



**South West
NRM**

Case Study

Managing non-wetting soils
in South West WA

Image Credit:
Ben Webb.

With an estimated ten million hectares of sandy soil, Western Australian agriculture is at particular risk from water-repellent or non-wetting soils.

Sandy soils are more prone to this significant production constraint because the larger sand particles give them a smaller total surface area compared to clay particles. This means they are more easily coated by waxy compounds left behind after the breakdown of organic matter, which repels water from entering the soil profile. The outcome is uneven wetting, patchy germination, and more weed pressure from delayed germination.

Already costing industry an estimated \$251 million annually (Dept Agriculture and Food 2013), the problem appears to be getting worse since the adoption of no-till farming which concentrates organic matter at the soil surface (Roper et al. 2015). Smaller and less frequent rainfall events at the break of the season are also likely to have an effect, along with earlier sowing than in the past.

In 2021, South West NRM spoke to Tincurrin agronomist, Clinton Mullan, about water repellency. He sees the complete absence of tillage as another problem:

"I think it's slowly getting worse, particularly on our sandy gravels, with our use of knife points and press wheels," Clinton said.

"We're not stirring the soil back up. I'm a believer in resetting the topsoil on certain soil types when you get the opportunity."

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Non-wetting soil on the right, compared to ameliorated soil on the left.

Strategic tillage

Clinton isn't the only advisor promoting the use of strategic tillage to invert the soil and bury the water-repellent layer below the soil surface. With trials running in the Kojonup area, Department of Primary Industries and Regional Development (DPIRD) research scientist, Glenn McDonald, believes that strategic tillage, whether with a Plozza plough, mouldboard plough (MBP), one-way plough or spader, is the most effective and profitable technique to deal with the issue on many soil types.

"The advantage of these operations is you do them once and get a long-term effect," Glenn said. *"In long-term trials, we're still seeing effects after eight years and counting."*

While tillage is often seen as detrimental to soil structure and soil carbon, evidence suggests impacts from a single event may not persist (Kirkegaard et al 2020). It is possible that in the long term, soil inversion could increase soil carbon if it removes constraints and results in greater plant biomass production. Assessing the benefits with trials on different soils may be warranted.

One of Glenn's key principles for improving the benefits of strategic tillage is to treat as many other soil constraints at the same time as possible, such as subsoil acidity and compaction.

"The thing about lime is it doesn't move very fast and can potentially take decades to get to the depth of an MBP (30–40 cm). So, if you've soil tested and have a lower pH at depth, applying a good chunk of lime upfront before any strategic tillage means the lime will be transferred into the subsoil to treat acidity."

The choice of machine for soil amelioration can come down to cost and suitability for specific soil types. Clinton has looked at several machines but doesn't think many are suited to our rocky, gravelly soils.

"For our sandy gravels, I think an old plough with Plozza discs gives us the best result long term. It's slow and a bit more work compared to what a \$180,000 machine will do for you, but for a \$15,000 investment, I'm happy to slowly go around and fix our sandy gravels for a more long-term effect."



Plozza plough in action west of Kojonup in spring with a summer cover crop being sown from a trailing seed box to mitigate erosion.

Glenn agrees, saying that while an MBP can handle roots and rocks, it tends to jump over them and lift them out of the soil whereas the Plozza tends to roll over rocks.

"The Plozza is more favoured in the forest country where there are more roots and rocks because it leaves more of them below the surface."

Ben Webb, who farms west of Kojonup, started using a Plozza in 2019 and has ploughed 250 hectares of mainly gravelly duplex loam over clay soils.

"The discs go in 25cm and invert the soil and mix it a bit too. The aim is to get a bit of that higher percentage clay soil onto the top. We will also mix through some of the lime we've been spreading and activate a lot of that."

He thinks he got his money back on the investment, but he said dealing with rocks that do come to the surface and levelling out paddocks after tilling can be a challenge, and the plough can be an art to drive. Ben would like to compare it with claying.

"In the worst of the non-wetting [area], there is a very small percentage that is still a bit non-wetting. I think it needs some actual clay mixed in with it," Ben said.

Claying and clay delving are more costly techniques that some farmers have taken on, especially on the south coast, because it's more of a permanent change to the soil.

However, Clinton believes other constraints should be considered first.

"You need to know the constraints before you start spending money on claying. That goes for things like pH and potassium as well. Fix everything else first because that's where most of your production is going to come from."

The downside of the Plozza is that while the amount of soil inversion can be varied depending on the Plozza disc shape and plough angle, Glenn says it can't fully invert the profile like an MBP, so won't completely bury herbicide-resistant weed seeds if that is an issue that also needs to be addressed.

"There will still be a thin strip of weeds if you maximise the inversion, so you need to think about what outcome you want."

Another consideration is what might be brought up from the subsoil in the tillage operation.

"If the subsoil's a bit toxic (e.g. sodic, high in boron), you don't really want to bring that to the surface with any machine," Glenn said.

"There's been numerous examples where people have done that and the paddock's gone backwards permanently."

Glenn also says the Plozza is generally cheaper to set up by modifying an old one-way plough and adding the Plozza discs, compared to purchasing an MBP. It also means you have your own machine to use when your conditions are ideal, rather than relying on an MBP contractor to be available at the right time. Given that water-repellent soils are usually light, sandy and at a relatively high risk of wind erosion, getting the timing right can be important.

"None of the strategic tillage options are without environmental risk," Glenn said. *"A lot of people try to do their amelioration before seeding. That has some big risks when it comes to things like erosion because you expose the soil to autumn winds."*

"For those with livestock, they might be able to graze the paddock until late winter – early spring, ameliorate and then follow it up with a cover crop of some sort or a cash summer crop. This later timing will be most relevant where wind erosion is almost certain. Sowing with a winter or early spring timing has a real place in the southern half of the state."

While tillage with these machines can address compaction to 30–40 cm, deeper compaction is addressed with deep ripping. Glenn generally recommends that any deep ripping is done after strategic tillage.

"If you go back over a deep ripped area with a spader or plough you're just re-compacting the deeper area. Also, a lot of strategic tillage works better if the soil hasn't been pre-loosened. There are exceptions but that's the general rule. The soil folds better with inversion ploughs if the soil hasn't been ripped first."



Plozza plough on the left of picture and not on the right. (Photo Ben Webb)

Soil wetters

Where resetting the soil isn't an option, Clinton is using soil wetters to get the crop established as best he can.

"Wetters have gained a lot of traction in the past two years with the dry starts. Initially, SACOA brought out Lure H20™, and I think that still has a fit for farmers with pasture."

One farmer who agrees is Simon Williamson from Kukerin who first used Lure H20™ in Williams ten years ago and found it worked better when applied immediately prior to rain. In 2020, he used it on a paddock that normally doesn't get going until August.

"I applied 10 litres per hectare with 190 litres of water in late May when rain was forecast. The paddock is 64 hectares and I applied it to 18 hectares. That year it was the first patch on the farm to get green and the sheep in that paddock ran on that 18 hectares most of the year."

"It was between rainfall events that you definitely saw a difference. It stayed greener and recovered better after rain. Our neighbour noticed it from a kilometre away. That was enough evidence for me."

However, for crops, spraying the entire paddock including inter-rows is less economical, so SACOA developed a furrow wetter, as Clinton explains.

"They looked at an on-furrow treatment, but that didn't work if a wind event blew repellent soil on top. So, they came up with an in-furrow product called SE14™."

Clinton believes it's an easy decision to use wetters on paddocks where 60–70% of the soil is non-wetting, more commonly found west of Narrogin and Williams.

"It's a no-brainer, you just do the whole paddock."

However, soil wetters aren't effective on all soils. On Clinton's farm, only 20–30% of the soil has an economic response to the product.

"We ran trials with it here, measuring yield with the header. We saw some really good gains with the non-wetting soils, but as soon as we went off those soil types there was no economic gain. So, we were spending \$22 per hectare for no benefit on those soils."

To reduce costs, Clinton realised he needed to get better at putting the product in the right place. So, he mapped out his non-wetting soils.

"If you are only treating part of a paddock, the investment is pretty good. I think out this way, it's probably [the way] to go. For us, that brought the cost down to \$4-5 per hectare."

Clinton said that while some farmers might not think they know their soil types, he's found that where they've had five- or ten years of experience with the farm, they get most of them right.

"I've sat down with a lot of clients over the years trying to map out soils and found they know them pretty well."

Clinton also suggested the thorium layer that comes with electromagnetic [EM] and radiometric mapping provides a pretty good representation of gravelly soils (non-wetting in most sandy soils), and this can help managers that are less experienced with a property.

Clinton is also a strong believer in doing soil cores and soil tests to 30cm across his farm to get a better idea of what the constraints are.

"Some of our soils are sand to 50cm, so you've just got to accept that it's a poor performing soil, or you've got to clay it."

The problem is these soils without a clay base are limited with water-holding capacity and yield anyway. So, you get the crop up, but they tend not to be the best-performing soils."

Clinton thinks using SE14™ to get the crop established could help to understand a particular soil's productive capacity by effectively stripping away the non-wetting constraint to better understand its fertility and water-holding capacity.

In-furrow wetters tend to be most responsive when sowing with marginal moisture, so another option to reduce cost is to not use it in wetter years. This is an approach used by Ben Webb who has been using SE14 for two years.

"If we've got a wet year we wouldn't use it," Ben said. "Or we might start using it but once you get to the cereals towards the end of seeding, turn it off."

Ben also agrees that SE14 works better in gravels.

"The loamier the soil the less effective it is."

Like many farmers, Ben tries to maximise moisture by retaining stubble and spraying summer weeds.

"Anything to keep moisture in the soil."

A paddock west of Kojonup treated with SE14 with a bare patch showing where it wasn't applied (Photo: Ben Webb).



Near row sowing

Another option to mitigate water repellency is on – or near-row sowing, placing the seed close to existing infiltration pathways made by roots from the previous crop. These pathways are maintained with a no-till system.

Soil moisture in these old rows also increases microbial activity in that part of the soil, including a large group of bacteria that degrade waxes and reduce repellency. These microbes can be present in far greater numbers under old rows compared to the dry inter-row. Promoting these wax-degrading microbes may be assisted by liming, which is a source of nutrition and can create a more favourable soil pH for microbial activity if soils are acidic. Inoculation with the microbes in the field has been less successful, unlike pot-trials, while some other groups of microbes can induce repellency.

Clinton says he has a few clients who have applied near-row sowing successfully using ProTrakker.

“Being able to sow two centimetres alongside last year’s row where rain will channel down last year’s root pores does give you a good crop establishment.”

Clinton agreed that there is the possibility of human error with a ProTrakker and ending up with the crop too far from last year’s rows.

“You don’t want 100% of your crop 4cm away! You’ve got to have your RTK system in place and be happy with your run lines and what fences to work off before you can get the ProTrakker. Again, that’s a big investment to have all that done.”

In summary, farmers looking for cost-effective solutions should consider testing proposed treatments on different soil types to see which ones respond, and then map these responsive soils to minimise costs. Also, consider whether other constraints such as subsoil acidity can also be addressed with strategic tillage. Given that non-wetting soils are usually light and at risk of wind erosion, it’s also important to consider the timing of any strategic tillage.

South West NRM has no affiliations with any commercial services or products mentioned in this article.

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References

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