Matthew Warnken:

Hello and welcome everyone to our sixth episode in AgriProve's webinar series on how to grow top soils. I'd like to begin by acknowledging the traditional custodians on the land, which were gathered wherever we're watching this webinar and pay our respects to elders past, present, and emerging. My name is Matthew Warnken, I'm Managing Director of AgriProve. AgriProve is a specialist in soil carbon solutions company, focused on enabling participation opportunities for farmers in the carbon markets, and other environmental markets, creating the potential to access additional revenues.

Matthew Warnken:

We're hosting this seven-part series and we're very fortunate to have Declan McDonald, Principal Soil Scientist with Regen Soils here to help unpack the journey on how to improve soil health and grow soil carbon. Declan is a certified professional soil scientist within the 30 years experience in soils and agriculture spending both private and public sectors. So very well placed to guide us on this journey into growing soil carbon. And so far over the past five sessions, we've traversed a huge amount of territory, how soils work, how plants grow, the focusing on the organic matter as a cornerstone of soil health and sustainable production. A deep dive into soil biology looking at mineral management and the role of macro and micro elements. And the last episode was managing fertility as how to build soil carbon. And there the standouts for me is the fact that we can't control soil carbon as easy as we can control a bag of urea. So we really do need to understand soil function more and spend that time on that management of soil, because it is an ongoing activity important in terms of changing those management practices that there are no sudden jolts.

Matthew Warnken:

And then a unique insight into not only conceptual models of soil, but how Declan conducts his banking affairs with labor resistance and recalcitrant soil carbon pools. But the labile pool being that cash the sort of more credit card activities being more than humus in the middle of the pool and the lump of gold that's tied up with your bank manager being the recalcitrant soil carbon pools. Declan, you can give us more of that insight later on today both of missed anything there but the importance of particulate organic carbon that labor pool which seemed to be low and complex systems, but does seem to respond very quickly to management practices. For those who are looking at a recording there was a great Q&A in that episode, episode number five, where we did a lot of follow-up. So well worth going back and delving in there.

Matthew Warnken:

This webinar is on management practices to grow soil carbon, this is where we really start to look at the practical ways to implement changes on farming and how we actually go about growing soil carbon. Before we start as usual, some housekeeping we are recording these webinars they are available on our website, so you can catch up. We'll go over past material if you do miss a session, we'll be running around an hour with Declan on for about 40 minutes and having questions at the end. We're also streaming on YouTube Live and there's a chat pane on YouTube Live there for questions and comments, and also please use the Q&A for questions and any comments if you're tuning in through Zoom. Feel free to also use the chat function. Without any further ado, webinar number six hand over to Declan. Thank you very much Declan, looking forward very much to this episode, and now we're working on a series.

Declan McDonald:

Thanks. Matthew. Okay. So hopefully you've got my presentation screen on display, so yes. Is that right, Matthew?

Matthew Warnken:

We've got you loud and clear but not your presentation.

Declan McDonald:

Yes. Okay. So you can see me okay? I'm going to try again, share that screen.

Matthew Warnken:

Yep. So we've got it now as your screen, but then I think you need to go to presentation view and there we've got it. Brilliant.

Declan McDonald:

Okay. Thanks for your patience everybody and sorry about I'm not sure what it meant to happen there. Okay. So we really want to get practical now and talk about management practices that we want to employ, change or adjust to grow soil carbon. And just by way of kind of catching up, when talking about sequestering carbon it's in its most simple terms, we're talking about a carbon balance. So how much carbon is going into the system versus how much carbon is leaving the system. And the loss of pathways for carbon is principally as carbon dioxide and this is respired carbon. So I shouldn't need to make the point, but I think I do need to make the point that, that the loss pathway of carbon is driven by soil microbes primarily and soil decomposition, as we've talked about before, decomposition in soil I should say is really the most important function because it's what drives nutrient cycling.

Declan McDonald:

And we've shown this little graph a few times, which shows that post clearing we've lost about 50% of our soil organic carbon. And in this particular example here where we've got a figure on the Y axis of 70 tons per hectare of organic carbon. What the graph is showing us is that we're down to 50% of that total. So we've gone from about a 5% organic carbon soil to 2.5% of organic carbon soil. And of course the challenge is that increasing soil organic carbon really requires some commitment. And we've talked quite a bit about that in previous webinars. And as a general rule of thumb, we talk about increasing soil carbon by 1% requires about 50 tons of dry matter to be put back into the soil. Now that's a pretty rough figure. And there's so many dependencies that hang off of that, which I won't talk about now. But it's there really to highlight the point that it really does take some commitment, and of course that's not going to happen suddenly. So we're looking at change over the long term.

Declan McDonald:

And it's important to note also that sequestered carbon, what we're trying to do is we're trying to build the humus pool in particular. As we showed last week, the short-term rise in sequestered carbon is primarily in the particulate or labor pool, which is wonderful. That's if you like the early stage of humus development, but ultimately when we're looking at change over the long term, it's humus carbon that we want to see change in. So what can we do to sequester soil organic carbon. Now, I guess so much of what I'm presenting here, I'm presenting in the context of regenerating soils and regenerative agriculture. And so there's these five broad principles of regenerative agriculture that we're working with and I've selected this graphic from the Lower Blackwood Catchments website. But it's a similar graphic to what I've used previously for other webinars.

Declan McDonald:

The principles are first and foremost, keep the soil covered. You know, it's such a no-brainer. Actually, most of these are no-brainers when we think about it, but keeping soil covered is so critical in terms of protecting the workers in the soil and making sure that the very top layers of soil, the most fertile and active layer in the soil is allowed to be just that, fertile and active. And if we bare the soil where we're having a disproportionate impact on the productivity of our soil. So we really want to keep soil covered and keep it covered year round. And ideally the second principle is we want to maintain living roots year-round as well, because we want to have that carbon constantly going into the soil. We don't want to have a feast and famine and that's problem that we have when we have say a six month fallow, or even where we're applying mineral fertilizers at the start of the growing season. We're applying a feast of nutrients, usually more than the soil is able to digest at one time. And then we're asking the soil to survive on that feed for the entire year, but of course, nature does not work like that. And if we can feed the soil every day across the year we're going to be supporting a continuous soil function.

Declan McDonald:

Part and parcel of that is minimizing soil disturbance. So as we've discussed any kind of soil disturbance, be it the compaction from an animal's hoof, a tractor cultivation anything like that is going to alter the soil environment in a small way or in a major way. And the soil community has to recover from that and that takes time. And whilst that's happening normal soil function is going to be interrupted. Integrating livestock is really important. Livestock gives us the opportunity, particularly on grazing land, of course, to really manage the pastures in a way that is going to optimize the input of organic material into the soil, and really promote high levels of biological activity and promote high levels of production. And the fifth principle is about maximizing diversity. And we talk about crop diversity, and we talked a lot about that in earlier modules about the importance of a diverse root architectures and the diversity of different compounds that each of different root types and plant types puts into the soil. And that promotes the low ground diversity in the form of a broad, resilient and stable soil population.

Declan McDonald:

So we talked a bit about it where sequestered carbon comes from. And I'm not sure if we talked too much about the myth of nitrogen fertilising, but the story that I was educated to, and unfortunately that I propagated for many years was that we grow organic carbon basically by growing big crops and growing lots of biomass and big roots and all that kind of thing. And that's what restores our soil organic matter, our soil organic carbon. And we do that by using fertilizers to grow big crops. And certainly the fertilizers grow big crops, but what we're understanding now, particularly with nitrogen, is the more nitrogen we put on the more we're burning up the organic matter that's in the soil.

Declan McDonald:

Organic matter preservation in the soil we've talked a little bit about is based on a few things, but one of the really important aspects of soil organic matter preservation is the carbon to nitrogen ratio in the soil. And nature is structured such that the carbon to nitrogen ratio is optimally around 12 to one, 12 parts of carbon to one part of nitrogen. 12, 15 to one, something around there. If we tilt the carbon to nitrogen ratio below 12, we are promoting the degradation of the carbon. Because we suddenly have a heap of nitrogen that's available, bacteria in particular will respond very strongly to that and they gobble up the soil carbon.

Declan McDonald:

And in fact, a lot of this work came as well as the Morrow plots in the United States, which are, I think the oldest ongoing research plots in the United States. And they showed that after 40 to 50 years of synthetic fertilizer addition, soil organic carbon declined despite massive residue incorporation. And the similar story has been repeated across geographic regions, soils and tillage practices. And in fact, the same has been shown here in Victoria under no till. Many of those systems are at best maintaining soil carbon levels, but many no till systems carbon is still slowly declining under those systems. And as I said, Mineral N enhances microbial degradation of plant residue, soil carbon, and consequently reduces the supply of organic nitrogen, which we've talked about before as well.

Declan McDonald:

Now, this is a really important paper that came out only last year and it's a review paper or it drew on a lot of recent research that showed that really large proportion of total soil carbon is contributed by microbial detritus. So where we once thought that soil carbon sequestration was a product of plant biomass, this paper is showing us that a substantial proportion, almost two thirds is a product of microbial detritus. So, that means we have to grow up really high levels of soil livestock to sequester carbon. The same research showed that total soil nitrogen and carbon were more important than rainfall, acidity and clay content to soil carbon sequestration. And that nutrient addition to fresh organic matter, and we're talking here about high carbon to nitrogen ratio material like hay and stubble can increase soil carbon sequestration really substantially. And it can also reduce mineralization of preexisting soil organic matter. So that means if we're adding nutrients to support the degradation of this fresh, organic matter, it's helping to preserve the organic matter that's already in the soil.

Declan McDonald:

So this emphasizes the need to think about soil agronomy rather than focus on plant agronomy and modern agriculture has very much grown up around what the plant needs. The NPK give the plant what it needs, grow a big plant, et cetera, but we're talking here about maintaining a whole system and growing soil health at the same time as growing productive and profitable crops. Now, we talked briefly about this, but I just wanted to reinforce the point as well, but you know this is about soil carbon storage capacity being a product of continuous inputs of organic matter. And even in discussing this diagram before the focus on the continuing input of organic matter, what we're not saying, but what we need to say, is that the continuous input of organic matter is driving those microbial populations and that is what's laying down sequestered carbon. So it's really about feeding the soil and continuing to feed the soil so that we get those microbial populations building and sequestering.

Declan McDonald:

So it begs the question, what should I be doing? And I've kind of divided the answer up to this very simply in two ways. One is what I've called fixing it and I include under that things like drainage management, ripping, efforts to keep water on the farm, tools like Soilkee, et cetera. And the other part of it is called helping it. And I've included under this heading grazing management, compost and subsoil manuring, inter-cropping/cover cropping and trees. So the fixing it is traditionally I think what we have been encouraged to do, which is to kind of get out there with our powerful machines. And if the soil is a bit sluggish or drainage is a bit of an issue, or we think we've got a bit of compaction, well, you know ripping it all up it kind of feels good. It feels like we're really doing something. And there's nothing more pleasurable in my experience in preparing a nice seed bed. But I think we tended to overdo that by getting in and with this kind of digging up, thinking that really puts ourselves in the forefront of the frame that says, I am going to fix this soil and I'm going to fix it by pulverizing it into submission. Which is what we've ended up doing in a lot of situations and continue to do.

Declan McDonald:

Keeping water on the farm is very much about altering the landscape as well with steel. And Soilkee was, you know I'm a big fan of Soilkee. Soilkee is still getting in and... So none of these things are bad it's just that they have their place. And I think our use of some of these tools has been less than strategic. And we'll talk a little bit more about these going through. The helping it is a little bit more, there I refer to it as a more kind of humble approach or a respectful approach where we're saying with these kinds of approaches we're working more with nature and encouraging nature to express its fertility and its potential through good management and through thinking about feeding soil function. So let's talk a little bit more about each of these as we go through.

Declan McDonald:

So when we talk about ripping, there's a lot of interest these days in the Yeoman's plow. And I got to say, I am a big fan of the Yeoman's plow. I think it's a fantastic tool. Generally narrow times, low level of disturbance doesn't mix sub soil with top soil and does a really good job breaking up subsurface compaction. The over-enthusiastic use of things like Yeoman's Plow that I've seen relate to, and in fact, I was on a farm just last week where there was a plan to rip the whole farm because there's issues with drainage on this farm. But when we talked it through, we identified that the reason that there's a problem on this farm with drainage is because of sodic subsoils. And if we rip too deeply into sodic subsoils we're likely to not only have little long-term gain, but we really run the risk of creating serious problems for ourselves, particularly on sloping grounds we can facilitate tunnel erosion at worst or really achieve very little at best.

Declan McDonald:

So in a situation like that, my advice was to really reduce the intended depth of ripping, but rip into the top, maybe two inches of this sodic subsoil. And if we can incorporate lime and one participant in this particular farm work had the intention of dribbling calciprill down behind the tine to drop the lime into this acidic sodic subsoil. Because as we've discussed in previous webinars, lime, calcium in particular is a really good flocculating agent. And if we can use that lime to help displace some of the sodium in the sodic soil and provide some measure of flocculation some measure of soil structural improvement, then we open the door for plant roots to go in, organic matter to be sequestered at greater depths in the soil, and gradually increase the depth of soil in that way.

Declan McDonald:

So that might mean that we go in every year or second year and just cultivate a little bit deeper each time. And in this way we can rehabilitate and solve the problem on these soils. But going in blindly or without a kind of backup plan, the backup plan being application calcium, getting deep roots down into the rip lines and retaining the opening that we've just done the chances are it will revert back to previous in a short period of time. Now, I want to talk briefly about keeping water on farms, and this is with a nod to Peter Andrew's natural sequence farming, which many of you are probably familiar with and also I just want to briefly mentioned Keyline design, which is Mr. Yeoman of the plow fame, his Water for Every Farm approach.

Declan McDonald:

So the issue is about keeping water on farms is we've got eroded gullies and tunnel erosion across so many of our landscapes, we've lost our Billabong system, which was a mechanism which held water up in our landscapes and allowed longer rehydration or rather prevented dehydration of the landscape. But

because we didn't like these things and because we saw them robbing us of potentially productive land, we straightened out the systems, we declogged the billabongs and we drained the landscape, we have dehydrated the landscape. And that is not something that we can afford to do in a brittle environment with distinctive lengthy, dry seasons. So some of the solutions of better management of water on farms is getting stock out of waterways, of course, thinking about where it's safe to flood. So using Peter Andrew's concept of Leaky weirs, the idea there is that we allow rivers to flood onto floodplains to not only deposit fertile sediments, if that's the case but also to help rehydrate landscapes. Leaky weirs are very much a part and parcel of that, planting and fencing waterways is part of getting stock out. And are we adequately addressing erosion risk associated with water movement on farms?

Declan McDonald:

And this is a graphic which I borrowed from Dopes which illustrates the benefit of creating these Leaky weir type structures and the benefits associated with raising local water table, maintaining water in the landscape and maintaining that hydration. Which used in conjunction with deep rooted perennials is going to significantly extend our growing sectors. But permaculture talks are very much about design and what we're trying to do with our design is to support natural self-organization that nature is trying to do. So we want to design systems that mimic nature or work with nature to meet our objectives. And permaculture has developed this concept of zones on a farm, agroecological principles similarly, aimed to work with the natural flow of the land. And, there's various disciplines such as landscape function that have been developed to monitor ground cover in particular and plant diversity and PA Yeoman's Keyline system and this here is an example of the placement of dams at strategic locations across the landscape and the distribution of water from ridge lines into dams and the use of contour plowing and contour planting, et cetera, to arrest the movement of water down slope, again, thereby slowing the dehydration of our landscapes.

Declan McDonald:

Most of you are probably familiar with the Soilkee machine and the beauty of the Soilkee is that it is allowing an oversowing of a pasture with localized disturbance, which effectively is a localized kind of green manuring of what's there with sowing in of annual or perennial plants but frequently it's annual plants which produce high biomass in a short period of time. And again, I've mentioned this before, but I think the spectacular improvements that we saw on Niels Olsen's farm in which resulted in him being the first farm to be paid for carbon credits. So much of that is most likely attributable to increased microbial function because of the way that his farm is now being managed. And these are a couple of measures that have been taken West Gippsland CMA ran a trial looking at the effect of the Soilkee. And these are just a couple of bunches of data that I pulled out of that report, just to show that the Soilkee has indeed increased dry matter, increased the ME of pastures. And in fact, by most measures the Soilkee improved output.

Declan McDonald:

That doesn't mean that you have to have Soilkee to get some of the benefits that we're seeing on this farm but it's quite an elegant machine to promote rapid improvement in soil condition. Now, the other way and now we're moving into the helping it realm here. And first amongst these really is grazing management from all I've seen and learned and observed and listened to on pastures across really quite a breadth of environments in Australia, I'm convinced that we need a new system for what are really brittle environments. And the vast majority of agroecological zones in Southeastern Australia in particular are brittle environments. And a brittle environment is really defined by extended dry periods. And we generally have a dominant wet season in Australia. We have to go, well actually the small

coastal areas might have reasonably rainfall year around but most of the time we're dealing with extended dry seasons.

Declan McDonald:

Now the kind of grazing management system that we have really has been important from the Northern hemisphere where water was seldom limiting and organic matter levels are really high in those soils. And so there are forgiving of set stocking and to a degree overgrazing. But when we have overgrazing in a situation where we have an extended dry period and the pastures have got no chance of recovery, because there's no rain, this is where we see really severe problems with lots of ground cover erosion, lots of fertility, et cetera. So let's take grazing management, I think offers us a really significant and beneficial alternative to the models that have developed in Australia, which are very much focused around animal productivity and are less focused on soil health, you know that thing we talked about earlier on soil agronomy versus pasture agronomy.

Declan McDonald:

A critical element in grazing on brittle environments is recovery time and recovery is all about allowing plants to grow big enough and allowing the litter to be deposited in sufficient quantity on the surface of the soil, to protect the soil between grazings. Stock density is a really important aspect of that, where in nature, we see very high stock density in grazing herds that once kind of roamed that Savannah and then a long period before those same pastures were revisited by the stock on their annual migrations. So pasture utilization in those situations is high because there's a lot of competitive eating, there's only so much grass, and there's a lot of mouths all lined up side by side, trying to get a belly full.

Declan McDonald:

Overgrazing is what happens when stock return to those plants before they have fully recovered. Overgrazing is not how short the pasture is grazed, it's about whether the plants have a chance to fully recover. So you can graze a plant really quite short, and it will regrow, and it might regrow from some of its root reserves, but it will regrow and regrow fully so long as it's left alone to do that before it's grazed again. We've talked a lot about diversity and what we're trying to do with this model of grazing is to increase diversity in this sward. And experience has shown that when we manage our pastures in this way, we have a natural accumulation of species, some of which that haven't been seen for years in these pastures, but the seed has been lying dormant in the soil waiting for an opportunity to emerge.

Declan McDonald:

And weed control is a really big part of this and I gave a couple of webinars on weed control recently, and I used this slide this picture rather which we have all seen, it's kind of massive thistle in an otherwise productive landscape. And the question I ask here is, have we got too much weed or have we got not enough pasture? And I think that's a good question to ask, because here there is so little pasture we have opened the door and welcomed in the weeds. But if we have dominant dense pasture that's grazed in the way that I've been talking about, we really limit the opportunities for weeds to come in. And when we manage pastures in that way, weeds just disappear.

Declan McDonald:

And what we're talking about doing with this is mulching the farm. And you know, we all understand the importance of mulching garden beds and mulching the vegetable garden, but we don't even think about it on our farm because it's a completely nonsense and impractical idea. How do you mulch hundreds or

thousands of hectares? This is a way to mulch hundreds and thousands of hectares by working with nature and working with stock with appropriately timed and strategic grazing to lay down the litter that we have grown under these plants and allowing that litter to function as a mulch while the plants regrow, and as a mulch to protect the surface of the soil, to protect soil function to help the plants regrow.

Declan McDonald:

Now, I wanted to talk briefly about compost and it's really important to say that compost ain't compost. The Australian standard for compost basically identifies three different types. One is called a pasteurized product, one is called a composted product, and the other is called a mature compost. And the three different types, if you like, are characterized primarily by the amount of time that they have been allowed to develop. So the pasteurized product is very young, very fresh product where much of it has not developed into stable forms of carbon into humus carbon. Whereas a composted product or a mature compost have higher levels of stable carbon, higher levels of humus. You may sometimes hear people talking about humified compost. Well, what's humified compost? Humified compost is really just mature compost. It's compost that's been allowed to age so that much of the carbon is able to develop into a humus.

Declan McDonald:

And depending on what your problem is, so you might say, "I think I need compost." Why do you need compost? Do you have a soil structural problem? Do you want to stimulate biological function? Do you want a fertilizer contribution from the compost? These questions will determine what kind of compost is most suitable for your situation. There's a lot of interest now in customizing compost, so if we're going to use compost, what else can we put in the compost to give us what we need? So for example, if we have a soil structural problem, then it's highly likely that the addition of gypsum or lime into the compost is going to greatly improve the response to that compost application. Because not only are we putting in organic effort to help with the soil structure we're also applying lots of calcium to help with that structure as well. So the consideration here as well, we might apply the lime and gypsum at the very end of the composting process, so that it's benefit is maximized. And the experience of adding lime in particular in composts shows us that we can get the same pH change from a lower application rate of lime. And this has to do with the area activation of the lime applied in this way by the soil life.

Declan McDonald:

And we can also add nutrients to compost. So if we're looking for a fertilizer contribution as well as a soil conditioning contribution from the compost, we can think about adding any kind of nutrients into the compost. We can think about putting in super phosphate if that's what we want to use, we can put in urea, we can put in potassium fertilizers, we can put in trace elements, we can really put in anything we like. The only caveat there is, depending on what it is we want to add some of these nutrients will be appropriate and beneficial to add them at the very start of the composting process, with others it could be quite detrimental to do that, and they need to go in at the very end of the composting process. But certainly doing it this way saves spreading costs and applying nutrients in an organic matrix is going to help with the stability of those nutrients and with their availability via those microbial agents.

Declan McDonald:

And the third question that we're beginning to explore more these days is how to apply the compost, where to apply the compost. So do we just put it out on the surface? Are we dealing with a grazing or

cropping operation? Is it safe to use? Do we apply it to high standing biomass low standing biomass? Do we work it into the soil? Et cetera. So as a general rule, compost is ideally, always best worked into the top soil, but in a grazing situation or a no till propping situation that's not an option. So in grazing, we will look at grazing the pastures down hard and then applying the compost to maximize the likelihood of the compost soil contact at the very start and then allow the pasture to grow up through that so that the breakdown of the compost is facilitated by the more constant humidity and temperature that will be found at the base of a tall standing sward

Declan McDonald:

Similarly, with cropping, it can be just tickled into the surface of the soil at the same time as the paddock is been direct drilled, and subsoil manuring is about placing the material in a depth to address subsoil constraint. And I mentioned the challenge of a sodic subsoil area, and subsoil manuring has been employed with great success to counter some of those hostile subsoils that have completely lost structure and function. There's a lot of things us these days in cover cropping and inter-cropping, and this is all about giving effect to what we've been talking about, getting more diversity in the sward and more diversity beneath the ground here. As this slide also illustrates leaving root year round so we've got between the plants, we've got dying off rye grass, and we've got emerging chicories and lucerne to sustain grazing throughout the warmer months.

Declan McDonald:

So cover cropping can be part of paddock rehabilitation, it can promote year round, it can be an alternative between cash crops or compliment cash crops, but diversity is the key. And with inter-cropping, all of this is about increasing root architectures and deepening root systems and increasing diversity. And increasingly, we want to look at say incorporation of a legume underneath a cereal crop for both nitrogen fixation and to help with weeds suppression. This is the really nice example from the United States of inter-cropping, a different form of inter-cropping a kind of alley inter-cropping or as the Americans call it fence row farming. Where we've got corn, soybean growing in rotation so next year, everything basically shifts over one block. So where the corn is this year, I didn't do that, where the corn is this year the soybean will be next year, et cetera. And they're seeing substantial increases in average yields just by doing this.

Declan McDonald:

And the proximity of even two different crops like this increases opportunity for bio control, by providing habitat for beneficial insects that may be preying on insects on the complimentary crop. And these kinds of systems are limited only by our imaginations, but if we understand that diversity is one of the principles of regenerating agricultural systems, we can and in fact, Googling inter-cropping or cover cropping, you'll see great examples of the new range of ways that these principles are being applied.

Declan McDonald:

So integrating trees is another part of helping the system along. So, whether it's a cash crop in the form of a farm forestry, or whether we're using trees to support alley planting, windbreaks, fodder trees, specialty crops, et cetera, et cetera. And even to work with boutique livestock and in fact, there's been a lot of interesting work done using saltbush with sheep. Not that I'm really calling saltbush a tree, but it's the same principle would apply where we're using something like saltbush as an alley planting to protect pasture land in between the alleys and to provide additional fodder and shelter.

Declan McDonald:

So in summary, we're getting towards the end of our series and hopefully some of these messages are beginning to coalesce. We're understanding that soil health is a product of balanced soil chemistry plus management practices. So, in today, we've really been talking about management practices and how by changing our focus on soil function, feeding the soil, getting the soil working with us is a really key element of soil health. I've seen some soils that are really nice balanced chemistry, but it doesn't mean that they are functional and it doesn't even mean that they're particularly stable or have good source structure or anything like that. We want to focus on organic matter generation, the growing of organic matter and the return and cycling of that organic matter. But every farm is different and every farm has the potential to sequester more organic carbon. I don't think that's too big a statement. I think there's few farms... I don't know of any farms that I can think of where I can say that that farm has maxed out on the amount of organic matter that it is able to hold.

Declan McDonald:

So every farm has the potential to be better and by better I mean, healthier and more sustainably productive. So we really have... You know there's so much more that we can do to make our systems more resilient and more productive. And when we're talking about carbon and organic matter, we're talking about less stress, less risk and more profit. And so in final summary, this is where we've come to to-date and next week, I'm going to talk about bringing it all together. The monitoring and evaluation, so how do we know that we're having success? We'll talk a little bit more about soil and tissue testing next week. And there was a question came in during the week specifically about soil and tissue testing which we'll cover in terms of chemistry, physics, and biology.

Declan McDonald:

And we'll also talk about the role of soil health cards which have been developed as very simple on farm tests that people can do, that don't involve the expense of laboratory analysis, but will yield really great information to allow you to know, are you making progress or not? Okay. Back to you, Matthew.

Matthew Warnken:

Great. Thank you very much, Declan. A lot to go through there, we've got some good questions to cover off. But those I thought that was great those five principles of building soil carbon to complete in line with that approach to regenerating soils like keep soil covered, maintain living roots year round, mininize soil disturbance, integrate livestock, maximize crop diversity, and some great examples too, that you pulled out. And I did like those two sort of categories in terms of fixing the problem and the drainage due to ripping Soilkees, those examples there as part of contrast with that approach in terms of helping as the fixing versus helping soils. Grazing, how we do our grazing management, compost, inter-cropping, cover cropping. And also what you touched on too, that different mindset I thought that example too, in terms of are we looking at a paddock with too much weeds or are we looking at a paddock with not enough pasture. And just then how that might trigger off a whole bunch of management activity all built around how we'd go about mimicking nature by design, in terms of those management systems. So they're kind of biomimicry with real consideration for those underlying system conditions such as the brittleness of the Australian landscape.

Matthew Warnken:

And in particular, I did like some of those concluding comments and just to highlight one in particular that every farm in Australia has the potential to build more soil organic carbon. So by no means have we

tapped out or we'd lost any of that sort of opportunity to build more soil organic carbon, and ultimately where does that lead to? Leads to less risk and more profit. So we'll jump into a few questions now, just in terms of going through the... One of the aspects that you pulled upon us was that role of nitrogen, overloading the nitrogen increasing microbial activity and decreasing soil organic carbon. So if there was a legacy load of nitrogen on farms, could that actually prevent increases in soil organic carbon? And then how would you assess if you had that legacy load and then how might you address that legacy load of nitrogen on a farm?

Declan McDonald:

Okay. Look, I'd probably say that in the first instance, legacy loads of nitrogen are probably less common than legacy loads of some other elements, such as phosphorus, for example. And part of the reason for that is the volatility of nitrogen. If there's a lot of excess nitrogen around in the form of nitrites and the like it's very susceptible to leaching as we've talked about it. And in wet conditions it's very susceptible to volatilization off. If nitrogen hangs around for a long in the soil, it's going to be grabbed by the soil microbial community. Because nitrogen is so volatile, nature has really evolved many, many mechanisms to get it and get it fast, because nitrogen is such a key element in protein synthesis, basically everything is after it. So you tend not to get too much free nitrogen, if we have, it will reach an equilibrium reasonably quickly, either in the form of immobilized in microbial tissue or plant tissue or in soil organic matter, or it will exit the system. We tend not to have too much free nitrogen floating around.

Matthew Warnken:

So then maybe just pick up on a theme in terms of other nutrients, are there similar interactions with phosphate fertilizers and then microbial soil carbon consumption, and then have that increases there are with the nitrogen? So is there a microbial response at all?

Declan McDonald:

Yeah, look, we're all fairly familiar I think with the concept of nitrogen drawdown, which is where we have a high carbon to nitrogen ratio, the soil microbes they're more competitive for the available nitrogen in the system. So they'll immobilize it, they'll compete for it, they'll grab it ahead of the plant and the plant will go yellow. So we'll say the plant is suffering from nitrogen drawdown. There's also a phenomenon known as phosphorus drawdown for exactly the same reasons. If there's available nitrogen in the system the soil microbes will always get at first. Now we tend not to see phosphorus drawdown in the same way that we see nitrogen drawdown, but it can manifest in terms of just poor or slow plant performance or reduced productivity. And how that's usually counteractive being is with the application of some kind of phosphorus fertilizer.

Declan McDonald:

But if we understand that it's very difficult to positively control or to direct control over sort of function over the microbes in the soil. So the work of Coonan et al was very much around saying, we need to make sure that we try and optimize nutrition really for the soil microbes, because if we provide them with the tools that they need, they will go to work and they will do what they do best, which is to organize their environment and work in conjunction with soils. Actually the microbes would be quite happy if we all just went away and left them alone. And they'd get on with things very well by themselves. So if anything, we need to think about managing the below ground herd and in a healthy soil, we've got in general terms, two tons of livestock below the ground per hectare. Which kind of equates to the carrying capacity of a lot of more fertile grazing land. So if we think we spend all this time

and focus managing our beef herd or our sheep herd, we need to commit equal enthusiasm or dedication to managing the below ground herd as well. And Matthew I think you've frozen or I hope I haven't frozen.

Declan McDonald:

Okay. Well, I'll answer another question just while Matthew is reconnecting and I'm trusting that you're still with me. And there was a question that was asked about how do I apply compost to 190 hectares, 190 acres sorry of hilly country? And yeah, that's an expensive and challenging operation because that will take a lot of compost over 190 acres. And if it's hilly country the principal impediment may well be terrain and whether it's even possible to get a large vehicle up and down large hills. So in some situations like that, spreading compost might not be the most appropriate thing to do. And I think in a situation like that, I would certainly be thinking, can I grow the carbon that I want in situ. And my focus therefore would be on regenerative grazing in the way that we've talked today and previously to capture carbon in those systems. It's cheaper, probably longer term, but ultimately just as effective and certainly sustainable.

Declan McDonald:

The other part of that question was about just related to the current concern that's been in the media about contaminated compost. The irony is that what those composts are contaminated with are phenoxyacetic herbicides residues, principally come from agriculture because that's where most of those types of herbicides are used. And they've got into the urban stream and have impacted lots of homegrown veggies and the like. There is a warning on a lot of phenoxyacetic herbicide saying that they're incompatible with certain crops. It's always good for compost makers to be doing their due diligence. And the scare, I think has alerted many of them to the risks that they're dealing with. And so there's a lot more testing going on at the moment to isolate those risks. As in general though, concentrations of those residues are really very low. They've got low-ish, half lives of around 40 days in a compost. So I think the risk to general agricultural use is relatively low.

Matthew Warnken:

Declan, you're talking about rehydrating landscapes and sort of using that key line natural sequencing. Is that applicable in all parts of the Australian farmland? Like for example Queensland with the sort of higher rainfalls?

Declan McDonald:

No, it's very much about keeping water on soil. So it's reversing that dehydration of landscapes, but I would say it's not applicable absolutely everywhere. So, there will be a number of caveats that I would put on it too. Caveat number one would be, if you have dispersed soils on sloping ground, you may end up doing more harm than good. Because as I mentioned before, if we start ripping into these with contour plowing or trying to divert water, and we go into dispersive soil, there's a high likelihood that we'll initiate tumbling in those landscapes, and that could be an absolute disaster. So we want to avoid that if possible. If we're in an environment where rainfall can be really heavy, it doesn't necessarily mean you wouldn't keyline on your farm, but you will need to be really careful about when you do it, so that the land is really stabilized before say the wet season comes around.

Declan McDonald:

And also these things can be done by degrees. So the kind of lowest degree, I guess of keyline planning would be just the use of contour banks to try and slow or rest or direct surface water movement across the farm. So that's the kind of thing that probably requires a bit really specific site assessment to determine the appropriateness of it and the safety of it. But certainly it should be used far, far more widely across, so much of Southeast in Australia than it currently is.

Matthew Warnken:

I guess, reinforcing that point that every farm is different. And that needs a level of customization in terms of the application of these principles and practices. Just coming up to the top of the hour, it's a few more things to cover across, Declan. So do you see opportunities to design inter-cropping systems such that they could supply bulk of plant nutrition? So moving beyond just say legumes and soil organic nitrogen?

Declan McDonald:

Sorry. So that they could do what?

Matthew Warnken:

Supply more plant nutrition beyond just say nitrogen drawdown?

Declan McDonald:

Absolutely. I mean what we're trying to do with this approach is to free up nutrient cycling right across the board. You know this is not focused on nitrogen, it's not focused on phosphorus. It's really about saying we've got to get everything moving again. Got to get the system unstuck. So yeah, it's certainly about broadening the availability of all nutrients.

Matthew Warnken:

And then there was a note from a Theresa, in that task is looking at the legumes into dry land pastures with the Soilkee strip tilling. So we get to follow up from a dry land context and the importance of legumes in that species mix. Thanks, Theresa. A question on your fence row farm example, and how did actually harvest the corn and the soybeans? Saw one of the harvesters had been driving over one of the crops? A practical question.

Declan McDonald:

Yeah. In that particular, because the soybeans were shown to wrap around the end of the corn, I did, the same question occurred to me, but the intention behind those systems is that they're laid out like as a header widths or multiples of header widths, so that harvesting and any kind of in crop activity is set out in a way that that can work as per normal. And is not impacted by the neighboring crop.

Matthew Warnken:

And now a question on sulfur deficiency and whether it can be viably fixed with sulfur to the soil, or whether it's best to continue supplementing feed stocks, supplementing by livestock?

Declan McDonald:

Yeah. Look, sulfur is easily augmented and elemental sulfur is a great thing to use. Bear in mind that elemental sulfur will have an acidifying effect on the soil. So if your soils are acid, you may need to just

keep an eye on that as well. But elemental sulfur is like 98% sulfur. It's a slow release form because it's a natural product. So you don't need very much of it because of its high concentration. So I'd be looking at using something like that, but sulfur is freely available in other elements as well so if you were to use gypsum for example, or potassium sulfate there's high contributions of sulfur in those compounds as well.

Matthew Warnken:

Right. Thanks, Declan we're at the end of a webinar six. And this was management practices and how to build the soil carbon. Thanks to our team at AgriProve and to Mel for pulling all the background webinar together. And thanks to the presenter, Declan McDonald from Regen Soils. As Declan said, next week's topic or the next webinar's topic is about bringing all of this together and looking at how we monitor and evaluate on farm. And then speaking of evaluation, we will also be sending out just an email, seeking your feedback on the content that we've covered through this webinar series.

Matthew Warnken:

And more importantly, what suggestions that you might have in terms of additional resources that you'd like and find useful that we could develop in the future in terms of assisting in that transition to growing healthier top soils. So, look out for that anything during the week, feel free to email us at team@agriprove.io. Once again, thank you for your attention we look forward to catching you up at the next and final episode and that's a bye for now. Thank you.

Declan McDonald:

Thank you.