Matthew Warnken:

Well hello and good afternoon to everyone, wherever you're gathered around, I'd like to welcome everyone to this the first in a seven-part webinar series hosted by AgriProve on how to grow top soils. We'd like to begin today by acknowledging the traditional custodians of the land on which we're gathered, wherever we might be around Australia. Pay our respects to their elders past, present, and emerging. My name's Matthew Warnken. I'm Managing Director of AgriProve. We're a soil carbon project developer trying to provide a one-stop shop to facilitate participation in the carbon market for Australian farmers. We're hosting a seven-part work webinar series. We're really fortunate to have Declan McDonald. He's the Principal Soil Scientist with Regen Soils, here to guide us on this journey on how to understand how to improve soil health and how to build soil carbon. I'll give Declan an intro in just a moment.

Matthew Warnken:

Before we get started, I'd like to just take this opportunity to introduce a few members of the AgriProve team. We've got a number of people online. Just bringing up their videos. We'll do a bit of a quick round robin of introductions, and then get on with the webinar proper. Stephen, maybe you could kick off with a quick intro.

Stephen Warnken:

Thanks, Matthew. Yes, Stephen Warnken, General Manager of AgriProve. Super excited to be hearing what Declan has to say today. I'm in Sydney at the moment, so broadcasting from Sydney. Got back from Bathurst this morning. It was great to get out to Bathurst, but yes, broadcasting from the sunny avenue of a sunny suburb of Camperdown.

Matthew Warnken:

We can probably trump that, because we're still in Bathurst. We're broadcasting live from the sunny and beautiful surrounds of Goonamurrah Angus Cattle Stud. While we're here, I'll do a quick change of places with Kieren Whittock our ops manager.

Kieren Whittock:

Hi, everyone. I'm Kieren Whittock, Operations Manager with AgriProve. Really excited to listen in to what Declan has to say today. Thanks.

Matthew Warnken:

And we might go around the countryside to Alexandra.

Alexandra De Blas:

Hi. I'm Alexandra De Blas. I'm AgriProve's Chief Storyteller and Communications Strategist. I'm coming from Melbourne today. Welcome, everyone.

Matthew Warnken:

Mel.

Melanie Addinsall:

Hi, everyone. I'm Melanie Addinsall. I'm based in Southwest Victoria and I work with farmer engagement and support, and projects.

Matthew Warnken:

We might jump across to Theresa.

Theresa Chapman:

Hi, I'm Theresa Chapman. I'm a soil ecologist, and living and working in Northwest Tasmania, and I'm the Tasmanian Field Officer for AgriProve.

Matthew Warnken:

Then we'll circle back to our new Albury offices. I think Brendan. Are you in Albury?

Brendan Fallon:

Yep. My name's Brendan. I'm part of the operations team, and we're tuning in today from our Albury office, our new Albury office regional hub down here. It's good to be here. Good to be tuning in.

Matthew Warnken:

Great. And Kate.

Kate Carmichael:

Yes. I'm Kate Carmichael and I'm the Soil Carbon Operations Officer based here in Albury, and super excited to see the presentation from Declan today.

Matthew Warnken:

Great. Thanks everyone. We just thought it was a good opportunity just to put some faces behind some of the names. If you're dealing at all with AgriProve, these are the team members that you'll be discussing soil carbon projects with on a day-to-day basis.

Matthew Warnken:

But now, just to introduce Declan, he's a Certified Professional Soil Scientist, over 30 years experience in soil and ag in a variety of roles, both public and private. And I've had the privilege to listen through many of Declan's presentations. I've always learned something, so really looking forward to the breadth of the theoretical and the practical knowledge that Declan brings. We hope that this generates a whole bunch of useful conversation. The sessions are being recorded, so will be accessible after the webinar is finished. As I said, it is a seven-part series, so I do hope that you're able to attend each session as we'll be attempting to build on the knowledge of each previous module. They're recorded, so if you do miss one, you can catch up later. We're going to adopt a format where Declan's going to run through a presentation and we will leave time at the end for questions. There is a Q&A function that should be on your screen down at the bottom so that you're able to post any questions there. If we don't get to all of them within the time of the webinar, we'll follow up, try and pick them up in successive webinar sessions, or someone from the team will reach out directly to answer that question.

Matthew Warnken:

Without further ado, Declan, really great to have you on board to run this webinar. Really looking forward to what you've got to say, so we'll turn over to you. Thanks, Declan.

Declan McDonald:

Okay. Thanks very much, Matthew, and good afternoon, everybody. Thanks for being here, and thanks to AgriProve for inviting me to present these webinar sessions. Just as Matthew said, I've been doing this for quite a while. I'm one of a very small number of soil scientists that are actively working in the regen ag space. And as we discuss going through, regen ag is really about taking a holistic view of production. Most of my soil science colleagues are focused on particular aspects of soil science, and doing deep research in those areas. And it's my job, really, to synthesize a lot of that information coming through and to help inform the bigger picture, and then how we need to manage it.

Declan McDonald:

I did brave the waters of regen ag and sustainable agriculture, as it was called, and biological agriculture, as it was called, and a few other names as well, in roles with the New South Wales, Tasmanian, and Victorian state governments over the last 20-odd years with varying degrees of success. I'm constantly encouraged that there is more and more appetite for good information about soil and more appetite for better management of soil. For example, in my new role with Regen Soils, a company that I established last year, we've already developed a range of regen ag videos and I'm working with Landcare to develop a method that's going to help accredit changes in natural capital on farm, starting with the soil.

Declan McDonald:

So, I'm going to share my screen now and we'll get on with the presentation. I have to click it. I've only got one screen. Sorry. I am used to having two screens. This is the one that I want. Yeah. Okay. As Matthew said, we've got a series of seven modules that we're going to work through, and I've structured it in a way that we're going to have a flow of information. There'll be a bit of iteration between the different modules and the intention is that they build on each other so that, by the time we get to the end, you've got a lot more confidence in terms of how you engage with regenerative management of your farm and with your soil in particular. Today, we're going to start really right at the beginning, and I'm not assuming any prior knowledge here, so apologies to those of you who may already be very skilled and very knowledgeable.

Declan McDonald:

But I'm going to start at the beginning and talk about how soil works and how plants grow. I'll talk a little bit about the drivers for the case of change and some of the matters for target that have been agreed nationally for soil management. Next week is going to be a bit of a master class on organic matter, which is really the cornerstone of soil health and sustainable production. And you can't talk about organic matter without understanding soil biology, because that's the life that's in the soil. We need to talk about mineral management, then the role of macro and micro elements. But I don't want to talk about that before we get the house in order, if you like, before we get the soil working. And then, we want to look at the relationship between managing fertility and building soil carbon.

Declan McDonald:

Now, whilst AgriProve is a project organization to develop soil carbon projects, I'm not going to talk too much about the soil carbon project side of things. I'm going to leave that to Matthew. I'm really just going to talk about building soil carbon and what we need to do to do that. I'm going to talk about the management practices in grazing, cropping, and perennial systems, and then, the last module is going to bring it all together. We're going to look at monitoring and evaluation. In other words, how do you know there's change? What do you look at? How do we evaluate change? And we'll talk about soil and tissue testing, and the like, and the role of various tools available to us.

Declan McDonald:

Okay, so today we're going to talk about how soil works and how plants grow. How do plants grow? Well, the very short answer, and without trying to be too clever about it is to say they grow the same way that they've done since before the dinosaurs. Now, I wanted to make that point, because what we will hopefully come to appreciate is that what we're dealing with in managing soil is we're managing an ecosystem, perhaps the most complex ecosystem on the planet, an ecosystem that has developed over millennia, so various forms of vegetation have come and gone, various forms of animals. The dinosaurs have come and gone. But the soil is what has remained, and the soil has built and changed and evolved. And as we start to appreciate the incredible abundance in the soil, the abundance of life, the incredible diversity of life in the soil, and the incredible range of responsibilities and tasks that all of those organisms have in the soil and how they work with plants to grow, it is truly mind-boggling.

Declan McDonald:

But let's go back to relatively simple things, not that photosynthesis is simple, but the original primary produce is the plant. Modern plants are called angiosperms. They're flowering plants and they grow through this process of photosynthesis. They're the original primary producer because all it takes for a plant to grow is sunlight, carbon dioxide, and water of course, and some nutrients from the soil. In return, the plants make sugar and they make oxygen, which are the building blocks of life. The roots are primarily around holding the plant up, accessing water supplies, and accessing nutrients. My take as a biased soil scientist is to say that really, any farmer is in the business of growing roots, because if you can grow a really great set of roots, you will grow great tops. And it's hard to grow great tops without great roots, so we've got to think about, what do we do to grow great roots?

Declan McDonald:

Now, the problem early on, I think, in the evolution of plants is that a plant root can access only so much soil. There's a graphic of a plant root, and all of this unreachable area that's going around the plant root. The problem for the plant was that even where the plant roots can access, the spaces between soil particles that are unreachable, and we're talking here about root hairs, so the tiniest roots, they're still not getting into some of the micro spaces, the micropores in the soil system. These micropores are where most of the water and nutrient elements that the plant needs are located, so the plant had a problem. So, the plant formed associations with a few friends. These associations extended the root system of the plants.

Declan McDonald:

Who are the friends? Well, back in the day, and not too long ago, we're talking maybe 15, 20 years ago, the only way we really knew what was growing in the soil was to take some soil samples, culture what was growing in the soil on a Petri dish, and we'd say, "Okay, well the white one is a particular type of fungus, the black one is a particular type of fungus, and the little blotches in the middle are particular types of bacteria." What that meant though was that we had a very narrow understanding of what was growing in the soil. Genomic technologies came along, and that means DNA analysis of the soil. And certainly, our knowledge and awareness of the sheer number and diversity of organisms in the soil absolutely exploded. You'll see on the bottom right-hand corner of this graphic a very large proportion of organisms in the soil are from the family archaea. Archaea are so called as, if you like, ancient bacteria. They're different to bacteria. We only knew of archaea from extreme environments like volcanic vents, hot mud pools, hypersaline environments. We didn't understand that they've got a really important and prolific role in nutrient cycling in the soil.

Declan McDonald:

Here is an example of just how poor our knowledge is about what's growing in the soil. If look at the top of this table, you'll see that of the vascular plants in the world, there's 350,000-odd known species, we've got 88% of them described. So, we've analyzed them, we've given them all names, et cetera. Come down to the bottom of the list. 15,000 known species, probably more than a million species, and we have described 1.5% of them, so there is so much we really don't know.

Declan McDonald:

In terms of these special friends that the plants formed associations with, they're primarily bacteria and fungi. And why are these friends so valuable to the plant? Well, it's because mycorrhizal fungi can grow in these micropores that plants can't reach, and the micropores are so small that it requires the tininess of fungal hyphae to be able to explore those areas, and fungal hyphae are much smaller even than the smallest root hairs. These fungal hyphae grow and grow, and as you can see in this clever graphic, they cover the surfaces of the tiny soil particles and proliferate within the pores. That's where they're accessing food and water, and they're exchanging that back to the plant in return for food that the plant gives them in the form of carbohydrates. This is how plants grow and how soil works. The plants deliver glucose into the soil, either freely through its root system for fungi and bacteria that are living in very intimate contact with the plant root, or in the case of some organisms, both bacteria and fungi who are able to grow inside the plant root, are able to directly access the carbohydrate that they otherwise are not capable of manufacturing.

Declan McDonald:

We have a really strong, mutualistic relationship here between plants and soil organisms, and certainly there's been lots of experiments that show that plants basically can't thrive in sterile soils, or do extremely poorly in sterile soils. And this is just, if you like, a summary of what I've talked about. We've got carbon dioxide and solar energy coming in. The primary producer is the plant. Nutrients and water coming up from the soil. Now, this is where things start moving, things start cycling. The plant is depositing organic matter in the form of dead leaves, but also sloughed off roots and root exudates, most importantly, those carbohydrates that get exuded into the soil. The primary consumers are the fungi and bacteria, the microscopic parts of the soil food web. The secondary consumers, things like mites, nematodes, springtails, protozoa, they have a range of functions which include shredding of organic matter to smaller and smaller particle sizes so that it's available to smaller organisms. And they also have a role in controlling the populations of fungi and bacteria, and each other as they prey on each other, and nutrients then in turn are cycled through from bacteria. For example, when protozoa consumer bacteria, they don't need the quantity of nitrogen that is available inside a bacterium, so some of that nitrogen then becomes available to the soil system for either plant roots or other soil organisms to mop up and keep cycling.

Declan McDonald:

And then, there's the higher-level consumers, such as the spiders, the millipedes, ants, worms, et cetera. This is not a linear system. This is really a cyclical system, because there is huge interdependency between all of these organisms.

Declan McDonald:

Now, part two. Those of you that might remember the old song, And Then Along Came Jones, Jones the farmer with his Wonder Grow. Everything changed post second World War, and the event of the Green Revolution. That was when we started feeding the plants, because we had these wonderful tools. And I'm sure most of you know, but most explosives and fireworks are made up of things like phosphorous and manganese, because when these things burn, they burn with particular colors and they usually burn with a huge intensity because they've got so much embedded energy in them. When the second World War ended and the Americans in particular had all of these munitions plants, they said, "What are we going to do with them?" They said, "Oh, well you can grow plants with some of this stuff." And of course, prior to that, the Haber-Bosch process was discovered by a couple of German scientists, which allowed the manufacture of synthetic nitrogen, and of course we understood that that could really make plants grow as well, so we said, "Well, okay. Well, we don't need all that old stuff of organic matter, and we don't really need to worry about soil microorganisms, because we can put this stuff on and make plants grow much better."

Declan McDonald:

Indeed we did. We averted famine in a number of countries, most specifically India, after the second World War with these high-value and high-strength inputs that really substantially increased production right across the board. The problem with feeding the plants with these synthetic fertilizers is it completely made the friends redundant. There's a reference there, and you'll get copies of these slides, there's a reference there to this video series that I've taken these graphics from. It's a really elegant little five- or 10-minute segment that runs through what I'm talking about. Whilst the organic fertilizers continued to feed the soil organisms, the synthetic fertilizers basically put them out of business and we lost the phosphorous solubilizers. These are the bacteria and fungi whose role has evolved over these millions of years that I was talking about at the start to access phosphorous from the soil and to transfer that phosphorous to plants, because in many soils, in many Australian soils in particular, phosphorous is inherently low and there are these wonderful evolutions that have developed over millennia to supply the plant with the phosphorous that it needs.

Declan McDonald:

On the left is a little micrograph of one of these mycorrhizal structures growing inside a plant root. And you can see that it's like a little tree, which is why it's called an arbuscle. This enormous surface area associated with each of these arbuscles, which facilitates that transfer of phosphorous into the plant and nutrient into the fungus. We also lost nitrogen fixers. This is a closeup photograph of some nodules on a legume and one nodule cut showing the nice, pink leghemoglobin inside the nodule, which is exactly what we're looking for. When we see that nice, pink color, we know that we've got healthy rhizobia in there and that they are busy sequestering atmospheric nitrogen for the plant. And of course, when we have legumes in our mix, particularly with grasses, the grasses are raiding the system and are trying to access the nitrogen that legumes have. What that means is legumes generally have to work harder and produce more nitrogen in the presence of grass, which is why legume grass lays have been something that's been around forever.

Declan McDonald:

But in the presence of high nitrogen, if we have dairy farming in particular, if we're putting on lots of urea in a very high-nitrogen environment, the nif gene, which is the gene in legumes responsible for nodulation, gets turned off. They say, "Well, we don't need to invest energy in manufacturing nodules and in supporting these alien bacteria in the form of rhizobium, because we're awash with nitrogen." So, that process dies off and we don't see natural nitrogen fixation.

Declan McDonald:

Really importantly, we removed deep roots as well in our shift to monocultures and annual systems, and we lost the breath of root architecture that we would've had under more natural systems. Now, what we understand and what you will understand more about, hopefully, as we go through this series is the role that plants have in maintaining the health of the soil. And when we're talking about maintaining the health of the soil, we're talking about maintaining its physical integrity, maintaining the ventilation and drainage network to depthen the soil. You can imagine, looking at this chart that, on the left, when those roots die, they're going to leave channels behind through which water can drain. But in a monoculture system, like on the right, those roots are not conditioning the soil anymore, and like disused mineshafts, they'll collapse in on themselves and drainage is going to be severely impaired in that soil.

Declan McDonald:

We till the soil, and when we till the soil, we disturb it. What this graph is showing, this is some work I did in Tasmania a number of years ago, the more disturbance the lower the populations of arthropods. And we were looking specifically here at arthropods, which is the group of animals between, well, really from worms down to the microscopic. And you can see, on the left-hand side, these are a couple of dairy paddocks. An organic one first, and then a conventional one. Populations of 65-80,000 individuals per square meter. Look then at what happens with random traffic of potatoes where there's lots of cultivation, and a number of cultivations during the growing season. And no surprise, we're look at about 6,000 individuals per square meter. Incalculable difference, and when you consider that these creatures are working to sustain their environment, well, we've got a seriously depleted population under the potatoes.

Declan McDonald:

Part of the problem of tilling soil is that it accelerates the loss of soil carbon. And as this graph from some New South Wales research shows that following clearing of native vegetation and conversion to agriculture, we have a precipitous drop in soil carbon. It drops like a stone. And then, it gets to a level which we call the equilibrium level, and it tends to hang in there at maybe 35%, between 35% and 50% of initial soil carbon, so it represents a huge loss in soil carbon, a huge loss in energy in that soil, a huge loss of food for everything that lives in the soil, and all of the things that you will learn that soil carbon does as well. What this shows is there's been a bit of improvement in the last 20 or 30 years with improved management practices like no-till, and that kind of thing, but there's still huge potential for soil carbon sequestration, and that's really what this is all about.

Declan McDonald:

We acidified the soil with the inputs that we're using, and we know particularly with a lot of nitrogen compounds that some of them have a severely acidifying effect. And certainly, the Western Australians have discovered that to their alarm and to their peril, because they started off with quite acid soils, and now some of those soils are so acidic that they have lost productive capacity.

Declan McDonald:

Most importantly, with all of these developments, we became dependent on external inputs to the point now where it's how we farm, and it's the only way that we're taught to farm. New graduates that are coming out of university now, most of them are really well-schooled in what fertilizers to use when and what spray to use when, and what input you put on and when, et cetera. But if suddenly there was a global price spike, like there was back in the late noughties in fertilizer prices, at that time, an awful lot of farmers were saying to me, "Well, how do I farm without access to these powerful inputs?"

Declan McDonald:

I'm ahead of time. In working through this series, we have a really strong focus on improving soil health, and what that means is regenerating soils. My business I've called Regen Soils, and my tagline is, "Bringing soils back to life." As we'll work through in the coming series of modules, we'll see just how important the contribution from those millions and billions of organisms are, so the more of those that we can have, and the greater diversity that we can have, the higher the health status of our soils is going to be. Part of that is bringing nature back into production systems. A lot of regenerative agriculture is about biomimicry, which is saying, "Okay, well how does nature do it?" And we all know that when we fight nature, we usually lose. The classic example of that is when we try to grow monocultures. The challenges that we have in keeping weeds, for example, out of that system are really considerable, and we've got to use a lot, a lot of inputs to keep weeds out of that system, but at considerable collateral damage. And we'll talk about that going through what are the impacts of herbicides on soils and what's the impact of continued use of herbicides or some of the other biocides that we routinely have used?

Declan McDonald:

We want to use these tools. I'm not saying that we have to stop using these tools, but because we have learned only one way to farm, and that is using these recipes of putting on fertilizer when, putting on ... I was in a commercial tomato paddock recently, and it was like, "Okay, on week three we can anticipate this weed pressure. In week seven, we can anticipate this pest, so we're going to preemptively start applying this pesticide. In week 10, we can anticipate that we're going to get this fungal attack, so we will put this on." We put a lot, a lot of chemicals on our food because we're operating an industrial system. But even those that are operating the industrial systems recognize that there is substantial collateral damage to the system from doing this, and we're trying to learn, as we're going forward, how to manage some of these impacts yet achieve the same kind of yields that we have been getting.

Declan McDonald:

My whole thing is about how do we have our cake and eat it? How do we sustain profitable yields and grow condition at the same time? Most farmers will say, "I would like to leave the land in better condition than when I got it," but in my experience, not many are able to articulate what that looks like, other than saying, "I want better fences and better-looking paddocks." For me, what it comes down to is, have you got more carbon in your soil? Are your systems able to produce with less inputs? Are your systems experiencing less pest and disease pressure so you don't have to apply so much of these powerful tools? We're still going to use herbicides, we're still going to use biocides, but we're going to use them differently. We're going to use them in a way where there's going to be less collateral damage, and we're also going to use them in a way that will help us to recover more quickly from the impact of the application.

Declan McDonald:

We want to tune the engine, and that's very much about feeding the soil. Modern agronomy doesn't consider, I think nearly importantly enough, how efficiently the soil is working. When we talk about how efficiently the soil is working, we're talking about nutrient use efficiency for example. I did some work when I was with the Victoria department a number of years ago as part of a project with Monash Uni. We looked at a comparative group of dairy farmers who were fully conventional, and then dairy farmers who were conventional and were making and using compost on their farms. And I'll show that data as we go through, but the farmers with the highest nutrient use efficiency were mainly the farmers that were using the compost as well. One of the conventional farmers was up there as well, obviously a very good farmer. The farmers who had a history of using compost were building more structure in the soil so the soil was able to take in, sequester, use that nutrient and have it available to the plant without losing as much of it as in the conventional systems. So, we're going to talk a fair bit about that.

Declan McDonald:

Look, we really want to talk about reducing costs. Our dependency on external inputs means that, as soil efficiency, which I've just been talking about, declines, so our requirement to increase our inputs increases. And I've seen so many times where a higher level of fertilizer is required to get the same level of input. It's not like the system is improving to a point where it's needing less fertilizer to produce the same carbons, it's needing more. And if we have to put more inputs on, it's going to impact on our profit. And what we're about is increasing profit. So, it's not about can we grow the biggest record crop that we've ever grown? That would be nice, but it's only worthwhile growing record crops if we're going to get record profit at the same time. There's a lot in this about reducing risk, and a cornerstone of regenerative agriculture is about operating in this new operating environment that we're in, principally an environment where the climate is changing really too fast. It's changed in my lifetime. It's changed in most of our lifetimes. It's not climate change is coming. Climate change is happening and we have to manage risks associated with how the climate is going to continue to change. That is a really serious risk for very many farming operations.

Declan McDonald:

And lastly, we want to enjoy farming, we want to reduce stress, we want to feel more in control, we want to feel less indebted, and we want to increase our knowledge base about how soils work, about how to reduce risk, about how to increase profit, reduce costs, et cetera, going back up through that list. And there's been some really interesting work done up in New South Wales that looked at farmer well-being in regenerative systems, and it consistently scored higher than those in conventional systems.

Declan McDonald:

To summarize, this is where we're going. We've just gone through, a little bit quickly, how soil works and how plants grow, and the drivers for the case for change. Next week, we have our master class in organic matter and we're going to talk about it and its relationship with so many other parts of the soil, physical, chemical, and biological properties. We're going to bore into soil biology more in week three. We'll talk about nutrient management in week four. Try to link then the managing fertility and building carbon in week five. In week six, we'll focus on management practices. This is where we're really beginning to talk about, okay, what are you going to do on your farm now to grow carbon? What needs to change? What can you change? And hopefully at this stage, our webinars will become just a little bit more interactive, because the thing about regenerative agriculture is it's not a recipe-driven system. It's a system where everyone's farm is different, so what you do on your farm might produce a particular result, and your neighbor doing the same thing might get a slightly different result. We definitely want to think about how we apply these principles and practices on our own farms.

Declan McDonald:

And finally then, like I said, how do we know things are changing? How do we know that things are changing for the better, or are they not? And what do we need to do to correct that? We'll talk there very much about the data that you need to be able to evaluate change. We'll use laboratory data in the form of soil testing and plant tissue testing, looking at the chemistry, physics, and biology of the soil. But we can also look at the role of soil health cards, which have been developed very much to provide really good feedback on how the soil is changing over time without necessarily having to go to the expense of lab testing. They don't replace lab testing, but if you engage with the soil health cards, you should get a lot of really valuable information.

Declan McDonald:

That is all I had to say today, so I'm going to stop sharing and go back to Matthew and see if we've got any questions.

Matthew Warnken:

All right. Look. Thank you very much, Declan. You've covered quite a range of terrain, no partial pun intended. But just everything from how that ecosystem of soils is functioning. And I quite liked that you take us through that journey in terms of those billions of years of evolution, and the Green Revolution, which I believe we've all benefited from in terms of increased food production, but some of the challenges there. So, the lost phosphorous solubilizers, the loss of nitrogen fixers, that loss of deep roots, the impact on tillage. And that's in particular around just that arthropod population count from 80,000 I think down to 6,000. And then loss of soil carbon and acidification, which obviously casts a big, blank picture. Hopefully by the time we get to module seven, we'll know exactly how to reverse all of those aspects.

Matthew Warnken:

And then, I did also like, too, that commercial focus, because ultimately these are all about tools and resources to enhance the farming enterprises, so that focus on, "Well, how do we reduce those costs? How do we increase our profits?" And then, putting that importantly, I think, which is often missed is that nuance in that the climate is actually changing. This is a risk mitigation aspect, it's a form of proactively adapting to the climate, which is not about climate change in 2050. We hear about net-neutral by 2050. If you work on the land, you can't afford to say, "Oh, that's a 2050 problem," because the climate is actually changing now. And then, you just sum up some tools and resources around the risk. And then, also bringing that human element, in terms of these are human enterprises, and arguably farming, many times, can be hugely stressful.

Matthew Warnken:

People with questions, there's a Q&A button in the chat. There's also email. I think we've got people standing by looking at that, if none of that works, taking emails. We are getting some questions through that we'd like to run. In no particular order. One question, Declan, is are synthetic chemicals always bad?

Declan McDonald:

That's a really good question, actually. And the short answer is no. They're not always bad. I'll give one example. Now, this is a slightly rubbery example, because these aren't very synthetic chemicals. And I'm thinking firstly about potassium as a fertilizer. Potassium is generally available most commonly in two forms, potassium chloride and potassium sulfate. Potassium chloride has got the highest proportion of potassium. It's got 49% potassium, but it's also got 51% chloride. As a result, it's got the highest salt index of any fertilizer. And as a funny aside, one of my first jobs very early on in my career in Ireland was working for a company, and what the company did was imported bulk potassium chloride into the country in 5,000-ton ships and sold it to the fertilizer industry. And I thought this was great. I thought potassium chloride was great, but I had a bit of a wake-up moment many, many years later in Tasmania. I was talking to a dairy farmer and he said, "I'll never use potassium chloride again," and I said, "Why is that?" He said, "Well, I applied it one time," and he said, "I came out the following morning and I think every worm on the farm was on the surface of the soil dead or dying." There had been a lot of rain overnight, but he had never seen anything like this.

Declan McDonald:

And I spoke to a soil chemist at La Trobe Uni sometime later, because this really puzzled me, and I said, "What do you think might've been going on here?" Well, he said two things. One was that the osmotic shock from so much chloride going on, and the other is that, in a really wet environment like that, there might've been some formation of hydrogen chloride, which is an acid, which would've also help to bump off the worms. What that told me was that, "Wow, if that's happening to the worms, what's happening to the rest of the soil ecosystem?" And I did more work then, looked into potassium chloride, and basically I have never recommended it since either.

Declan McDonald:

There's a guy called Graham Shepherd, who's a New Zealand soil scientist, and many of you have probably come across Graham because he developed the Visual Soil Assessment methodology. He's a very good scientist. He did some work where he applied potassium sulfate to one side of the paddock, potassium chloride to another side of the paddock, no fence in between, and monitored a response. Both sides pretty much grew the same, but when the stock went onto those paddocks, the stock were all on the potassium sulfate side of the paddock. None of them were grazing on the potassium chloride side of the paddock. Now, that's just a little story about potassium.

Matthew Warnken:

Maybe also, Declan, just as you paused, this is something else in terms of concept that you may have heard of, of buffering with biological products. Is that something also to throw into the mix? Is that what you're saying? It's not black and white, there's a suite of appropriate tools, and products, and resources.

Declan McDonald:

That's exactly right. And we'll talk about that a fair bit more as we go through, too. The only other thing I was going to say about synthetic fertilizer, it's not that they're bad. What's bad, I would say, is the way we use them. We have been using them like blunt weapons. When I used to work in Tasmania, I worked across all industries, but as part of my newsletter feed, I subscribed to the Tasmanian Dairy Research Group's monthly newsletter, and I found it hard reading, because it seemed month by month they were reporting on how they had applied more and more urea and how they were getting better and better responses, yet so many farmers that I've worked with since got to a point where they fell off the cliff with urea where soils were just as hard as a rock, there was no clover, no worms, stock were unhealthy. And when we backed off from those very high levels, health started coming back into the system, not only into the soil, but in terms of reduced vet bills and all that kind of thing as well. We didn't stop using urea, we just used it completely differently and at much lower application rates, and in conjunction with buffering materials as well.

Matthew Warnken:

That's interesting, Declan. Are you kind of suggesting that in terms of these conventional monocultures, I think you talked before about the challenges that monocultures then present in terms of those input costs and those input costs going up, that not only do those input costs continue to come up, but is there in fact a plateau effect in terms of what you cannot use culturally and not getting more production through that system into another product?

Declan McDonald:

Yes, that's right. And I've seen it most in dairy systems, because they tend to be high-input operations. Where there's encouragement to applying more and more urea, and people have said this before, it's like the drug, you can't get off it, because if you suddenly stop using urea, or many of these other fertilizers, the mechanisms that used to work to feed the plant, you've gotten rid of them. You've made them all redundant. They've died off. They're there in tiny numbers and they're just not up to the job. So, the system crashes, and you think, "Okay, well I've got to keep doing it."

Declan McDonald:

Another really nice example, and we'll talk about this a bit more as we go through as well was, with grazing management, I worked with Camperdown Compost for a number of years, still working with them actually, but early on in the piece, they had the first group of farmers that we were working with who were using compost were doing really well. They were getting great results. The second group of farmers that came in were getting more mixed results. One said, "Look, it's just not working. The grass isn't growing. I'm going to have to go back to my old ways." So we said, "Let's go and visit your farm, and see why things aren't working on your farm compared to the others." What we found was this farmer was grazing his paddocks down harder than the better farmers, if you like, and because he was grazing them down so hard and not allowing enough recovery time for those pastures, they weren't producing as much bulk as he needed. Contrast to the better farmers who weren't grazing down so hard, who were allowing more recovery time, the system was working really well for them.

Declan McDonald:

If you don't work in more sympathy with the system, you have to use these high-input fertilizers to get production, but it becomes a negative downward spiral, both in soil condition and in cost.

Matthew Warnken:

Declan, I know you probably pick up a lot of this in subsequent webinars, but you talked about biomimicry. Can you maybe just give some examples of what are those biomimetic farming systems or practices, that will be coming up, I guess in further modules, or the working with and mimicking nature?

Declan McDonald:

Yeah. Look, I think one of the best examples and an area that there's a lot of interest, and rightly so at the moment, is in the area of holistic grazing. Now, I crossed swords on more than one occasion, particularly with the Victoria department with the people that were running the EverGraze project. Now, EverGraze was a great program, but from my way of thinking, the thing that EverGraze kind of missed was the soil. EverGraze really focused on you put this much nutrient on, you allow it to grow for this long. It was all about getting the stock to eat the grass at the grass' most nutritious so the stock did really well. And there's no arguing with that, but the soil does really poorly because you're not allowing the plants to grow big root systems, you're not allowing any kind of litter to cover the surface of the soil, you're not protecting the surface of the soil. When we look at how grazing occurs in natural systems, generally grazing occurs in very long cycles, and you have a mob of grazing animals going through. They eat everything, because there's a lot of them. They're eating competitively. What they don't eat, they trample, and then they leave the rest.

Declan McDonald:

But those plants have a really long time, then, to recover. And in the process of that mob grazing, we get a lot of litter deposited onto the surface, so even though there's not a lot of standing plant material, the surface of the soil is protected. The surface of the soil is always protected in those systems, either by long grass or by litter on the surface. That's the way nature designed these grassland systems to sequester carbon most importantly, but to facilitate high levels of production. Those systems weren't getting any input except from what came out of the back of an animal. That's, for me, a really beautiful example of biomimicry that we want to see, "Well, can we make that work? And can we make that profitable in our conventional grazing systems?"

Matthew Warnken:

Great. Another question here, just in terms of depleted soils and microbial density. How do you expect that microbial diversity to return? Or does it need direct intervention? Let's say if you were to adopt holistic grazing. Does the microbial diversity return, or do you need to actually reintroduce, actively, proactively reintroduce microbial communities into soils?

Declan McDonald:

Okay. Well, if I tell you that for years, the vegetable industry in particular used an incredibly toxic compound called methyl bromide and they used it to sterilize the soil. The reason they wanted to sterilize the soil was so that the diseased organisms wouldn't come and damage their crops. Happily, methyl bromide has been banned now. Not only is it extremely poisonous to humans, but it's a nasty greenhouse gas as well. The thinking behind that was that we'd sterilize the soil and everything will be fine, but of course, things started to come back in. What I'm saying is that, even in the toughest of environments, soil organisms have evolved over millennia to survive extreme hardship and adversity, extreme droughts, fire, flooding, you name it. So, there's so many organisms in the soil, so many survival mechanisms. They come back, and all they need is the opportunity to come back, and they come back so fast. The work that I did with those dairy farmers in Southwest Victoria where, like I said, they couldn't put a spade in the ground. And I've been on dairy farms where soil is moist, grass is long, you'd expect the soil to be soft. You can't put a spade into the ground.

Declan McDonald:

When we take the pressure off those systems and we start feeding them what the system actually needs, which is organic matter, within three years, we see these systems beginning to turn around. And within seven years and longer, that's when they really start firing.

Matthew Warnken:

Very positive. No farm's too far gone.

Declan McDonald:

No farm is too far gone. Even the nuked farms are recoverable. Now, we can help them along the way, and with things like compost. It's basically things to feed the soil microbes. I'm not a fan of necessarily introducing soil microbes. Some of it can be good. I've just seen too many hit-and-miss results. Compost tea, for example. In some places, great result. In another situation, zero result. And we don't understand yet quite enough why that's the case, but we're getting better. And we certainly will maintain an open mind about all of that.

Matthew Warnken:

Right. We're approaching the top of the hour. We do want to get to a couple more questions though, Declan. One interesting one, a shout-out to Andy Gulliver over in WA. I hope you're not suffering too much through the shutdown. Just a query just in terms of, because these changes don't occur in isolation. What about that human element in terms of the science around behavioral change in terms of to get that system? How important is that behavioral change aspect, Declan, in terms of making these changes to farming systems?

Declan McDonald:

Look, enormous. I'm working at the moment, actually, on developing, which is a really exciting project, an agroecology and food economy strategy for the Mornington Peninsula Shire council. There's been lots of talk about, "Well, what do we need to engage with farmers and help them to move to the next level, and effect change?" And there's been a lot of talk about, "Well, do we an agricultural scientist, an agronomist, or do we need a social scientist?" And actually, there's a lot of sound argument that says we need a social scientist, because basically, it's like what's between our ears is our greatest strength and our greatest weakness. So, it's about helping us to overcome our fear, and there's a lot of fear in some of this because it's new, because it's unknown. If we have a recipe that has served us well for the last 30 years, "You're asking me to throw that away and do something different? Why should I believe you?" So, we're going to talk a lot about not throwing the baby out with the bathwater. We're going to talk about, "Okay, how do you put your toe in the water? How do you prove it to yourself, and what small steps can you make to provide really good feedback and self-learning?" Because this is all about teaching you and freeing you from relying on somebody else to tell you what you should put on your land.

Matthew Warnken:

That's great. And then, maybe just one final one, and another practice change one. Question about is burning, I presume it says stubble burning, is that a pathway to sequestering carbon? And then, also a practical one is just in terms of how composting is applied in relation to say large pastures on a compost application scale.

Declan McDonald:

Sorry, the first part of that, Matthew, what was that?

Matthew Warnken:

Oh, in terms of, I presume this is stubble burning, but is that a pathway to actually building carbon in soils?

Declan McDonald:

Stubble burning is a pathway to releasing carbon from your soil, because when we burn the stubble, stubble is very high in carbon, and when we burn it, we release that carbon as carbon dioxide and carbon monoxide into the atmosphere, and it's gone forever. So, stubble burning is generally a pretty bad idea. And there's been a lot of work trying to move away from stubble burning over the years. Some farmers occasionally still burn if they run into a major problem with slugs or whatever else, but we also know that in a less monoculture, the more diversity we can get into some of these systems, if we can get higher beetle numbers into these systems, beetles eat slug eggs, so talking about biomimicry, we're looking for natural controls. Give me a few million beetles in my cereal paddock any day, rather than have to go out there with some heavy slug baits.

Declan McDonald:

The second part of that question, Matthew, was?

Matthew Warnken:

Was on the practical role of how you actually practically apply compost. And what we might do is leave that as a segue to pick up next week in terms of just the practical spreading of compost, because I know some work in compost, we might pick that up next week. Just conscious now that we are at the end of the first webinar. This was a webinar on how soil works and how plants grow. There's been some great questions and really a great introduction to this whole concept of building top soils.

Matthew Warnken:

First of all, thanks to our presenter, Declan McDonald from Regen Soils. This is the first in a seven-part series. The next webinar module is on organic matter, the cornerstone of soil health and sustainable production. This module will be available to download. As Declan mentioned, we will get a copy of the slides out. A shout-out to our other team, especially to Mel for her help in putting all of this together. If you don't get a copy of the notes or whatever, please drop us a line at team@agriprove.io, team@agriprove.io. Or any further questions or things you might like to ask to pick up as we progress through this webinar series. Once again, thank you for your interest and your attention. Thank you to Declan for presenting. And we look forward to continuing this conversation at our next webinar. Bye for now.