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No-till On The Plains

No-till for Profitability

by Roger Long

Curiosity may have killed the cat but it prompted this Lebanon, KS farmer to try a new way of growing crops. When asked what prompted him into no-till, the first response was, "Curiosity, I guess! . . . I was intrigued with the idea of being able to grow crops other than wheat." That curiosity, along with the urging of a consultant specializing in no-till systems (Matt Hagny) and friends throughout the country, got Kent started with part of his acres in no-till in 1994. By 1997, Kent had switched completely to no-till.

Photo by Tim Christian.

Kent Stones, Lebanon, KS, strives for precision no-till seeding with his Flexi-coil air drill with modified FSO openers.

Kent tells a story of a past attempt to build soil. "The '85 Farm Bill mandated conservation compliance. I was out with a NRCS technician and mentioned that 'I'll be glad to get these terraces finished so I can start building some soil.' The technician pointed out that I wouldn't be *building* soil. He told me that the average soil loss for the area was eight tons per acre per year and that with the terraces, I would be only losing about four tons per acre. My thought was that it would now take me twice as long to ruin my farm." Kent saw no-till as a way to build soil by increasing residue, increasing organic matter, and virtually eliminating erosion. The interview with Kent was taken on a combine while harvesting sunflowers. The 160-acre field was two separate 80-acre fields two years ago. Kent had one of the 80s in no-till for over four

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Photo by Tim Christian.

During a summer tour, Kent explains his changing rotations and the role of cropping diversity in helping him achieve his profitability and risk-management objectives.

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Just what is this organization, and where did it come from? We understand your confusion, what with all the personnel changes, moved offices, varying phone numbers, and (now) even a name change. No, we're not schizophrenic—just a very young organization struggling to serve our agricultural origins, to provide a conduit for information and ideas, and sometimes struggling just to survive. But one thing has kept us focused: as always, we are *"by farmers, for farmers."*

Photo by Tim Christian.

In addition to a Winter Conference, No-Till on the Plains offers many other educational activities, such as the bus tour across Kansas last summer. Here, tour participants discuss details of no-till drill openers at a stop at Kent Stones' farm.

A bit of our history might clarify things. In the late 1980s, Bill Richards, then Chief of USDA's Soil Conservation Service (now Natural Resources Conservation Service, or NRCS) conceived the idea for a coalition to provide education on the methods and benefits of reduced tillage, especially for curbing wind and water erosion and for helping producers comply with the conservation provisions of the '85 U.S. Farm Bill. Within the framework of Richards' 'National Crop Residue Management Alliance' were to be state organizations to further those educational goals. In exploring the possibility of such an entity by Kansas' NRCS leadership, Tim Christian with NRCS and Pat Murphy with K-State Ag Engineering were tapped to organize the first meetings in 1990 in Salina, at which about forty separate interests were represented, including federal and state agencies, conservation districts, agribusinesses, and individual farmers. The fruition of those meetings was the 'Kansas Crop Residue Management Alliance' (KCRMA).

From the outset, the leaders recognized that the organization was to fulfill a need not being accomplished by NRCS or K-State Extension. During the formative process, Bud Davis (NRCS) was the strongest proponent of creating the organization outside of NRCS,

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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.

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no-till: "You have more grain to deal with, so you need more bins and your combine wears out faster." What a tragedy!

Envision, then Get After It!

An advantage to no-till is that they are able to have their own grain handling facility and trucking capabilities. Without the countless hours spent in tillage operations, Kent has more time to expand the scope and control of how his crops are taken to market. "Our philosophy has always been to extend our involvement of the production of the crop." Having their own combine, grain bins, and over-the-road semi allows them to take advantage of more marketing options. The on-farm grain bins allow them to market identity preserved grains and to extract market premiums from many of their crops. "We are currently growing crops under contract for three different companies." He normally has 60 to 65 percent of his crop contracted for sale before harvest and would like to have 100 percent of his crop contracted before harvest. With a vastly more diverse crop mix and unique harvesting times, the grain bins also provide a harvesting convenience compared to waiting for local elevator operating hours.

"If you look ten years down the road, don't you think almost all of the acres will be in no-till? If that is true, then why not get there now?"

Kent places a very high value on having relationships with processors. He has been working toward producing as few 'commodities' as possible. "I think you have to look 10 years down the road and see where you need to be." Once you see where it is you want to be, then "Get after it!" Being a "price taker" of commodities is tough and "it's only going to get tougher." That is why Kent believes it is very important to "position" yourself with processing companies now. That same philosophy carries through to why he has converted to no-till: "If you look ten years down the road, don't you think almost all of the acres will be in no-till? If that is true, then why not get there now?"

'Cerebral' Rotations

Kent has added several new crops with the implementation of no-till. Their conventional tillage break out of crops consisted of 50 percent wheat, 25 percent milo, and 25 percent summerfallow. His crops under management now are: wheat, corn, milo, soybeans, sunflowers, and alfalfa. "Cropping diversity and intensity are key principles in a no-till system." His typical rotation consists of wheat >>corn or milo >>soybeans or sunflowers and then immediately to wheat. He has also been successful with adding 'stacking' to his rotation, meaning that a particular crop is grown back-to-back (2 consecutive years) in the same field within the context of a longer rotation. Kent has stacked all of the crops at one time or another with the exception of sunflowers. He especially likes the yields of the soybeans after soybeans. Currently, he's looking for a broadleaf winter annual to add to his rotation. He expresses some interest in canola, since he has a friend who had a very positive experience with the crop this past year.

Economics do play a role in his rotation decisions. "We have been steadily increasing our stacked corn and milo in the rotation. Generally, we've been dropping milo out in favor of more corn." Kent is noticing that milo and sunflowers aren't pulling their weight for profitability and so he's moving more towards corn and soybeans to fill those places in the rotation. "On our better soils, we will do corn >>corn and then to sunflowers or soybeans, but on poorer soils we go corn >>milo and then to the broadleaf crop or crops. As our soils continue to improve under no-till, we may end up doing stacked corn on some of those thinner soils as well." Kent keeps wheat on 20 to 33 percent of his acres. Wheat is currently on about 20 percent of his acres but if it were more profitable it would be higher because of the increased residue it leaves behind. Kent concedes that even in very low-disturbance no-till, it is sometimes difficult to keep as much residue on the surface as he would like. His Lebanon area receives an average of 23 inches of precipitation per year

Photo by Roger Long.

Keeping large amounts of crop residues on the soil surface is critical to Kent's ability to turn more moisture into grain with intensified rotations. In addition to the standing 'flower stalks, note the previous year's milo stalks, and 2-yr. old wheat stubble (even older residues are visible to the discerning eye).

so producing large quantities of biomass is not always accomplished.

When asked which rotation is more difficult to manage, Kent's response was that his no-till rotation is more "cerebral" than the old wheat and milo mix but is much less stressful from a manpower standpoint. The more diverse crop mix also creates a more diverse planting and harvesting schedule. They no longer have big crunch times of extremely long working days. They also no longer have extended periods of idle time so their workload stays relatively even. Besides Kent and Cindy, the operation has only one other full-time employee, since no-till and diverse rotations help reduce total labor needs. Cindy spends about 40 hours per week in the office on accounting and financial activities. Perhaps the most important aspect for Kent is the lifestyle: "You spend less time in the field and more time with your family. You show more respect for their needs."

"You can't really be 1000 percent better at any one thing but you can be 1% better at a thousand different things."

Soil testing is done regularly and fertilizer applications are made accordingly. For corn and sunflowers, he broadcasts approximately 90 percent of the nitrogen requirements in the winter as urea and the balance is applied with the planter in a '2x2' placement (actually 3x0, or 3 inches away from the seed furrow and about the same depth as the seed). All of his phosphorus goes on at planting in a 2x2 or in the seed furrow, and sometimes he uses both 2x2 and furrow placement at the same time. He doesn't use any anhydrous ammonia because of the negative impact on the soil. "I want my worms happy and prosperous." For wheat, Kent applies 11-52-0 with the seed, then top-dresses a urea blend during winter to supply his nitrogen and sulfur needs.

He has grid sampled his fields and some of those fields have been grid sampled twice within a four year interval. He has the capability to variably apply fertilizer with his seeding equipment and do variable seeding rates. Kent used grid samples to variably apply fertilizer and has seen the soil test variability reduced in the second set of grid samples. His contention is that grid sampling and site specific management have made him more profitable but he admits that it is difficult to point to any one particular facet. "I have more details and that makes me a better manager."

Photo by Kent Stones.

Stones' planter going into heavy wheat stubble.

"You can't really be 1000 percent better at any one thing but you can be 1% better at a thousand different things." Managing every component of crop production for profitability is what has led this no-till farmer to success. "I can't imagine what else I could have done with my background and education that would have been more financially rewarding."

Soil Health and the Limits of Human Knowledge

by Matt Hagny

PERSPECTIVE

Matt Hagny is a consulting agronomist for no-till systems, based in Salina, KS

I am often asked questions that force me to answer, "I don't know." Sometimes a check of the literature or industry professionals turns up a plausibly decent answer. Other times, none is forthcoming; sometimes this is merely a reflection of the amount of time available for searching, or an indicator of shortcomings in indexing or networking the knowledge base. In other cases it is quite likely that *no one* really knows the answers to the questions, and even the best guesses aren't that great. Some of the toughest questions have to do with soil health or what might be loosely defined as a diverse and robust ecosystem of soil organisms that can benefit vascular plants (crops). This is an area of study that is in its infancy. Just how naive we really are I hope to convince you.

In agriculture, we are confronted almost daily with 'opportunities' to improve our soils' condition or 'health.' Certain companies and no-till gurus have instilled these thoughts in our heads, and it has

Photo by Matt Hagny.

Growing high yielding crops under continuous no-till will improve soil 'health' in and of itself. Beyond that, *¿quién sabe?* (who knows?)

become quite fashionable to market many disparate products by claiming benefits to soil health. While we most certainly *should* be concerned about our soil ecosystems' health, what I sincerely doubt is we have anywhere near enough knowledge to do anything consistently to improve them.

When I was in Argentina two years ago, numbed by the ferocious adoption of no-till there and their remarkable level of expertise, I ran across a pleasant fellow who was a follower of Carlos Crovetto's. We spent several days with the fellow, touring his fields and going to meetings and field days and neighboring farms. This fellow was doing an excellent job with his rotations, as were many others we met in Buenos Aires province. His crops looked good and yielded well, as did many others' in the area. But he was applying some expensive and rather unusual fertilizer sources to his fields, and promulgated these practices for enhancing soil microbiology. We had several debates and discussions with others in the group. I was skeptical, and was not getting my point across (perhaps partly due to the translation, but mostly because my own thoughts were murky on these issues). Then the perfect analogy hit me. It was one I had used before, in a slightly different flavor, at a no-till symposium. But it was perfect here: I told them I would like to eat the foods and drink the wines that would allow me to live to be 300 years old, and to be able to think with incredible clarity at that age, and to be able to climb a jutting mountain in my 300th year. But since no one knows what those foods and wines are, I eat and drink whatever I want…. I shrugged. They laughed, but they also got the point (I think).

Healthy Living?

Think about the current state of understanding of the human body, medicine, and nutrition. Think about all the effort that has gone into studying human nutrition. How far along are we? First we hear that a certain food (say eggs, or beef, or butter) has all these negative effects. Then, a few years later, a study negates the first study, or discovers some new permutation (the food contains substance *x*, which prevents some other ailment), or that the substitute food (e.g., margarine for butter) is more harmful than the original. The long and short of it is that despite this field of study being highly relevant to each of us, and considerable time and money spent on it, we still do not know much. We still do not know if we should eat eggs, or not. Or avocados, or not. Or attempt a low fat diet, or not. Or pursue a low carbohydrate diet, or not. Or abstain from alcohol, or not.

My point being that our bodies are enormously complex and interactive, and still very poorly understood despite centuries of diligent scientific studies. In comparison, soil microbiology is perhaps even more complex, is likely even more variable, and is certainly less understood. Only in the last few decades has anyone even been vaguely aware that there's a lot more happening under our feet (when our feet are in the field, that is) than what is above ground. And the resources invested in studying these ecosystems is miniscule compared to what is spent on studying human health. It's preposterous for anyone to claim to know what's really going on in soil ecology, and even more silly for anyone to have any real grasp of what happens when nutrient *x* is added, or crop *y* grown, or herbicide *z* sprayed.

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Physician, Heal Thyself

Let's review some past follies of medicine, just to see where our arrogance has led us astray in the past. Just four or five centuries ago, blood-letting and leeches were commonly prescribed therapies for a wide range of afflictions. It was thought that these ailments were caused by bad blood, and getting rid of some of the blood helped. I've been to see physicians a few times over the years, and have yet to have one prescribe blood-letting. So we've moved beyond that.

Then there were the mistaken notions about malaria. Someone noticed that people usually contracted it when they went to swampy places—hence the name 'malaria,' from the Latin 'mal' for bad and 'aria' or air. Stagnant air was thought to be the causal agent, so swamps were drained. This worked, but for the wrong reason. We now know that mosquitoes vector the malaria virus. Mosquito netting would have been much cheaper, more effective, and less environmentally destructive than draining swamps, if only we had known.

Only recently has the medical field realized that most stomach ulcers are caused by bacteria, not stress, with profound implications for treatments being prescribed. Certain cancers have now been conclusively shown to be caused by infectious agents, rather than the traditional view of causation by damaged or mutated DNA. Other principles widely accepted within the medical community are being successfully challenged by new evidence and new theories. It has been said that scientific knowledge is like a small clearing in a vast forest of ignorance, and the clearing only gets larger by chopping down the trees on the fringes, often producing some new information that won't fit nicely within existing views, requiring the views to be revised or discarded entirely in favor of a new theory.

Some of modern medicine's mistaken notions have had dreadful consequences, Hippocratic oath notwithstanding. Thalidomide was once prescribed in Europe to alleviate the 'morning sickness' of pregnancy, but its use has since been discontinued upon the discovery of its ability to induce horrible malformation of the developing fetus' limbs.

A few grams of soil contains an entire ecology, with its members all doing something different as they go about their business of living and reproducing. Doing things to each other, to other species, to the mineral component of the soil, and to vascular plants, and the atmosphere!

So perhaps all that is history—we are now at a stage when we really can get medicine right. I doubt it. There are more debates than ever, and very few unambiguous precepts. Progress has been made, certainly, and lots of it, but there is much to be done yet. Still no cure for AIDS, or many cancers. Some 'cures' are very damaging. Some bacterial species are resistant to all or nearly all known antibiotics. We have sequenced the human genome, but have no idea how the vast numbers of proteins created by that genome will fold and interact with other molecules (protein folding is key to their functioning and holds the mysteries to many diseases and drug activity, giving rise to the new science called proteomics). We know that aspirin makes pain go away and thins the blood (and some of the mechanisms for these reactions), but do not know all the implications on every cell type and metabolic pathway. A clear indicator of the current state of our knowledge is that drug interactions and side-effects *are generally discovered, not predicted.* Perhaps in another century or two, we will have complete understanding.

Soils: Coming Back to Life

Getting back to soil microbiology. A few grams of soil contain an entire ecology, with species numbering in the tens of thousands—not the total number of *organisms*, which is in the billions, but number of *species.* Thousands of species. All distinct. All doing something different as they go about their business of living and reproducing. Doing things to each other, to other species, to the mineral component of the soil, and to vascular plants, and the atmosphere! Most species haven't even been identified and given names yet, let alone figuring out what they do for a living.

So we can't yet untangle that snarl of causation—the soil ecosystem is too complex, and science has a long way to go here, even further than in human medicine. For now, the best we can do is observe the more readily quantifiable macro effects. Since our end goal is to efficiently produce foods, fibers, and chemicals from vascular plants, we can measure the yields of those crops to see if we are bringing about the desired soil ecology. But this, too, is fraught with uncertainty. For instance, the initial tillage of the prairies unlocked the nutrients tucked away in soil organic material, which produced dramatic yield increases in the first few decades, but ultimately left the soil impoverished. We can easily imagine some similar early yield response to a (human induced) change in soil ecology, only to have the whole system crash even more dramatically a few years later.

So what can be done? What do we know with certainty? Well, just the fact that you are doing low-disturbance no-till is a good start. The simple fact that soil OM declines when a native prairie is tilled, and continues to decline with each additional tillage operation, but stabilizes and starts to rebuild[1] with no-till, tells us that there's a bigger ecosystem happening 'down under' when the soils are not tilled. Surveys of types of soil organisms (microbes to fungi to arthropods) show that there are higher numbers in every category when the soil is left undisturbed. Now, some of these are harmful to our crops, certainly, as anyone with take-all in their wheat or stalk rot in their milo or corn can attest. But most others are benign or even beneficial. One important beneficial group are the mycorrhizal (AM, formerly VAM) fungi. Many other beneficial organisms exist as well. The important thing to realize is that a more densely populated soil ecosystem leaves less room for some population explosion or imbalance to occur. Indeed, I think we see this. In tillage-based cropping systems, particularly monocultures, there is always some outbreak of this or that pest requiring intervention or nicking away at yields. This doesn't appear to happen nearly so often in well-managed no-till. Sure, we get nipped sometimes, but it just doesn't seem to happen nearly so often nor in such catastrophic degree.

No-Till on the Plains Inc. supports the activities of 13 local and regional farmer-led alliances. For information about upcoming events in your area, see the calendar of events on page 21 or check out our website at www.notill.org.

We shouldn't be surprised that no-till is a good habitat for soil ecology as well as our crops. All life is dependent on water, and no-till cycles the water much more effectively. Furthermore, no-till moderates temperatures and stabilizes gas exchange with the ambient atmosphere. Ecologies can usually handle small disruptions, but big ones cause major population changes, even to the point of mass extinctions and implosion of the ecosystem. As Dwayne Beck has pointed out, from Nature's standpoint, tillage is a catastrophic event.

Okay, so you're not doing any tillage. What else can we do to improve soil health? My answer is "nobody knows." While I don't disagree that the substances we apply directly or indirectly to the soil (not just fertilizers and lime, but also herbicides and insecticides and fungicides and adjuvants)—and the choice of which crops to grow—certainly can and do have major effects on the soil ecosystem, I assert that we haven't a clue as to which are beneficial and which are harmful. There just isn't enough knowledge —not even if you gathered up every soil microbiologist and plant nutrition person in the world and sucked all the information and ideas out of their heads and were able to instantly organize it all. We just don't know—get over it (and get back to worrying about whether those eggs you had for breakfast are helping or harming you, or is it just the act of worrying that is harmful??).

The mere act of growing high yielding crops in a low-disturbance no-till system will continue to build your soil's ecology by enlarging the pool of carbon and by improving the water cycling in that soil.

Make your decisions about crop inputs based on things that are (sorta) known and quantifiable —prices of the inputs, probabilities of yield responses, constraints on methods and timings of application, etc. Heck, we even struggle to get this macro-level stuff optimal, so how are we ever going to get it right on the micro scale? However, the mere act of growing high yielding crops in a low-disturbance no-till system will continue to build your soil's ecology by enlarging the pool of carbon and by improving the water cycling in that soil. Given the state of our current understanding, choosing or avoiding certain inputs based on supposed effects on soil 'health' is most likely pure folly.

Editors' Note: Matt does indeed live by his own advice—he eats and drinks whatever he pleases, but tends to favor a low-carb. diet supplemented by judicious consumption of red wine (and occasional excessive consumption of scotch). His copious consumption of Diet Mountain Dew flirts with largely unknown and potentially harmful consequences, but does appear to aid in his production of writings such as this article. His prognosis is that he will most likely die sometime this century, perhaps yet this week.

[1]Not all soils and climates exhibit rapid rebuilding of soil OM following the reversion to no-till. The reasons are not entirely understood, but include cropping intensity and amounts of fertilizers applied. Further, our current methods are not accounting for the quality (carbon-to-nitrogen ratio, etc.) of the OM—there's a difference between very old OM and newer OM. Some components of OM are known to be stable over centuries, other components exhibit a rapid turnover.

The following is from Dwayne Beck—a late-night entry in his Manager's Diary for Dakota Lakes Research Farm Inc., from www.dakotalakes.com and reprinted with permission (edited here).

SUBJECT: FERTILIZER PLACEMENT

DATE: 20 APR 1999

TIME: 00:54:21

There is always a great deal of discussion on what is the "best" method of fertilizer placement. The answer is "It depends." I heard Bob McNabb of Minnedosa, Manitoba say at a conference a few years ago that "many producers forget the first role of the seeder is to do a good job of seeding." In other words, fertilizer placement becomes their first priority. Fertilizer placement is not a limiting factor if a good uniform stand is not achieved. Placing excessive amounts of nitrogen, potash, thiosulfate, etc. with the seed can delay emergence without necessarily reducing or eliminating the stand. The producer often thinks that there was no negative impact. Soil and moisture conditions can vary the impact appreciably.

So what do you do if you can't put the material all down with the seeder? Put on some P with the seed and do something else with the rest. In humid environments with no-till and abundant surface residues, broadcasting P appears to be perfectly acceptable from a plant uptake perspective (some environmental concerns may be raised with this practice on a long-term basis). In these regions, moisture remains in the surface layers throughout most of the growing season. Roots and VAM (mycorrhizae) stay active in this zone. In drier environments, there may be need for banding P. Don't disturb the seedbed to place P this year. Put all you can with the seed and work on changing the system before next year. Appreciable amounts of P can be placed with the seed if the N and some of the other compounds are applied elsewhere.

We have gotten a lot of calls in the last few weeks concerning N losses from surface applied urea (46-0-0) and UAN (28-0-0). It is true that significant amounts of N can be lost if urea or UAN are broadcast on the surface when conditions are wrong, but keep it in perspective. Losses do not always occur. If it is cool and it is going to rain in a few days the loss will be low to minimal. If you are surface stripping the material (a one-inch band every 15 inches for example) you can greatly reduce the potential for loss. Even if you lose 10% of a 100 lb/acre application it is worth $2.00 or less this year. Knifing will cost you more than that and you could spend even more cleaning up the weeds that result.

Don't get me wrong. I am a strong proponent of fertilizer placement with the seeder but it is more from the standpoint of increasing the competitiveness of the crop relative to the weeds than it is from increasing fertilizer efficiency. The other issue is to increase workload efficiency by having a one-pass operation. There are other ways to get the N and P on that will work until you or someone else gets the engineering right for placing it all with the seeder. It just takes some planning and looking at the weather forecast.

My last thought tonight concerns the large number of calls we receive concerning non-traditional fertilizers. The things that are predictable about a downturn in grain prices are that politicians will bluster, organic farming will get lots of press, and nontraditional fertilizers will come along that claim to perform miracles. I will not say there are not many unknown areas in understanding soil fertility—there are, but the cure is not magic. I am convinced of that. If the salesman talks about activating your microbes, unlocking tied up nutrients, balancing your soil, etc., beware that many of these pitches have been around before and didn't deliver on the claims. Don't spend short operating capital this year on magic. Concentrate on the basics. Many fertility responses occur because the plant does not have a healthy root system. Healthy roots growing in healthy soils (good biology) seem to find what they need quite well as long as we have done a reasonable job of assuring there is enough present (soil test). There is magic in that but it doesn't come in a can, bag, or tank. We produced 94 bu/a winter wheat, 70 plus bu/acre of soybeans, and over 230 bu/acre of corn last year with normal N and P plus good biology (and some luck). The P (50 to 70 lbs of 10-50-0) was placed with the seed. Most of the N was surface applied since we were still working on our placement system.

The bottom line is that you have to do the calculations. If it is questionable this year, don't do it or at least do a limited amount in replicated strips and weigh the results.

Editors' Note: The amounts of N and K that can be safely applied with the seed is limited, and varies by row spacing, crop species, and soil moisture conditions. Thiosulfate should never be applied in the seed furrow.

Beyond No-Till

By Bud Davis

Bud Davis is a NRCS state agronomist out of Salina, KS

PERSPECTIVE

When I began promoting no-till systems, I often said I believed we had just started farming in Kansas. I still believe this is true. The development of no-till has been like cooking a campfire stew; we've stirred in a lot of ingredients and each one influences the outcome, some good, some bad. As we progress with our no-till stew, we start to wonder what spices we might be missing….

Last summer I made a trip to Paraguay to see what I could learn in a nation that leads the world in no-till adoption. The week's activities consisted of a wild ride through the countryside (what they called a "tour"), a meeting of international no-till associations, and a regional "direct seeding" symposium that paralleled the annual No-till on the Plains Winter Conference in Salina, Kansas. One of the people I met during the week was Rolf Derpsch, one of the world's most highly regarded no-till researchers. Our group spent two days racing across Paraguay reviewing different no-till farming techniques and the use of biological systems to reduce input costs, guided by Derpsch and a 'livewire' Brazilian farmer of German descent named Herbert Bartz. My main challenge was to sort out what was being said at each stop through a variety of interpreters consisting of English, Spanish, Portuguese, French, German, and Guaraní. The translations were a constant source of laughter since our primary interpreter, the energetic Mr. Bartz, usually had multiple conversations going at once. At least 3 languages were spoken in the car along the route, and Bartz spoke them all (plus a couple of others) and was translating for everyone. In his enthusiasm, *Herr* Bartz sometimes forgot who needed which translation, and the English speakers would sometimes get the Spanish version while the Spanish speakers might get a mix of Portuguese and French, all intermixed with a heavy load of German! It didn't take long, however, to realize I was spending the week with the pioneers of no-till farming systems in South America, and that we in the United States are just beginning to understand what the no-till system really is.

Photo by Bud Davis.

South American farmer "rolling down" a cover crop. The blades on the roller drum crimp the vascular tissue of the plants, killing them. Cover crops are used extensively in Paraguay and parts of Brazil to reduce costs by suppressing weeds and recycling nutrients.

While on our tour we observed the incredibly rapid adoption of a farming system that included no-till and the use of cover crops. South American farmers are provided no subsidies and when a new farming system makes sense, makes money, and cuts their workload, the adoption rate is phenomenal. This no-till revolution was also aided by the efforts of men like Derpsch and Bartz and by public awareness programs carried out by the associations they represent. Derpsch's organization has concentrated on assisting the small farmer in the adoption of "cover management systems" and by providing the farms with a one-row no-till planter that is pulled by a horse or oxen. You won't be talking these farmers into plowing or disking anytime soon—they really know the meaning of a reduced workload! With the new farming systems, they've also tripled their income in less than five years.

The enthusiasm of these men opened my eyes to opportunities to improve the profitability of systems in the U.S. in ways that have mostly been ignored since many of our grandfathers passed away. Commercial fertilizers and USDA farm programs virtually eliminated

Photo by Matt Hagny.

Cover crops in Kansas: hairy vetch planted after wheat harvest. The vetch will overwinter and be killed with herbicides when the corn or milo is planted the next spring.

the use of crop rotations and cover crops. We now use pesticides, tillage, intensive crop breeding, and other technology as our 'solutions' to our agronomic problems. Our grandfathers had to raise crops without these luxuries and had to use their knowledge of biological methods to accomplish the same tasks. Now we need to learn this all over again.

A good no-tiller should have no qualms about borrowing some biological solutions from the 'organic' producer. This is what the South Americans have figured out.

Borrowing from 'Organic'

The most unlikely marriage would be a no-till farmer to an 'organic' gardener: can you imagine the disagreements? However, if our farming systems are to reach a new level of profitability these differing methods need to merge. Granted, you will probably never convince the 'organic' gardener that even limited use of man-made chemicals has a place in their gardening, but the use of biological systems that assimilate and recycle nutrients or cut weed and insect control costs definitely has a place in today's production agriculture. A good no-tiller should have no qualms about borrowing some of these biological solutions from the 'organic' producer. This is what the South Americans have figured out. Herbert Bartz uses viral infections as an insect control. They initially inoculated an insect that was causing crop damage (sorry, it was a South American bug that I didn't recognize) with a virus that would destroy the insect. After the insects die, some are collected, stored in a jar in the freezer, then ground up and mixed in the spray tank to replenish the fields with the controlling virus. And yet Bartz has no problem with using a dose of chemical pesticide when necessary—getting the best of both worlds.

Cover crops are another facet of biological solutions to problems encountered in production agriculture. What Derpsch and his cohorts are doing is using plants like the oilseed radish and black oats as "primary transition" crops in their rotations. The cover crops are planted between production crops such as wheat or corn; the cover crops utilize this short growing window to recover nutrients and/or create a better growing environment for the following crop, but are rarely allowed to reach maturity. The intentions are to get rapid growth from the cover crops to provide competition against weed populations and some allelopathic control, recycle nutrients, increase the organic matter, and improve the infiltration of the soil. A common cover crop species in Paraguay or Brazil is the oilseed radish *(Rhaphanus sativus)*, which grows very fast and has a tuberous taproot that creates a very large macropore, plus the plant recovers an incredible amount of nitrogen that would otherwise leach from the soil. Another cover crop in the region is black oats *(Avena strigosa)*, used for many of the same reasons but also being grazed sometimes to further utilize it. The South Americans had also done studies that showed the black oats improved the cation exchange capacity of the soil. After the cover crop has served its purpose, it is then "rolled down" prior to planting with a heavy roller fitted with crimping blades that knock down the plants and crimp the vascular structure of the stems to kill them without chemical treatment. In the Bartz system, the cash crops are planted directly into the standing green cover crop prior to rolling down. He has better seed placement with this method.

Cover Crops in Kansas

I can hear the rumblings now, "Never heard of these crops—they sure aren't grown here in Kansas." That was my first question to Derpsch. He said, "I don't know, but you have other crops that would work the same way. What about sunflower, soybeans, rye, oats, clovers, etc.?" I had to be reminded that most of our cash crops are introduced species anyway and just because the growing location is different, the principles are the same. Whether the focus is on nutrient recovery or assimilation, weed or insect suppression, infiltration rates, biomass production, or moisture management, there can be a vast number of plants and methods from which to select.

To date, limited research has been conducted in Kansas considering the use of cover crops and other biological controls. Whether the methods, management, or intentions were on target is beside the point. In most cases, the reports indicate that cover crops have very limited use in this state for production agriculture. But for every creative spirit with a new idea there are usually a thousand mediocre minds who say it won't work. Some of the 'lunatic-fringe' ideas just happen to be incredibly successful. So perhaps the use of cover crops in Kansas isn't so insane?

To effectively use cover crops, the primary intention needs to be determined, the cover crop selected, and then managed in a way that it doesn't cause adverse effects in the system or rotation. For instance, if the intention is to produce or recover nitrogen, the cover crop would need to have enough of a growing season to fix nitrogen or grow enough biomass to cycle the nutrients back to

the surface. However, if the same plant has to grow through a period when rainfall is limited, moisture storage may be more critical to the following cash crop. If the intention is to reduce weed control costs, the cover crop would need to be managed so that frost, mowing, rolling or low rates of herbicide can be used to terminate the plants' growth. This would also be timed so that viable seed would not be produced by the cover crop.

Finding Efficiencies in Biology

My Spanish was as bad as my Portuguese and German, so I learned just enough to be extremely dangerous, but also became very curious about the use of biological systems to reduce inputs in our own growing conditions. No-till systems as we define them mean a wide variety of ways to get the seed in the ground with as little soil inversion as possible, as part of a continuous permanent scheme of rotational cropping without disturbing the soil. "Direct seeding" in South America means virtually the same thing. However, Derpsch feels the important part of this systems approach to farming is how the "cover" is managed, focusing on biological solutions to production problems. For Derpsch, "cover" includes the growing commodity crops, crop residues, and transition cover crops used for the various purposes between commodity crops. The no-till pioneers of South America are shifting to this emphasis of cover management to reduce fertilizer and herbicide costs. They do it very well.

Photo by Matt Hagny.

Sunn hemp *(Crotalaria juncea L.)* in a cover crop test plot on the Joe Swanson farm. The sunn hemp reached a height of 8 feet in 100 days of growth and was amazingly good at suppressing weeds. Read more about cover crop experiments in future editions of *Leading Edge*.

The concept isn't new—our grandfathers had to use these methods to control weeds, provide nutrients, and manipulate insect populations, since they didn't have many of the products available to us now.

The use of cover crops in Kansas will have to go through the same experimentation phase that the no-till system is going through now, but it needs to be the next handful of spices in the no-till farming stew pot. Presently the difference in profitability between tillage and no-till systems is not enough to convince many farmers that the change is worth the effort, although no-till's economic advantages are becoming more evident as no-till techniques continue to improve. Bettering our methods will likely include the addition of more biological controls, such as cover crops. One of the most consistent objections to the use of cover crops is a perception that "we don't have enough moisture to grow extra cover crops," but for years the tillage-based system sacrificed moisture with each pass of the tillage equipment. Even with the move to higher intensity crop rotations with no-till, we may still be wasting moisture that could and should be put to good use.

The use of cover crops and other biological solutions will be challenging. But the concept isn't new—our grandfathers had to use those methods to control weeds, provide nutrients, and manipulate insect populations, since they didn't have many of the products available to us now. This is not to suggest that we ignore the luxuries our commercial products provide, but to recognize the possibility that we've bypassed something very important in those biological solutions. I remember my first introduction to an Aloe vera plant, when my grandmother rubbed a piece of it on a burned finger. Aloe vera is now known to have over 200 biologically active components including enzymes, trace minerals, amino acids, polysaccharides, growth factors and wound-healing hormones that help the body's ability to rejuvenate tissue. Skin care products now commonly advertise the use of extracts from this plant. No-till is

itself a biological solution for many things, such as erosion control, nutrient management, weed control, etc.—getting the picture?

Cover crops or other biological solutions may not fit into everyone's no-till stew pot just yet, but ten years ago many were just starting a fire under that pot. Now that the stew is cooking, let's see what other spices we have to toss in.

Editors' Note: Rolf Derpsch will be a keynote speaker for the No-Till on the Plains 2002 Winter Conference in Salina, Kansas on the 21st and 22d of January, and will share his vast experience with no-till systems around the world, including his insights and methods for cover crop management. Derpsch speaks English fluently along with several other languages.

Stand Tall with Stacked Rotations

by Matt Hagny

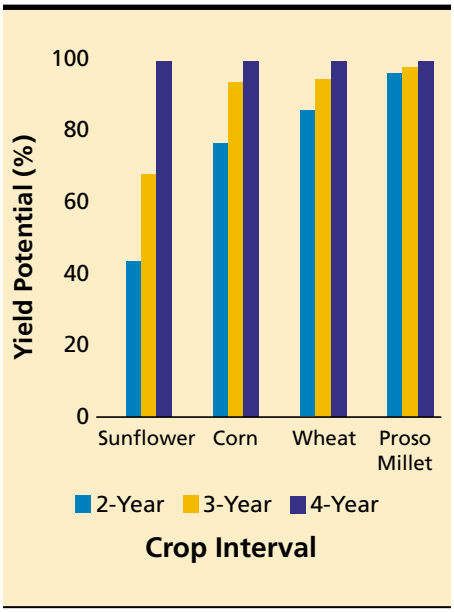
SCIENCE

No, we're not talking about square bales or pallets of seed—'stacking' of crops means planting a field to the same crop two years in a row, within the framework of a longer rotation. For instance, wheat >>wheat >>corn >>corn >>soybean >>soybean would be a fully stacked rotation, although many others are possible. For all of you no-tillers who already have a good mix of crops in your rotations (both broadleaf crops and grasses, with cool- and warm-season habits) and are looking for further improvement in your rotations, stacking holds great promise.

Photo by Matt Hagny.

Stacked (second-year) soybeans emerging, planted into cover crop rye which was planted into the first-year soybean stubble. Note the abundance of corn stalks remaining from the two years of corn previous to the beans.

Personally, I think we are going to see more and more stacking. The concept is theoretically sound, and, more importantly, all the evidence so far supports it. Stacking has several benefits: 1) It creates a much longer break from any one crop type, which can drive weed and disease potential to extremely low levels. 2) It adds diversity (diverse seedbeds). For instance, corn into corn stubble is generally a warmer and drier seedbed (due to the coarseness of the residue) and capable of being planted earlier than corn into wheat stubble. This spreads risk since you never know what will be the biggest limiting factor facing that crop that year—will it be late-season drought, disease, or the fact that you didn't get it planted on time because it was too wet? 3) It reduces waste of fertilizer N, since the legumes are all clumped together in the rotation. Any leftover N applied to one non-legume will likely be utilized by the following non-legume, at least on soils where N isn't prone to losses. Possibly only once in a five- or six-year rotation is leftover fertilizer N 'wasted' on a subsequent legume crop. 4) It allows long residual herbicides to be used in the first year of the stack.



Yield potential is improved by longer rotations, as shown in this research conducted at Akron, Colorado by Randy Anderson, USDA/ARS. Many other benefits go along with longer rotations. 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, as moisture recharge, allelopathy, and pest potentiality are altered—the study of crop sequencing is a science that has been long neglected.

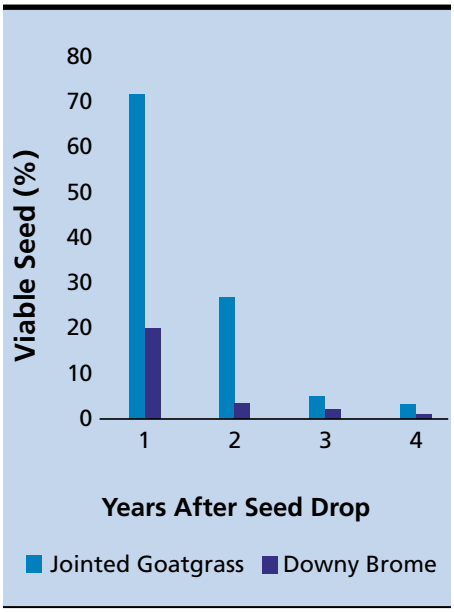
5) It prevents the development of weeds, insects, and diseases with extremely long dormancies. All of these deleterious organisms have dormant stages, the duration of which is genetically influenced. If we start doing very 'predictable' things with our rotations, especially shorter rotations, then we will increase the long-dormancy biotypes, and will soon have more organisms capable of lying dormant for several years awaiting the proper host crop to be planted in that field. Note that this is not a potential problem for any pest organism with very short life-cycles (multiple per crop), nor for organisms that are very mobile. To help prevent problems from developing with the non-mobile organisms having only 1 or 2 life cycles per crop (for example, Sclerotinia), you need the quick succession of two host crops back-to-back to increase or 'reward' the short-dormancy biotypes. The extended diapause corn rootworm beetle is a biotype that waits an extra year to hatch and has become prevalent in the Corn Belt after widespread use of a corn-soybean rotation in areas that were previously continuous corn. This is just an early warning that we are not thinking carefully about rotations, and although it might take 20 or 30 years to validate some of these biological predictions experimentally, we should take heed of their logic. Dwayne Beck rolls the concepts together nicely with the statement, "We don't want to be consistent in either sequence or interval," although he's certainly *not* saying that any haphazard sequence will do just fine.

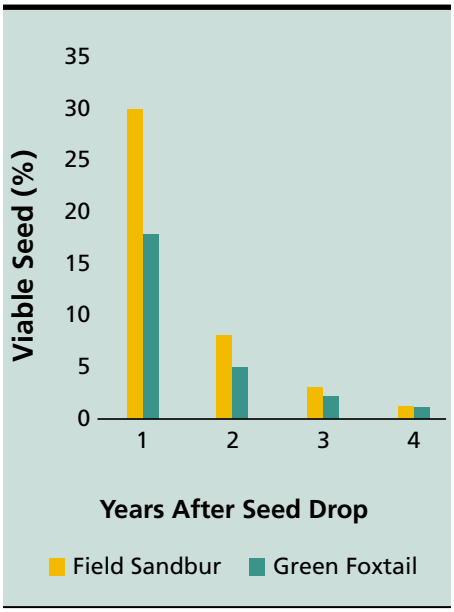
Dwayne Beck on rotations: "We don't want to be consistent in either sequence or interval."

Rotational Engineering: Baby Steps

While no one person gets credit for the "Eureka" moment of inventing stacked rotations, several have played influential roles in developing the concept as they mentally danced around the edges of it for years before fully realizing what they had discovered. Of course, monocultures are hardly anything new, and stacking can be seen somewhat as reaching back and taking a few of the benefits of monoculture and transplanting them into the much better world of a diverse well-managed rotation. Sounds easy, although stacking took a surprisingly long time to develop from ideas of simpler rotations.

During the 1980s in S. Dakota, as well as western Nebraska and eastern Colorado, a few no-till producers discovered that seeding winter wheat into some type of thick upright stubble would help it get through the winter in much better condition (these areas are otherwise quite susceptible to winterkill). The w. wheat was often seeded into proso millet, barley, or oat stubble, with good results. Spring wheat stubble also worked, but only if there were some other crops in the rotation to break up the root disease cycle prior to the 2 wheat years. For the producers who wanted to have at least 50% wheat in their rotation as well as maximize subsidy payments under the 'pay/92' provisions of the U.S. Farm Program, Dwayne Beck proposed a rotation of spring wheat >>winter wheat >>corn >>sunflower, which has become quite popular in central S. Dakota since. What led him to propose stacking the wheats? Beck already knew from seven years of rotational studies at the SDSU research farm at Redfield, SD that the alternate-year wheat (wheat >>soybean) was getting in trouble, and suspected that the 2-year break might help more than what the back-to-back wheat would hurt in his proposed 4-year rotation. Ten years of rotational data from Dakota Lakes Research Farm at Pierre, SD do indeed show





Seeds left on the soil surface lose their viability rather rapidly, as this research by Randy Anderson demonstrates. Note that a small percentage of the seeds has a very long dormancy. Nearly all the research shows seeds maintain viability longer when buried in the soil. Loss of weed seed germination over time is an important ally: Long breaks from a crop type can drive weed pressures to very low levels.

that 2-in/2-out is better than every-other-year wheat. Interestingly, R. Jim Cook's research in the Pacific Northwest has demonstrated that two-years-in/two-years-out is better than every-other-year wheat for suppressing some root/crown diseases.

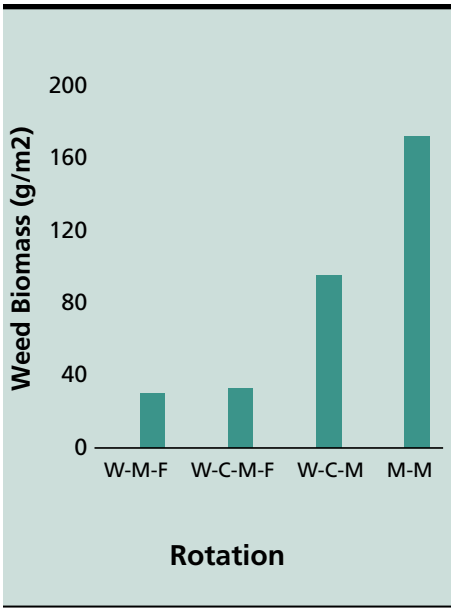
The stacking of corn within a longer rotation is an offshoot of the old "ecofallow" program developed by Bill Phillips (K-State at Hays, KS), and named by Gail Wicks (Univ. Neb. Extension at N. Platte) where a high rate of atrazine applied during the corn or milo year of a wheat >>corn (or milo) >>summerfallow rotation was a very affordable way to control weeds during not only the corn crop but also well into the fallow period (atrazine is rather persistent in the High Plains' semi-arid climate with a long winter, often with high pH soils). It was then a small step to recognize that a 2d corn crop could also take advantage of the carryover atrazine from the first corn crop, which some producers in south-central SD were doing by the early 1990s—typically with some broadleaf crop following the 2d corn to provide the transition to wheat. Another plus for the stacked corn was the "hedge-your-bets" advantage to diverse seedbeds, which Beck had previously pointed out, although not in a stacking context necessarily. As for the stacked soybeans, producers had noticed much earlier that on 'virgin' or new soybean land (never having grown a soybean crop previously), planting beans back on the first-year bean stubble often resulted in some of the best soybeans you could ever grow—this practice was discouraged as part of a 'regular' rotation due to disease and erosion concerns. However, now that we're talking 5- or 6-year rotations, those concerns go out the window.

The stacking concept has been bolstered by other considerations. In recent years, Dwayne Beck and Jason Miller (NRCS at Pierre, SD) were playing around with models of weed seed banks, which decline along a log. curve (see graphs) until they get a chance to produce a new generation of seed. The models prompted Beck to start thinking about stacking as a way of exhausting the supply of weed seeds (during this timeframe, the weed seed bank depletion concept was also being researched by Randy Anderson, USDA/ARS scientist at Akron, CO, now at Brookings, SD). Running the predictive models showed that the 2-in/2-out rotation would eventually get in trouble also, which did indeed happen with 'cheatgrass' during the second and third cycles of the wht >>wht >>corn >>sunflower rotation in central SD, hastening the addition of stacked corn. About this same time, I was thinking about the potential of genetic shifts of dormancy tendencies in weeds and other crop pests. Many of our thoughts on stacking began to 'gel' in the fall of '98 when Beck, Miller and I put together a paper for an ASA conference in Baltimore (available at dakotalakes.com, under Publications). And the more we think about it, the more convinced we are that stacking is the right answer, both theoretically and from a practical standpoint.

Field Results

While certainly not the final word on the subject, our experiences with stacking have been favorable so far. No-till stacked wheat is successful and popular in the drier areas of Kansas (west of Hwy. 14) and SD, as well as Colorado, so long as there is a 2- or 3-year break from wheat prior to the first year of the stack (it is also important to control volunteer wheat, cheat, and downy brome during the years out of wheat to prevent some carrying of root diseases). In central Kansas, we've always done lots of stacked milo in our no-till rotations. Some of my clients started doing stacked corn over 6 years ago now, with generally good results—contrary to what some of you may be thinking, rootworms haven't been a significant problem in the 2d-year corn in the very long rotations, although perhaps eventually we'll select for a biotype that causes more problems in this rotation. And we're getting started on stacked soybeans, which seems to be working well. Stacked cotton is working good, too, with cover crop wheat or oats between the cotton crops to prevent rill erosion and to keep some biological activity going until the next cotton crop is installed. However, some crops (like sunflowers) have many native pests and simply do not have enough disease resistance bred into them to work well in a stack, although stacked sunflowers have sometimes been done successfully in drier areas of S. Dakota.

Windom, KS no-till producers Joe & Sue Swanson's best wheat field in 2001 was one that followed stacked soybeans, as compared to all their other wheat fields which followed single-year soybeans. One thing the stacked beans (or other broadleaf crop) does ahead of wheat is allow more time for the corn and milo stalks to get further decomposed, both of which tend to be allelopathic to wheat seedlings (I've observed milo stalks inhibiting wheat seedling growth even where a soybean crop separates the two and the milo stalks had over 12 months to decay). As to yields of 2d-year beans compared to first-year beans (after corn or milo), there could be some yield loss on drier years, since the 2d-year beans go into a lower-residue environment (bean stubble), although there should still be a good mulch in long-term low-disturbance no-till, and the drier environment can be partially managed by reduced seeding rates. However, there are many accounts of exceptionally good second-year beans under dryland conditions. Under better moisture conditions,



Effect of rotation on weed pressure at Akron, Colorado. Study initiated in 1990, biomass measured in '97 and '99. W = Wheat, C = Corn, M = Proso Millet, F = Fallow. Conducted by Randy Anderson, USDA/ARS.

the 2d-year beans have a distinct advantage: Dwayne Beck's year 2000 yields on the irrigated part of the research farm showed huge yield advantages to the second-year beans, which is likely due to the build-up of Rhizobia numbers during the first year of beans, and possibly also due to increases in populations of soybean-preferring mycorrhizae and/or other beneficial species that specifically colonize or interact with soybean roots. This is speculative, but it may well be the case that the first year of a crop 'preps' the soil biology for that particular crop species' roots and root exudates, then the second year of that crop makes maximum use of this soil ecosystem, but in subsequent years (the 3d & 4th years of that crop) these benefits are often overwhelmed by negative factors—building populations of harmful organisms.[1] On sloping fields, one of the problems with the stacked soybean is the vulnerability to erosion, particularly before the 2d soybean crop is established, which is also the timeframe most likely to have heavy rains. We have been doing some experimenting with cover crop rye between the soybean crops to keep the slopes from washing, with encouraging results (an excellent aid to weed control, and no yield loss to the beans even on a dry year). Winter oats would likely be a better fit as a cover crop between the b-lf (broadleaf) crops since it is much less likely to carry diseases into the cash-crop wheat that normally follows the 2d-year b-lf crop. A crop or cover crop of oats also appears to directly benefit a subsequent cash crop of wheat, perhaps by suppression of take-all or by actually stimulating wheat's growth ('allelostimulant').[2]

Stacking b-lf crops also works with cotton, as many producers in south-central Kansas and north-central Oklahoma can attest. A cover crop of oats or a similar cool-season grass between the cotton crops is generally beneficial, by creating a better seedbed, building beneficial insect and spider populations, and preventing erosion. Note that the cotton stack is within a diverse rotation that avoids most, if not all, of the problems associated with monoculture cotton. Another b-lf crop that could work well in a stack in this climate/region is cowpeas.

Research shows that long breaks between crops can drive weed and disease pressures to very low levels, translating into higher yields and lower costs.

Stacked Wheat Wins

On the central plains of the U.S. the b-lf crops are typically followed by wheat, which can also be stacked. Many producers in western KS, NE, and eastern CO have discovered this; it is also a common practice in S. Dakota primarily due to Beck's research and his promotion of the practice. The two wheat crops can both be winter wheats, or else the first can be spring wheat followed by winter wheat. Winter wheat into standing stubble generally comes through the winter in better condition than when planted into low-residue conditions, such as bean stubble or sunflower stalks. Again, the diversity of seedbeds is a good thing. Glen Elder, KS no-till farmer Doug Palen reports that quite often his 2d-year wheat outyields the first year.

The wetter areas of Kansas, Nebraska, and Oklahoma pose additional problems for stacking wheat. The successive wheat crops don't use enough of the accumulated precipitation, requiring a double-crop or cover crop to be grown between the wheat crops. Often not enough time is available to grow a double-crop to maturity, get it harvested, and get the 2d wheat crop planted in a timely manner (although this may not be a problem in eastern Oklahoma or Texas). Cover crops may hold the key to unlocking the potential of stacked wheat in these areas. Sunn hemp *(Crotalaria juncea L.)*, cowpeas *(Vigna unguiculata)*, or some other fast-growing summer cover crop could fill the niche between the two wheat crops. The

[1]Why this occurs may be due to the plant having evolved to cooperate with its symbionts (to nurture them and allow their numbers to increase) while suppressing its enemies or pathogens, which likely results in symbionts repopulating more quickly than pathogens, even though the later population growth of pathogens may be very explosive. Also there are limits in terms of ecological resources as to how far populations will build—symbiont populations will build until there is no more 'room' (lack of suitable and available surface on host roots, for instance), while pathogens may quite easily build until they wipe out the plant, and then nearby plants, and then eagerly await next year's crop.

[2] 'Allelopathy' within the scientific community means both stimulating and inhibiting effects on other plants. As the word so often has a negative connotation in agriculture, I make this attempt to clarify.

only way this will be viable is if the cover crop for this niche enhances yields or reduces costs of the following wheat crop, or if it provides revenue as in the case of cowpeas taken for hay. The cover crop could benefit the 2d wheat crop in a number of ways, including using excess soil moisture or suppressing some of the diseases or other harmful organisms awaiting the second wheat crop.[3] Other possible benefits would be a cover crop that would be allelostimulant to the following wheat crop, and/or allelopathic to winter weeds, or one that otherwise changed the soil ecology in a way to benefit the wheat. It is also quite important that the cover crop not host any diseases or nematodes which would be detrimental to cash crops to be grown in subsequent years of the rotation. Probably the key is finding cover crops that are rather unrelated to the cash crops already being grown.

Stacking the warm-season grasses is old hat to many producers. Milo on milo is very common. Dryland corn on corn is much less common; in fact, it's been shunned in the recent past on the western Plains. But many no-till producers now embrace this sequence. It need not yield as well as the corn following wheat, as the second-year corn is usually cheaper to grow (no wheat stubble herbicides to charge against the upcoming corn crop, reduced seeding rate, lower N requirement), and it provides a diversity of seedbeds. Anytime it's too wet to plant wheat stubble, move to (first-year) corn stubble and roll for a couple days until the wheat stubble dries out again. Some years, you may not be able to plant all the corn into wheat stubble in a timely manner, and will be happy to have kept your corn acreage up with some 2d-year corn. Although the second-year corn yield sometimes lags the first year (mostly due to lower moisture-retaining ability of coarse corn stubble vs. plentiful and fine wheat stubble), it often pulls its weight in the rotation. At Hillsboro, KS, no-tiller Rod Peters' highest yielding upland corn (ever) was 2d-year corn. More commonly, the 2d-year corn lags by 5 – 8 bu/a, although the cost/bu of production is still very respectable. As long as we don't give up too much potential on the 2d-year corn, we will continue to do it as it lengthens the rotation and gives us diverse seedbeds.

Glen Elder, KS no-till farmer Doug Palen reports that quite often his second-year wheat outyields the first year.

Randy Anderson's extensive research in dryland cropping systems at Akron, CO (truly dryland) provides ample data to support the validity of longer rotations. One can certainly see the value of driving weed species to extremely low levels with the longer rotational intervals, as Anderson has shown will occur. Many non-mobile pathogens also decline rapidly during those intervals. To accomplish the long breaks between crops, one needs either to grow a rather unusual roster of crops (and ones that are not hosts for one another's diseases and insects) or do the stacking trick with more typical crops. Better yet, do some of both.

Both theory and field results are favoring the stacking concept. But don't sweat it—you needn't implement a fully stacked rotation on every acre right this minute. Some of you are still working at getting some of the major crop types into your sequences and getting the agronomy right and maintaining profitability. Stacking is a goal to work toward. A goal would be to have any and all of your cash crops stacked in every field at some point over a 10 to 15 year period. If a crop is new to you, don't worry about stacking it just yet. For those of you who already have a diverse rotation, take it to the next level with stacking.

Editors' Note: Randy Anderson will be a featured speaker at our Winter Conference on 21-22 January, 2002 in Salina, KS and will share with us more details of his research into rotational effects on weed density, disease prevalence, and crop yield, as well as interactions of row spacing, population, and N placement on weed competition.

[3]The suppression may be either active/primary chemical inhibition of the pest (for instance, nematocidic) or a secondary effect brought about by the increased biological activity and microclimate changes that occur under a living plant canopy, which result in more weathering, chemical degradation, and predation of the pest organisms and their resting stages.

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We are pleased to announce Great Plains Manufacturing's generous contribution to support No-Till on the Plains' activities for the upcoming year. Thanks!

Thanks to these dedicated sponsors of the No-Till on the Plains 2002 Winter Conference:

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Touring No-Till in S. Dakota & Kansas

No-till on the Plains, Inc. produced two bus tours this past summer—the seventh annual South Dakota No-Till Tour, 6-8 August, and the first annual Kansas No-Till Tour, on 21- 22 August. Both tours were highly successful, not only in terms of numbers participating (over 130 between the two) but in the energy and interaction of everyone involved.

The South Dakota trip focused not only on research being conducted by Dwayne Beck and staff at Dakota Lakes Research Farm, Pierre, but also on the methods of skilled no-till producers in the area: this year featured Steve and Todd Taylor at Presho, Ralph Holzwarth near Gettysburg, and Dave and Carol Gillen at White Lake. Some of these have been tour stops in the past, and it is quite interesting to follow the progress and new ideas of some of the lead no-tillers in the area—we came away with plenty of new thoughts. Also along for the tour was Ray Ward, soil scientist and founder of Ward Laboratories at Kearney, NE, which was another tour stop, and Matt Hagny of Salina, KS, consulting agronomist for no-till systems.

The Kansas tour covered a sizeable chunk of the state in just two days, with large variations in soils and climate amongst the stops. This tour looked at six production farms, as well as taking a few more experts along: Paul Jasa, planting equipment specialist at the Univ. of Neb.-Lincoln; Bob Wolf, sprayer specialist, K-State, Manhattan; Matt Hagny; and Ray Ward. The tour was a whirlwind of activity, so at least those that traveled by bus got to share a few more thoughts with each other. No-till farmer stops included Doug Palen, Glen Elder; Kent and Cindy Stones, Lebanon; Harold Krause, Hays; Randy Schwartz, Great Bend; Gene Albers, Cunningham; and Joe Swanson, Windom.

Look for a complete report of these adventures in upcoming issues of *Leading Edge* (for a recap of last year's SD Tour, see www.notill.org).

Photo by Tim Christian.

Ray Ward of Ward Laboratories, Kearney, NE, discusses no-till soil properties with participants of the Kansas bus tour. Ward has also accompanied the last two South Dakota No-Till Tours and provides us with many useful insights on soils, fertilizers, and agronomy. Known for never leaving home without his beloved spade.

We hope to see you on the next round of tours coming in the summer of '02!

No Fear No-Till

by Roger Long

When you talk to Randy Schwartz of Great Bend, Kansas about his history as a farmer, one thing becomes strikingly evident: his fear of uncharted waters is nonexistent. The list of "new things tried" by this producer far exceeds even the most progressive of growers. From his first steps into no-till in the early '90s, to drilled dwarf corn, to relay-cropping, to a new vineyard, this grower thrives on innovation.

Randy began farming in 1977 as he was graduating from high school. His uncle had passed away and he took over his 800-acre farm. At the time, all acres were under conventional tillage and, Randy notes, "We also did a lot of 'match-till' back then." Burn, disc, field cultivate twice, and plant some more wheat was a common regiment. His primary crops were wheat and alfalfa with a sprinkling of milo. He later took over his father's acres in 1986 bringing total cropland to approximately two-thousand acres. It didn't take long after '86 until Randy found his tillage equipment becoming worn-out and in need of being replaced. Exploring an alternative, he rented a Great Plains no-till drill in the fall of 1990 and used the drill to plant half of his wheat that year. Then in 1991, "We burned the ship." Randy sold all of his tillage equipment that year and never looked back. "Selling all the tillage equipment made it easier to go to no-till because you had to make it work." Randy then used some of the money from the tillage equipment sales to buy a 30-foot Great Plains no-till drill with 10-inch spacing.

The workhorse of the operation is still that same no-till drill. Maintenance has been very low on the drill, as Randy got 10,000 acres out of the first set of coulters and has not made any modifications to the drill. It plants all of the crops in the rotation with the exception of the corn, which is done with a 6-row 30-inch JD 7000 planter. Before he owned a planter, Randy had experimented with a five-acre plot of drilled dwarf corn, which confirmed his suspicion of needing the precision of a planter to successfully add corn to his rotation.

"There is never a problem with too much residue, you just have to know how to manage it and plant through it."

Randy currently uses a wheat >>corn >>milo >>soybean rotation and many times 'stacks' wheat or milo within the sequence. He first added milo to his rotation because he had much more moisture in the soil due to no-till and wheat wasn't taking advantage of the extra moisture; corn and soybeans were added later. He is constantly looking for new crops to work into his rotation to provide greater diversity. Crops that Randy has grown in the past ten years include canola, cotton, and sunflowers. Interests in new crops to expand diversity are: chickpeas (garbanzo beans), lupin, and possibly more canola. Randy has done some research on lupin, a cool-season legume that prefers very acidic soils and is fairly drought tolerant. Also, lupin grain doesn't need to be heated to make the protein available during livestock digestion. The decrease in protein prices (soybean meal) has deterred Randy from the crop for now. Randy points out that the biggest challenge with new crops is not the production but the marketing. Randy also emphasizes the importance of covering risks when trying any of these new crops, either by having good insurance coverage or by doing them on very limited acreages during the early experimental stage.

To add to the mix, Randy would also like to have a cover crop following wheat, such as Austrian winter peas or cowpeas, but doesn't know how to work around the limited 24 – 26" annual precipitation and the untimeliness in which it comes. "The untimeliness really creates problems in stand establishment." In one attempt to avoid problems with establishing stands after wheat harvest, Randy tried relay-cropping by drilling soybeans very early in the

Photo by Tim Christian.

Randy Schwartz discusses his experimenting with adding sunflowers to his rotation—Randy was a stop on the 2001 Kansas No-till Tour.

Photo by Roger Long.

Schwartz harvesting solid-seeded (10") milo.

spring into an existing wheat stand. "It planted really nice, a lot nicer than I thought it would." Unfortunately, he picked one of the drier years in recent history and the emergence was slow and eventually the soybeans ran out of moisture completely. Explaining his intrigue with having a crop growing after wheat harvest, he quotes no-till producer Carlos Crovetto, whom he met on an educational trip to Chile a couple years ago, " 'Always keep a growing crop on your field every year [to keep the soil biology active].' " Also from Crovetto, speaking passionately about the soil ecology, " 'Grain is for the farmer, stubble is for the soil. You have to feed the soil because it is a living, breathing organism.' "

Randy makes numerous presentations on the benefits of no-till every year at various meetings. If you have caught one of his presentations, you probably heard, "There are three key areas of management: moisture, residue, and time. With no-till, it takes much less time per year but you must be much more timely. I drill my milo because of convenience and time savings, more residue is created, and my herbicide costs are less." Randy said that he hasn't seen milo hybrids perform any differently comparing 30-inch rows to 10-inch drilled planting. "You do have to make sure you have a hybrid with good standability, but that normally isn't a problem." Randy's fields carry more moisture into the spring than neighboring conventionally tilled fields. Given this fact, a person would assume that he is planting later than his neighbors, but because conventional tillage farmers are busy with spring tillage for so long, Randy is actually planting before them normally. Even before no-till, Randy purchased a pickup mounted sprayer that he still uses today. He does almost all of his own spraying which, again, allows him to be "more timely."

"My passion is corn, I love to plant and grow corn." Randy plants 100 to 110-day maturities and likes a 103-day corn the best with a planting date of around the 10th of April. "The 103-day maturities have just yielded better." He tries to plant a hybrid with good ear flex because that has given him the best yields over the years. His population is from 18,000 to 21,000 based upon length of maturity—on the low side for a longer maturity hybrid, and higher populations for earlier hybrids. He does not vary population based upon soil moisture. In past years when liquid fertilizers were priced more in line with other forms of nitrogen, Randy applied liquid fertilizer with his own sprayer during the winter months. Now that dry urea is much cheaper than liquid, he has been using a local retailer to apply his dry nitrogen fertilizer. The wintertime surface applications of N seem to work rather well in his semi-arid climate and soils with good internal drainage. Randy uses a starter in-furrow and generally puts down five gallons of 10-34-0. Randy would like to eventually move to a narrower row spacing for corn but doesn't like the prices of narrow-row corn heads. Other than contemplating a narrow-row planter, Randy is very happy with the equipment he is now running, although he is always looking for ways to improve.

Planting into 80-bushel-plus wheat stubble can be a real challenge. Randy has noticed that residue decomposition at the soil surface has sped up dramatically, due to increased microbial activity from his many years of no-till. Those microbes are very helpful, but they also feed on the base of wheat stubble, making the stalks detach easily when you plant through them. "When the stalks break off, they plug up a planter or drill." If the stubble is extra heavy, Randy remedies this by running a mower over it after harvest to create a better planting situation the following spring. His New Cambria soils (high clay, river bottom) are where he winds up doing the mowing. These are the areas that produce the most straw and are the muddiest in the spring.

Soils improve with continuous no-till: "They're more mellow and not as sticky as they used to be."

Coming in the Next Issue!

Oklahoma No-till Success

Feature Farmer Tony Kodesh of Red Rock has been 100% no-till since '97 and can't imagine going back. No-till is working great for Kodesh, with the right mix of cattle, high-yielding wheat, double-cropping, alfalfa, soybeans, milo and cotton. In the not-so-forgiving climate of central Oklahoma, Kodesh finds an abundance of opportunity.

Why Only These Crops?

Ever wonder why we grow the crops we do? (The western Plains wasn't always wheat monoculture.) Where to look for crops to expand diversity? Some history and insight into cropping and crop breeding.

Recap of the 2001 South Dakota No-Till Tour

Reinforcing past lessons, plus a bunch of new or rekindled ideas, including an oat/pea mix for hay in the rotation, split N applications on wheat, Gillens' cover crops, long-term no-till effects on soils, Beck's double-crop millet, the latest on the Concept Seeder, etc. All the details.

Plus, another Feature Farmer story, an update on cover crop research, tips and tricks to get ready for spring seeding, and more!

"I don't mow unless I absolutely have to; there's a big difference between 40- or 50-bushel straw and 80- or 90-bushel straw." Randy does utilize Auscherman Terra-tines on his planter, a floating single-wheel attachment to help move residue out of the path of the row unit. "There is never a problem with too much residue, you just have to know how to manage it and plant through it."

How does he get those kinds of wheat yields? The 10-inch spacing on his no-till drill is a little wider than some drill spacings in the area but Randy normally seeds early with 90 to 100 lbs. of seed per acre which seems to make up for the wider spacing. In good years, Randy has produced well over 70 bu/a wheat on numerous occasions so he must be doing something right!

Randy also uses his no-till drill to plant alfalfa (currently approximately 200 acres). He has been very happy with his stand establishment and has had success with both spring and fall plantings. "You don't get seeds getting buried by soil washing into the furrow with no-till, so it makes it a lot easier from that standpoint."

The improvement of soil condition shows in many places. Randy has increased soil organic matter substantially in a couple of fields, and planting in high clay content soils has also become easier because soil tilth has improved dramatically. "They're more mellow and not as sticky as they used to be." It didn't happen overnight though; it took six or seven years before Randy saw an appreciable difference. He has also seen a reduction in pH on his New Cambria soils that once carried a pH of over 8.0. They are now down into the high 7s. Randy also has some fields that have low pH readings (5.7) and made a pelleted lime application in the fall of '99. He didn't see any change in pH from his '00 soil tests, which he expected, and hasn't tested the soils yet this fall but expects improvement in the next couple of years.

Randy also likes no-till for what it has done for his bindweed problem. "I used to have a lot of bindweed and I just don't have any anymore." Randy attributes the absence of bindweed to not spreading and planting bindweed with tillage plus the use of timely herbicide applications. When talking to Randy, it becomes very evident that he wants to leave his fields in better condition than how he found them. When asked what he looks forward to five years from now, he states, "I'm excited about what the soil health will be in future years."

Recent years haven't been particularly kind to Randy, with three major hailstorms in as many years, plus this year's drought, then flooding and lightning strikes. However, this Great Bend farmer remains undeterred. Those thoughts of more diverse rotations, increasing residue, better time efficiency, improving soil condition, and increasing soil moisture remain constant goals for this adventurous no-till pioneer.

Calendar

January

7–8
FACT Conference
Liberal, KS

9–12
Lessiter's National No-Till Conference, St. Louis, MO

16
Sumner Co. No-Till Meeting

17
Kingman Co. Farming for the Future, Kingman, KS

21–22
No-Till on the Plains' Winter Conference, Salina, KS

which has perhaps granted it the freedom it needed to be truly effective. Another source of strength since the beginning was the Alliance's being very project oriented, rather than being overly concerned with its public image. The early structuring, combined with immense selfless volunteer work by dozens of people, has allowed it to develop and flourish.

Paralleling the evolution of KCRMA, smaller local alliances started forming in the early '90s to target educational efforts for an area. In early 1991, Christian and Davis met with NRCS county staff and producers in a few locations in Kansas where farmers and agency people had shown an interest in forming groups to get information into the hands of producers. The first alliance to result from those meetings was the Golden Belt Alliance, formally organized in the summer of 1991 for Barton County. Other groups organized over the next few years.

At the state level, KCRMA's loose organizational effort was producing a few educational tools, and in 1992 the group organized more formally by appointing a steering body, developing a plan of action, and setting up teams to address specific educational efforts. The Alliance was also in need of a person to head-up the expanded activities. After discussion on potential partnering efforts with the Kansas Association of Wheat Growers (KAWG), NRCS provided underwriting to KAWG to hire a half-time Coordinator to manage Alliance activities; Mike Doane served in this role from 1994 until 1996. During this time, the Alliance's goals were also furthered greatly by the efforts of Hans Kok, K-State Research and Extension, who toured the state with a rainfall simulator to vividly demonstrate the effects of crop residues on improving water infiltration.

Photo by Doug Palen.

Dwayne Beck shares his thoughts on how no-till alters the water cycling in the soils at Dakota Lakes Research Farm during our South Dakota No-Till Tour.

As KCRMA evolved, the group began focusing more on the *profitability* of reduced tillage systems, particularly no-till. Davis had early on recognized that no-till far surpassed other conservation systems in efficiency, and helped nudge the organization in this direction. In the summer of 1995, Davis, Matt Hagny, and Mike Doane put together KCRMA's very first bus trip, dubbed the 'South Dakota No-Till Tour,' with the idea that producers seeing 'real' no-till first-hand would be far more useful than endless descriptions of it. The tour focused on what Dwayne Beck was doing with crop rotations and no-till at the Dakota Lakes Research Farm near Pierre, SD, as well as long-term no-till producers who were implementing some of Beck's ideas. The trip became an annual event, and has been quite popular with a number of Kansas and Oklahoma producers. Since that time, KCRMA has further shifted its efforts toward providing information primarily on no-till systems and more sophisticated cropping rotations.

It soon became apparent that farmers really were in need of a regional conference to exchange ideas and experiences, again with Davis first recognizing the potential. In 1997, the 'No-Till on the Plains' Conference was born, managed by Eric Lund. Dwayne Beck was the featured speaker and the format was designed to promote farmers sharing information with other farmers. This format, combined with a large no-till trade show, proved to be a shockingly successful mix, with the attendance the first year topping 600. Since then, the conference has been held each January in Salina

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with attendance of 1,000 to 1,300 ever since. It'll be back, bigger and bolder than ever on 21-22 January 2002!

The Alliance was invigorated by the enthusiasm and ideas of Dave Berck, who became the full-time Coordinator in 1997. With the arrival of Berck, many of the Alliance activities were conducted from his home near Wichita, although the Alliance continued to rent office space from KAWG in Manhattan. One of Berck's many projects for KCRMA included a tour across Kansas in '97 with South American no-till pioneer Carlos Crovetto, stopping at a half-dozen no-till operations in various parts of the state. Berck put together other educational trips including traveling to the No-Till Field Day at Milan, TN, and another to Crovetto's farm near Concepción, Chile. Berck's departure in the spring of '99 left the group in a bit of a lurch, and duties had to be divvied up among Board members and advisors in an attempt to carry on. Charles Atkinson, NRCS, served as interim Coordinator for part of a year. Tom Blackburn, with BASF, was serving as President during this time, and Tim Christian was hired to manage the conference in 2000, and again '01. Upon completion of his term of office Blackburn resigned from the Board in 1999 due to business obligations, and Doug Palen has succeeded him as President.

Which nearly brings us to the present day. This spring, Christian was hired as Coordinator, and he is assisted by Drue Durst from their office in McPherson (the organization no longer maintains an office or phone in Manhattan). The group is once again expanding its activities, this time with the highly successful 'Kansas No-Till Tour' to complement the South Dakota Tour. And, to ease your addled tongues, we've (finally) discarded the stodgy mouthful of KCRMA in favor of our established brand name, making us the almost frolicky 'No-Till on the Plains, Inc.' A new name, and a new publication, but rest assured we're still dead serious about providing the very best information and ideas to improve profits and sustain resources of agri-producers everywhere. We are witnessing the dawning of a new era in agriculture, and we're excited to be a part of it!

Editors' Note: In addition to all the players mentioned above, the Board and its Advisors would like to extend their thanks to the many others who helped KCRMA/No-Till on the Plains, Inc. get on its feet, including Hank Ernst, Alan States, John Tibbits, Clyde Mermis, John Hickman…. As our collective memories fade over the years, we may very well have omitted a name or two—we sincerely regret the oversight and ask that you fill in your name here:

_____.

Leading Edge isn't the only venue for information from No-Till on the Plains—check out our website at www.notill.org for highlights of past conferences and tours, research updates, links, and more. Don't miss out on the '02 Winter Conference, the biggest, most forward-thinking no-till conference in the nation!—see the insert or call us at 888.330.5142.

Note from the President

Doug Palen—President, Chairman, & Farmer

Photo by Tim Christian.

In the words of Oliver Wendell Holmes, "Man's mind, once stretched by a new idea, never regains its original dimensions." Do you feel like your mind has just been stretched a bit by the articles in this publication? In my opinion, the future of farming in the Central Plains will hinge on how well farmers educate themselves and create new efficiencies in their operations. Big changes lie ahead, and will bring challenges and uncertainty but also opportunities never before seen. Coping and even thriving during the changing times will require insightful decisions built on education and experience. How current is your education? While experience comes along almost inevitably, education must be actively pursued. We can learn from others—we shouldn't have to make all the mistakes ourselves!

No-Till on the Plains is committed to providing education on no-till farming systems, and to continually developing and improving those systems. Being led primarily by active full-time farmers makes us unique—*"by farmers, for farmers"* captures our true spirit and pushes us to organize activities that can improve management today while looking to the future of production agriculture. Today's global markets dictate that farmers in the U.S. learn to become low-cost producers. The focus will shift from how many bushels you can produce per acre to the more important issue of how cheaply and efficiently you can produce that bushel of grain.

No-till farming has been around for over 25 years, yet the adoption by farmers in the U.S. has been quite slow. Perhaps the uncertainty of change has hindered the adoption in the past, but with challenging times ahead, coupled with the proven efficiencies that no-till systems can offer, I feel that no-till adoption will increase dramatically in coming years. Increased adoption and understanding of no-till will bring about a need for ag research to take on a 'systems approach,' where inputs and methods are studied for effects on the entire crop rotation and the soil itself, and where whole farm efficiency can be evaluated. Tomorrow's farmer will demand this research. Industry, too, particularly equipment manufacturers, must cope with the fact that no-till is here to stay, and will likely become the 'normal' farming practice in the very near future.

If you have attended any of the activities that No-Till on the Plains has organized in the past, you probably noticed they aren't fancy or flashy, just informative and 'down-to-earth'—farmers, researchers, and industry people exchanging information and ideas, and finding new questions to ask. To expand that process, we have recognized the need for a quality publication to keep you on the *Leading Edge* of no-till and sound agronomic practices. If you like what you see and want more, take advantage of the offer on previous page. Comments, suggestions? Let us know; we want *Leading Edge* to meet your needs. Use the phone, write a note, or e-mail us—we want to hear from you! (Contact info on page 2.)

No-till On The Plains

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