Decode 6

DECODING CARBON AND ECOSYSTEM SERVICES

HOW DOES SOIL HEALTH IMPACT WATER QUALITY?

Featuring Dr. Ron Turco

Professor of Agronomy, Purdue University

DJ May:

Welcome to the Decode 6 Podcast, where we take your questions about carbon and ecosystem services and match them to the experts with the answers. I'm your host DJ May, and today we're tackling a big question, how can improving your agricultural soil impact water quality?

Before we dive into that though, let's meet our guest Dr. Ron Turco. Ron is a soil microbiologist and professor of agronomy at Purdue University, plus he's head of the agronomy department and the 2022 President of the Soil Science Society of America. So welcome, Ron. Great to have you.

Ron Turco:

Hey, how's it going?

DJ May:

Good. Thanks for being here today.

Ron Turco:

Great.

DJ May:

Well, we'll jump right in because we're on the clock. So how can improving your soil impact water quality, whether that's edge of field or otherwise?

Ron Turco:

So you got to remember about soil is that it supports plant growth, it recycles materials, it regulates processes, it controls and filters water, and then water interacts with it all the time. So you either have water moving across it or through it or sitting in it. So soil's got an important role in that regard in the environment. So it also supports plant life, it supports animals, it supports microbes. So soil is very dynamic, very functional, very organic, very alive thing out there. So water interacting with soil is really the critical step. And so, as water moves across or into soil, it's that interactive phase of how the soil retains things that really controls what gets into the water, which affects the water quality. So it's really issues around that, can you regulate the carbon content of make the soil fluffier? That's a good term for soil. Stronger aggregates allow for water to infiltrate as opposed to runoff. Those are all the kind of things that really, really affect soil's ability to impact water quality.

DJ May:

Great. Well can you break that down a little bit more? Which practices have the biggest impact on water quality?

Ron Turco:

So it's an interesting process, right? So you think about agriculture, you think about soil, it's basically, how do you allow soil to function? And by functioning you get, again, the plants and the microbes all going to doing their jobs every day. Transposing materials from living forms, if the plant dies it gets reused by the microbes turned over. So basically any process that stabilizes soil is good. So organic matter turnover, root growth, great thing for increasing soil stability. And the other part of this, which everyone always forgets about is the question of, how does carbon get in the soil? Is it magically arriving there from the atmosphere and just sort of laying in there and sticks in there?

No, no, no. It has to go through the plant. And the plant is a conduit for carbon into soil. So if you have a good plant growth going on, you've got a strong process there with plants or trees for that matter, anything where you have a root in soil and you have CO2 being trapped by the plant and then that's processed and you get some leaking out and the plant rises here, that's how you really improve soil in terms of carbon sequestration and in terms of a retention of properties in there that you want.

So again, water keeps interacting with soil every day. It's just some process going on in soil related to water. Is the soil holding nutrients or is it releasing into the water that really reflects the amount of carbon that's there and the amount of organic matter that's there? More organic matter tends to hold onto things better. So if the soil is able to accept water as opposed to running off, is it accepting water? Is it retaining the water on the surfaces of the soil particles? Is it not leaching things too quickly?

Those are all the processes that really help you to retain water. And to get to those and answer your question, are things like, how do you have a good impact on soil? It's really, I think is related to use of cover crops, reduced tillage, crop rotations, and then working, this is a really tricky one that's people always forget about. But working soil when you have the proper water content and soil, that eliminates compaction or slows compaction down, all those things that you do to a soil that allow it to remain porous and you want your soil porous with strong structure, aggregate structure to allow the water to infiltrate, to interact, that's really the optimal condition to improve water quality.

DJ May:

Okay. Excellent. So to summarize, and help me out here if I get this wrong.

Ron Turco:

Yep.

DJ May:

You're looking at cover crops, you're looking at when you till, you're looking at the water content of the soil when you're doing all these different actions to prevent compaction. Okay.

Ron Turco:

Yes.

DJ May:

Yeah. So pretty complex, not a simple answer.

Ron Turco:

Then you can throw into that a little bit, a couple other things in terms of crop rotations, maybe do you want to change up what you're planting, your corn and soybean rotations or other things into the mix, improve the kind of roots that are there, change the roots around. They can affect the structure that's in there by being more fibrous or more pour... I mean those kind of questions. And then the other thing is this is really tricky because it really has more to do with the processes we use as nutrient management. You want to add nutrients at the right time and the right rates so that you don't overload the system. So that's a really tricky thing. It's complex in that regard. How much do you put in when you put it in and then how much is the plant taken out? Then what happens when you have a big water event occur?

If there's as a rainfall event, is it going to run off and take your fertilizer material with it? Is it going to leach? That kind of thing. So you summarize it nicely, it's incredibly complex. You've got traffic issues with equipment, you've got cover crops you could use to keep a green cover on things and lots of roots as far into the winter as you can get. You've got crop rotations where you can get different root materials there to sort of do things differently and then change some dynamics with disease cycles. You've got nutrient management and then you've got questions around reduced tillage that can help in terms of maintaining carbon in the system.

DJ May:

Great. Yeah. So I guess just obviously it's very dependent on all of these different factors and agriculture is super local, but if you had someone, no matter where they are, that's thinking about improving their soil health and being concerned about water quality, what advice would you give them when they're looking at these practices?

Ron Turco:

So that's a great, great question because it's really a question about, it's got a philosophical component mixed into it. So I was thinking about this for this podcast and a couple other times recently, and it's really thinking about long term multiple cycles of what you're doing. So are you looking, and most folks are working ground maybe a year out thinking like next Spring. That's about the longest you're thinking, that kind of thing. But you got to be thinking multiple years in here, are you talking about how many cycles of plant growth are going on? How many cycles of harvest are you doing? When are you going to put your cover crops in? What's your plan for your nutrients next year? And so you can kind of manage that cycling of things is really, I think, a really important sort of different way of looking at this. So you look at it a couple, three, four years out, where do you want to be?

How can you use a cover crop or a reduced tillage practice to get where you want to be in three to five years? Because you won't change, It's hard to change soil carbon levels quickly. I will say that. That's plenty of research that shows that. So it's a concerted effort over time that allows you to increase the amount of soil carbon and increasing the amount of soil carbon can help you again, with the agri stability, keeping your poorest structure there, keeping things active in terms of the microbes and such. But you're not going to build up soil carbon incredibly quickly, so you have to be thinking long term and long term ties back to what you're doing, crop rotations, your nutrient applications that the use of cover crops and then that reduced tillage or tillage components are as important. So what can you really do to improve things is really what can you do to push up the amount of infiltration you have in the system is really the first up.

So that's again, aggregates, increase the poorest nature of soil. So you get water moving in, not across. Water is an incredibly huge force, and when you see it, when you look at flooding pictures and that big wall of water moving, we don't get quite that typically in a farm field, but you do get that erosive push and you can end up with eroding soil

moving stuff off the surface and overloading the system and that dumps into whatever local water body you have. So that's an important thing to keep in mind is that water is pretty powerful, especially when you have a lot of it in a short period of time. So anything you can do to increase the amount of water moving into the profile and keep things in the soil itself and not moving off, that is really the critical step.

The other thing I'd say is that, is stay informed on what's out there and what people are thinking in terms of practices and clever new things people are doing, new implements, new tools, new decision support, equipment around, maybe there's a little tweak on your VT tool or whatever tool you're using for tillage. So you use all kinds of subtleties around that need to be watched for. And then just keep up on what the new programs are from the fed side as well. And then again, new technologies are really critical here. So there's lots of opportunities in the technology space.

DJ May:

Great. Yeah. Well you anticipated me, I was going to throw you a curve ball and ask about resilience when something crazy happens, like tons of rainfall but...

Ron Turco:

Tons of rainfall are hard to be, I don't care really what you do, it's really hard to deal with that. You can go to the best case scenario of having a really porous soil, have a green cover on there, that will delay the inevitable. But it's just hard to deal with all that. I mean, water weighs a lot, right? So water weight, the volume, depending on your slope, you can get a lot of energy into that and it's going to run down. That's going to be an erosive force. I mean, it's rough. I'm surprised we're actually still on the earth. You just get shoved off by the water at some point. So it just amazes me. We have a research site town that we look at tile water moving in, the water that comes through the soil, just amazes me because we actually look at the tile water coming out of the plots. We track the volume.

It just amazes me how much water actually moves out of those plots through those tiles. And we have the tipping buckets that ca measure the volume. They make a noise when they hit. You can't even go into this little room we have because it's so loud with these buckets hitting when you have a big storm event occur. This is all about water really. It shouldn't be really soil science, it should be water science going on here. Soils just get in the way of the water. So we have to figure out ways to keep the soil in place by using organic carbon, using the microbes in soil, the roots, the processes, it glues it altogether, making that really happen in a good way to fight the water, basically. So you're right, it's just dramatic bad things happen because of the water.

DJ May:

Yeah. Yeah. Well, excellent. That was perfect. Thank you so much for being here today. And it was-

Ron Turco:

No problem. I enjoyed it.

DJ May:

...It was great to have you! If you're curious about the science behind water quality and soil health and you want to read up on it, check out the show notes for links to related research. And if you want to know more about carbon and ecosystem services or you have questions that we can pose to our experts, come visit us at decode6.org to learn more.