Track repair part of controlled traffic management

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Wet conditions in many parts of the country over the past three years have served to focus attention on wheel track maintenance in controlled traffic systems; an unforseen issue for many CT practitioners.

Consultant Tim Neale, principal of Precision Agriculture, said the recent wet seasons had brought the issue of wheel track management and maintenance to the fore, and accelerated demand for track renovators across the country.

A variety of track repair or renovation machines is available, using mechanisms ranging from discs to scrapers. Mr Neale tends to favour the Grizzly renovator, a machine that uses off-set discs to pull soil back onto the wheel track, and which he describes as robust and quite aggressive.

One of the issues with track renovation is whether or not there is dirt to bring back onto the track.

"While growers talk about soil being pushed or squeezed out of the track, that does not mean there are obvious ridges of displaced soil along the sides of the track," he said.

"Sometimes it is just that the profile of the track has changed, with a depression down the centre with no obvious sideways displacement or ridging. Soil can be washed away along tracks, too, which poses a different challenge."

Seeding crop on tracks, which is not usually done in the northern cropping zone because crop on tracks matures at a different time to the rest of the paddock and often produces quite different grain quality, can help limit damage to tracks by stabilising and helping protect the surface, he said.

"Where a track has been washed out and a renovator cannot bring enough soil back onto the track to repair the eroded area it might be necessary to rip the area and start again, which means the track will be soft for the following few months."

Mr Neale favours prevention over 'cure' for wheel tracks and advocates rotating the tracks used for spraying.

"Most growers have their boom spray three times the width of their seeder so they use every track once at seeding but use only every second or third one for the rest of the growing season. It is those spray tracks that suffer most wear and tear and can rapidly become deeper than the others".

CT CAN PAY BIG DIVIDENDS IN IMPROVED CROPPING SOILS AND SPRAY TIMELINESS, AS THIS CLEAN, HEALTHY CROP OF CANOLA DEMONSTRATES.

It's not always easy to see the effect of deep compaction because it is out of sight deep in the soil; possibly as deep as a metre in some soil types and situations.

"Rotating tracks – using one set for spraying one year and another the next to spread the wear and tear – avoids one set of wheel tracks being cut out so much deeper than the rest.

"If the spray tracks look like they are starting to get too deep, take the pressure off them by rotating to another line."

Having tracks that are worn deep enough to hold water that drains off other parts of the paddock increases the risk of them being damaged, he said.

"Water will move across the paddock, either over the surface or through the topsoil, until it reaches a deep track or rut. Keeping all the wheel tracks in good condition goes a long way towards avoiding the problem."

Lay out, particularly whether tracks run up and down or across a slope, is also important, with annual rainfall, soil characteristics and degree of slope all needing to be taken into account.

"In districts like south-west Victoria, where growing season conditions are often cold and wet and waterlogging is a potential issue, growers use a combination of raised beds with permanent wheel tracks that are graded and laid out so the tracks carry excess water away from the cropping beds down gradients designed to ensure water movement without sufficient speed to cause water erosion."

For SA conditions Mr Neale tends to favour running permanent wheel tracks up and down slopes so water doesn't collect on the tracks, provided the gradients are not steep enough to increase the risk of wash.

He believes wash is unlikely to be a major issue in SA conditions, given growing-season rainfall in most districts and the fact that, with less compaction, the

cropping soil between the wheel tracks will absorb and hold more water. Where wash does occur it is often because insufficient attention has been paid to getting the lay out direction right, he suggests.

Disc seeders can contribute to the risk of wheel track erosion because they do not leave furrows along the rows like a tined seeder, so any excess water finds the lowest part of the paddock and concentrates there.

"Discs tend to leave the surface of a paddock flat. With a disc seeder there are no or only slight depressions to hold water or slow the movement of water across the paddock when there is intense rainfall or high rainfall on already wet soil, so in a paddock sown with discs more water ends up in the wheel tracks.

"Consequently, growers using disc seeders need to pay attention to their track layout in relation to the gradients in their paddocks to minimise the risk of water pooling on tracks and keep a close eye on track depth."

When to renovate tracks can be an issue, he said.

"Soon after harvest when the soil is dry is probably best because it gives maximum time for the tracks to stabilise again ahead of spraying and seeding, but working hard, dry soil will require more power than doing the same job when there is some moisture in the soil."

Mark Branson, who farms at Stockport, in the Lower North, and has been using a controlled traffic system for his seeding and growing-season operations since 2004, is facing the need to renovate wheel tracks in several of his paddocks.

ON THE STRAIGHT AND NARROW. A TRACTOR ON PERMANENT WHEEL TRACKS ON RUSSELL ZWAR'S PROPERTY.

He has all his seeding and spray equipment on 2.8 m axles but his header and other harvest equipment are not part of the CT system at this stage, partly because of the logistical challenges and cost and partly because he is still inclined to think machinery causes little compaction on his soil types when the soil is dry and hard.

However, in recent seasons he has often had to put the header, trucks and bins into paddocks in which the soil is still quite soft and plastic, so he is beginning to wonder whether there might not be benefit from going to a full CT system with all machinery, including the header and trucks, on a common three-metre wheel base and confined to permanent tracks so the cropping soil is not compacted.

Compaction was a major factor in Mark's 2004 decision to adopt a CT system, which he describes as a 'fantastic' farming system that has improved his soil structure and profitability.

His holistic, continuous-improvement approach to cropping means he struggles to put a figure on the degree of improvement due specifically to confining his seeding and growing-season traffic to permanent wheel tracks but he has no doubt the cropping soil between the wheel tracks is growing better crops than ever before because it is no longer being compacted by heavy farm machinery during the growing season.

Mark remains acutely aware of compaction and makes a clear distinction between the shallow compaction caused by the sheep that are still part of his farming system and the deep compaction caused by machinery.

"The shallow compaction caused by sheep

EROSION OF PERMANENT WHEEL TRACKS CAN BE AN ISSUE IN SOME CIRCUMSTANCES.

goes away in one year of no-till cropping.

"It's not always easy to see the effect of deep compaction because it is out of sight deep in the soil; possibly as deep as a metre in some soil types and situations. It takes a lot longer for that to break down than the topsoil compaction caused by sheep."

Research done in WA suggests that heavier farm machines mean more compaction at greater depth.

According to WA researcher Paul Blackwell, as wheel loads increase, stresses on the soil below 100 mm will increase correspondingly. Use of lower tyre inflation pressures or tracked machinery, two measures promoted as reducing soil compaction, will not significantly reduce subsoil stresses and may in fact increase the depth to which soil is compacted.

The extra weight of modern farm machinery is likely to also be contributing to the track degradation issues being encountered by CT practitioners.

Mark would have less track damage to deal with if he had waited for tracks to dry out more before using them, but conditions in 2010 and last year were such that in many cases that simply wasn't an option, he said.

The other side of the coin is that having the compacted tracks enabled him to get in and spray, spread or do whatever needed doing earlier than he would have been able to without them. And confining the machinery traffic to the permanent wheel tracks means that he only has to deal with damage to the tracks; not rutting across the whole paddock.

NSW grower Michael Pfitzner, who farms near Griffith, in NSW, reported similar experiences at the SANTFA conference this year.

Michael implemented a CT system, with all machinery including the header running on permanent wheel tracks, when he found no-till was producing little improvement in his red sandy loam soils that have very little capacity to 'self repair' through swelling and shrinking.

In 2010, when more than 200 mm of rain fell during harvest, the permanent wheel tracks made it possible to harvest paddocks he would not otherwise have been able to get into without them.

Michael's tracks had been established only the previous year, so were still comparatively soft and were extensively damaged by the machinery, which bogged

GOOD LAYOUT DESIGN CAN MINIMISE THE RISK OF WATER BEING TRAPPED ON PERMANENT WHEEL TRACKS IN CT SYSTEMS.

Where wash does occur it is often because insufficient attention has been paid to getting the lay out direction right.

in several places. However, they still enabled him to get machinery into his paddocks and confined any damage to the tracks.

He is now looking at buying a renovator and implementing a planned program of track maintenance and renewal.

Most of the track damage on Mark Branson's property has occurred where water pooled on tracks, softening the clay or clay loam soil and making it plastic so the surface of the track is deformed by the wheels of the machinery, which push soil out of the centre of the track, creating a deeper depression that fills with water in the next rain so the process is repeated.

Almost all Mark's problem areas involve spray tracks. His spray boom is four times the width of his seeder, so each track in the paddock is used during seeding but every fourth track is used every time he needs to make an in-crop application of a chemical or nutrient.

In some seasons that can mean six or seven passes on the 'spray' tracks during the growing season, so they are deeper than the 'seeder' tracks and any water that moves across the paddock is trapped in those deeper depressions.

When conditions are dry there is no issue, Mark said, but even in well-drained areas the wear and tear on the tracks are causing them to spoon out and become deeper in the centre than the edges. This increases areas in which water is held on the tracks, so it is easy to make the situation worse if he needs to get into a paddock before the tracks have dried out completely.

He is now looking to buy a track renovator that will pull soil from the cropping area adjacent to the damaged area of track back into the traffic line, where it will be compacted by the next pass of the seeder or sprayer.

Most of the track damage on Mark's property is in low-lying area and he is considering changing the layout in that part of the property to minimise the risk of water pooling on wheel tracks.

He is hoping to come up with a design that will keep more water on and in the cropping soil, reducing the volume reaching the wheel tracks, and drain away water that gets to the tracks.

Mark is a strong believer in the weed control benefits of crop competition and always seeds his tracks – by dropping seed on the surface and letting the traffic roll it into the surface – so there is little risk of water erosion on his tracks, although he did get some damage from run-off two years ago when he got 150 mm of rain overnight.

SANTFA board member Russell Zwar, who farms near Wirrabara, in the Mid North, is a relative newcomer to CT, with the 2012 season just his third year. However, he is already facing track maintenance issues because those three years have all been quite wet, so the tracks have been soft and easily damaged.

"The machinery causes ruts or depressions in the surface of the tracks so they collect water, which pools and softens the soil."

Russell can trace the origins of some of his current problems back to what happened in 2010, his first year of CT.

"That was a very wet year and our first year with tracks and we went into some paddocks when they were too wet.

"That damaged the tracks, which were still soft at that stage, and they have just stayed like that or got worse in the past two seasons."

Russell has all his seeding, spray and fertiliser spreading machinery on 3 m wheel bases but not his harvest machinery. His seeder is 9 m wide and his sprayer and spreader both 27 m, so every third track is a spray track.

His is currently working through the issues around the track damage, how to repair it and how to avoid it in future.

One of the issues is that his tracks have not consolidated and become as hard as he expected.

"Tracks may set and stay hard in dry areas, but in higher-rainfall areas like ours the tracks get wet and the machinery pushes soil out of the centre, so there is a depression along the track, which collects more water."

The slopes on Russell's property are also an issue because the tracks interact with the topography, so water tends to pool and concentrate in some areas and run off others, resulting in surface wash in some areas when there are heavy falls of rain.

Changing the track layout to better address the slopes might solve the problems but he is still exploring what would be involved in doing that and possible flow-on effects.

Russell is using a disc seeder, so there are no ridges or depressions in his paddocks to hold water on the cropping soil or slow water movement across the surface of the paddock. As a result, water that does not immediately infiltrate into the soil quickly drains off the cropping areas into the wheel tracks.

"With discs there are no press-wheel furrows so there is nothing to impede the movement of water over the soil surface," he said.

"We can get quite a lot of runoff and a lot of water speed along tracks down gradients.

"It's a lot easier to prevent or control run-off with knife points and press wheels, which leave depressions in the soil along the crop rows."

Only the spray tracks are being damaged, he said, and most of the issues are confined to the steepest 25% of the property.

"CT is working well on 75% of the farm but there are some issues on the other 25% because of the gradients. We need to work around that."

Russell adopted a CT system to get rid of compaction from his cropping soils.

"We have a lot of machinery passes each season, so we decided to confine the traffic to permanent wheel tracks so we don't compact the cropping soil.

"Changing to CT has made cropping easier and produced significant benefits in soil structure, crop growth and trafficability.

"The system is good, but not bulletproof, and you need to be careful and not create problems, particularly in first few years.

The system needs time to settle down and growers need time to come to terms with the issues."

He has thought of moving away from CT again, but keeps coming back to the compaction caused by seven or eight machinery passes through and over the crop during seeding and the growing season each year.

"It has to benefit the crop to confine that compaction to permanent tracks and keep it off the cropping soil."

MORE THAN ACCURACY FROM CT

Autosteer gives many of the accuracy benefits once associated with CT but does not achieve the compaction control that provides the yield and trafficability gains of CT systems.

Recent research shows that changing to a CT system can increase farm profit by about 50 to 60% in WA conditions, with about 70% of the net financial benefit coming from eliminating soil compaction by moving wheeled machinery onto permanent wheel tracks, according to DAFWA scientist Paul Blackwell, who is involved in a new project promoting the uptake of CT in WA.

"Many farmers who have changed to using autosteer to improve their in-paddock accuracy are still missing out on large profit increases because they have not moved all their machinery onto permanent wheel tracks," Dr Blackwell said.

"Any machine with an axle load of more than a tonne should be part of the CT system.

"Our research shows that, in sandplain country, about 70% of the estimated net profit increase from using autosteer and CT comes from minimising soil re-compaction, with only 15% of the benefit coming from the increased accuracy due to the autosteer."

Even without taking account of compaction, losses from machinery wheels can be significant, with seeder wheel tracks reducing yields by 21% and the yield loss in early-season boomspray wheel marks measured at 68%.

Wheel tracks over crops later in the season, at about flowering, resulted in 100% yield loss; the same as that in permanent wheel tracks in a CT system.

Consultant Tim Neale, principal of Precision Agriculture, estimates the yield benefit from adoption of CT in SA conditions to be around 15%. In Queensland and northern NSW, where summer crops are grown, that the winter crop benefit of CT is nearer to 18%.

A CT system with machinery on a 3 m wheel base, which is becoming the industry standard, effectively takes about 10% of the paddock out of crop.

Potential benefits in addition to gains in yield include reduction in inputs, improved fertiliser efficiency because of improvements in the cropping soil or better timing and machinery performance because of improved trafficability and traction on the compacted permanent wheel tracks.

WA research results show that eliminating soil compaction in sand-plain soils in no-till farming systems can increase wheat yields by 8 to 13%, lupin yields by 10% and canola by 11%.

Those gains, over a four-year rotation, were achieved by deep ripping to break up a sub-surface hard pan ahead of implementing a CT system.

Previous research showed deep ripping WA sand plain soils to a depth of at least 30 cm could improve crop yields by 30%, which illustrates impact of soil compaction on crop performance in that environment.

According to Dr Blackwell sub-soil compaction is an insidious restriction on grain production on Western Australian sands, with yield losses due to compaction increasing as the size and weight of cropping machinery increases.

"Vehicle weight and axle load are the most important vehicle factors influencing compaction and modern agricultural machinery, particularly harvest machinery, tends to be large and heavy," he said.

"The greater the axle load, the greater the sub-surface compaction.

"When it is necessary to harvest on wet soil compaction is further increased, with vehicle loads of 10t capable of creating sub-surface compaction to 50 cm."

This is also the case in Queensland, where harvester compaction was measured at 60 cm.

In SA, despite solid data that there is soil compaction in cropping paddocks and satellite images of SA properties showing that wheel tracks from decades earlier are still reducing biomass production in current crops, relatively few growers are using CT systems.

This may be because there has been little research to determine whether or not there are benefits from confining field machinery to permanent wheel tracks under SA conditions, although the fact that CT produces yield, access and traction benefits in diverse soil types – from sands to clays – in WA and Queensland would seem to suggest that getting wheeled traffic off cropping soils should also pay dividends in SA conditions.

A major trial at Roseworthy from 1989 to 1995 showed this is definitely the case for the red-brown earths typical of the Mid North and Lower North.

The researchers, who compared the effects of wheel traffic and deep ripping, found the structure of the Roseworthy soil regenerated under CT. This effect was previously thought to be restricted to cracking black soils of Queensland and NSW, as CSIRO scientist Tim Ellis pointed out in a paper at the World Congress of Conservation Agriculture last year.

When the trial was established in 1989 there was a compaction layer about 10 cm thick about 75 mm below the surface.

No-till and exclusion of wheel traffic decreased bulk density and penetration resistance in the cropping soil between wheel tracks, resulting in improved soil structure and infiltration, worm population, root growth and crop yield.

Dr Ellis, who initiated and led the trial while teaching at the University of Adelaide, said that shifting all traffic to permanent tracks also increased the load-bearing capacity of the permanent tracks.

The combination of more friable soil in the cropping areas and improved trafficability due to the compacted permanent wheel tracks improved tillage and direct drilling efficacy through reduced tractor power requirements and more timely chemical application, he said.

There were four treatments in the GRDC-funded trial: conventional wheel traffic, no wheel traffic (CT), conventional wheel traffic after deep ripping to a depth of 30 cm and no wheel traffic after deep ripping.

The greatest improvements occurred when wheel traffic was excluded without deep ripping.

Sheep were grazed on all treatments over the dry summer months and the crops grown during the trial were barley, faba bean, wheat and medic pasture.

In five of the six years over which the trial ran the CT treatment improved barley, wheat and bean grain yields by 12 to 17% and pasture biomass by 22%, which more than compensated for 10% of land area lost to the permanent, bare wheel tracks used in the trial.

These results add to the 'ample and longstanding evidence that CT can improve yields, possibly about 20%, and protect and improve the structure of swelling and non-swelling soils in southern Australia', Dr Ellis said, and suggest greater attention should be paid to the potential for CT systems to raise yields, improve soils and lower inputs on farms across south eastern Australia.

WA growers recognised the significance of soil compaction several decades ago and turned to deep ripping – typically every two years – to overcome compaction in cropping soils in many regions of the State.

In recent years considerable work has been done on the benefits of using CT to avoid or slow re-compaction in the wake of deep ripping.

Dr Blackwell has no doubt that CT cropping systems help minimise re-compaction of sandy and loam soils after deep ripping, deep cultivation, spading or ploughing and make cropping operations more cost efficient.

Soils with the capacity to recover from compaction through natural mechanisms such as shrinking and swelling will also have more opportunity to self-repair their structure if farm machinery is confined to permanent wheel tracks so the soils are not re-compacted by farming operations, he said.

"Less compacted soils should be healthier and enable crops to make better use of water and nutrients, resulting in uniform crop growth, greater yield and better grain quality. This in turn reduces the need for inputs and increases farm profit."

Economist Ross Kingwell has calculated that changing to controlled traffic on a 2,000 ha farm in WA's central wheat belt could increase profit by 40%.

Despite a survey indicating significant compaction in cropping soils on Eyre Peninsula, trials by researchers based at Minnipa Agricultural Centre showed no economic benefit from deep ripping in those conditions.

That work, co-ordinated by research officer Cathy Paterson, showed that deep ripping is a high risk option in below-average years and that the benefits of ripping are unlikely to last for more than two years.

The deep ripping broke up the compacted layer but the trials were conducted from 2006 to 2008, when EP had three successive years of Decile 1 rainfall, making moisture the limiting factor; with crops growing in soils with compacted layers able to extract as much water as those growing in deep-ripped soils, Ms Paterson said.

The researchers found deep ripping resulted in small yield increases in some years at some of the trial locations but reduced yield in others.

The reduced yield phenomenon has also been observed in WA, where it has been attributed to a combination of improved soil conditions as a result of deep ripping and dry seasonal conditions effectively 'shortening' the season by enabling crop plants to exhaust limited moisture supplies earlier in the season than they can in compacted soil.