# GRDC PODCAST TRANSCRIPT

**Ameliorating sandy soils to increase production**

[00:00:05] **Intro** This is a GRDC podcast.

[00:00:12] **Prue Adams** Dealing with sandy soils has long been the bane of many grain growers. But a six-year GRDC investment in sandy soil amelioration in the southern region has come up with a raft of research and grower options which are providing impressive on-farm results. Hello there, I am Prue Adams. Back in 2017, as a result of farmers complaining about underperforming crops on sandy soils, GRDC established the investment which brought in a range of skills from agronomists to financial analysts, to engineers. The project has now wrapped up and because of it, affected growers are increasingly turning to deep ripping and spading to improve productivity. In this jam-packed episode, I speak with some of the experts involved in the project. We recorded these interviews at the very last on-farm workshop, held to discuss and disperse vital information about how growers can get the best from their sandy soil. First up, Therese McBeath, research team leader from CSIRO Agriculture and Food.

[00:01:20] **Therese McBeath** This project started in 2017 and it came off the back of farmers observing that crops on sandy soils were underperforming and there was water left behind in the paddock, so they weren't utilising all of that resource. The investment has run for this full six years and we're now coming to the end of this project. And the culmination of this project is this series of masterclass workshops.

[00:01:45] **Prue Adams** So you're six years in, basically, over that time, has the information evolved and your learnings evolved? And are there any key points that have come out of it that you think are really important?

[00:01:58] **Therese McBeath** It certainly has, Prue. When we started this work and we were consulting with growers, particularly in lower-rainfall environments, there was quite a reluctance to think about strategies like deep tillage of sands to improve crop performance. And what we've seen recently is growers very rapidly adopting deep tillage techniques for their poor performing sands. And this is really being supported by this collaboration where we work through that problem and we ask the question, "What is my constraint?", "What's the problem in my soil profile?", "What tools do I use?" So thinking through the engineering and how do I optimise the engineering of those tools to overcome that constraint? What will I then expect from my plant? What will the crop yield performance be and how does that translate with respect to profit and risk?

[00:02:48] **Prue Adams** And I suppose a really important point now is, given that this project is over, where can growers get the information that has come from it?

[00:02:55] **Therese McBeath** So we've produced a number of factsheets that are available via the GRDC website, both on that aspect of "What is my constraint and how to identify that constraint?" also, "How do I optimise the set up of my deep tillage machinery to get the best performance?" That also sits on our Sandbox app where we've housed all of our crop trial results as well. So, people can use a searchable map to find research trials in their environment and look at the types of responses we've measured over this period.

[00:03:30] **Prue Adams** Knowing just what your constraints are is the first step in dealing with the problem according to Dr. Melissa Fraser, who runs Soil Function Consulting.

[00:03:41] **Dr Melissa Fraser** For me, Prue, I like to work with farmers to help them understand what their constraints are. Because I found that so many people love to get out deep ripping, that's a thing that's been adopted the most and, it doesn't always work and people don't always know why it doesn't work, or why it did work. And so really, the first place to start in sandy soil amelioration is by diagnosing and identifying your constraints. Where they start, where they stop, how severe they are. So that includes things like water repellence at the surface, extremes in pH throught the profile, high soil strength or compaction and then issues with nutrients, either deficiencies or toxicities. So my role is helping people to understand some really complex soil science in a really easy way with some really easy tools.

[00:04:22] **Prue Adams** So those constraints are they things that farmers are generally across, or do you find that they have a bit of an understanding of what the constraints are, but not necessarily the whole picture?

[00:04:32] **Dr Melissa Fraser** I think most people are aware that their sandy soils are compacted. It sort of makes sense that that's happened over time as the machinery has got bigger. But things like water repellence, for example, don't express in every year. If you have a nice wet start to sowing, you won't always see poor crop establishment. And so, it can catch you by surprise in some years in some parts of the paddock and I think that's something that's also been developing over time as well. Since we haven't been cultivating our soils, we're seeing more repellence developed at the surface. And acidity is one of these ones that we know is really widespread, actually, in the sandy soil landscape, but it's not very uniform and it often occurs at a depth below where we're doing our traditional soil sampling or monitoring. So historically, we take a soil sample in the top zero to 10 centimentres to look for nutrient deficiencies, to make nutrient recommendations. But we can actually, in that case, not identify well an acidity issue which is occurring between, say, five and 15cm. So, the constraints are usually there, but we're not always looking for them in the right places at the right time.

[00:05:28] **Prue Adams** Now, I've watched you today at this workshop, basically going through pH testing, looking at the water repellence, I suppose, as well. What's all that about? What's the message that you're getting across there?

[00:05:41] **Dr Melissa Fraser** You really need to know which constraints you've got and where they occur in the profile and how bad they are so that you can choose the right machinery. That's what it mostly comes down to, people are going to look to a machinery solution before they probably look to something like lime or treating water repellence. But we know that we heard it today, the main message, "Do it once and do it right". And so, if we just went deep ripping in a sand, which is actually water repellent and acidic as well, we don't actually get a lot of mixing across the surface with a deep ripper. So, you go on and you spent the money, you've disrupted your soil, you try to get it stabilised again, but you've actually missed the opportunity to treat multiple constraints. So, knowing your constraints in the first place, helps you to select the kind of machine that you're going to use. Whether you want to invert the profile, or mix the surface, or just deep rip and decompact. And the range of ameliorates that you'll need as well, so, whether you actually need some additional lime or maybe some gypsum, acidity issue, lowering the profile, or the ability to incorporate some organic materials at the same time.

[00:06:39] **Prue Adams** We're in Cummins at the moment, which is on the Eyre Peninsula in South Australia. You've done a few of these workshops now, what do you find are the similarities and differences I suppose, when it comes to sandy soils, because they're not all made the same, are they?

[00:06:52] **Dr Melissa Fraser** No, they're not. And in fact, I've really enjoyed coming back to the Eyre Peninsula this week for work to explore the sandy soils here because it's something we don't talk about much, like where does your soil come from? And how old is it? And what are the constraints that it's likely to express depending on where those sands came from? So, in the upper-Western Eyre Peninsula, the sandy soils there have been derived from the ocean floor when the sea was offshore about 20,000 years ago. So, they contain a lot of shell fragments which makes the pH very high. As we move to the Eastern Eyre Peninsular, our sands can be deep and still, about 20,000 years old, but they don't have that background shell load, so they are more prone to the development of acidity. And then here where we are near Cummins, this is a basin which has been forming for about 40 million years from ranges which are 1.2 billion years old. If we go into the South Australian Mallee, the older, surface soils exposed there, about seven million years old. The East-West dunes are about 700,000 and then the grey soils, again, have blown in the last 20,000 years. And so each of those different sandy soil types means we have different profiles, depth of sand in the profile, where the clay is underneath, and also then, whether we have lots of carbonate material in that clay material as well, or salt or boron. So understanding how your soils formed and where they came from also has an influence on the kinds of constraints they'll express and the kind of machine and amelioration package you might need then, to fix that.

[00:08:14] **Prue Adams** So if there was one key message that you were banging home at all these masterclasses, what would it be?

[00:08:20] **Dr Melissa Fraser** Zone it up. Diagnosing constraints, the first place to start is looking at your variability. Use your information that's already available to you - yield maps, NDVI, freely available from satellite, you can get that information to look at variability across your paddocks. Pull up things like historic imagery in Google Earth, look at variability over time in your paddocks so that you know where to start digging holes. And once you've dug your holes, characterise those constraints. It's really simple, with a pH kit, a bit of demineralised water and a shovel, you can answer a lot of questions just with those three things. Maybe a penetrometer, and from there, use that information to help you make good decisions.

[00:09:00] **Prue Adams** So, you know the constraints on your sandy soil, what do you do? That's where Chris Saunders from the University of South Australia comes in. He's a research fellow in the Agricultural Machinery Research and Design Group.

[00:09:13] **Chris Saunders** We would normally try and choose a machine based on the constraint that the grower is trying to overcome and the sort of a range of complexity in machines to address multiple constraints. So, if it's a single constraint, a machine may be more simple, more straightforward. And as we go through multiple constraints, we would try and add functions to that machine or choose a machine that could do more functions to try and address those multiple constraints.

[00:09:38] **Prue Adams** So what are you telling growers at these workshops at the moment?

[00:09:41] **Chris Saunders** So at the moment we're just trying to highlight what machines are currently available and what they expect to achieve. And we're showing that sometimes a machine doesn't achieve completely what the expectation might be. And so, if the farmer has an understanding of that, he can maybe try and choose a different tool or set the machine up slightly differently to try and improve the ability of that machine to address the constraint.

[00:10:01] **Prue Adams** Are there stand outs, are there things that farmers should have in their tool kit to start with?

[00:10:07] **Chris Saunders** Well, I guess if we think of the constraints, probably one of the most simplistic for a machine to address is a physical constraint. So, we would be looking at a ripper to overcome a physical constraint in the soil. And we then need to determine what depth that constraint would be, under the surface. So, we would do some penetration resistance measurements, we would dig a pit and we would look at, maybe, bulk density through the profile so we determine how deep we need to drip. And then we could go back to the tool and say, okay, what length tyne, what size machine do I need to get to that depth? And then given the tractor power available on the farm, we could choose the size of ripper, the width of machine and then we want to make sure that that ripper was actually loosening the soil to the depth of work or to the depth of the constraint, and also completely across the width of the machine so that we're actually doing an effective job over the whole width of the machine.

[00:10:54] **Prue Adams** You were talking before about active inclusion ripping, what is it and what can it do?

[00:10:59] **Chris Saunders** I guess the next step then is, so okay, if we're using a ripper to get rid of a physical constraint, we may also have a water repellent surface layer, which is a constraint to crop establishment. Ripping alone doesn't tend to address that constraint very well at all because we're not getting rid of any of that surface layer. By adding an inclusion plate behind the ripper, we're actually providing the opportunity to remove some of that soil from the surface and put it to depth and dilute the pressure on the surface of that non-wetting. Now what we find is with inclusion plates, there's a wide range of shapes and sizes available and some of them don't actually include very much material at all because they rely on a passive soil flow from the surface, into the cavity provided by the inclusion plate. So, depending on the speed of operation and the length and the size of the inclusion plate, farmers might do inclusion ripping with a plate at the moment and really include very little material from the surface. And through our testing we found that speed of operation is quite critical to that, so, the slower you go, the more material you tend to include behind the plate, and also, the shape and the design of the plate. And one of the things that we've progressed to is actually having an active system where we don't just rely on the passive nature of the soil falling into the cavity created by the inclusion plate, but, we're actually using discs and rollers to actually move soil over the cavity and place it where we need it, and gather that material together over the rip line and maximise the amount of material that goes down in between the inclusion plate. And then, by using a roller behind, we can actually consolidate that, so we're not left with a large trench behind the rip line so it's leaving a trafficable and seedable surface in one part. So, the active inclusion is, you know, the active ability of moving soil to the exclusion plate. But there's additional things that actually make it sort of, what we're calling 'seeder ready' as well.

[00:12:42] **Prue Adams** There was a bit of talk about spading. How useful is that?

[00:12:46] **Chris Saunders** I've talked about inclusion as a method of removing some of the non-wetting pressure from the surface and diluting that surface pressure. But if we want to go to the next level of sort of, amelioration of the surface, the spader is a really good tool. It's one of the best tools we've got for actually mixing the soil profile to a working depth. So, spaders can work down to 350 millimetres, give or take, and do a really good job of mixing that surface layer in through the profile. So, rather than just relying on, you know, getting rid of a bit of non-wetting behind an inclusion plate on the rip line, this actually mixes the whole profile across the working width of the machine. Obviously, it's a slower operation and it's a much more expensive machine so, you know, it's the next level of investment maybe. And then we also have to consider a good crop establishment afterwards, because we've completely modified the profile, we've taken organic material away from the surface, we've taken residue away from the surface, we've often not got the nutrition in the surface where we're putting our seeds, and we also leave our surface soil prone to erosion in a wind event. So, we have to be aware of those issues and we need to try and get that seeded as quickly as we can, try and get some ground cover back on the soil so we can get that protection for erosion.

[00:13:53] **Prue Adams** Listening to some of the growers at the workshop today, they've tried a lot of these tools. Are you finding that as you are going out to farms that tried a lot of the tools and they are experimenting?

[00:14:04] **Chris Saunders** In terms of deep ripping, there's been a lot of people try that and a lot of wide range of different conditions, different machines, etc. Inclusion plates also, they've tried a few. Active inclusion, no one has tried yet, that is a novel sort of process that we've developed through the research, through trials and engineering to try and increase the benefit of that inclusion ripping because obviously, going out ripping is quite a high-draft, high-power required operation. Adding an inclusion plate increases that power requirement because we are taking more draft to pull that ripper through the soil. So, if we're doing that high energy activity, we want to make sure that we're doing it to the best that we can. So, adding the active components to bring the soil in and make sure we optimise the amount of soil that is included, is obviously a more beneficial process. And we're seeing better responses from good levels of inclusion behind that active system than we would just from maybe some of the more basic inclusion plates have been tried in the past.

[00:15:02] **Prue Adams** So, what are the financial constraints around purchasing the type of equipment Chris Saunders just referred to? To answer that question is Royce Pitchford from Pinion Advisory.

[00:15:14] **Royce Pitchford** Ata trial plot level where there was a severe constraint and we overcame that mechanically, most of the time we're seeing a pretty profitable response. Some of the trials where we added a few too many additives, be it lucerne pellets or compost or chicken litter depth, that cost crept up too high to have a profitable response, despite an uplift in production. And then when we go to a whole farm level, we're moving away from that trial plot level, so we need to understand the variability across the paddock and how much response we're actually going to get. We sort of talk about your best country that's going to respond is going to be, you say, "class A" country and then you have "class B" and "C", which will respond less and less. So, we want to make sure that we're really targeting those class A areas and we're getting the best bang for our buck when we do a ripping pass. And then, if we move into "do we go and purchase a piece of equipment?", what we find is that we did some sensitivity analysis in that there is a bit of a buffer there that if costs do blow out, it is still fairly profitable, like, it does hold up where there's a significant yield improvement. But the big drivers behind our profit would be if you did buy a ripper or another piece of equipment and implement a program on-farm. Things like variations in fuel price don't matter so much, but how much capital we have invested has a big impact and how much area we're covering each year has a big impact too. So, to get the most out of it, really, if there's constraints there that need to be ameliorated, we need to do it sooner rather than later to reap the full rewards from that. And so, then it becomes a matter of time management and how much can we realistically get done in a given season.

[00:16:37] **Prue Adams** So, have you been involved with the project for a while? And has the information that you're giving evolved over that time, or has it been pretty much the same?

[00:16:46] **Royce Pitchford** Initially, we looked at sort of, variations in seasonal conditions, following that amelioration pass and price variations, and that probably got a bit too tricky to track and present on. But the big one has been machinery prices have changed significantly in the last three years and some of the numbers we were using were old and we were using historic grain prices, which have changed a bit. But what does it look like with higher fuel costs or with higher repairs and maintenance? And we can start to see that some of those operating costs don't matter too much because there are significant yield benefits there but, the capital investment in a piece of equipment and how much we're utilising that investment has a really big impact on how profitable the whole venture is.

[00:17:26] **Prue Adams** One grower who has deep ripped and found a substantial improvement is Will Long. He and his family farm near Cummins and it was in their huge machinery shed where the last Sandy Soil Amelioration Masterclass Workshop was held.

[00:17:43] **Will Long** We farm, at this farm, canola, wheat, barley, and lupins and now some beans on some soils we have ameliorated. A real mixture of soil types, from gravels to sands to better clays.

[00:17:59] **Prue Adams** So how have you traditionally dealt with the sandy soils?

[00:18:03] **Will Long** It's actually a new farm to us, so this is only our third-year farming here and we've learnt a lot of lessons about sandy soils very quickly. We've tried a few mitigation strategies to get started - some seeder set up and some time for sowing and now, we're going down the path of ameliorating with deep ripping and delving.

[00:18:24] **Prue Adams** So what have you done in terms of the deep ripping in the delving?

[00:18:27] **Will Long** We've played around for a few years when we got here, trialling a few different machines on the farm, seeing what might work and what didn't. But it really wasn't until this last year that we bought a ripper and started ripping and then was able to use the neighbour's machine and do some delving on some deeper sands. And then the result we've seen as we've gone there, over close to 300 hectares, across the whole landscape, has been well above and beyond what we thought we were going to achieve.

[00:18:56] **Prue Adams** Has it really? In what way?

[00:18:59] **Will Long** Well, the constraints here are the non-wetting soils. But the one that was really the culprit of the huge yield gap was waterlogging and we seem to have broken through that cap layer of clay at depth and allowed water to drain and flow far better than it ever has, and reduce the severity length of waterlogging and crops and just been able to grow.

[00:19:20] **Prue Adams** So with this change, and the information that has come from this particular project, will it change the way that you farm this site?

[00:19:27] **Will Long** I think it's really got me thinking about the system. And as we're still developing our system, a few key things have been the control traffic conversation, rotation with beans, and probably those two. It's really important.

[00:19:41] **Prue Adams** And what's the next step, then, for you?

[00:19:43] **Will Long** We've got a program for this coming summer, so I think I'll just go back to the drawing board on that a bit and try and think of ways we can maybe make it a bit more clinical and a bit more cost-effective.

[00:20:01] **Prue Adams** It's a lot to take in, but as Therese said right back at the beginning, if you want more information, then search for the factsheets on the GRDC website or the Sandbox app where all the trial results are housed. Many thanks to the CSIRO's Therese McBeath, Mel Fraser, Chris Saunders, Royce Pitchford and grower Will Long. This has been a GRDC podcast, I'm Prue Adams. Thanks for listening.