Controlled Traffic, Anyone?

by Matt Hagny

TECHNIQUE

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Some are more prone than others, but we all run the risk of 'buying into' whatever the latest fad, hype, or buzz might be. If you hear it often enough, surely it must be important and true. Behavioral scientists demonstrate just how conformist we really are.

Controlled traffic seems to be the talk lately. For long-term no-till producers in virtually any region, controlled traffic is of dubious value. In fact, it might have very serious consequences long-term that are not noticeable during the first few years.

'Controlled traffic' is where the majority of the loaded tires of the machinery are following the same path in the field every year, accomplished either with GPS guidance or 'old-school' gaps (tramlines) in the planted crop. For instance, the tractor tires, combine tires, and sprayer tires might follow the same path (lane) year after year. Since most factory settings on combine and tractor tires don't match up, often some modified version is used. Perhaps the tractor doing the planting and weed control always follows the same path, and all those implements are the same width, or their multiples (20 ft, 60 ft, etc.).

Controlled traffic certainly isn't new—the idea has been floating around for several decades at least. The reasoning behind it was that those loaded wheels were very damaging to the soil, causing compaction and restricting root growth as well as curtailing the flow of water and air in the soil, and so the damage should be confined to the same area year after year. The remaining soil between the lanes would generally be in better condition (untrafficked) for growing crops. Also, some tractive efficiency was gained: since the trafficked paths were driven over repeatedly and packed into a respectable road, less wheel slip and horsepower loss occurred. Remember, all this was conjured in the days of heavy tillage. It was very popular with ridge-till, since a considerable amount of tillage could be done, yet you could easily find and follow the traffic lanes.

Photo by Matt Hagny.

Tread carefully. Where you drive—and how often—affects vegetation, mulch, and soil characteristics. For many landscapes and climates, controlled traffic will eventually create massive problems.

Unintended Consequences

A danger lurked in this logic, which wasn't fully realized until lately. In many agricultural areas of the world, large precip events occur which cannot be fully infiltrated into the soil during the short time of the event. Some runoff occurs. Even under native vegetation, such as the prairie, some runoff occurred. This is why draws, creeks, and streambeds are part of the native landscape in many areas. Annual cropping, even in the best rotation in long-term no-till, doesn't overcome this in most of these areas. There will eventually be precip events which are not totally infiltrated. This may be a 10-inch rain in a single storm, or whatever.

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Controlled traffic creates a different infiltration rate in the repeatedly trafficked lane versus the rest of the field. Remember, it is the 'sacrifice' area. The repeated compacting of the wheels has left the soil with less structure to move water downward quickly. The wheels have pulverized much of the surface residue, resulting in surface sealing during a rain event (see Derpsch's 'Understanding Infiltration' in the Dec. '03 *Leading Edge*). And less crop residue is produced in the lane area itself anyway: often the lane isn't planted to anything (to make it more visible, and/or to economize on seed since it is the 'sacrifice' area). These effects are cumulative. As the area gets more and more packed, it grows less and less. As the soil OM is depleted in that lane area (since nothing is growing there, and little residue is returned), it becomes more vulnerable to compaction. It is a downward spiral.

So the controlled traffic has created areas of the field (the well-traveled lanes) which cannot infiltrate as much as the rest of the field. Tests have proven this. Eventually a precip event causes runoff, which occurs primarily in the lane areas. Erosion cuts the lanes down. This will make them even more likely to run water the next time a big rain occurs, since some of the best soil (and residue) washed away.

Furthermore, in soils with a significant amount of clay, the repeated driving of wheels over those soils while damp causes a 'marshmallowing' effect—the soil under the lane yields and starts to push up the soil nearby. Again, this concentrates water in the lane. It also prevents whatever water is ponding in the lane from escaping out into the untrafficked area where it might be infiltrated.

If the controlled traffic field has any slope at all, the end result is that you have created a rill or gully where you want to drive. It will inevitably get deeper, and the problem will accelerate for the reasons stated above. The result is inescapable: if you create differences in infiltration rates in straight lines up and down your hills, and your region sometimes has large precip events, runoff will occur which will be concentrated in those lines, creating a gully.[1]

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These processes will occur at different rates in different locales, based on frequency of large rainfall events, ability of the local soils to infiltrate water, and slope. The problem will become apparent in the loess hills of Kansas and Nebraska before the glacial soils of the Dakotas. Areas that never experience runoff will largely escape the problem (however, the marshmallowing of high-clay soils could still result in deepening tracks and mechanical difficulties, such as on the Darling Downs in Queensland, Australia.)

Photo by Kirk Gadzia.

Originally the prairies had random traffic by native herds of buffalo, elk, and other large herbivores. Uneven, isolated, or 'controlled' traffic, whether by cattle walking single file, mountain bikes on a trail, or ag machinery tires traveling on trams or lanes, will cause lines or areas of soil with reduced infiltration capabilities. The result is gullies.

The argument can be made that steps can be taken to overcome this. For instance, the lane could receive additional chaff or straw from the combine. Perhaps a second species could be seeded into the lane to provide a living cushion. Now, we are adding further cost and complication. And still, the plants aren't going to grow as well in that area. Even a living root system is not impervious to damage. Cattle will beat out a trail in perennial grass. Humans, with only 6 – 8 psi footprints (maybe a few with a bit more) and nice spongy rubber-soled shoes, will pound out a trail across a perennial grass park or lawn. My point is that it would take quite a remarkable system to maintain infiltration in the trafficked area relative to the untrafficked. My guess is that utilizing the methods mentioned would slow the process, but the eventual outcome would still be the same (if the area has any potential at all for runoff).

Correction: In the dynamics of walking, humans have soil contact pressures of 18-25 psi. (Walking cattle apply 40-48 psi).

A few will argue that on sloping land, controlled traffic should be done on the contour. While feasible, I seriously doubt it is realistic. The time loss, not to mention costly overlaps, almost guarantee the costs will outweigh the benefits.[2]

Additional Considerations

Somewhat ironically, the reasons for doing controlled traffic are largely diminished in long-term no-till. As soils regain structure in well-managed no-till, they are considerably less likely to suffer compaction. Organic matter, glomalin, etc. are holding the soil particles in place. For similar reasons, tractive efficiency is greater in no-till.

1 A vivid example is the gullies created by center pivots on steep hillsides—the gullies exactly match up to the paths taken by the pivot wheels. Controlled traffic at its finest. Note that the problem takes a few years to become obvious, and that it is very difficult (expensive) to remedy.

2 Most soils of N. America have good enough structure under no-till that controlled traffic is of limited value, plus the slopes and rainfall are often such that controlled traffic soon creates huge problems. Australia, however, does have some very low-OM, high-clay soils which exhibit rather high susceptibility to compaction and therefore would benefit more from controlled traffic. However, managing the erosion in the lanes is still a major issue.

The wheels aren't sinking in loose destabilized soil. Structured soil gives the tire lugs something to 'bite.' On established alfalfa or native grasslands, we don't worry much about causing compaction or getting traction, at least not to the point of creating controlled-traffic lanes.

Plenty of other problems with controlled traffic exist. Machinery may need to be modified to get wheels to line up; this results in an immediate cost as well as possible future costs in terms of extra repairs or decreased resale value. Even worse, it 'forces' some decisions into unnatural (i.e., inefficient) outcomes, such as sizing your planter and drill to something other than what they might be if only crop mix and planting windows were considered. And what if you acquire more land, necessitating slightly wider equipment, but not quite justifying double the current width—so either you're stuck with inappropriate equipment widths, or you adjust all your lanes and start cropping the old abused and eroded lanes.

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All told, controlled traffic doesn't mix well with continuous no-till. For nearly all cropland climates and topographies, it is a loser, eventually resulting in massive mechanical problems and permanent soil damage that will be extremely expensive to repair or overcome. Controlled traffic was somebody's brilliant idea. Unfortunately, it just doesn't work out very well in the real world—it looks nifty only until the 2d or 3d major rainfall event. People who are invested in the idea, either figuratively or in hard currency, will not want to admit these failures. That, unfortunately, is human nature at its worst.

If the producer really wants to take some steps against compaction in areas where crops are grown, the answers are out there, and relatively affordable and simple (at least in comparison with permanent lanes). If continuous no-till is used, about 3/4 of the problem is already solved. Just maximize your residue cover. All that remains to be done is good footwear for your tractors and combines. Large, wide radial tires at low pressures are by far the best. Bar-lugs are preferred whenever possible.

So control yourself when deciding how much to control—sometimes a little randomness is in order (pun intended).

Asian Rust Outlook: U.S. Plains

After gathering some information from our South American friends, we are convinced that the risk of Soybean Asian Rust (SAR) on the U.S. Plains is considerably overblown. Dirceu Gassen, a Brazilian entomologist by training but widely knowledgeable on many agricultural topics, explained that SAR requires 12 – 14 hours of free water on the leaf surface for infection to occur, and that these conditions need to be repeated over a series of days (~ 15) for the numbers of spores in a given locale to be great enough for serious problems. While we have no doubt that SAR spores will blow in to the central and northern U.S. Plains annually from overwintering sites in south Texas and Mexico, the likelihood of weather conducive to major problems seems rather low for KS, NE, and the Dakotas. Gassen also stated that shorter nights during summertime in these regions would hinder development of SAR, just as it does in northern China and southern Brazil. (Loren Giesler, U.Neb-Lincoln soybean pathologist, has presented a value of 6 – 8 hrs of leaf wetness for infection to occur.)

Further supporting this conclusion are comments by Agustin Bianchini and César Belloso as to SAR spores being detected in their areas (Rosario and Pergamino) of Argentina the last 2 seasons, blown in from Brazil. However, those areas of Argentina have yet to develop any noteworthy outbreaks of SAR. This, despite those areas of Argentina being closer to the equator (longer nights in summer) and having more rainfall and humidity than most of the U.S. Plains. For instance, the Argentinean area mentioned would have summertime nights 20 – 30 minutes longer than KS. Humidity, a very rough indicator of moisture conditions, again shows a smaller likelihood of problems: comparing similar seasons (Aug. in the U.S. is equivalent to Feb. in Argentina), the average humidity at Rosario being 65% compared to 59% for Wichita, KS.

While we cannot say these areas won't have problems with SAR, we think all things considered, it's not going to be a chronic production problem for soybeans on the U.S. Plains.