Leading Edge
The Journal of No-Till Agriculture
September 2003 • Volume 2 • Number 2
No-till On The Plains

Farm Smarter!

by Rod Peters

For those who have partaken of various no-till events in recent years, the name 'Doug Palen' may have some familiarity. Outgoing, and an outspoken advocate for no-till, many of you may have already been introduced. Behind the smiling face and joker personality, the keen mind of a businessman churns away.

Doug, the third of four siblings, and the one showing the most interest in farming, committed himself to that endeavor in 1993 when his father invited him to manage the cropping side of the livestock/crop operation in the rolling hills near Glen Elder, KS. Doug had earned a bachelor's in agribusiness from Fort Hays State University, and worked for one summer as a crop scout for Servi-Tech in Nebraska, but this was a serious assignment! By '94, Doug had assumed the full workload and all the financial responsibility for the cropping enterprise of the farm—without much oversight by dad or other family members, it was 'sink or swim' for young Doug.

While Doug's professors at FHSU had casually introduced him to the concept of no-till, the summer spent scouting in Nebraska was a pivotal event for Doug—he saw firsthand that no-till was indeed possible. That experience also opened his mind to a different level of management, and taught him that farming could be very profitable—it was just management. When he was plunged into operating the Palen farm, he immediately recognized the possibility of applying no-till's efficiencies. In the beginning stages, what intrigued Doug about no-till was how he could conserve the resources and his labor. Without hired help or family members, getting everything done in a tillage system would have had Doug in a pinch. So he decided to learn all he could about no-till. Doug's considering such a major break from the tradition of doing tillage is not so sur-

Photo by Doug Palen.

Palen's rig planting corn into two years' worth of wheat stubble—boatloads of stubble, in fact.

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prising once one comprehends Doug's penchant for adventure: "I returned to the farm with the desire to do things differently." In '93 Doug tried his hand at no-till and began to see that the machinery used for tillage was no longer needed. By '94 he was convinced that he had neither the time nor any real reason for doing tillage. By '95 he was 100% no-till.

When he returned to the farm, Palen promised himself that he would work "smarter" and not necessarily harder to make a profit. A wise creed.

Palen's 500 hp 1150 Versatile and another 170 hp tractor were traded for a 200 hp 8400 Deere FWA tractor to better handle row crops, and the 60-foot sweeps and various other tillage tools were sold. He purchased a used 12-row (30-inch) JD 7200 planter and a 3-point sprayer, and hired his wheat seeding done for a couple years until biting the bullet in '96 and buying a pair of JD 750 drills on a hydraulic hitch. Although he's since added a larger pull-type sprayer, and another tractor & loader to help with alfalfa hay, the original 8400 tractor, 750 drills, and planter are still in service today.

Photo by Matt Hagny.

Second-year soys on Palen's farm.

Fully reconditioned every winter, Doug sees no compelling reason to update seeding equipment until something truly superior comes along.

Hired Efficiencies

His father soon retired from farming after Doug took over, and since then Doug has almost doubled the acreage with half the horsepower. In January of 2002, Doug hired on a full-time man, Kip Jeardoe, who had previously worked part-time for Doug and now is an integral part of the operation. Having Kip around frees Doug to focus more on management—something that can easily get neglected if a person gets too caught up in day-to-day activities.

Doug spends as much time at the computer entering data and determining break-evens as he does at the steering wheel of a tractor. Conversing with Doug, you can tell he does a lot of cost analysis for his operation. He promised himself when he returned to the farm that he would work "smarter" and not necessarily harder to make a profit. Doug also relies on outside help and expertise from a marketing advisor, an accountant, and an agronomist. He prefers to spend his time analyzing data and making decisions, rather than gathering information or doing other tasks that would best be outsourced or delegated. "Grandpa always said, 'Do what you can yourself, and to hell with the rest.' "—Doug thinks he meant outsourcing.

The Palen knack for finding the right business solution has had them on both sides of the custom harvesting fence. Doug grew up helping his dad custom harvest every year "from the day school got out, until the day we went back to school in the fall." Doug has fond memories of the family cutting wheat from Texas to Kansas, then going back to Texas for milo harvest. Interestingly, even though Doug knows well the 'ins

Leading Edge

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$25 per year (U.S.) subscription rate

No-Till on the Plains Inc. publishes ***Leading Edge*** four times per year.

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P.O. Box 379
Wamego, KS 66547-0379
888.330.5142
Website: www.notill.org

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Additional funding provided by U.S. EPA § 319 grant, through the Kansas Dept. of Health & Environment

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.

and outs' of combining, he has all his crops custom harvested. Doug explains that, as a young producer and a one-man operation in the early years, it just didn't make sense to buy all that equipment and still look for help to haul the grain. Even now with the addition of a hired man, Doug still doesn't think he can justify owning all that equipment, explaining that he simply couldn't be as timely getting the harvest out as a custom crew.

Yet another shock is Palen's unwillingness to buy lots of farmland, preferring to grow by renting instead. "At these cropland prices, parking dollars there won't provide the returns to which I've become accustomed."

The Game of No-till

After a decade of experience with true no-till, Palen has a greater appreciation for the differences of that system compared to tillage cropping. Some of the greatest challenges have been to think and plan beyond the current crop—that is, developing the strategies and foresight needed to prevent problems, and taking advantage of the opportunities that come along. Doug compared the amount of planning necessary for traditional tillage farming to playing a game of checkers, while no-till farming is more like playing a complicated and well thought-out chess game.

Photo by Doug Palen.

Drilling Palen's 2002 soybeans into milo stubble—again, a mountain of residue.

When it comes to planning, Doug expends considerable effort on his rotations, trying to walk the thin line between using all his available moisture and yet storing enough for the next crop. Doug's cropping consists of roughly 1/3 wheat, 1/3 corn or milo, and 1/3 soybeans, plus 200 acres of alfalfa as a cash crop. Where once he did 'simple' rotations, he has now moved forward into 'stacking' the crops, so that his rotation commonly would look like: soybeans >>soybeans >>wheat >>wheat >>milo >>milo, then back to soybeans again. Palen once grew many acres of sunflowers in the mid-'90s, but discontinued the practice in favor of soybeans—his 8-year average soybean yield seems quite acceptable for an area that had virtually no soybeans at all 10 years ago. Diversification is important, as well as using crop insurance to manage risk. Doug points out that we in the U.S. have great opportunities to manage risk with the boards of trade, crop insurance, and financing possibilities that some other countries do not have.

The stacked rotations are working quite well for Doug. While some believe that second-year no-till wheat can't be done, Doug has many years of experience that say otherwise. "Without exception, every year I've had stacked wheat, it has been my highest yielding." The key, he explains, is a long break of summer crops ahead of the first wheat. Doug has experienced phenomenal yields from his stacked wheat. While not in the least inclined to brag about such, Palen divulges that in '03, for instance, he had several fields of second-year wheat making over 80 bu/a (one quarter-section topped 90 bu/a), and has the scale tickets to prove it. When asked about those results, Doug attributes them to an exceptionally good growing season. Still, he obviously had the management in place to take advantage of those conditions.

Photo by Doug Palen.

Soybean harvest '02.

Why doesn't the first-year wheat peg those yields? Palen replies that the stubble from the first wheat crop holds good moisture, whereas going directly from soybeans to wheat is a little more difficult (dry)—often you're harvesting soybeans in October and drilling wheat in the same field only a few days later. As a transition from the soybeans to wheat, Doug has for a couple years tinkered with spring oats—although he has considered taking them for hay or grazing, both years he ended up harvesting the oats for grain. Palen notes that the wheat going into oats or wheat stubble does cost slightly more to put in compared with soybean stubble, since typically a couple sprayings are needed to keep the stubble clean. However, it's part of a grand plan to accumulate a really heavy mat of residue from the double wheat, which will store moisture for his milo or corn in years to follow. Since Palen's farm is all dryland, and often touch-and-go for moisture, the extra savings often pays good dividends.

Stacked no-till milo has an even longer history on Palen's farm, and it too is working well. In contrast to the wheat, often it's the first-year milo that is the most expensive. Yields have been respectable on the 2d-year milo, and the economics look good. Stacked corn is also done, although Palen is emphasizing milo more than corn in recent years due to continued drought and differences in insurance levels. Stacked soybeans were added 3 years ago, and seem to be holding up rather

well. The beans are drilled in 15-inch rows (one rank of openers locked up)—to preserve the residue and reduce wear and tear on the drill, versus drilling in 7.5-inch rows.

Palen is currently refining ways to maximize the soil cover and yet have good seedling establishment. In the beginning years of no-till, Doug was fearful of all the stubble that was left on the field and how to cope with it. Now he often marvels at how quickly it disappears, and it has become a precious resource for him to manage. Palen asserts that you just can't beat a nice stubble for a seedbed, and for reaping the rewards of water infiltration with little or no soil loss. Given his respect for the stubble, it comes as no surprise that Doug recognizes the importance of ultra low-disturbance for seeding equipment.

In his beginning years of no-till, Palen was fearful of all the stubble left on the field. Now he often marvels at how quickly it disappears, and it has become a precious resource for him to manage.

Many of Doug's seeding operations include applying some fertilizer. The winter cereal grains (wheat & oats) get all their phosphorous (and a little nitrogen) at seeding with the intent to top-dress the majority of the nitrogen as urea during the spring when the crop is starting to grow. The planter is equipped to apply fertilizer in two locations—a pop-up in the seed furrow, and another blend with a separate opener. Palen has in the past applied all his N requirements for milo and corn through the planter, but due to fertilizer pricing, these last few years he's opted instead to surface broadcast urea in late winter for his corn and milo plantings.

When asked if he has seen a yield advantage after no-tilling for ten years, Palen's answer is a modest "yes"—he attributes most of his upward yield trends to stand establishment and proper plant nutrition, and to lengthy rotations. He reports that changes in his soils have been especially notable on the poorer thin soils—the tough clay used to be either mucky wet or hard and dry, and it took several years for it to begin healing from the abuse of tillage.

Photo by Doug Palen.

Low disturbance is the mantra at Palen's farm.

Without Limits

Doug's personal motto is "Forever a student," which quickly becomes apparent in talking to this inquisitive personality. It's further exemplified by the study tours that have taken Doug to rural China, Chile, Argentina, Australia, Brazil, and Paraguay. He zips around the U.S. plenty, too. And everywhere he goes, Palen 'collects' friends like the rest of us do with trinkets or coins or stamps—he seems genuinely interested in everybody, and thoroughly enjoys playing host whenever a cadre of friends drift through Kansas for a visit.

In light of having recently completed a three-year stint as President of No-Till on the Plains, Inc., what advice might Palen have for the producer who is starting out trying to understand the concepts of no-till? Doug responds by encouraging those interested in no-till to network with other producers. "Farmers can really learn from one another. Your neighbor may even be your greatest resource, and not necessarily your biggest competitor." Doug encourages all of us to draw on other people's experiences and ideas to stretch our minds. He notes that we are a product of life experiences, and Doug does indeed try to gather perspective from his wide range of active interests. From the trips abroad, Doug has brought home a much greater awareness of what's really possible to maximize efficiencies. He has seen farmers in other countries having similar resources but doing so much more with them. In a nutshell, the trips abroad have taught Doug that the bar can be set a lot higher than one thinks.

Photo by Doug Palen.

Soybeans going into corn stubble.

Never one to shy away from big projects, Doug is currently investigating some future endeavors that could bring more income to his farming operation. He contemplates some opportunities for blending a cattle-grazing enterprise into his cropping operation. Also, he's full-throttle into creating a process for identity preservation of grains and

Photo by Tim Christian.

Are we ready to roll?

for marketing unique products that tomorrow's consumer may demand. Having seen firsthand the fickle nature of some of these marketing endeavors, Doug approaches them with healthy skepticism, but also with a nagging suspicion of their importance.

For a young man of 32, Doug is already a seasoned manager. For whatever success he's had so far, Doug gives a lot of credit to his father for giving Doug the opportunity and the freedom to make his own business decisions. "Dad pushed hard in farming for 30 years. When he felt his excitement for farming slipping, he decided he would do well to make way for someone else. He's enjoying another career now, and I have mine . . . . It's sort of like running a relay race—there are times when the most important thing you can do is pass the baton. You don't *have* to do the whole thing yourself. I hope I realize when it is time for *me* to pass the baton, and have the discipline to do it." With miles to go, Doug seems to be feeling the surge of a second wind.

Photos by Tim Gogolski, Matt Davis.

Doug shrewdly manages his time to make sure his work doesn't consume him. His calendar includes free time for pursuits such as riding mountain bikes, here with his friend Keith Thompson. In whatever he's doing, Palen likes to push out to the boundaries: "Right up to the edge, with my toes hanging over."

Wheat Establishment: Profitable Details

When seeding wheat this fall (or spring), be sure to run an adequate amount of in-furrow 'pop-up' fertilizer. If your drill isn't equipped to do this, now is the time to get that remedied. Wheat yields (and profit) depend on it.

Wheat is more responsive to phosphorous than most other grain crops, and surface applications simply aren't acceptable for providing P for the upcoming wheat crop. Even with rather high soil test levels of phos., a pop-up application will often be of economic benefit. According to Ray Ward, up to 25 lbs. per acre of N + K_2O can safely be included in-furrow on 7.5- or 10-inch rows of wheat. The amount of N needed for fall tillering is dependent on plant densities.

Another important component of wheat establishment is quality seed. Low vigor seed (often associated with low test weight, but not always) will not produce healthy strong seedlings. Weak seedlings don't have top yield potential, and are more prone to other stresses such as winter injury, weed competition, waterlogged soils, or other problems that may arise.

Photos by Matt Hagny.

Springtime photo of winter wheat in stacked soybean stubble, long-term no-till. A few rows on this drill weren't putting out any pop-up fertilizer, but otherwise were functioning normally—do you think they'll ever catch up? Don't think so.

Crop Sequence & Interval

What Causes the Yield Response?*

by Randy Anderson

Randy Anderson is a USDA-ARS scientist at Brookings, SD, formerly at Akron, CO.

SCIENCE

**Editors: The following is from a paper to be published in a forthcoming American Society of Agronomy book, printed (and edited) here with permission of the author.*

While the writing may have been intended for the science community, we include it here for the gems of knowledge ready to be applied, and for properly surveying the literature for some of the very real consequences of crop rotation. For research and experience in designing rotations for the U.S. Plains, check out the Speaker Notes from the '02 Winter Conference at www.notill.org, including more by Randy Anderson.

Further Note: With a few lapses, the term "sequence" typically refers to a particular crop as following a certain previous crop in a field or plot, while "rotation" refers to a series of crop sequences that is commonly (sometimes rigidly) practiced or being studied, and includes the entire cycle of sequences. Obviously, in very short 2-year rotations, the terms have the same meaning. "Rotation" also captures the concept of crop "interval"—the length of time that a particular crop is absent from a field or plot.

Crop yield can be affected by the sequence or arrangement of crops, a response termed the "rotation effect." For example, rotating pearl millet (*Pennisetum glaucum*) with cluster bean (guar) (*Cyamopsis tetragonoloba*) increased pearl millet grain yield two-fold compared to a monoculture of pearl millet in India.[1] In Minnesota, rotating corn (*Zea mays*) with soybean improved yield of both crops at least 15% compared to a monoculture system of either crop.[2] As tillage diminishes worldwide, crop sequencing will become more valuable as a management strategy because the rotation effect is greater in minimum- and no-till systems.[3]

Photo by Dwayne Beck.

Spring field peas can improve subsequent wheat yields, and may be an excellent addition to the rotation—especially now that they're a "program" crop under the new U.S. Farm Bill. Scientists have not fully explained the yield response to crop rotations, yet almost every study finds a yield response.

The rotation effect has been attributed to a multitude of factors, such as changes in soil moisture levels, nutrient cycling and availability, soil structure, soil microbial community, and pest infestations.[4] Understanding the causes and trends of yield responses to crop sequences will help scientists and producers develop more advantageous rotations. Therefore, this article will examine interactions among crops for impact on grain yield, with the goal of recognizing principles that can guide management decisions for sequencing crops.

Broadleafs Favor Grass Crops

Broadleaf crops usually increase yield of following grass crops, but identifying the specific cause of this yield response has been difficult. For example, A.T. Wright compared three legume crops, field pea (*Pisum sativum*), lentil (*Lens culinaris*), and faba bean (*Vicia faba*) for impact on barley (*Hordeum vulgare*) yield in

[1] Praveen-Kumar, R.K. Aggarwal & J.F. Power, 1997, Cropping systems: effects on soil quality indicators and yield of pearl millet in an arid region, *Am. J. Altern. Agric.* 12: 178-184.

[2] R.K. Crookston, J.E. Kurle, P.J. Copeland, J.H. Ford & W.E. Lueschen, 1991, Rotational cropping sequence affects yield of corn and soybean, *Agron. J.* 83: 108-113. *(Editors' Note: Kent Crookston points out, "Remember we're getting that yield increase after doing everything we can to overcome problems of continuous corn. What if we didn't use insecticides, fertilizer, and herbicides?" [from Larry Reichenberger, Magic of crop rotation is still a mystery,* Farm Journal, *mid-Jan. 1996.] See also the Morrow Plots at U. Illinois:Champaign-Urbana, where rotations have been compared for 125 years. Recent data show continuous corn to lag the rotated plots by ~ 50 bu/a when "recommended" rates of N-P-K and lime were used. The yield advantage to the rotated corn is even greater in the subplots receiving no fertilizers or amendments.)*

[3] F.J. Pierce & C.W. Rice, 1988, Crop rotation and its impact on efficiency of water and nitrogen use, in *Cropping Strategies for Efficient Use of Water and Nitrogen*, ed. W.L. Hargrove, American Society of Agronomy.

[4] L.T. Kurtz, L.V. Boone, T.R. Peck & R.G. Hoeft, 1984, Crop rotations for efficient nitrogen use, in *Nitrogen in Crop Production*, ed. R.D. Hauck, American Society of Agronomy. R.L. Higgs, A.E. Peterson & W.H. Paulson, 1990, Crop rotations: sustainable and profitable, *J. Soil & Water Conserv.* 45: 68-70.

Saskatchewan, Canada.[5] Barley responded equally to those preceding crops, yielding 21% more than if barley was the preceding crop. Searching for possible causes of the legume effect, Wright found that barley's yield response did not relate to differences in N cycling, soil moisture, or disease; he suggested the yield response could only be explained by the complex interaction of multiple soil factors.

Other research, analyzing multiple years of data from hundreds of producer fields in the traditionally continuous spring wheat region of Manitoba, found that wheat yields were significantly improved following broadleaf crops when compared to continuous wheat. Further, flax's (*Linum usitatissimum*) effect on subsequent wheat yield was substantially greater than the effect of field peas or canola (*Brassica napus*) as preceding crops.[6] The research also found that flax provided the most consistent wheat yield benefits. Flax is not a legume; thus, its yield stimulus on wheat must be related to factors other than N fixation. The scientists working on this study agreed with Wright—that multiple factors contribute to the broadleaf effect on grass crops.

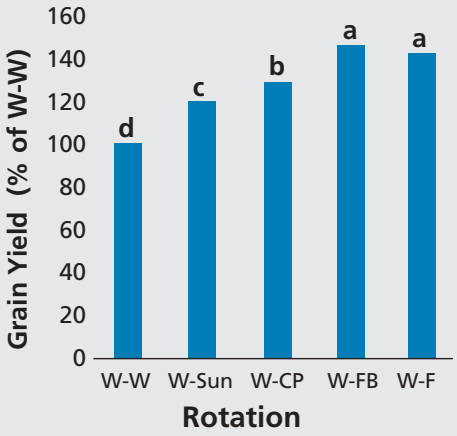
At a semiarid site in southern Spain, researchers examined the impact of sunflower (*Helianthus annuus*), chickpea (*Cicer arietinum*), and faba bean on winter wheat yield compared to continuous winter wheat. Wheat responded the most to faba bean, with yield 46% greater than if wheat followed wheat (see graph).[7] If sunflower was the preceding crop, yield increased 18%, whereas chickpea increased wheat yield 28%. Yield differences of wheat planted after sunflower vs. faba bean probably reflected differences in soil moisture available to the following wheat crop, as this yield difference did not occur in growing seasons with above-normal precipitation.[8] However, faba bean was always more favorable than chickpea, regardless of growing conditions. Applying N fertilizer did not eliminate the yield response of wheat to these two species, nor were differences in pests or diseases observed. These data suggest other factors caused the yield difference.

To better understand the broadleaf effect on wheat, it is helpful to differentiate between "N benefit" supplied by a legume and "non-N benefits," such as disease suppression, or the reduction of allelopathy associated with certain crop residues. Researchers in Saskatchewan found that the N benefit from a legume varied among years.[9] Other researchers had previously quantified the N and non-N benefits of field pea on wheat yields at several sites and found that the ratio of N to non-N benefits not only varied among sites but also was affected by cropping histories and growing season conditions.[10] Both research teams suggested devising rotations that include both legume and non-legume broadleaf crops to maximize the rotation effect on the cereal (grass) crop.

The research team in Minnesota, evaluating soybean

Photo by Matt Hagny.

Corn in broadleaf stubble is a desirable sequence in Canada, N. Dakota, or other parts of the northern Corn Belt where the short growing season (lack of heat) is more of a limiting factor for corn than is soil moisture storage. In most of Kansas and Oklahoma, the opposite is true—storing moisture and keeping the soil cool by mid-season are overriding concerns, so corn in broadleaf stubble isn't a good idea. Here, corn in soybean stubble suffers through a Kansas summer—it wasn't even a hot summer, by Kansas standards.



Impact of broadleaf crops on yield of winter wheat, compared to continuous wheat (W = winter wheat; Sun = sunflower; CP = chickpea; FB = faba bean; and F = fallow). Data are averaged across 7 years; study conducted at Cordoba, Spain. (Adapted from Lopez-Bellido et al., 1996.)

[5] A.T. Wright, 1990, Yield effect of pulses on subsequent cereal crops in the northern plains, *Can. J. of Plant Sci.* 70: 1023-1032.

[6] L. Bourgeois & M.H. Entz, 1996, Influence of previous crop type on yield of spring wheat: analysis of commercial field data, *Can. J. of Plant Sci.* 76: 457-459.

[7] L. Lopez-Bellido, M. Fuentes, J.E. Castillo, F.J. Lopez-Garrido & E.J. Fernando, 1996, Long-term tillage, crop rotation, and nitrogen fertilizer effects on wheat yield under rainfed Mediterranean conditions, *Agron. J.* 88: 783-791.

[8] L. Lopez-Bellido, R.J. Lopez-Bellido, J.E. Castillo & F.J. Lopez-Bellido, 2000, Effects of tillage, crop rotation, and nitrogen fertilizer on wheat yield under rainfed Mediterranean conditions, *Agron. J.* 92: 1054-1063.

[9] H.J. Beckie & S.A. Brandt, 1997, Nitrogen contribution of field pea in annual cropping systems: 1. Nitrogen residual effect, *Can. J. of Plant Sci.* 77: 311-322.

[10] F.C. Stevenson & C. van Kessel, 1996, The nitrogen and non-nitrogen rotation benefits of pea to succeeding crops, *Can. J. of Plant Sci.* 76: 735-745. *(Editors: The study showed a 43% yield response of wheat after field pea vs. monoculture wheat—a response that falls roughly in the middle of the range reported in other studies, and is often only partly mitigated by additional N fertilizer.)*

impact on corn, suggested that the broadleaf effect on corn was related to "corn being bad for corn" rather than a beneficial effect of soybean.[11] Further research by this team supported this hypothesis, as the broadleaf effect on corn did not differ among alfalfa (*Medicago sativa*), soybean, or sunflower.[12] They theorized that autotoxins from decomposing roots of the previous corn crop reduced yield in continuous corn.[13] *(Editors: Alternatively, undetected diseases or harmful insects could be causing the yield reductions in the continuous corn, with all three of the broadleaf crops in that study reducing those pest levels equally, and otherwise being agronomically superior to continuous corn in that climate.)*

Even though broadleaf crops are usually favorable for grass crops, in some situations they can be detrimental to following crops. For example, on the semiarid plains at Akron, CO, sunflower was found to decrease yield of winter wheat.[14] Comparing two rotations, wheat >>sunflower >>summerfallow, with wheat >>corn >>fallow, wheat yielded 32% less with sunflower in the rotation. Yield loss was partially attributed to less soil water at planting time of the winter wheat. The authors speculated that sunflower stalks were less effective than corn stalks for capturing snow, thus reducing recharge of the soil profile during fallow. *(Editors: Infiltration & evaporation differences between sunflower and corn stubble likely account for more than snowcatch; indeed, the scientists conducting the study did observe more water ponding and soil crusting in the sunflower rotation versus the corn rotation.)*

In the study at Akron, in a wheat >>sunflower >>summerfallow rotation, sunflower reduced winter wheat yield 36% when compared with a benchmark rotation; in contrast, wheat yield was reduced only 8% with a wheat >>corn >>sunflower >>fallow rotation. Furthermore, a disturbing trend occurred with the wheat >>sunflower >>fallow rotation—wheat yield decreased over time, declining from 81% in 1994 to 48% in 1999 (see graphs), whereas wheat yield in wheat >>corn >>sunflower >>fallow remained above 90% in 5 years out of 6. Wheat yields in 1995 and 1998 with wheat >>corn >>sunflower >>fallow reflect precipitation extremes: above normal in 1995 and below normal in 1998. However, yield in wheat >>sunflower >>fallow declined 7% per year ($r^2 = 0.86$) regardless of precipitation. The explanation for this trend has not been determined, but lengthening the rotation by adding corn ameliorated sunflower's negative impact on wheat yield. *(Editors: Again, probably a moisture-storage effect.)*

Effects on Broadleaf Crops

Comparing sorghum and corn as preceding crops for corn, yield was reduced 20 to 25% if sorghum was the preceding crop. Yield loss was attributed to allelopathy.

Most of the research exploring rotation effects has focused on improving yield of grass crops, such as corn or wheat. However, the rotation effect also occurs when grasses precede broadleaf crops. In one study, soybean yield was increased 17% if rotated with corn, compared to continuous soybean.[15] The researchers were unable to identify the cause of this yield response. A study in Saskatchewan found that flax yielded more when grown after wheat compared to after canola, another oilseed crop.[16] Flax's yield response to wheat stubble was attributed to reduced diseases as compared to canola stubble.

Similar Crops, Fewer Benefits

Rotating within a crop type, such as between flax and canola or between wheat and barley, is not as favorable as between crop types. The difficulty with sequencing broadleaf crops together is that plant diseases usually proliferate. Karen Bailey, with Agri-Food Canada at Saskatoon,[17] cautions producers from growing broadleaf crops—especially oilseeds—too frequently because of disease problems. Furthermore, oilseed and legume crops can serve as common host plants for pathogens that infest both crops, such as *Sclerotinia*. If such plant pathogens are present, broadleaf crop frequency may have to be reduced to avoid extensive disease infestation. She suggests mixing a diversity of grass crops with oilseed and legume crops in long-term rotations.

Alternating grass species usually does not impact yield as much as rotating broadleaf crops with grasses. For example, a rotation study in Turkey showed that winter wheat

[11] Crookston et al., 1991.

[12] P.M. Porter, R.K. Crookston, J.H. Ford, D.R. Huggins & W.E. Lueschen, 1997a, Interrupting yield depression in monoculture corn: comparative effectiveness of grasses and dicots, *Agron. J.* 89: 247-250.

[13] S.E. Nickel, R.K. Crookston & M.P. Russelle, 1995, Root growth and distribution are affected by corn-soybean cropping sequence, *Agron. J.* 87: 895-902.

[14] R.L. Anderson, R.A. Bowman, D.C. Nielsen, M.F. Vigil, R.M. Aiken & J.G. Benjamin, 1999, Alternative crop rotations for the central Great Plains, *J. Prod. Agric.* 12: 95-99.

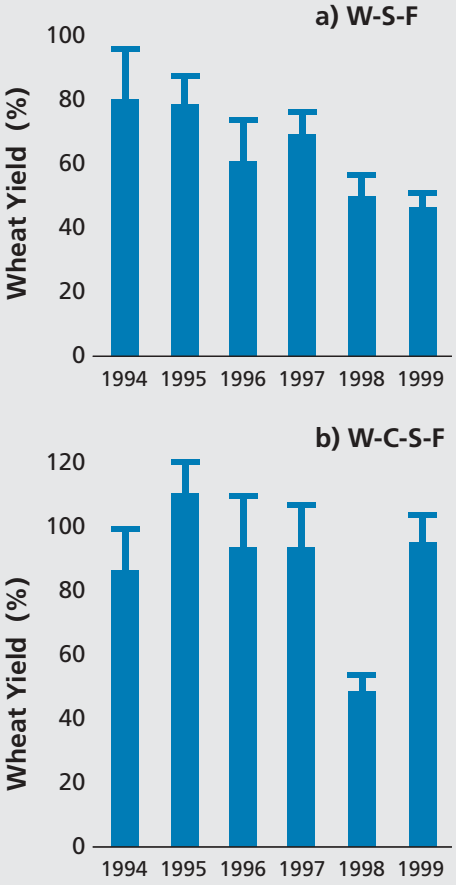
[15] Crookston et al., 1991.

[16] Beckie & Brandt, 1997.

[17] K.L. Bailey, 1996, Diseases under conservation tillage systems. *Can. J. of Plant Sci.* 76: 635-639.

yield did not differ between a wheat >>barley rotation and continuous wheat.[18] In contrast, rotating wheat with safflower (*Carthamus tinctorius*) increased wheat yield 32%. Soil water and N levels at wheat planting were similar in both rotations, suggesting that other factors improved wheat growth after safflower.

Certain grass sequences can be detrimental to yield. In the Great Plains region of the United States, planting winter wheat into sorghum residue reduced grain yield 15 to 30%, compared to wheat planted into pearl millet stubble or fallow.[19] Yield loss was attributed to allelopathic compounds released by decomposing sorghum residue. Sorghum also was detrimental to corn in Ghana (on the west coast of Africa).[20] Comparing sorghum and corn as preceding crops for corn, yield was reduced 20 to 25% if sorghum was the preceding crop. Yield loss was attributed to allelopathy and N immobilization by sorghum residue.



Impact of sunflower on winter wheat grain yield in two rotations at Akron, Colorado: a) wheat >>sunflower >>fallow (W-S-F); and b) wheat >>corn >>sunflower >>fallow (W-C-S-F). Wheat yields in these rotations were compared to wheat yields in a benchmark rotation of wheat >>corn >>proso millet >>fallow. (Adapted from Anderson et al., 1999.)

However, other grass crop sequences can increase crop yield. A long-term rotation study at Akron, CO demonstrated that growing corn in place of proso millet in a rotation improved winter wheat efficiency in converting water into grain.[21] In a wheat >>corn >>fallow rotation, wheat produced 3010 kg/ha with 250 mm of water use; in contrast, wheat in a wheat >>proso >>fallow rotation produced only 2060 kg/ha with the same water use. With corn instead of proso in the rotation, wheat produced 46% more grain with the same water use.

Longer intervals favor the natural decline of pathogen populations in the soil.

The rotation effect appears to be a universal phenomenon, and can be beneficial with appropriate crop sequencing. A guiding principle in designing rotations is to diversify crops as much as possible, especially using both grass and broadleaf crops. However, it is difficult to extrapolate across all crop combinations, soil types, and environments. For example, soybean's effect on corn was more pronounced in low-yielding environments,[22] contrasting with cool-season grass crop (wheat, barley, etc.) response to broadleaf crops, which was more pronounced in high-yielding environments.[23] These contrasts suggest that the complexity of crop/soil/environment interactions may lead to anomalies among crop combinations.

Length of Rotation Important

Crop yield is affected by how frequently the crop is grown. This concept, known as the "crop interval," is simply the number of years since the crop was last grown. Longer intervals favor the natural decline of pathogen populations in the soil.[24] The optimum interval varies among crops and climatic conditions. Corn's optimum interval was 2 years in Wisconsin, 3 years in Minnesota, and 4 years in Nebraska,[25] whereas soybean's highest yield occurred with a crop interval of either 2 or

[18] N. Durutan, K. Meyveci, M. Karaca, M. Avci & H. Eyuboglu, 1988, Annual cropping in dryland areas of Turkey, in Proceedings: Challenges in Dryland Agriculture Conference (Bushland TX, 15-19 August 1988), ed. P. W. Unger et al., Texas Agric. Exp. Stn.

[19] C.M. Roth, J.P. Shroyer & G.M. Paulsen, 2000, Allelopathy of sorghum on wheat under several tillage systems, *Agron. J.* 92: 855-860.

[20] G. Schmidt & E. Frey, 1988, Crop rotation effects in northern Ghana, in Proceedings: Challenges in Dryland Agriculture Conference (Bushland TX, 15-19 August 1988), ed. P.W. Unger et al., Texas Agric. Exp. Stn.

[21] Anderson et al., 1999.

[22] P.M. Porter, J.G. Lauer, W.E. Lueschen, J.H. Ford, T.R. Hoverstad, E.S. Oplinger & R.K. Crookston, 1997b, Environment affects the corn and soybean rotation effect, *Agron. J.* 89: 441-448.

[23] Bourgeois & Entz, 1996. Lopez-Bellido et al., 1996.

[24] R.J. Cook & R.J. Veseth, 1991, *Wheat Health Management*, American Phytopathological Society Press.

[25] M.G. Lund, P.R. Carter & E.S. Oplinger, 1993, Tillage and crop rotation affect corn, soybean, and winter wheat yields, *J. Prod. Agric.* 6: 207-213. Porter et al., 1997a. T.A. Peterson & G.E. Varvel, 1989, Crop yield as affected by rotation and nitrogen rate, *Agron. J.* 81: 735-738.

Photo by Brian Lindley.

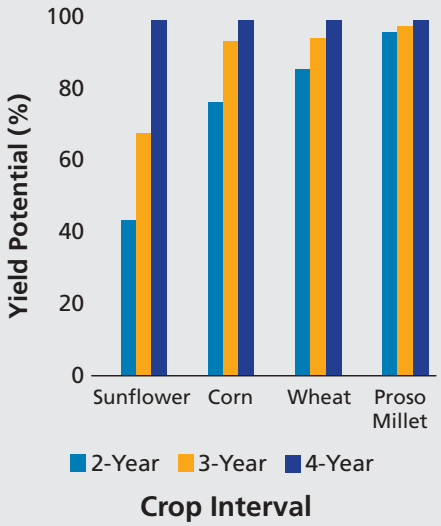
Long intervals, good sequences—the art of crop rotation. Kansas producer Doug Palen's second-year ('stacked') soybeans. Looking closely, one can see the upright stubble from the first-year soy, as well as plentiful corn stalks left from the two years of corn that preceded the two soybeans. After this soybean crop comes off, the field will go to wheat for two years.

3 years.[26] Winter wheat yielded the most in the Pacific Northwest when grown once every 3 years.[27] *(Editors: Often the stated "optimum" or highest-yielding interval is simply the longest interval included in that particular study; i.e., longer intervals may provide some additional yield enhancement, but those very long intervals were not studied.)*

In a study at Akron, CO comprised of four crops, sunflower was the most responsive to crop interval, yielding the most if grown once every 4 years (see graph).[28] When grown more frequently, soil-borne diseases such as phoma (*Phoma macdonaldii* Boerma) severely reduced sunflower yield. Grass crops were less affected by crop interval; yields of corn and winter wheat were reduced when grown every 2 years compared to a 4-year interval, but proso millet was not significantly affected by crop interval. These data affirm Bailey's concern about plant diseases proliferating if broadleaf crops such as sunflower are grown too frequently.

Weed management was improved by a cycle of four crops with two winter-annual crops followed by two summer-annual crops; this design favored the natural decline of weed seeds in the soil.

Crop growth can be further improved by arranging different crops in a series of four. Researchers evaluating rotation length in a rainfed region of southwestern France, found that a four-crop rotation was more productive compared to rotations with fewer crops.[29] In studies at Akron, weed management was improved by a cycle of four crops with two winter-annual crops followed by two summer-annual crops; this design favored the natural decline of weed seeds in the soil, thus reducing weed densities in future crops.[30] Research in Canada found that N fixation by lentils increased in rotations with four different crops compared to rotations of fewer different crops.[31]



Yield potential is improved by longer rotations, as shown in this research conducted at Akron, Colorado. Data were derived from sequences for Sunflower: S-M (proso), W-S-F (fallow), W-C-S-F; for Corn: M-C, W-C-F, W-C-M-F; for Proso Millet: W-M, W-M-F, W-C-M-F; for Winter Wheat: W-F, W-C-F, and W-C-M-F. The exact sequences used will affect the outcome somewhat, as moisture recharge, allelopathy, and pest potentiality are altered. (From Anderson et al., 1999.) Many other benefits go along with longer rotations.

These studies suggest that designing rotations to lengthen intervals can enhance the sequencing effect. Longer rotations may accrue additional yield improvements through multi-year benefits. Wright found that the broadleaf effect on cereal grains persisted for two cereal crops.[32] Thus, crop rotations could be devised where positive interactions occur among several crops in a series.

[26] B.G. Meese, P.R. Carter, E.S. Oplinger & J.W. Pendleton, 1991, Corn/soybean rotation effect as influenced by tillage, nitrogen, and hybrid/cultivar, *J. Prod. Agric.* 4: 74-81. Porter et al., 1997b.

[27] Cook & Veseth, 1991.

[28] Anderson et al., 1999.

[29] P. Debaeke & A. Hilaire, 1997, Production of rainfed and irrigated crops under different crop rotations and input levels in southwestern France, *Can. J. of Plant Sci.* 77: 539-548.

[30] R.L. Anderson, 1998, Designing rotations for a semiarid region, in Proceedings: 10th Annual Meeting, Colorado Conservation Tillage Association (Sterling CO, 4-5 February 1998), Colo. Conserv. Tillage Assoc. *(Editors: See also* Leading Edge*, Dec. 2001, for a discussion of long-interval 'stacked' rotations and their role in reducing pest populations.)*

[31] A. Matus, D.A. Derksen, F.L. Walley, H.A. Loeppky & C. van Kessel, 1997, The influence of tillage and crop rotation on nitrogen fixation in lentil and pea, *Can. J. of Plant Sci.* 77: 197-200.

[32] Wright, 1990. *(Editors: Other studies also indicate positive rotational effects persisting beyond a single year.)*

Managing Yield Variability

In rainfed agriculture, especially in semiarid regions, a continuing problem for producers is erratic precipitation and subsequent yield variability. Diversifying crops in rotations can moderate the effect of drought on crop yield by improving water-use efficiency. For example, one study has monitored corn yields over 35 years as affected by crop rotation. Compared to continuous corn, *not only was grain yield increased, but yield variability of corn was reduced two-fold in diverse rotations.*[33] In evaluating the study, the researchers attributed this response to improved root growth of corn. Other researchers have also reported that diverse rotations improved water-use efficiency of corn in dry years.[34] Similarly, the rotational studies from India found that during dry years, pearl millet was more productive when grown in a diverse rotation because the crop used the limited water supply more efficiently.[35]

Photo by Doug Palen.

Palen's wheat.

Crop diversity can stabilize yields from stresses beyond dry weather. One study has found that year-to-year *variability* in production of *all* crops was lowest in rotations with the most diversity.[36] At Akron, in a traditional winter wheat >>summerfallow region, yield variability was reduced 15% with diverse rotations compared to wheat >>fallow.[37] Producers in a winter cereal production area of Australia found that adding broadleaf crops to their rotations not only improved farm productivity and profits, but also increased management flexibility and income stability because of diversified income sources.[38] Diverse crop rotations can aid producers in minimizing the 'boom or bust' cycles that are common in drier climates.

[33] C.F. Drury & C.S. Tan, 1995, Long-term (35 years) effects of fertilization, rotation, and weather on corn yields, *Can. J. of Plant Sci.* 75: 355-362.

[34] W.W. Sahs & G. Lesoing, 1985, Crop rotations and manure versus agricultural chemicals in dryland grain production, *J. Soil & Water Conserv.* 40: 511-516.

[35] Praveen-Kumar et al., 1997.

[36] J.D. Smolik, T.L. Dobbs & D.H. Rickerl, 1995, The relative sustainability of alternative, conventional, and reduced-till farming systems, *Am. J. Altern. Agric.* 10: 25-35.

[37] Anderson et al., 1999.

[38] S. Lockie, A. Mead, F. Vancaly & B. Butler, 1995, Factors encouraging adoption of more sustainable crop rotations in south-east Australia: profit, sustainability, risk and stability. *J. Sustain. Agric.* 6: 61-79.

Photo by Brian Lindley.

Doug Palen's first-year milo following two years of high-yielding wheat. The heavy thatch of wheat stubble stores considerable moisture, which the milo is good at converting into grain.

Editors, Again: The message that shines through the fog of data: Long intervals are very good for improving yield and reducing pests. When combined with economic realities such as the need for low overhead and reduced risk, the diverse rotations necessary for long intervals look all the better. Choosing and arranging the crops in ways that enhance each other will be somewhat dependent on details of climate, soil ecology, farming practices, and crop genetics, although certain sequencing effects will be universal.

'03 Whirlwind Expo in Review

This crisp new event from No-Till on the Plains was a smashing success right out of the box, however you measured it. From the enduring energy of the crowds to the sharp exchange of ideas, the show was a class act.

Day One was at the Doug Palen farm, south of Glen Elder, KS, with Day Two hosted at Ron Jacques' south of Hutchinson, KS, and Day Three in northern Oklahoma at David Young's, Tom Cannon's, and Tony Kodesh's, with other stops mixed in. Attendance was strong, with 70 to 110 at each site. The format included both focused presentations and in-the-field discussions. In case you missed out, a few of the highlights:

Photo by Brian Lindley.

Photo by Tom Will.

Photo by Brian Lindley.

(Top) Bob Wolf, KSU sprayer specialist, demonstrates nozzles and pressure variation.

(Right) Ray Ward examines structure in Palen's loess soil.

(Bottom) Bud Davis describes the destructive forces unleashed by raindrop impact on bare soil.

Bud Davis, a NRCS agronomist, used the rainfall simulator to visually (shockingly) demonstrate the value of residue for water infiltrating the soil. "A raindrop strikes the soil with enormous energy—basically like a bomb going off—which breaks loose the soil particles and clogs the macropores. Stubble disperses the force from that impact and protects the soil."

Ray Ward, soil scientist and founder of Ward Laboratories, explained the natural formation of soil structure (occurring in the absence of tillage) as primarily being biological in origin—polysaccharides, or long chains of sugars, bind the miniscule soil particles together into crumbs or 'aggregates.' Good soil structure has benefits beyond improving plant rooting, explained Ward: "The nitrogen ion is held inside the soil aggregate, where it is less prone to water leaching it away. This is good news, not only for the farmer, but also for people concerned about groundwater."

Ward further explained the chemical processes involved with soil tillage: "When you light a fire, what happens? The wind comes up, because the fire is drawing oxygen. The same thing happens when you till the soil—you introduce oxygen, which the microorganisms use to decompose organic matter. You're rapidly 'burning' off the soil's organic matter . . . . Leaving the soil undisturbed is the slowest burn. So if you want more organic matter in your soils, don't do tillage." After examining the root development in pits dug in Palen's, Jacques', and Kodesh's fields, neither Ward nor Paul Jasa (equipment researcher at U.Neb.-Lincoln) could find any root-restricting layers that would benefit from ripping.

Greg Scott, a NRCS soil scientist in Oklahoma, explained that the exchange of air through the soil must be continuous—the supply of oxygen feeding the roots and microorganisms can be depleted very quickly. Scott noted that the structure occurring in untilled soils, such as pastures or long-term no-till cropland, allows this continuous air exchange from deep within the soil.

Matt Hagny, an agronomic consultant, presented ideas for improving crop rotations: "You do the preventive maintenance on your machinery, why not on your rotations? Don't wait until you have a major problem before taking action." He later elaborated, "Can you make a two-crop rotation like wheat >>wheat >>milo >>milo work? —Yes, but would it be better with more crops? —Yes; the two-crop

Photo by Brian Lindley.

Photo by Matt Hagny.

(Top) Doug Palen & Matt Hagny talk agronomy in Palen's field.

(Bottom) Paul Jasa explains planter attachments at Jacques' farm.

Photos by Matt Hagny.

(Top) David Young discusses production of corn, which has made a strong showing in his area during the past decade. Young has been 100% no-till for 5 years, and the success is apparent.

(Bottom) Day Three of the Expo, the crowd listening intently to Paul Jasa on no-till seeding methods. David Young's air drill in the background.

rotation needs more inputs to keep it going, and never really has the outstanding yields like the longer, more diverse rotations."

This sampling of quotes hardly conveys the magnitude of information and ideas exchanged during the 3 days—"whirlwind" is indeed a fitting descriptor for this blur of activity. See you in '04.

Photo by Matt Hagny.

Photo by Brian Lindley.

Photo by Matt Hagny.

(Top Right) Greg Scott describes natural soil aeration in continuous no-till; seedling double-crop milo visible.

(Left & Bottom Right) Ray Ward & Greg Scott discuss soil properties in Kodesh's long-term no-till; the field was '03 wheat, harvested with a stripper head, now with Group 5 double-crop soybeans growing.

Covered up

In eastern Kansas and Oklahoma, on fields going to cotton or soybeans next year, *winter* oats offers great potential to improve stand establishment and suppress weeds. Cotton seedlings especially can benefit from the shelter of upright residues keeping the wind off, as well as from the improved seedbed (well-drained) in which to establish roots. Oats tends not to carry diseases commonly found in wheat, and is therefore a better rotational break than cover crops such as rye or triticale.

Winter oats should be planted immediately after winter wheat seeding is finished. 'Dallas' is reportedly the most winter hardy variety currently available, although 'Walken' is not far behind. Neither is as winter hardy as 'Jagger' winter wheat, although the winter oats seems to be surviving reasonably well in no-till conditions in the south-central part of Kansas.

Photo by Matt Hagny.

Cotton in cover-crop winter oats. The oats certainly keeps the weeds and erosion to a minimum, but guessing the right termination timing is a year-to-year challenge.

The Law of Efficiency

by Roger Long

Every successful no-tiller has found a management scheme that fits their own set of environmental factors, profit goals, personal preferences, and ideals. From these variables, an infinite number of philosophies arise, with each manager developing a unique underlying theme that pervades their management decisions. For Robert Miller of Wellington, KS, one could say his theme is "Lean efficiency." You would have to travel far and wide to find a producer managing as many acres and growing five different crops with as little machinery and labor as what Robert uses. He values his current machinery inventory at just under $100,000, and has only himself as the labor force for approximately 3,000 acres of cropland.

Miller retired from the Kansas House of Representatives in 1996 and was farming about the same acreage as currently, but with two John Deere four-wheel-drive tractors, a couple 30-foot hoe drills, several field cultivators, discs, chisels and various other pieces of tillage equipment typical of that style of cropping. He also employed three to five full-time personnel to run all that equipment and get everything done in the narrow time window of a 100% continuous wheat operation. Remember, Miller farms about 30 miles south of Wichita in Sumner County, the heart of wheat country. So, all that equipment . . . and labor . . . to grow . . . wheat!

That was then. The adoption of no-till has produced a cascade of fruitful developments at the Miller farm. It all began when he started planting more summer crops as well as double-cropping them into wheat stubble. With the break from monoculture, "It just didn't make any sense to till." Both the time and moisture loss that came with tillage ahead of planting were unnecessary costs. Miller soon expanded that attitude towards all of his planting operations. He began attending no-till meetings, taking in the No-Till On the Plains conferences, and seeking out other successful no-tillers in his area—he credits a progressive group of no-tillers in western Cowley County as being his helpful mentors. Miller still farms roughly the same number of acres as he did with tillage, but now with greater intensity and economic return.

Once Miller escaped from monoculture, "It just didn't make any sense to till."

Photo by Robert Miller.

Miller planting cotton. Low overhead, good organization, and maximum efficiency are the rules for Miller's farm. If only the government ran this well . . . .

Photo by Roger Long.

Miller's milo, notably lacking in Johnsongrass.

Rewriting Rotations

As is the case with all successful no-till systems, a diverse crop rotation has been instituted. When asked for his typical crop rotation, Robert chuckles and pauses, "You mean, 'What do I try to do?'—I shoot for a cotton >>wheat /[double-crop] milo >>milo rotation. But that doesn't always happen." Weather, soil moisture, landlords, weed pressures, changing economics, and a healthy dose of ingenuity keep tearing and grinding away at the plan.

Miller takes pride in all that he does, but a noticeable passion exudes when he talks about his cotton programs. And why not? "With the summers we've had the past two years, the milo and soybeans have been looking pretty tough by [August], but the cotton has done well. For profitability, . . . year-in and year-out . . . cotton has done better than wheat, or even hundred-bushel milo for that matter." Those remarks are very understandable considering his best yield to-date came last year when he grew 980 lbs/a of dryland cotton. While not in his "planned" rotation, Miller

has had several fields each year in Roundup Ready soybeans. "I primarily used them to clean up weed problems, but now that I'm learning more about how to manage weeds in cotton, I'll be replacing the beans with cotton in those instances."

Miller has also been looking at double-cropping cotton after wheat harvest, and then following the double-crop cotton with another cotton crop before rotating to milo. The current unknown that could cause him to rethink this increased frequency of cotton in the rotation: how long the wheat stubble will last in the growing cotton. "If my wheat residue breaks down too fast, I'll have to back off the cotton a little bit." Spoken like a true no-tiller. *(Editors' Note: Other no-till producers in the region caution against leaving cotton or other broadleaf stubble over the winter without a wheat crop or cover crop established in it, due to the erosion potential. Also, milo would do better in conditions with more abundant stubble than what cotton provides.)*

"If you like to spend time on a tractor seat, you don't want to use no-till."

Strategic Alliances

For cotton scouting and production advice, Miller utilizes Rex Friesen, an entomologist working formerly in the Texas extension service and now as a consultant employed by the Southern Kansas Cotton Growers' Co-op (for which Miller serves as a board member). Miller notes that timeliness in catching problems as they develop (especially insects like fleahoppers, thrips, and bollworms) is one of Friesen's best attributes, but he brings other expertise to the table as well. At Friesen's urging, last year Miller had Farmers' Co-op Grain of Wellington apply a spray solution containing 20 pounds of actual N in the form of "feed grade" urea (feed grade tends not to 'burn' leaves like a fertilizer grade of urea)[1] during the boll development stage (early Sept.). Miller saw a significant increase in lint quality from that foliar N application compared to his adjacent fields without the treatment—good for a return on investment of 2 ½ to 1.

Photo by Roger Long.

Close-up of a cotton bloom (white flower) and green boll.

Photo by Roger Long.

Miller's cotton into milo stalks. Blooms are showing out the top of the canopy.

Miller's diverse rotation no longer necessitates being on every acre at the same time, resulting in considerable efficiency gains, although he still finds reason to rely on outside resources for some field operations. As he eased out of tillage, Robert slowly sold off the four-wheel-drive tractors and his tillage implements. He even downsized his grain drills. "I was really nervous about getting rid of my big drills, but I've found that I really don't miss them." With far less dependence on wheat, he's had plenty of time to get those wheat acres planted in a timely manner with smaller equipment. His operation is now comprised of a JD 4630, a JD 4440, a 12-row Case-IH 955 planter, and a 25-foot Crustbuster 4000 double-disc drill—and Robert. Noticeably absent is lots of expensive horsepower, tillage iron, and hired labor. You would also be hard-pressed to find spraying equipment. Miller does admit he will probably be buying a hooded sprayer next year for his cotton, and a spray setup on his ATV is currently employed to polish up field edges. Robert's reliance upon custom applicators sets him apart from most no-tillers—the relationship skills developed in Topeka undoubtedly serve him well as he works with the local co-operative to get his spraying done. "I'm fortunate that I have an excellent Co-op to work with. They can get things done very timely."

"If I was doing the harvesting myself, I would have needed four or five extra people to get the same thing accomplished."

All of his harvesting is hired done as well, which Miller sees as a huge labor savings, not to mention capital. "Since I'm my only labor, custom harvesters work out great. For instance, this summer while they were cutting my wheat, I was able to be planting cotton and milo." The timeliness of planting literally minutes after harvest is paying nice

[1] 'Feed grade' has lower levels of biuret, a molecular variation in which the two ingredients of urea joined up slightly differently. Biuret is more toxic to the leaf tissue of most crops as compared to the common urea molecule.

returns. The fall of '02 saw Miller strip a field of 900-pound-per-acre cotton and immediately plant wheat. He then harvested 58 bu/a of wheat this past July and right away double-cropped cotton in that same field. He now has a great-looking cotton crop for this coming fall. "If I was doing the harvesting myself, I would have had to have four or five extra people to get the same thing accomplished." He uses traveling crews for his wheat and then has neighbors do most of his fall harvesting.

Progress on Many Fronts

As with all good system changes, benefits are more than one-dimensional. Miller's soils are more productive now, for various reasons. Soil organic matter is up, and soil structure has also improved. When Miller began no-tilling with his current planter and drill, he added frame weight to get the down-force needed to go into his clay loam soils. After four to eight years of continuous no-till, Robert has noticed that his soils are more mellow now and so he plans to start removing some of that added weight.

Other differences are noticeable even from the infamous "50 mph drive-by." As you drive around in the Wellington area, Johnsongrass and bindweed are prevalent in many fields. But looking at Miller's fields, you discover a notable lack of the troublesome weeds found in neighboring tilled fields. Where did the Johnsongrass go? "After about four years of no-till you really see a big decline in the amount of Johnsongrass in a field. Just not dragging those roots around all the time with tillage equipment is what I think makes a huge difference."

A final observation: tilled fields in the area can't hide their bindweed patches—all residue is plowed under and you see one smooth plane that highlights each and every weed. Miller not only leaves the residue for vertical dimension, but has a crop growing (and fairly green for a drought) on nearly 100% of his acres (double-cropping after wheat is standard practice for him). Thus, a 'get-out-and-look' approach is needed for bindweed scouting. Then, when you do get out and browse around, Miller's fields are conspicuously absent of bindweed. He has replaced weeds with a harvestable crop.

Photo by Robert Miller.

The custom crew for stripping Miller's cotton.

Miller's propensity towards politics and public service didn't end when he left the House of Representatives. He now serves as a delegate to the National Cotton Council, the first and only producer from Kansas to serve (the National Cotton Council lobbies the U.S. Congress regarding policies affecting the cotton industry). If that wasn't enough, he plans to travel to Mozambique this fall to help farmers in the region after civil war decimated their social and political structure. Miller could serve up a resume listing his other board seats and numerous activities—if he had the inclination or time to write one. No, you won't find many wasted motions if you follow Robert around for very long. In fact, between farming, being an active philanthropist, and still taking time for family, he's a little hard to follow at all!

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