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No·till On The Plains

His Chosen Path

by Roger Long

If it ain't broke, don't fix it, but if it is, don't wait for tomorrow—Rod Peters seems determined to figure out what is needed, and get on with it. Rod has farmed nearly all his life on a family operation south of Hillsboro, KS, and like most kids growing up on a farm in the '60s and '70s, he learned to farm with methods typical of the day, such as cropping with tillage. Then, when necessity met opportunity in 1995, Rod made a wholesale switch to 100% no-till. It was in the summer of '95 that his father and uncle, whom he had farmed with since graduating from K-State in 1976, had made the decision to retire due to their both having Parkinson's Disease. That same summer, a local Extension meeting was touting the benefits of no-till. The system *was* broke, and this farmer was ready to fix it! Peters hasn't tilled a field since.

Peters also faced the fact that he was losing productivity on his Rosehill and Clime (high clay) soils, primarily due to water erosion on his sloping fields from the extremely slow infiltration rates of those soils when tilled or bare. Rod notes that even with no-till, it is a struggle to keep the more sloping fields from eroding. "These fields lost way too much soil when they were being tilled—I can't afford to lose any more. . . . My soils are very thin. I still hear an occasional 'clang' as planter openers hit rock." You see, Rod farms on the edge of the Flint Hills. These hills are famous for their grasslands—not their deep productive soils. Peters has limestone outcroppings and gravelly areas throughout many of his fields. It is not uncommon to have only


Photo by Roger Long.

Rod Peters' wheat gets a good start for '05.

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20 inches of soil before reaching bedrock, making the total water-holding capacity extremely low. These soils are inherently shallow—couple that with 100-plus years of tillage on considerable slopes, and one can see why no-till was a 'must' if Rod was going to continue to grow crops on those acres.

No-till appeared as though it would cure many ills on Peters' farm in '95. The idea of fewer hours spent in the field, plus the soil conservation attributes, was just what Rod needed. "I saw three major issues I was facing: a need for better soil preservation, my labor force, and the need for increased expertise in agronomy." Back in '95, Rod, his father, his uncle, and two high-school-age summer employees, were one skilled year-round employee, and himself. Rod says, "Now, there's just the three of us—me, myself, and I." But he still farms the same number of acres, plus the cow/calf herd. As the hired labor went away, so did the hogs (funny how that works). Rod's two sons help for a few hours here and there, as does one neighbor, but it's almost literally a one-man show.

After delving into Peters' situation, it becomes apparent that no-till is not just a better way to farm, but—for Rod—the *only* system that could have ever had a chance to work. To shrink the labor force that drastically, some tasks had to be eliminated, and more outside expertise hired. From the beginning of his transition to no-till, Rod has had a

Photo by Rod Peters.

Rod's planter in the spring of '96, planting corn in wheat/dc sunflower stubble. The planter has two completely separate liquid fertilizer systems. The planter has further been modified with row cleaners, Keetons, and a spoked closing system. Despite the improvements and attention to adjustments and other details, getting consistent emergence percentages in Rod's high-clay soils is quite a challenge.

the labor force for a farrow-to-finish swine operation, a feedlot for backgrounding calves, a small cow/calf herd, and 1,500 acres of cropland. With his father and uncle retiring, the most skilled part of the labor force was shrinking by 2/3—that was a major problem. With the conversion to no-till, Rod was able to shrink the total workforce from 5 people to two—with the hiring of consultant hired to supply advice on various crop production questions. Accounting and marketing services are also hired, and field operations were streamlined.

Peters does all his own harvesting, including storing all grain on-farm, all spraying, seeding, and tendering product to those machines—and the planter with two blends of liquid

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No-Till on the Plains Inc's Mission: To assist agricultural producers in implementing economically, agronomically, and environmentally sound crop production systems.

Objective: To increase the adoption of cropping systems that will enhance economic potential, soil and water quality, and quality of life while reducing crop production risks.

fertilizer, no less! One might wonder how does one guy do all this? Rod points out that he does have the convenience of having most of his acres within a four-mile radius of his farmstead, but many additional steps have been taken to increase efficiency. Upsized grain augers for fast harvest-time unloading help make up for lack of personnel. And, employment of ingenuity takes the place of bodies as Rod uses his 4-wheeler with home-built hitch to pull behind whatever is going to or from the field. Rod also spends the necessary time in the winter months servicing and making numerous upgrades to keep everything working smoothly during crunch time.

What Peters accomplishes over the course of a year is even more astonishing given a few other details. For instance, he hays over 100 acres of waterways for cattle feed, and his largest field is only 120 acres. Few fields have more than one straight headland, and what they lack in straight edges they make up for in miles of terraces. Because of no-till, he can now plant up and over most terraces instead of following contours as was once done.

Photo by Roger Long.

Peters' corn stalks, plentiful in a good year like '04. The waterway is one of many dozens on Rod's farm in the rolling limestone hills of Marion County. After 9 years of continuous no-till, Rod appreciates the soil improvements and productivity gains—he looks forward to the day when everyone understands that value, and land prices reflect it.

What Makes It Go

After nine years of continuous no-till, Rod will tell you that no-till is not so much a beginning or end, but rather a path you take. Crop sequence, cover crop management, fertility placement, herbicides, and many more components are continually refined as he better understands his surroundings on this new path.

Once Rod made that fateful decision to switch to no-till in '95, he quickly began selling unneeded iron and diesel drinkers. Gone are two tractors and the typical inventory of tillage tools, replaced with a Spra-Coupe and newer equipment. With lots of labor, Peters would run three rather dated combines. The rules had changed, so in '96 all three were traded on a used JD 9500 combine. Rod also seized the opportunity to convert much of his tillage equipment into no-till-friendly tools via trades with equipment dealers. He upgraded to a new 6-row planter, and traded his 30-foot min-till drill for a 15-foot 750 no-till drill. When all the buying, selling, and trading was done, Rod had reduced his machinery overhead by more than $30,000, and he was now running better equipment.

Peters' switch to no-till let him pare his labor force from 5 to 1, and shave $30,000 from his machinery line-up.

The diversity of crops afforded by no-till also helps Rod by scattering his planting and harvesting times across more calendar months. Peters' rotation is flexible but follows general principles. A soybean >>wheat >>wheat/dc soy >>corn (or milo) >>corn (or milo) is his standard but he has some variations which are sometimes used to combat certain problems (weeds) or take advantage of opportunities (residual nitrate). Rod closely follows some sequencing rules. "Corn planted into soybean stubble plants real nice and gets up great, but I rarely do it because there isn't enough residue to provide mulch for moisture retention to get us through July and August." Corn typically goes into wheat stubble, and stacked corn is common. Soybeans are rarely stacked due to the lack of residue for soil protection—because of his very thin soils, Rod must be diligent about maintaining both high levels of residue across his fields as well as functional terraces. Wheat is either planted into soybean stubble or stacked behind wheat. Two years of milo are sometimes grown instead of corn (in the absence of shattercane) and occasionally a year or two of milo is grown *following* 2 years of corn.

Time of harvest and soil moisture determine whether soybeans or milo will be double-cropped after wheat harvest, or whether a cover crop gets planted into the stubble. Those choices are made in light of future

Photo by Matt Hagny.

In Peters' system, wheat stubble is commonly seeded to double-crop soybeans or milo, or to cover crops.

rotational plans for that field. Rod will sometimes plant corn into double-crop milo stubble but has noticed severe allelopathic effects of the milo residue on the corn. "Where I'm using 15-inch rows on milo, it's hard to plant corn far enough away from an old milo row. If you can split an old 30-inch row, it really minimizes the effect." Rod regularly puts his cow herd onto stalks during winter months. Peters has noticed that the allelopathic effects of sorghum stubble can be minimized by putting some of that stubble into a cow, but he exercises care so as not to remove too much residue and create an erosion problem. Normally, fields double-cropped to milo will go to milo for another year or two, then to soybeans, thereby avoiding the allelopathy problem entirely. The double-crop milo to corn issue only arises when the level of shattercane in a field is misjudged.

Peters has also had volunteer wheat harbor chinch bugs that then became a problem for his seedling corn crop. The volunteer wheat wasn't killed earlier because Rod thought it had value for grazing his cows (this was done over the stern objection of his agronomist, albeit for other reasons). As the chinch bugs wrecked a considerable amount of corn in that field, keeping the volunteer was 'penny-wise and pound-foolish.' Rest assured, Peters has duly noted the mistake and will have care not to let it happen again.

Peters has a keen mind for problem-solving, and tries to learn the lessons his fields are teaching. Seeing a potential fix for soggy wheat stubble, Peters experimented with and now regularly plants cover crops for different management goals. Mung beans have been used for forage and added mulch for corn following wheat, and also to keep fields from being waterlogged between stacked wheat crops. Peters has also used sunn hemp between stacked wheat crops, and sometimes cowpeas for hay following the second wheat crop. Getting adequate inoculation on some of those species has been a problem, Rod notes, since the bacterial species needed is different from what colonizes soybean roots. An additional 'watch out' is weeds in cover crops—Rod has sometimes had weeds go to seed before the cover crop was killed with herbicides.

Finding the Answers

Rod plants most of his milo and all of his soybeans in 15-inch rows by locking up the front set of openers on his JD 750 drill (yep, it's still going after 9 years and 14,000 acres). The planter is used primarily for corn. Whether using the drill or planter, everything (except soybeans) gets a dose of 10-34-0 fertilizer in the furrow: 10 gal/a on wheat, and 5 gal/a on milo and corn. Corn also gets 28-0-0 applied in a 3x0 with the planter (sometimes with additional P and/or S blended in), so Rod is currently applying his total fertility program for corn with the planter.

The nitrogen for Peters' milo generally comes in the form of dry urea, which he tries to get applied to the milo right before a rain. "Lately, we've been applying most of the urea to milo after emergence." Applications are made with a floater, so milo does get run down, but Rod has found that if they wait till the milo is six to ten inches it readily

Peters on no-till networking: "You need to know what questions to ask."

Photo by Rod Peters.

Soybean harvest on Peters' farm.

Photo by Roger Long.

A dense carpet of residue makes Rod sleep better at night, and this seedling wheat doesn't mind a bit.

bounces back—go too soon and the tender seedlings get crushed severely and die. Wheat gets urea anytime between mid-March and early April. The later application on both milo and wheat minimizes nitrogen loss (via the process of de-nitrification), which was a major problem for Rod back when he was making wintertime applications of N. Peters' soils get waterlogged much too easily, and delaying the application until the crop is using more water minimizes the N loss problem.

Peters' fertilizer rates and other decisions are based on 65 bu/a as a wheat goal, 90 bu/a milo, 110 bu/a corn, and 40 bu/a soybeans. The '04 harvest netted him some very nice summer crops with yields exceeding his management goals. On soils this thin, Rod considers the results to be acceptable, and a welcome change from the four previous years of severe drought and low yields.

Rod continually strives to further refine his crop input decisions—with frequent hybrid plots and various population and fertilizer studies, but he defers to his consultant to get more useful multi-year multi-location information. With such thin soils dominating his farm, the perennial question from Rod is, "Can I get by with less?" With such extremes of high and low yields, a steady hand is needed.

Peters is no slouch in other areas of management, either. Rod regularly forward contracts up to 40% of his expected yield as much as one year in advance. He utilizes a marketing alliance that also provides trucking grain off the farm. The Bartel & Peters operation has been in K-State's Farm Management since that program's inception in the early '70s, and Rod thoroughly analyzes those cost figures. He crunches through the insurance choices. The dollars are watched very closely.

Recognizing the many positives Rod has seen on his farm, he actively promotes no-till to anyone with an ear. Peters currently serves on the No-Till on the Plains board of directors, and is involved locally too: "I've hosted the Marion County no-till field day five different summers." Rod knows he benefits from the networking: "I don't know any no-tillers who try to keep a secret—it's not a selfish group. . . . [but] you do need to know what questions to ask."

Peters truly does enjoy the journey of no-till, and sharing that journey with others. His sense of adventure was perhaps galvanized as a young man—when choices and circumstances dropped him into Brazil for 27 months as part of a Peace Corps-type organization (the Mennonite Central Committee). He had to learn Portuguese, to gain the respect of the locals, and to look out for himself in the tumultuous streets. "I learned a lot of respect and admiration for anyone trying to learn a second language beyond childhood. And respect for other cultures is something you learn while in other countries. It gives you the mindset of acceptance—acceptance of something very different. Maybe that acceptance let me adopt no-till sooner." If so, it has indeed been quite a journey.

KDHE (whose funding helps support No-Till on the Plains, Inc. and *Leading Edge*) admires Rod Peters' efforts to keep the soil in place and out of the streams.

Controlling Tough Grasses in No-Till

Courtesy of The Samuel Roberts Noble Foundation, Ardmore, Oklahoma.

Prairie cupgrass is an annual, although it can tiller enough in a season to give it a clumpy appearance.

Tumble windmillgrass, prairie cupgrass, and threeawn are some of the more challenging grasses to control on the southern plains. While none are terribly prolific, these "go-back" grasses may come to dominate a field's weed spectrum if given the opportunity. The farmer's job is to deny them that opportunity. Here's a closer look at each, including their vulnerabilities.

Prairie Cupgrass (*Eriochloa contracta*)

Prairie cupgrass is an annual, germinating over a long period during spring and summer—much like foxtails and crabgrass. The major difference is the susceptibility to glyphosate: if you've done lots of low-rate glyphosate (16 – 24 oz of 4 lbs/g active ingredient, a.k.a. 3 lbs/g acid equivalent[1]) in the past, you've probably eliminated lots of the more easily killed species and allowed the cupgrass to proliferate. Some fields may have a predominance of cupgrass for other reasons—this species may be slightly more tolerant of drought, poor soils, etc. than are some of the other summer annual grasses (green and yellow foxtail, crabgrass, etc.).

Control of prairie cupgrass can be accomplished with higher rates of glyphosate (40 to 64 oz), which can be especially effective if the cupgrass is not extremely stressed from heat and drought. Great Bend, KS producer Kevin Wiltse has done battle with cupgrass on many occasions, and reports good success with tank-mixing grass herbicides (Select, Assure, etc.) with glyphosate either as burndowns or post-emerge in RR soybeans. Note: these grass herbicides have some minor soil residual which has the potential to adversely affect germination of grass crops such as milo or corn; therefore, this tankmix program is best suited to preplant situations for broadleaf crops such as sunflowers, or when planting of the grass crops will be delayed to allow the grass herbicide to degrade—a week or two is sufficient for many of these products, but check the label or consult with a knowledgeable sales rep. According to Pat Geier, K-State weed scientist at Hays, 8 oz of Select alone post-emerge in sunflowers works good on prairie cupgrass, and is their "standard treatment." For glyphosate alone, Geier's research has shown 48 oz to be reasonably consistent. Geier concurs with Wiltse that the tankmixes of Select and glyphosate are very good on cupgrass.

Wiltse: "The guys having trouble with cupgrass are the ones doing chem-fallow."

In milo or corn, prairie cupgrass can be controlled with pre-emerge applications of most acetamides (e.g., Bicep, Guardsman), although the rate may well need to be higher than for the more easily controlled foxtails and crabgrass. According to Geier, the acetamides are effective on cupgrass, although at slightly higher rates than what are needed for controlling barnyardgrass or stinkgrass, which in turn require a bit more than foxtails or crabgrass.

Courtesy of The Noble Foundation.

Prairie cupgrass seed head. The seeds shatter easily as they mature, sometimes with the upper seeds already fallen while the lower seeds are still green.

[1] All rates of glyphosate in this article refer to this concentration, which is found, for example, in the 'old' Roundup and Roundup Ultra, GlyphoMax, Touchdown IQ, Glystar Plus, etc.).

Cupgrass seeds remaining on the soil surface do not appear to have great longevity. Shallow tillage or high-disturbance openers favor cupgrass by planting the seeds. Kevin Wiltse has cleaned up entire fields of prairie cupgrass in his pure no-till system, albeit with methods that rely heavily on crop competition to keep the troublesome weeds in check: "Driving around the area, some fields are totally infested with cupgrass, but from what I've seen, the guys having trouble are the ones doing chem-fallow instead of soybeans like we're doing." Wiltse is also attentive to ensuring the cupgrass rarely if ever goes to seed in his fields.

Tumble windmillgrass (*Chloris verticillata*)

This native perennial is very short in height and easily escapes notice—until it forms a dense mat. The seed heads tumble with the wind, so seed is frequently brought in from field borders, ditches, and neighboring grasslands. It may become prevalent in alfalfa fields after several years.

The best bet is not to allow this species to establish in your fields. It is slow growing, but tougher to kill once established. Considered a warm-season grass, it starts to green up relatively early in the spring and may produce a seed head anytime from May to October in Kansas. It dislikes being shaded, so dense crop canopies help control. Windmillgrass is rather shallow-rooted, and is greatly disadvantaged if aggressive crops such as sunflowers can get established, and even corn and milo can provide decent suppression. Heavy wheat stubble will also block enough sunlight to inhibit windmillgrass. Where windmillgrass is allowed to become a solid mat, getting the crops established without interference from the windmillgrass can be a challenge.

Herbicidal suppression or control of windmillgrass can be obtained with substantial rates of glyphosate (48 – 64 oz), and again a grass-herbicide tankmix such as Select greatly improves results. However, Jack Schmitt of Scott City, KS reports killing windmillgrass with two sequential glyphosate applications (32 & 20 oz) in RR soybeans, as well as pre-emerge in milo with similar rates. Great Bend producer Randy Schwartz also describes killing windmillgrass relatively easily with glyphosate in mid-summer (typically 32 oz rates), especially with sequential applications. Consultant Matt Hagny reports similar experiences from the Great Bend area and to the north and east. However, some consultants and researchers—especially in the drier regions—indicate their results are more erratic with those 'low' rates of glyphosate. The key may well be the timing, with mid-summer and fall applications being better than late spring or early summer. Geier reports that dry weather following application helps control, whereas a rain may revive some of the stolons. Since windmillgrass is a perennial and active well into the fall, it is possible that late summer applications of high rates of glyphosate or glyphosate + Select will prove to be highly effective (we know of no research or other experiences to answer this; however, many perennial species are much more effectively controlled with herbicides in the fall as opposed to the spring).

Acetamides and most other soil residual herbicides are largely ineffective against established windmillgrass, although Geier thinks that these products prevent many windmillgrass seedlings from establishing. If you have established windmillgrass, delay planting milo long enough to take a swing at the windmillgrass with glyphosate or glyphosate + Select. Not many decent choices are available in corn, either, except for using RR corn. In a broadleaf crop such as sunflowers, using substantial rates of post-emerge grass herbicides can be useful.

Windmillgrass is common on the edges of Wiltse's fields, but poses no real threat despite 7 years of low-disturbance no-till: "Competition is the key to the whole deal."

This may well be an instance where preventing the problem is far easier than curing it—don't let the windmill-

Photo by Matt Hagny.

Clumps of tumble windmillgrass have established on the edge of this field. The vegetative part of the plant is only a few inches tall, and often escapes notice until it forms a sizeable mat. The seed head is a distinctive feature for this species. (In this photo taken in late fall, the windmillgrass clumps are dried up—the green vegetation is seedling wheat.)



Photos by Charles Butterfield, Chadron State College, Neb.

Purple (red) threeawn is a perennial found in eastern Colorado, where it frequently invades no-till fields from adjacent grasslands.

grass get bad before taking action. Troublesome weeds are much more economical to address on field borders than on whole fields. And crop competition will be one of the most effective weapons in both the prevention and the cure. Wiltse notes that windmillgrass is common on the edges of some of his fields, but poses no real threat to him despite 7 years of low-disturbance pure no-till: "[The windmillgrass] never gets any worse. . . . I think we'd have problems without the soybeans. Competition is the key to the whole deal."

Red or Purple Threeawn (*Aristida purpurea*) & Prairie Threeawn (*Aristida oligantha*)

In still more arid regions, such as eastern Colorado and far western Kansas, threeawn becomes a significant factor. This warm-season native perennial is also quite slow growing, although it gets taller than windmillgrass by a considerable margin. Threeawn grows in isolated clumps typically, with very slender leaves. It produces relatively little seed and invades rather slowly.

Established threeawn may be controlled in the summer with hefty glyphosate rates, such as preplant for sunflowers and milo. For corn, the best choice is Roundup Ready. In sunflowers, Select appears to have some value. Again, acetamides won't do much to suppress established threeawn.

Knocking Out Perennials

There is a time and place for low rates, just as there is for high rates. The cost of high rates or additional tankmix ingredients once every so often to knock out tough species is trivial compared to the true costs associated with one tillage pass. Most of the region with these tougher species is acutely and persistently short of moisture—*any* tillage adversely impacts moisture storage capabilities of a soil for many years following that disruption. And if the farmer periodically buries the weed seeds from the soil surface, plus stirs up old ones from below, this will ensure those weed populations continue to do well in those fields.

Cropping strategies should be devised to limit the ability of perennial species to establish, since the seedlings are much more vulnerable than the older plants. Improved crop competition with narrower rows and practices that produce vigorous crop canopies will help tremendously. Reducing fallow periods can be another tactic to let crops do more of the suppressing. Stresses multiply, and if the unwanted perennial is subjected to intense competition for sunlight and nutrients, as well as having to survive the usual diseases, insects, and tough winters—then the herbicides need only weaken that plant a bit more to send it on its way. Wiltse understands the secret: "Summerfallow is a train wreck waiting to happen. The nutsedge flourishes [as do the other tough weeds]. I'd rather have soybeans, sunflowers, oats for graze-out—*anything* but fallow."

Jack Schmitt of Scott City, KS reports killing windmillgrass with two sequential glyphosate applications (32 & 20 oz) in RR soybeans, as well as pre-emerge in milo with similar rates.

2005 Winter Conference

Another blockbuster event is scheduled for Jan. 24-25th in Salina, KS with highlights from Dwayne Beck, César Belloso ("the Dwayne Beck of Argentina"), soil ecologist Jill Clapperton, Kevin Wiltse, Dan Forgey, David Gillen, Tony Kodesh, and many others.
See you there!

Cropping Strategies in Semi-Arid Climates

by Dwayne Beck

TECHNIQUE

Dwayne Beck is manager of Dakota Lakes Research Farm at Pierre, SD.

In the not-too-distant past, tillage-based cropping systems in the U.S. Great Plains and Canadian Prairies relied heavily on relatively long fallow periods. In southern winter wheat >>summerfallow systems, the time from harvesting one wheat crop until the next one was seeded and had grown enough to cover the soil surface was 14 to 17 months. In the northern spring wheat >>fallow areas, the time period was 20 to 21 months. These long periods were necessary because of the staggering inefficiency in water storage associated with the large number of tillage passes normally used. Although they were very inefficient in water use, the long-fallow systems were profitable for many years. This profitability was related to the fact that the soils were initially rich in organic matter, and fuel, labor, and machinery were relatively cheap. In reality, two types of stored energy (fuel and soil organic matter) were being mined to produce these profits.

Circumstances have changed. Much of the easily decomposable organic matter has been mined from U.S. soils. Labor and land costs have risen appreciably. Most producers are looking strongly at alternatives to both tillage and long fallow periods but are not certain how to make the changes. A better understanding of soil moisture cycles and cropping strategies should help the producer in evaluating the choices available.

What Tillage Did

In order to intelligently talk about replacing tillage and long fallow periods, it is helpful to recognize the synergism these two had in traditional systems. There are several reasons producers used tillage-based long fallow periods. Primary among these was the fact that it normally provided sufficient moisture to establish a winter wheat crop (if the hoe drill could go deep enough, and the wheat variety could emerge from that depth). As stated previously, black fallow was tremendously inefficient at storing water but what little was stored was there at the critical crop establishment time for winter wheat. Getting a good stand in the fall was important both for yield and to keep the black fallow from blowing during the winter.

An important role played by tillage in the long-fallow systems was wasting water.

Tillage played additional roles in these systems. It accelerated the decomposition of soil organic matter by adding oxygen to the soil and by breaking large soil particles into smaller ones. This is like stirring a fire (fire without visible flames). A consequence is that the organic matter decomposed more quickly than it normally would and made more nitrogen available for use by the subsequent crop. In the era before commercial nitrogen fertilizer was available, this was the simplest way of furnishing the crop with this nutrient. Farmers in more humid areas grew legume crops to produce nitrogen. There was not enough moisture in semi-arid areas to grow green manure crops *and* do tillage. There sometimes was enough to do one or the other, but not both. Tillage was the obvious choice until quite recently.

Tillage also increased the speed at which residue-borne crop diseases were cycled. Some diseases were made worse by tillage, but the ones that survived as resting phases on plant residue and in the soils were decreased by tillage.

Many weeds reacted similarly. Multiple tillage passes over 14 to 20 months made it difficult for many weeds. There were exceptions such as wild oats in the North and cheatgrass and goatgrass in the South. Buckwheat, kochia, and various mustards also found a home. Weeds like field bindweed and quackgrass actually seemed to like the tilled-fallow systems. But, in general, if the producer did enough tillage in the proper way, many weeds could be controlled.

The last important role played by tillage in the long-fallow systems was wasting water. That may seem like a negative, but if fallow periods were going to remain long, water needed to be wasted. If the water wasn't

Photo by Matt Hagny.

Highly profitable no-till wheat can be achieved even in semi-arid regions, but the rotational practices to get there are not obvious.

Photo by Brian Lindley.

Beck explains rotational effects during one of many tours of Dakota Lakes Research Farm.

wasted, excess moisture would cause a myriad of problems with diseases, nutrient loss, and soil degradation.

Effects of Reducing Tillage

The first experiences of many producers with reduced- and no-till systems were dramatic failures because they changed tillage without changing other aspects of the system. They had to find other ways of doing the things tillage was doing in the old system.

The ecofallow system was somewhat successful but it still used fairly long fallow periods and created opportunities for weeds like yellow nutsedge, tumble windmillgrass, cupgrass, foxtails, and sandbur. However, it did balance moisture storage and usage for this region.

The first research that started to focus on alternative approaches was the "ecofallow" work done in Kansas and Nebraska (both states claim they were first). I do know that Gail Wicks (one of the researchers) was born and raised in South Dakota. Maybe we should claim rights. The original ecofallow concept was to replace winter wheat >>summerfallow systems with winter wheat followed by no-till grain sorghum and next a minimum-tillage fallow. This approach did several things. The sorghum added a deep-rooted crop to take advantage of moisture (and nutrients) that would not have been used in a traditional winter wheat >>fallow program. Sorghum (or corn) also allowed the use of atrazine for weed control. This long-residual product controlled many weeds for the sorghum year and also carried over to help with weed control during the fallow year. This reduced the number of tillage passes needed. The fact that sorghum was planted in late May and used water late in the summer meant that a single long fallow period (14 – 17 months) was being replaced by two shorter fallows (around 11 months each in Kansas). Any time a crop is not growing, we consider it to be a fallow. The diversity added by including sorghum in rotation created a longer interval between wheat crops. This reduced disease pressure and increased wheat yield. Since tillage was used between the sorghum and winter wheat crops, the farmer was still seeding wheat in the same manner as in the past. He did have to use some sort of no-till planter for the sorghum. Two crops were harvested every three years instead of one in two years. That was good also. There is not a great deal of difference between the (average annual) amount of fallow time in the two systems. The difference is when these periods occur.

The ecofallow system was somewhat successful but it still used fairly long fallow periods and created opportunities for weeds like yellow nutsedge, tumble windmillgrass, cupgrass, foxtails, and sandbur. One thing the ecofallow system did was balance moisture storage and usage for this region, much like its predecessor, the wheat >>fallow system. The ecofallow system stored more water by retaining the wheat stubble, but the deeper rooting and summer growth pattern of the sorghum (or corn) used more, keeping an approximate balance.

With no-till, the fallow period ahead of winter wheat can and should be reduced.

Transitions in No-till: Alternatives to Summerfallow

If the producer desires to complete the shift begun by ecofallow and reduce tillage further (to zero), the crop extraction must again be increased to balance the additional water being stored. With no-till, the fallow period ahead of winter wheat can and should be reduced, within limits. Finding rotations with the proper lengths of fallow periods for a particular set of soils and rainfall probabilities is imperative, even if the appropriate crop sequences are not immediately obvious.

The most challenging sequence for many producers is determining how to best transition from warm-season crops like sorghum or sunflowers to winter wheat without using a long fallow. The warm-season crops are important components in adding diversity and intensity to rotations. In most areas, time or moisture constraints (or both) prevent sequencing immediately to winter wheat. Planting an early soybean in the hopes it can be harvested early to allow wheat planting (or other such schemes) might work at times but they add substantial risk to the system. In many areas this only works in the best of years. The problem is even greater than it appears due to the importance of proper fall establishment of winter wheat to have a shot at normal yields. The bottom line is that it makes no sense to try to switch the 3-year rotation of winter wheat >>sorghum >>fallow to a 2-year program of winter wheat >>sorghum as a means of getting rid of the summerfallow. That would be like jumping from the frying pan into the fire.

The warm-season crops are important components in adding diversity and intensity to rotations. In most areas, time or moisture constraints (or both) prevent sequencing immediately to winter wheat.

There are several better choices for replacing the summerfallow. The most obvious is to use a spring-seeded cool-season crop and a short fallow. The primary advantage of using the spring-seeded crop is that the conflict between harvesting the summer crop and seeding the winter crop is avoided. In addition, there is time for some moisture recharge to occur between summer crop maturity and spring seeding. This helps to assure proper uniform stand establishment. The uniform crop canopy is important to compete against weeds. As with adding sorghum to the old wheat >>fallow system, the producer will need to educate himself as to the practices for growing the new crop.

The cool-season crop can be grown for grain, forage, or a "green fallow." The greatest risk and highest potential for return is associated with production of a grain crop. The risk is associated both with production of the crop itself and the potential reduction in the yield of the subsequent winter wheat crop. Crops used in this manner include peas, flax, canola, lentil, spring wheat, barley, oats, etc. Each of these choices has advantages and disadvantages. The broadleaf crops provide a better disease and weed break as precursors to winter wheat, but they often leave little residue. Spring wheat and barley can build pest problems for the winter wheat crop(s), but they provide more residue. This residue aids in assuring adequate surface moisture for germination of the subsequent winter wheat crop and provides superior winter survival characteristics.

Photo by Roger Long.

Summer crops like sorghum are good additions to a no-till rotation. The secret is transitioning from those late-season water-users to winter wheat without summerfallow: cool-season crops hold the answer.

Harvesting the cool-season crop for forage can result in low residue levels as well. It helps if the crop has time to regrow after harvesting but before it is chemically killed to begin storing moisture for wheat. There are advantages to using a forage crop in this position. The most obvious is that forage crops present much less risk than trying to grow a grain crop in sequences that are short of moisture. The time between maturity of the preceding summer crop and maturity of this cool-season crop is only part of a year. Consequently, the water available is limited. Grain crops will not produce any yield until a basic amount of water is used (see sidebar references). Beyond this threshold, additional moisture produces harvestable quantities of grain. With forage crops the amount of biomass produced is directly proportional to the amount of water used over a fairly large range of moisture levels. There is a much higher probability that adequate moisture will fall to produce usable quantities of forage. In other words, grain crops are much more likely than forage crops to use all the available water and produce no yield. Another advantage is that forage crops are harvested earlier than grain crops. This means there will be less water used by the forage crop. Earlier harvesting also allows more time for rainfall to occur before winter wheat seeding. Harvesting a cool-season crop for forage will mechanically terminate cool-season weeds before they

Grain crops are much more likely than forage crops to use all the available water and produce no yield.

have time to produce viable seeds. This is especially effective for weeds that are difficult or expensive to kill.

The third choice is to use a cool-season species as a "green fallow," also known as a cover crop. This approach does biologically what tillage-based fallow attempted to do mechanically. Tillage wasted water; the cover crop does the same. If the soil becomes overly saturated during a long fallow period, problems occur. In the process of getting rid of extra water, tillage destroyed soil organic matter and soil structure while making N available. The green fallow crop uses extra water to actually *produce* organic matter, nitrogen, and soil structure. Tillage causes residue-based disease organisms to cycle more quickly. Cover crops do this by raising the humidity at the soil surface and by adding low C:N-ratio material. An additional advantage of a green fallow is the high-residue environment it creates. The cost of this option initially looks prohibitive. This is not true if the cover crop is effective at competing with weeds so that herbicide use is curtailed.

Most legitimate crop sequences should fail if you only get half of normal rainfall.

Some crop species are suitable for use as 'flex crops,' which refers to those that can be grain crops in normal and good years, be harvested for forage in moderately dry years, and be used as green fallow crops in extraordinarily dry years. Field peas would be a crop that fits this mold for cool-season species. Oats is another. Lentils might work although the tonnage of forage would not be high. The danger with flex crops is the temptation to harvest them too often for forage, especially during a series of very dry years when forage is scarce. It is important to not be dependent on this to be forage every year if residue levels need to build.

Dan Forgey, cropping foreman for Cronin Farms at Gettysburg, SD, describes practices for high-yielding winter wheat. Summerfallow was a common practice for them before no-till, but no more.

Photo by Brian Lindley.

Green fallow crops capture nutrients (N and C) from the air. These are transformed into organic compounds that will benefit future crops. Until the producer determines how nutrients cycle in his new ecosystem, he should not begin reducing fertilizer inputs. This is especially true for N. Think of it as putting N into a savings account, not the checking account. You don't want to write a check that could bounce.

You will notice I did not talk about chemical fallow as a way of handling a long fallow period. It is simply too costly and results in excessive moisture in the system. Erosion, saline seeps, waterlogged conditions, etc. can all occur. In warm climates (western Kansas, Oklahoma, Texas), considerable decomposition of the stubble and surface thatch will occur during this long fallow and may leave the soil in poor condition ("hard" and dry) for seeding the winter wheat crop. The problem here is lack of surface residue and lack of soil structure (a hangover from years of tillage). More crop residue must be produced.

Chemical fallow works for short fallow periods (where precipitation normally does not exceed the soil's capacity) in some locations.

Rotational Choices & Risk

Estimating the quantity of moisture available to grow a crop can be a useful endeavor when comparing possible rotations (the method is described in the sidebar, p. 202). With minor efforts, the producer can get a decent idea for his particular climate and soils. Calculating the yield and revenue effects of 50% and 150% of long-term average precipitation is another useful planning tool.

Some crop species are suitable for 'flex crops,' which can be grain crops in normal and good years, forage in moderately dry years, and green fallow in extraordinarily dry years. Field pea fits this mold for cool-season species. Oats is another.

Most legitimate crop sequences should fail if you only get ½ of normal rainfall for the period from the maturity of one crop to the maturity of the next. Rotational sequences that do not fail under this scenario are likely to waste substantial water during 'normal' years. This means problems occur with trafficability, waterlogging, diseases, saline seeps, etc. during most years, as well as failing to turn that moisture into revenue. In wetter-than-normal years, these rotations can be a total wreck.

Receiving 1½-times normal rainfall is not as rare as receiving only ½ of normal, but it is rare. Most rotational sequences would be expected to waste water when these conditions occur. The sequences that don't waste water when it is a 'wet' year will be risky when less moisture is available, but they are normally very profitable. They would be expected to fail badly in a 'dry' year. Hopefully the producer has saved enough money by then to weather the storm. If not, the acreage dedicated to this approach should be limited.

At this point it is clear that some rotations present more risk (fail because of drought) than others. They probably also produce more return in a 'normal' or 'wet' year. The producer must decide if the added return is sufficient to compensate for the additional risk. What kind of crop insurance is available? If the farmer uses low-risk rotations, there is not usually a benefit to having crop insurance for drought. For low-input crops and/or low-risk rotations, the producer may be able to self-insure until the insurance industry catches up with the new practice (for example, when a new crop becomes insurable, or when their actuarial tables take into account the tillage method used). Remember, a no-till farmer has reduced the risk of a particular rotation failing due to drought.

(*Editors' Note: If the farmer is in a position where insurance is deemed necessary for some crops, the rotational choices may be more restricted. In some counties, insurance is not available for "continuous crop" (non-fallow) wheat. Usually some date is used to determine if a crop was grown the previous year, such as June 1. If this is the case, and insurance on wheat is thought necessary, the cool-season crops will need to be managed for forage or cover crops, and terminated by the critical date.*)

If you anticipate failures of a given sequence during a 'dry' or 'wet' year, what is Plan B? Let's say you plan to do a wheat >>wheat >>corn >>corn >>pea rotation. The potential areas of problem due to drought are the second corn and the field pea. If you have livestock, it is possible to salvage value from both of these crops by grazing or harvesting them for forage (if you have livestock, these are the years when you would be short of forage). The peas make excellent green fallow if they are simply left unharvested. If this will only happen 1 or 2 years out of 10, that might be acceptable depending on yields other years and the availability of crop insurance. The cash outlay for field peas is relatively low (mostly just seed, inoculant, and some glyphosate + Spartan preplant). Low inputs plus the forage option make this crop relatively low risk without insurance.

Photo by Doug Palen.

Oats is a cool-season crop that can readily be used for grain, forage, or a cover crop. It finishes using water early, which allows several months to capture rainfall for winter wheat establishment, plus the upright stubble provides winter survival benefits for the wheat.

This rotation would be expected to fail in 'wet' years in the corn following wheat because of excessive moisture in the wheat stubble. The first method of mitigating the problem would be to look at "prevented planting" insurance possibilities. In some locations, delayed planting does not pose the same potential loss as in other areas. Switching to grain sorghum or millet is a viable option for some. If livestock are involved in the operation, using forage sorghum might also be viable. Actually, growing a late-seeded corn as a grazing crop offers potential benefits that deserve to be investigated.

Some farmers never want to have a crop fail from lack of moisture. If we could design a rotation that did that, it wouldn't make money.

Using long-term (30- to 100-year) averages to develop rotational ideas has difficulty in that Mother Nature often throws short-term aberrations into the mix. There will be three- to five-year stretches of wetter or drier years that challenge the producer's resolve and screw up the crop insurance program. When these happen, it is appropriate to step back and review the thought process that caused you to pick the rotations and sequences now being used. If these choices were done properly, making small temporary shifts in management might be warranted. *Making drastic* *changes in management in an attempt to 'outguess' the weather will cause problems when the short-term cycle reverts to normal.*

Short-term variations during droughts could include substituting field peas for sunflower as a broadleaf component. Substituting forage or grain sorghum for a risky corn sequence would be another variation. Wet-cycle variations could include use of additional forage or cover crops during some of the longer fallow periods.

Dakota Lakes' data indicate winter wheat behind peas produces slightly better yields than wheat following chemical fallow.

Many farmers want to hit 'home runs' on every crop in the rotation, every year. That is not going to happen. It just leads to more failures than successes. Other farmers never want to have a crop fail from lack of moisture. If we could design a rotation that did that, it wouldn't make money.

The Secret

You must keep everything in perspective. Take the old ecofallow rotation (winter wheat >>sorghum >>fallow) and replace the fallow with a field pea crop. Most producers think the pea crop has to make a good profit for it to be viable. If the wheat yields stay the same, then *the peas only have to lose less money than is lost on the fallow*. Dakota Lakes' data indicate the winter wheat behind peas produces slightly *better* yields than wheat following chemical fallow.

Making the transition from warm-season crops to winter wheat is challenging but it is not insurmountable. Many producers create problems for themselves by using rotations that lack diversity. For instance, rotations like winter wheat >>sorghum >>fallow; winter wheat >>corn >>millet >>fallow; and winter wheat >>corn >>millet, lead to development of problems with hard-to-control grass species like tumble windmillgrass or cupgrass because the crop species used are all grass types and the rotation is very predictable. Creating a more unpredictable rotation that utilizes some broadleaf species can be extremely helpful. It is especially useful if residual herbicides can be used as a normal part of the program. A weed species becomes a problem only because we gave it an opportunity. This opportunity has to be taken away for lengthy periods during the rotation for that weed to be kept in check.

Above all, tillage-based fallows are not a viable option. They stir up all the old weed seeds, bury new ones, degrade the soil, and destroy the improvements that were made during the other phases of the rotation.

Calculating Water Storage & Crop Yield

by Dwayne Beck

Soils can only hold a finite amount of water. The best soils can store no more than 8 to 10 inches of plant-available water to a four-foot depth. If a long fallow is used, and there is no wastage of water, it is common that more precipitation will be received during the fallow period than even the best soils can hold. If the soils are shallow or sandy it is almost certain.

The NRCS has soils books for almost every county in the U.S. These books are free, and give you an approximate water-holding capacity for the soils on your farm. Combine that information with data on the average rainfall for each month of the year where you live. Use the average rainfall, ½ of average, and 1½ of average to represent normal, dry, and wet years respectively. Add the rain received[1] from the time one crop stops using water (roughly two weeks before harvest) until the next crop starts (two to three weeks after seeding). If you fill or nearly fill your soil during a 'dry' year, the fallow interval is too long. If you do not fill your soil during a 'wet' year, the fallow may be too short.

Now take this one step further. Assume you were able to get the crop planted; calculate the amount of water that was available for that crop. This will include the amount stored in the soil (not to exceed the maximum capacity of the soil) plus the amount that falls during the growing season. Find a crop response model from your area and calculate the likely yield in a normal, wet, and dry year. The USDA-ARS has developed models for most areas of the prairies. Several Universities have also.

With a spreadsheet it is relatively straightforward to do this for all of your soil types and several crop sequences. It is oversimplified and leaves out some important considerations but it is not meant to predict yields exactly. Rather it gives you a feel for the relative risk of certain rotations and sequences.

Further explanations and examples can be found at www.no--till.com/publications/mandk290.pdf. An example of the relationship of water use to yield for various crop species is at www.akron.ars.usda.gov/fs_water.html.

[1] *Editors' Note: 100% efficiency in precipitation storage isn't achieved even in long-term no-till, although the data from some locations demonstrate remarkably high efficiencies. Due to evaporation losses, the efficiency is often closer to 80% in non-crop periods. However, on the usage side, well-managed no-till crops are producing more grain than what the equations predict should occur—Beck's hypothesis is that elevated CO_2 levels in the crop canopy allow the plant stomata to be open less, which cuts down on water loss from the leaves.*

Harvest for Better Seedbeds

The astute no-tiller recognizes the success of his next crop starts with the field 'preparation' of the previous harvest—getting the straw and chaff spread uniformly across the header width. Wheat straw is obviously a major concern, but so is soybean stubble—particularly if wheat seeding will commence shortly after those soybeans are harvested. The problems of non-uniform or bunched straw behind the combine include hindering opener penetration or performance (hairpinning, depth irregularities, etc.), variations in moisture at the soil surface, variations in temperature, N immobilization ("tie-up"), etc.

The struggle is ongoing, with combine manufacturers improving their offerings, plus many aftermarket kits becoming available. We offer these experiences for those who wish to improve their lot. Note: We won't cover every combine make and model in existence, but the principles apply to all machines. Also, since chaff spreaders are well-recognized and widely marketed (and widely used), we'll focus more on straw distribution as it seems to be the most typical and serious shortcoming.

Case-IH Axial Flow

These machines rely on dual spinners to fling the material outward as it comes off the rotor. Most of the improvements fall into 3 categories: larger diameter discs to hold the material longer as it is gaining momentum from the spinning; taller or more aggressive bats on the disc; and speed-up pulley kits to cause the discs to spin faster. According to Kent Stones of Lebanon, KS, experience has taught that both the speed-up kit and the larger discs are important in getting good residue distribution when running a 30-foot header. Also, various configurations of taller bats—flat or curved—help considerably, according to many producers who have used them. Some older models (e.g., 1460) will not have enough space available to make two large-diameter discs fit side-by-side. At least one company makes a kit to drop one disc below the other.

Photo by Matt Hagny.

CIH with more aggressive bats installed.

During the 2100-series, a curtain and v-shaped deflector became available from Case-IH to redirect straw or stalks coming off the rotor—the material didn't fall equally onto the spreader discs due to its momentum coming off the rotor.

Deere Combines

Straw spread from Deeres with choppers can vary from atrocious to quite good, depending on maintenance and adjustment. Knives must be maintained, or the cutting will be hindered and stalks not thrown as far. Machines such as the 9600 can be retrofitted with Redekop knives (see the Sept. '02 *Leading Edge* for a pic), which dramatically increase the distance that material can be thrown. Redekop choppers are available from Deere on the newer models.

Photo by Keith Thompson.

Farmer-built extensions for the chopper vanes.

Often the fins or vanes are set improperly (outside ones not far enough to the outside), or are damaged. The vanes are highly important, as demonstrated by some alterations. Deeper vanes (from JD) improve the throw. Longer vanes (see photo) help even more. Craig Ewy, Hesston, KS built his own longer vanes and reports his chopper now easily throws wheat straw out across the full 30-foot swath. Stones, who has experience with these machines as well, emphasizes the interaction of the chopper components: "Last year we had a custom cutter with four 9750 JDs. They had the older original choppers and they were horrible compared to [machines with] the Redekop choppers with the larger tailboard and large fins."

Deere machines with the older spinners (the type with floppy belting to do the throwing) generally don't spread

Photo by Matt Hagny.

Deere with Redekop chopper.

as good as machines with well-maintained choppers. The problem with spinners is that material is almost inevitably bunched together, unless it is powdery dry. Newer spinners (see photo) are available which handle both straw and chaff; these are an improvement over the old spinners, but still not as good as a well-maintained chopper typically.

AGCO Gleaner Rotors

These machines have the most difficulty spreading straw, since it comes out one corner of the combine, dropping onto a single spinner disc. Taller bats and speeding up the disc help, but the results are often rather marginal. Many producers struggle to cope with the ribbon of residue left by these machines despite the modifications.

Shelbourne Stripper Headers

What about avoiding the entire problem by not taking the straw into the combine? This has several advantages, such as improving the efficiency of the machine in terms of bushels or acres per hour, and leaving a tall stubble to better catch snow and reduce evaporation. But downsides exist.

Standing stubble rots at the soil surface long before the rest of the straw decomposes. Winds tug at the taller straw, and may eventually cause it to drift into piles. The longer straws may also bridge up worse when encountering the seeder opener. On the plus side, the straw is more durable, since it wasn't cut and smashed going through the combine. The key is getting the next crop established before the tall straws start to detach from the surface. Once the new crop is established, it will prevent further wind redistribution.

In the northern U.S. & Canadian plains (e.g., the Dakotas, Manitoba, Saskatchewan), no-till producers generally have had favorable results with stripper headers. The long winters reduce decomposition, and so typically the next crop is established before the straw detaches from the surface. And again, in areas where double-cropping is standard procedure (central Oklahoma, south-central Kansas), the strippers headers are excellent choices.

However, in southern regions with less-than-sufficient rainfall to double-crop or cover crop consistently, producers report numerous problems with plantability the following spring in the stripper stubble. Kent Stones has had several split-field comparisons of stripper- and sickle-harvested wheat: "Planting difficulties were enough worse in the stripper-harvested wheat that they offset any moisture advantages." He describes problems even in relatively light stripper-harvested stubble (such as drought-stricken 25 – 40 bu/a wheat) when seeding corn or milo 9 months later. Dale Schmitt of Beloit, KS reports similar problems, even with establishing second-year wheat just 3 months after harvesting the first wheat with a stripper head. For these producers, the aggravations far outweigh any potential gains. The long and the short of it (pun intended), is that the best choice is often driven by climate and rotations.

Photo by Matt Hagny.

A late-model Deere with new-style spinners.

Photo by Keith Thompson.

Those vane extensions (photo, p. 203) easily let the chopper throw soybean stems 30 feet, the width of the flex-head used in this field.

Controlling His Destiny

by Matt Hagny

Josh Lloyd wasn't the kid who always wanted to farm. In fact, he largely ignored it during his college years: "I was going to go make my millions elsewhere, but eventually I realized being my own boss wasn't so bad." He studied business at K-State, so when he suddenly decided to go into farming with his dad, it was all new. Josh had certainly helped out with farm labor over the years, but never took much interest in what happened when, or why, until he returned to the farm in '98—and suddenly needed to know!

Josh's inquisitiveness during that first year back prompted him to ask why they weren't doing continuous no-till. Josh's father, Gale, had been experimenting with no-till but was having trouble getting over the hurdle of 'this is the way we've always done it.' Mostly no-till was still a crazy idea, though. They'd heard of only a couple success stories in the region. Josh's father had attended the '97 No-Till on the Plains conference in Salina, and suggested they attend the January '99 rendition of the conference. Apparently it was quite convincing, since Lloyds went 100% no-till that spring.

Lloyds already had decent crop diversity in place, with wheat, milo, and soybeans grown on their farm southwest of Clay Center, KS well before no-till came along. The main issues in Josh's mind for converting to no-till were: 1) getting the seed planted properly, 2) figuring out how to fertilize no-till effectively, and 3) doing the weed control. Josh got busy searching for answers.

Following the example of a few other successful no-tillers in the area, Lloyds' starting point for a no-till drill was the Deere single-disc opener, specifically, a 15-foot JD 1560 box drill. That quickly got traded for a 30-foot 1860 air drill—"It seemed like I spent all summer on the tractor with the fifteen-foot drill. I didn't want to work that hard." Eventually that air drill got traded for their current 1890 on 7.5-inch spacing.

"Getting things sprayed on time makes a big impact as far as how much chemical to use, level of control, and yield reduction caused by letting the weeds get too big in-crop."

Solutions to Josh's question on no-till fertilization continue to be developed on their farm. Lloyds' program currently uses dry pop-up applied with the air drill for wheat and milo, plus additional fertilizer during the winter. They also apply hog manure from a neighbor's hog barn. The manure is injected about 6 inches deep on 36-inch spacing, and while the applicator does disturb some soil, the main problem they've faced is wheat lodging in the year following the application. Josh is going to try using milo for the first crop after the manure application, although lodging could still be a problem in it as well. Josh notes that he could reduce the rate of hog manure, but he wants to get as much out there in one shot as possible: "I only want to apply to a field once every 5 or 10 years. The applicator disturbs the soil more than I'd like, plus the weight of the wagon with all that liquid manure on board creates some compaction issues."

Photo by Josh Lloyd.

Josh strives for precise placement of his wheat seed, while preserving as much residue as possible.

Lloyds quickly figured out they needed to be doing all their own herbicide application, which is accomplished with a 3440 Spra-Coupe. Hiring their application work proved to be too costly, and timeliness was unsatisfactory much of the time. "Getting things sprayed on time makes a big impact as far as how much chemical to use, level of control, and yield reduction caused by letting the weeds get too big in-crop. Hiring it done also meant that we had to buy the chemical from them. So not being at someone else's mercy was another factor." Josh roughly calculates that for $3/a application fee, 3 times a year on their acres—the decision to buy the self-propelled sprayer was "a no-brainer." They'd previously owned a tractor-mounted sprayer, but soon discovered that it tied up an expensive tractor much of the year, was uncomfortable at 8 mph in the field, and was a hassle to use: "It just wasn't the right tool for the job."

Josh scouts the fields frequently: "Dad was always good about running the numbers, but [after planting] he only windshield inspected, then just showed up with the combine." Some surprises were unpleasant, so Josh is more vigilant and checks on the crop by actually going into the field periodically. To Josh, it's just like monitoring any other investment.

Adjusting Their Agronomy

With his business education, Josh watches the numbers even more closely than Dad did, and is always trying to sleuth out a way to make a few more dollars growing the crop. For instance, Josh is trying to improve wheat yields with better management: "We are seeing wheat yield increases from no-till and longer rotations. Moisture is not a limiting factor here—it's having so damned much disease." Also, inadequate fertility in some fields. Josh notes some huge (17 bu/a) responses to pop-up fertilizer on wheat in some testing he's done, and recognizes the need to push the fertility harder on wheat.

In past years, Lloyds' pop-up fertilizer on wheat has consisted of 135 lbs/a of blended product to end up with 11-35-25-1 (N-P-K-S) applied. For the fall of '04, they opted to simplify by applying 100 lbs. of 11-52-0, with Josh noting that they can broadcast the potassium with the urea during the winter.

Lloyds have used their air drill to apply urea during the winter for the past 3 years. Josh describes taking all the down-pressure off, so that the opener is barely nicking the soil to place fertilizer. He's left some check strips where he had the openers completely out of the ground, and couldn't tell any difference in the crop. Since he has some concern about wear-and-tear on the openers, plus the stubble destruction, he is planning on running everything this winter with the openers up. He's also planning on blocking off some runs to achieve a 15-inch spacing with the urea.

Photo by Matt Hagny.

Josh does the detective work to help ensure good economic results over the long-term.

"We are seeing wheat yield increases from no-till and longer rotations."

"We're trying to push the envelope with the wheat," notes Josh. "When we first made the switch we weren't putting down enough seed and fertilizer . . . . The overlaps with the drill always yielded 5 to 10 bushels more—and consistently 5 bu/a better, year after year." While he's unsure of whether it was the 2X pop-up or the 2X of seed that made the difference, he upped both for now—until he can do more research to sort it out. His seeding rates now run from 120 to nearly 150 lbs/a.

Milo also gets pop-up fertilizer along with the seed on 15-inch spacing. In the past, Lloyds applied 20-40-5-7-1 (lbs/a of actual N-P-K-S-Zn) in-furrow, although Josh thinks he's seen some germination problems on occasion, and is planning on dropping some of the extra N out of the milo pop-up mix. The remaining fertilizer for milo is applied during the winter with the air drill. Josh continues to check yield variation from stand densities, and has incrementally pared seed drop back from 95,000 to approximately 45,000 without yield penalty even on good years. He notes some decrease in weed suppression with the lower plant densities.

Lloyds' soybeans are planted at a frugal 125,000 seeds/a, and in 2004 Josh made some check strips planted at 100,000 to test the idea of going even lower. Despite good conditions (a 43-bu/a farm avg.), Josh found no yield reduction in the thinner strips. Josh says he'll stay with the 125,000 seed drop for now, but will continue his experiments.

Some Analysis Required

Josh also studies his yield maps, looking for any clues to help his management along. He notes that one high-yielding area with suspiciously well-defined edges has been quantified as consistently producing milo and wheat yields 20+ bu/a better than adjacent areas. "We could always tell visually that something was going on there. It wasn't until we asked Grandpa that we found out that 55 or 60 years ago it was an old feedlot." Soil tests revealed soil OM to be somewhat different, but the real eye-opener was the high levels of P and K persisting in the old feedlot area—which prompts the question of how hard we should be pushing the fertility on wheat.

Josh expresses some frustration with the process, however. "I'm trying to eliminate all weather and other abnormalities influencing my yield data [by averaging multiple years]. I want better [composite] yield maps. . . . I was all gung-ho on yield mapping and soil sampling, but it didn't tell me a damn thing." That may be slightly overstated, but his point is taken. Josh describes the fact that his milo yield maps overlay nicely across multiple years (the low-yielding areas are always low yielding), but soil tests are inconclusive as to the cause—if not nutrient level or other obvious characteristics, perhaps it's soil depth and water-holding capability?

"With no-till, we're a lot more profitable."

Josh's main concern with his yield mapping's lack of correlation with measured soil parameters has to do with his knowledge of the details, and how they can often flip from year to year. "How do I get organized to analyze this data, and make sure what I'm seeing is real? It's hard to sort this out and figure out exactly what I'm seeing . . . ." Josh's questions: "What happened? What is the conclusion? What can happen to throw it off?" He cites the example of lodged wheat seriously hurting yields, despite high nutrient levels.

Josh's other record-keeping has proven more fruitful. He tracks yields on each field, and has them going back more than 15 years on many tracts they farm. His spreadsheet shows how a field did in relation to the farm-wide average that year, and then these can be totaled for a period of years for each crop. It gives him a nice picture of which fields are productive and which are not. Josh notes that it comes in quite handy when the question arises as to whether to be aggressive or not in retaining a rented tract, or how much it might be worth if up for sale.

He picks out some other trends by comparing whole field averages, such as the fact that the ones having had an application of hog manure often yield up to 35% more wheat—if they don't lodge. Josh's soil testing provides further confirmation, which reveals the fields with higher P readings tend to produce better wheat yields.

Evidence of Progress

Lloyds continue to experiment with their rotations too. Before no-till, they often did two years of wheat followed by a single year of milo and then a soybean (on all except the poorest fields). Currently they are working from a 'simple' wheat >>milo >>soybean rotation to a fully

Photo by Matt Hagny.

Lloyds have installed Flexi-coil distribution towers on their JD1890 to improve uniformity of seed flow to each opener.

'stacked' wht >> wht >>milo >>milo >>soy >>soy. Josh has seen no yield lag on any of his second-year crops. Corn was once part of their rotation as well, but milo has been more profitable during the drought; Lloyds traded their planter off last year, so that's the end of corn for them for now.

Josh was once much more enthusiastic about double-cropping, but a long series of abnormally dry summers has seriously wounded that enthusiasm. He does like a strategy of double-crop sudan for hay, then grazing the regrowth (Lloyds background a large number of steers) on wheat stubble destined for milo the next year. He intends to ramp up

Yield map of the mysterious high-yielding area (northeast corner) that was eventually discovered to have been a feedlot some 60 years ago. Soil tests reveal the persistence of large nutrient differences:

	Old Feedlot	Adjacent Area
	(0-6 inch)	(0-6 inch)
OM	3.1%	2.6
P (Bray 1)	84 ppm	24
K	567 ppm	256
	(6-18 inch)	(6-18 inch)
OM	2.1	2.5
P (Bray 1)	124	11
K	689	281

double-cropping again when the moisture pattern returns to normal or wetter-than-normal. He hasn't had any trouble with excessive moisture in his wheat stubble so far, but he notes that it has been abnormally dry basically since he returned to the farm in '98.

Photo by Matt Hagny.

Josh finds no-till's improvements in soil structure and earthworm numbers quite remarkable. Both depend on the heavy residue cover.

Josh is actively pursuing cover crops, especially looking for something between the stacked soybeans to maintain residue levels—currently he's experimenting with both spring & winter oats, barley, and several other species to see which, if any, provide sufficient cover and weed suppression to be worthwhile.

Lloyds are gaining efficiencies in other areas, too. GPS guidance gets them to plus-or-minus 6 inches for spraying and seeding, significantly reducing costly overlaps. Josh has starting doing more seeding and harvesting up and over terraces as well, rather than on the contour. Josh notes that these changes have improved efficiencies by 20% on those field operations.

Lloyds find many indicators confirming that no-till is moving them in the right direction. Josh mentions the soil crumbling apart in his hands, and takes satisfaction in the high number of earthworms in residence. He notes the importance of the thatch layer by relating one experience planting corn a couple years ago: "I got more mud on my tires driving down the road *to get to* the field than I did once I was in the field."

Josh says yields are good with no-till, and that their yields are edging out their neighbors' who're still using tillage. Josh also points to other benefits: "[In '04] anywhere I did tillage to smooth up waterway edges or old tillage ridges—that was the only place the milo went down. And the milo was more sickly looking in those areas. Neighbors who 'skip-a-till'—or more [full tillage every year]—had more problems with lodging."

"With no-till, we're a lot more profitable. And we have more time to spare—sometimes we're actually looking for stuff to do." Josh eagerly puts some of that time into minding the Ps and Qs of the operation. Right on track: well-planned, well-executed. Nice returns on investment. Free time. Ahh, the good life.

The SD No-Till Association is planning another top-notch conference for Feb. 14-15th, 2005 at Pierre, SD. More info at www.sdnotill.com.

No·till On The Plains

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