# Cover Your Acres Winter Conference

## 2nd Annual
## February 3, 2005
## Gateway, 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 | Room 5 | Exhibit Hall |
|---|---|---|---|---|---|---|
| 7:45 - 8:15 | Registration | | | | | |
| 8:15 - 8:35 | Welcome with Dave Mengel, Department of Agronomy Chair | | | | | |
| | University Sessions | | | Industry Sessions | | |
| 8:45 - 9:33 a.m. | GPS Guidance Systems* | Cover Your Acres Results# | Corn vs. Grain sorghum production | Rimsulfuron: New herbicide for RR Corn | | Sponsor Displays (machinery, equipment, and information from industry) |
| 9:40 - 10:28 | Spray Application Technology* | Crop Insurance | Dryland strip-till and skip row corn | No-till Harvesting Equipment | Sunflower Production | |
| 10:35 - 11:23 | Soil Sampling and Precision Ag: Does it Pay? | Dryland strip-till and skip row corn | N & P fertilizer in no-till systems | Sunflower Production | Cimarron Max for Pastures | |
| 11:30 - 12:30 | Managing changing weed populations brought on by glyphosate* | | | Noon Meal | | |
| 12:40 - 1:40 | Managing changing weed populations brought on by glyphosate* | | | Noon Meal | | |
| 1:50 - 2:38 | Soybean Rust Management* | Spray Application Technology* | Tree Loss in Windbreaks# | | GPS – basics, yield mapping, auto steer vs. assisted steer | Sponsor Displays (machinery, equipment, and information from industry) |
| 2:45 - 3:33 | N & P fertilizer in no-till systems | Dryland Soybean Productions | GPS Guidance Systems* | Redball LLC: Applying Innovation | | |
| 3:40 - 4:28 | No-till Crop Production (10 year study) | Drill vs. planted dryland grain sorghum and soybeans | Soybean Rust Management* | The Only Way to Spray | Advantages of the new JD skid-steer | |
| 4:35 - 5:23 p.m. | Corn vs. Grain sorghum production | Dryland Soybean Productions | No-till Crop Production (10 year study) | Advantages of the new JD 4920 Sprayer | | |
| 5:30 - 6:10 | Q & A with Daryl Buchholz, Associate Director of K-State Research and Extension and Dan O'brien, Area Director | | | | | |
| 6:10 - 8:00 | Industry Sponsored Bull Session (refreshments and heavy hors d'oeuvres provided) in commercial display area | | | | | |

#CEU credits for CCAs have been applied for all university sessions with the exception of the 8:45 a.m. Cover Your Acres Results and the 1:50 p.m. Tree Loss in Windbreaks.

*CEU credits for 1A for Commercial Pesticide Applicators have been approved.

Coordinated by:
Brian Olson, K-State Multi-County Extension Agronomist
Please send comments or suggestions to bolson@oznet.ksu.edu

To become a member of the Northwest Kansas Crop Residue Alliance, please call Stan Miller (President) at 785-693-4561

PLEASE TURN ALL CELL PHONES OFF OR TO VIBRATE. THANK YOU.

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# GATEWAY

Oberlin, Kansas

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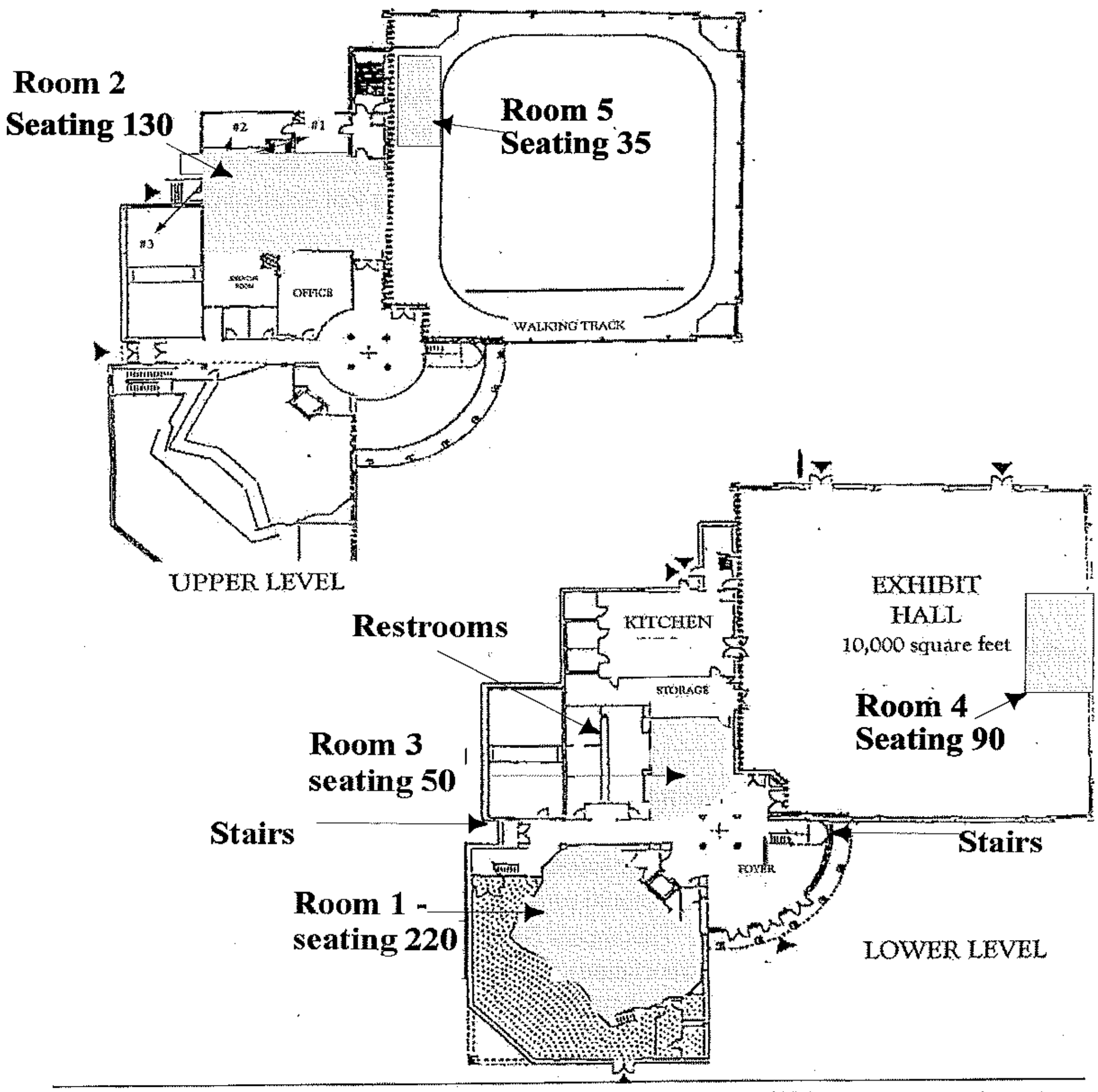


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# *GPS Guidance Systems*

Randy Taylor
Extension Engineer, Machinery Systems
Biological and Agricultural Engineering
Kansas State University

With the increasing availability of GPS receivers and changes in farming practices the popularity of guidance systems is rising. The availability of free differential correction over a wider area has increased the number of lower priced DGPS receivers. As well, the increase in reduced and no-till acres has increased the importance of crop protection application and created challenges for producers to follow their desired path in the field. Crop stubble creates an environment where seeing the previous pass can be difficult. Several manufacturers have introduced GPS guidance systems to address these problems and several more will enter the market soon. GPS guidance systems rely on a satellite signal to indicate a vehicles location and indicate to the operator where he should be driving. Systems range from those that indicate a desired path to the operator via a display of lights or image to ones that automatically steer the vehicle.

## Why GPS Guidance?

GPS guidance systems are intended to increase productivity by minimizing overlap and skips which could potentially reduce crop inputs such as chemicals and fertilizers, as well as other inputs such as fuel and time. They allow producers to operate in conditions that have historically been challenging. They can be used to extend operational hours for tillage, spraying, or planting while not increasing operator fatigue. In some cases a GPS guidance system can replace traditional marker systems such as foam or planter markers, while sometimes they are used to supplement traditional markers. Either way they can help improve driving accuracy in low visibility conditions such as night, dust, fog, or no-till stubble.

One of the best and often overlooked uses of a guidance system is to count rows when operating in a growing row crop. As you enter the turn rows and make your turn, the guidance system will lock onto the next swath to help you locate your next path through the field.

## Compatibility

GPS guidance systems come in many shapes and forms and though they may initially be purchased for guidance only, they have many potential uses. The GPS portion of the guidance system can be used to provide position information for yield monitors, controllers, and data loggers. The GPS for a guidance system should provide the necessary flexibility to communicate with these other devices. This means the capability of providing a standard NMEA (National Marine Electronic Association) string output, usually a GGA and VTG string. The GGA string contains position and signal quality information and the VTG string contains speed information. These communication protocols have become agriculture industry standards. Newer GPS receivers have the ability to connect to a Controller Area Network (CAN), which is quickly becoming standard on all new ag vehicles. The CAN bus allows easy, reliable communication from all standard CAN devices regardless of manufacturer.

## GPS Accuracy

Performance of a GPS receiver can be considered in two ways, accuracy and precision. Accuracy is defined by how well the receiver can locate itself on the face of the earth. This is more important when you want the capability to return to an exact location at some time in the future. Precision is determined by the consistency of the receiver. It is capable to be precise without being accurate.

## Position Accuracy

Though there are no standard procedures or tests for measuring dynamic (moving) GPS accuracy. Furthermore, manufacturers typically use their own definitions of static accuracy. Though static accuracy may not be a good indicator of dynamic accuracy, most sub meter GPS receivers can be fairly precise for short periods. This short term precision aids guidance system performance.

Several recent studies have attempted to evaluate dynamic accuracy of current GPS technology. Though there is some variability in the results, DGPS receivers commonly used for guidance have pass-to-pass errors less than 10 inches. Some receivers have pass-to-pass errors lees than 6 inches.

In general, guidance systems can be broken into three categories based on GPS accuracy. A real time kinematic (RTK) GPS system is the most precise and accurate. They offer one-inch pass-to-pass precision and very repeatable accuracy. These systems are the most expensive and require a base station. They can achieve sub-inch accuracy. Multiple vehicles can use a signal from the same base station as long as they are within range of the radio signal. Operation requires line of sight so typical ranges of operation will vary with terrain, but are usually less than 6-8 miles. It is possible to set up repeater stations to extend the range of the radio signal.

The second category contains receivers capable of providing pass-to-pass accuracy less than 4 inches. These are general dual frequency DGPS receivers that require a subscription signal for differential correction. The cost of the signal varies with providers. Since there is no base station, these systems have a wider range of operation. Though the pass-to-pass precision is good, they are not as accurate or repeatable as RTK systems. However, advances in differential correction techniques are improving the accuracy.

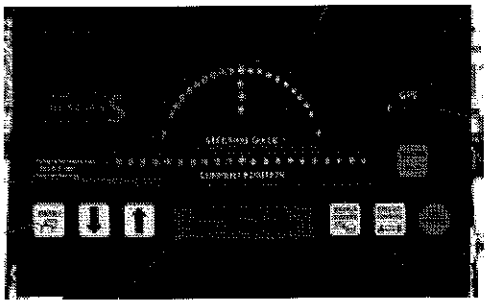
The third category offers pass-to-pass precision of about 8-10 inches. These are typically powered by GPS receivers that are using a single frequency differential correction from a subscription provider or the FAA's Wide Area Augmentation System (WAAS).

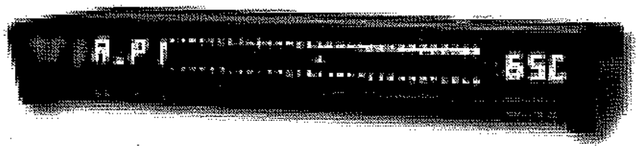
## GPS Mounting Location

What about slope? Mounting the GPS antenna on the cab of a tractor or sprayer puts it 9-10 feet above the ground. This could possibly create problems when operating on contours. As long as slope is consistent, there won't be much problem since the receiver will always be indicating downhill. Antenna height becomes a problem when the slope is changing. For example, a pass is made on relatively level ground near a terrace and the next pass is made on the back for the terrace where there is more slope. The location of a GPS antenna relative to the center of the tread will be different for these two passes. The difference will depend on the antenna height and slope. This is inherent to all systems, unless they correct for slope, and the user should be aware of the operational characteristic.

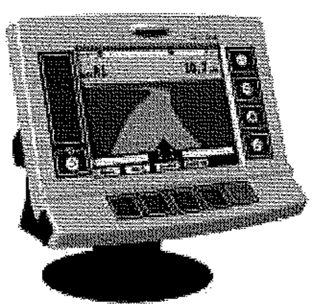
## Operator Interface

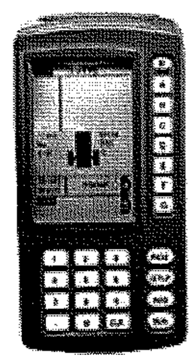
GPS accuracy is irrelevant if the operator cannot interpret the signal and make timely steering corrections. There are two basic types of operator interfaces for guidance systems. One uses an array of lights and the other uses an image. There are different configurations of each type and multiple ways to configure some units. Operators should find one that is easy to configure and interpret.





Light based systems, like the two shown above, use lights to indicate what the operator should do to maintain the desired path. Image based guidance systems, like the two below, use an image of the vehicle and an indication of where the vehicle should be relative to the desired path. Some may also incorporate audible commands to the operator. While determining which type is the most effective would be a challenging research project, operators can typically determine which one they prefer quickly.





## Features and Abilities

The most common, and simplest, feature of most guidance systems is straight line guidance. The operator drives and logs a reference pass and the parallel passes of a preset swath width are created. The operator logs the reference pass by recording an A point at the beginning of the pass and a B point at the end. Each time the operator turns, the guidance system finds a new pass and indicates a steering pattern to follow this pass. In the straight guidance mode, all subsequent passes are typically referenced to the initial A-B line. The reference pass is typically place in a location that is easily driven in a straight line. This could be along a fence line or road. Straight line guidance can be conducted in back and forth or racetrack patterns.

Contour guidance is a feature of most systems. This feature allows the operator to drive a curved pass. At the end of the first pass, the guidance system creates a new pass parallel to the initial pass. Each subsequent pass is typically created parallel to the previous pass and not the initial pass. Though contour guidance may be a feature, it should be noted that it can be difficult to use especially in the absence of other peripheral information such as terraces and other land features.

Most guidance systems also provide the ability to mark points in the field. This may be a location where application was stopped and you want to return to the point to resume. However, it may be difficult to use this feature if the system just indicates the distance and direction. The operator may not be able to take the most direct route and thus must learn how to use the information to find the point using another route.

## Auto Steering

Automatic steering for agricultural tractors and sprayers has been accomplished with GPS systems. Initially these used only RTK GPS systems that were very accurate and precise. However in the last few years, systems that use less accurate GPS receivers have been introduced. The pass-to-pass precision of these less accurate systems is adequate for some field operations, but they may not be able to return to the same exact spot at some point in the future.

The key item to consider when selecting an auto steer system is accuracy of the GPS system. For example, RTK guidance may be more than you need for typical field tillage or maybe even spraying. However, the RTK system may be exactly what you need for planting row crops or strip tillage. Other features to consider are ease of use and the operator interface. The best thing to do is take a test drive before you purchase a system.

# Spray Application Technology

PULSE WIDTH MODULATION TO CONTROL SPRAY DROPLET SIZE FOR INCREASED EFFICACY AND SPRAY DRIFT MITIGATION

Robert E. Wolf[1]

Off-target drift is a major source of application inefficiency. When spraying pesticides, there is always a chance some product will escape from the target area. Drift is a concern because it removes the chemical from the intended target, making it less effective and depositing it where it is not needed and often not wanted. When a pesticide is applied where it is not wanted, it becomes an environmental pollutant that can injure susceptible vegetation, damage wildlife and contaminate water supplies. Although drift cannot be completely eliminated, selecting and using proper equipment can help maintain drift deposits within acceptable limits.

Specific knowledge about crop protection product performance as it relates to spray droplet size will be necessary information for future application decisions. Spray droplet characteristics influence the ability of crop protection products to deposit on certain leaf types. If the size of spray droplets can be better controlled then better efficiencies are expected (Smith, et. al., 1999). Droplet size produced by the nozzle is a controlling factor in gallonage per acre, target deposition, uniformity of coverage, efficacy, off-target movement, and resulting exposure. Many forces impinge on droplet size, but drop size must be manipulated to optimize performance and eliminate associated undesirable results (Williams, et. al., 1999).

For normal agricultural spray operations the flow rate and the consequent volume of application (GPA) are typically regulated through adjustments in pressure, speed, or by changing to a different nozzle orifice size. As pressures are adjusted through a given orifice size the spray droplet size will also change (Womac, et. al., 1997). With today's abundance of spray machines with electronically controlled applications systems, pressure variations can occur rapidly as application speeds change, thus changing the quality of the spray equally as often. Even though the pressure changes are beneficial to maintaining calibrated spray rates, a dramatic change in the spray droplet size emitted from the spray system occurs. For instance, to double the flow from a given orifice, a four-fold pressure increase is required. Thus, in field spraying situations with electronic controllers, doubling the speed of application requires doubling the flow to maintain the calibrated rate, increasing the pressure four-fold, resulting in dramatic changes in spray droplet size.

Technology is available to alleviate the problems associated with this scenario. A system utilizing pulse width modulation (PWM) for controlling droplet size while varying application volumes, speeds, and pressure is currently available commercially (Capstan Ag Systems, Inc., Topeka, KS). By maintaining the application volume while adjusting spray pressure, operators are able to manipulate droplet size to meet changing wind and weather conditions or protect sensitive downwind areas. It is also possible to adjust application volumes without changing nozzles or adjusting pressure. This technology can also help maintain pattern uniformity when slowing in turns, for corners, and on hills preventing over-application at lower speeds and reducing under-application during acceleration. However, adaptation by the industry is slow because the system adds considerable expense to standard spray systems, adequate scientific data supporting the use of the technology does not exist, and exposure to the application industry has been limited.

Management of spray droplet size is a critical issue in the search of accurate and efficient crop protection application systems. Giles and Ben-Salem reported in 1992 the development of a computer controlled valve attachment for agricultural spray nozzles. The valve system uses an electronically actuated solenoid valve coupled to the inlet of the spray nozzle to provide a variable-duration, pulse spray emission. As first reported the PWM could modulate flow without distorting droplet size or spray pattern uniformity over a 4:1 range for a given size orifice (Giles, Young, Alexander, and French, 1995. In 1996, Giles, Henderson, and Funk reported the same response but over a 10:1 flow adjustment. In both reports a constant pressure was maintained. With the inclusion of PWM for flow control, the speed and pressure affects are

[1]Assistant Professor and Extension Specialist Application Technology, Biological and Agricultural Engineering, Kansas State University, 148 Seaton Hall, Manhattan, KS, 66506.

minimized, eliminating major variations in droplet size. Thus, high-pressure scenarios normally producing smaller spray droplets with higher drift potential are minimized. Providing a more uniform droplet spectrum should increase field efficacy while drift is minimized (Giles, Henderson, G., and Funk, K 1996).

The application of crop protection products is an important step in the growing of agronomic crops in our countries economy. A better understanding of PWM should provide the application industry, which includes growers, commercial applicators, agrochemical companies, scientists, and extension personnel with the information necessary to make the best choices regarding this technology for the application of crop protection products. Future EPA label directives will require applicators to adhere to spray droplet standards (ASAE-572) during application as a means to improve efficacy and minimize drift into sensitive areas.

## References:

Giles, K. and Ben-Salem, E., 1992. Spray Droplet Velocity and Energy in Intermittent Flow from Hydraulic Nozzles. *Journal Agricultural Engineering Research.* Vol. 51, 101-112.

Giles, K., Henderson, G., and Funk, K. 1996. Digital Control of Flow Rate and Spray Droplet Size from Agricultural Nozzles for Precision Agricultural Application. *Proceedings of the 3rd International Conference – Precision Agriculture.* American Society of Agronomy-Crop Science Society of Agronomy-Soil Science Society of America. Minneapolis, MN. pp. 729-738.

Giles, K., Young, B., Alexander, P., and French, H., 1995. Intermittent Control of Liquid Flow from Fan Nozzles in Concurrent Air Streams: Wind Tunnel Studies of Droplet Size Effects. *Journal Agricultural Engineering Research.* Vol. 62, 77-84.

Smith, D., Askew, S., Morris, W., Shaw, D., and Boyette, M. 2000. Droplet Size and Leaf Morphology Effects on Pesticide Spray Deposition. *Transactions of the American Society Agricultural Engineers.* Vol. 43(2):255-59.

Williams, W., Gardisser, D., Wolf, R., and Whitney, R., 1999. Field and Wind Tunnel Droplet Spectrum Data for the CP Nozzle. American Society of Agricultural Engineers/National Agricultural Aviation Association., Reno, NV. Paper No. AA99-007.

Womac, A.R., Goodwin, J.C., & Hart, W.E., 1997. Tip Selection for Precision Application of Herbicides, University of Tennessee CES, Bulletin 695.

## NEW SPRAY TECHNOLOGIES

Robert E. Wolf[2]

Several technological advancements in spray systems have occurred in recent years as the application industry searches for ways to apply crop protection products more efficiently and safely in the environment. Many of these technologies have been present for several years but adoption has been slow for different reasons. Much of the design emphasis in recent years has been to minimize drift potential. This paper will give a brief review of several of these technologies.

**Drift Reducing Spray Nozzles** - Several application equipment technologies for boom sprayers have been developed to assist in the minimization of spray drift. The most popular and least costly to the industry has been in the design of spray nozzles. Most all manufactures have designed new nozzles with the emphasis on improved droplet size control to enhance efficacy and minimize drift potential. Chamber and venturi style tips have been the most successful with this effort. Refer to K-State Research and Extension Publication MF-2541, Nozzle Types for Boom Sprayer Applications of Crop Protection Products.

**Air-Assisted Boom Sprayers** - Air-assisted boom sprayers, uses a high-velocity air stream channeled along the boom to assist or shield the spray into the target. Research data will support improved deposition, but unless used in a canopied target the excess air velocity has potential to increase spray drift.

**Electrostatic Sprayers** - Another technology involves the use of system that will create and distribute electrically charged spray droplets into the target. The spray droplets are charged with an opposite polarity

[2]Assistant Professor and Extension Specialist Application Technology, Biological and Agricultural Engineering, Kansas State University, 148 Seaton Hall, Manhattan, KS, 66506.

of the plant material and theoretically are attracted into the canopy. This is similar to the process used to spray paint new automobiles. Electrostatic spray systems are available for both ground and aerial sprayers. Electrostatic sprayers have moderate acceptance for increasing coverage in certain parts of the canopy, mostly in the upper portions. Electrostatic applications have also shown potential to increase droplet coverage on the underside of leaves. This feature is more critical when applying fungicides and insecticides rather than when applying herbicides. However, because of the need to develop fine spray droplets for the system to work effectively to achieve improved coverage potential, reducing the incidence of spray drift has not been as easily demonstrated.

**Pulse Width Modulation** - A third technology is available that is designed to alleviate drift problems associated with sprayers equipped with rate-controllers and capable of large spray speed fluctuations during the application process. The technology utilizing pulse width modulation (PWM) for controlling droplet size while varying application volume, speed, and pressure is available. By maintaining a constant application volume while adjusting spray pressure, operators are able to manipulate droplet size to meet changing wind and weather conditions or protect sensitive downwind areas. It is also possible to adjust application volumes without changing nozzles or adjusting pressure. This technology can also help maintain pattern uniformity when slowing in turns, for corners, and on hills preventing over-application at lower speeds and reducing under-application during acceleration. See supplemental abstract - Pulse Width Modulation to Control Spray Droplet Size for Increased Efficacy and Spray Drift Mitigation

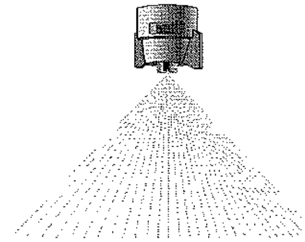
**Hoods and Shield** - Spray hoods and shields have proven successful for reducing spray drift. Proper design is very critical for hoods to be beneficial. Hoods are typically designed to completely cover the boom while shields are usually placed in front or behind the boom and act strictly to shield the boom from wind. Other systems are designed to individually shield rows of sensitive crops from specific herbicides applied between the rows. Caution must still be used when highly active pesticides are used upwind of sensitive crops or around trees and gardens. Field conditions, size and added weight to modern agricultural spray systems has limited the adoption of this technology. The use of hoods or shields does not allow applicators to ignore label statements about drift. If the label states a wind speed limit, that limit must be followed.

**Sensors** - The use of optical sensors to actuate spray tips in combination with individual row hoods can be an effective tool in reducing spray drift. By design, the system only sprays a detected weed, and since it is not spraying all the time it is most effective for drift control because it is reducing the amount of pesticide being applied. However, in combination with improper tip selection and high pressures this technology would not be very effective.

**Site-Specific Applications** - Additional technologies are forthcoming that will utilize many of the above systems in combination with on-the-go site-specific application practices to help reduce drift. Sprayers utilizing prescription application maps for variable rate applications and others with sensors to identify targeted pests to apply crop protection products when and where needed are in development.

Each of the above technologies has seen limited adoption because of the additional cost added to the spray equipment. As future application guidelines regarding increased efficacy and spray drift minimization are established, more technologies will be developed and adopted. These developments will require sound research to support adoption. Additional information on each system discussed above is available by doing a basic web search. Use a key word describing the system of interest, ie. hooded sprayers, electrostatic sprayers.

# Nozzle Types for Boom Sprayer Applications of Crop Protection Products



Application Technology Series

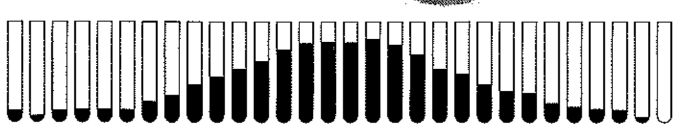
Robert E. Wolf, Extension Agricultural Engineer, Kansas State University
Dennis R. Gardisser, Extension Agricultural Engineer, University of Arkansas
John Slocombe, Extension Agricultural Engineer, Kansas State University
Bryan W. Shaw, Extension Agricultural Engineer, Texas A & M University

Regardless of the type of application system and cost, selecting the correct type and size of spray nozzle is essential. The nozzle determines the amount of spray applied to an area, the uniformity of the application, the coverage of the sprayed surface, and the amount of drift. Drift can be minimized by selecting nozzles that produce a large droplet spectrum, while providing adequate coverage at the intended application rate and pressure. All nozzles develop a range of droplet sizes. Those that develop the least amount of fines are least drift prone. Although nozzles have been developed for practically every kind of spray application, only a few are commonly used in crop protection product applications. Emphasis in nozzle design during the past few years has resulted in a vast improvement in spray quality. A few commonly used nozzles are described in this publication.

## Nozzle Types

### Extended Range Flat-Fan (has essentially replaced regular and low-pressure flat-fan, available from all nozzle manufacturers)

*Extended or total range flat-fan nozzle*

*Extended range flat-fan spray pattern*

Extended range flat-fan nozzles are frequently used for soil and foliar applications when better coverage is required. Extended range flat-fan nozzles are available in 80- and 110-degree fan angles. The spray pattern produced by this nozzle has a tapered edge distribution. The outer edges of the spray pattern have reduced volumes. This makes it necessary to overlap adjacent patterns along a boom to obtain uniform coverage. Eighty-degree flat-fan nozzles are usually mounted on 20-inch centers at a boom height of 17 to 19 inches. One hundred ten-degree nozzles can be mounted on 20 or 30-inch centers, at boom heights of 16 to 18 inches, and 20 to 22 inches, respectively. To achieve maximum uniformity in the spray distribution, regardless of the spacing and height, the spray patterns should overlap 50 to 60 percent of the nozzle spacing (25 to 30 percent on each edge of the pattern). Foam markers and computer-aided guidance systems are commonly used to help operators with swath width overlap requirements on multiple passes.

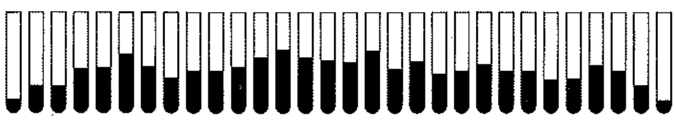
For soil applications, the recommended pressure range is 10 to 30 psi. For foliar application in which smaller drops are required to increase coverage, pressures from 30 to 60 psi may be required. The incidence of drift may increase when operating pressures exceed 30 psi. Nozzle wear rate is also increased at higher pressures.

### Flooding Flat-Fan Nozzles (old style nozzle, several manufacturers have similar designs)

Flooding flat-fan nozzles produce a wide-angle, flat-fan pattern, and are used for applying herbicides, herbicide mixtures, and liquid fertilizers. The nozzle spacing should be 40 inches or less for common sprayer application. When flooding flat-fan nozzles are used for commericial application on "floaters," 60-inch spacings are used. These nozzles are most effective in reducing drift when they are operated within a pressure range of 10 to 30 psi. Pressure changes affect the width of the spray pattern more with the flooding flat-fan nozzle than with the extended range flat-fan nozzle. In addition, the distribution pattern is usually not as uniform as that of the extended range flat-fan tip. The best distribution is achieved when the nozzle is mounted at a height and angle that obtains at least double coverage or 100 percent overlap. Uniformity of application depends upon the pressure, height, spacing, and orientation of the nozzles. Pressure directly affects droplet size, nozzle flow rate, spray angle, and pattern uniformity. At low pressures, flooding nozzles produce large spray drops; at high pressures, these nozzles actually produce smaller drops than flat-fan nozzles at an equivalent flow rate.

The spray distribution of flooding nozzles varies greatly with changes in pressure. At low pressures, flooding nozzles produce a fairly uniform pattern across the swath, but at high pressures the pattern becomes heavier in the center, tapering off toward the edge. The width of the spray pattern is also affected by pressure. To obtain an acceptable distribution pattern and overlap, you should operate flooding nozzles within a pressure range of 10 to 30 psi.

*Flooding flat-fan nozzle*



*Flooding flat-fan spray pattern*

Nozzle height is critical in obtaining uniform application when using flooding nozzles. Flooding nozzles can be mounted vertically to spray backwards, horizontally to spray downward, or at any angle between vertical and horizontal. When the nozzle is mounted horizontally to spray downward, heavy concentrations of spray tend to occur at the edges of the spray pattern. Rotating the nozzles 30 to 45 degrees from the horizontal will usually increase pattern uniformity over the recommended pressure range of 10 to 30 psi. For uniform distribution over a range of pressures, mount the nozzles to obtain double coverage at the lowest operating pressure.

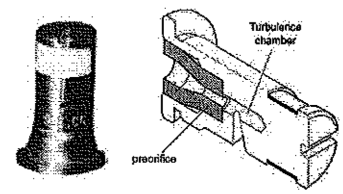
## Turbulation Chamber Nozzles

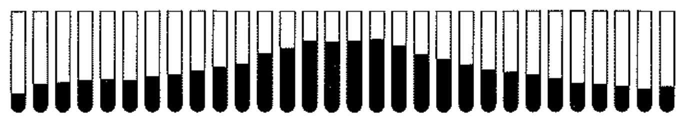
The most recent improvements in nozzle design have incorporated a pre-orifice concept with an internal turbulation chamber. These design changes have resulted in larger, less driftable droplets and improved spray pattern uniformity. Turbulation chamber nozzles are available in flood and flat-fan tip designs.

## Turbo® Flood Nozzles

Turbo® flood nozzles combine the precision and uniformity of extended range flat-fan spray tips with the plugging resistance and wide-angle pattern of older style flooding flat-fan nozzles. The design of Turbo® flood nozzles results in larger droplets and improved distribution uniformity. Turbulence in the chamber portion of the spray tip lowers exit pressure, reducing the formation of small driftable droplets. Exit orifice design changes improve

*Turbo® flood nozzle*



*Turbo® flood spray pattern*

pattern uniformity over older style flooding nozzles. Turbo® flood nozzles are designed to operate at pressures of 10 to 40 psi.

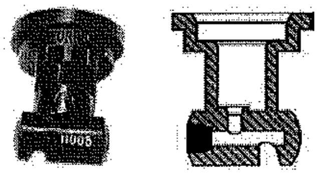
Turbo® flood nozzles require an overlap of at least 50 to 60 percent of the nozzle spacing (25 to 30 percent on each edge of the pattern). The relationship between nozzle pressure, height, and spacing is critical for obtaining uniform application. Typical floater boom configurations have Turbo® flood nozzles spaced on 60-inch centers and range up to 48-inches above the ground. Nozzles can be mounted vertically to spray backward, horizontally to spray downward, or any angle between vertical and horizontal. For uniform distribution, proper overlap is required regardless of the nozzle mounting angle.

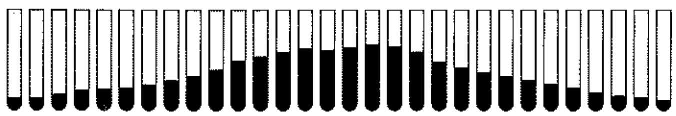
Turbo® flood nozzles are highly recommended for soil applications, particularly when applying tank mix combinations of fertilizers and herbicides. Turbo® flood nozzles produce larger droplet spectrums than standard flooding nozzles and work well in drift-sensitive applications.

## Turbo® Flat-Fan Nozzles

The Turbo® flat-fan nozzle design develops a greatly improved spray pattern compared to the extended range flat-fan and other drift reduction flat-fan nozzles. This nozzle was modeled after the Turbo® flood, but for use in the application of postemergence products. Turbo® flat-fan nozzles are wide-angle, pre-orifice nozzles that create larger spray droplets across a wider pressure range (15 to 90 psi) than comparable low-drift tips, reducing the amount of driftable particles. The unique design of these nozzles allow them to be mounted in a flat-fan nozzle body configuration. The wide spray angle will allow for a 20- or 30-inch nozzle spacing, and requires an overlap of at least 50 to 60 percent of the nozzle spacing (25 to 30 percent on each edge of the pattern) to achieve uniform application across the boom. Position the tip so that the preset spray angle is directed away from the direction of travel. The Turbo® flat-fan nozzle is recommended for use with electronic spray controllers where speed and pressure changes occur regularly.

*Pre-orifice Turbo® flat-fan nozzle*



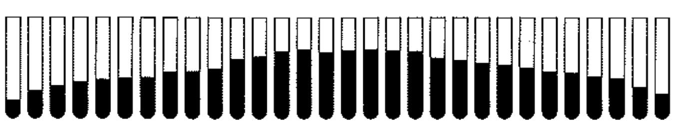


*Turbo® flat-fan spray pattern*

## Turbo® Turf Flood Nozzles

The Turbo® turf flood is a new nozzle designed for the turf industry. It is modeled after the Turbo® flood nozzle, which is used extensively in the application of crop protection products for agricultural field crops. The major difference is that the Turbo® turf flood nozzle incorporates a larger orifice to accommodate heavier application volumes, which are common in the turf boom sprayer industry.

*Turbo® turf flood nozzle*



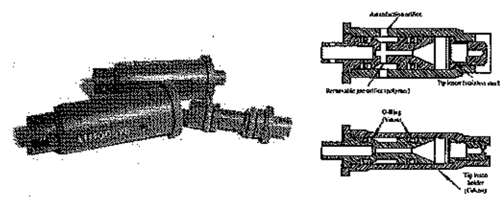
*Turbo® turf flood spray pattern*

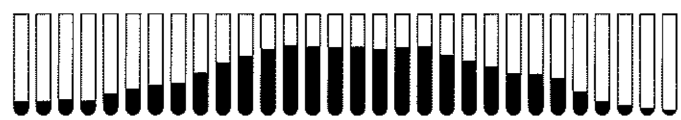
Otherwise, this nozzle exhibits the same high quality spray pattern when placed on the boom from 20 to 30 inches apart, and at a height above the turf at 14 to 20 inches. Actual spacing should overlap at least 50 to 60 percent of the nozzle spacing (25 to 30 percent on each edge of the pattern) for a uniform application. As with the field crop version of this nozzle, the Turbo® turf flood has excellent drift control, resulting from the turbulation chamber creating larger spray droplets and less driftable fines. This nozzle may have use in applying certain agricultural products on soil as a replacement for the Raindrop® nozzle.

## Air-Induction/Venturi Nozzles

A recent trend in drift reduction nozzle design is incorporating air into the spray mixture to produce an air-fluid mix. Several different designs are currently being marketed, and are commonly referred to as air-induction or venturi nozzles. Air is entrapped into the spray solution within the nozzle. To accomplish the mixing, an inlet port and venturi is typically used to draw the air into the tip under reduced pressure. The air-fluid mixture forms a larger spray droplet to help transport the droplets to the target. By increasing the size of the spray droplet, spray drift is reduced by minimizing smaller driftable fines. The current design of these tips requires a higher operating pressure to maximize performance. Most all venturi nozzles are designed to spray a wide-angle flat spray pattern.

*Air induction/venturi nozzle*





*Air induction/venturi spray pattern*

Venturi nozzles, which are currently more expensive, dramatically reduce the potential for drift. In addition to providing good protection against drift, research indicates they also provide adequate efficacy. The efficacy levels achieved relate closely to coverage and mode of action for the crop protection products being used. It is also important to maintain at least 40 psi as an operating pressure to maintain uniform pattern development while properly atomizing the spray solution.

Please note any special calibration requirements for the venturi nozzles. For example, Greenleaf, designer of the TurboDrop® venturi two-piece nozzle, requires the exit orifice to be two-times (2X) the size of the venturi orifice. Otherwise the exit orifice may create a negative pressure effect in the venturi area, resulting in failure of the nozzle to create the proper spray quality (actually reversing flow from the air inlets). Therefore, you will need to select and calibrate the TurboDrop® nozzle based on the venturi orifice, which is color-coded to meet manufacturing standards. A chart is available from the manufacturer for this purpose. Other venturi nozzle styles are one piece and do not have this precaution.

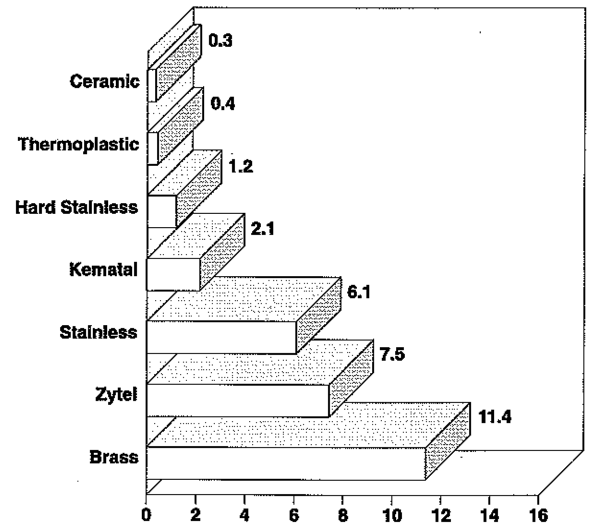
*TurboDrop® flat-fan nozzle*


*TurboDrop® spray pattern*

## Nozzle Materials

Spray nozzle assemblies consist of a body, cap, check valve, and nozzle tip. Various types of bodies and caps (including color-coded versions), and multiple nozzle bodies are available with threads as well as quick-attaching adapters. Nozzle tips are interchangeable or molded into the nozzle cap and are available in a variety of materials including hardened stainless steel, stainless steel, brass, ceramic, and various types of plastic. Hardened stainless steel and ceramic are the most wear-resistant materials, but they are also the most expensive. Stainless steel tips have excellent wear resistance with either corrosive or abrasive materials. Plastic tips are resistant to corrosion and abrasion, and are proving to be very economical tips for applying crop protection products. Brass tips have been very common, but are not recommended for use. They wear rapidly when used to apply abrasive materials, such as wettable powders, and are corroded by some liquid fertilizers. Typically, smaller tips with elongated orifices are impacted greatest by wear. Spray tip life is dependent on pressure, how abrasive the spray solution is and other factors, such as corrosion. A "rule-of-thumb" is to change tips when the flow becomes 10 percent greater than in new tips.

**Materials and Wear**




**Percent increase in nozzle flow rate. Flat-fan spray nozzles after 40 hour test.**

*Source: Unviersity of Illinois, Agricultural Engineering*

Venturi nozzles are typically designed from polymers, and may incorporate stainless or hardened stainless orifice inserts for the actual tip. Many of these nozzles are designed as two-piece units with the pre-orifice removable for easier cleaning.

No one tip will perform well in all of the applications currently being used. Refer to manufacturers' catalogs and web pages for selection and setup assistance. Proper selection and setup will enhance the efficacy and safety of all spray applications. Many chemical labels may specify a specific droplet quality classification in the near future. These are excellent resources to ensure compliance.



**Kansas State University Agricultural Experiment Station and Cooperative Extension Service**

MF-2541 April 2002

**Soil Sampling and Precision Ag: Does it Pay?**

*Cover Your Acres Winter Conference, Oberlin, Kansas, February 3, 2005*

complete text at www.agmanager.info

Terry L. Kastens and Kevin C. Dhuyvetter, K-State ag economists

Biological change within soils ensures substantial buffering capacity and causes effects of fertilizer to be smoothed across years. That, along with large differences in annual rainfall, make accurate predictions of yield response to fertilizer notoriously difficult. That may be why few farms routinely soil test. Yet, small average annual increases in yields or reductions in average annual fertilizer rates often can justify the cost of soil testing. And, small differences in average annual revenues or costs separate the successful and surviving farms from the unsuccessful and disappearing ones.

## Typical fertilizer recommendation formulas

Soil testing laboratories routinely provide (often online) mathematical formulas depicting recommended fertilizer rates for crops. Typically, but not always, recommended rates depend on soil tests. For example, Eq. [1] shows the nitrogen (N) fertilizer recommendation for corn based on KSU's fertilizer recommendations (MF-2586).

[1]
$$Corn\ Nrec = (1.6 * YG) - (20 * OM) - Profile\ N - Manure - Other\ N\ Adjustments - Previous\ Crop\ Adjustments\ .$$

In Eq. [1], *Corn Nrec* is N fertilizer (*fertN*) in lb N/acre, *YG* is yield goal in bu/acre, *OM* is percent soil organic matter in the top 6 inches of soil, *Profile N* is lb of nitrate nitrogen ($NO_3$-N) per acre in a 2-foot soil profile, often referred to more simply as lb N/acre, and the other categories are to remind the user that other N credits (suggested in MF-2586) may need to be considered. *Nrec* formulas routinely depend on yield goal (*YG*). Though rarely made explicit, *YG* is typically taken to be 110% of statistically expected (i.e., historical, or possibly trend-adjusted average) yield. Also, a 30 lb N/acre minimum and a 230 lb N/acre maximum (300 for irrigated corn) underlies Eq. [1]. The *OM* term in Eq. [1] represents the expected mineralization of organic matter to usable N fertility during the production cycle. Thus, a soil with 2.0% *OM* is expected to need 20 lb/acre less *fertN* than a soil with only 1.0% *OM*. Although not shown, KSU's wheat *Nrec* gives a credit of only 10 lb N/acre for each percent *OM*, since wheat production occurs during cooler temperatures than corn, implying less N mineralization.

Eq. [2] shows KSU's sufficiency phosphate ($P_2O_5$) fertilizer recommendation for corn. Likely, "sufficiency" means profit-maximizing even if the land is controlled for only one year.

[2]
$$Corn\ Prec = 50 + (0.2 * YG) - (2.5 * STP) - (0.01 * YG * STP)\ .$$

In Eq. [2], *Corn Prec* is P fertilizer (*fertP*, phosphate) in lb $P_2O_5$ /acre, *YG* is yield goal in bu/acre, *OM* is percent soil organic matter in the top 6 inches of soil, *STP* is the Bray 1P soil test value (0-6 inches) for P in ppm. Underlying Eq. [2] is an assumption that the minimum *Prec* is 15 lb/acre whenever $STP < 20$.

In the *Nrec* and *Prec* formulas above it is fundamental that higher soil test levels lead to lower fertilizer recommendations. That is, it must be the case that fertilizer and soil fertility are economic substitutes for each other in crop production. Higher levels of *either* fertilizer or fertility lead to higher crop yields. Generally, the management question around fertilizer is, Given the soil test, how much fertilizer should I apply to maximize my profit? That is, what rate should I apply, so that the last increment of fertilizer induces just enough yield increase to offset its cost?

**Using fertilizer to change soil fertility**

If it happens that fertilizer can impact not only crop yields but also soil fertility, the fertilizer decision becomes more complex. That is, depending on the relative yield response to fertilizer and fertility, it may pay to place "extra" fertilizer today to build up soil fertility for future crops, especially if the soil nutrient in question is fairly immobile. KSU considers that P might need to be treated in such a fashion, and provides the alternative build-maintain *Prec*:

[3]
$$Prec = \frac{18 * (20 - STP)}{years\ to\ build} + P_2O_5\ removal\ in\ crop\ .$$

Eq. [3] indicates an *STP* target of 20 ppm (KSU expects no yield response to *fertP* above that level) and that it takes 18 lb/acre *excess fertP* (i.e., above what the crop removes annually) to increase *STP* by 1 ppm. For example, to "jump" from an *STP* level of say 12 ppm to the 20 ppm target would take an application of 144 lb $P_2O_5$/acre above crop removal rates. KSU assumes crop P removal rates to be 0.33, 0.40, 0.50, and 0.80 lb $P_2O_5$ per bushel harvested, for corn, milo, wheat, and soybeans, respectively. Hence, assuming an expected 40 bu/acre wheat crop, 164 lb $P_2O_5$/acre would be recommended to make the jump in 1 year. Though Eq. [3] depicts how *fertP* might change *STP*, it is critical to note that, unlike Eq. [1] and [2], it does not explicitly provide a recommendation that maximizes profit, and offers no guidelines regarding the optimal number of years to build *STP*.

**Yield response models**

Given that a farm manager chooses to soil test, fertilizer recommendation formulas like Eq. [1] and Eq. [2] provide some insight into what KSU believes are optimal (profit-maximizing) fertilizer rates. Even in the absence of soil testing, assuming one is willing to plug in typical or average soil tests, useful fertilizer recommendations should emerge. On the other hand, such formulas provide absolutely no insight to help answer potentially relevant questions such as whether it even pays to soil sample, how fertilizer and crop prices impact optimal rates, whether grid soil sampling pays, etc. Answering such questions requires yield models that depict expected crop yields as mathematical functions of levels of managed or measured variables such as fertilizer rates and soil fertility levels. Only with such models can we determine how much profit might be conceded by applying the "wrong" fertilizer rates. Only then can we learn just how fast we should build up *STP* to maximize profits.

Though fertilizer recommendation formulas do not depict yield response to crop inputs, Kastens, Schmidt, and Dhuyvetter (KSD) have devised a way to uncover expected yield models that likely underlie such fertilizer recommendations (process described in the referenced publication). That is, given long-run historical crop and fertilizer prices, using KSD yield models to simulate crop yields from input variables will result in profit-maximizing fertilizer recommendations that are similar to those provided directly by *Nrec* and *Prec* formulas such as those in Eq. [1] and [2]. Discussion that follows depends on inferences from the KSD yield models which are described in more detail in the complete text of this paper.

**Does it pay to learn soil fertility information?** It is likely that many farm managers apply the "usual" fertilizer rate from year to year, whatever that is. If we take "usual" to mean that implied by a typical soil test, then we can use the yield models to answer questions like, How much does my profit change if the true soil test is different from my expected soil test? Given a wheat-corn-fallow (WCF) rotation in western Kansas with expected yields of 45 bu/acre and 75 bu/acre for wheat and corn, respectively, and average prices (wheat \$3.20/bu, corn \$2.31/bu, *fertN* \$0.225/lb N, *fertP* \$0.250/lb $P_2O_5$), Figure 1 shows how profit varies when the true *STP* value is something different than an expected value of 16 ppm (*STN* and *OM* are held constant at 40 lb/acre and 1.6%, respectively). The expected soil test level is what the fertilizer decision is based on. Note that, when the actual and expected soil tests are equal, our profit benchmark is \$0. The figure shows that especially large losses occur when true *STP* is a lot lower than expected, which indicates the *potential* benefit to gathering more information about *STP*, such as through a soil test. That is, a manager thinking that *STP* was 16 ppm would have applied much less *fertP* than he would have had he known that *STP* was actually 6 ppm. A comparable figure could be made for N. Clearly, the cost of misapplication of fertilizer is not as large for over-fertilization as it is for under-fertilization, and likely the reason farmers often would rather err on the side of applying too much fertilizer. This is important given that the frequency of true soil tests being below their average generally is greater than the frequency of being above their average.

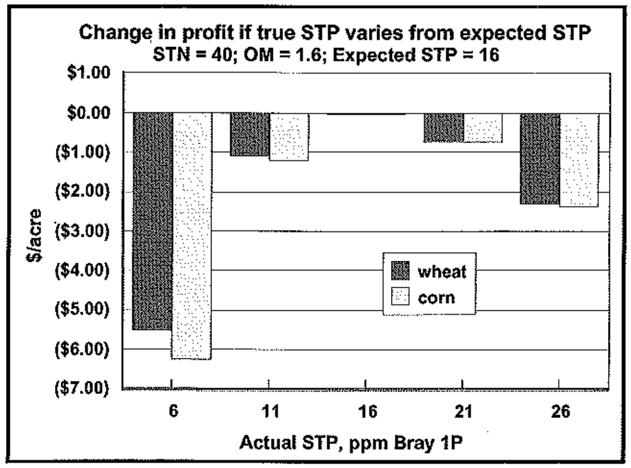



**Figure 1**

While pictures like Figure 1 reveal the *potential* returns to soil sampling, we would need to examine a whole distribution of plausible soil tests before we could quantify our *expected* returns to soil sampling over many fields and many years. To better understand this, we used the 10,000 simulated fields that were used to estimate the KSD yield models to test how a single fertilizer rate across the 10,000 fields (that rate based on average soil tests) would compare in terms of profitability with assigning the proper rate to each field. Fundamentally, this would be like a farmer who has a good idea about average fertilizer rates over time and space, and then wants to apply that average N and average P rate across all of his fields. Then, he asks the question, What might I gain by taking a single multi-point soil sample from each field, sampling for *STN*, *STP*, and *OM*? Figure 2 answers that question regarding gross returns to soil sampling, splitting out the information between N and P.

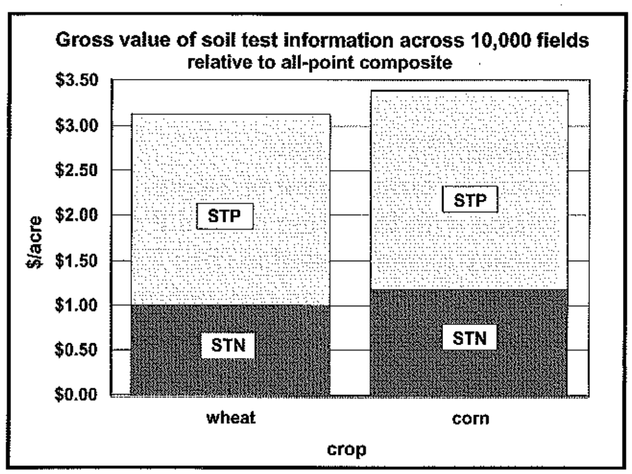



**Figure 2**

Figure 2 shows an average gross return (before subtracting laboratory fees) to soil sampling of

$3.26/acre in this setting where expected wheat and corn yields are 45 and 75 bu/acre, respectively. Assuming a 41-acre field, a $30/field labor charge, and a $10.50 lab charge, the cost is about $0.99/acre, leaving a $2.27/acre net return to soil sampling, and a 227% return on investment (i.e., 2.27/0.99). Sampling even down to 15 acres would still provide a 21% return.

**How do crop and fertilizer prices affect returns to soil sampling?**

The relevant question here involves the value of soil sampling. Figure 3 compares that value across different combinations of adjustments to crop and fertilizer prices (e.g., an x-axis value of -25%/+25% means 25% lower crop prices and 25% higher fertilizer prices). The center bars of the figure are identical to the values shown in Figure 2. From the figure, it is obvious that fertilizer price, not crop price, mostly drives the value of soil sampling. Generally, going from fertilizer prices 25% below average to 25% above average increases the value of soil sampling by more than $1.50 per acre. It is interesting to note that the returns to soil sampling are greater when crop prices are lower. This is due to the fact that returns to fertilizer are less at lower crop prices. Hence, more fields would see recommended fertilizer rates whose returns are insufficient to cover the cost of application, which means that more fields would not need to be fertilized. The manager who merely applies the farm-wide rate on all fields would miss this opportunity to profit from a savings in application costs. This is a reminder that returns to soil sampling come from both applying the correct rate – and not applying at all when returns are insufficient to cover application costs. Note that, if application costs were 0, then the returns to soil sampling would be greater at higher crop prices, rather than lower as shown here.

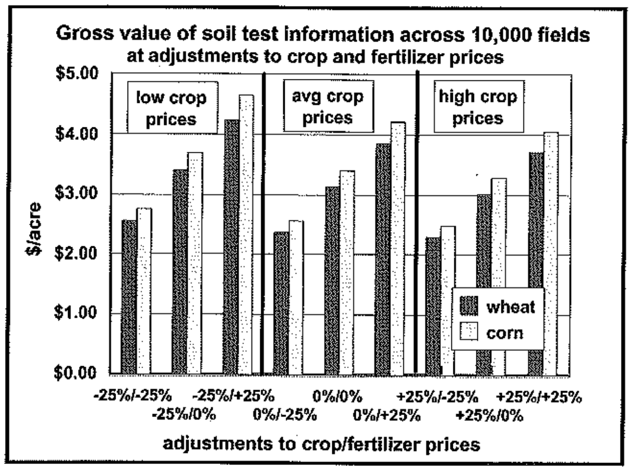



**Figure 3**

**Managing STP over time**

Assuming a starting point of 5 ppm, Figure 4 shows the 20-crop (30 years) *STP* time paths associated with following several P management schemes over an infinite horizon: KSU's P sufficiency recommendation (like Eq. 2), KSU's suggested 4-, 6-, and 8-year build-maintain programs (like Eq. 3), and the optimal (profit-maximizing) fertilizer program (the dashed line). Additionally, the $/acre/crop profits (relative to P sufficiency) are textually noted. Note, that KSU's faster-build P recommendations especially should be questioned, and especially if a manager controls the land for less than around 30 years (since that would make the negative profits even worse). Yet, the optimal path, which builds fast at first and then slows down, is decidedly more profitable than the P sufficiency recommendation. Figure 5 depicts another way to show the economics of the time dimension of P. For example, it shows that, in a 3-year rental contract, land with an *STP* value of 30 ppm would be worth about $6/acre more annual rent than the typical 15 ppm parcel – a significant increase in an area where cash rent likely is around $34/acre.

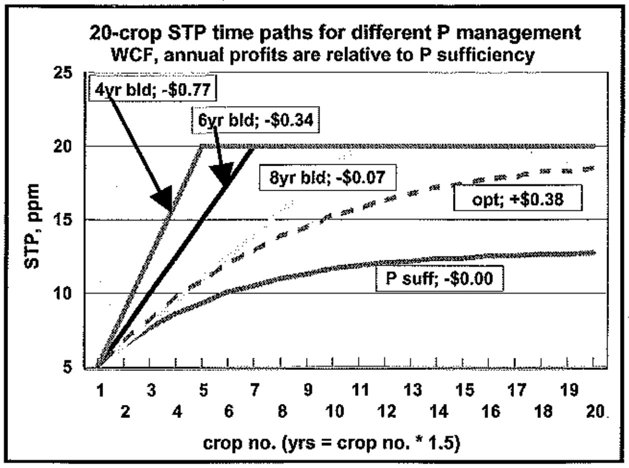



Figure 4

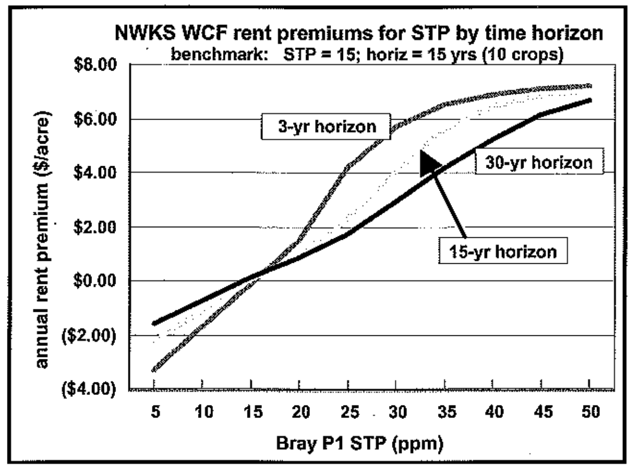



Figure 5

## Soil testing and precision agriculture

Generating profits from soil testing is always based on the tradeoff between informational costs and the expected benefits arising from that information. For example, basing fertilizer rates off of the usual 15-point field composite sample implies that the soil sample is used as merely a reasonable predictor for all points in the field. Moreover, it is about the tradeoff between costs and benefits of informational sources that may have different degrees of accuracy. Hence, for example, a site-specific grid soil sample likely (but not necessarily) will provide a more accurate map of a field's soil fertility than will a field composite. But, that grid map will come at a higher cost than the simple field-wide composite soil sample. Also, considering soil properties in precision agriculture may be about using proxies for soil tests (e.g., electrical conductivity, remote sensing, crop yields). Such proxies are expected to be less accurate than actual lab-based soil testing, but might still be more profitable since they may have lower costs.

Although more details are provided in the complete text, Figure 6 shows the potential benefits for each of several site-specific scenarios in this simulated spatially-dependent 100-acre field, alongside the field-level composite regime. They are *potential* benefits because no informational costs are considered in this figure, only the "yield revenue less fertilizer cost" values associated with the different informational regimes. In the figure, *1c*, *5c*, and *10c*, indicate the frequency of information gathering (i.e., every 1 crop, 5 crops, or 10 crops). *FCmp* is the field composite soil sample and the bar shows the same $3.26/acre shown in Figure 2. The *GS* labels depict various 2.5-acre grid-sampling strategies, the *EC* labels depict various electrical conductivity (sensor-based) strategies, and the *Ent-1c* measure relies only on yield data, an annual field composite soil test, and some slightly obtuse mathematics.

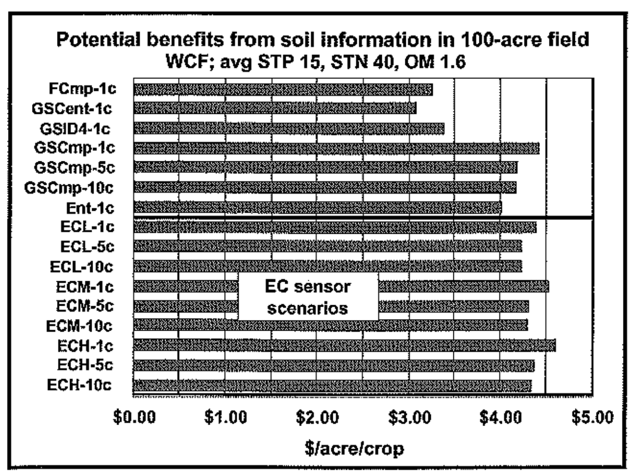



Figure 6

Figure 6 showed that many site-specific strategies have *potential* for profit. But, when expected informational costs are subtracted, the result is Figure 7. Now, the standard annual field composite soil sampling regime (*FCmp-1c*) is superior to all site-specific programs. This is especially noteworthy given that many of the assumed costs are what we believe they will be in the future, which generally is lower than today. However, the *Ent-1c* scenario is only $0.25/acre/crop short of the profits associated with a field composite soil sample. This is especially encouraging since the $1/acre/crop office work charge assumed for this program likely is already adequate to cover its costs, especially if computer time and software costs can be spread over several thousand acres each year. Hence, slight improvements in this program likely would make it a viable candidate for site-specific soil fertility management. Moreover, if the field in question were only 41 acres (like assumed earlier) rather than the 100 acres assumed here, *Ent-1c* would already be $0.33/acre more profitable than *FCmp-1*. A second encouraging information scenario in Figure 17 is *ECM-10c*, which had profits only $0.22/acre/crop less than those of the field composite. Functionally, this program "uses a Veris machine" every 10 crops. The accuracy correlations assumed in this program already have been observed on the Kastens farm and so are certainly plausible. Moreover, the assumed $3/acre operating cost, along with the $1/acre/crop office charge likely are already reasonable today. Hence, as with *Ent-1c*, slight improvements to this program likely would make it a viable candidate for site-specific soil fertility management in this 100-acre field. All in all, for this dryland cropping example, it appears that soil test proxy information might be more appropriate than grid soil sampling – especially considering that such information is likely to improve more in terms of accuracy and costs than is grid soil sampling (whose costs have already been largely lowered from current custom charges), which depends heavily on field labor and soil testing laboratory charges.

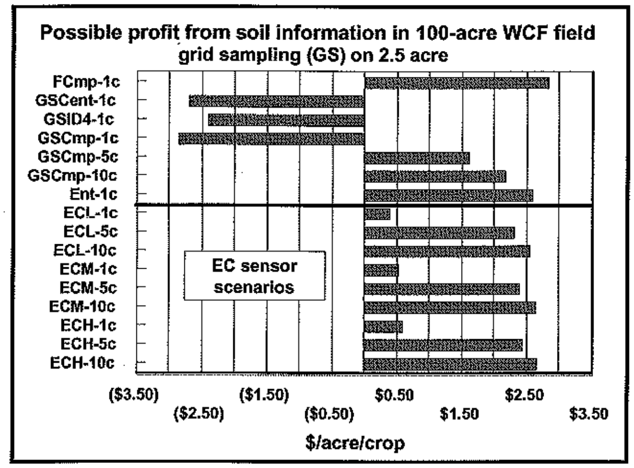



**Figure 7**

It should be remembered that the foregoing describes a short-run analysis of site-specific management, where 20 future crops were considered, but where for each crop the optimal decision was based on the assumption that land would be controlled for only one year. Earlier we had shown that managing some soil properties dynamically, for example P, can mean increased profits. Consequently, if site-specific management is considered to be an integral part of long-run dynamic management of P – as it might be, for example, when crop removal rates are computed on a sub-field scale, this would add perhaps $0.50 to $1.50/acre to each of the site-specific regimes shown in Figure 7, making a number of them more profitable than the traditional field composite.

## References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MF-2586. Soil test interpretations and fertilizer recommendations. September 2003. Available online.

# Managing Changing Weed Populations Brought on by Glyphosate

**Phillip Stahlman and Dallas Peterson**

## Implications of Glyphosate Resistant Cropping Systems: Weed Shifts and Resistance

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**Kansas State University Agricultural Research Center-Hays**

Weed shifts in agricultural cropping systems are changes in weed flora composition resulting from selection pressures imposed by innovations and modifications of agricultural practices that alter their habitat to some extent. Species that are able to survive the new practice flourish, reproduce, and eventually may completely displace lesser adapted species. The two most common types of selection pressure placed on agricultural weeds are those arising from changes in crop production practices and those arising from changes in weed control method (Hammerton 1968). There are many examples where continuous use of a control method (herbicide, tillage, crop rotation, or other agronomic factor) has resulted in weed population shifts. Weed shifts typically occur more rapidly when herbicides are the control method because of the greater selection they impose on the population.

Just as weed shifts develop when a system is constantly exposed to herbicides with similar modes-of-action, repeated selection may influence genetic adaptation and lead to herbicide resistant biotypes. Herbicides with a single site-of-action used as the sole or primary herbicide for many years may eliminate susceptible species or biotypes from an existing population and allow naturally tolerant or resistant biotypes to flourish and dominate the population. Rarely is resistance due to a mutation caused by herbicides; rather it arises from the selection of natural mutation or small pre-existing populations of resistant plants. Herbicide resistance is a key issue in weed management.

Currently, there are at least 286 documented weed biotypes with resistance to one or more of the herbicide families (Anonymous 2004). Cases of resistance to sulfonylurea herbicides developed in as few as 4 to 5 years, whereas glyphosate was used extensively for 25 years before the first case of resistance was confirmed (Powles et al. 1998). However, in the past 10 years six species have developed resistance to glyphosate and confirmation of a seventh species is pending. Glyphosate-resistant horseweed (also called marestail) was first reported in Delaware in 2000 (VanGessel 2001), 5 years after the introduction of Roundup Ready soybean, and is now reported in 12 states.

Glyphosate use increased dramatically with the widespread adoption of conservation tillage practices in the 1980s and 1990s to become the largest selling crop protection chemical with a global agricultural volume demand of 74,045 tons of technical acid in 1997 (Woodburn 2000). Global glyphosate use has grown substantially since then, paralleling the rapid adoption of herbicide-tolerant crop programs that use glyphosate as the primary herbicide. Genetically modified (GM) crops were grown on an estimated 167.2 million acres worldwide and 105.7 million acres in the United States in 2003 (James 2003). During the eight year period from 1996 to 2003, herbicide tolerance was the dominant GM trait followed by insect resistance. In 2003, herbicide tolerance deployed in soybean, maize (corn), canola, and cotton occupied 73% or 122.8 million acres of global GM crops (James 2003); glyphosate tolerance is predominating in each.

Within the past 10 years, several major agricultural crops including corn, soybean, canola, cotton, sugar beet and alfalfa (pending) have been genetically modified for resistance to glyphosate. When coupled with its declining cost, glyphosate use likely will continue to increase, which in turn increases exposure and selection pressure in weed populations. The rapid, widespread adoption of herbicide-resistant crops has raised biological and ethical concerns within the scientific community and among consumer and environmental groups about the risks and long-term sustainability of herbicide resistant crops. The biological concerns most often expressed are (1) that volunteer plants of herbicide resistant crops could become major weeds in subsequent crops; (2) that selection pressure from over reliance of a herbicide-resistant cropping system could cause weed shifts and lead to resistance in formerly susceptible species; (3) that genes inserted into crops to confer resistance might escape by introgression into wild populations; and (4) that plant diversity could be reduced further, allowing prolific growth of any species that adapts to the altered system.

Producers can practice numerous strategies to reduce selection pressure for herbicide resistance in the weed community. Various groups and organizations have developed and are promoting recommended stewardship guidelines for glyphosate use, and some university weed scientists in the upper Midwest are advocating mandatory regulations that would restrict the frequency of glyphosate use. Foremost among stewardship guideline recommendations are to tank mix glyphosate with other mode-of-action herbicides and alternate glyphosate use with other mode-of-action herbicides in successive years. These recommendations are based on assumptions and examples for managing resistance in other herbicide families, though the mechanisms for resistance development to glyphosate are considerably more complex compared to other herbicide families in which resistance has developed. Whereas most producers would most likely practice science-based recommendations to manage herbicide-resistant weeds, results of an unscientific survey of commodity organizations and weed science professionals in the western United States found no support for regulations restricting glyphosate use. Most believe weed resistance is a management and education issue, not a policy issue.

Though several studies have been initiated in the past two or three years, there are few long-term studies designed to evaluate the long-term impacts of continuous glyphosate use on weed species shifts, weed population dynamics, and the development of glyphosate-resistant weeds. In 1998, a regional study was initiated to determine if glyphosate use pattern in glyphosate-resistant crops (continuous corn and corn/sugar beet/wheat or corn/soybean/wheat rotation) alters weed population composition and dynamics, or leads to development of glyphosate resistant weed biotypes. Sites at Fort Collins, CO, Scottsbluff, NE, and Torrington, WY are tilled each year and receive in-crop irrigation, whereas sites at North Platte, NE and Colby, KS are continuous no-till and receive no in-crop irrigation. The study is ongoing.

Key finding after 7 years include:

- Glyphosate use rate has affected weed population dynamics more than crop or herbicide rotation.
- At all five sites, using a half-rate of glyphosate (0.375 lb ae/ac) in-crop twice each year has shifted the weed spectrum to species that have higher natural tolerance to glyphosate and, at Colby, to species capable of late emergence that escape glyphosate. Using the full recommended rate of glyphosate (0.75 lb ae/ac) twice in-crop each year continues to provide excellent weed control at all five sites.

- The most dramatic weed shifts have been to common lambsquarters (*Chenopodium album* L.) at each of three irrigated sites and to wild buckwheat (*Polygonum convolvulus* L.) at the Fort Collins and Torrington irrigated sites. Lesser shifts include increases in Palmer amaranth (*Amaranthus palmeri* S.Wats.), prairie cupgrass (*Eriochloa contracta* Hitch.), and proliferation of puncturevine (*Tribulus terrestris* L.) at the dryland Colby site.
- Regardless of crop sequence, alternating glyphosate with conventional (non-glyphosate) herbicides in successive years has been less effective in preventing weed spectrum shifts than using the full labeled rate of glyphosate each year. The poor weed control with the conventional soil-applied herbicide treatments was because of inadequate or untimely rainfall at dryland sites and development of sulfonylurea herbicide tolerance in the sugar beet rotatin at Scottsbluff.
- Crop rotation also influenced weed populations by allowing common lambsquarters to increase when sugarbeet and wheat were grown at Scottsbluff, wild buckwheat to increase when continuous corn was grown at Fort Collins and Torrington, and devil's claw, Palmer amaranth, and puncturevine to increase when soybean were grown at Colby.
- Weeds resistant to glyphosate have not been observed at any location.

To date, the results of this ongoing study do not indicate need to limit the use of glyphosate-resistant crops as long as the recommended rate of glyphosate is used as directed on the herbicide label. However, because of the high value glyphosate and glyphosate-resistant crop technology offers growers, neither should be used with impunity and users should be watchful and alert to weed spectrum shifts and possible resistant species biotypes. There are valid agronomic reasons to occasionally rotate crops and herbicide modes-of-action, and mixing herbicides with different modes-of-action often enhances weed control and broadens the spectrum of weed controlled while reducing risks of herbicide resistance development.

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# Managing Glyphosate Tolerant Weeds

Glyphosate

Glyphosate

**Glyphosate**

## Does Glyphosate Control all Weeds?

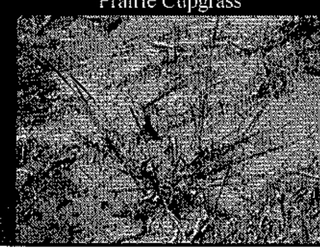
## Weed Escapes from Glyphosate

- Rate Too Low
- Environmental Stress
- Subsequent Weed Flushes
- Inadequate Spray Coverage
- Water Quality/Tank-mix Antagonism
- Tolerant Species
- Weed Resistance

## Hard to Control Weeds with Glyphosate

- Prairie Cupgrass
- Windmillgrass
- Yellow nutsedge
- Spurges (toothed, nodding, prostrate)
- Lambsquarters
- Morningglory
- Waterhemp
- Velvetleaf

## Prairie Cupgrass



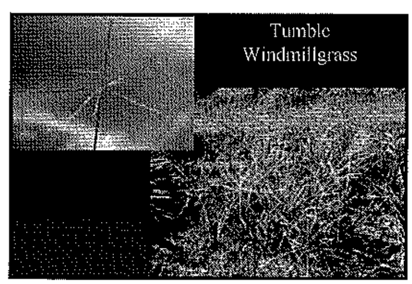
## Prairie Cupgrass Control

- Dual/Harness/Outlook/Intrro can give good early season control in corn and/or sorghum
- Select herbicide in fallow?
  - Costly, only controls grasses
  - Early application stage critical
  - Does not work well with hot, dry conditions
- Undercutter in problem areas?
- Crop competition – Intensify crop rotation

## Prairie Cupgrass Control with Glyphosate

- Apply to young actively growing plants
- Use adequate application rate
- Apply in the morning
- Use appropriate adjuvants
  - Ammonium sulfate
  - Extra surfactant may help

## Tumble Windmillgrass



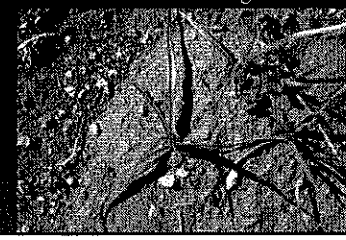
## Tumble Windmillgrass Control

- Select/Poast Plus/Assure II etc. provided better windmillgrass control than glyphosate in KSU research.
  - Costly, only controls grasses
  - Early application stage critical
  - Does not work well with hot, dry conditions
- Use undercutter as needed in problem areas?
- Try to prevent seed production and dispersal if possible.
- Intensify crop rotations?

## Tumble Windmillgrass Control with Glyphosate

- Use high rates, especially around field margins and areas of new patches.
- Apply during times of minimal environmental stress, if possible.
- Use appropriate adjuvants
  - Ammonium sulfate
  - Adequate surfactant

## Yellow Nutsedge



## Yellow Nutsedge Control

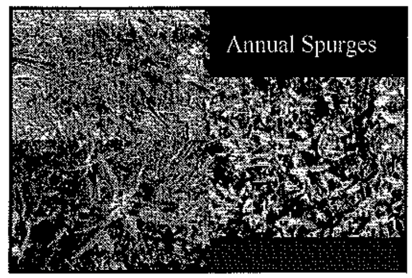
- Permit/Yukon* herbicides can give good postemergence control in corn, sorghum, & fallow
- Spartan herbicide can give good control in sunflower and soybeans
- Beyond/Raptor and Pursuit* provide suppression of emerged plants in labeled crops
- Dual/Harness/Outlook/Intro give some early season suppression in labeled row crops
- Undercut problem areas?
  - Most effective if hot and dry conditions

* Be aware of crop rotation restrictions

## Yellow Nutsedge Control with Glyphosate

- Use high rates (2 to 3 qt/A) where patches of nutsedge occur
- Apply when nutsedge is in the early flowering stage of growth
- Apply during times of minimal environmental stress, if possible
- Use appropriate adjuvants
  - Ammonium sulfate
  - Adequate surfactant

## Annual Spurges



## Annual Spurge Control

- Add dicamba (Banvel, Clarity, Distinct) to corn, sorghum, and burndown treatments when possible
- Make herbicide applications to young, actively growing plants
- Apply during times of minimal environmental stress, if possible

## Annual Spurge Control with Glyphosate

- Add dicamba (Banvel, Clarity, Distinct) to corn, sorghum, and burndown treatments when possible
- Make herbicide applications to young, actively growing plants
- Apply during times of minimal environmental stress, if possible
- Use appropriate adjuvants
  - Ammonium sulfate
  - Adequate surfactant

## Glyphosate Resistant weeds?

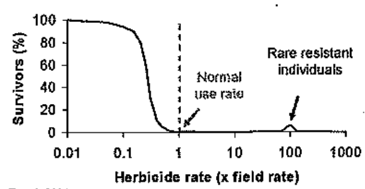
- Annual ryegrass (*Lolium spp.*)
  - Australia, California, South America, S. Africa – 1996
- Goosegrass (*Eleusine indica*)
  - Malaysia – 1997
- Horseweed/marestail (*Conyza canadensis*)
  - East and SE US. – 2000
- Common Ragweed (*Ambrosia artemisiifolia*)
  - Missouri - 2004
- Waterhemp?
  - Missouri, Iowa, Illinois
- Common lambsquarters?
- No confirmed glyphosate resistant weeds in Kansas at this point in time.

## Types of Herbicide Resistance Evolution

- Qualitative
  - Sudden appearance of resistance
  - High level of resistance; environment independent
  - Single gene
  - Examples: ALS and triazine resistance
- Quantitative
  - Creeping increase in herbicide $LD_{50}$
  - Low level of resistance; environment dependent
  - Accumulation of multiple alleles
  - Example: diclofop resistance in rigid ryegrass
    glyphosate resistance?

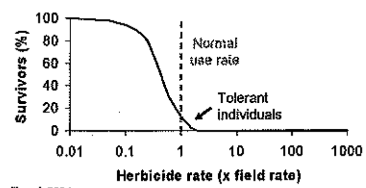
Tranel, 2004

## Qualitative Herbicide Resistance



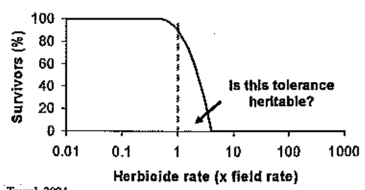

Tranel, 2004

## Quantitative Herbicide Resistance




Tranel, 2004

## Gradual shift of species response curve?




Tranel, 2004

## How does herbicide rate affect resistance development?

- Higher rates may enhance selection for single gene, highly resistant biotypes.
- Lower rates may select for multi-gene, low level rate creep or marginally controlled weeds.

## Best defense against herbicide resistant weeds and weed shifts:

- **Avoid continuous selection for R-biotypes**
  - **Rotate and/or tankmix herbicides with different sites of action, within and across years**
  - **Crop rotation**
  - **Include other control tactics (cultivation, prevention, crop competition, cultural practices)**
  - **"Use the proper rate at the proper time"**

## Maximize Glyphosate Activity

- Use proper rate
- Apply at proper stage
- Use proper adjuvants
- Use proper spray volume
- Avoid application with environmental stress
- Avoid application late in the day or before sunrise in the morning
- Avoid application with heavy dew

## New Glyphosate Products

- Many new glyphosate products
- Different concentrations, formulations, and adjuvant requirements
- Need to read labels carefully and follow rate and adjuvant recommendations
- KSU research: few or no differences among most glyphosate products at <u>same acid equivalent rates</u> and <u>with recommended adjuvants.</u>

## Active Ingredient (a.i.) vs. Acid Equivalent (a.e.)

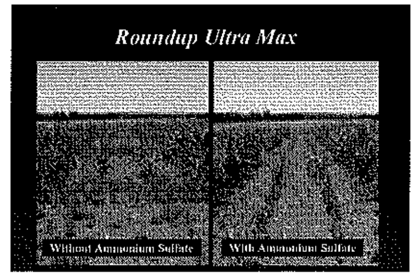
- <u>Glyphosate acid</u> is the active form of glyphosate in plants.
- Nearly all glyphosate products formulated as salts, ie, isopropylamine (IPA), diammonium (DA), or potassium (K).
- Salt portions of formulated molecules have different weights.
- Active ingredient weight <u>includes the salt part</u> of the molecule, while <u>acid equivalent weight does not</u>.
- Acid equivalent weight provides a better comparison of the herbicidal component of the different glyphosate salts.

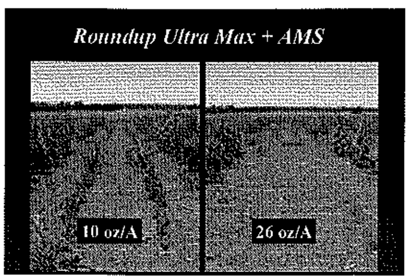
## Surfactant Requirements with Glyphosate

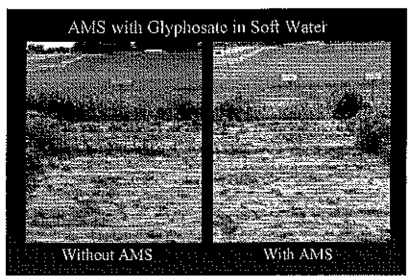
- Some glyphosate products always recommend using surfactant, some indicate the addition of surfactant is optional, while other products do not need additional surfactant.
- READ THE LABEL.
- KSU generally recommends adding a source of ammonium sulfate to all glyphosate applications, to condition the water carrier.

Adjuvant effects on weed control with glyphosate, Manhattan, 2002 (Peterson & Regehr, SB200220).

| Herbicide | Rate | Velc. | Cosf | Sorg | Corn |
|---|---|---|---|---|---|
| | (oz/A) | ---------(% control)--------- | | | |
| *RU Ultra Max* + AMS | 9.7+2% | 89 | 96 | 93 | 93 |
| *RU Ultra Max* + AMS | 9.7+1% | 88 | 97 | 92 | 95 |
| *RU Ultra Max* | 9.7 | 72 | 94 | 85 | 90 |
| *RU Ultra Max* + *Array* | 9.7+9lb/100g | 90 | 97 | 94 | 96 |
| *Cornerstone*+NIS+AMS | 12+.25%+2% | 88 | 94 | 91 | 96 |
| *Cornerstone*+*Class Act* | 12+2.5% | 87 | 96 | 92 | 93 |
| LSD (5%) | | 4 | 3 | 4 | 4 |

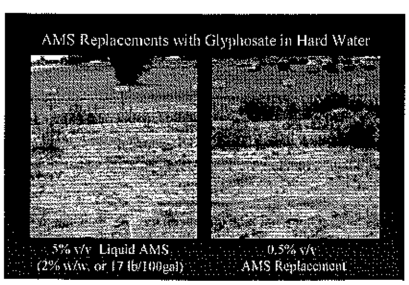



Ammonium sulfate replacement comparisons with glyphosate (Peterson&Regehr, MS200403).

| Roundup WM +: | Rate | Hing | Velc | Sorg | Corn |
|---|---|---|---|---|---|
| | (% v/v) | ---------(% control)--------- | | | |
| Liquid AMS | 5% | 85 | 90 | 98 | 99 |
| Class Act NG | 2.5% | 82 | 85 | 97 | 97 |
| Alliance | 1.25% | 80 | 83 | 99 | 98 |
| Choice | 0.5% | 63 | 43 | 88 | 85 |
| Request | 0.5% | 67 | 57 | 88 | 87 |
| Speedway | 0.5% | 70 | 62 | 93 | 90 |
| Blendmaster | 1% | 80 | 53 | 88 | 85 |
| US500 | 0.25% | 63 | 60 | 83 | 85 |
| None | | 43 | 37 | 85 | 77 |
| LSD (5%) | | 14 | 13 | 5 | 4 |




## Roundup Application Time of Day

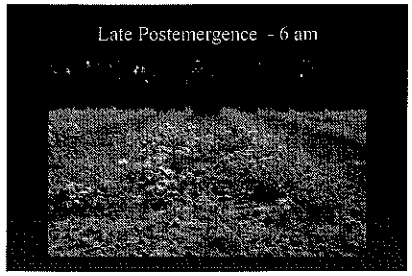
- Farmers and applicators claimed reduced weed control with early morning or late evening applications of Roundup.
- Does light or dew effect Roundup performance?

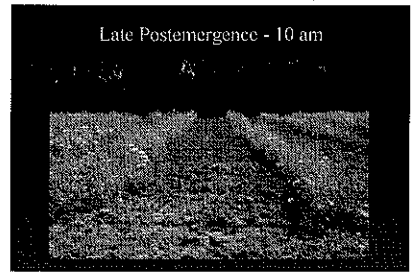
## Roundup Application Time of Day Material and Methods

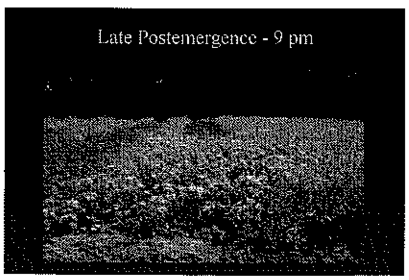
- Roundup rate: 1 pt/A
- Application Stages:
  - P: 4-8 inch velvetleaf and Palmer amaranth
  - LP: 6-12 inch velvetleaf and Palmer amaranth
- Application time of day:
  - 6 am, 10 am, 1:30 pm, 5 pm, 9 pm

The influence of application time of day on Roundup performance, Manhattan, KS, 1999.

| Application Time of Day | Palmer amaranth | | Velvetleaf | |
|---|---|---|---|---|
| | Post | LP | Post | LP |
| | ----------(% control)---------- | | | |
| 6:00 am | 96 | 85 | 96 | 47 |
| 10:00 am | 99 | 100 | 99 | 99 |
| 1:30 pm | 100 | 100 | 99 | 99 |
| 5:00 pm | 100 | 99 | 97 | 97 |
| 9:00 pm | 99 | 88 | 95 | 47 |
| LSD | 3 | | 9 | |




## Application Time of Day

- Weed control with Roundup was less when applied pre-dawn or post sundown than during the middle of the day.
- Possible reasons:
  - presence of dew
  - light influence on physiological interactions
  - plant leaf orientation

K•STATE
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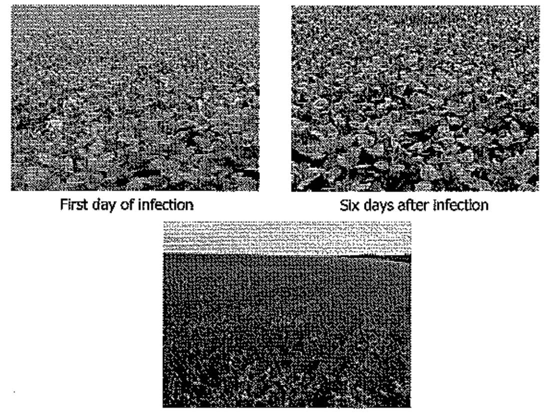
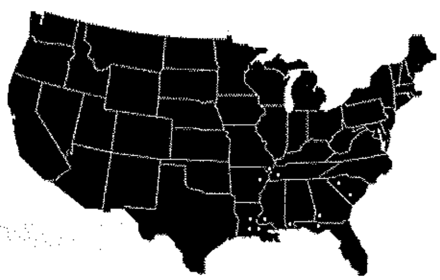
# Soybean Rust:
# *It's Finally Here, Now What?*

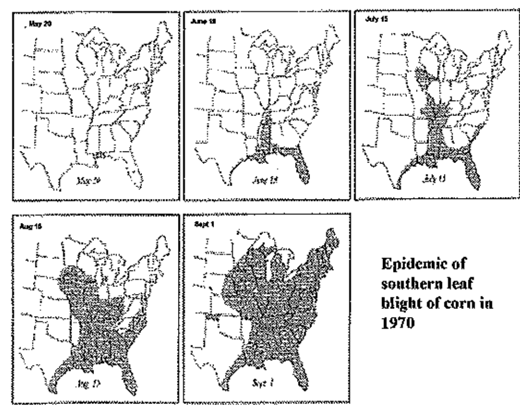
**Doug Jardine**
**Extension State Leader, Plant Pathology**

Some slides provided courtesy of Dr. Loren Giesler
University of Nebraska

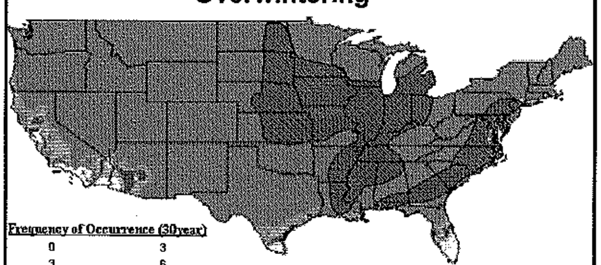

First day of infection
Six days after infection
Thirteen days after infection

## Current distribution of Asian soybean rust



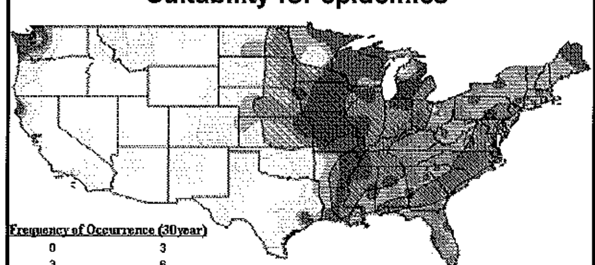

Epidemic of southern leaf blight of corn in 1970

## Overwintering

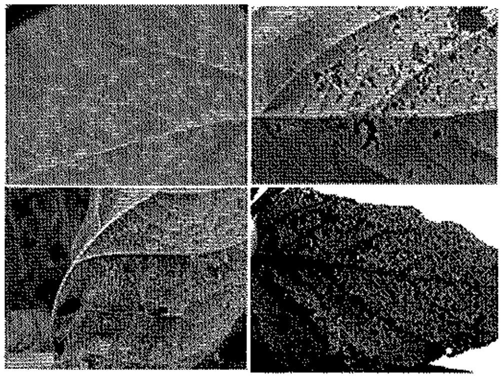


Probability of freezing temperatures in January and February

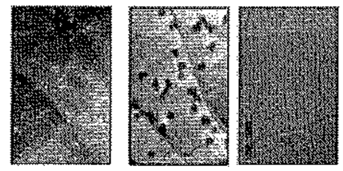
## Suitability for epidemics



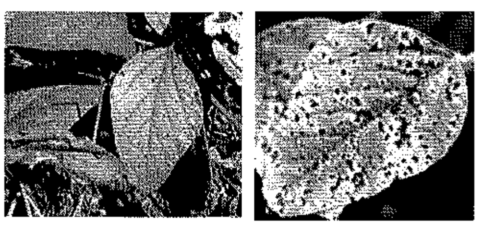
Greater than 15 favorable days



## Reaction Types

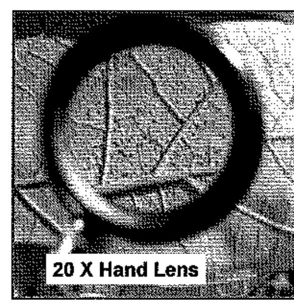



## Beware of look alikes

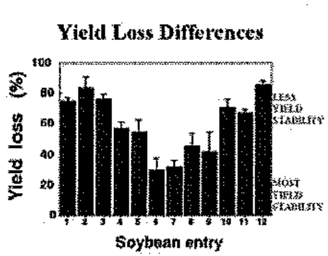


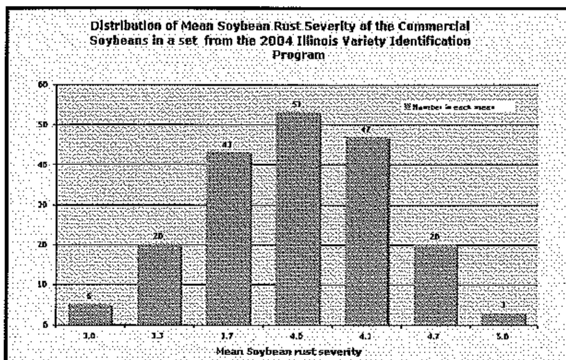
## Key to Identification will be Magnification

**In Kansas, Septoria Brown Spot will be the most difficult disease to differentiate from soybean rust.**




## Will resistant varieties be available

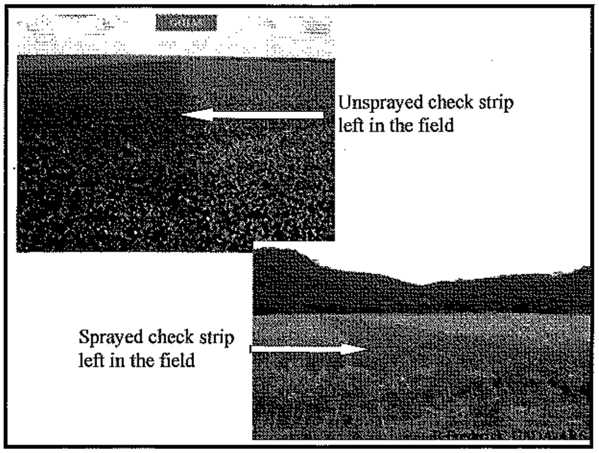



Means separated by LSD of 1.1 (p=0.05)
28 of 192 lines had RB reactions in 2/3 of evaluations.

# What about fungicides?

- What to use?
- When to use them?
- What rates to use?
- How to use them?
  - Method of application (ground, air, pivot)
  - Pressure, gallonage, nozzle types
  - Compatibility with herbicides and insecticides
- When is it too late to spray?
- Resistance issues




## Fungicides Registered for Use on Soybean and Labeled for Control of Soybean Rust in the US

**Chlorothalonil**

**Bravo 500 (Syngenta)**
**Echo 720 (Sipcan Agro)**

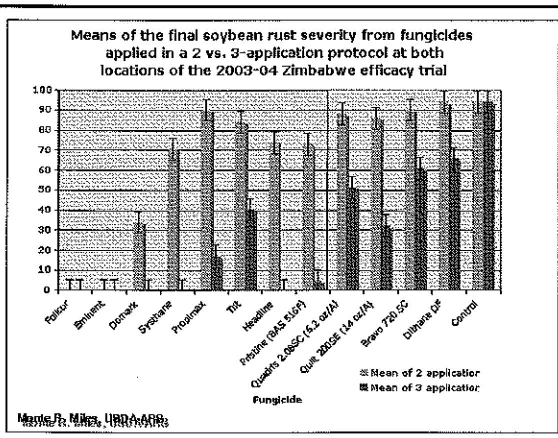
**Strobilurins**

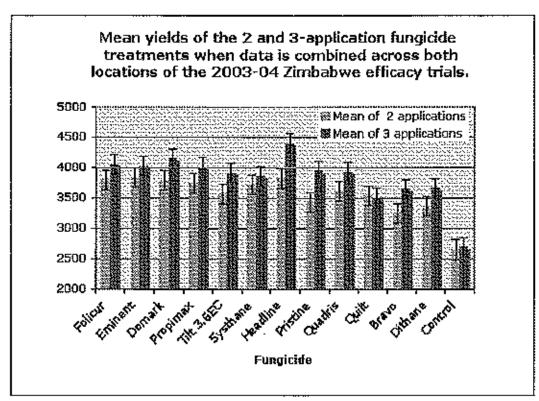
**Quadris - Azoxystrobin (Syngenta)**
**Headline -Pyraclostrobin (BASF)**

## Fungicides on the Section 18 Emergency Exemption Request

(Products in blue have been approved for use on soybean rust.)

**Triazoles**
**Laredo EC and EW (Myclobutanil)**
**Tilt, Propimax, Bumper (Propiconazole)**
**Folicur (Tebuconazole)**
**Pristine (Pyraclostrobin + Boscalid)**
**Domark (Tetraconazole)**
**Stratego (Trifloxistrobin + Propiconazole)**
**Quilt (Azoxystrobin + Propiconazole)**



## Yield Results

Don Hershman, Univ. of Kentucky, 2003

| Yield Range (bu/acre) | Number of Fields<br>6.2 oz Quadris + 2.56 oz Warrior |
|---|---|
| 0 or less | 2 |
| +0.1 to 2 | 9 |
| +2.1 to 4 | 12 |
| +4.1 to 6 | 12 |
| +6.1 to 8 | 11 |
| +8.1 to 10 | 3 |
| >10 | 2 |

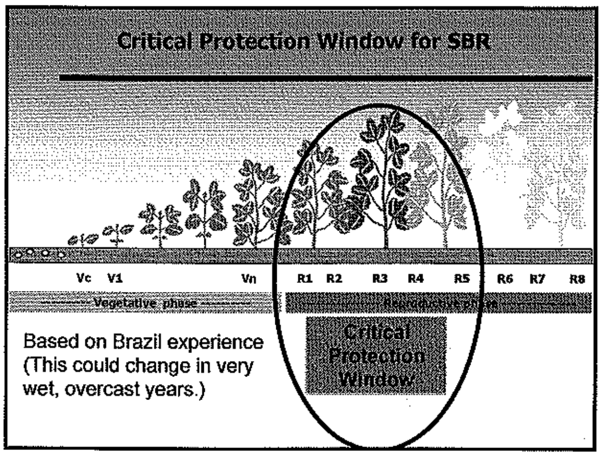
Average: 4.63 bu/acre

## Fungicide Economics

**Cost per spray is estimated at $23**

| Price/bu | Bushels to break even |
|---|---|
| 4.50 | 5 |
| 5.00 | 4.6 |
| 6.00 | 3.8 |
| 7.00 | 3.3 |
| 8.00 | 2.9 |
| 9.00 | 2.6 |
| 10.00 | 2.3 |
| 11.00 | 2.1 |
| 12.00 | 1.9 |

23 of 51 growers would have lost money or only broken even with prices at 5.00 or less




## Will fungicide use on soybeans be economical for Kansas farmers?

- Certainly when soybean rust is present before pod set
- Use in the absence of rust would depend on the price of soybeans and yield potential
- Disease pressure in Kansas is likely to be less than in states to the east of us in most years
  - 2004 would have been an exception
- Can they depend on the availability of custom applicators?

## Will rust get to Kansas in 2005?

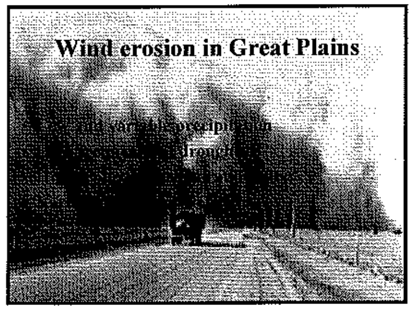
- Keys
  - Watch for the occurrence of rust in gulf coast states in the spring and early summer
    - This will determine the number of spores available to blow northward
  - The July-August weather conditions
    - Cooler temperatures (80's) and frequent dews are favorable
  - Northward movement of rust spores
    - Watch for reports from Arkansas, Missouri and Oklahoma

## How is Kansas preparing for the arrival of rust?

- Identification cards and fungicide manuals will be made available
- Surveillance systems and sentinel plantings will be established
- Fungicide trials will be established
- A goal of 24 hr turn around time on leaf diagnoses

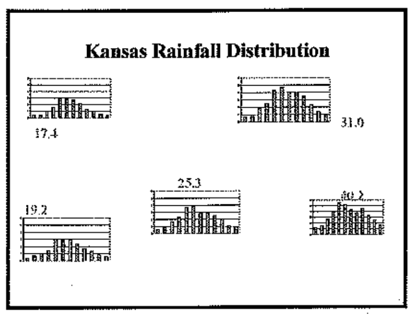
## Soybean Production on the High Plains

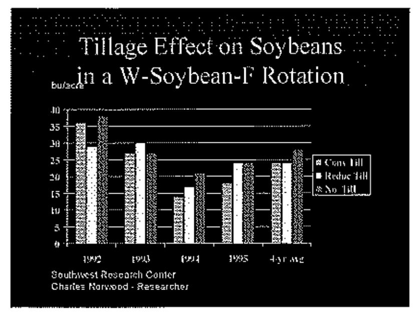
Dale L. Fjell
Professor and Extension Specialist
Kansas State University

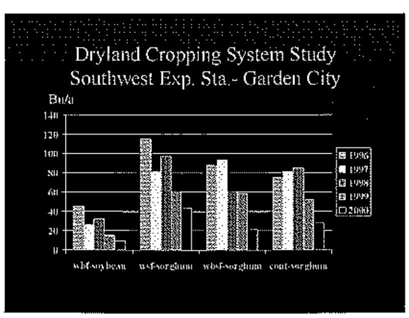



## Soybean Production on the High Plains

- Introduction/situation
- Variety selection
- Seeding date
- Seeding rate
- Row spacing
- Fertility
- Weed/pest control

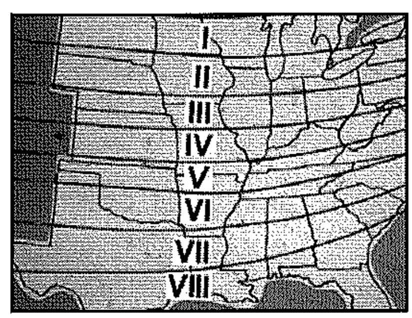


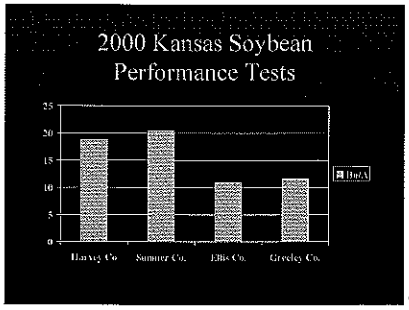



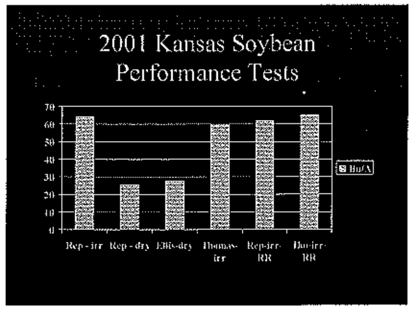



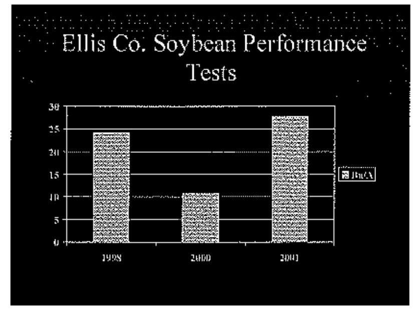

## Variety Selection

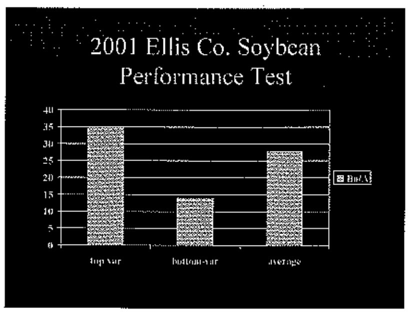
- Maturity Group
  - higher elevation=shorter maturity
- Variety characteristics
  - iron chlorosis tolerant
  - heat and drought tolerant
  - plant height and pod height
  - bushy or upright growth

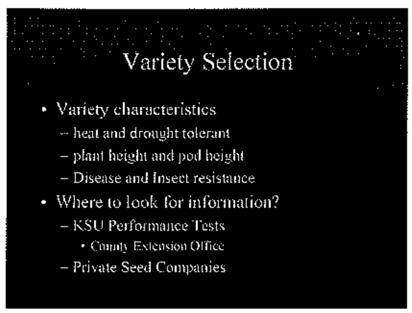



2000 Kansas Soybean Performance Tests
25
20
15
10
5
0
Harvey Co
Sumner Co.
Ellis Co.
Greeley Co.
Bu/A

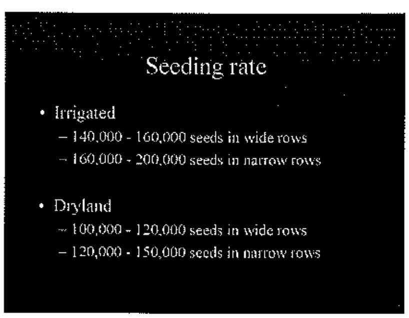

2001 Kansas Soybean Performance Tests
70
60
50
40
30
20
10
0
Rep - irr
Rep - dry
Ellis-dry
Thomas-irr
Rep-irr-RR
Do-irr-RR
Bu/A

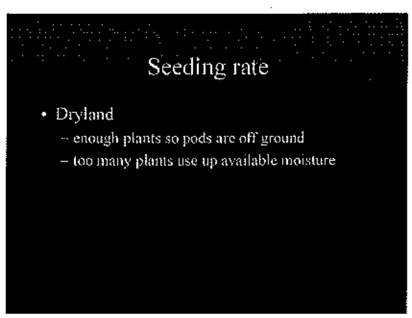

Ellis Co. Soybean Performance Tests
30
25
20
15
10
5
0
1998
2000
2001
Bu/A

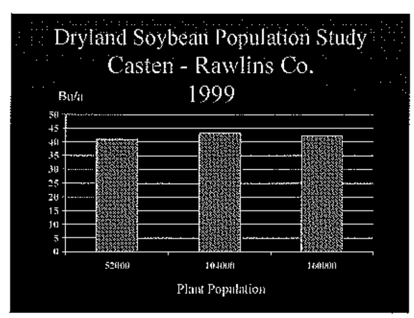

2001 Ellis Co. Soybean Performance Test
40
35
30
25
20
15
10
5
0
top var
bottom-var
average
Bu/A

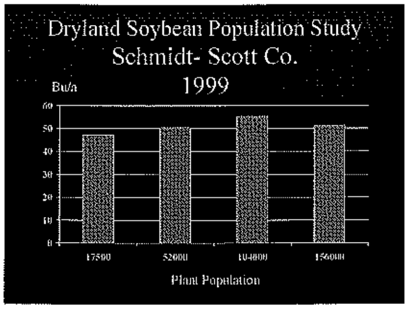

Variety Selection
• Variety characteristics
– heat and drought tolerant
– plant height and pod height
– Disease and Insect resistance
• Where to look for information?
– KSU Performance Tests
• County Extension Office
– Private Seed Companies

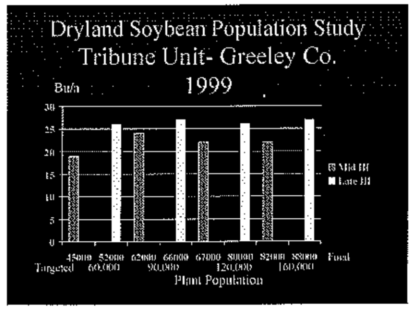

Seeding date
• Soil temperature
– >60 degrees
– residue will delay seeding
• Wide seeding window
– early generally better than late
• Do not want pod filling during mid Aug.

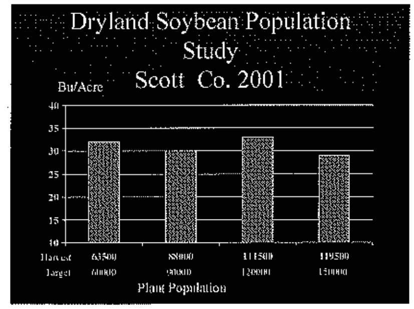

Seeding rate
• Irrigated
– 140,000 - 160,000 seeds in wide rows
– 160,000 - 200,000 seeds in narrow rows
• Dryland
– 100,000 - 120,000 seeds in wide rows
– 120,000 - 150,000 seeds in narrow rows

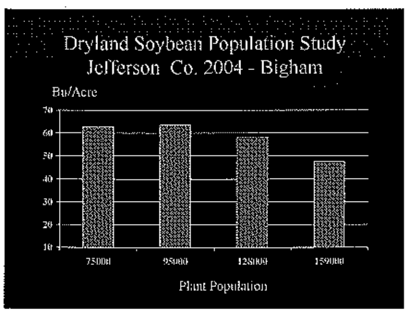

Seeding rate
• Dryland
– enough plants so pods are off ground
– too many plants use up available moisture

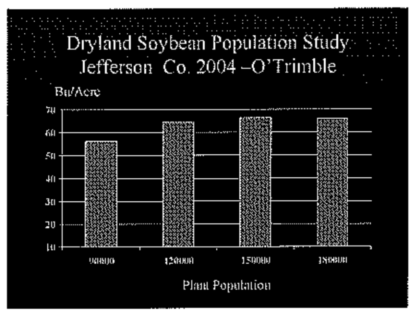

Dryland Soybean Population Study
Casten - Rawlins Co.
1999
Bu/a
50
45
40
35
30
25
20
15
10
5
0
52000
104000
160000
Plant Population

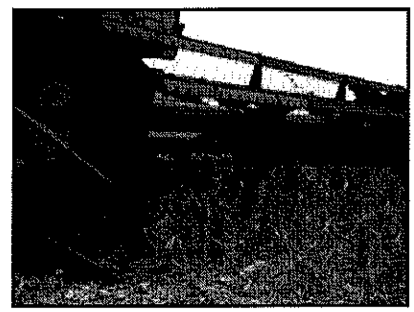

Dryland Soybean Population Study
Schmidt- Scott Co.
1999
Bu/a
Plant Population

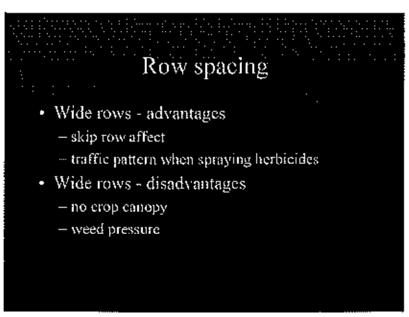

Dryland Soybean Population Study
Tribune Unit- Greeley Co.
1999
Bu/a
Final
Targeted
60,000
90,000
120,000
160,000
Plant Population

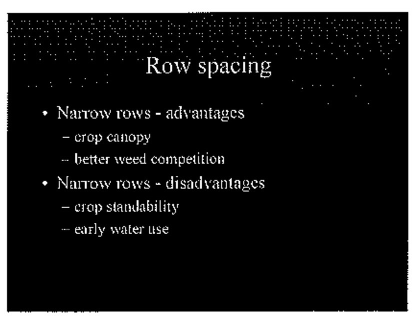

Dryland Soybean Population Study
Scott Co. 2001
Bu/Acre
Plant Population


Dryland Soybean Population Study
Jefferson Co. 2004 - Bigham
Bu/Acre
Plant Population


Dryland Soybean Population Study
Jefferson Co. 2004 –O'Trimble
Bu/Acre
Plant Population




Row spacing
• Wide rows - advantages
– skip row affect
– traffic pattern when spraying herbicides
• Wide rows - disadvantages
– no crop canopy
– weed pressure


Row spacing
• Narrow rows - advantages
– crop canopy
– better weed competition
• Narrow rows - disadvantages
– crop standability
– early water use

## Fertility

- Starter fertilizer
  - with seed or beside or below
- Inoculation
  - liquid versus dry
- Late season fertilizer
- Secondary and micronutrients

## GMO'S: Should we grow them?

- Domestic concerns
- World concerns

## Soybean Check-off Funds

- KSU Breeding Program
- Applied Production Research
- End Use Research
- Soybean Growers Association
- Change in Soybean Commission Format

## Planting Date and Maturity Group Effects on Soybean Production

## Research Supported by

KANSAS SOYBEAN ASSOCIATION

KANSAS SOYBEAN COMMISSION

## Objectives

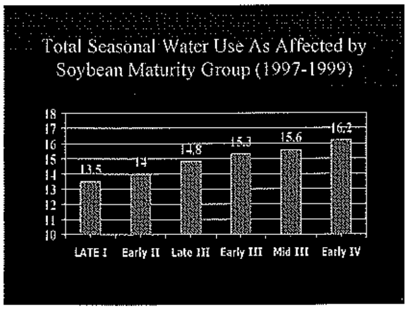
- Different maturity groups may produce different yields at different planting dates.
- The objective of this study is to determine optimum planting dates based on yield for soybean maturity groups in Kansas.

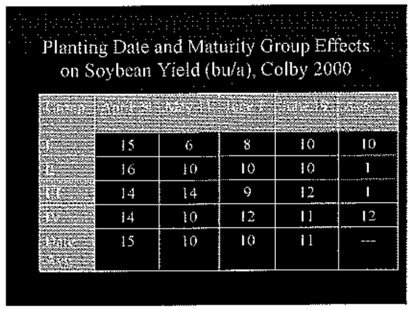
## Locations

- Belleville, Powhattan, Silver Lake
- Ottawa, Parsons
- Hutchinson, Argonia
- Hays, Colby, Garden City

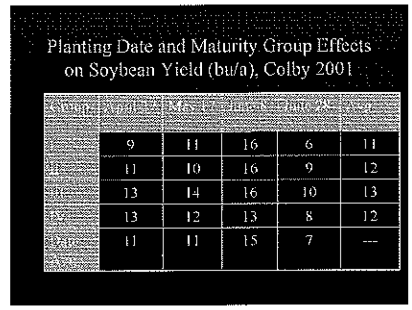
## Maturity Group Effect on Soybean Yield (bu/acre), Belleville

| Maturity Group | [illegible] | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|
| [illegible] | 29 | 40 | 33 | 34 |
| [illegible] | 35 | 44 | 36 | 38 |
| [illegible] | 42 | 43 | 43 | 43 |
| [illegible] | 42 | 44 | 45 | 44 |
| [illegible] | 45 | 44 | 43 | 44 |
| [illegible] | 31 | 35 | 37 | 34 |

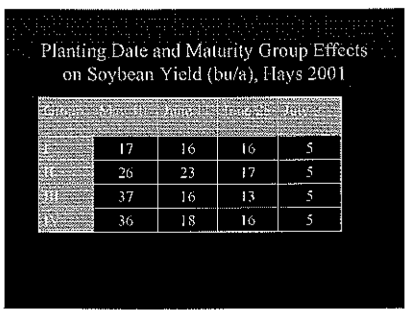


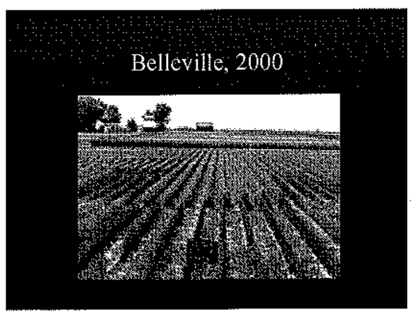

| | | | | | |
|---|---|---|---|---|---|
| I | 15 | 6 | 8 | 10 | 10 |
| II | 16 | 10 | 10 | 10 | 1 |
| III | 14 | 14 | 9 | 12 | 1 |
| IV | 14 | 10 | 12 | 11 | 12 |
| Date | 15 | 10 | 10 | 11 | --- |

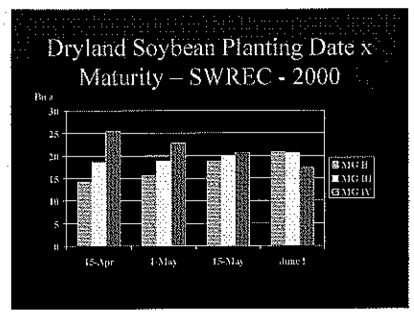


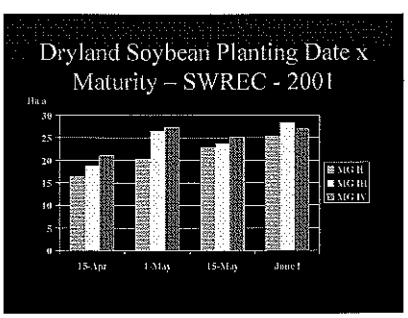

| | | | | | |
|---|---|---|---|---|---|
| | 9 | 11 | 16 | 6 | 11 |
| II | 11 | 10 | 16 | 9 | 12 |
| | 13 | 14 | 16 | 10 | 13 |
| | 13 | 12 | 13 | 8 | 12 |
| | 11 | 11 | 15 | 7 | --- |

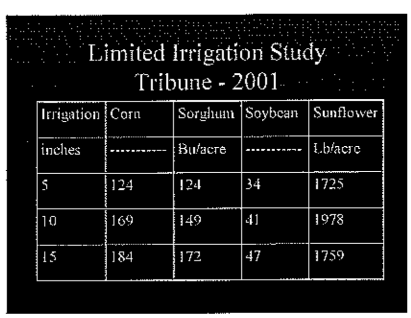



| | | | | |
|---|---|---|---|---|
| I | 17 | 16 | 16 | 5 |
| II | 26 | 23 | 17 | 5 |
| III | 37 | 16 | 13 | 5 |
| IV | 36 | 18 | 16 | 5 |

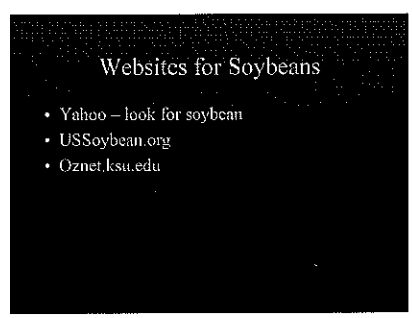



| Irrigation | Corn | Sorghum | Soybean | Sunflower |
|---|---|---|---|---|
| inches | ---------- | Bu/acre | ---------- | Lb/acre |
| 5 | 124 | 124 | 34 | 1725 |
| 10 | 169 | 149 | 41 | 1978 |
| 15 | 184 | 172 | 47 | 1759 |

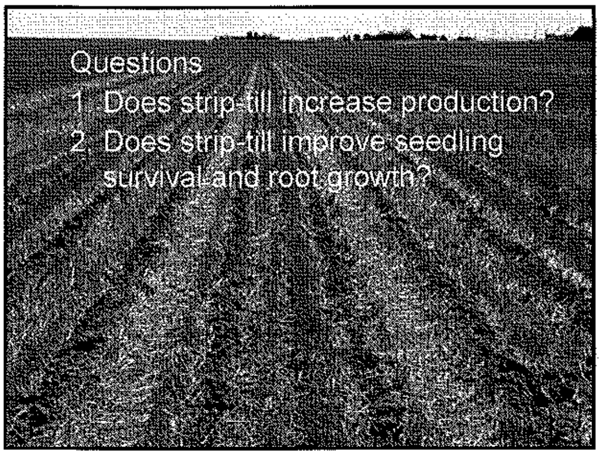


# Dryland Strip-till and Skip-Row Corn

Brian Olson, Barney Gordon, Alan Schlegel, Rob Aiken, and Ray Lamond

## Strip-till

- Strip-till is a tillage process by which a six to ten inch strip of ground is tilled. The basic configuration consists of a coulter, disks, and a sub-surface knife for injecting fertilizer.
- Probable benefits from this system
  - Drying and warming of the ground in the spring which provides an ideal environment for seedling crops while still maintaining the benefits of no-till on the majority of the field.
  - Destruction of the compaction zone which is prevalent in many NW KS fields




## Treatments

- Strip-till treatments - all treatments had a total of 75 lbs/A of N applied
  - Fall applied strip-till - 50 lbs/A of N applied as UAN on December 1, 2003 plus 25 lbs/A of N applied as urea 2x2 at planting
  - Winter applied strip-till - 50 lbs/A of N applied as anhydrous ammonia on January 23, 2004 plus 25 lbs/A of N applied as urea 2x2 at planting
  - Spring applied strip-till - 50 lbs/A of N applied as UAN on April 19, 2004 plus 25 lbs/A of N applied as urea 2x2 at planting
  - No-till - 75 lbs/A of N applied as urea 2x2 at planting
- History
  - Previous crop wheat
  - No-till previous five years, ground still had a minor compaction layer

## Sunflower

| Treatments | Test weight | Moisture % | % Oil | Population (plts/A) | Lbs/A adj. 10.0% moisture | |
|---|---|---|---|---|---|---|
| Spring strip-till | 27.3 | 9.6 | 38.5 | 15682 | 2422 | a |
| Winter strip-till | 28.7 | 9.3 | 37.8 | 12923 | 2392 | a |
| Fall strip-till | 28.6 | 9.2 | 38.4 | 13649 | 2127 | b |
| No-till | 29.0 | 9.0 | 38.2 | 11180 | 2090 | b |
| LSD (0.05) | NS | NS | NS | 779.7 | 256.1 | |

DeKalb DKF3880 CL planted May 28 at 17,300 seeds/A

## Corn

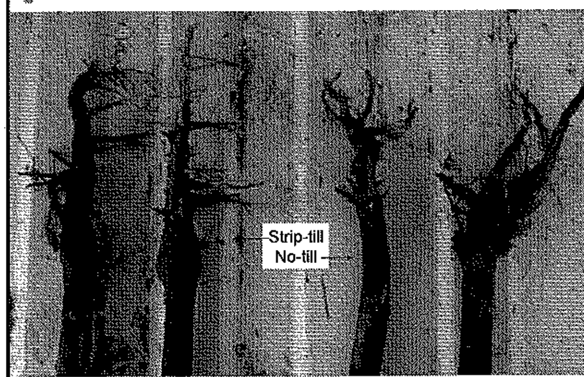
| Treatments | Test weight | Moisture % | Population (plts/A) | Bu/A adj. 15.5% moisture | |
|---|---|---|---|---|---|
| Winter strip-till | 59.9 | 14.6 | 16,843 | 114.3 | a |
| Spring strip-till | 59.2 | 14.3 | 16,988 | 100.9 | b |
| Fall strip-till | 59.4 | 14.3 | 16,408 | 100.0 | b |
| No-till | 59.8 | 14.3 | 15,682 | 93.2 | b |
| LSD (0.05) | NS | NS | NS | 8.6 | |

Pioneer 33B49 planted April 28 at 16,600 seeds/A

## Grain Sorghum

| Treatments | Test weight | Moisture% | Bu/A adj. 14.0% moisture | |
|---|---|---|---|---|
| Fall strip-till | 52.9 | 20.8 | 107.2 | a |
| Winter strip-till | 51.8 | 21.1 | 106.1 | a |
| No-till | 52.5 | 19.7 | 104.6 | a |
| Spring strip-till | 51.1 | 20.2 | 104.4 | a |
| LSD (0.05) | NS | NS | NS | |

NC+ 5B89 planted May 28 at 51,800 seeds/A




## Sunflower Roots

| Tillage | Taproot Mass | Straight Taproot | Lateral roots | Secondary roots | Average Root Score |
|---|---|---|---|---|---|
| Spring Strip-till | 3.3 | 1.7 | 1.7 | 2 | 2.2 |
| No-till | 3 | 3.7 | 3 | 3 | 3.2 |
| LSD (0.05) | NS | 1.6 | 0.9 | NS | NS |

## Grain Sorghum Roots

| Tillage | Root Mass | Root Mass Straightness | Lateral roots | Secondary roots | Average Root Score |
|---|---|---|---|---|---|
| Strip-till | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 |
| No-till | 4.0 | 3.0 | 2 | 2 | 2.8 |
| LSD (0.05) | 1.85 | 0.93 | NS | NS | 0.73 |

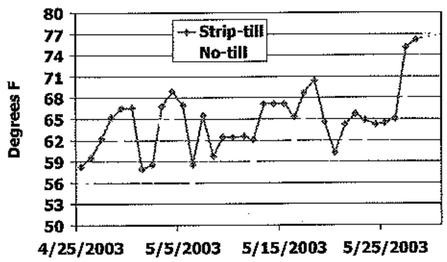
*No difference observed with corn roots

## Summary

- Results from one year
- No far reaching conclusions should be drawn, but strip-till had higher yields than no-till for sunflower and corn.
  - The site had slightly higher than normal average rainfall for the period of April to September (2004 - 20.51 inches, Average - 17.79 inches).
- Root development was better in strip-till than no-till for sunflower and grain sorghum, but no difference with corn.
- There was no benefit to strip-till for grain sorghum
- Study will be duplicated next year to see if the results are similar.

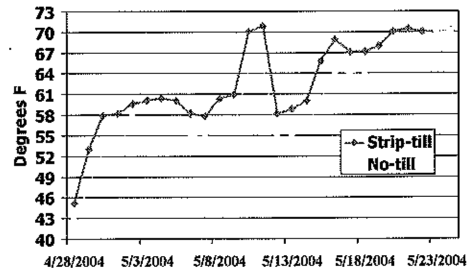
## North Central Strip-till Results

## Soil Temperature at Planting Depth Belleville, 2003




Soil temperature taken at depth of seed

## Soil Temperature at Planting Depth Belleville 2004




Soil temperature taken at depth of seed

## Treatments

- ***Fertility Treatments***
  1) 0-0-0 Check
  2) 40-30-5-5
  3) 80-30-5-5
  4) 120-30-5-5
  5) 80-15-2.5-2.5(Fall) +40-15-2.5-2.5(Spring)
- ***Timing***
  1) Fall Strip-Till +Fall Applied Fertilizer.
  2) Fall Strip-Till + Planting Time Fertilizer.
  3) No-Till Planting + Planting Time Fertilizer.

## Corn Yield, Belleville 2003

| Fertilizer Treatment | Strip-Till Spring Fertilize | No-Till |
|---|---|---|
| | bu/acre | |
| 40-30-5-5 | **52** | **45** |
| 80-30-5-5 | **60** | **48** |
| 120-30-5-5 | **71** | **51** |
| Average | **61** | **48** |

## Grain Yield, Belleville 2003

| Fertilizer Treatment | Strip-Till, Fall Fertilize | Strip-Till, Spring Fertilize |
|---|---|---|
| | bu/acre | |
| 40-30-5-5 | **56** | **52** |
| 80-30-5-5 | **58** | **60** |
| 120-30-5-5 | **68** | **71** |
| Average | **61** | **61** |

## Corn Yield, Belleville 2003

| Fertilizer Treatment | Yield, bu/acre |
|---|---|
| 120-30-5-5 Fall | **68** |
| 120-30-5-5 Spring | **71** |
| 120-30-5-5 Split (2/3 fall, 1/3 spring) | **75** |

## Belleville, 2003 corn

| Treat. | V-6 Dry wt, lb/a | Day to Mid-Silk | Moist, % | Yield*, bu/a |
|---|---|---|---|---|
| Strip-Till | 299 | 56 | 14.5 | 60 |
| No-Till | 168 | 66 | 17.5 | 45 |

*Includes unfertilized check

## Corn Yield, Belleville 2004

| Fertilizer Treatment | Strip-Till Spring Fertilize | No-Till |
|---|---|---|
| | bu/acre | |
| 40-30-5-5 | 161 | 146 |
| 80-30-5-5 | 174 | 159 |
| 120-30-5-5 | 186 | 165 |
| Average | 174 | 157 |

## Corn Yield, Belleville 2004

| Fertilizer Treatment | Strip-Till, Fall Fertilize | Strip-Till, Spring Fertilize |
|---|---|---|
| | bu/acre | |
| 40-30-5-5 | 161 | 161 |
| 80-30-5-5 | 174 | 174 |
| 120-30-5-5 | 185 | 186 |
| Average | 173 | 174 |

## Corn Yield, Belleville 2004

| Fertilizer Treatment Strip-Till | Yield, bu/acre |
|---|---|
| 120-30-5-5 Fall | 185 |
| 120-30-5-5 Spring | 186 |
| 120-30-5-5 Split (2/3 fall, 1/3 spring) | 186 |

## Belleville, 2004 corn

| Treat. | V-6 Dry wt, lb/a | Day to Mid-Silk | Moist, % | Yield* bu/a |
|---|---|---|---|---|
| Strip-Till | 421 | 55 | 13.8 | 160 |
| No-Till | 259 | 66 | 16.2 | 144 |

*Includes unfertilized check

## Corn Yield, Manhattan 2003

| Fertilizer Treatment | Strip-Till Spring Fertilize | No-Till |
|---|---|---|
| | bu/acre | |
| 40-30-5-5 | 185 | 152 |
| 80-30-5-5 | 187 | 168 |
| 120-30-5-5 | 187 | 153 |
| Average | 186 | 158 |

## Corn Yield, Manhattan 2003

| Fertilizer Treatment | Strip-Till, Fall Fertilize | Strip-Till, Spring Fertilize |
|---|---|---|
| | bu/acre | |
| 40-30-5-5 | **182** | **185** |
| 80-30-5-5 | **192** | **187** |
| 120-30-5-5 | **205** | **187** |
| Average | **193** | **186** |

## Corn Yield, Manhattan 2004

| Fertilizer Treatment | Strip-Till Spring Fertilize | No-Till |
|---|---|---|
| | bu/acre | |
| 40-30-5-5 | **189** | **169** |
| 80-30-5-5 | **210** | **201** |
| 120-30-5-5 | **225** | **209** |
| Average | **208** | **193** |

## Corn Yield, Manhattan 2004

| Fertilizer Treatment | Strip-Till, Fall Fertilize | Strip-Till, Spring Fertilize |
|---|---|---|
| | bu/acre | |
| 40-30-5-5 | **189** | **189** |
| 80-30-5-5 | **217** | **210** |
| 120-30-5-5 | **222** | **225** |
| Average | **209** | **208** |

## Grain Sorghum Yield as Affected by Tillage, Fertilizer Placement and Timing, Belleville 2004

| Tillage | Fertilizer | Timing | Placement | Yield, bu/a |
|---|---|---|---|---|
| Strip | 120-30-5 | Fall | 5-6 in. under row | **131** |
| Strip | 120-30-5 | V3 stage | Side dress in middle | **120** |
| Strip | 120-30-5 | Planting | 2 x 2 | **125** |
| No-Till | 120-30-5 | Planting | 2 x 2 | **117** |
| No-Till | 120-30-5 | V3 stage | Side dress in middle | **113** |

## Summary

- Early-season plant growth and nutrient uptake was greater with strip-till than no-till.
- Grain yields were significantly improved with strip-tillage.
- Under Kansas conditions, fall applied fertilizer was as effective as spring applied.

## Skip-Row Corn

## Skip-Row Corn

- In the past few years, skip-row corn has received some interest from producers looking for a more sustainable method of producing corn in the highly variable environment of western Kansas and Nebraska.
- In 2003, research from the University of Nebraska North Platte Research Center indicated skip-row dryland corn produced 32 percent better yields than did conventional dryland. In these field trials, two rows were planted and two skipped. Another treatment, where every other row was skipped, produced 17 percent better yields than the traditionally planted corn field. The treatments yielded 54 and 48 bushels per acre respectively compared with 41 bushels per acre for the conventional.
- In 2004, three sites in Kansas evaluated skip-row corn.

## Quinter Results

| Row Spacing | Final stand (plts/A) | Test weight | Moisture % | Bu/A adj. 15.5% moisture | |
|---|---|---|---|---|---|
| Every row | 18,000 | 60.7 | 15.3 | 119.8 | a |
| | 12,000 | 59.4 | 16.1 | 100.7 | b |
| Plant 2/ skip 1 | 12,000 | 59.7 | 16.6 | 97.4 | b |
| | 8,000 | 59.8 | 17.3 | 89.4 | c |
| LSD (0.05) | | 0.54 | 0.81 | 7.5 | |

All treatments had 75 lbs/A of N applied 2x2 at planting. The corn was planted on April 28 using Pioneer 33B49 no-till into wheat stubble.

## Tribune Results

| Row spacing | Target population (plts/A) | Test weight | Moisture % | Bu/A | Actual population (1,000 plts/A) |
|---|---|---|---|---|---|
| Every row | 10,000 | 54.8 | 21.5 | 72 | 9.5 |
| | 15,000 | 55.9 | 20.6 | 116 | 15.0 |
| | 20,000 | 56.5 | 19.1 | 117 | 18.5 |
| Plant 1/ skip 1 | 10,000 | 54.9 | 22.0 | 75 | 9.4 |
| | 15,000 | 56.7 | 20.1 | 97 | 14.5 |
| | 20,000 | 56.6 | 19.1 | 118 | 18.8 |
| Plant 2/ skip 1 | 10,000 | 56.1 | 20.1 | 64 | 9.1 |
| | 15,000 | 55.8 | 20.1 | 98 | 14.5 |
| | 20,000 | 56.7 | 19.9 | 105 | 19.5 |
| Plant 2/ skip 2 | 10,000 | 55.5 | 20.6 | 68 | 9.3 |
| | 15,000 | 55.9 | 20.3 | 86 | 13.5 |
| | 20,000 | 56.8 | 19.3 | 90 | 19.6 |
| CV, % | | 2.3 | 6.7 | 12.7 | 7.8 |

All treatments had a 80 lb/A UAN dribbled on February 26 and 4 gal/A 10-34-0 dribbled beside row on May 9. Corn was planted May 9 using Pioneer 33B25RR no-till into wheat stubble

## Belleville Results

| Row Spacing | Final stand (plts/A) | Bu/A |
|---|---|---|
| Every row | 24,800 | 151 |
| | 16,600 | 137 |
| Plant 2/ skip 1 | 16,600 | 131 |
| LSD (0.05) | | 6.0 |

All treatments had 200 lb/A N applied as NH3. Corn was planted on April 15 using DeKalb DK 60-19 no-till into soybean stubble.

# EFFECT OF NO-TILL ON SOIL PROPERTIES AND GRAIN YIELD IN A WHEAT-SORGHUM-FALLOW ROTATION

**Alan Schlegel, Loyd Stone, Troy Dumler, and Curtis Thompson**

## SUMMARY

A study was initiated in west-central Kansas near Tribune to evaluate the long-term effects of tillage intensity on soil properties and grain yield in a wheat-sorghum-fallow rotation. After 10-yr, water infiltration was 50% greater with no-till (NT) than either reduced tillage (RT) or conventional tillage (CT) and comparable to undisturbed sod. Aggregate stability was also better following NT than RT or CT. Grain yields of wheat and grain sorghum increased with decreased tillage intensity. Averaged across 14-yr, yield of NT wheat was 3 bu/a greater than RT and 8 bu/a greater than CT. Average NT sorghum yields were 12 bu/a greater than RT and 34 bu/a greater than CT. For grain sorghum, in particular, the advantage of reducing tillage intensity has increased with time. For instance, NT sorghum yields were 118 bu/a in 2004 compared to 67 bu/a for RT and 44 bu/a for CT.

## PROCEDURES

Research on different tillage intensities in a WSF rotation at the K-State Southwest Research-Extension Center at Tribune was initiated in 1991 on land just removed from native sod. The three tillage intensities are CT, RT, and NT. The CT system was tilled as needed to control weed growth during the fallow period. On average, this resulted in 4 to 5 tillage operations per year, usually with a blade plow or field cultivator. The RT system through used a combination of herbicides (1 to 2 spray operations) and tillage (2 to 3 tillage operations) to control weed growth during the fallow period. In 2001, the RT system is a combination of NT from wheat harvest through sorghum planting and CT from sorghum harvest to wheat planting. The NT system exclusively used herbicides to control weed growth during the fallow period. All tillage systems used herbicides for in-crop weed control. Plot size was 50 by 100 ft with four replications.

Grain yield was determined by machine harvesting the center of each plot after physiological maturity. Profile soil water was measured near planting and after harvest of each crop to a depth of 8 ft. Water infiltration (steady-state) and wet-aggregate stability were measured in the summer (July) after 10 yr of the tillage treatments.

## RESULTS AND DISCUSSION

### Water infiltration and aggregate stability

Water infiltration was 50% greater with NT than other tillage treatments for all crop phases (Fig. 1). Infiltration tended to be greater in wheat stubble (wheat) than in growing stubble (sorghum) or sorghum stubble (fallow). In this study, infiltration was no greater in undisturbed sod than with NT.

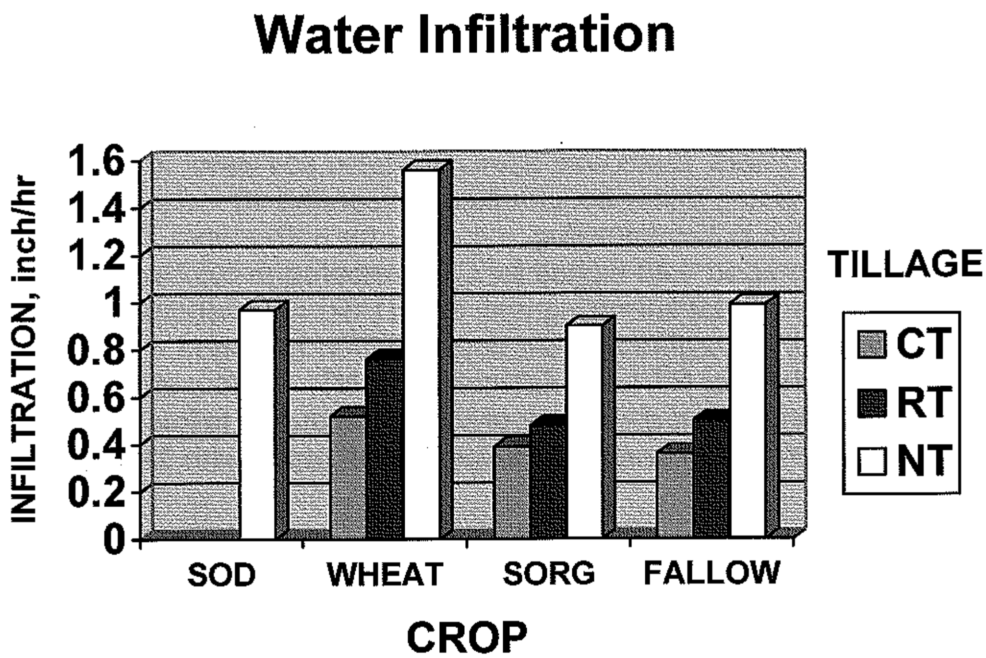



Figure 1. Steady-state water infiltration after 10-yr of tillage compared to undisturbed sod in a wheat-sorghum-fallow rotation, Tribune, KS.

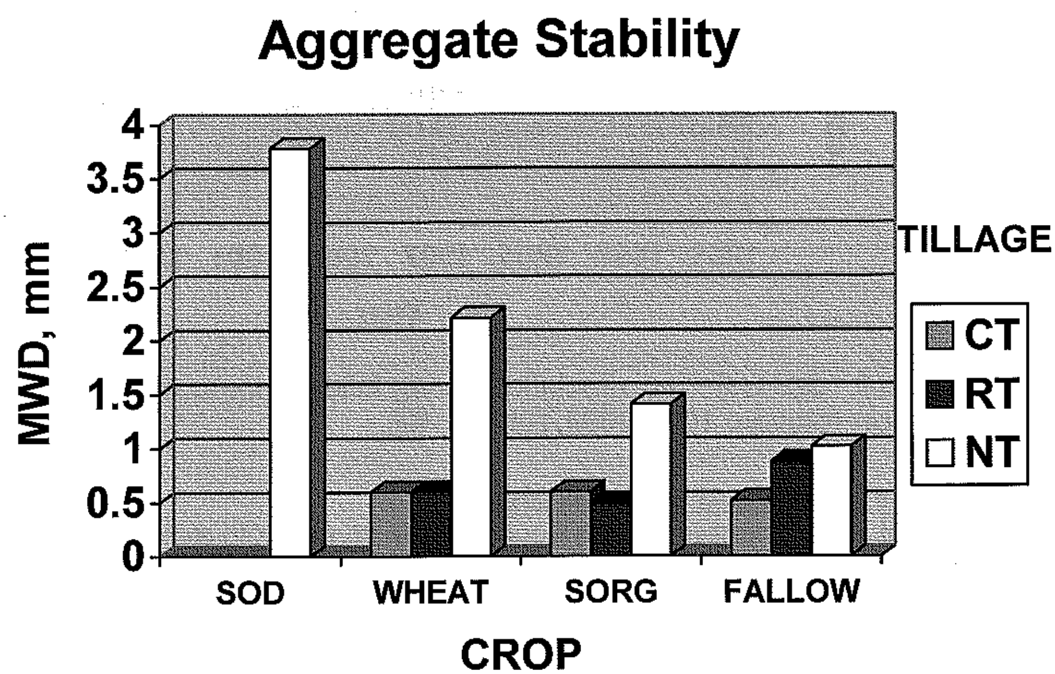



Figure 2. Aggregate stability (mean weight diameter) after 10-yr of tillage in a wheat-sorghum-fallow rotation compared to undisturbed sod, Tribune, KS.

Similar to water infiltration, aggregate stability (Mean Weight Diameter or MWD) was greater with NT than other tillage systems (Fig. 2). For this measurement, the larger the value the more stable the aggregates. Although as expected, aggregate stability was greatest in the undisturbed sod.

**Soil water**

The amount of fallow accumulation varied widely among years for both crops (Fig. 3 and 4). In some years, there was a loss of stored soil water from harvest to planting while, in other years, fallow accumulation exceeded 10 inches. On average, CT was the least effective in accumulating soil water for both crops. Prior to wheat, fallow accumulation averaged 4.43 inches for CT compared to 5.52 inches for RT and 5.07 inches for NT. Somewhat surprising was the NT did not accumulate more water than RT. Similarly, prior to sorghum, fallow accumulation averaged 4.04 inches for CT compared with 5.32 inches for RT and 5.02 inches for NT. Fallow efficiency (amount of water accumulated during fallow divided by precipitation during fallow) ranged from less than 0 to more than 50% and averaged 24% for CT compared with 32% for RT and 28% for NT.

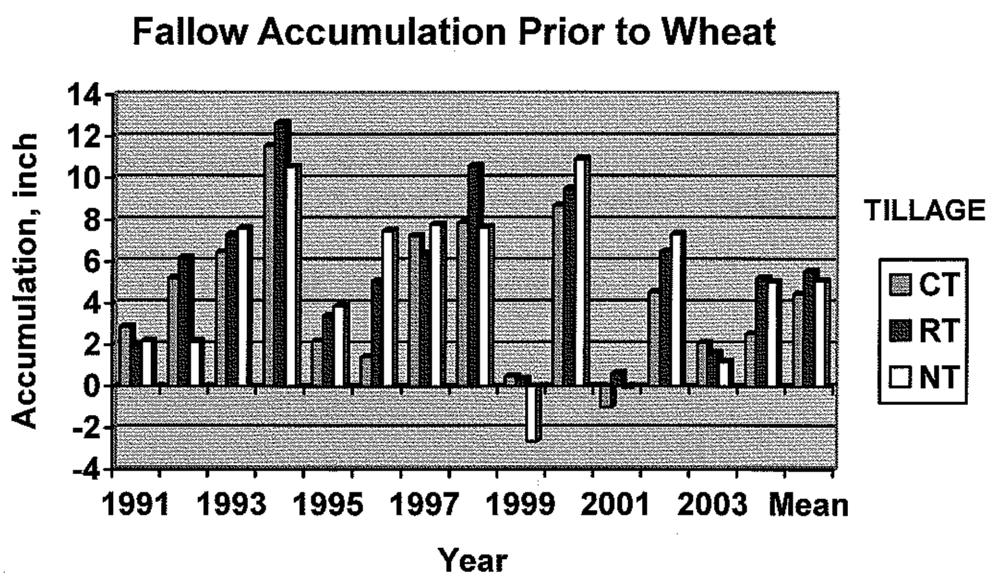



Figure 3. Soil water accumulation during fallow prior to wheat in a wheat-sorghum-fallow rotation, 1991-2004,Tribune, KS.

**Grain yield of wheat and grain sorghum**

Wheat yields increased with decreases in tillage. On average (1991-2004), wheat yields were 8 bu/a higher for NT (38 bu/acre) than for CT (30 bu/acre). Wheat yields for RT were 5 bu/a greater than CT. During the first 5-yr of the study, wheat yields were similar for CT and RT with NT yields 3 bu/a greater (Fig. 5). During the late1990's (1996-2000), NT yields were 5 bu/a greater than RT and 14 bu/a greater than CT. The two yr with the lowest wheat yields (less than 5 bu/a) of the entire study

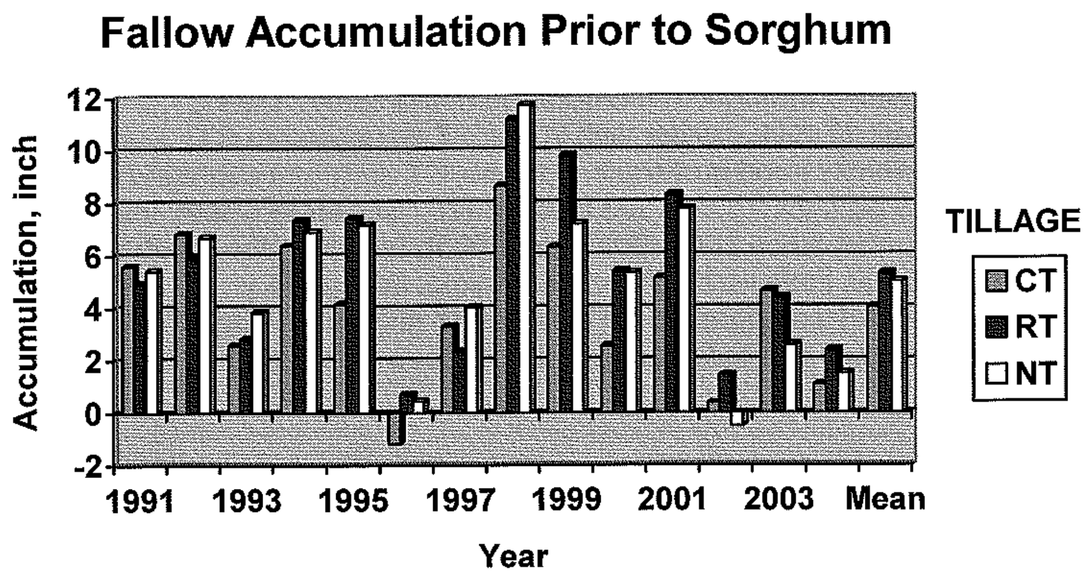



Figure 4. Soil water accumulation during fallow prior to sorghum in a wheat-sorghum-fallow rotation, 1991-2004,Tribune, KS.

occurred in the past 4 yr (2002 because of drought and 2004 because of mid-May freeze). Although average yields during this 4-yr period are very low, NT produced 6 bu/a more wheat than CT.

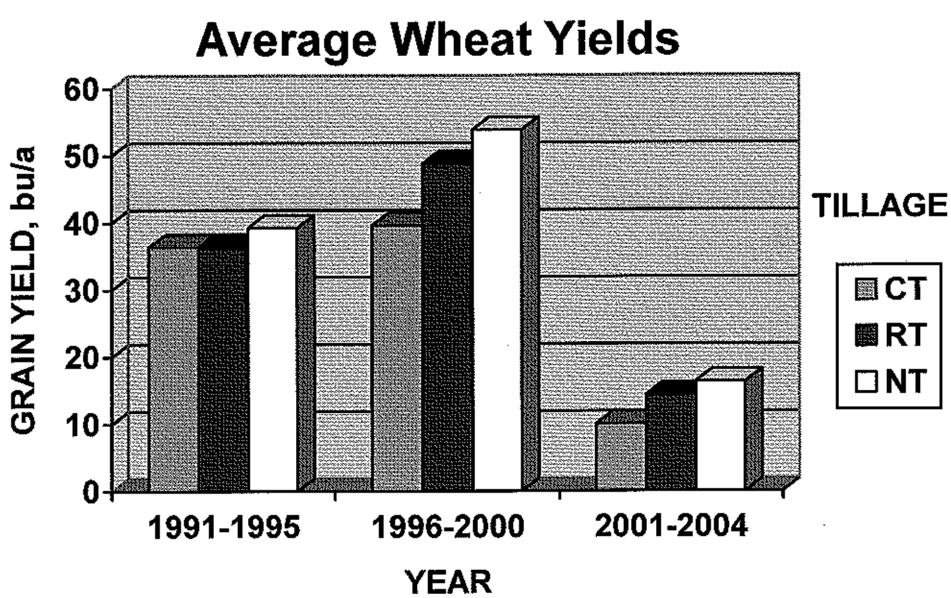



Figure 5. Average wheat yields as affected by tillage in a wheat-sorghum-fallow rotation, Tribune, KS.

The yield benefit from reduced tillage was greater for grain sorghum than for wheat (Fig. 6). Grain sorghum yields for CT averaged 36 bu/ for the entire study period compared to 58 bu/a for RT and 70 bu/a for NT. The yield benefit from reduction in tillage has increased throughout the duration of the study. During the first 5-yr, sorghum yields were about 17 bu/a greater with RT or NT compared to CT. During the late 1990's with generally good growing conditions, CT sorghum averaged 57 bu/a compared to 88 bu/a for RT and 103 bu/a for NT. Similar to wheat, there has been two poor sorghum years since 2000 (2002 and 2003), however, the relative advantage to reducing tillage has increased. Averaged across the past 4-yr, NT sorghum yields were 55 bu/a for NT compared to 29 bu/a for RT and only 14 bu/a for CT. In 2004, NT sorghum yields were 118 bu/a compared to 67 bu/a for RT and 44 bu/a for CT.

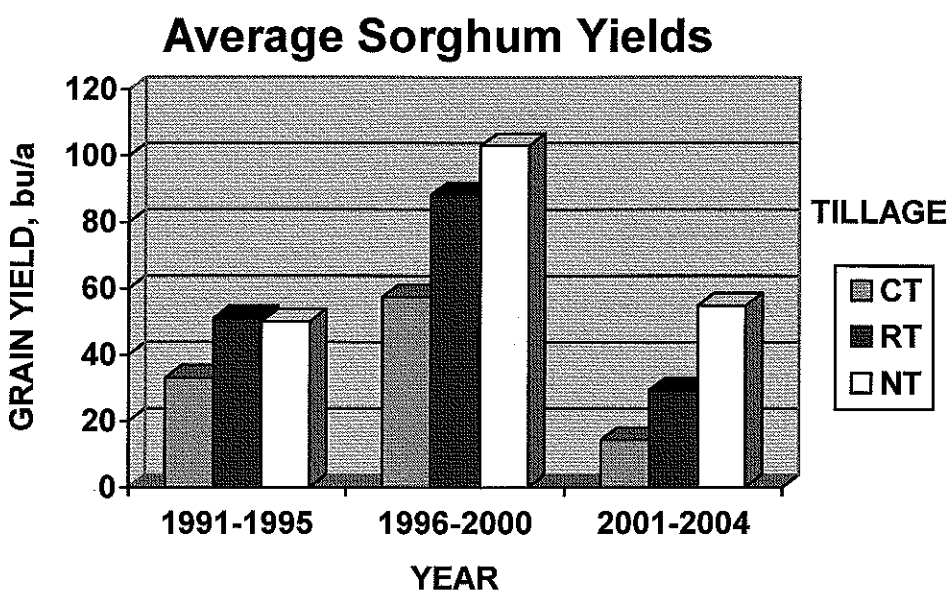



Figure 6. Average grain sorghum yields as affected by tillage in a wheat-sorghum-fallow rotation, Tribune, KS.

# Multi Peril Crop Insurance - 2005

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Managing the inherent risk associated with agricultural production continues as one of the most important factors in determining the survivability of farm operations. Multi Peril Crop Insurance (MPCI) is a critical component in most of the risk management strategies employed. 2004 was another difficult year for our region, with "causes of loss" ranging from drought to excess precipitation.

By this January 10th, paid '04 indemnity within the nine northwestern Kansas counties exceeded 126 million dollars with the likelihood of this increasing significantly once all claims are processed. Unfortunately, this was not an isolated event. Starting in 2000, annual indemnities for this area have been 31.5, 28.8, 101.0 and 66.9 million dollars. Adjacent counties in both Colorado and Nebraska have also experienced multiple years of loss. (Source: FCIC Crop Year Statistics for 2000-2004)

MPCI mimics a life-form, evolving over time. It is extremely important for producers to consult with their agents to assess how change will impact their farm operation. The following material represents our understanding of the MPCI program at this point in time but does not reflect any official sanction.

Crop year 2004 brought with it a new common policy and other changes that exposed us to 1st & 2nd crop issues, double cropping regulations, changes in final planting dates, revised added land guidelines, and new Substantial Beneficial Interest (SBI) requirements, to name but a few. Crops planted in the spring of '05 will be handled under yet another "new" common policy, but this policy does not seem to have the same potential for impacting producers with changes more in the line of clarification and refinement than in out and out new methodology. The following definitions and statements illustrate:

- Earliest planting date -- "The initial planting date contained in the Special Provisions, which is the earliest date you may plant an insured agricultural commodity and qualify for a replanting payment if such payments are authorized by the Crop Provisions."

- Limited resource farmer --"A person with:
    1) Direct or indirect gross farm sales not more than $100,000 in each of the previous 2 years …" (with future inflation adjustments); "and
    2) A total household income at or below the national poverty level for a family of four, or less than 50% of the county median household income in each of the previous 2 years (to be determined annually using Commerce Department Data)."

- Practical to replant -- The following statement was removed from the definition.

  "It will not be considered practical to replant after the end of the late planting period, or the final planting date if no late planting period is applicable, unless replanting is generally occurring in the area."

- Substantial beneficial interest -- The prior definition was modified to include the statement: "The spouse of any individual applicant or individual insured will be considered to have a substantial beneficial interest in the applicant or insured unless the spouses can prove they are legally separated or otherwise legally separate under state law…."

**Your duty in case of loss**: The new policy reiterates and strengthens the requirement that notice of loss be given "within 72 hours of your initial discovery of damage (but not later than 15 days after the end of the insurance period), by unit, for each insured crop."

It also specifies that "If representative samples are required by the Crop Provisions" you must "leave ***representative*** samples intact of the unharvested crop if you report damage less than 15 days before the time you begin harvest or during harvest of the damaged unit (The samples must be left intact until we inspect them or until 15 days after completion of harvest on the unit, whichever is earlier." Unless otherwise specified, samples must be left in each field of the unit and be 10 feet wide and extend the entire length of the row; or if the crop is not planted in rows, the longest dimension of the field.

Claims must be filed no later that 60 days after the end of the insurance period "unless you request an extension in writing and we agree to such extension. … Failure to submit a claim or provide the required information will result in no indemnity, prevented planting payment or replant payment."

**Prevented planting:** The following statement was added to the policy: "(Failure to plant when other producers in the area were planting will result in the denial of the prevented panting claim)."

## Other Items of Interest

The Risk Management Agency will again focus major attention on reducing **Waste, Fraud and Abuse**. Be sure that you can substantiate reported data. Claims of "new producer" status are closely reviewed. 2005 brings a new Sorghum Silage Pilot Program, GRP and GRIP Policy availability, Livestock Risk Protection and T-Yield adjustments.

T-Yields are reviewed periodically and reflect recent yield trends within a given area. The influence of the severe drought our region has experienced over several years is reflected in the following table that illustrates T-Yield changes associated with major crops within our region.

# Change in County T-Yields

| State | County | Prac | Corn | Gsorg | Snflr (oil) | Snflr (conf) |
|---|---|---|---|---|---|---|
| | | | Crop by Year (04/05) | | | |
| Colorado | Yuma | Irr | 160/165 | 55/65 | 1650/1650* | 1550/1570* |
| | | NIrr | 51/ 45 | 18/26 | 1000/1000* | 900/ 900* |
| | Kit Carson | Irr | 155/154 | 68/66 | 1565/1565 | 1440/1485 |
| | | NIrr | 58/ 47 | 25/28 | 1100/1100 | 1000/1045 |
| | Cheyenne | Irr | 151/150 | 42/62 | 1650/1650* | 1500/1570* |
| | | NIrr | 56/ 44* | 30/31* | 975/ 975* | 900/ 900* |
| Kansas | Cheyenne | Irr | 146/145 | 91/85 | 1850/1687 | 1465/1608 |
| | | NIrr | 60/ 49 | 55/45 | 1234/1068 | 911/1012 |
| | Rawlins | Irr | 141/139 | 92/90 | 1650/1513 | 1389/1442 |
| | | NIrr | 66/ 57 | 60/53 | 1199/ 958 | 939/ 908 |
| | Decatur | Irr | 145/143 | 96/94 | 1683/1695 | 1463/1616 |
| | | NIrr | 72/ 60 | 65/58 | 1147/1073 | 1034/1017 |
| | Sherman | Irr | 153/157 | 97/90 | 1649/1629 | 1609/1547 |
| | | NIrr | 67/ 52 | 56/50 | 1258/1105 | 1037/1047 |
| | Thomas | Irr | 162/166 | 93/89 | 1917/1642 | 1597/1560 |
| | | NIrr | 70/ 57 | 64/60 | 1278/1026 | 1079/ 975 |
| | Sheridan | Irr | 169/173 | 99/91 | 1641/1662 | 1584/1584 |
| | | NIrr | 79/ 66 | 69/62 | 1094/1053 | 1071/ 977 |
| | Wallace | Irr | 144/146 | 90/83 | 1650/1591 | 1612/1515 |
| | | NIrr | 57/ 49 | 53/45 | 1286/1145 | 1028/1095 |
| | Logan | Irr | 152/145 | 93/89 | 1650/1588 | 1508/1514 |
| | | NIrr | 59/ 49 | 59/51 | 1126/1006 | 961/ 953 |
| | Gove | Irr | 139/138 | 95/90 | 1650/1584 | 1500/1510 |
| | | NIrr | 70/ 63 | 68/60 | 1050/1003 | 950/ 950 |
| Nebraska | Dundy | Irr | 153/167 | 89/89 | 1577/1577* | 1498/1498* |
| | | NIrr | 54/ 43 | 54/43 | 959/ 959* | 911/ 911* |
| | Hitchcock | Irr | 142/149 | 89/92 | 1801/1773 | 1711/1600 |
| | | NIrr | 66/ 52 | 66/56 | 1095/1108 | 1040/1053 |
| | Red Willow | Irr | 149/152 | 88/94 | 1848/1857 | 1756/1767 |
| | | NIrr | 73/ 63 | 67/61 | 1123/1112 | 1067/1055 |
| | Furnas | Irr | 149/156 | 94/94 | 1848/1779 | 1756/1691 |
| | | NIrr | 83/ 70 | 77/68 | 1123/1112 | 1067/1055 |

* Denotes existence of multiple map areas with APH shown being for area with highest yield.

Note! T-Yields did not change for soybeans, dry beans, barley or oats within these counties. Yields for some specialty crops did change, but are not addressed here.

A T-Yield change impacts most producers of that crop. Review of the tabular data shows 78 of 128 (over 60%) of year-to-year comparisons with a reduced T-Yield in 2005. Reductions vary from minor to slightly over 20 percent, with, as one would expect, dryland practices showing the highest incidence and amount of reduction. As T-Yields drop, so does the ability to offset risk. This economically disadvantages producers with units that do not qualify for a simple average yield, have units with less than 4 years of actual production history, or have any unit that in the future is eligible to use a substituted yield based on a downward revised T-Yield value. Producers should review crop selection choices on any given tract of land in light of revised T-Yields.

Crops in Sherman County, Kansas, illustrate an extreme case. T-yields for irrigated corn increased from 153 to 157 (02.6%) but decreased from 67 to 52 (22.4%) for non-irrigated corn. T-Yields for grain sorghum and sunflowers were generally lowered for both practices but not as severely. To visualize the impact, let's assume a new producer of corn using a 70% CRC policy with an estimated base price of $2.30, optional units and premium rate standardized to that currently estimated for 2005. Under this example, MPCI coverage between '04 and '05 would change as follows:

| | Prac | Year | Guar bu/ac | Guar $/ac | Prem/ acre | Difference |
|---|---|---|---|---|---|---|
| Corn | Irr | 2004 | 107.1 | 246.33 | $9.82 | |
| | | 2005 | 109.9 | 252.77 | $9.82 | +$6.44/ac @ same cost |
| Corn | NIrr | 2004 | 46.9 | 107.87 | $8.20 | |
| | | 2005 | 36.4 | 83.72 | $8.79 | <$24.15>/ac @ higher cost |

Note the drop in risk protection on the dryland practice of over $20/acre. Compare this to grain sorghum with an estimated price of $2.25, other assumptions the same.

| | Prac | Guar Year | Guar bu/ac | Guar $/ac | Prem/ acre | Difference |
|---|---|---|---|---|---|---|
| Gsorg | Irr | 2004 | 97.0 | 152.78 | $7.05 | |
| | | 2005 | 90.0 | 141.75 | $7.06 | <$11.03>/ac @ same cost |
| Gsorg | NIrr | 2004 | 56.0 | 88.20 | $8.38 | |
| | | 2005 | 50.0 | 78.75 | $8.73 | <$ 9.45>/ac @ higher cost |

In 2004 planting dryland corn had a risk coverage advantage of approximately $20/acre over grain sorghum, but in 2005 that advantage has dropped to less than $5/acre. Producers need to work with their agents to assess how MPCI may influence upcoming cropping decisions.

Policy expansion will provide additional options to producers. Starting this year and running through 2008, silage sorghum will be a covered crop under a new pilot program in 2 counties in SE Colorado and 37 counties in Western Kansas. Group Risk Plan (GRP) and Group Risk Income Protection (GRIP) policies will be available on corn in selected Kansas counties with GRIP being added to some counties in Nebraska. GRIP and GRIP-HRO (with harvest revenue option) will now be available on grain sorghum in all counties where GRP was previously available plus, being added in several SE Colorado counties. These "group risk" policies feature lower premium costs but are based on loss occurrence within a county, not your specific farm or unit of your farm. See your agent for details and help in evaluating how these changes may impact your operation.

Sorghum Silage Insurance: A New Pilot Program

J. A. Dahlberg

The lack of insurance for silage sorghum has prevented many producers from growing this drought tolerant and "water-sipping" crop. The Silage Sorghum Pilot insurance contract is a new tool that will allow producers in 37 Kansas counties and two Colorado counties to manage their production risks more effectively. The Silage Sorghum Pilot insurance contract is available for Colorado producers in Baca and Prowers counties. Eligible Kansas counties include Barton, Decatur, Ellis, Finney, Ford, Gove, Graham, Grant, Gray, Greeley, Hamilton, Haskell, Hodgeman, Kearny, Lane, Logan, Meade, Morton, Ness, Norton, Osborne, Phillips, Rawlins, Rooks, Rush, Russell, Scott, Seward, Sheridan, Sherman, Smith, Stanton, Stevens, Thomas, Trego, Wallace, and Wichita. Sorghum varieties grown for harvest as silage will be eligible for coverage under the new pilot program launching in 2005 and continuing through 2008. The definitions for insurability match category 1 or 2 as defined by FSA LP-1955, but the list cannot guarantee insurability. A series of workshops have been put together with the stated goal of familiarizing producers with this new Insurance Policy for Sorghum Silage. Please note: **NAP will no longer be available for sorghum silage in regions where the pilot program is available.** The primary difference between grain sorghum and forage sorghum is in its use. Forage is defined simply as "food for animals" and in sorghum these are often tall. They can be thick or thin stemmed, tiller profusely, may or may not contain grain, and in some cases can be very short. These types of sorghum are typically grown for hay, grazing, silage, or other industrial uses. **Who can be insured?** I) The crop insured will be on all of the silage sorghum planted in the county for which a premium rate is provided by the county actuarial documents, in which the insured has a share; and: a) That is adapted to the area based on days to maturity and is compatible with agronomic and weather conditions in the area; and: b) That is planted for harvest as silage, and is not: 1) a grain sorghum hybrid (a variety insurable under the terms of section 5(d) of the Coarse Grains Crop Provisions); 2) a variety developed for haying or grazing only; 3) interplanted with another crop; or 4) planted into an established grass or legume. II) Any acreage of the insured crop damaged before the final planting date, to the extent that the majority of producers in the area would normally not further care for the crop must be replanted unless the insurance provider agrees that it is not practical. Refer to the Loss Adjustment Manual (LAM) for replanting provision issues. Refer to Section 4 of this handbook for replanting payment procedures. III) No written agreements may be authorized under the Pilot Silage Sorghum Endorsement to modify any terms of the contract or to extend coverage to any county for which actuarial documents are not filed.

# Cover Your Acres 2004 Field Day Results

Conducted by Northwest Kansas Crop Residue Alliance
Members who coordinated field day: Stan Miller, Dennis Leichliter, Dan Grafel, Dan Skrdlant, Shannon Metcalf, Spencer Braun, and Todd Sumner

## *COVER YOUR ACRES HARVEST REPORT*

| | |
|---|---|
| Cooperator | Grafel Farms |
| Address | Cover Your Acre's Plot ( Sunflowers ) |
| City | Oberlin |
| State | KS |
| Zip Code | 67749 |
| County | Decatur |
| Phone | |
| Date | 10/28/2004 |
| Additional Notes/Directions | |

| Planting Date | Harvest Date | Row Width | Planting Rate | Irrigation | Soil Texture | Tester Hybrid | Tester Average |
|---|---|---|---|---|---|---|---|
| 6/4/04 | 10/28/04 | 30 | | NO | Clay Loam | D K 38-30 | |

| Ent | Ck | Brand | Hybrid | Row Pltd | Row Hrvt | Row Length | | % Harvest Moisture | Test Weight | Harvest Weight | Pounds per/Acre |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | X | | Tester | 8 | 8 | 670 | | 9.3 | 27 | 580 | 1900.0 |
| 2 | | Dekalb | 38-30 | 8 | 8 | 670 | | 9.2 | 28 | 530 | 1738.0 |
| 3 | | Fontanelle | 902NS | 8 | 8 | 670 | | 9.1 | 28 | 520 | 1707.0 |
| 4 | | Triumph | 665 | 8 | 8 | 670 | | 8.7 | 24 | 540 | 1780.0 |
| 5 | | Triumph | 645 | 8 | 8 | 670 | | 8.9 | 24 | 560 | 1843.0 |
| 6 | | Triumph | 658 | 8 | 8 | 670 | | 8.9 | 25 | 540 | 1777.0 |
| 7 | X | | Tester | 8 | 8 | 670 | | 8.7 | 25 | 550 | 1814.0 |
| 8 | | 17,000 | | 8 | 8 | 670 | | 8.6 | 25 | 460 | 1518.0 |
| 9 | | 24,000 | | 8 | 8 | 670 | | 8.4 | 26 | 480 | 1588.0 |
| 10 | | 28,000 | | 8 | 8 | 670 | | 8.0 | 23 | 500 | 1661.0 |
| 11 | X | | Tester | 8 | 8 | 670 | | 7.9 | 23 | 540 | 1796.0 |
| 12 | | narrow row | 10" | 20' | 20' | 670 | | 8.1 | 27 | 410 | 1360.0 |

# COVER YOUR ACRES HARVEST REPORT

Cooperator: Grafel Farms

Address: Cover Your Acre's Plot ( Soybeans )

City: Oberlin | State: KS | Zip Code: 67749

County: Decatur | Phone:

Page 1

CROP

EXP

I herby authorize the Cover Your Acres and it's representatives to use this information, my name, and photo for promotional purposes.

Cooperator's Signature

Date: 10/28/2004

Additional Notes/Directions

| Planting Date | Harvest Date | Row Width | Planting Rate | Irrigation | Previous Crop | Soil Texture | Tester Hybrid | Tester Average |
|---|---|---|---|---|---|---|---|---|
| 6/4/04 | 10/28/04 | 30 | | None | Wheat | Clay Loam | AV6289RR | |

| Ent | Ck | Brand | Hybrid | Row Pltd | Row Hrvt | Row Length | Pop (000's) | Root Lodge | Stalk Lodge | % Harvest Moisture | Test Weight | Harvest Weight | Yield per/Acre @ 13% Moist |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | X | | Tester | 8 | 8 | 660 | | | | 14.6 | 56 | 350 | 18.9 |
| 2 | | NC + | 3A53RR | 8 | 8 | 660 | | | | 15.2 | 51 | 380 | 20.4 |
| 3 | | NC + | 3A12RR | 8 | 8 | 660 | | | | 15.4 | 53 | 360 | 19.3 |
| 4 | X | | Tester | 8 | 8 | 660 | | | | 13.4 | 55 | 320 | 17.5 |
| 5 | | Fontanelle | 9301 | 8 | 8 | 660 | | | | 13.4 | 54 | 280 | 15.3 |
| 6 | | Fontanelle | 9011 | 8 | 8 | 660 | | | | 13.8 | 55 | 300 | 16.4 |
| 7 | X | | Tester | 8 | 8 | 660 | | | | 13.5 | 56 | 320 | 17.5 |
| 8 | | G. H. | 2393 | 8 | 8 | 660 | | | | 13.4 | 55 | 310 | 17.0 |
| 9 | | G. H. | 2811 | 8 | 8 | 660 | | | | 11.4 | 55 | 270 | 15.1 |
| 10 | X | | Tester | 8 | 8 | 660 | | | | 13.0 | 55 | 320 | 17.6 |
| 11 | | Dekalb | 37-51 | 8 | 8 | 660 | | | | 15.1 | 55 | 310 | 16.6 |
| 12 | | Dekalb | 28-53 | 8 | 8 | 660 | | | | 15.2 | 52 | 390 | 20.9 |
| 13 | X | | Tester | 8 | 8 | 660 | | | | 13.4 | 55 | 320 | 17.5 |
| 14 | | Asgrow | 3801 | 8 | 8 | 660 | | | | 15.0 | 56 | 280 | 15.0 |
| 15 | | Asgrow | 3202 | 8 | 8 | 660 | | | | 15.0 | 55 | 330 | 17.7 |
| 16 | X | | Tester | 8 | 8 | 660 | | | | 13.9 | 55 | 320 | 17.4 |
| 17 | | AgVenture | 35J2RR | 8 | 8 | 660 | | | | 13.3 | 55 | 380 | 20.8 |
| 18 | | AgVenture | 6274RR | 8 | 8 | 660 | | | | 13.5 | 54 | 390 | 21.3 |
| 19 | X | | Tester | 8 | 8 | 660 | | | | 13.1 | 55 | 360 | 19.8 |
| 20 | | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | | |
| 22 | | **Population Study** | | | | | | | | | | | |
| 23 | | | | | | | | | | | | | |
| 24 | | 75,000 | | 8 | 8 | 660 | | | | 13.2 | 56 | 290 | 15.9 |
| 25 | | 100,000 | | 8 | 8 | 660 | | | | 12.6 | 55 | 360 | 19.9 |
| 26 | | 150,000 | | 8 | 8 | 660 | | | | 13.0 | 55 | 370 | 20.4 |
| 27 | | 125,000 | 20" | 15' | 15' | 660 | | | | 12.9 | 55 | 300 | 16.5 |
| 28 | | 125,000 | 10" | 20' | 20' | 660 | | | | 12.6 | 56 | 350 | 19.3 |
| 29 | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | |
| 31 | | | | | | | | | | | | | |
| 32 | | | | | | | | | | | | | |
| 33 | | | | | | | | | | | | | |
| 34 | | | | | | | | | | | | | |

# SELECT SEEDS HARVEST REPORT

Cooperator: Grafel Farms

Address: Cover Your Acres Plot ( Corn )

City: Oberlin | State: KS. | Zip Code:

County: Decatur | Phone:

Page 1 | CROP: Corn | EXP:

I herby authorize Cover Your Acres and it's representatives to use this information, my name, and photo for promotional purposes.

Cooperator's Signature | Date: 10/17/2004

Additional Notes/Directions

Plot adjusted to tester    Plot Average 77.10 bu. per acre

| Planting Date | Harvest Date | Row Width | Planting Rate | Irrigation | Previous Crop | Soil Texture | Tester Hybrid | Tester Average |
|---|---|---|---|---|---|---|---|---|
| 5/21/04 | 10/17/04 | 30 | 18,000 | None | Wheat | Clay Loam | AV 852 | 80.8 |

| Ent | Ck | Brand | Hybrid | Row Pltd | Row Hrvt | Row Length | Pop (000's) | Root Lodge | Stalk Lodge | % Harvest Moisture | Test Weight | Harvest Weight | Yield per/Acre @ 15.5% Moist |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | Tester | | 8 | 8 | 640 | | | | 18.5 | 54 | 1,200 | 70.3 |
| 2 | | Wilson | 7595 RB | 8 | 8 | 640 | | | | 15.3 | 54 | 1,210 | 79.9 |
| 3 | | Wilson | 7624 RB | 8 | 8 | 640 | | | | 16.0 | 53 | 1,250 | 81.7 |
| 4 | | Tester | | 8 | 8 | 640 | | | | 18.8 | 55 | 1,350 | 78.8 |
| 5 | | Triumph | 1120 Bt RR | 8 | 8 | 640 | | | | 19.8 | 54 | 1,240 | 76.4 |
| 6 | | Triumph | 1141 A BT | 8 | 8 | 640 | | | | 20.5 | 54 | 1,220 | 74.7 |
| 7 | | Tester | | 8 | 8 | 640 | | | | 20.1 | 54 | 1,270 | 73.0 |
| 8 | | NC + | 4492 BC | 8 | 8 | 640 | | | | 16.7 | 53 | 1,360 | 85.0 |
| 9 | | NC + | 5423 B | 8 | 8 | 640 | | | | 21.4 | 53 | 1,290 | 76.4 |
| 10 | | Tester | | 8 | 8 | 640 | | | | 17.9 | 54 | 1,380 | 81.5 |
| 11 | | MidWest | G 7652 B | 8 | 8 | 640 | | | | 18.4 | 56 | 1,310 | 74.7 |
| 12 | | MidWest | G 7716 B | 8 | 8 | 640 | | | | 19.0 | 55 | 1,440 | 81.7 |
| 13 | | Tester | | 8 | 8 | 640 | | | | 20.6 | 55 | 1,480 | 84.5 |
| 14 | | Golden Harvest | H8224BtRR | 8 | 8 | 640 | | | | 15.7 | 53 | 1,490 | 85.9 |
| 15 | | Golden Harvest | H8446BtRR | 8 | 8 | 640 | | | | 18.1 | 54 | 1,340 | 74.5 |
| 16 | | Tester | | 8 | 8 | 640 | | | | 18.8 | 55 | 1,470 | 85.8 |
| 17 | | Fontanelle | 7798CBRR | 8 | 8 | 640 | | | | 17.1 | 54 | 1,460 | 82.9 |
| 18 | | Fontanelle | 7R418 | 8 | 8 | 640 | | | | 17.2 | 55 | 1,480 | 84.0 |
| 19 | | Tester | | 8 | 8 | 640 | | | | 18.3 | 55 | 1,430 | 84.0 |
| 20 | | DeKalb | 58-80CBRR | 8 | 8 | 640 | | | | 16.3 | 53 | 1,310 | 75.5 |
| 21 | | DeKalb | 63-81CBRR | 8 | 8 | 640 | | | | 19.1 | 55 | 1,220 | 67.6 |
| 22 | | Tester | | 8 | 8 | 640 | | | | 17.4 | 55 | 1,420 | 84.4 |
| 23 | | Circle Seed | 8005 RR2 | 8 | 8 | 640 | | | | 20.5 | 53 | 1,300 | 70.2 |
| 24 | | Circle Seed | 7421 | 8 | 8 | 640 | | | | 20.1 | 53 | 1,240 | 67.2 |
| 25 | | Tester | | 8 | 8 | 640 | | | | 17.6 | 55 | 1,440 | 85.3 |
| 26 | | AsGrow | RX718RRYG | 8 | 7 | 640 | | | | 17.6 | 55 | 1,180 | 77.2 |
| 27 | | AsGrow | RX752RRYG | 8 | 8 | 640 | | | | 17.1 | 55 | 1,310 | 75.4 |
| 28 | | Tester | | 8 | 8 | 640 | | | | 17.5 | 54 | 1,380 | 81.9 |
| 29 | | AgVenture | AV 832 | 8 | 8 | 640 | | | | 18.5 | 54 | 1,260 | 74.0 |
| **30** | | **AgVenture** | **AV 812 CB** | **8** | **8** | **640** | | | | **17.9** | **55** | **1,310** | **77.4** |
| 31 | | Tester | | 8 | 8 | 640 | | | | 16.9 | 55 | 1,330 | 79.5 |
| 32 | | POP | 20000 | 8 | 8 | 640 | | | | 17.1 | 55 | 1,290 | 76.9 |
| 33 | | POP | 16000 | 8 | 8 | 640 | | | | 17.9 | 54 | 1,360 | 80.3 |
| 34 | | POP | 14000 | 8 | 8 | 640 | | | | 20.2 | 54 | 1,510 | 86.7 |

# SELECT SEEDS HARVEST REPORT

Cooperator: Grafel Farms
Page: 1
Address: Cover Your Acres ( Grain Sorghum )
CROP: Milo
City: Oberlin | State: KS | Zip Code: 67749
EXP:
County: Decatur
Phone:

I herby authorize the Select Seeds Inc. and it's representatives to use this information, my name, and photo for promotional purposes.

Cooperator's Signature

Date: 11/26/04

Additional Notes/Directions

Plot Was Adjusted to Tester Plot AVE. 63.3 bushels per acre.

| Planting Date | Harvest Date | Row Width | Planting Rate | Irrigation | Previous Crop | Soil Texture | Tester Hybrid | Tester Average |
|---|---|---|---|---|---|---|---|---|
| | 11/26/04 | 30 | 45,000 | NON | Wht | Loam | AV 372 | 58.3 |

| Ent | Ck | Brand | Hybrid | Row Pltd | Row Hrvt | Row Length | Pop (000's) | Root Lodge | Stalk Lodge | % Harvest Moisture | Test Weight | Harvest Weight | Yield per/Acre @ 14% Moist |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | AgVenture | Tester | 8 | 8 | 672 | | | | 15.3 | 53 | 1,000 | 57.0 |
| 2 | | AgVenture | 330 | 8 | 8 | 672 | | | | 13.7 | 42 | 650 | 41.3 |
| **3** | | **AgVenture** | **377** | **8** | **8** | **672** | | | | **16.5** | **54** | **1,310** | **77.1** |
| 4 | | | Tester | 8 | 8 | 672 | | | | 15.9 | 53 | 930 | 52.6 |
| 5 | | AsGrow | Pulsar | 8 | 8 | 672 | | | | 15.9 | 55 | 840 | 56.9 |
| 6 | | AsGrow | Seneca | 8 | 8 | 672 | | | | 16.4 | 55 | 980 | 64.5 |
| 7 | | | Tester | 8 | 8 | 672 | | | | 15.8 | 54 | 800 | 45.3 |
| 8 | | DeKalb | 36-10 | 8 | 8 | 672 | | | | 15.9 | 53 | 1,000 | 64.8 |
| 9 | | DeKalb | 42-20 | 8 | 8 | 672 | | | | 16.2 | 53 | 1,200 | 75.6 |
| 10 | | | Tester | 8 | 8 | 672 | | | | 15.8 | 53 | 970 | 55.0 |
| 11 | | Fontanelle | 3245 | 8 | 8 | 672 | | | | 14.0 | 42 | 740 | 45.7 |
| 12 | | Fontanelle | 4532 | 8 | 8 | 672 | | | | 16.8 | 55 | 1,180 | 69.0 |
| 13 | | | Tester | 8 | 8 | 672 | | | | 16.1 | 54 | 990 | 55.9 |
| 14 | | GdHarvest | 430 Y | 8 | 8 | 672 | | | | 15.6 | 53 | 1,200 | 68.1 |
| 15 | | GdHarvest | 390 W | 8 | 8 | 672 | | | | 15.6 | 51 | 1,260 | 71.5 |
| 16 | | | Tester | 8 | 8 | 672 | | | | 15.7 | 53 | 1,100 | 62.4 |
| 17 | | Midwest | G 530 | 8 | 8 | 672 | | | | 16.6 | 54 | 1,240 | 66.7 |
| 18 | | Midwest | G 567 | 8 | 8 | 672 | | | | 17.0 | 54 | 1,370 | 73.6 |
| 19 | | | Tester | 8 | 8 | 672 | | | | 15.9 | 53 | 1,060 | 60.0 |
| 20 | | NCt | 5B89 | 8 | 8 | 672 | | | | 15.9 | 54 | 1,140 | 61.6 |
| 21 | | NCt | Y363 | 8 | 8 | 672 | | | | 15.7 | 53 | 1,150 | 62.3 |
| 22 | | | Tester | 8 | 8 | 672 | | | | 15.6 | 53 | 1,100 | 62.5 |
| 23 | | N K | 5418 | 8 | 8 | 672 | | | | 15.7 | 52 | 1,140 | 57.5 |
| 24 | | N K | 310 | 8 | 8 | 672 | | | | 15.8 | 53 | 1,080 | 54.0 |
| 25 | | | Tester | 8 | 8 | 672 | | | | 15.9 | 53 | 1,210 | 68.5 |
| 26 | | Triumph | 460 | 8 | 8 | 672 | | | | 18.1 | 55 | 1,400 | 69.6 |
| 27 | | Triumph | 438 | 8 | 8 | 672 | | | | 17.8 | 52 | 1,220 | 59.9 |
| 28 | | | Tester | 8 | 8 | 672 | | | | 15.9 | 53 | 1,120 | 63.4 |
| 29 | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | |
| 31 | | | | | | | | | | | | | |
| 32 | | | | | | | | | | | | | |
| 33 | | | | | | | | | | | | | |
| 34 | | | | | | | | | | | | | |

# Tree Loss in Windbreaks

**Jim Strine**
**NW District Forester**
**Kansas Forest Service**

Areas in northwest Kansas have experienced high mortality in cedar windbreaks. An insect called the Texas flatheaded borer (Chrysobothris texana) and an unidentified bark beetle have been found in dead and dying cedar trees. However, these insects are not the real cause of the mortality. The extreme dry conditions that we have experienced have put the trees under severe stress. When trees are under stress for any reason such as drought, hail or wind damage, root injury, or old age they are more susceptible to insect attacks.

These insects are not a new pest to northwest Kansas. They are here all of the time, but their numbers are not great enough to cause problems with cedar trees. Healthy trees have natural defenses to ward off harmful insects. For example, when the larvae of a boring insect attacks a healthy tree the tree's sap flow can encase the insect or wash the larvae out of the tree. Drought stricken trees have limited sap flow and do not have the capability to defend against boring insects. As the population of boring insects increase tree mortality becomes more severe.

The best method of controlling these insects is to get the trees healthy again so that their natural defenses can ward off the borer attacks. Irrigating (where practical) is highly recommended and is the most beneficial practice that a landowner can do to the windbreak. Removing dead and dying trees will help reduce the insect population and thinning the windbreak will help reduce the stress on the trees.

Trying to control these insects with chemicals can be very difficult. Two problems must be over come before the chemical treatment can be effective. First, total coverage of the trunk and major branches must occur. It does no good to just spray the foliage of the tree. Also, the chemical must be applied before the newly hatched larvae have time to bore into the tree. This may require more than one treatment per year.

It is very difficult to replace individual trees in a well established or mature windbreak. If just a few trees are dead and no gaps are created, removing the dead trees is advisable. If the mortality is significant to reduce the effectiveness of the windbreak and if there is room on either side of the windbreak, planting one or two additional rows of cedar would be appropriate. Plant the new rows no closer than 25 to 30 feet from the existing tree row.

In some situations, the entire windbreak will have to be replaced. Before replacing the windbreak landowners need to consider the design of the windbreak. A poorly designed windbreak may not provide all of the benefits anticipated by the landowner.

The design of a windbreak depends on the objective of the landowner. For instance, if wind protection is all that is needed two rows of a dense evergreen tree such as eastern redcedar will be adequate. If wind protection and controlling drifting snow are needed, the windbreak should have additional rows. A windbreak consisting of three to five rows of eastern redcedar and deciduous trees and shrubs will provide excellent wind protection and control drifting snow.

The area of protection provided by a windbreak depends on its density and height. Windbreaks can reduce wind velocity to a distance equal to 30 times the height of tallest trees. The most effective area of protection extends to about 10 times the height of the windbreak. For example, if the windbreak is 30 feet tall, good protection can be expected within an area of 300 feet downwind of the windbreak. The greatest wind protection occurs within three times the height of the windbreak. However, this is also the area of greatest snow accumulation. Locating the north or west row of the windbreak 150 feet from the protected area will provide adequate wind protection and allow for snow accumulation outside of the protected area.

Windbreak density affects the pattern of air movement around the windbreak. Wind velocity is reduced as the density is increased and the area protected tends to be decreased. Farmstead and livestock windbreaks should have a density of 60 to 80 percent.

Wind eddies and snow drifts will form at the ends of a windbreak. Therefore, windbreaks should extend at least 100 feet beyond the area to be protected. Any gaps in the windbreak will funnel the wind, eliminating much of the windbreak's effectiveness.

For recommendations on designing, planting, or managing your windbreak, contact district foresters through your K-State Research and Extension office, district conservationist at the USDA Natural Resources Conservation Service office, or district wildlife biologist.

# Direct Drill vs Planter Seeding of Grain Sorghum and Soybean in Semi-Arid Cropping Systems

**R. Aiken, L. Dible and R. Wolf**
*K-State Northwest Research—Extension Center*

## Introduction

Direct drilling of warm-season crops into wheat stubble may offer the advantage of earlier canopy formation. Faster canopy cover by crop would suppress weed growth by shading; also reducing soil evaporation and increasing the crop water use fraction of evapotranspiration. If effective, direct drilling of summer crops would reduce implement requirements and may help justify the investment in no-till drills. Soybean and grain sorghum are good candidates for drilling because of seed size and cost. However, superior emergence percentage and uniformity is expected for seeding with row-crop planters, relative to direct drilling.

## Objectives

1) Determine effects of seeding rates and planting methods on yield of dryland soybean and grain sorghum.

2) Evaluate effects of planting rates and methods on formation of canopy and yield for dryland soybean and grain sorghum.

## Procedures

Grain sorghum (Mycogen 737) was seeded at 1X and 1.5X rates on 5/24/2003 and 5/19/2004. Soybean (Turner) was seeded at 1X and 1.5X rates on 5/22/2003 and 5/19/2004. Plots were established in weed-free wheat stubble. Following planting, glyphosate (Roundup Ultra Max, 24 oz/A) was applied to all plots; soil fertility was amended with 89 – 30 – 0 lb/a N, P, K applied as liquid with injection nozzles at 15" spacing. Pre-emergent herbicide for soybean was a tank-mix application of pendimethalin (Prowl 3.3EC, 3.5 pt/A) and sulfentrazone (Spartan, 3 oz/A); for grain sorghum atrazine (Aatrex 4L, 0.5 lb/A) and S-metolachlor (Dual II Magnum, 1.3 pt/A) were applied as a tank-mix. The row crop planter was a JD 7300 vacuum seeder, equipped with a Yetter 2967 no-till attachment. Direct drilling used a GP 1005 no-till drill, 7.5" drill spacing, with either all drill gates open (solid-seeded), or alternating pairs of gates open and shut (paired-row).

Field observations included weekly emergence and growth stage notes, stand counts after emergence, bi-weekly vegetative cover by NDVI digital photography, bi-weekly leaf area by Li-Cor 2000, components of yield (stand, heads, seeds/head, seed weight) for hand-samples and plot yield by combine.

## Results

Weather conditions (Table 1) in 2003 were drier and warmer than normal, with a particularly hot and dry spell in July, which limited yield formation. Conditions in 2004 approached normal in both precipitation and temperature.

Soybean final stand, from hand-sampling, averaged 66% and 69% of seed drop (Tables 2, 3) in 2003 and 2004, respectively. Grain sorghum population (Tables 2, 4), at harvest, averaged 87% and 102% of seed drop in 2003 and 2004, respectively. Crop stands increased with the 1.5X seeding rates for both soybean and grain sorghum in both years. Seeding with the row crop planter increased soybean stands at harvest, relative to direct drill; stands were least with solid seeding in 2003 and with paired rows in 2004. Planting method did not significantly alter final stands for grain sorghum, though drilled seeding tended to result in numerically greater stands.

The fraction of sorghum plants with emergent heads was reduced for the 1.5X seeding rate in 2003, but no difference was observed in 2004. Planting method did not significantly alter head emergence rates, though data indicate a trend to fewer heads per plant when seeded with the row crop planter.

Seed set (number of harvested seed per plant) decreased for the 1.5X seeding rate for both crops in both years. Planting method altered seed set, generally compensating for differences in final stand. The exception was low seed set for grain sorghum in 2003, when seeded with row crop planter. Seed weight did not differ with planting rate or with planting method for both crops in both years.

Grain yields (hand harvest) differed with planting method. However, results from plot combine are considered more representative due to the larger sampling area. Sorghum grain yields exceeded the NWREC performance test average (11 bu/A) in 2003, but not in 2004 (50 bu/A). Grain harvest by plot combine indicated no significant effect of planting rate on grain yield for either crop in both years. Solid seeded soybean yielded less than soybean drilled in paired rows in 2003; yield of soybean established with a row crop planter was intermediate between the two drilling methods. Soybean yields in 2004 did not differ with planting methods, though solid seeding resulted in numerically greatest yield. Planting methods did not significantly alter yields in grain sorghum in 2003 and 2004 though crop seeded with row crop planter in 2003 was numerically least.

## Summary

Seeding grain sorghum by two methods of direct drill and by row crop planter resulted in similar stand establishment, proportional to seeding rates, in a dry and normal growing season. Seeding soybean by row crop planter resulted in greater final stands than direct drill methods. Differences in seed set generally compensated for differences in final stands, though seed set was significantly less for grain sorghum during the dry year when seeded with a row crop planter. Seeding rates and planting methods did not significantly alter weight of harvested seed. Yields harvested by plot combine were generally similar for seeding rates and planting methods, though soybean yield was greater for the paired row method of drilling, relative to solid seeding method during the dry year, but not different from row crop planter. Results from these experimental conditions demonstrate that direct drilling is a feasible means of establishing dryland soybean and grain sorghum crops in this semi-arid cropping system.

## Acknowledgement

Authors acknowledge the capable contributions of Chris Erickson, Alicia Leavitt, Ivy Ramsey, Nathan Harter, Jennifer Wilson and Dana Inloes in completing this study.

Table 1. Monthly weather conditions in 2003 and 2004 growing seasons at NWREC, Colby, KS*.

| | Precipitation (inches) | | | Average Temperature ($^oF$) | | | Growing Degree Units ($^oF$-day, base 35 $^oF$) | | |
|---|---|---|---|---|---|---|---|---|---|
| Month | 2003 | 2004 | Normal | 2003 | 2004 | Normal | 2003 | 2004 | Normal |
| Nov—Mar | 1.8 | 1.8 | 3.1 | 35 | 35 | 32 | 12 | | 7 |
| April | 2.2 | 2.6 | 1.8 | 52 | 51 | 49 | 534 | 500 | 433 |
| May | 2.3 | 1.1 | 2.9 | 60 | 63 | 60 | 783 | 865 | 770 |
| June | 4.7 | 3.2 | 3.1 | 68 | 68 | 70 | 989 | 997 | 1,063 |
| July | 0.4 | 4.6 | 2.9 | 80 | 73 | 76 | 1,400 | 1,200 | 1,286 |
| August | 3.0 | 1.2 | 2.2 | 77 | 71 | 74 | 1,300 | 1,111 | 1,210 |
| Sept | 0.0 | 2.6 | 1.5 | 64 | 69 | 65 | 869 | 1,017 | 898 |
| Oct | 0.2 | 1.2 | 1.1 | 57 | 54 | 53 | 668 | 620 | 543 |
| Total | 14.8 | 18.2 | 18.6 | 53 | 52 | 51 | 6,555 | 6,310 | 6,210 |

* Source: 2003 and 2004 Kansas Performance Tests with Grain Sorghum Hybrids.

Table 2. Seeding rates and final stands (average of 2003, 2004) for grain sorghum and soybean crop as affected by planting method.

| | Seeding Rate (Seeds/a) or Final stands (Plants/a) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Grain Sorghum | | | | Soybean | | | |
| | 1X | | 1.5X | | 1X | | 1.5X | |
| Planting Method | Seeds/a | Plants/a | Seeds/a | Plants/a | Seeds/a | Plants/a | Seeds/a | Plants/a |
| Solid Seeded | 48,000 | 50,000 | 69,000 | 69,000 | 155,000 | 89,000 | 235,000 | 132,000 |
| Paired Rows | 46,000 | 52,000 | 69,000 | 62,000 | 154,000 | 96,000 | 229,000 | 140,000 |
| Row Crop Planter | 51,000 | 44,000 | 87,000 | 64,000 | 139,000 | 123,000 | 209,000 | 170,000 |

Table 3. Stand and components of soybean yield for direct drill and row crop planter seeding methods at two seeding rates.

| | Population Plants/a | Seed Set Seeds/plant | Harvested Seeds Seeds/a | Seed Weight g/100 seed | Hand-harvest bu/a at 13% | Combine-harvest bu/a at 13% |
|---|---|---|---|---|---|---|
| 2003 | | | | | | |
| Planting Rate | | | | | | |
| Normal | **99,000 a*** | **56.1 a** | 5,500,000 | 9.60 | 20.8 | 13.4 |
| Increased | **147,000 b** | **35.1 b** | 5,200,000 | 10.06 | 20.2 | 14.7 |
| LSD** | 34,000 | 9.2 | | 0.69 | 6.2 | 1.4 |
| Planting Method | | | | | | |
| Solid Seeded | **96,000 a** | **61.2 a** | 5,900,000 | 9.42 | 20.5 | **12.8 a** |
| Paired Rows | 125,000 ab | **43.7 b** | 5,500,000 | 10.05 | 21.5 | **15.0 b** |
| Row Crop Planter | **149,000 b** | **32.0 c** | 4,800,000 | 10.01 | 19.4 | 14.3 ab |
| LSD | 42,000 | 11.2 | | 0.85 | 7.5 | 1.7 |
| 2004 | | | | | | |
| Planting Rate | | | | | | |
| Normal | **110,000 a** | **54.0 a** | 5,900,000 | 12.07 | 27.6 | 21.4 |
| Increased | **152,000 b** | **37.6 b** | 5,700,000 | 11.70 | 25.1 | 21.9 |
| LSD | 20,000 | 14.4 | | 0.94 | 8.0 | 4.0 |
| Planting Method | | | | | | |
| Solid Seeded | 125,000 ab | **66.0 a** | 8,200,000 | 10.66 | **35.9 a** | 23.4 |
| Paired Rows | **112,000 a** | 51.1 ab | 5,700,000 | 11.90 | **23.8 b** | 19.2 |
| Row Crop Planter | **143,000b** | **33.0 b** | 4,700,000 | 12.48 | **22.9 b** | 22.0 |
| LSD | 26,000 | 18.6 | | 1.21 | 10.4 | 5.1 |

*Means followed by differing letters are statistically distinct at the 5% probability level.

**Least Significant Difference; the difference between two means must exceed this value for statistical significance at the 5% probability level.

Table 4. Stand and components of grain sorghum yield for direct drill and row crop planter seeding methods at two seeding rates.

| | Population Plants/a | Heading Head/Plant | Seed Set Seed/Head | Harvested Seeds/a | Seed Weight g/100 seed | Hand-harvest bu/a at 12.5% | Combine-harvest bu/a at 12.5% |
|---|---|---|---|---|---|---|---|
| 2003 | | | | | | | |
| Planting Rate | | | | | | | |
| Normal | **46,000 a*** | **0.85 a** | 902 | 35,000,000 | 2.30 | 36.2 | 31.8 |
| Increased | **58,000 b** | **0.70 b** | 630 | 26,000,000 | 2.25 | 26.7 | 33.4 |
| LSD** | 6,000 | 0.14 | 344 | | 0.19 | 15.4 | 12.1 |
| Planting Method | | | | | | | |
| Solid Seeded | 56,000 | 0.86 | 917 ab | 44,000,000 | 2.21 | **42.1 a** | 35.9 |
| Paired Rows | 51,000 | 0.85 | **1,080 a** | 47,000,000 | 2.17 | **43.0 a** | 33.5 |
| Row Crop Planter | 50,000 | 0.69 | **510 b** | 18,000,000 | 2.36 | **19.3 b** | 28.4 |
| LSD | 8,000 | 0.18 | 440 | | 0.25 | 19.7 | 14.8 |
| 2004 | | | | | | | |
| Planting Rate | | | | | | | |
| Normal | **50,000 a** | 0.96 | **1,372 a** | 66,000,000 | 1.69 | 49.0 | 39.1 |
| Increased | **72,000 b** | 0.96 | **1,099 b** | 76,000,000 | 1.58 | 48.7 | 44.0 |
| LSD | 10,000 | 0.22 | 186 | | 0.13 | 9.3 | 6.5 |
| Planting Method | | | | | | | |
| Solid Seeded | 64,000 | 0.99 | **1,380 a** | 87,000,000 | 1.68 | **57.9 a** | 40.7 |
| Paired Rows | 62,000 | 0.93 | 1,317 ab | 76,000,000 | 1.70 | **55.7 a** | 43.8 |
| Row Crop Planter | 59,000 | 0.97 | **1,122 b** | 64,000,000 | 1.58 | **40.9 b** | 40.9 |
| LSD | 13,000 | 0.29 | 240 | | 0.17 | 12.0 | 8.4 |

*Means followed by differing letters are statistically distinct at the 5% probability level.
**Least Significant Difference; the difference between two means must exceed this value for statistical significance at the 5% probability level.

## Corn or Grain Sorghum for Dryland Production in Kansas?

B. Gordon, S. Staggenborg, and R. Vanderlip

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## Grain Sorghum in North Central Kansas

In the mid-1990's grain sorghum acreage dropped. Dryland corn production expanded.

1) Above normal rainfall pattern.
2) Corn production allows for earlier planting.
3) Government programs and Insurance coverage favor corn over sorghum.
4) Improved herbicide options, and perceived superior genetics of corn hybrids.

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## Corn vs. sorghum – Outline

- Direct comparisons
- ET versus yield relationships
- Performance Test Yields
- Economics

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**Corn- Grain Sorghum Comparison, Belleville and Manhattan, KS**

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## *Treatments*

- 2 Sorghum hybrids (NC+ 7R83 and DK 47 at Belleville; P 8505 or NC+7R37 and P 84G62) at Manhattan
- 2 Corn hybrids (NC+5018 and Pioneer 34K77)
- N-Rates (0, 40, 80, 120, 160 lb/acre)

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## Grain Sorghum/Corn Comparison, Belleville 2000-2003

- *Grain Sorghum*
- **Previous Crop: Wheat**
- **Tillage: None**
- **Planting Date: Mid-May**
- **Seeding Rate: 62,000 seed/acre**
- **Final Stand Avg: 48,000 plants/acre**
- **Harvest : Sept 15, Oct 3, Oct 12, Oct 22.**

- *Corn*
- **Previous Crop:Wheat**
- **Tillage: None**
- **Planting Date:Early April**
- **Seeding Rate: 24,000 seed/acre**
- **Final Stand Avg: 21,500 plants/acre**
- **Harvest : Sept 11, Sept 28, Sept 10, Sept 23.**

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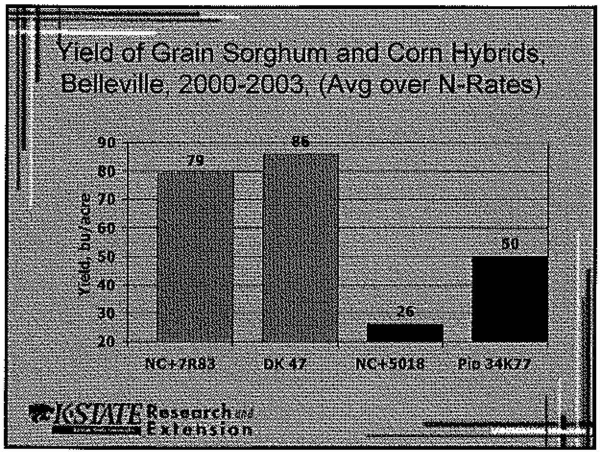


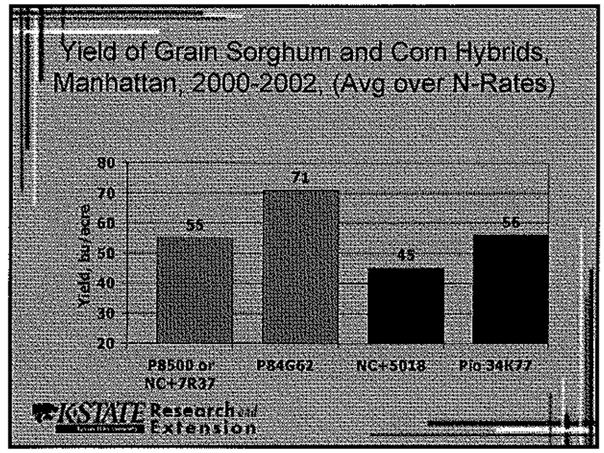


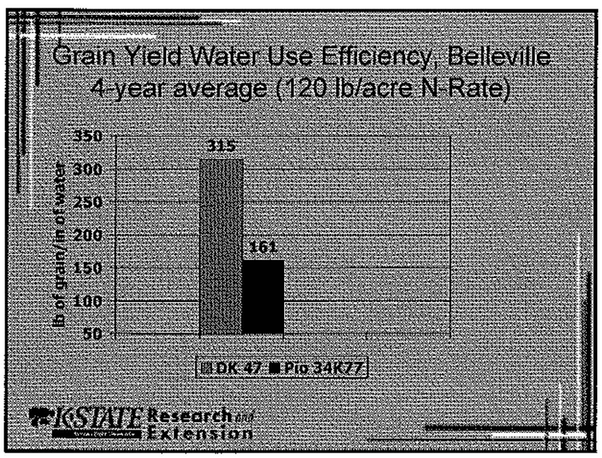


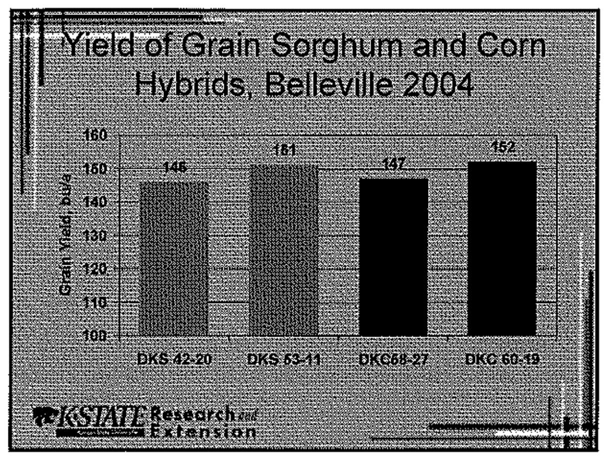


## Yield of top 5 hybrids in 2004 Performance Tests

| Crop | Republic | Nemaha | Riley | Average |
|---|---|---|---|---|
| Corn | 134 | 195 | 216 | 182 |
| Grain Sorghum | 127 | 195 | 178 | 167 |

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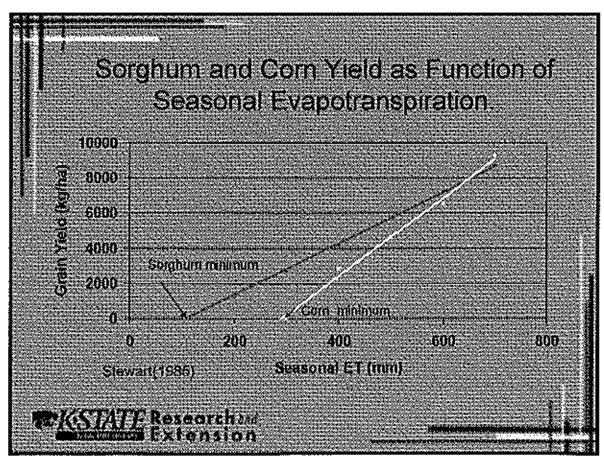
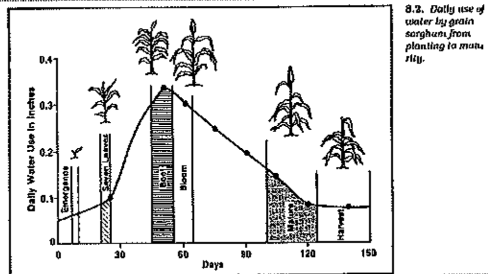


## Crop Water Use

| Crop | Seasonal Water Use, Inches | Daily Water Use, Inches | WUE (lb of yield/inch of water) |
|---|---|---|---|
| Corn | 25 | 0.19 | 335 |
| Sorghum | 21 | 0.19 | 325 |
| Soybeans | 23 | 0.19 | 138 |
| Sunflower | 22 | 0.25 | 105 |

Hattendorf and Stone, 1988

## Grain Sorghum Water Use




## Water Deficit Effects on Yield of Grain Sorghum

| Growth Stage | % Yield Reduction Due to Soil Water Deficit |
|---|---|
| Late vegetative to boot | 17 |
| Boot through bloom | 40 |
| Milk through soft dough | 10 |

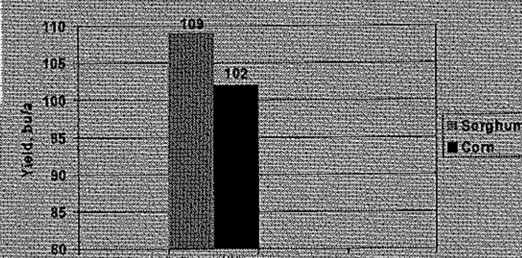
## Summer Rainfall Frequencies for Belleville Field, 1942-2003. (average 12 in.)

| Rainfall as % of Total | Rainfall, inches | Number of years | Percent of Years |
|---|---|---|---|
| <40 | <4.8 | 2 | 3.3 |
| 40-60 | 4.8-7.2 | 6 | 9.8 |
| 60-80 | 7.2-9.6 | 9 | 14.8 |
| 80-100 | 9.6-12.0 | 16 | 26.2 |
| 100-120 | 12.0-14.4 | 15 | 24.6 |
| >120 | >14.4 | 13 | 21.3 |

## Yield Projections for Belleville, KS

| Rain, % of Average | Sorghum, bu/acre | Corn, bu/acre |
|---|---|---|
| 40 | 21 | 0 |
| 60 | 39 | 17 |
| 80 | 59 | 45 |
| 100 | 85 | 78 |
| 120 | 110 | 115 |

## Corn vs Sorghum, 35 site years
Manhattan, Belleville, South Central, Southeast Neb.



## Base Assumptions for Economic Analysis

- Sorghum cost*- $193.78/a
- Corn cost- $230.44/a
- Sorghum price**- $1.89/bu
- Corn price- $2.02/bu
- Government payment $15.27

*Costs include land, labor, machinery, and production costs.

**Prices based on projected prices for next five years, price ratio=93.6%

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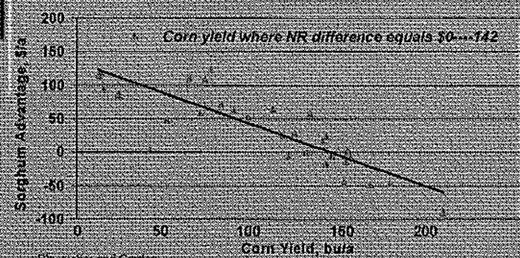
## Grain Sorghum-Corn Economic Comparison

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## Summary

- Only when summer rainfall is above normal does corn have a yield advantage over sorghum.
- Under dryland conditions, grain sorghum water use efficiency is better than corn.
- Grain sorghum is an excellent risk management tool. It offers more stable yields under variable rainfall conditions.

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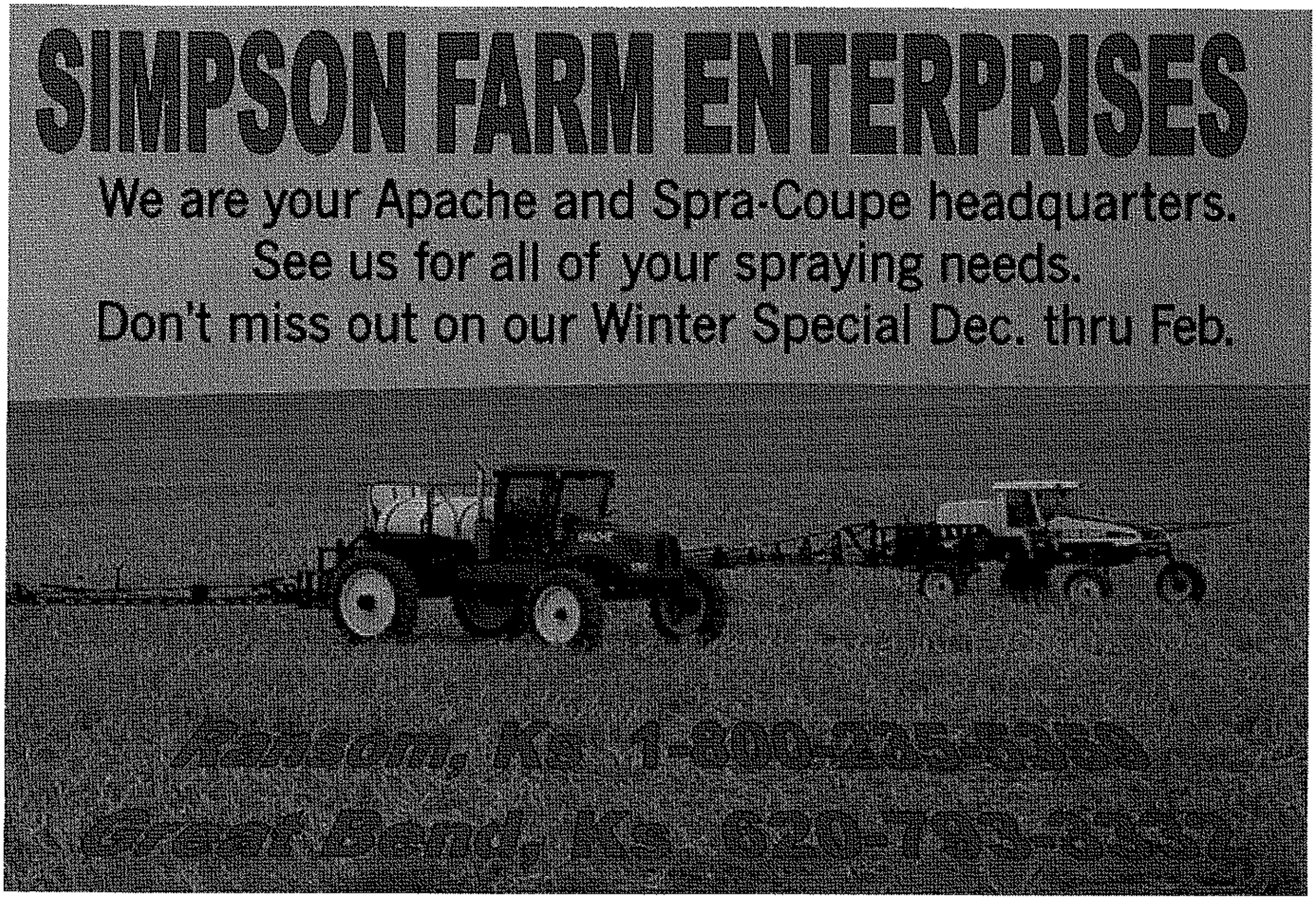
**Additional contributions provided by Sigco Sun and Red River Commodities**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