



HOW DOES CARBON GET INTO THE SOIL?

Featuring Dr. Jerry Hatfield
Agricultural Consultant

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 answering one big question; how does carbon get into the soil? Before we dig in though, let's meet our expert, Dr. Jerry Hatfield. Jerry was formerly a laboratory director and plant physiologist for the United States Department of Agriculture: Agricultural Research Service. Now in retirement, he's staying plenty busy by serving as an agricultural consultant. He is an expert in evaluating the dynamics of the soil-plant-atmosphere continuum, all with the goal of increasing crop production efficiency, enhancing soil health and combating climate change. All of that to say Jerry is the perfect person to answer this big picture question. Jerry, thank you for being here.

Jerry Hatfield:

Well, thanks, DJ. It's a pleasure to be here because I think you can understand that we have a complex topic and everything, and I think it's a pleasure to begin to explain some of the dynamics to our listeners so they can understand what they can do and what they can't do and the opportunities they have.

DJ May:

Definitely. Well, we'll jump right in. How does carbon get into the soil?

Jerry Hatfield:

Yeah, that's a question everybody asks. People magically think that carbon is in the atmosphere in terms of CO₂, and we talk about CO₂ being in excess of 400 parts per million right now. People magically think that carbon that's in there just ends up in the soil. But that's not the case. It really is a very dynamic process and requires a living plant. It's that simple in terms of the process. But let's think about it from the perspective of what that plant does.

Here, you've got CO₂ in the atmosphere, goes into that plant leaf. Through the process of photosynthesis, we take and convert that CO₂ plus water through the photosynthetic process, create a simple sugar, glucose, and then we transport that glucose all over the plant. Some of it goes into metabolic process. Some of it goes into obviously growing that plant, but there's a portion of it that goes into the roots. Some of it's exuded out, and it's that gooey stuff that we see along roots and everything that actually is some form of sugar. But then, all of that growth material that goes into roots is carbon as well. We take that carbon that's in the atmosphere and through this whole process of photosynthesis, convert it, move it, and then we leave it in the soil. That's how carbon really gets into the soil in a very simplistic way. But it's a very dynamic process and it is also a very fascinating process to the fact that the more plants we can put out there to keep extracting that CO₂, the more carbon we can put into the soil.

DJ May:

Yeah. Well, I mean, here's the tougher question. Once we have some carbon in the soil, how do we keep it there?

Jerry Hatfield:

Well, now that gets to be the more interesting question of all of this, is maintaining that carbon within the soil. Now, we've put it into the soil through this plant, and then we can say, "Well, what is that carbon balance?" We can think about it as a checkbook. I often explain carbon increase in the soil as much like your retirement account. We've got a retirement account. We keep depositing into our 401k or any other form we have. We diversify that portfolio to make sure we get maximum returns on it, and we avoid taking anything out of that. That's the piece we'll talk about. The other piece of this is then, your financial advisor will tell you is don't look at it every day because you'll get all panicked. But if you look at it over time, and we do see changes.

Now, we've put it into the soil through that living plant, and so how do we keep it there? Well, we keep it there from the primary aspect of reducing the intensity of tillage, because we know that when we till the soil, we disturb all those soil particles. We actually excite the microbial activity, so there's a lot of activity going on that gets into a high respiration rate. We blow off a lot of CO₂. A lot of CO₂ is just kind of trapped in the intercellular pieces of the soil and everything else. We break those apart and we get that puff of CO₂ coming out. One of the first ways to avoid losing a lot of CO₂ is reduce the intensity of tillage.

The other piece that we can lose carbon is through the whole process of soil erosion. Because if you look at a soil profile, you notice it's darker-colored near the surface, because that's where the organic matter is. When we erode that off, we erode a lot of that organic matter to different parts of the field, so we redistribute that as well. It's basically physical processes that take a lot of the carbon back out of the atmosphere or out of the soil back into the atmosphere.

DJ May:

Perfect. You mentioned in your retirement account analogy, diversifying your portfolio. What does that look like for a farmer?

Jerry Hatfield:

Yeah. You're not the first one to ask that question in terms of how do you diversify your portfolio? Think about a simple little process of saying, if you want to continue to improve our soil and put more carbon in there, let's just think about it very simplistically and saying, if we're growing a crop like corn or soybeans, it's only growing in the Midwest during three months of the year. Part of that diversification is adding a crop, like a cover crop that's growing before that corn plant is planted or the soybean and then afterwards as well. Now, we've diversified our portfolio. We can also diversify it through changing crop rotations. Those attributes to soil health where we talk about extending crop rotations or adding cover crops are the dynamics of diversifying your portfolio.

DJ May:

Yeah, exactly. I love that. Do you have any last thoughts or advice for people who are considering how to keep carbon in the soil? How to get it there?

Jerry Hatfield:

I think that two things come to mind when we talk about looking at how do we keep carbon in the soil. I think one of the first ones is to take stock of what you have. Go out and determine what your soil organic matter content is and really look across the field. Don't just look at the bad parts of the field and say, "Well, my organic matter's 1% because I sampled this really poor part," because you might have other parts of the field that are 4 or 5%. Really take a good stock of what you have and then develop a strategy saying, "What am I going to do to improve this?" Because you'll see a lot greater return on that investment of changing that cropping system and reducing tillage on the poor parts of the field than on the really good parts. If you add money to that retirement account and you have \$50 in there and you add another 50, you've doubled your money already. But if you have a million dollars and you add only 5,000, you don't see much of that change in it.

I mean, look at it from that perspective and then really develop a plan. I think a lot of producers, if you look at this and say, "If I want to change my carbon, what do I have? What's my path to getting there?" And then, how do I begin to look at these dynamics over time and saying, "Am I making progress towards my goal?" And not be afraid to change. I think that this whole dynamic is really in this aspect of what I call adaptive management. Adaptive management saying, "I look at where I am. Now I look where I'm at and what tweaks do I have to make to make sure I'm headed towards the goals that I want?"

DJ May:

Great. I think that wraps it up really nicely. Thank you so much, Jerry.

Jerry Hatfield:

You're welcome.

DJ May:

If you have more questions about soil carbon or you want to read up a little bit on the research that's been done, check out the show notes for links. If you're curious about carbon and ecosystem services, come visit us at decode6.org to learn more.