treated urea products yielded better than the untreated urea, and were similar to ammonium nitrate. There were no significant differences in yield of ESN, Agrotain, or Nutrisphere-N. In the corn experiment that included UAN (28%), yield of UAN treated with Agrotain Plus or Nutrisphere-N was greater than that of untreated UAN. A two year study was also conducted to compare banding and broadcasting of urea-containing fertilizers. With both urea and UAN banding resulted in greater yields than broadcasting on the soil surface. The use of fertilizer additives however, still resulted in additional yield increases even when banding. If producers wish to broadcast urea-containing fertilizer on the soil surface in no-tillage production systems banding is more effective than broadcasting and there are several products available that are very effective in limiting N losses and increasing N–use efficiency.

INTRODUCTION

Surface application of N fertilizers is a popular practice with producers. N losses due to volatilization from broadcast urea-containing fertilizers in no-tillage production systems can be significant. Depending on conditions, losses can be 10-20% of the applied N. Nitrogen immobilization can also be a problem when N fertilizers are surface applied in high residue production systems. Nitrogen leaching can be both an agronomic and environmental problem on course-textured soils. Polymer coated urea, long used in turf fertilization, has the potential to make N management more efficient when surface applied in no-tillage agricultural systems. The urea granule is coated, but allows water to diffuse across the membrane. N release is then controlled by temperature. A polymer-coated urea product is now available for crop use and is marketed under the name of ESN. The use of urease inhititors applied with urea-containing fertilizers can reduce volatilization losses. In the soil urea is hydrolyzed relatively quickly by the

[1] Mention of a specific trade name is for reader information and does not imply endorsement by the author or Kansas State University.

soil enzyme urease. Agrotain, a commercially available urease inhititor, and has in numerous studies proven to be effective in reducing N losses due to volatilization. Agrotain Plus is a product that contains both a urease inhibitor and a nitrification inhibitor (DCD). Recently, a new product that is a co-polymer of maleic and itaconic acids has become available (Nutrisphere-N) that has shown potential in reducing urea-N losses. The cation nickel is essential for the action of urease, Nutisphere-N is thought to sequester or inactivate the nickel ions rendering urease inactive. In addition Nutrisphere-N also blocks nitrification through action on soil bacteria. The objective of these experiments were to evaluate N efficiency from surface broadcast applications of urea-containing N and to try to reduce N loss and improve efficiency with the use of products designed to limit N volatilization and loss.

METHODS

Irrigated experiments were conducted at the North Central Kansas Experiment Field on a Crete silt loam soil from 2005-2007. Soil test information from the site: soil pH was 7.0; organic matter was 2.8%; Bray-1 P was 28 ppm, and exchangeable K was 240 ppm. The previous crop was corn. The corn hybrid DeKalb DKC 60-19 was planted without tillage into corn stubble in late April each year of the 3-year study at the rate of 31,000 seeds/acre. Nitrogen was applied on the soil surface immediately after planting. Treatments consisted of controlled released polymer-coated urea (ESN), Nutrisphere-N coated urea, Agrotain coated urea, urea, and ammonium nitrate applied at 3 rates (80, 160, and 240 lbs/a). A no N check plot also was included. Additional treatments included UAN (28%), Agrotain treated UAN, Agrotain Plus+ treated UAN, and Nutrisphere-N treated UAN. An additional experiment was conducted for two years (2008-2009) that included banded verses broadcast nitrogen treatments with both urea and UAN. The experimental area was adequately irrigated throughout the growing season in both experiments.

RESULTS

In the first experiment, grain yield of irrigated corn plots receiving untreated urea were lower than plots receiving urea treated with Agrotain, ESN or Nutrisphere-N at all levels of applied N (Table 1). Yields achieved with Agrotain, ESN, and Nutrisphere were equal to those of ammonium nitrate. Yield of UAN (28%) was also lower than those of UAN treated with Agrotain, Agrotain Plus+, or Nutrisphere-N. When averaged over N-rates, yields of all treated N products were greater than untreated urea or UAN (Table 2). There were no significant differences in yields of Agrotain, Agrotain Plus+, ESN, and Nutrisphere-N. The lower yields with urea and UAN indicate that volatilization of N may have been significant problem.

In the second experiment that included comparisons of broadcast verses banded urea and UAN, there were no significant differences in yield of ESN and Nutrisphere-N, however, urea+Agrotain+ did not perform as well. In 2008 there were no differences in performance of the three products, but in 2009 the yields obtained with the urea+ Agrotain+ were significantly less than that of the other two products. Conditions after application in 2009 were very dry and that may have affected the efficacy of the Agrotain Plus+. Yield of UAN treated with Agrotain Plus+ or Nutrisphere-N was greater than that of untreated UAN. Banding urea containing products was more effective than broadcasting, but greatest yields were achieved with the use of the additive products. If producers wish to broadcast urea-containing fertilizer on the soil surface in no-tillage production systems there are several products available that are very effective in limiting N losses and increasing N–use efficiency.

Results of this study suggest that the efficiency of surface broadcast urea-containing fertilizers in no-tillage production systems can be improved by use of several products that are effective in reducing N volatilization losses.

Table 1. Effects of N source and rate on corn grain yield, earleaf N, and grain N, Scandia, (2005-2007).

N Source	N-Rate	Yield	Earleaf N	Grain N
	lb/acre	bu/acre	%	%
	0-N check	152.2	1.72	1.13
Urea	80	152.0	2.30	1.22
	160	169.3	2.65	1.26
	240	183.1	2.68	1.30
ESN	80	171.6	2.89	1.28
	160	186.6	2.95	1.32
	240	196.9	3.05	1.40
Nutrisphere-N	80	165.8	2.89	1.29
	160	187.7	2.94	1.36
	240	196.9	3.06	1.41
Urea+Agrotain	80	171.6	2.91	1.30
	160	179.7	2.96	1.36
	240	196.6	3.04	1.38
UAN (28%)	80	156.6	2.45	1.24
	160	167.0	2.69	1.28
	240	180.8	2.74	1.27
UAN+Agrotain	80	170.5	2.88	1.30
	160	191.2	2.98	1.35
	240	195.8	3.03	1.39
UAN+Agrotain Plus+	80	168.2	2.90	1.31
	160	185.4	2.99	1.38
	240	195.8	3.08	1.42
UAN+Nutrisphere-N	80	170.5	2.87	1.30
	160	192.0	3.01	1.38
	240	195.8	3.04	1.41
Ammonium Nitrate	80	173.9	2.86	1.30
	160	187.8	2.96	1.35
	240	195.8	3.05	1.40
Average(not including check)		181.1	2.88	1.33

Table 2. Effects of N (av. over rate) on corn yield, earleaf-N and grain-N, Scandia (05-07).

Treatment	Yield,bu/acre	Earleaf-N, %	Grain N, %
No N check	152.0	1.72	1.13
Urea	168.1	2.52	1.26
ESN	185.0	2.96	1.33
Nutrisphere-N	183.5	2.96	1.35
Urea+Agrotain	182.6	2.97	1.35
UAN	168.1	2.62	1.26
UAN+Agrotain	185.8	2.96	1.35
UAN+Agrotain Plus+	183.1	2.99	1.37
UAN+Nutrisphere-N	186.1	2.97	1.36
Ammonium Nitrate	185.8	2.96	1.35
LSD (0.05)	6.2	0.09	0.04
CV%	6.8	4.5	4.9

Table 3. N-Rate and granular N-source effects on corn grain yield (2008-2009).

N-Rate	Urea	ESN	Urea+NSN	Urea+Agrotain+
		bu/acre		
80	204.4	243.4	244.7	233.0
160	233.3	262.6	267.8	255.3
240	246.2	272.5	272.8	263.4
Average	**227.9**	**259.5**	**261.8**	**250.6**
LSD(0.05)=10.3				
CV%=4.1				

No N Check=154.9 bu/a

Table 4. N-Rate and liquid N-source effects on corn grain yield (2008-2009.

N-Rate	UAN	UAN+NSN	UAN+Agrotain+
		bu/acre	
80	224.3	245.9	234.9
160	233.4	271.9	258.1
240	252.7	273.4	263.9
Average	**236.8**	**263.7**	**252.3**
LSD(0.05)=10.3			
CV%=4.1			

No N Check=154.9 bu

Table 5. N-Rate and method of application effects on corn grain yield (2008-2009).

N-Rate	Urea, Broadcast	Urea, Band	UAN, Broadcast	UAN, Band
		bu/acre		
80	204.4	211.0	224.3	227.0
160	233.3	246.3	233.4	241.6
240	246.2	257.6	252.7	262.8
Average	**227.9**	**238.3**	**236.8**	**243.8**
LSD (0.05)=10.3	CV%=4.1			

FOUR ROTATIONS WITH WHEAT AND GRAIN SORGHUM

Alan Schlegel, Troy Dumler, and Curtis Thompson

SUMMARY

Research on 4-year crop rotations with wheat and grain sorghum was initiated at the Kansas State University (KSU) Southwest Research-Extension Center (SWREC) near Tribune in 1996. Rotations were wheat-wheat-sorghum-fallow (WWSF) and wheat-sorghum-sorghum-fallow (WSSF) along with continuous wheat (WW). Soil water at wheat planting averages about 9 in. following sorghum, which is about 3 in. more than the second wheat crop in a WWSF rotation. Soil water at sorghum planting was approximately 1.2 in. less for the second sorghum crop compared with sorghum following wheat. Grain yield of recrop wheat averaged about 80% of wheat following sorghum; grain yield of continuous wheat averaged about 70% of the yield of wheat grown in a 4-year rotation following sorghum. In most years, recrop wheat and continuous wheat yielded similarly, however in 2009, recrop wheat yielded more than wheat following sorghum. Wheat yields were similar following one or two sorghum crops. Similarly, average sorghum yields were the same following one or two wheat crops. Yield of the second sorghum crop in a WSSF rotation averages about 70% of the yield of the first sorghum crop.

INTRODUCTION

In recent years, cropping intensity has increased in dryland systems in western Kansas. The traditional wheat-fallow system is being replaced by wheat-summer crop-fallow rotations. With concurrent increases in no-till, is more intensive cropping feasible? Objectives of this research were to quantify soil water storage, crop water use and crop productivity of 4-year and continuous cropping systems.

PROCEDURES

Research on 4-year crop rotations with wheat and grain sorghum was initiated at the SWREC near Tribune in 1996. Rotations were WWSF, WSSF, and WW. No-till was used for all rotations. Available water was measured in the soil profile (0 to 8 ft) at planting and harvest of each crop. The center of each plot was machine harvested after physiological maturity, and yields were adjusted to 12.5% moisture.

RESULTS AND DISCUSSION

Soil Water

The amount of available water in the soil profile (0 to 6 ft) at wheat planting varied greatly from year to year (Fig. 1). Soil water was similar following fallow after either one or two sorghum crops and averaged, across the 12-year period, about 9 in. Water at planting of the second wheat crop in a WWSF rotation generally was less than the first wheat crop, except in 1997 and 2003. Soil water for the second wheat crop averaged more than 3 in, (or about 40%) less than the first wheat crop in the rotation. Continuous wheat averaged about 0.75 in. less water at planting than the second wheat crop in a WWSF rotation.

Similar to wheat, the amount of available water in the soil profile at sorghum planting varied greatly from year to year (Fig. 2). Soil water was similar following fallow after either one or two wheat crops and averaged (13 years) about 8 in. Water at planting of the second sorghum crop in a WSSF rotation was generally less than the first sorghum crop, except for 2008 when it was slightly greater. Averaged across the entire study period, the first sorghum crop had about 1.2 in. more available water at planting than the second crop.

Grain yields

Wheat yields were average in 2009 for wheat following fallow but considerably higher for recrop wheat (Table 1). Averaged across 13 years, recrop wheat (the second wheat crop in a WWSF rotation) yielded about 84% of the yield of first-year wheat in WWSF. Before 2003, recrop wheat yielded about 70% of the yield of first-year wheat. In 2003 and 2009, however, recrop wheat yields were much greater than the yield in all other rotations. For the 2003 recrop wheat, this is possibly due to failure of the first-year wheat in 2002 , which resulted in a period from 2000 sorghum harvest to 2003 wheat planting without a harvested crop. However, this was not the case for the 2009 recrop wheat. Generally, there has been little difference in wheat yields following one or two sorghum crops. In most years, continuous wheat yields have been similar to recrop wheat yields; however, in several years (2003, 2007, and 2009), recrop wheat yields were considerably greater than continuous wheat.

Sorghum yields in 2009 were greater than average for sorghum following wheat, although quite variable (Table 2). Sorghum yields in 2009 were similar following one or two wheat crops, which is consistent with the long-term average. The crop yield of recrop sorghum typically averages about 70% of the yield of the first sorghum crop while, in 2009, recrop sorghum yields were only about 50% of the yield of the first sorghum crop.

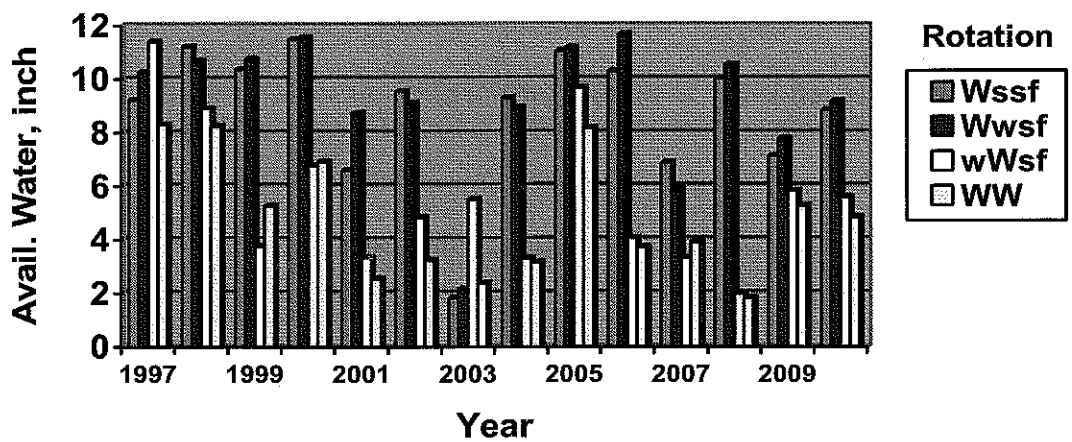


Figure 1. Available soil water at planting of wheat in several rotations, Tribune, 1997-2009. Capital letter denotes current crop in rotation.

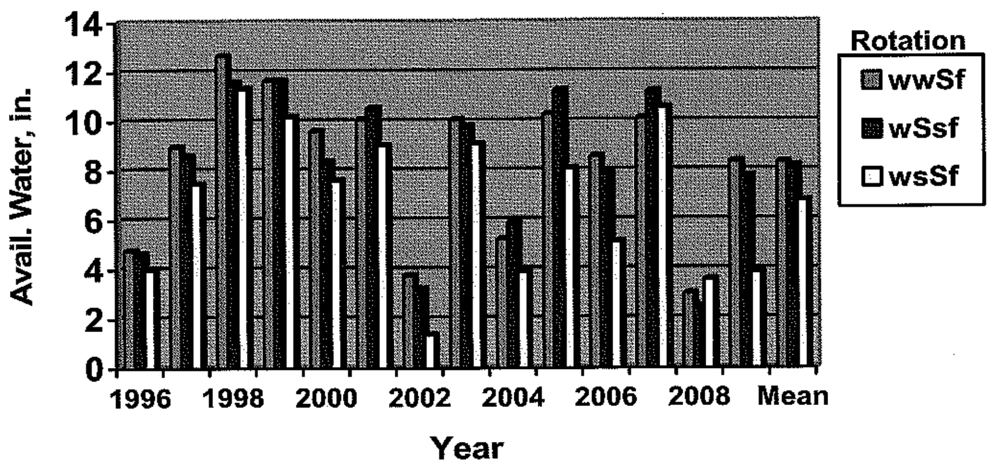


Figure 2. Available soil water at planting of sorghum in several rotations, Tribune, 96-09. Capital letter denotes current crop in rotation. Last set of bars is average across years.

Table 1. Wheat response to rotation, Tribune, 1997-2009

Rotation[a]	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Mean
							bu/a							
Wssf	57	70	74	46	22	0	29	6	45	28	75	40	37	41
Wwsf	55	64	80	35	29	0	27	6	40	26	61	40	39	39
wWsf	48	63	41	18	27	0	66	1	41	7	63	5	50	33
WW	43	60	43	18	34	0	30	1	44	2	41	6	24	27
$LSD_{0.05}$	8	12	14	10	14	---	14	2	10	8	14	5	15	3

[a] Capital letters denote current year crop.

Table 2. Grain sorghum response to rotation, Tribune, 1996-2009

Rotation[a]	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Mean
								bu/a							
wSsf	58	88	117	99	63	68	0	60	91	81	55	101	50	103	75
wsSf	35	45	100	74	23	66	0	41	79	69	13	86	30	89	73
wwSf	54	80	109	90	67	73	0	76	82	85	71	101	57	44	50
$LSD_{0.05}$	24	13	12	11	16	18	---	18	17	20	15	9	12	53	4

[a] Capital letters denote current year crop.

Long Term Crop Rotation Results

Rob Aiken and Brian Olson
Northwest Research—Extension Center

Introduction

Available water frequently limits productivity in semi-arid cropping systems. The wheat-grain-sorghum fallow system accumulates water over a 1.5 year period for each crop, spreading production risks over spring (winter wheat) and summer (grain sorghum) growing seasons. Tillage, providing weed control, often leaves the soil exposed to evaporative and erosive forces. The objectives of these studies are to compare tillage effects and fertilizer application timing on wheat and grain sorghum yields and to evaluate effects of intensive annual cropping on wheat water use, grain yield, and biomass productivity.

Procedure

Tillage effects on grain productivity of a wheat-grain sorghum-fallow crop sequence was evaluated using conventional sweep tillage (CT, as needed for weed control), no-tillage (NT, herbicides for weed control) or reduced tillage (CT after sorghum, NT after wheat). Fertilizer for wheat was applied either with coulters, prior to at planting or at spring green-up by dribbling on surface; for grain sorghum fertilizer was applied at planting. A separate, long-term cropping sequence study includes three-year cycles of wheat, feed grain (corn or grain sorghum) and oilseed (sunflower, soybean, canola or fallow).

Crop water use was measured by precipitation and change in soil profile water content from emergence to flowering to harvest (physiological maturity). Yield components (stand, mid-vegetative and harvest; flowering units, seed weight) and above-ground biomass were hand-sampled at maturity. Yields were adjusted to standard moisture contents.

Results

Tillage effects

Wheat yields (Table 1) were similar, with respect to tillage effects; however, spring application of N fertilizer reduced wheat yields, relative to fall application, in 2008 and 2009, but not 2007.

Table 1. Wheat grain yields in a Wheat-Grain Sorghum-Fallow crop sequence at Colby, KS.

		Wheat Yields (bu/A @ 13% moisture)		
Tillage	**Fertilizer placement**	**2007**	**2008**	**2009**
CT	**Fall, coulter**	63.9	72.7	51.6
RT*	**Fall, coulter**	66.2	71.3	52.4
NT	**Fall, coulter**	57.0	76.6	57.1
NT	**Spring, surface**	62.2	66.3	38.8

*No-till after wheat harvest, sweep tillage for weed control after sorghum harvest

No-till resulted in greater yield for grain sorghum in 2007, but not in 2008 nor 2009 (Table 2), though reduced tillage (no till after wheat, sweeps after grain sorghum) resulted in numerically greater yields in 2008.

Table 2. Grain sorghum yields in a Wheat-Grain Sorghum-Fallow crop sequence at Colby, KS.

	Grain Sorghum Yields (bu/A @ 12.5% moisture)		
Tillage	**2007**	**2008**	**2009**
CT	68.5	103.0	104.4
RT*	69.5	119.5	101.0
NT	96.8	108.4	99.7

*No-till after wheat harvest, sweep tillage for weed control after sorghum harvest

Long-term crop sequence effects

Long-term crop sequence effects were reported in 2008 Cover Your Acres proceedings. In the 2008 growing season, continuous cropping reduced wheat yields, relative to wheat after fallow, consistent with the previous reported. However, in 2009, wheat productivity, in continuous-crop systems was similar to that of wheat after fallow.

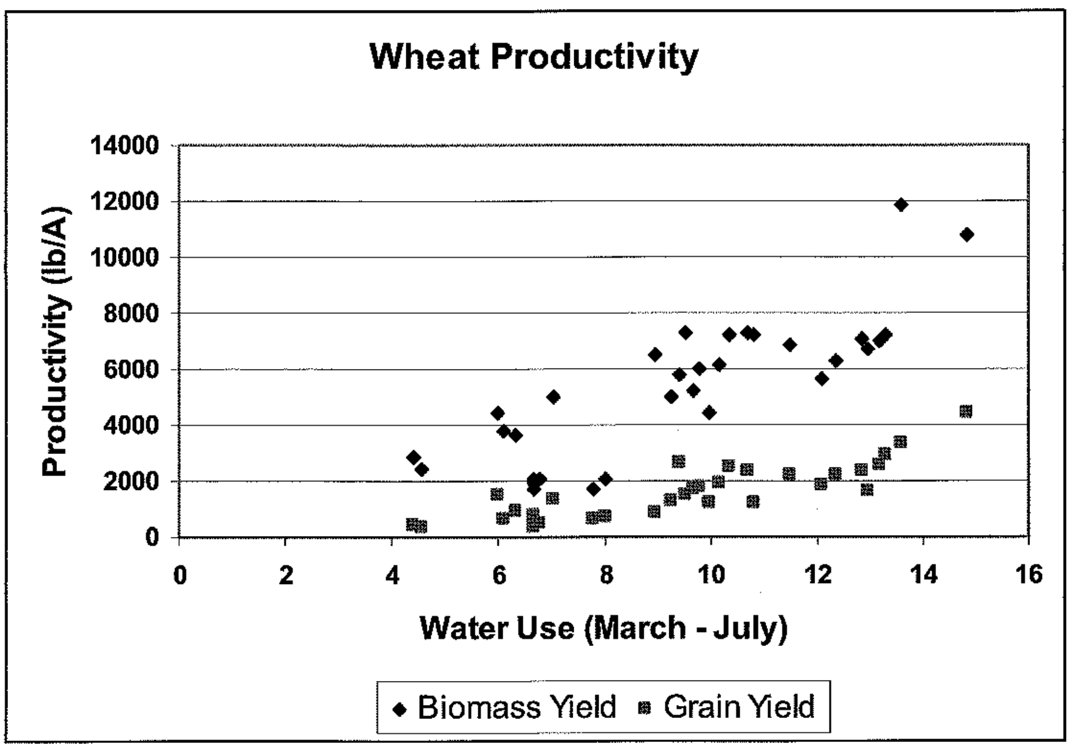


Figure 1. Effects crop water use, from spring green-up through harvest, on biomass productivity (diamond symbols) and grain yield (square symbols). Results from long-term crop sequence study, conducted at Colby, KS, 2002 – 2009.

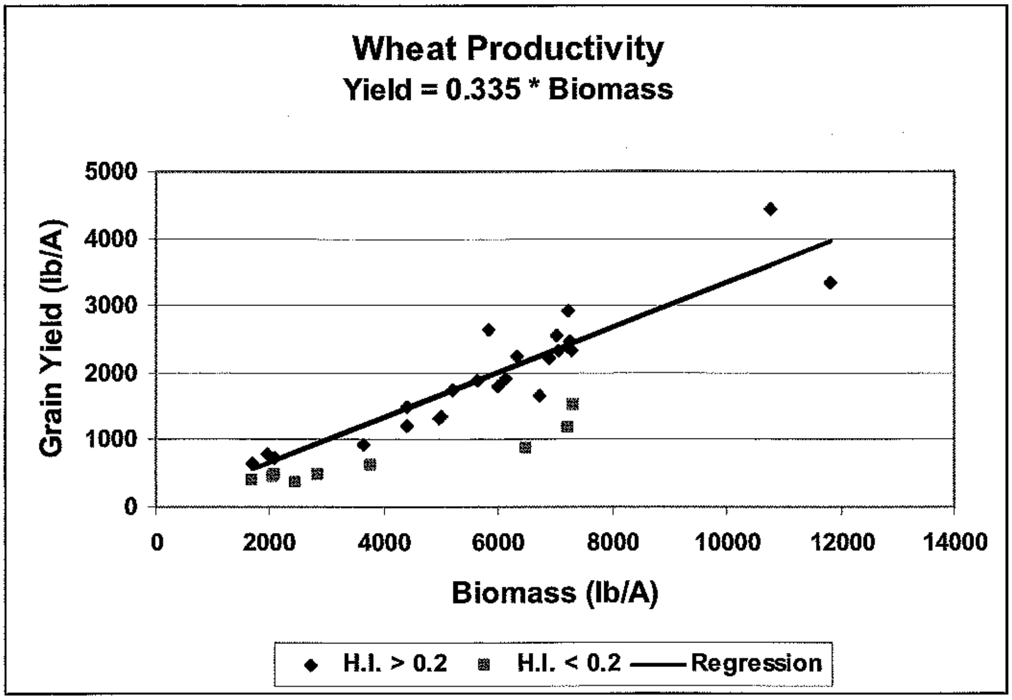


Figure 2. Harvest index (H.I.) is the fraction of above-ground biomass which is converted to grain. Under adequate growing conditions (where harvest index exceeded 0.2), harvest index corresponded to 0.335, or 33.5% of above-ground biomass. Reduced yield occurred under some conditions, due to smaller harvest index, rather than biomass productivity (where biomass productivity exceeded 6000 lb/A).

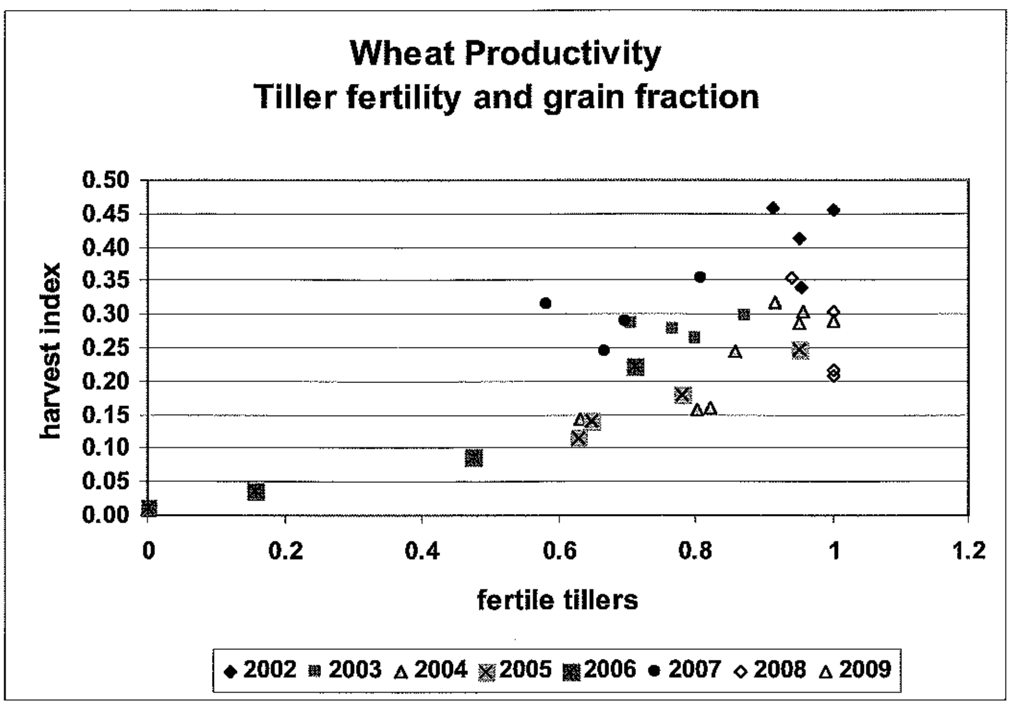


Figure 3. Small harvest index (less than 0.15) corresponded with fewer tillers which were fertile (viable head formation); this occurred in 2005 and 2006 for continuous-crop systems.

Converting CRP Land to Crop Production

Alan Schlegel

Kansas State University
Southwest Research-Extension Center
Tribune, Kansas

Cover Your Acres
19-20 December, 2010

Challenge of Cropping

- Prevent Soil Erosion
- Maintain Soil Quality
- Provide Farm Profitability
- Maintain Wildlife Habitat??

Cover Your Acres
19-20 January 2010

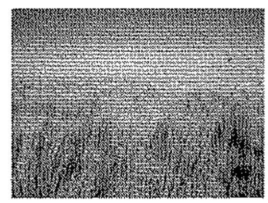
Objective

- Determine best management practices for returning CRP land to crop production in western Kansas.

Cover Your Acres
19-20 December, 2010

CRP Grasses

- Primary species:
  sideoats grama
  blue grama
  buffalograss
  little bluestem
  switchgrass



Cover Your Acres
19-20 December, 2010

Treatments

- Residue Pretreatment
  - –Burn, Mow, or Leave stand
- Grass Controls Methods
  - –Tillage, chemical, or both

Cover Your Acres
19-20 December, 2010

Grain Sorghum

- Conventional Tillage
  Disc: July & August
  Sweep Plow: September & June
- No-Till
  Glyphosate: July (2qt/a)
  Glyphosate: September (2qt/a)
  Glyphosate: June (1 qt/a)

Cover Your Acres
19-20 December, 2010

Sorghum Planting

Tillage	Burn	Mow	LS
	available water/6' profile		
Conv. Till	6.7	7.9	9.6
Reduced Till	7.1	9.4	--
No-till	5.7	8.3	10.3

Kuttler S96

Cover Your Acres
19-20 December, 2010

Grain Sorghum after Fallow

Tillage	Residue Treatment Burn	Mow	LS
	grain yield, bu/acre		
Conv. Till	31	26	24
Till-Chem	22	18	--
Chem-Till	12	14	--
No-till	6	8	5

$LSD_{0.05}$ 7 bu/a

S96

Cover Your Acres
19-20 December, 2010

Wheat

- Conventional Tillage:
  - July –Disc
  - August—Disc
  - September—Sweep Plow
  - June—Sweep Plow
  - July—Sweep Plow
  - September—Sweep Plow

Cover Your Acres
19-20 December, 2010

Wheat

- No-Till:
  - July —Glyphosate (2qt/a)
  - June —Glyphosate (2qt/a)
  - August—Glyphosate (2qt/a)

Cover Your Acres
19-20 December, 2010

Wheat Following CRP Residue Left Stand

	Wheat Grain Yield ($bu\ ac^{-1}$)			
N Rate ($lb\ ac^{-1}$)	0	50	100	150
Conv. Till	24	30	36	44
No-Till	7	16	28	34

W97

Cover Your Acres
19-20 December, 2010

Wheat Following CRP Residue Mowed

	Wheat Grain Yield ($bu\ ac^{-1}$)			
N Rate ($lb\ ac^{-1}$)	0	50	100	150
Conv. Till	17	29	37	40
Reduced Till	10	18	31	30
No-Till	8	17	27	32

W97

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Wheat Following CRP Residue Burned

	Wheat Grain Yield (bu ac^{-1})			
N Rate (lb ac^{-1})	0	50	100	150
Conv. Till	16	27	34	37
Reduced Till	12	23	28	33
No-Till	4	15	21	28

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Residue Treatment and Timing of Initial Tillage

- Time of Initial Tillage:
  - Fall vs. Spring
- Tillage:
  - Disc vs. Sweep Plow
- Residue Treatment:
  - Leave stand or burn
- Second tillage was the opposite of first.
- All then received sweep plow twice.
- N Rates: 0, 50, 100, and 150 lb N ac^{-1}

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Winter Wheat Following CRP

Fall Tillage Leave Residue Stand					
	Wheat Grain Yield (bu ac^{-1})				
	Nitrogen Rate (lb ac^{-1})				
Tillage Method	0	50	100	150	Mean
Disc	10	21	25	31	22
Sweep	8	17	26	31	21
Control:	1	6	8	11	6

$LSD_{0.05}$ treatment=10 N rate=2

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Winter Wheat Following CRP

Spring Tillage Leave Residue Stand					
	Nitrogen Rate (lb ac^{-1})				
Tillage Method	0	50	100	150	Mean
Disc	8	18	27	33	22
Sweep	11	18	26	32	22
Control:	1	6	8	11	6

$LSD_{0.05}$ treatment=10 N rate=2

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Winter Wheat Following CRP

Spring Tillage Burn Residue					
	Nitrogen Rate (lb ac^{-1})				
Tillage Method	0	50	100	150	Mean
Disc	9	17	26	34	21
Sweep	10	17	30	34	23
Control:	1	6	8	11	6

$LSD_{0.05}$ treatment=10 N rate=2

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Considerations

- Residue Removal
  - Burn, mow, or leave stand
- Elimination of CRP grasses
  - Tillage vs. chemical
- Soil Water
- Soil Nutrients – Fertilizer Placement
- Perennials weeds

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CRP conversion for grazing or haying

Sandy Johnson, livestock specialist

As CRP contracts expire, some landowners are considering what needs to be done to transition the acres into a productive grazing or haying enterprise. The obvious first concern is fencing and water. If water and fencing must be developed, it is an opportunity to do so in such a way that grazing distribution is optimized and to consider needs for alternative grazing systems.

Because of the mature height of the common grasses seeded in CRP acres in western Kansas, a stand can appear very productive but in reality be thin with large areas of bare ground between plants. A key to converting CRP acres into productive grazing or haying acres is to improve the quality of the stand. If no removal of plant material has occurred for five or more years, plants have a limited root system and low vigor. Tall grasses produce large amounts of standing dead material and shade young plants that try to grow.

Increasing plant density and vigor is the first step to improving the stand for use as pasture or hay. Spring burning is an effective method of removing the standing dead material and mulch to allow sunlight to reach the crown of the plant. If allowed to remain, previous years forage growth will dilute the diet of grazing animals and suppress growth of young plants. Burning will also help control undesirable plants such as the Eastern Red-cedar. Your local county extension office has materials about controlled burning and can help you find burn contractors or burn schools in your area.

Mowing or haying in March or April is another method to remove litter, although hay removed at this point would be relatively low in protein and energy. A study from the University of Nebraska indicated that burning was the most effective in improving subsequent production with grazing and haying providing intermediate improvement compared to shredding or no treatment (Table 1).

Table 1. Year-end yields following one year of treatment on CRP

Treatment	Yield (lbs/acre)
Burn	4420
Graze	3200
Hay	3080
Shred	2160
Control	2130
	B. Andersen, 2009

A three year study with sites in Edwards, Greeley, Kearny and Reno counties compared spring burning or spring mowing in year one to non- treated CRP. Data in Table 2 show average performance on the mowed plots over the 3 years of the study was from 2 to 5 percent higher than performance on the non treated plots. Stocker performance increased 6 to 38 percent after spring burning compared to no treatment. At the Edwards County site grazing cow/calf pairs, no difference was observed in calf performance due to treatment. Net returns per acre for the treatment year indicated mowing was only economically feasible on the Reno County site, where as prescribed burning was economically feasible in Greeley, Kearny and Reno Counties.

Since burning and mowing won't fit all situations other options should be considered. CRP acres could be used as a calving pasture and would provide plenty of bedding and clean ground. Lactating cows would need supplementation to meet both protein and energy needs.

Extreme grazing, known as "flogging" in the graziers glossary, has a goal of leaving little residual forage. It is achieved by using a very heavy stocking for a short period of time (80 - 100 cows per acre for one to seven days). This results in trampling the dead litter into the soil and opening up new areas for seedlings and tillers. Temporary electric fencing is often needed to concentrate animals in a smaller area and then allow movement to the next section. If grazed as early as allowed in the fall, nutrient content will be relatively higher, reducing supplement needs.

Other limiting factors in CRP productivity are undesirable weeds and brush. These problems may be best addressed while still under contract since herbicide options are broader for CRP than for use for hay or grazing. Mechanical control may be needed for larger trees and brush. Goats may be an option for biological control of some weed species. In the long run, increasing the vigor of the stand through good grazing management is the best weed control.

Just like anything that hasn't been used for awhile, CRP stands need some type of rejuvenation to make them more productive. Individual pasture conditions will help determine if burning, mowing or grazing is the best technique to employ.

Table 2. Average daily gain, days grazed and stocking rates for CRP converted to pasture at four KS locations.

Site	1994*	1995	1996	Stocking rate, lbs/acre
Edwards Co – Cow/Calf pairs, calf performance shown				212 - 267
days grazed	*144*	*168*	*130*	
No Trt	2.36	2.20	2.36	
Spring mowed	2.44	2.22	2.48	
Spring burned	2.48	2.12	2.32	
Greeley Co- Early Intensive heifer grazing				175 - 196
days grazed	*58*	*74*	*79*	
No Trt	2.73	2.49	1.31	
Spring mowed	3.07	2.21	1.39	
Spring burned	3.47	2.27	1.22	
Kearny Co – Season long stocker grazing				112-156
days grazed	*130*	*103*	*94*	
No Trt	1.16	1.61	1.57	
Spring mowed	1.27	1.60	1.57	
Spring burned	1.93	2.10	1.96	
Reno Co – season long stocker grazing				162-169
days grazed	*103*	*141*	*112*	
No Trt	2.01	1.15	1.79	
Spring mowed	2.55	1.24	1.44	
Spring burned	2.65	1.39	1.68	

* mowing and burning applied in 1994 only   Langemeier et al. 1997 Cattlemen's Day Report

Soil Quality: Impacts of no-till

Humberto Blanco, Kansas State University

No-Till and Soil Compaction

Soil compaction can be a concern in no-till farming. Most no-till soils, however, develop a natural buffering capacity against excessive compaction with time. One of the main reasons for this is the gradual accumulation of soil organic matter in the upper layers of no-till soils. This increase in organic matter makes the soil more elastic, improves soil aggregation, enhances microbial processes, and reduces the bulk density of the whole soil. Across various long-term (20 to 43 years) tillage systems (conventional till, reduced till or mulch tillage, and no-till) in Hays and Tribune, KS; Akron, CO; and Sidney, NE, we measured near-surface maximum soil density (parameter of soil compactibility) and the soil organic carbon (SOC) concentration in the 2-inch (0 to 5 cm) soil depth. The higher the maximum soil density, the greater the risks of compaction.

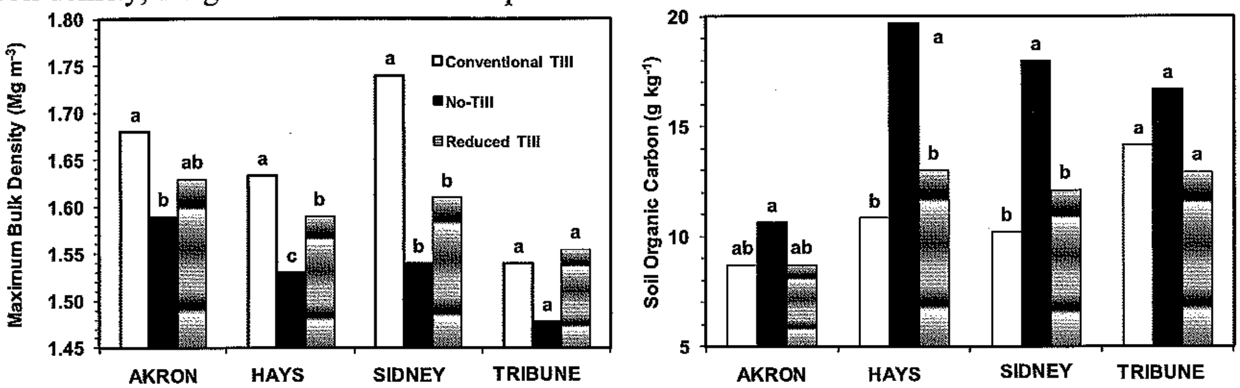

Fig. 1. Maximum bulk density and soil organic C in four soils. Bars followed by the same letter within the same soil are not statistically different.

We found that no-till soils are less prone to compaction than conventionally tilled soils (Fig. 1). Coincidently, SOC concentration in no-till soils was also generally greater than in tilled systems (Fig. 1). Changes in SOC concentration explained 57% of the changes in the near-surface maximum soil compactibility (Fig. 2). In other words, long-term no-till systems can develop a natural defense against shallow compaction by increasing SOC concentration. The study also showed that no-till soils can be trafficked at greater soil water contents with lower susceptibility to compaction. In contrast, plowed soils are more readily compacted at water contents much lower than no-till soils. Reduced till can also reduce a soil's susceptibility to compaction, but the benefits are smaller than with no-till farming.

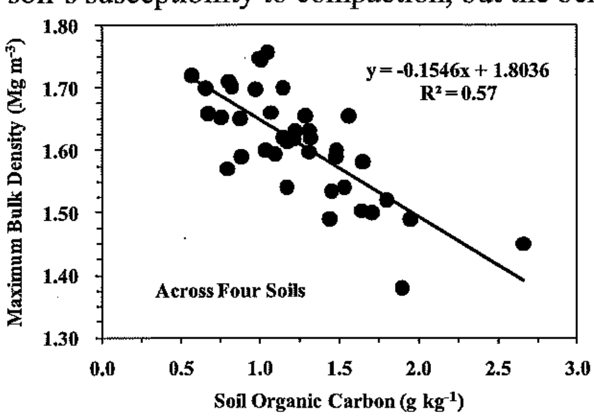

Fig. 2. Maximum bulk density or soil's susceptibility to compaction decreased with an increase in organic carbon concentration across four soils in the 2-inch (0 to 5 cm) soil depth in the central Great Plains. The higher the maximum bulk density reading, the denser or more compacted the soil.

Not all soils will react the same to no-till. The ability of a no-till soil to resist shallow compaction with time will depend on the rate of SOC accumulation, length of no-till management, and soil type (e.g., differences in textural class). In systems with limited return of crop residues, where there are little or no gains of SOC, and on clayey and poorly drained soils, no-till may have only limited effect on the ability of the soil to resist compaction. Benefits of no-till in reducing soil compactability may also be smaller in deeper soil because most of the SOC is accumulated near the surface layers. Increasing SOC not only is important to sustaining crop production, filtering pollutants, improving soil structure, enhancing microbial processes, and reducing risks of global climate change, but also to reducing the shallow soil compaction.

No-Till: Controlled Traffic and Soil Properties

Excessive wheel traffic in no-till systems can degrade soil quality and reduce crop production. We recently assessed differences in soil physical and hydraulic properties between wheel trafficked and nontrafficked rows for continuous grain sorghum, wheat-sorghum-soybean, wheat-sorghum-sorghum-soybean, and wheat-soybean-sorghum-soybean rotations managed under no-till after 8 yr of management at Hesston, KS. Results showed that traffic compacted soil and reduced effective porosity, water infiltration, and plant available water (Fig. 3).

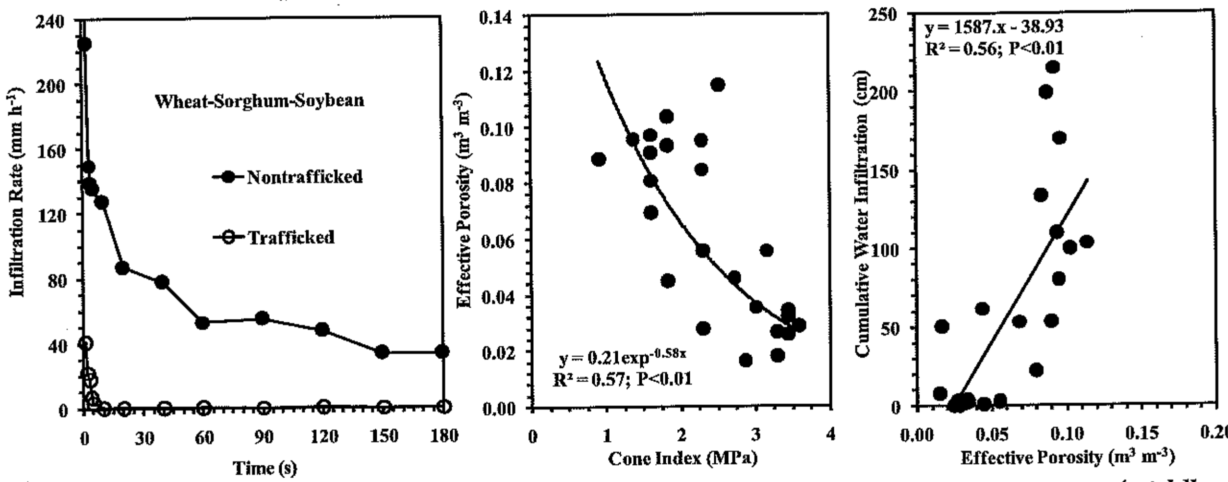

Fig. 3. Wheel traffic reduces water infiltration (left) by reducing soil effective porosity (middle and right) macroporosity.

No-Till and Crop Residues

Most producers are aware that no-till can help control water and wind erosion because of increased surface residue. Crop residue helps break the impact of raindrops and reduces the erosive power of wind at the soil surface level. What if surface crop residue is sparse in a no-till system? No-till and high surface residue levels do not always go together. Surface residue may be sparse in no-till if crop yields are very low, if low-residue crops (such as sunflowers and soybeans) are a big part of the rotation, or if the crop residue is removed for biofuels or some other use. Will no-till still help control water and wind erosion under those conditions?

The answer to this question depends on whether no-till improves near-surface (upper few inches) soil structural properties. Soil aggregate stability is another factor at work in determining the susceptibility of a soil to water and wind erosion. If the soil aggregates in the upper layer of the soil are strong and stable, they will be more able to resist breakdown by striking raindrops and to withstand the abrasive erosive energy of wind. Our regional study (mentioned earlier) across the central Great Plains using long-term reduced till, no-till, and conventional till experiments in KS, CO, and NE showed that no-till farming improved soil aggregate properties that affect water erosion but had no effect on aggregate properties that affect wind erosion.

No-Till and Water Erosion

The greater aggregate resistance to breakdown under raindrops is partly due to greater SOC concentration in no-till soils (Fig. 4). In our study, SOC in no-till was greater than in plow till in most soils in the surface 0 to 2 in (Fig. 1). Organic matter is the key to the improvement in aggregate stability found in no-till soils. Soils rich in SOC provide organic binding agents which join micro-aggregates together into stable macro-aggregates. The increase in SOC concentration with no-till farming also reduces rapid wetting of soil aggregates. The SOC compounds often coat soil aggregates and impart slight hydrophobic properties, which are critical for aggregate stabilization.

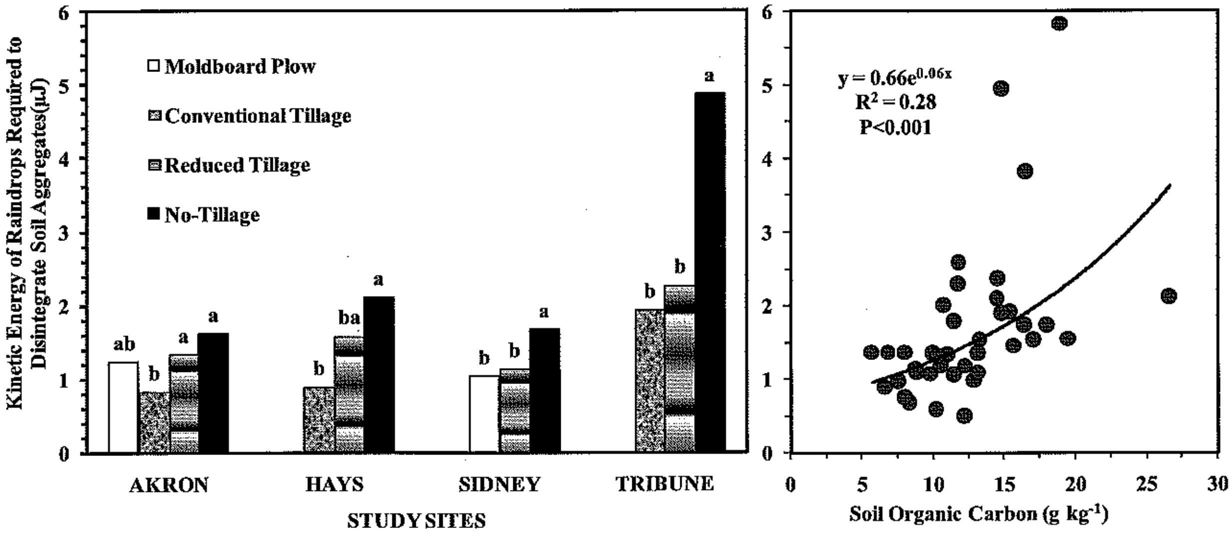

Fig. 4. No-till management increases soil aggregate resistance against raindrops (left) by increasing soil organic C concentration (right).

The bottom line is that aggregates from no-till soils are more water-stable, less wettable, and have greater SOC concentration than soils under conventional till. Aggregates of plowed soils are weaker because of frequent soil disturbance, which disrupts aggregate formation and accelerates losses of soil organic matter. It is, however, important to note that no-till soils can also become susceptible to water erosion if crop residue is continually removed at high levels for off-farm uses. Continued removal of residue can eventually reduce wet aggregate stability and other structural parameters influencing soil water erodibility.

Residue Removal Effects on Water Erosion

Crop residue is in high demand in some areas of Kansas and other states, either as feedstocks for cellulosic ethanol production, industrial uses, livestock feed, or other uses. Producers may get paid for selling their crop residue for these uses. But is it really a good idea to remove and sell crop residue? What is the cost of crop residue removal in terms of loss of soil quality and productivity, and potential impairment of surface water quality? Leaving crop residue on the soil surface is the best way of reducing water and wind erosion. Widespread residue removal for expanded uses may accelerate soil erosion and increase the loss of sediments, nutrients, and pesticides in runoff water. The producer may want to remove some residue and leave some. How much residue can be removed from crop fields without creating erosion and runoff problems?

The answer is not fully known, and partially depends on the level of crop productivity. In some cases, particularly in semiarid regions such the Great Plains, not enough residue is produced most years to protect soil from water and wind erosion and maintain adequate levels of soil organic matter. In those cases, any removal of residues may further degrade soil quality, increase water pollution, and reduce crop production.

We determined on-farm impacts of variable rates of residue removal from wheat and sorghum fields on water erosion in plowed and no-till soils near Hays, KS in 2008. The stubble remaining after harvest was removed at 0, 25, 50, 75, and 100%. Simulated rainfall was applied to the plots to give the effect of a rainstorm with a return period of 25 years for western Kansas. Results showed that wheat and sorghum residue removal exponentially increased loss of sediment, SOC, and nutrients in runoff regardless of tillage system (Fig. 5). Where most or all of the residue was left intact after harvest, the runoff water after an intense rainstorm was clearer. Where half the residue was removed, sediment loss increased after the rainstorm. Freshly tilled wheat plots (tilled immediately after the residue removal) lost more sediment, SOC, and nutrients than no-till wheat plots for the same level of residue removal.

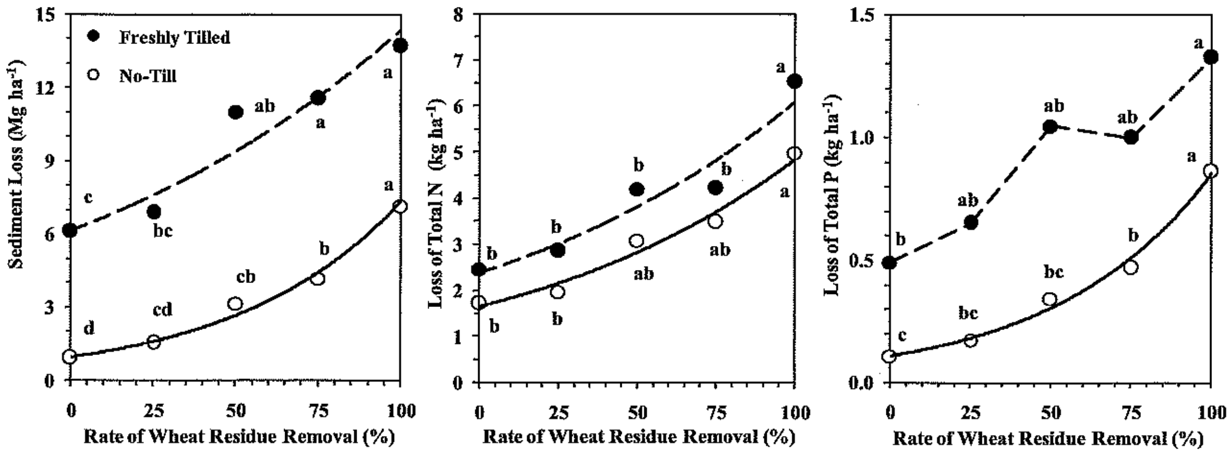

Fig. 5. Influence of wheat residue removal on sediment, total N, and P loss. Means followed by the same lowercase letter within the same tillage level are not significantly different.

Another finding, which may surprise many, was that removing 75% or more of the residue after harvest can negate many of the benefits of no-till in reducing runoff. We found that the loss of pollutants from no-till soils was equal to those from plowed soils when residues were removed at or above 75% (5). This indicates that no-till may be no better than plow till if residues are removed at high rates. Excessive residue removal from no-till soils can negate the erosion control benefits attributed to no-till. No-till benefits for controlling soil erosion are quickly lost when residue is removed at rates above 25%. Residue cover is needed to keep the soil in place. Residue removal also increased losses of essential nutrients, particularly total N and total P (Fig. 5). Loss of nutrients in runoff increased with residue removal above 50% in no-till wheat. Residue removal reduces nutrient pools through two pathways: 1) nutrient removal with residues and 2) via increased runoff.

Results of this study show that crop residues are indeed essential to reduce sediment, SOC, and nutrient loss in runoff, regardless of tillage system. Crop residue removal is not recommended if soil and water conservation, water pollution control, and SOC buildup are high priorities. Residue left on the soil surface protects the soil against impacting raindrops, helps maintain the integrity of soil aggregates, and improves rain water infiltration. A small fraction (about 25%) of residue may be available for removal from no-till soils, but further studies are needed to determine the amount of harvestable residue.

No-Till and Wind Erosion

Results of our regional study in the central Great Plains also showed that under very dry soil conditions, aggregates from no-till soils may be no more stable (or even less stable) than those in plowed soils. The greater SOC-enriched materials in no-till soils may have a more positive impact on stabilizing wet aggregates than dry aggregates due to greater adhesive (e.g., glue-like binding substances) forces of organic materials acting in wet aggregates. This finding suggests that no-till soils, if left without residue cover, can be eroded by wind at equal or even at higher rates than plowed soils.

This also points out the critical need for maintaining surface residue cover to protect soil from wind erosion. Residue cover buffers the erosive forces of wind, reduces evaporation, and minimizes abrupt fluctuations in wetting and drying cycles that weaken soil aggregates. No-till soils with limited above-ground biomass production are highly vulnerable to wind erosion as compared to plowed soils where the transient roughness created by tillage may reduce wind erosion. Under typical no-till conditions, with high levels of residue on the surface, wind erosion rates are expected to be lower in no-till soils.

Depending on the amount of residue, no-till soils tend to be wetter than plowed soils due to reduced evaporation, which reduces soil detachment by wind. The greater the water content of surface soils, the lower the wind erosion rates.

Impacts of No-Till and Intensive Cropping Systems on Soil Properties

To improve soil properties and SOC levels in the central Great Plains, producers will likely need to use a combination of no-till and increased cropping intensity. Rotations that include fallow periods may deteriorate soil properties and reduce SOC concentration due to reduced biomass input. Increasing SOC concentration with intensive cropping systems may lead to improved soil properties. At the KSU-Agricultural Research Center at Hays, we evaluated the impact of 33-yr no-till and reduced till under five cropping systems (sorghum-fallow, continuous sorghum, wheat-sorghum-fallow, wheat-fallow, and continuous wheat) on soil properties.

We found that continuous wheat had the greatest beneficial impacts on near-surface soil physical properties and SOC concentration. Continuous wheat increased soil structural stability by two to five times over sorghum-fallow for the surface 1-inch (2.5 cm) soil depth. Continuous wheat and wheat-sorghum-fallow retained about 13% more water in the soil than sorghum-fallow in no-till. Continuous wheat also increased cumulative water infiltration over other cropping systems under no-till (Fig. 6). Soil surface sealing and crusting in crop-fallow systems can reduce water infiltration compared to rotations with permanent residue cover. The greater residue cover in intensive cropping systems can also reduce loss of water through evaporation and runoff. In semiarid soils, the increase in water infiltration through intensification of cropping systems is critical to capture precipitation water and increase soil water storage.

The SOC concentration was greatest in continuous wheat and lowest in sorghum-fallow in both tillage systems at the 1-inch soil depth (Fig. 6). Under no-till, continuous wheat resulted in 50% greater SOC concentration than wheat-fallow, continuous sorghum, and wheat-sorghum-fallow and 100% greater than sorghum-fallow. Under reduced till, continuous wheat had greater SOC concentration than continuous sorghum and sorghum-fallow. The greater SOC concentration in continuous wheat is attributed to the greater annualized return of crop residues compared with sorghum-fallow. No-till had greater SOC concentration than reduced till by about 40 to 100%, depending on the cropping system (Fig. 6).

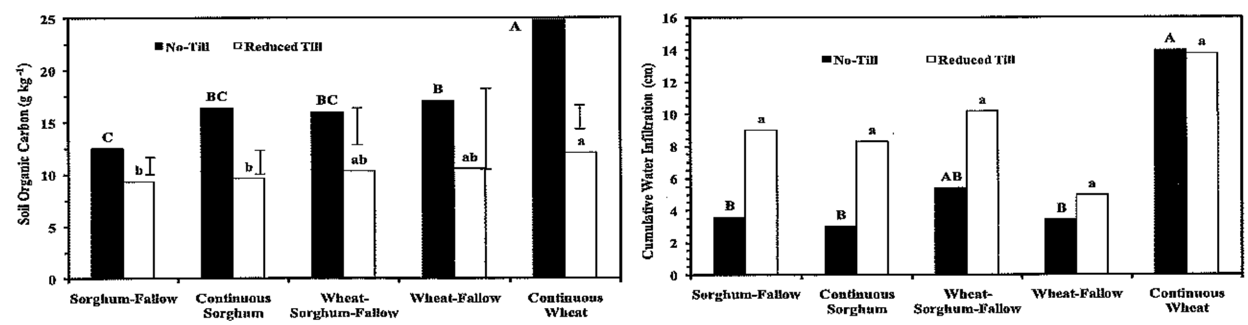

Fig. 6. Soil organic C concentration in top one-inch of soil and cumulative water infiltration. Means with the same letter within the same tillage system are not significantly different. Error bars are LSD (Least significant differences) values to compare tillage effects within the same cropping system.

The greater concentration of SOC in intensive cropping systems has many ancillary benefits. Bulk density decreased while total porosity, soil water retention, and cumulative water infiltration increased with an increase in SOC concentration within no-till. The proportion of macroaggregates increased with increases in SOC concentration.

Continuous Wheat vs. Continuous Sorghum

Improved soil conditions under continuous cropping systems with no fallow period are directly attributed to their greater annual return of crop residues than under crop-fallow systems. But if that is true, then the obvious question is: Why did continuous sorghum not have the same beneficial effect on soil physical properties and SOC concentration as continuous wheat in this study? The answer has to do with the differences in residue cover on the soil between those two crops. The uniform residue cover in wheat most likely protected the soil surface better than the coarse and sparse sorghum residues. The soil surface has less protection with the wider row spacing in sorghum compared to wheat, which increases soil temperature fluctuations and evaporation rates, accelerates the decomposition of residues, and leads to a reduction in SOC accumulation. Figure 6 shows a visual comparison of residue levels.

Fig. 7. Residue cover under continuous wheat (left), sorghum-fallow-sorghum (middle), and continuous sorghum (right) under no-till.

Summary

No-till farming can improve soil physical properties and increase SOC concentration over plow till. Accumulation of SOC under no-till and diversified crop rotations provides many benefits to soil, environment, and crop production. For example, it can offset some of the risks of soil compaction because soil organic matter imparts elastic and resilient properties to soil. Controlled traffic and accumulation of SOC in no-till soils can reduce soil degradation, maintain or increase water infiltration, and increase water storage. Soil aggregates under no-till are more resistant to the erosive forces of raindrops compared with those under plow till. Residue mulch left on the soil surface protects the soil from water and wind erosion. It also reduces loss of sediment, nutrient, and SOC in runoff. Intensive or diversified cropping systems in no-till maintain a permanent residue cover on the soil surface. The greater wet aggregate stability, soil water retention, porosity, water infiltration, and SOC concentration in continuous cropping systems than in crop-fallow in no-till indicates that management systems which exclude summer fallow practices improve soil physical properties and sequester SOC.

Fertilizing for No-till
Kent Martin Southwest Research Extension Center at Garden City

As no-till and reduced till acres increase, it is important to gain a better understanding of the differences in nutrient management between conventional, reduced till, and no-till production systems. There are many factors that tillage influences that have an effect on nutrients in the soil-plant system. These may include:

- Soil temperature
- Soil moisture
- Soil physical properties
- Water infiltration
- Microbial dynamics
- Nutrient distribution

Each one of these factors or a combination of these factors influences how producers need to manage nutrients to maintain optimal crop production and efficient utilization of nutrients. The objective of this paper is to focus on managing the primary nutrients, nitrogen (N), phosphorus (P), and potassium (K), in no-till and reduced till production systems. Nitrogen will be discussed in relation to microbial effects and placement of N, then immobile nutrient utilization, placement and stratification will follow.

Nitrogen

Any discussion on N should provide a foundational understanding of soil organic matter. Soil organic matter is made up of plant and animal residue that has been degraded by microbes. When this process occurs, the microbes break down plant and animal residues as well as soil organic matter and release plant available N. This process is termed mineralization. In the process of decomposition, not all N will be mineralized to a plant available form. A portion of it will be immobilized or transformed to organic products by plants or microbes. This organic N will continue through the cycle again to be mineralized. The importance of this discussion is that it has long been known that soil organic matter will have an equilibrium or mineralization that is equal to immobilization. The question still remains how tillage affects this process.

Tillage affects the soil structure by breaking it up and providing aeration and preparing the soil for added heat absorption and thus a warmer soil environment. The conversion of soil organic matter to plant available N occurs faster in the presence of oxygen (aerobic) than without oxygen (anaerobic) and is quicker in higher temperatures. This means that the rate of mineralization increases thereby decreasing soil organic matter. Over time, the decrease of organic matter decreases the source of mineralizable N. The opposite is also true. No-till systems generally maintain or increase soil organic matter that acts as the reservoir for N. Knowing the soil organic matter must maintain a balance of mineralization to immobilization; building soil organic matter must require N to immobilize back into organic matter. It takes a considerable amount of time (e.g. decades) and N to increase soil organic matter even one percent. Producers should not expect significant differences in a short period of time. Some studies report additional N requirements of 0.2 to 0.4 pounds of N required per bushel of corn in no-till production as compared to conventional tillage. These same studies also showed that economic returns were greater in no-till corn as compared to conventional tillage. Western Nebraska data shows a 19% decrease in soil nitrogen as a result of conventional tillage after 12 years.

Another obvious result of no-till is that crop residues are left on the soil surface. Surface residues have a direct impact on nitrogen management because of the energy required by microbes for decomposition. Residues of different types require variable amounts of energy to break down their organic matter, which is represented by carbon (C) to N ratios. Crop residues with a wide C:N ratio means that microbes will consume more N to break down the residue than crops with a narrow C:N ratio. The breaking point is at a ratio of 25:1 and at a narrower ratio, mineralization occurs, while at a wider ratio, immobilization occurs. Crops with a net mineralization include alfalfa (13:1) or soybean residue (15:1), while crop residues with a net immobilization include corn stalks (60:1) or small grain straw and grain sorghum stalks (80:1).

Management considerations for minimizing immobilization are primarily method of application. Since microbes utilize N fertilizer as an energy source, minimizing their uptake of N fertilizer will minimize immobilization. So, knowing that microbes are actively working on the pieces of stalks and straw in a field, it is intuitive that minimizing the contact of N fertilizer and residue will increase N efficiency. Any method of injecting N fertilizer below the soil surface whether preplant or as a starter (e.g. 2 by 2 with a planter) will place the fertilizer in a manner that will maintain the highest efficiency. If fertilizer must be applied on the soil surface, applying in a stream to minimize contact with residue will enhance efficient use. Possibly the most inefficient method of applying N is to apply as a broadcast over the surface residue. These examples insinuate the use of liquid N sources, but urea is the most common N source world wide. If urea is applied as a broadcast, the enzyme urease (present in crop residues) will break down urea to ammonium carbonate, which can then be lost to the atmosphere as ammonium gas. This can represent a significant loss potential in addition to immobilization. In this example, the best option (assuming urea must be used) is to treat the urea with a urease inhibitor. Still another available N form is anhydrous ammonia. It is present as a gas, which must be injected below the soil surface. These properties make it the most efficient N form for no-till.

Phosphorus and Potassium

The primary concern of immobile nutrients in the conversion from conventional to reduced or no-till is the stratification of nutrients. The term stratification refers to layers of varying nutrient concentrations, commonly with the greatest concentration near the soil surface. There are several reasons these conditions develop. First is that typical application of these nutrients occurs as a broadcast with little or no incorporation to provide a uniform concentration through the tillage zone. The second cause of stratification is that plants take up substantial amounts of nutrients in the plant tissue. After reproduction and harvest, the plant material must decompose on the soil surface. This decomposition process releases these immobile nutrients on the soil surface, which do not move considerable distances into the soil. Without subsequent soil mixing through tillage, higher concentrations develop near the soil surface. This cycle is repeated with each crop, thus exaggerating the stratification each year.

The stratification mentioned here can occur both vertically and horizontally. From the discussion above, it should be clear that vertical stratification occurs by decreased tillage coupled with application techniques and nutrient release on the soil surface. However, horizontal stratification can also occur by plants removing immobile nutrients from a zone near the plant roots and decaying on the soil surface. The other method of horizontal stratification is by applying nutrients in bands. Bands are often preferred, specifically for P, because it creates a zone of concentrated nutrients that remain plant available for a longer period of time by reducing soil contact. When nutrients are applied in this manner, the result is an enriched zone at application and a depleted zone of nutrient uptake.

The first important consideration is whether or not stratified nutrients are a problem in reduced or no-till systems. Next is the question of whether or not alternate forms of application (e.g. deep band) are needed to create uniformity in nutrient concentrations. The answer to these questions seems to vary by nutrient, location, and research study. In an ongoing study in Kansas, altering placement strategies did not improve crop yields at sites with a range of soil test P values from low to very high. Some studies support these findings, while others find a benefit from deep placement. However, some studies indicate there may be benefits from deep placement of K in stratified, deficient soils.

Another outcome of trying to overcome vertical stratification is the decreased confidence in soil testing as a result of creating horizontal variability. This often leads producers to question what the true soil test value is and whether or not it is reliable enough to utilize for recommendation purposes.

Conclusions

When producers switch from conventional to reduced or no-till cropping systems, there are some nutrient considerations that are important. First, ensure N application rate is slightly elevated and that the method of application guarantees efficient use of the N. When N is applied, consider the source of N to limit the loss of N. No-till producers should realize the crop residue on the soil surface is an enormous benefit, but must be managed carefully. When immobile nutrients are applied, have a good understanding of nutrient requirements. Producers should realize that the most common yield benefit from P is from a starter application. If the goal is to increase the soil test P, it must be done carefully. Application of P in a zone will not increase the soil test P, but will only create enriched zones. If K is required, deep banding may be warranted, but more research data is needed to confirm this. Again, application in zones will only enrich portions of the soil.

Ultimately, reduced or no-till cropping systems are productive management techniques that require different nutrient requirements than conventional tillage.

Does Stacked Corn Pay on Dryland?

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Introduction

Dryland corn acres have increased substantially in the Great Plains during the past 20 years. The National Agricultural Statistics Service (2009) reports that dryland corn acres in western Kansas, southwest Nebraska, and eastern Colorado increased from roughly 150,000 acres in 1990 to 1.5 million acres in 2008, an average increase of nearly 75,000 acres per year. Corn yields have been highly variable in this area during that time period, with average yield per acre ranging from 85 bu/acre in 1998 and 1999 to less than 30 bu/acre in 2002 and 2003. The average yield for the period was 54 bushels per acre.

Corn seed prices have increased at the same time as corn acreages have increased. An annual survey of crop production input prices conducted by Troy Dumler (2009), K-State Southwest Area Extension Agricultural Economist, showed that the price of non-traited corn hybrids increased from $1.23/1,000 in 2005 to $2.02/1,000 in 2009. In 2009, the price of hybrids with herbicide or insect resistant traits was nearly $0.55/1,000 greater than the price of hybrids without those traits.

Corn grain prices have also increased in recent years. Average cash prices fluctuated between $2.00 and $2.50 per bushel for most years from 2000 through 2006. Since then, prices have reached highs of more than $5.00 per bushel in 2008 but dropped back to an average of $3.79 per bushel during 2009 (National Agricultural Statistics 2009).

Several economic and technological reasons have caused the increase in dryland corn acreage. No-till, high-residue management practices have facilitated more intensive cropping systems, resulting in more corn acres and usually in greater profitability. Herbicide tolerance traits in corn have facilitated this transition by reducing the cost and increasing the effectiveness of post-emergence weed control in high-residue cropping systems. The availability of corn borer resistance traits has provided an additional, effective tool for managing the often damaging infestations of southwestern and European corn borer.

For the purposes of this paper, "stacked" corn hybrids contain traits conferring resistance to northern and western corn rootworm (RW) in addition to corn borer (CB) resistance and glyphosate tolerance traits. Several studies have documented the effectiveness of these traits. Oleson et al. (2007) showed that all versions of the RW traits reduced root injury as well or better than in-furrow insecticides. Studies in Illinois, Pennsylvania, and New York documented yield increases from these traits of 14%, 7%, and 3% respectively (Cox et al., 2009; Dillehay et al., 2004; Haegele and Below, 2009). These studies were conducted primarily in cropping systems where corn borer is a significant threat, with continuous corn or in areas with rootworm variants that delay emergence or lay eggs in soybean fields.

The value of stacked hybrids for dryland corn in the Great Plains is not immediately apparent. Dryland corn is most often planted in complex rotations, usually including at least two years between corn crops. In Kansas, the corn rootworm has not been documented to display the variants found in areas of the Corn Belt (Whitworth 2009), making rotation an effective tool for reducing feeding damage to roots and protecting yield. Yields are often less than 100 bushels per acre, reducing the gross returns available to pay for potentially greater seed costs. This leads to the question: Do stacked corn hybrids pay in dryland production systems in the Great Plains?

Methods

With no access to an extended series of studies specifically designed to answer this question, one approach is to use information embedded in the dryland corn performance tests conduced every year at several locations throughout Kansas (Lingenfelser 2009). Since 2000, these tests have included hybrids with different traits and combinations of traits, including stacked hybrids. However, yields are highly variable across years and locations in these tests, making calculations of average yields over years and locations essentially useless for hybrid comparisons.

Feyerherm et al. (2004) developed a method for comparing wheat varieties across years and locations within a geographic region with similar growing conditions. This method assumes that the environment for each trial acts as a randomizing agent and uses yields of check varieties that appear in all trials as a standard against which all other entries are measured. These differences from check varieties, referred to as the differential yielding ability (DYA), are based on the statistical model $D_{ij}(v) = \mu_D(v) + S_i(v) + L_{ij}(v)$, where

Dij(v) = DYA for:

- cultivar (variety or hybrid) (*v*) = 1, 2,..., *V*
- location (*j*) = 1, 2,..., *n*
- season (year) (*i*) = 1, 2,..., *N*
- *μD(v)* = population mean DYA value for cultivar *v*
- *Si(v)* = random environmental effects for season *i*, which are normally and independently distributed with mean zero and variance *σS(v)*
- *Lij(v)* = random environmental effects for location j in season i, which are normally and independently distributed with mean zero and variance *σ2L(v)*.

For this analysis, the DYA was calculated by determining the yield difference between each of the top three hybrids in each trait group and the average of two checks at each location and year in dryland corn performance tests at Belleville, Hesston, Hays, Colby, Tribune, and Garden City, Kansas. This set of differences facilitated the calculation of standard errors for the DYA of each trait group, which were used to estimate significance of differences. Because check hybrids changed over time, the data set was divided into three sets of years with common check hybrids: 2001 to 2004, 2005 to 2007, and 2007 to 2009. The average yield of the check hybrids was added to each trait group DYA to provide standardized yields for trait comparisons. All tests were conducted in no-till cropping systems with complex rotations, W/C/F, W/C/SB, etc., that did not include corn after corn.

Results

Standardized yield estimates and standard errors for each trait group within each set of years with common hybrids are presented in Table 1. Yields averaged 74, 88, and 121 bushels/acre in 2001-2004, 2005-2007, and 2007-2009 respectively. These averages reflect the growing conditions in each period. All four years in the 2001-2004 period had below average growing season precipitation (Knapp 2009). In particular, 2002 and 2003 were nearly four inches below normal during May to September. Growing season precipitation was closer to normal in 2005 to 2007 and was at or above normal in 2008 and 2009.

Table 1. Standardized yields for top-yielding hybrids with different sets of traits from Kansas corn performance tests during three different sets of years.

	2001-2004		2005-2007		2007-2009	
Trait Group	Yield	SE	Yield	SE	Yield	SE
			bushels per acre			
Conventional	74	1.6	81	1.9		
CB	80	1.1	88	2.2	124	1.5
CBRW					122	4.9
HX			80	3.0	117	4.2
HXX			97	8.2	118	4.1
RR	70	2.2	84	2.3	115	3.5
RRCB	70	3.1	92	1.9	123	2.1
RRHX			87	6.9	118	2.6
TS			90	2.8	122	2.4
VT3			93	4.2	133	1.9

The first set of years (2001 – 2004) included only conventional, corn borer resistant (CB), glyphosate resistant (RR), and combinations of those two traits. Top yielding hybrids containing corn borer resistance traits yielded an average of 6 bushels per acre (9%) more than top-yielding conventional hybrids. Hybrids with RR traits and combinations of RR and CB traits were either similar to or less than conventional hybrids in this set of years.

The second set of years included stacked hybrids with both CB and RW resistance traits in the same hybrid. Hybrids with resistance traits yielded up to 19% more than conventional hybrids in this set of tests. Hybrids with insect resistance traits yielded up to 11% more than hybrids with glyphosate resistance traits only. Hybrids with both CB and RW traits had yields similar to hybrids with only CB traits.

The last set of years, 2007 to 2009, overlapped the previous set because the check hybrids overlapped, providing a greater number of comparisons. These tests contained an insufficient number of conventional hybrids to make meaningful comparisons with the various trait groups. Hybrids with insect resistance traits yielded up to 15% more than hybrids with glyphosate resistance only. Triple stack hybrids (TS) had yields similar to hybrids with the CB trait only. However, VT3 hybrids had a 7% yield advantage over RRCB hybrids.

Conclusions

Results of this analysis indicate the potential for significant yield benefits (2% to 5% or more) with stacked hybrids compared to CB only hybrids in dryland production in the Great Plains. This advantage was not always consistent and depended on the set of years being examined and the specific hybrids being compared. Assuming $3.79/bu market price for corn and an additional cost of $11/acre for stacked hybrids, stacked hybrids result in greater profits at yields of 60 bu/acre or more if they provide a 5% yield advantage. If the yield advantage is only 2%, stacked hybrids are profitable only when yields are 150 bu/acre or more. The yield advantage needed for stacked hybrids to be profitable decreases as the seed price differential decreases.

A few qualifiers must be kept in mind when considering the above analysis. The data set contained a limited set of hybrids. Hopefully the performance tests contain the best hybrids companies have to offer, but not all companies enter their hybrids in these tests. As a result, the best available hybrids may not have been represented in each trait group. Another consideration is that stacked hybrids may have represented the latest genetics. In any year, the newest hybrids were typically those with the greatest number of traits. In addition, trait identification of hybrids may not have been 100% accurate. In other words, some stacked hybrids may not have been included in the appropriate groups, or some hybrids identified as conventional may have had one or more traits. The information companies provide when hybrids are entered in the performance tests is not always complete, opening the door for these kinds of errors. Finally, price differentials used for the economic analysis may not be accurate. The pricing structure for hybrid seed changes constantly, and prices paid by individual producers vary greatly depending on timing, volume, special offers, etc.

It is important for corn producers to look at independent yield data, compare the whole hybrid package – not just traits, and make their own comparisons using their own costs and prices. Taking advantage of seed pricing and grain marketing opportunities will reduce the yield advantage required to make stacked hybrids profitable.

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Evaluation of Annual Cover Crops for Forage Yield in a Wheat-Fallow Rotation[1]

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Summary
Producers have expressed interest in growing a cover crop during traditional fallow periods. Western Kansas crop yields are limited by moisture and heat stress, and fallow is an important component of the system because it stores moisture for subsequent crops. Of the precipitation received during the traditional 14-month fallow period of a wheat-fallow rotation stores about 20% in conventional tillage and 35% in no-tillage systems. Thus there is great interest in increasing the efficiency of storing precipitation during the fallow period. This study evaluated replacing the fallow period with either a fall or spring cover crop grown either as a green manure or forage crop. This report presents the first 3 years of findings on cover crop forage yields. Triticale and broadleaf mixtures with triticale produced greater forage yield than broadleaf species alone. Winter crops produced more forage yield than spring crops.

Procedures
Beginning in 2007, fall and spring cover crops were planted in the fallow phase of a winter wheat-fallow rotation at the Southwest Research-Extension Center in Garden City, KS. The experiment was a completely randomized block design with four replications. Main plot was cover crop species in plots 30 ft wide × 135 ft long. Each main plot consisted of a winter- or spring-sown cover crop. Fall cover crop species included yellow sweet clover, hairy vetch, winter lentil, winter pea, winter triticale, and all broadleaf species in combination with winter triticale. Spring cover crop species included spring lentil, spring pea, spring triticale, and all broadleaf species in combination with spring triticale. Cover crop species were changed slightly after the first year (Table 1) once suitable cover crop species were identified in a preliminary study. Winter lentil was substituted for winter clover in the third year. Winter cover crops were seeded on Sept. 15, 2007, Oct. 3, 2008, and Oct. 1, 2009 and Feb., 2010, and spring cover crops were seeded on Mar. 30, 2008, and Mar. 5, 2009. Cover crops were harvested when triticale headed or June 1, whichever came first. In 2007, winter cover crops were harvested on May 15, and spring cover crops were harvested on June 1. In 2008, winter cover crops were harvested on May 13, and spring cover crops were harvested on June 1. In 2009, winter cover crops were harvested on May 18, and spring cover crops were harvested on June 1. Cover crops were harvested with a Carter harvester 3 to 4 in. above the soil surface, and a subsample was oven dried at 60°C for 48 hours to determine dry matter yield. Data were analyzed with PROC MIXED in SAS (SAS Institute, Inc., Cary, NC). Replication and all interactions with replication were considered random effects in the model. Treatment effects were determined significant at $P<0.05$, and when ANOVA indicated, significant effects means were separated with pairwise *t*-tests at $P\leq 0.05$.

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[1] This research is funded in part by the USDA-CSREES North Central Region Integrated Pest Management grants program.
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Results and Discussion

Triticale and broadleaf mixtures with triticale produced greater forage yield than broadleaf species alone (Figures 1-3). Winter pea planted in mixture with triticale tended to yield more than triticale alone (Figures 2 and 3). Yellow sweet clover did not produce enough yield to harvest in 2008 when planted alone (Figure 2). Yellow sweet clover failed to produced very little forage yield in either 2007 or 2008 and thus was replaced by winter lentil in 2009. Hairy vetch winter killed and did not produce enough yield to harvest in 2009 when planted alone (Figure 3). Legumes tended to survive the winter better when planted in mixture with triticale. When the winter crops that did not survive the winter were excluded, winter crops produced more forage yield than spring crops (Figures 4-6). Spring cover crops were harvested approximately 2 weeks later than winter cover crops each year.

Future Research

More information is need on the impact of growing cover crops on winter wheat yields over more growing seasons. Nitrogen contribution from successfully grown cover crops will be evaluated. Yellow sweet clover does not produce enough biomass within this type of cropping system but might fit a crop rotation that allows it to grow longer into the summer. Hairy vetch produced good forage yields in 2007 and 2008, but winter killed in 2009. Hairy vetch might not be a suitable cover crop if it does not survive the winter well, can have a hard seed coat that enables it to germinate later in the growing season, and is suspected of occasionally having been toxic to livestock. Winter peas have not had good winter survival and not produced grain, in part, due to poor winter survival. Planting winter peas earlier in the growing season or as a dormant planting might increase survival. Future research will evaluate different planting dates of winter peas on winter survival. Winter lentils needs to be evaluated over more growing seasons. Winter cover crops out yield spring cover crops when they survived the winter.

Table 1. Cover crop treatments.

Season	Cover Crop	Year Produced				
		2007	2008	2009	2010	2011
Fall	Yellow sweet clover	x	x			No
Fall	Yellow sweet clover/Winter triticale		x			No
Fall	Hairy vetch	x	x	x	x	?
Fall	Hairy vetch/Winter triticale		x	x	x	?
Fall	Winter lentil			x	x	x
Fall	Winter lentil/Winter triticale			x	x	x
Fall	Winter pea (grain)		x	x	x	No
Fall	Winter pea (forage)	x	x	x	x	?
Fall	Winter pea/Winter triticale		x	x	x	?
Fall	Winter triticale	x	x	x	x	x
Spring	Spring lentil	x	x	x	x	x
Spring	Spring lentil/Spring triticale		x	x	x	x
Spring	Spring pea	x	x	x	x	x
Spring	Spring pea/Spring triticale		x	x	x	x
Spring	Spring triticale		x	x	x	x

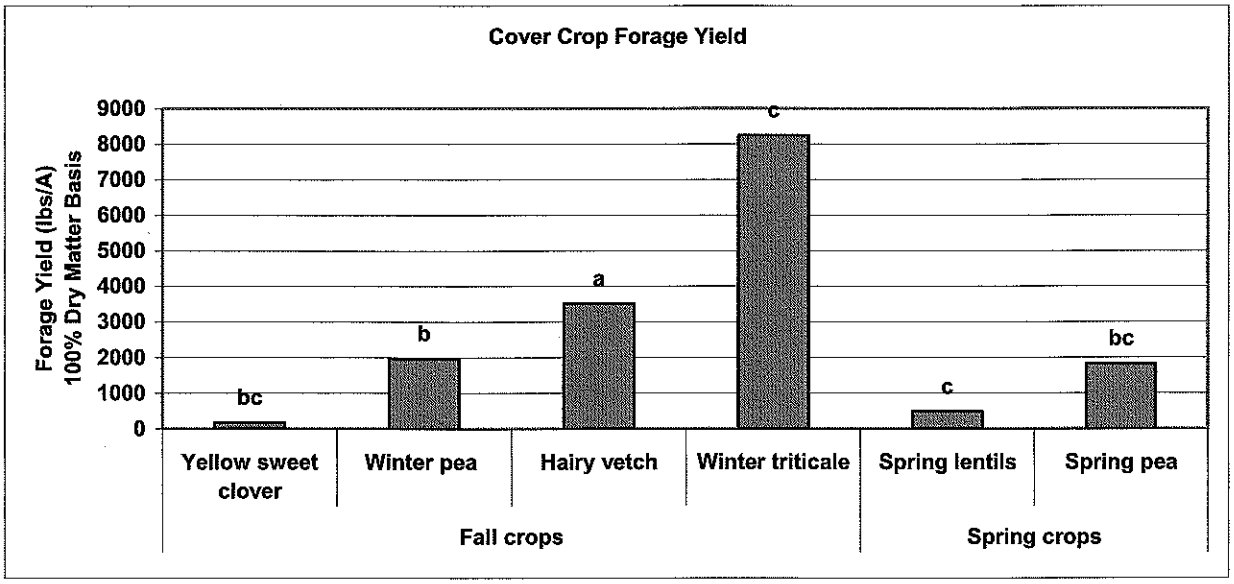


Figure 1. Cover crop forage yield in 2007. Means followed by the same letter are not significantly different at $P \leq 0.05$.

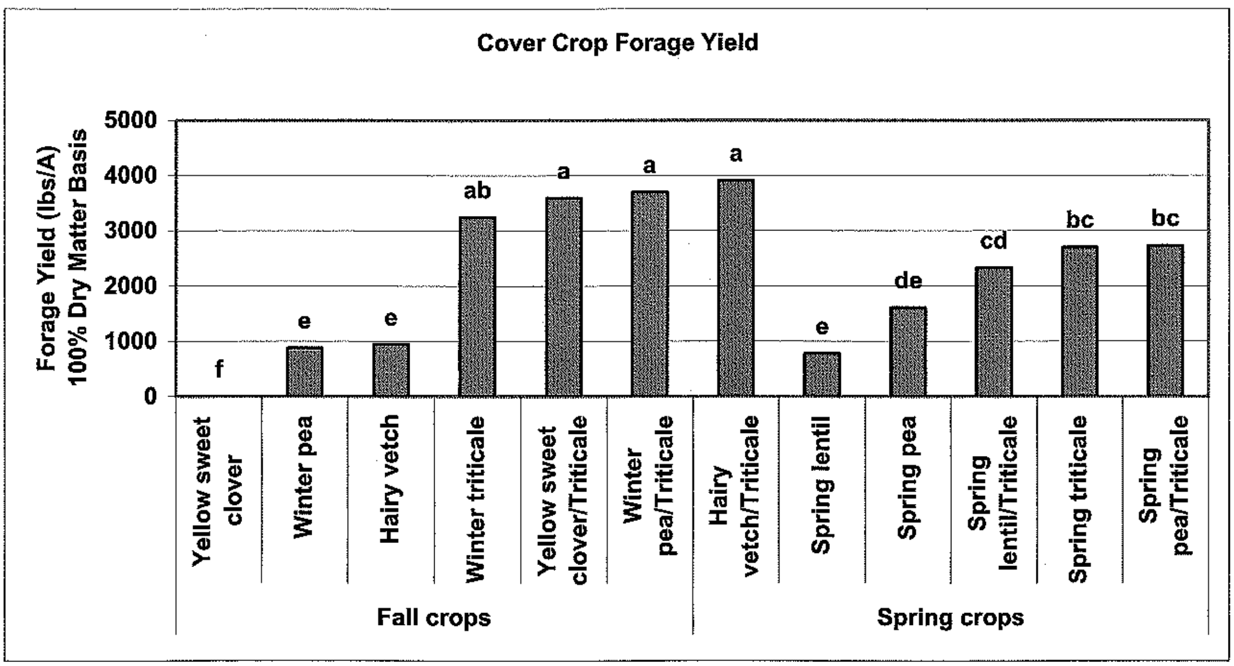


Figure 2. Cover crop forage yield in 2008. Means followed by the same letter are not significantly different at $P \leq 0.05$.

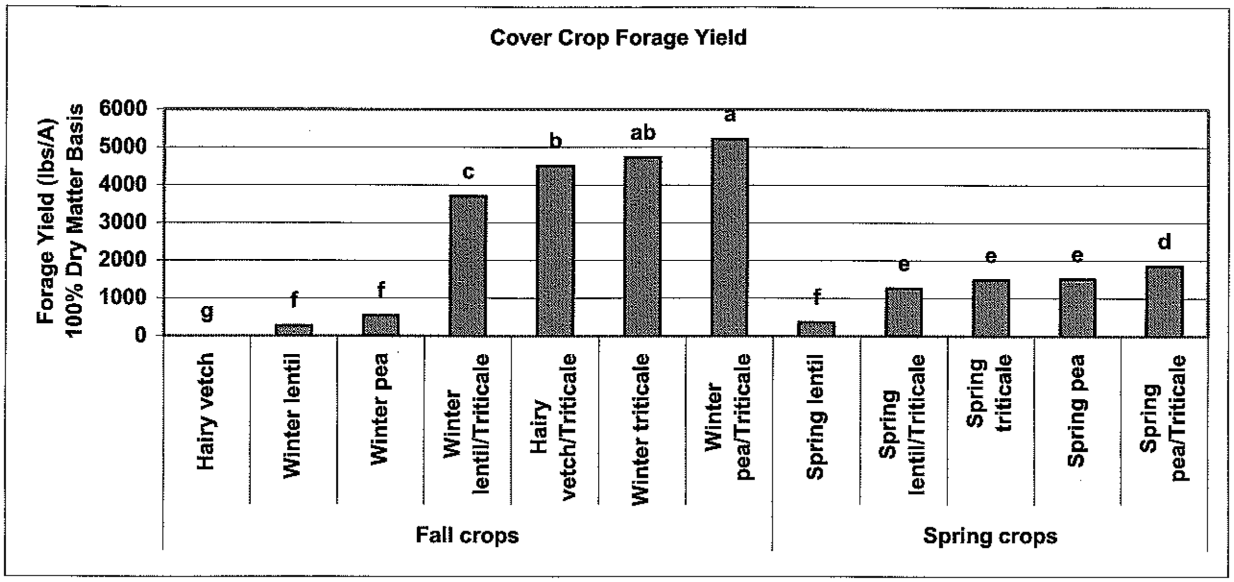


Figure 3. Cover crop forage yield in 2009. Means followed by the same letter are not significantly different at $P \leq 0.05$.

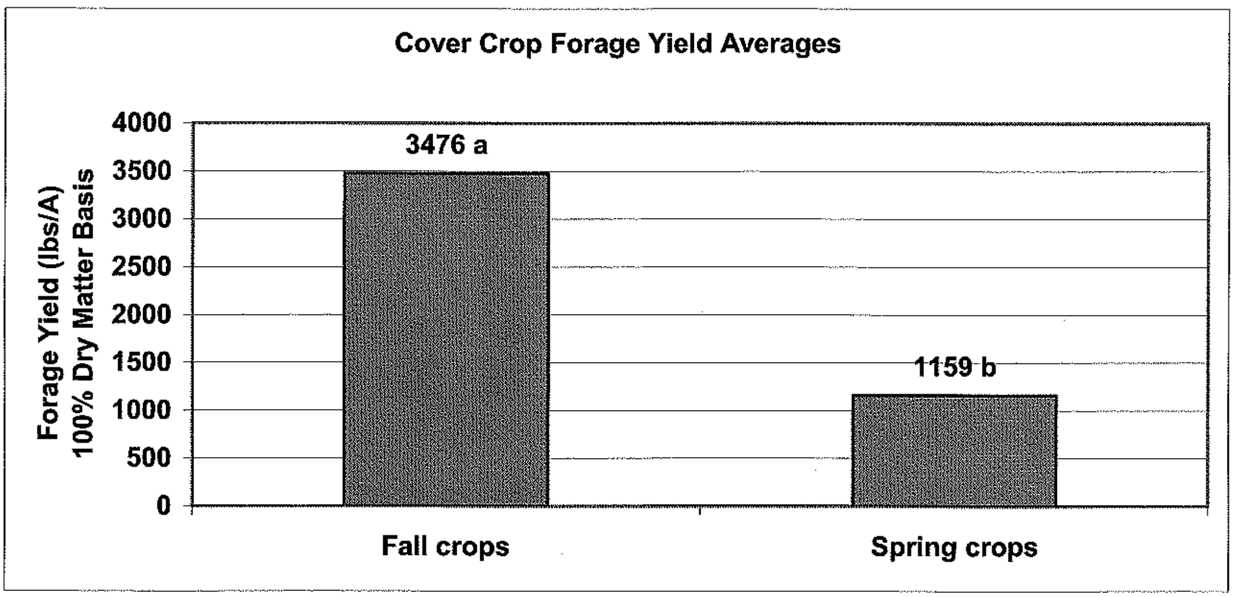


Figure 4. Fall and spring cover crop forage yield averages in 2007. Means followed by the same letter are not significantly different at $P \leq 0.05$.

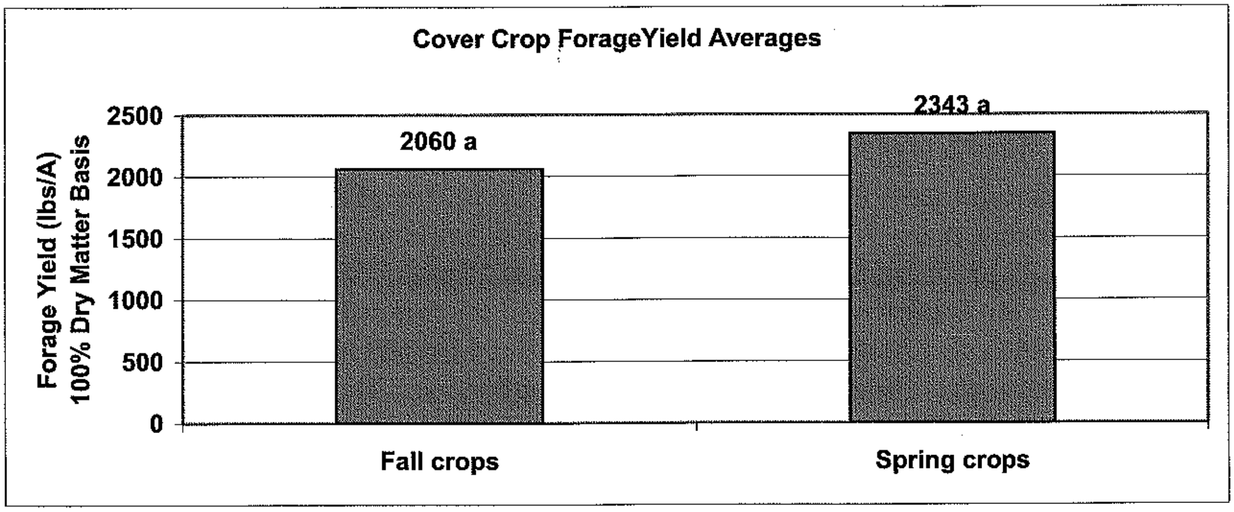


Figure 5. Fall and spring cover crop forage yield averages in 2008. Means followed by the same letter are not significantly different at $P \leq 0.05$.

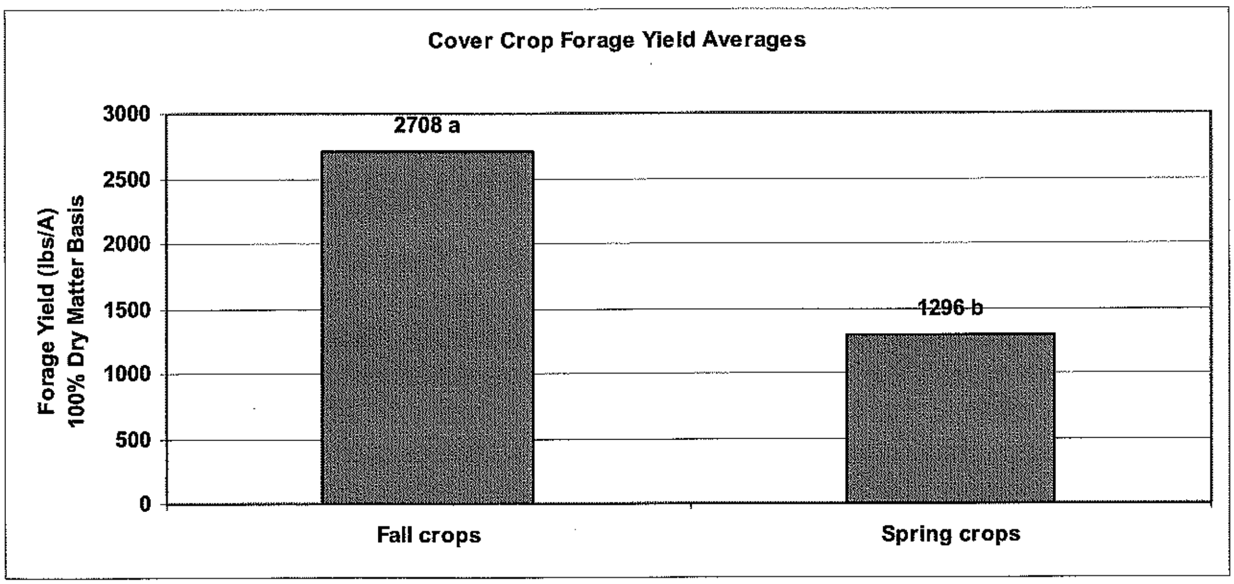


Figure 6. Fall and spring cover crop forage yield averages in 2009. Means followed by the same letter are not significantly different at $P \leq 0.05$.

Micronutrients and Major Crops

Dorivar Ruiz Diaz, Assistant Professor, Kansas State University

The value of micronutrients for optimum production of a variety of crops has been recognized for many years. When needed, these essential nutrients can have a substantial positive impact on production. However, neither the need for nor the importance of each micronutrient is universal across the region. The need of micronutrients is greatly affected by crop, soil properties, and production environment. With traditional thinking over the years, thoughts have focused on band, broadcast, or foliar applications. There are always questions about source and rate. There are, however, some new questions and ideas about the use of micronutrients in fertilizer programs for modern crop production. In contrast to concerns about management of nitrogen, phosphorus, and potassium in various production environments, micronutrient management has not recently been the focus of many soil fertility research programs.

<u>Significant Response with Small Amounts:</u>
Any nutrient required in small amounts to achieve optimum plant growth is, by definition, a micronutrient. This is illustrated by a couple of examples. In the first, zinc was applied in a suspension fertilizer in a band close to the seed and corn was grown in a field where the soil test for zinc was classified to be very low (0.3 ppm with the DTPA extractant) (Table 1).

The response to zinc, regardless of source, was substantial. Yield was doubled by the low rate of 0.1 lb. zinc per acre. It would not be realistic to expect a response of this magnitude in all corn fields where a need for zinc is indicated via soil testing. These results illustrate the value of very low rates when a micronutrient is deficient. When soil testing shows a need, the application of a micronutrient, zinc for example will be profitable. In this research, uptake of zinc by young corn plants was also measured (Table 1). Uptake calculated in terms of micrograms of zinc per plant increased as the rate of applied zinc increased. The effect of rate of applied zinc on uptake did not parallel the effect on yield.

When averaged over all rates applied, uptake was greater when a chelated source (EDTA) was used. Uptake from the other sources was about the same (Table 2). Zinc uptake, however, does not correspond to yield. There is research data to show that zinc uptake is highly influenced by the probability of root incorporation. Therefore, greater uptake can be expected when either fluid grades or suspensions are used.

A second example is summarized in tables 3 and 4. In these studies the effect of Zn and Fe application increased yield of wheat and soybean significantly. There can be some question about optimum rate for these nutrients for these studies, however is evident the large yield response that can be attained with small application rates.

Table 1. Influence of rate of applied zinc on corn yield and uptake by young corn plants.

Zinc Applied	Yield	Zinc Uptake
lb. /acre	bu/acre	micrograms/plant
0	62.1	120
0.1	130.7	180
0.3	136.6	223
1.0	139.6	258
3.0	142.0	392

G. Reem, 2006

Table 2. Zinc uptake by young corn plants as affected by zinc source.

Source	Plant Uptake
	micrograms per plant
EDTA	388
Nulex	220
Zinc oxide	218
Zinc sulfate	225

G. Reem, 2006

Table 3. Effect of zinc application on grain yield and tissue Zn in winter wheat.

Zn rate	Application time	Grain yield†	Tissue Zn
lb/acre		bu/acre	ppm
0	N/A	30.1	20
2	Fall	32.4	20
2	Spring	33.0	22

† Yield differences are statistically significant at the 0.05 probability level

Lamond and Martin, 1994

Table 4. Influence of iron applied with the seed on yield of soybeans.

Location	Fe applied with the seed†	
	No Fe applied	0.6 lb Fe/acre
	------Yield (bu/acre) -----	
Finney Co	31.1	34.4
Lane Co 1	36.6	55.3
Lane Co 2	43.8	57.5

† All yield differences are statistically significant at the 0.05 probability level

D. Ruiz Diaz, 2009

Foliar Application of Micronutrients

Foliar application of plant nutrients has always been of interest to researchers in soil fertility and plant nutrition. The concept seems to have merit; however, this practice is not widely used for the application of the macronutrients due to the application rates required. Since requirements for micronutrients are much smaller, there have been questions about the use of this method of application.

Foliar application of iron to the soybean crop when iron deficiency chlorosis is a problem is perhaps one of the most common practices. However, even though foliar application of Fe shows an obvious effect on plant green up, questions remain regarding the effect on final grain yield. In 2009, a study was initiated in western Kansas (4 locations). Soils at these locations were Ulysses silt loam and Richfield silt loam with pH values ranging from 8.12 to 8.23 and EDTA extractable soil Fe varied from 2.9 to 3.2 ppm. Two iron chelated sources were foliar applied at 0.1 lb Fe/acre at the 2 to 3 trifoliate stage. Adequate levels of P and K were ensured for all locations.

Grain yields from this trial showed large variability and inconsistency with the foliar application of Fe, and average differences are not statistically significant (Table 5). Foliar application of Fe generated a rapid plant green up, however this effect did not translate into grain yields consistently. This may be due to several factors including a low application rate (0.1 lb Fe/acre) that did not fulfill the plant needs. This will potentially require several applications or increase in the application rate. Another factor is the plant stage for application and the availability of sufficient plant leaf at this stage of 2-3 trifoliate. Foliar application of Fe should be done early enough to help the plant overcome the deficiency. However, with the little amount of available leaf, little fertilizer may be getting in contact with the plant.

Table 5. Influence of foliar applied Fe on soybean grain yields using two varieties.

Foliar Fe (0.1 lb Fe/acre)	Variety IC tolerance† Low	High
	Yield (bu/acre) ‡	
Control	39	35
Chelated – EDDHA (6.0%)	40	35
Chelated – HEDTA (4.5%)	37	38

† Varieties are AG3205 (low tolerance) and AG2906 (good tolerance)
‡Yield differences are NOT statistically significant at the 0.05 probability level

D. Ruiz Diaz, 2009

Seed Coating is Another Concept

The need to apply small amounts of a needed micronutrient in a manner so that it is accessible to all plants grown on any given area is a dilemma in fertilizer management. This need might be difficult to achieve if dry materials containing the needed micronutrient are broadcast and incorporated before planting. The problem may diminish if the micronutrient is mixed with a fluid fertilizer, and applied in a band near the seed at planting.

Another approach if economical, would be to coat the seed with the needed micronutrient. This approach has been used in recent years to address two problems. One is iron deficiency chlorosis in soybeans. The second is zinc deficiency in corn.
The coating of soybean seed with iron has been evaluated in recent years. Chelated iron materials are chosen because of ease of handling in the coating process and relatively high solubility. A summary of one study is provided in table 6.

In this study, EDDHA-Fe was coated on soybean seed to supply approximately 0.6 lb. Fe per acre if the seeding rate was approximately 170,000 seeds per acre. The experiment locations were in fields where iron deficiency chlorosis had been a persistent problem. The increase in grain yield due to the seed coating treatment is significant. Comparing the low and high tolerance varieties, increase in grain yield due to seed coating was generally larger in the low resistance variety. This shows the contribution of variety selection to improve this issue. Based on the results of this and other trials, the coating of seed appears to be an effective way to supply iron when iron deficiency chlorosis is a problem. The challenge is to make this practice cost effective; however, in areas with severe problems the increase in yield would certainly cover the cost of this practice.

Table 6. Yield of two soybean varieties as affected by Fe seed coating.

	High IC tolerance Var.		Low IC tolerance Var.	
	Seed Fe treatment†			
Locations	No	Yes	No	Yes
	------------- Yield (bu/acre) --------------			
Finney Co	34.4	35.3	27.7	39.8
Lane Co 1	31.4	55.1	41.7	55.6
Lane Co 2	41.4	59.9	46.1	55.2

†All yield comparisons between seed treatment (within each variety) are statistically significant at the 0.05 probability level

D. Ruiz Diaz, 2009

The concept of coating seed with a micronutrient has also been evaluated previously for corn production. The effect of the coating was evaluated with and without the application of zinc in a band placed with the seed at planting. In this study, application of zinc either on the seed or in a band at planting increased corn yield. Results, however, were not conclusive when a single application either on the seed or in a band is compared. It appears that a combination of seed treatment and banded application was not needed for optimum yield. The results of this study show that the practice of coating the corn seed with zinc shows promise. This technology may be especially important for growers who need zinc in a fertilizer program but are not equipped to apply banded zinc.

Table 7. Corn yield as affected by rate and placement of three sources of zinc.

	Zn Rate (lb/acre) and Placement			
	0.1		0.5	
Source	With Seed	Top of Seed	With Seed	Top of Seed
	---------------- bu/acre ----------------			
Nulex	218	211	213	204
Tra-Fix	201	207	213	200
Origin	210	205	201	217

Yield of control (no zinc) = 209 bu./acre

G. Reem, 2005

Minimizing Your Risk Through Marketing

Paul A. Burgener, Agricultural Economics Research Coordinator
University of Nebraska, Panhandle Research and Extension Center, Scottsbluff, NE 69361

The past few years have brought us a whole new appreciation fo risk and the potential for volatility in commodity markets. It has become common for the markets to move either up or down in large swings, leaving the average crop producer wondering what happened and how to catch up with these markets. For a typical wheat producer with 50,000 bushels of wheat in the field or in storage, a daily move of $0.20 per bushel is $10,000 on the bottom line. With this type of volatility, it has become more important than ever to understand marketing, and the importance of having some type of marketing plan.

The typical grain marketing plan is relatively simple, depending on the goals and risk preferences of the producer. The financial status of the farm is also critical to developing a marketing plan. The tools that can be used and timing of sales will be influenced by both financial position and risk preferences of the producer.

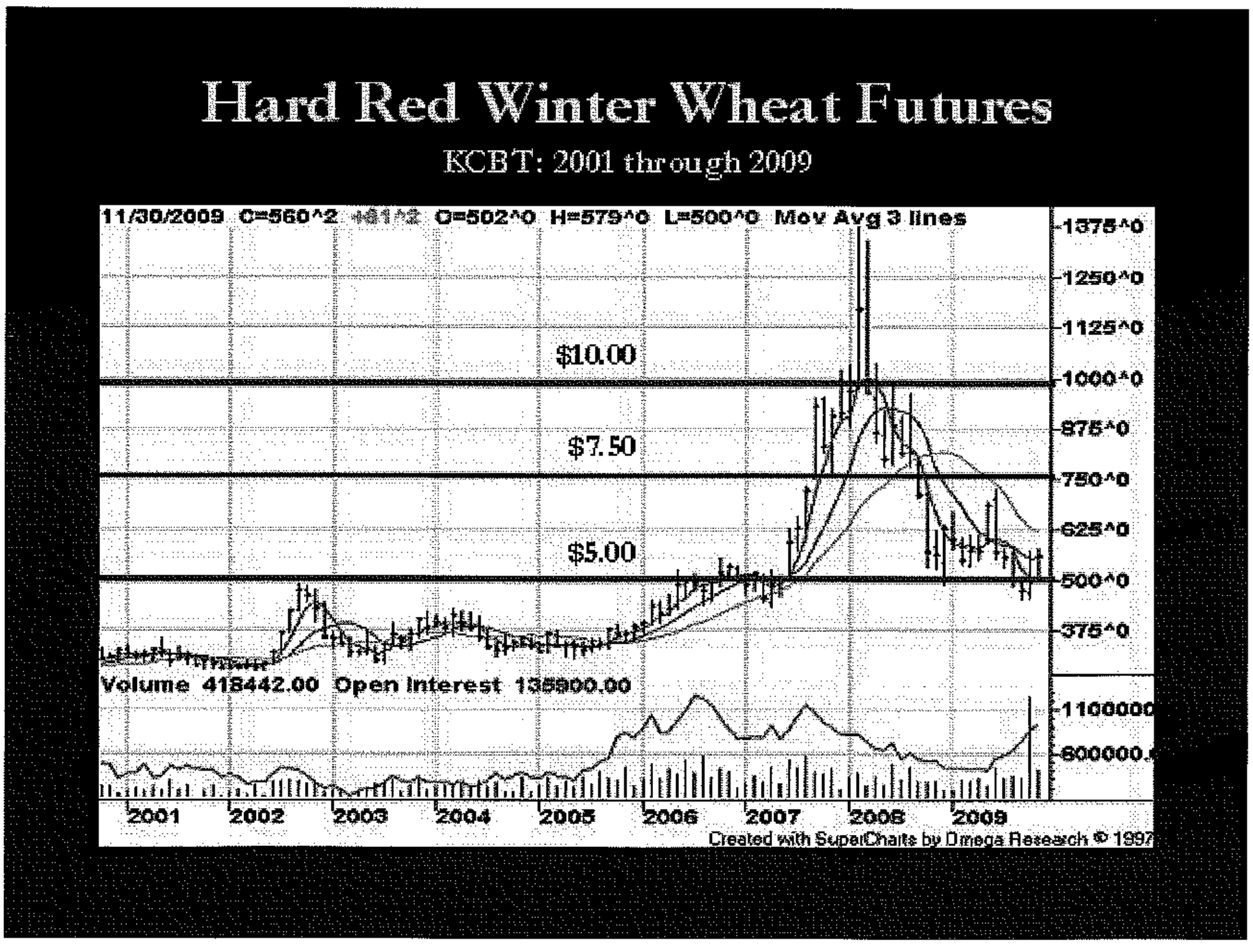
Determination of the actual cost of production for each crop is critical to development of a marketing plan. Without knowledge of the cost per bushel, it is difficult to determine when prices are profitable. As with crop prices, the prices of fuel, machinery, crop protection chemicals, fertilizer, and other inputs have been volatile for the past few years. Accurate estimates of the cost of production in these times is difficult, but necessary to set target prices. The link for University of Nebraska crop budgets online is: http://www.ianrpubs.unl.edu/sendIt/ec872.pdf, while the link for Kansas State University crop budgets is: http://www.agmanager.info/crops/budgets/proj_budget/default.asp. These budgets are an excellent place to start to develop cost projections, but actual values should be substituted wherever possible.

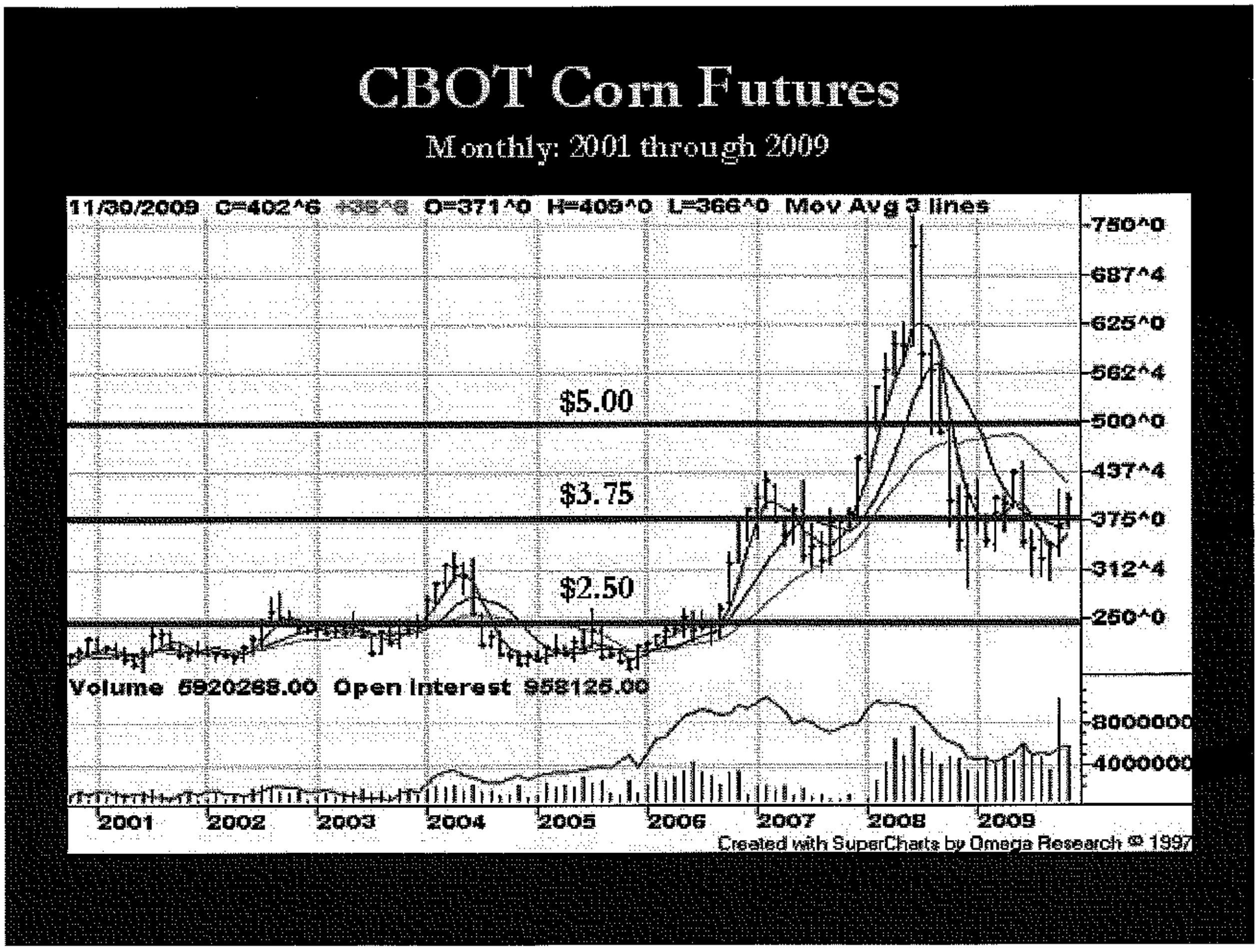
Crop insurance is a critical part of the marketing plan that cannot be overlooked in today's high risk environment. The unpredictability of the weather in this region makes it critical to have the crop insured, especially if pre-harvest sales are planned. Nothing is worse than having a commitment to deliver grain and having none due to a weather event. Crop insurance will offset some of this loss, making the consequences less severe.

Storage options will also influence the potential for making post-harvest sales. Timing of the sales and cost of storage should be considered as real costs when developing the marketing plan. Where the storage is located (on-farm or commercial) plays a big role in the overall decision making when marketing grain. On-farm stored grain offers flexibility in terms of buyers and delivery options in terms of location and timing.

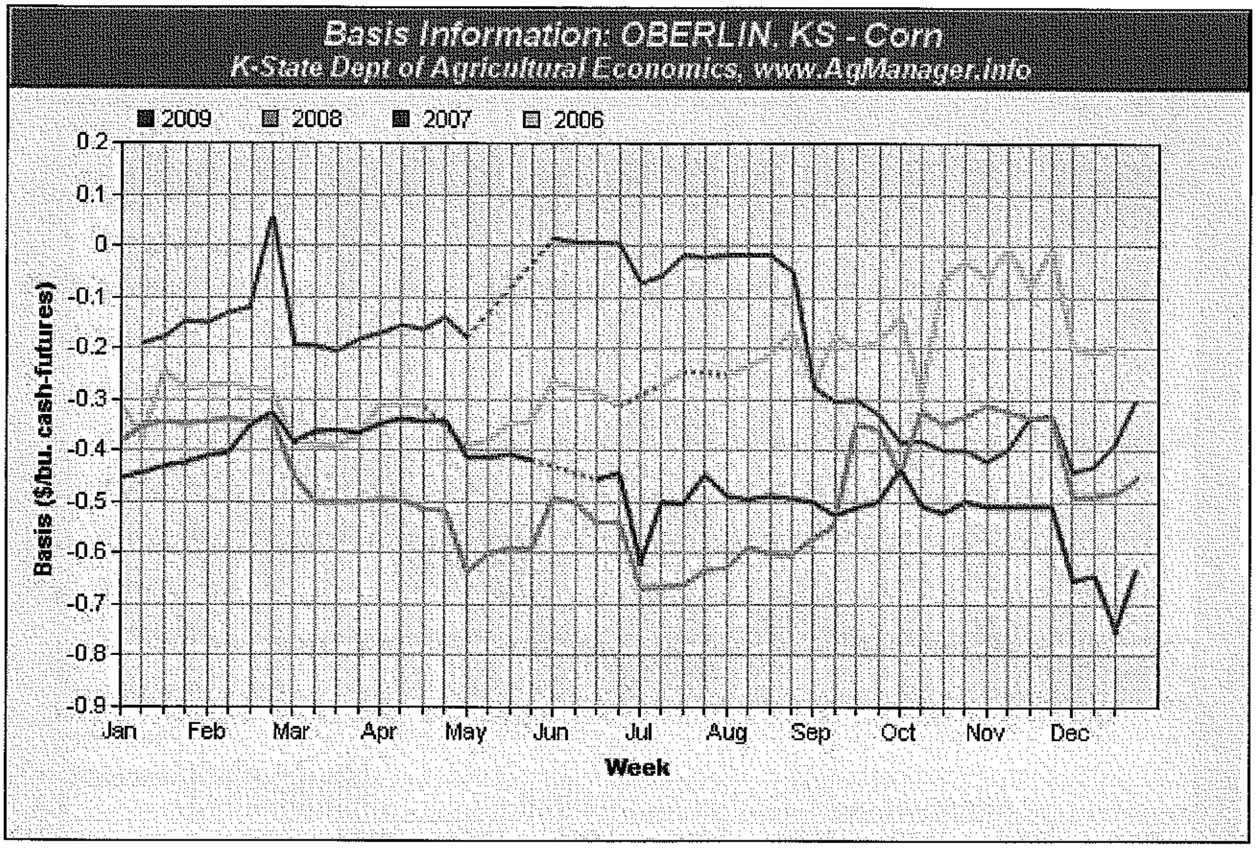
Once the big decisions have been made in terms of pre-harvest versus post-harvest, storage options, insurance, marketing tools, prices targets it is critical to watch the markets closely for those sales opportunities. A quality source of market information that is readily available could make the difference between hitting the $0.20 per bushel upswing or not. As we noted before, this could be $10,000 or more. There are a number of different sources of market information that can be used to make these decisions, and they are available in a number of different outlets. Knowing when the market hits a trigger point makes it much easier to actually pull the trigger. Another option is to preset the next trigger point with the elevator or the broker and allow them to make the trade if the point is achieved.

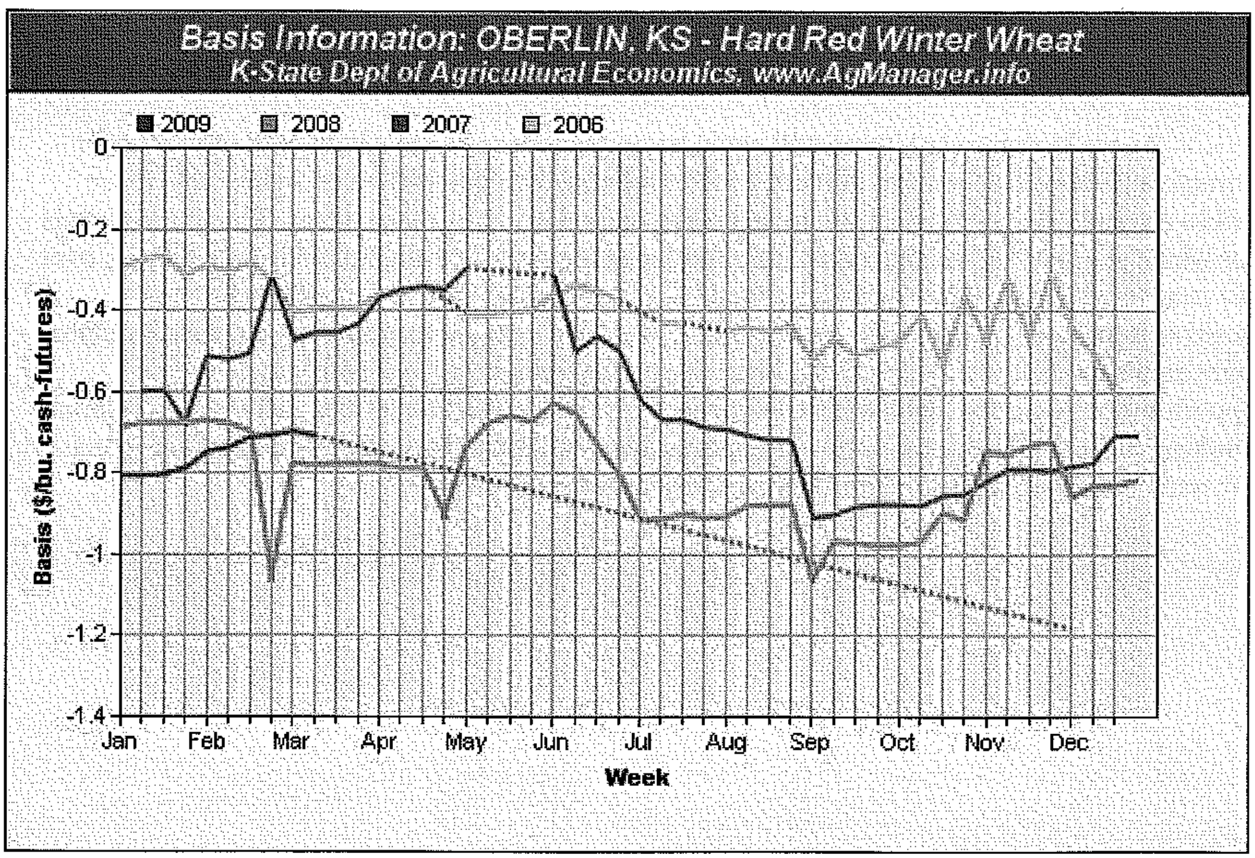
As we enter 2010 looking at selling the remainder of the 2009 crop and marketing the 2010 crop, there is no reason to believe that we will see a reduction in the market volatility of the past few years. Knowing this, the opportunities still exist to price both corn and wheat at profitable levels if we are on top of the markets. In each year since 2006, there has been a month that futures prices averaged above $3.75 per bushel for corn (above $4.37/bu in 2007,2008, and 2009), and above $5.00 per bushel for wheat (above $6.25/ bu in 2007, 2008, and 2009). However, the basis relationships have not been as attractive over the past few years with both corn and wheat basis widening as the prices have moved higher, especially after the summer of 2007. This relationship and volatility is critical to making marketing decisions into the future.





As we look forward, there will again be opportunities to price both corn and wheat at attractive levels either prior to harvest, or after harvest. The key will be knowing what those prices are and making the decision to sell when market gives us those prices. The fundamentals for wheat suggest that the market is a bit flooded at the present time, but this could change over the next few months. One positive for the U.S. wheat market is the weak dollar that has a positive impact on export sales. As the dollar remains weak, we could see an increase in export sales as we move toward harvest, Keep an eye on the market in April and May for some opportunities to market 2010 wheat. In the corn market, higher fuel prices and a weak dollar are working in favor of prices. Continued opportunities will arrive this spring and summer to market the remaining 2009 corn and pre-harvest sell some of 2010 crop.


Basis Information: OBERLIN, KS - Corn
K-State Dept of Agricultural Economics, www.AgManager.info
2009
2008
2007
2006
Basis ($/bu. cash-futures)
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Week


Basis Information: OBERLIN, KS - Hard Red Winter Wheat
K-State Dept of Agricultural Economics, www.AgManager.info
2009
2008
2007
2006
Basis ($/bu. cash-futures)
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
Jan
Feb
Mar
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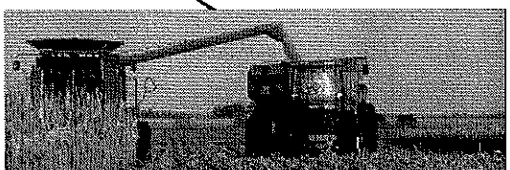
Dec
Week

Principles of On-Farm Research



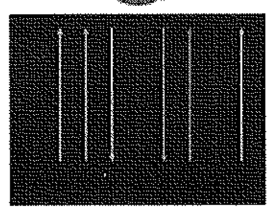
Making Informed Agronomic Decisions

- How to figure it out
  - Get educated
    - Biology never lies nor does it change very fast
    - Same goes for chemistry, physics and math
  - Get informed
    - Find data
    - Read blogs (www.newagtalk.com)
    - Collect your own data

On-Farm Research

- Yield monitors and other precision ag technologies are making it easier for cooperators to conduct research.
- Allows producers to collect data to supplement our understanding of basic crop production.

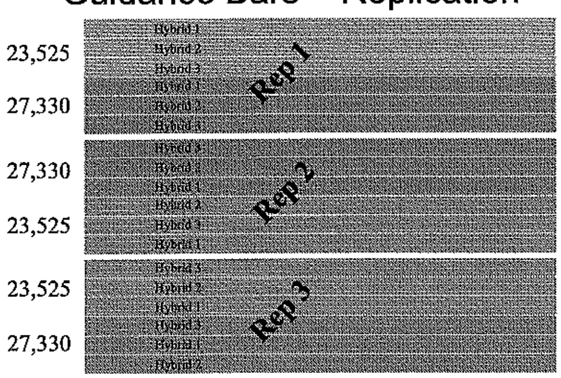
Technology Aiding On-Farm Research



Guidance System for parallel swathing

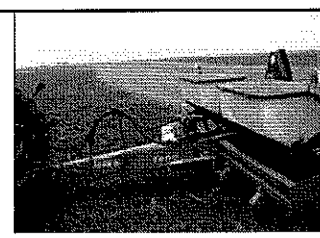
Mass Flow Sensor for Yield Monitor

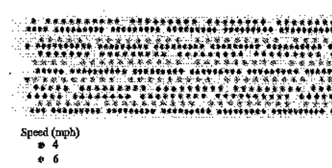
Guidance Bars = Replication



Data Recording

New planting and spraying equipment record data. You can also mount a GPS unit on equipment during use - combined with handheld computers results in real time record keeping.





Important Points

- Replication
  - necessary for analysis and required to have confidence in results.
  - Often does not require a great deal of extra time if planned correctly.
- Strip plots or split planter treatments (without replication)
  - Can be confounded by planter problems
  - Does not allow for analysis of data.
  - Regression analysis may still be a useful tool

Using Yield Monitors to Harvest Plots

- Use yield monitor to replace weigh wagon (measure grain mass).
- Depending on yield monitor type, use monitor to measure grain moisture.
- Measure plot width and length manually.
- Calculate yields and adjust for moisture as you normally would.
- Do not use yield monitor calculated yields!! Errors could exist in plot length calculations by yield monitor because of incomplete header width and GPS error.

Calculating Yield

Yield = plot grain weight / plot area / lb bushel (adjust for moisture)

	Plot Area		Test
Grain Wt.	**Distance**	**Width**	**Weight**
Weigh Wagon	Tape	Tape	na
Mass flow sensor	GPS Speed/ or transmission	Header Width	na

Yield Monitors and Plot Yield Determination

- Study conducted in Doniphan county in 1999.
- Treatments included:
  - Two sizes of soybean seed sizes:
    - Large (2400 seed/lb) and small (5000 seed/lb)
  - Four planters
    - John Deere, Kinze, White, Case-IH
- Plots were 300 feet long, replicated 3 times, and harvested with a combine equipped with a yield monitor.
- Each plot was also weighed with a weigh wagon.
- Yields calculated based on the mass measured by each system and compared.

Yield Monitor Examples

Source	Weigh Wagon	Yield Monitor
	--- Prob of F ---	
Rep	0.04	0.18
Company (C)	0.93	0.86
Seed Size (S)	0.01	0.01
C x S	0.25	0.38
Average	38.40	37.84
C.V.	6.84	7.12

Yield Monitor Examples

Planter	Small Seed		Large Seed	
	Weigh Wagon	Yield Monitor	Weigh Wagon	Yield Monitor
	----- Grain Yield (bu/acre) -----			
AGCO – White	34.2	34.3	41.9	42.7
Case-IH	36.1	34.1	41.0	40.7
John Deere	33.2	32.1	44.5	43.9
Kinze	33.9	32.2	42.3	42.6
LSD(0.05)		ns		

Objective of this Session

- We want to cover some examples of research projects that have been conducted on farms using precision ag technologies
- By examining these projects, we hope to generate some discussion about K-State's role in on-farm experiments

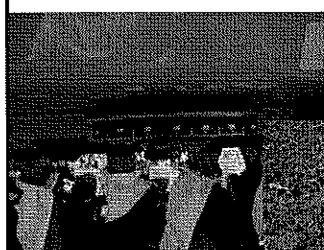
Soybean Drill Study

- Objective: Evaluate soybean establishment and yield with drills and row crop planters.
- Participants/Responsibilities:
  - KSU – research design and infield data collection
  - Industry – Planting equipment
  - Producer – Land, seed and yield data

2003 Drill Study

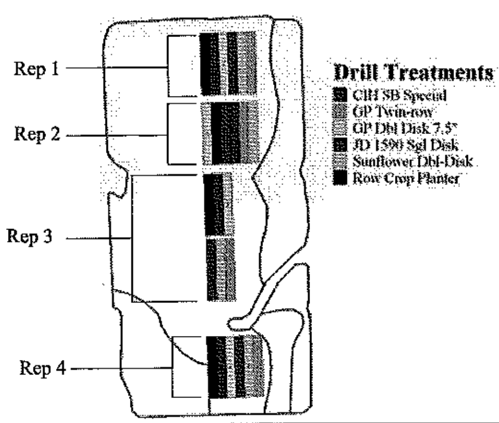
- Soybeans were drilled into corn and milo stubble at 5 fields in NE Kansas
- Planted on May 14, 15, 22, and 28
- We used 3 drills (Deere 1590, GP 1510P, Sunflower 9412) on 7.5" spacing, the farmer's planter (30"), and GP twin row
- Four replications at each field

Drill Calibration

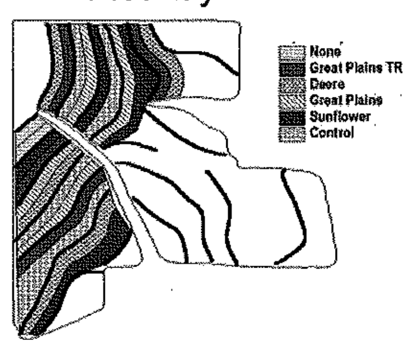


We calibrated each metering cup on the fluted feed drills.

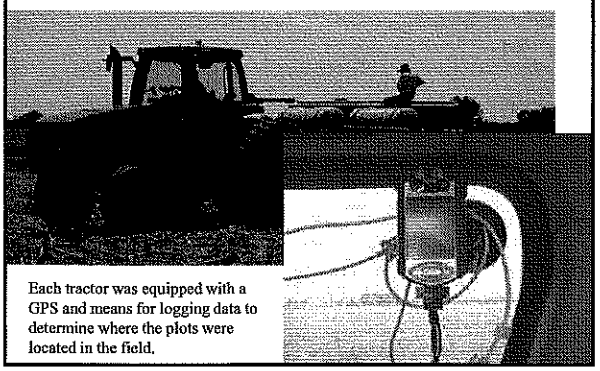
Then we knew which row we were on when we counted stands for emergence percentage.



Plot Layout

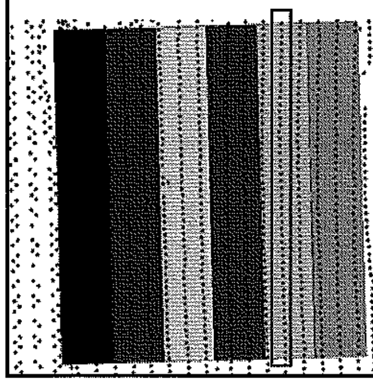


Data Collection



Each tractor was equipped with a GPS and means for logging data to determine where the plots were located in the field.

Extracting Harvest Data



If you make plots 3x harvest width, you do not need to worry about harvest path, one "clean" pass should be extractable if planter widths do not match harvest widths

Yield Results

	Staggenborg	Hofmann	Kramer	Karl
Deere	21.2	15.5[a]	20.5	33.0
GP 7.5	21.5	14.7[a]	21.8	31.8
GP TR	27.5	16.1[a]	22.0	32.6
Sunflower	23.5	15.4[a]	21.6	32.8
Planter	21.6	20.7[b]	21.4	32.5

Definitions

- Hypothesis:
  - The question you are trying to answer.
  - Example: Does starter fertilizer increase yields in no-till corn?
- Treatments:
  - The manipulations that you do to answer the question. For the above hypothesis you might have two rates of starter fertilizer and an untreated control
- Levels:
  - The different treatment rates.

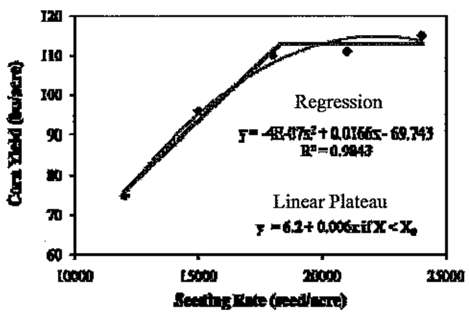
Treatment Selection

- You should think about how you are going to analyze your data before selecting your treatments (seldom done in reality)
- Keep it simple
  - 5 to 6 treatments should be the limit early on
  - Consider interactions carefully (hybrid x fertilizer)
  - Binary treatments (yes/no) can be applied via split planter, depending on equipment.

Data Analysis

- Regression for rate related equations
  - You are often looking for the optimum amount of seed or fertilizer.
  - Select treatment levels that span the wider range than you think you would use in management.
    - + or – your current levels work well.
    - Example: Current corn seeding rate is 15,000 seed/a you might use 12, 15, 18, 21 and 24,000 seed/a
- Regression is easy to do in Excel – "fit trend line" in graphs is the easiest

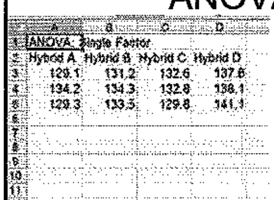
Regression Analysis



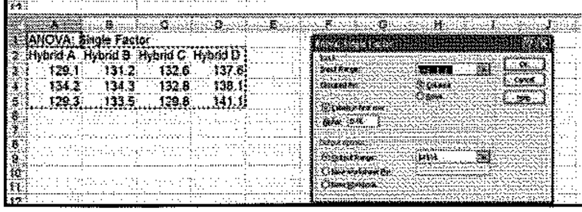
Other Data Analysis

- For non-continuous variables, Analysis of Variance should be used
  - Non-continuous variables are things like different starter fertilizer types, planter comparisons, hybrid comparisons, etc.
- Simple analyses can be completed in Excel

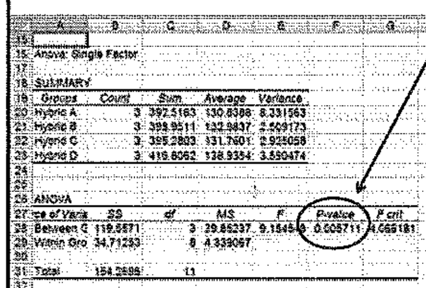
ANOVA in Excel



- Organize data by replication in columns.
- Select Data/Data Analysis/ANOVA: Single Factor



ANOVA Results



P-Values less than 0.05 are typically considered "significant" However, for things like hybrids or fertilizer rates, 0.10 may be acceptable

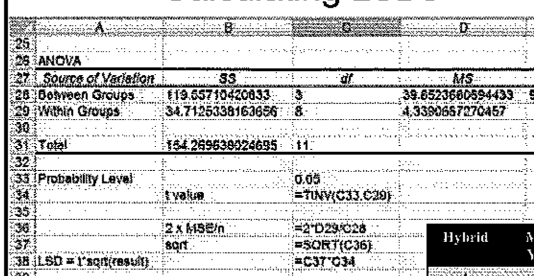
Significant means "The hybrids are different"

ANOVA Results

- Which one is different?
- We often use "Least Significant Difference" or LSD
  - $$\text{LSD} = t_{0.05}\sqrt{\frac{2 * \text{Mean Square Error}}{\text{number of entries}}}$$

We can get the $t_{0.05}$ value using the TINV function in Excel

Calculating LSDs



Hybrid	Mean Yield
A	130.8 a
B	133.0 a
C	131.8 a
D	138.9 b
LSD	3.9

Kansas Agricultural Research Association

- Formed in 2000
- Not-for-Profit Corporation in Kansas
- Annual dues are $100
- Governed by a Board of Directors (5)
- Officers include, President, Vice-President, Secretary, and Treasurer
- List serve for members only

On-Farm Research Groups

- A mechanism for progressive producers to interact.
- A mechanism for progressive producers and university faculty to work together on problems that are of interest to all
- Beneficial to all members
  - Producers can get answers to their questions on their own farms
  - Faculty members can conduct research under actual production systems

Specific Objectives

- Identify new technologies practical for precision agriculture with consideration to financial returns for producers.
- Identify agronomic practices that reduce economic/environmental risks thus promoting stewardship
- Serve as a membership network that provides a venue for members to share agriculture research experiences with each other.

KARA Member Benefits (cont)

- Winter Conferences:
  - KARA is a co-sponsor with K-State for the Kansas Precision Ag Conference held each year. 2009 will be the 11th Annual Conference.
- Research Grants
- Collaborative Research Projects with KSU

KARA Research Topics Funded

- Phosphorous in corn
- Low cost soil pH and VRA lime
- Corn population
- Soil sampling vs check book method
- No-till cover crop
- BioDiesel evaluation
- EC soil moisture model development
- Correlation between EC, soil type, fertilizer and yield.

Common Production Problems

Jim Shroyer
Extension Agronomy

No matter how many acres you manage, no matter of all the precautions you have taken something goes wrong in a particular field. It may be your fault or not, it may be the weather's fault, it may be the hybrid's fault, it may be the herbicide applicator's fault, it may be the ground your farming's fault, or it may be a combination of all of the above. One always want to know what went wrong so that problem can be avoided in the future. Being able to diagnosis a production problem requires an individual to ask the right questions and to have some observation skills. In this session we will discuss how to diagnosis problems and examples of common problems.

What questions do you need to ask when solving a production problem? Generally, there is a set of questions I ask to get the ball rolling. Depending on the situation this set of questions relates to the variety or hybrid planted, planting date and rate, a soil test, soil pH, fertilizer rate and application method, herbicide used, herbicide rate and application timing, location of the problem in the field, tillage practices, environmental factors, and previous crop and herbicide used. Interestingly, questions related to this list will help diagnosis a majority of problems, but when you are in the field more questions may be required. If you see patterns in the field that may conjure up more questions related to mechanical or human-made problems, such as, what type of planter or drill was used and what was the width of the tillage machine or spray rig.

A list of common production problems that have been observed over the recent past and that will be discussed include:

1. drill speed and planting depth
2. compaction and traffic patterns
3. herbicide issues
   carryover, drift, timing, and spray tank contamination
4. nutrient deficiencies
5. nutrient stratification
6. residue management
7. pest problems
8. weather

Aggressive no-till crop rotations: farmer panel

Kris Schroeder and Stan Miller, farmers from northwest Kansas

Notes:

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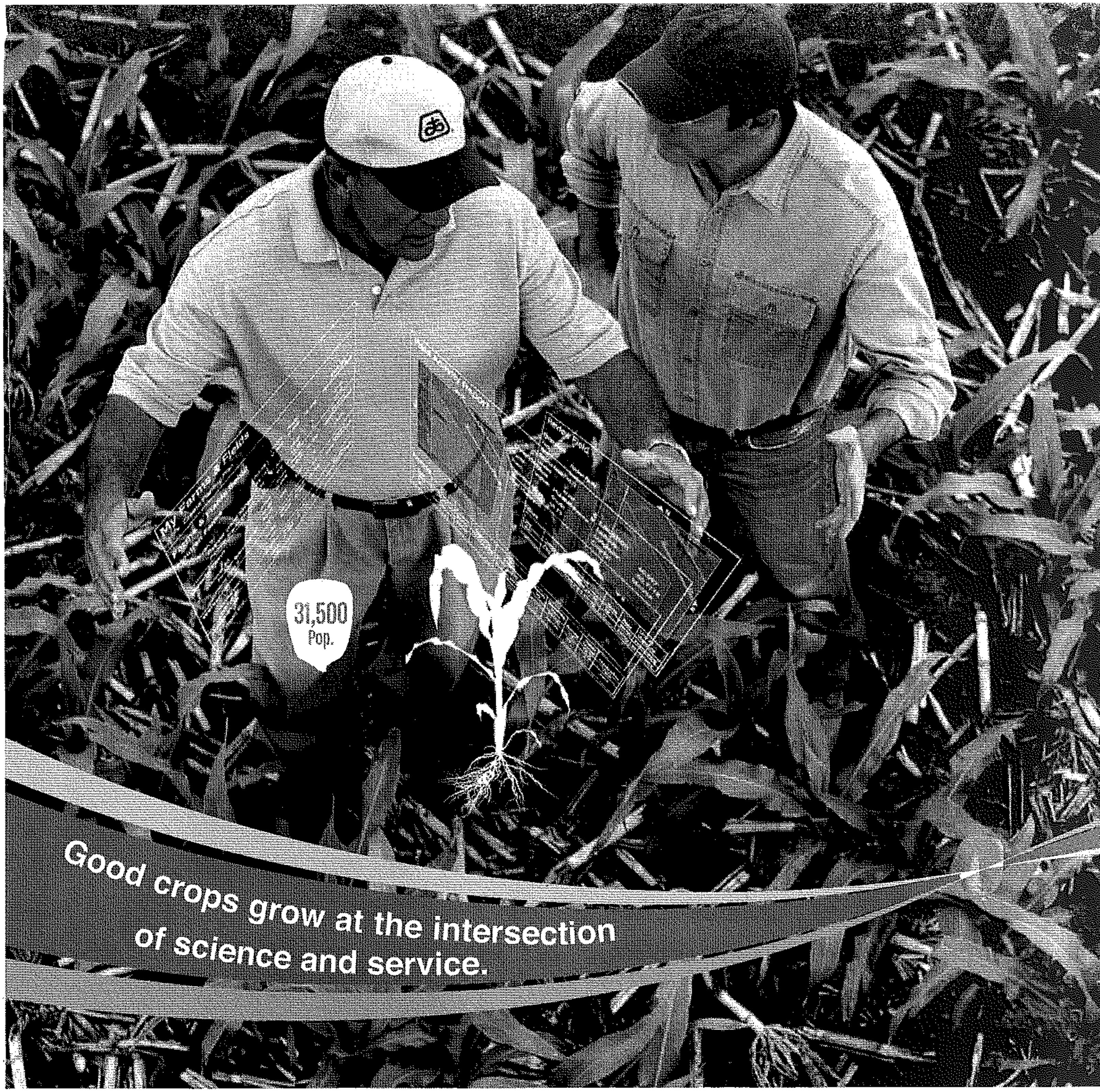

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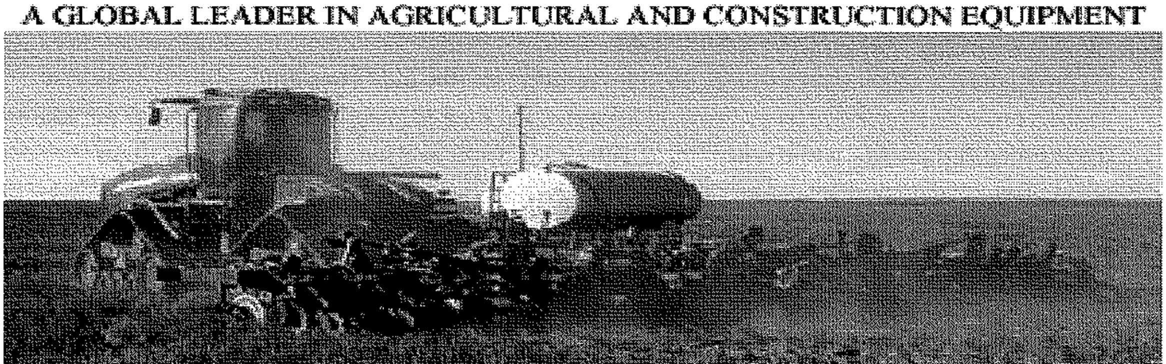

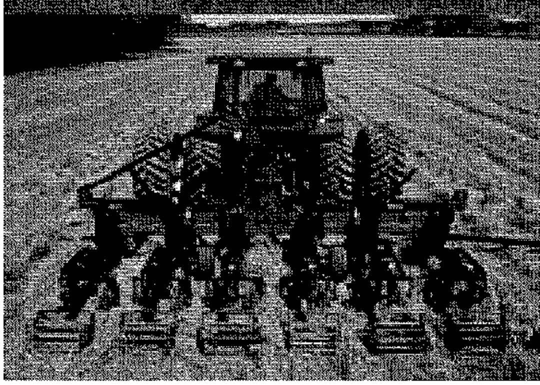

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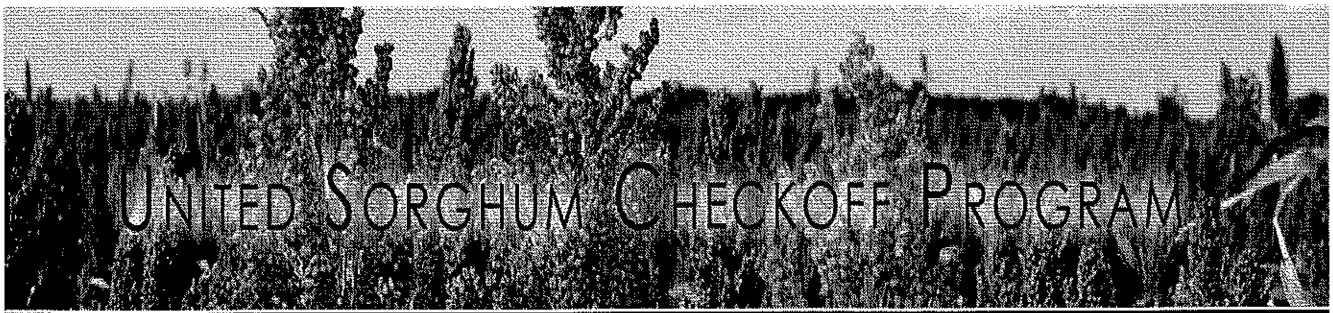

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