Plants Dig Soil | Season 4 | Episode 3 | 027 Cash Crop Intercropping | May 4, 2022

Hello! This is Scott Gillespie and welcome to the fourth season of Plants Dig Soil. In this podcast, you will learn how to think critically about regenerative agriculture claims so that you can apply proven and profitable practices that benefit your farm now and in the future.

[TRANSITION MUSIC]

Intercropping has been gaining popularity on the Prairies lately. If you haven't heard of it, or are still trying to figure it out, the basic concept is to grow two or more crops at the same time on the same piece of land. Most of the time they are planted at the same time and then harvested at the same time.

In the southern United States, where the seasons are longer, a similar concept is used, except its usually called relay cropping. Just before one crop takes off in growth another crop is interseeded between it. If the timing works out, you harvest the first crop with the second crop established and it is ready to grow for the remainder of the season.

Where I've seen this work is to have a cool season winter wheat crop that establishes in the fall and explodes in growth in the late winter or early spring. A warm season crop, such as soybeans, is established in the cool part of the spring when its not going to grow much. The winter wheat comes off early and the soybeans are ready to grow in the heat of the summer. For this to work you need be precise in your field operations, not have many weather delays, and have lots of moisture. You are growing two crops after all.

While the soybeans will be making their own nitrogen, they will also be using all the other nutrients in the soil. This is along with the nutrients that the winter wheat took. You have two cash crops and two potential sources of income, but you also have exported nutrients from two crops.

Back to the Prairies, where this type of system is unlikely to work. I'm not being overly negative; I'm just being realistic. We have a much shorter growing season and lack the precipitation required. We can't get two crops off the land that each grow as a monoculture, but we can grow two crops as a polyculture.

When intercropping we do not get twice the yield. Each of the crops in the system don't get the full potential of yield that they would if they were a monoculture. If the crops are well matched, you should expect to get a percentage of each. If the portions add up to 100% then you've grown the same total amount of crop on one field compared to what you could have gotten if you'd split the field and planted a portion of each on separate sides.

However, most people want more than this. If they are going to go through the trouble of planting, harvesting, and separating two crops on the same piece of ground, they want to see more than 100% yield. The reason must be better than seeing other people do it and think it looks like a good idea, so let us look at the potential reasons for doing this.

[TRANSITION MUSIC]

The main reason I usually hear is that it's to cut down on fertilizer use. The idea is to pair a legume, which makes its own nitrogen, with a non-legume. It's expected that the legume will give the non-legume some of its nitrogen. I find this hard to understand. Why would a plant give up nitrogen that it

has traded its own sugars for? It has let nitrogen fixing bacteria setup in its roots and is supplying sugars made from photosynthesis to them in exchange for nitrogen. It's a mutually beneficial relationship.

In my reading of the underground economy, and I'm speaking of the soil here, no-one gives up something without getting something. The most fascinating story I heard was of a mycorrhizal fungus that hoarded phosphorus and would only release to the plant that gave it the most carbon[1]. It preferentially sent the nutrient to the plant that would pay it the most.

Now it probably had a good reason to do this: It was working hard to get phosphorus from places that plants can't get, and it needed resources to do this. It may have even been needing to sub-contract the work out to some bacteria that could go to places it couldn't go, due to their tiny size and biochemical machinery.

Even though it seems unlikely to me, recent research shows that there is some evidence that this transfer does in fact happen[2]. A study with pea and mustard in Saskatchewan showed that some of the biologically fixed nitrogen had transferred to the mustard.

How did this happen? Mustard is known not make mycorrhizal associations, preferring to go it alone in the underground economy. If a legume is planted with a plant that does make mycorrhizal associations, it is possible that the non-legume uses the inter-root fungal network to pay the legume some sugar energy in exchange for nitrogen.

This would not explain how it works with non-mycorrhizal crops, such as canola and mustard. Perhaps it's more sinister. Maybe the brassica raids the legume? Or maybe it gets close to its roots and picks up any leakage of nitrates before the legume can get it? Maybe it recruits pathogens to attack the legume and sits in the ready to absorb the carnage? I'm just speculating here but would not doubt it if someone discovered this actually to be the case.

In a perennial system, mixtures of legumes and grasses can grow well for years without added nitrogen. The mechanism for this is understood not to be a direct transfer but the fact that the grasses are quicker at the uptake[3]. In the spring, the leaves, stems, and roots leftover from the previous year start to break down but if the grass is quicker getting the nitrogen, it takes it before the legume can, and forces it to ramp up production with the rhizobia bacteria.

When grazing, it is possible nodules are sloughed off or roots are pruned to compensate for the loss of the above ground photosynthetic factory. There is also the direct return of most of the nitrogen to the system in the manure. Again, if the grasses are quicker on the uptake, the nitrogen transfers to them.

In an annual cropping system this transfer wouldn't happen, but what could happen is the free nitrogen in the soil is taken up quicker by the non-legume. Legumes tend not to root deeply, so the non-legume may be able to get nitrogen deeper down that the legume can't and force it to make more of its own. If seeders were setup to put some nitrogen fertilizer close the non-legume, it would have a chance to grab it first. The closest root wins.

I saw this firsthand one year while scouting a winter wheat crop. I came across areas of good growth and poor growth. It was sometimes patchy and sometimes would follow rows. One row would look good, and its neighbour would not be. The field had been in potatoes the previous year and solid cattle

manure was spread, worked in, and the winter wheat seeded in the fall. No fertilizer was added to the drill, so in case you are thinking fertilizer injury or row plugging on some rows, that is not the case.

It's hard to get cattle manure evenly spread and it turned out if a row didn't have direct access to the manure chunk, it was short of nitrogen. Tissue tests confirmed this, and a top-dress of nitrogen fertilizer was applied. The field evened out, but the slow areas likely never reached the potential of the fast areas. It was so sporadic there was no way to measure with the combine. Yes, I could have marked the rows and hand harvested, but I wasn't that committed to knowing the answer.

[TRANSITION MUSIC]

Really quick break. Are you on my newsletter list? Social media only shows my posts to those who it thinks should see it. On email I know that sending something out always gets to you. I don't want to overwhelm your inbox, so I only send something out once a month. There will be a sign-up link in the episode description, and you can always find it at www.plantsdigsoil.com. Thanks!

[TRANSITION MUSIC]

So far, I've focused entirely on nitrogen. This is what most farmers focus on too. It's the nutrient that drives growth and is the most watched nutrient. There can be some synergies with intercropping on nitrogen, but not necessarily for the others. Nitrogen is the only nutrient that can come back to field through the air. All others must be applied. There may be synergies with the others in that one crop may be better suited to access one, but in the end, you are exporting nutrients. For a more in-depth discussion on this take a listen to an earlier episode of Plants Dig Soil called: 018 Three Pillars Propping Regen Ag[4].

If you over yield, that is, get greater than 100% in the polyculture as compared to equivalent monocultures, you are exporting more off the land than you would in a monoculture. In this way intercropping may not cut back on fertilizer use, it may actually mean more use.

One of the biggest challenges, besides separating the seeds at harvest, is controlling the weeds. There are very few herbicide options that will work for both crops. Herbicides work by killing mostly everything except for the cash crop. Introducing two makes it tougher to find solutions. You must start with a field with low weed pressure, or you must go with high seeding rates to crowd out the weeds.

Seeding rates can be a big challenge with intercropping. You must have the right ratio to allow for the non-competitive crop to get ahead. In all of the research and farmer experience I've seen, the optimal ratio depends on the year. What works in one year doesn't work in others. The best you can get is to aim for a safe ratio, take notes, and adjust the next year.

There's also the disease or insect wild card. If it happens to be the year one insect is worse for one of the crops, it may get damaged too much and you end up with mostly a monoculture of one crop. However, if the presence of one of the crops helps to lower the disease or insect pressure in the other, synergies may develop.

Beyond nutrient supply and pest control there are not many other reasons to grow intercrops. One special case that has potential is to help a low growing crop have something to trellis up and keep it off the ground. This is where peas and canola – sometimes called peola – have great potential. In fact, this was the impetus for the original intercropping in the Prairies 40-50 years ago[5]. The original pea varieties

lodged, and the canola varieties had little to no chemical weed solutions. As breeding developed better pea varieties and genetic engineering allowed the development of herbicide tolerant canola varieties the system fell out of favour. I'll link to an excellent resource on this topic where I learned this history by one of the gurus of intercropping on the Prairies: Lana Shaw.

[TRANSITION MUSIC]

Trellising, nutrient transfer, and pest control are all features of an ancient practice that was used near my area up until about 150 years ago. You've probably heard of it: The Indigenous practice of growing corn, beans, and squash together. Commonly it's referred to as the three sisters. The corn provides the trellis for the beans, the beans make nitrogen and either share or spare other sources for the corn and squash, and the squash covers the ground the best for weed control[6].

It works better than our highly mechanized system because maturities don't need to be matched. Each species is hand planted at its ideal time. The corn grows faster initially but soon the beans catch up. The squash is the laggard but then it covers the ground once the early weeds are removed and makes something that can harvested late into the fall.

It also excels in the nutrient export problem that we have: That's because nutrients aren't exported. They may not come back to the exact spot the crop was grown but they stay close by. It's all consumed locally. Fields were used as long as they produced well and then were left to go back to nature for generations. The land supported the number of people, animals, and plants that could live off it. For a more in-depth discussion on this refer to an earlier episode of Plants Dig soil called: 017 The Long View of Regeneration[7].

So where do I see intercropping fitting into our modern agricultural systems? I think it will become a tool that works for specific crops that work well together. Like all other things in agriculture, it needs to solve a problem and it needs to be profitable.

I personally think that what will prove to occupy more acres and be more profitable in the decades to come will be intercropping cover crops, not cash crops. I'll be exploring that idea and making the case for it in my next episode.

[TRANSITION MUSIC]

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Another great way to help me is to share on your social networks. This could be with something interesting you learned and using the #RealisticRegenAg or sending direct to a person that you know could benefit.

I always like to know how people that give out information for free actually make money. The podcast is free so that you can learn something new and get to know how I work through issues. If you need a little more help than the podcast can provide, I have a self-directed, online course to help you dig a little deeper. Included in the course are office hours that let you have time with me to fine tune your plans. When you need more than that, I provide one-on-one consulting services

My expertise is centred around the Canadian Prairies. I have a B.Sc. (Agr.) with an agronomy focus and a M.Sc. with a focus on Plant Science. Beyond my formal education, I have attained, and maintained, my Certified Crop Advisor designation and am a member in good standing with the Alberta Institute of Agrologists.

Closer to my home in Southern Alberta, Canada (just north of Montana, U.S.), I provide scouting services throughout the summer with weekly field checks for crop staging, pest presence, and, under irrigated fields, soil moisture and weekly irrigation plans. I go beyond the standard crops of wheat, barley, canola, and peas to include things like potatoes, quinoa, and hemp. And of course, I love taking on cover crops.

Ecoregions do not respect country boundaries, so if you are in the Northern Great Plains of the United States, I am sure I can help you as well with remote consulting options. Are you further afield than that (pun intended)? Many of the principles and frameworks that I have created adapt to farming anywhere in the world.

I use Anchor (from Spotify) to send this podcast out to the world across many platforms and it tells me I have listeners from every continent. Oddly, it even says I have listeners from Antarctica. If that, is you, I would love to hear from you, or wherever you are in the world. Send me an email or connect on Twitter or LinkedIn. If you go to Anchor you can leave me a voice message.

See you next time.

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[1] Riling Lab. December 17, 2020. Life in the soil: Episode 3 18:24-19:24.
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[2] Saskatchewan Agriculture. Mar 22, 2022. Intercrop Webinar. 18:00-21:30
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[3] Alberta Agriculture. 2009. Alberta Forage Manual. p.176. https://open.alberta.ca/dataset/077326082x

[4] Scott Gillespie. May 9, 2021. 018 Three Pillars Propping Regen Ag.
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[5] Lana Shaw. March 10, 2021. Chickpea Flax Intercropping: Why its worth the trouble.
https://youtu.be/uynn8N7EE5w?t=109

[6] Robin Wall Kimmerer. 2013. Braiding Sweetgrass. “The Three Sisters.”
https://milkweed.org/book/braiding-sweetgrass

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https://www.plantsdigsoil.com/podcast/017-the-long-view-on-regeneration