

Transcript: Plant Breeding Stories Podcast

S1E7 - Laurie McKenzie



[Theme Music Plays]

Hannah Senior :

Welcome to this episode of The Plant Breeding Stories Podcast, where I talk to leading lights in plant breeding, asking what they do, what makes them tick and what fascinates them about the world of plants. I'm your host, Hannah Senior of PBS international, world leaders in pollination control. We design and produce specialist pollination bags and tents used by plant breeders and seed producers all around the world. And through this, I've been privileged to get a unique perspective on how plant breeding globally affects our diets, farming systems and the environment. I'm excited to share a little of this with you. As we meet some of the amazing people who make plant breeding their life's work.

Hannah Senior :

Today I'm talking to Laurie McKenzie, Research & Education Associate with the Organic Seed Alliance. In this episode we talk about why seed bred specifically for organic production systems is so important, we dig into why the art of plant breeding, alongside the science of course, is so critical for this discipline, and Laurie shares her enthusiasm for some truly beautiful carrots!

Hannah Senior :

Like so many of the guests we talk to, Laurie's passion and enthusiasm for her work comes through so clearly in this conversation - I hope you enjoy it.

[Theme music fades out.]

Hannah Senior:

Why don't you introduce yourself? Tell us a little bit about you.

Laurie McKenzie:

I am Laurie McKenzie and I'm the Research and Education Associate for the Pacific Northwest region here at Organic Seed Alliance. So I am a Pacific Northwest native girl. I was born and raised in Oregon, and I have always been into things that are related to the environment and being outside and environmental sustainability and adventures. I studied environmental studies and when I graduated, I had the ambition and dream to run and manage a CSA farm, which is a community supported agriculture, where you essentially buy a share and then every week you get a pickup or delivery of a box of food. And I just really liked that model of farming. And when I moved back to the Pacific Northwest and worked on a farm that did that, I realized how much work farming is and what a toll it can take just on your livelihood and your relationships and what a challenging career it is and decided that maybe that wasn't exactly what I wanted to do. I really loved the lifestyle of farming, but I didn't love how consuming it was. And that was an unanticipated and big challenge for me.

Hannah Senior:

So how did you make the jump from farming to plant breeding?

Laurie McKenzie:

While I was working on this CSA farm, I met Frank and Karen Morton who have a seed company called Wild Garden Seed and I started working with them. I really loved and appreciated their approach to things. I didn't really have any particular interest in growing seed. I liked them as people and I found them interesting, and we worked from nine to five. We've never had to start at six and end at nine, and I really appreciated that. So I got into working with them and then I really got hooked by growing seed. Also did some plant breeding and have branched out since then, this was back in the early 2000's - so almost 20 years ago.

Hannah Senior:

You told me before a little bit about the pepper breeding that went on there, just tell me a bit about that, because that was really vivid.

Laurie McKenzie([03:24](#)):

Yeah! So it was great. What I really learned from Frank that I'm super grateful for was both the art of plant breeding and just the engagement and the process and the courage and the creativity and the curiosity to take on a project. And the great example of that is the pepper project where one of the farmers at the farm where Frank grew a lot of his commercial seed at the time. She came to him and said, "Hey, I have this hybrid pepper that I really love." It was a red roasting pepper called La Perri. It was a hybrid and it was gone. She could not get seed of it anymore. It had been dropped by the seed company and she said, "Hey, Frank, can you breed something out of this?". And Frank had no experience with peppers. You had, you know, little experience with any kind of fruit seed.

Laurie McKenzie:

And he said, "Sure! I'll give it a try." And for several years he just grew it out and he kind of grouped it by what he saw. And he was very lucky as was she, that they had started with a hybrid that just had a lot of genetic diversity and had very good genetics and very good background. And so out of this red roasting pepper, Frank got red roasting peppers that were smooth, red roasting peppers that were wrinkled, ones that were long and skinny, ones that were short and fat, ones that were bell types. He also got orange peppers and yellow peppers and all these different shapes and configurations and each year he would take these fruits and he would kind of group them with like, okay, this end of the field, they're all the reds. And at this end of the fields are all the yellows. And he knew that there would be some crossing and that there would be some self pollination.

Laurie McKenzie:

So things that he wanted to keep the same, or if he liked that type, he would kind of put them farther away from other things or things that he thought might be cool if they crossed together, mixed up a little bit, they could go right next to each other. So it was really this really fun sort of engaged evolution. Frank was just working with what he saw and making the best decisions that he sort of intuitively knew to make based on his experience and what he was seeing. I think that that really formed a big part of my

foundation and interest in plant breeding, just watching that evolution happen and watching those plants show the diversity. And now I think Frank has at least a dozen, if not more, commercialized stable varieties that he has out of that one hybrid. He got very lucky, not every hybrid, de-hybridization or breeding out of a hybrid project will go that well.

Hannah Senior:

Tell me, how did you get from that sort of initial experience of “This is really interesting, I’m really engaged in this.” to working with the Organic Seed Alliance?

Laurie McKenzie:

When I was working with Frank, I started to get really excited and interested in plant breeding and seed production. I wanted to know why these things were happening and how they were happening. And so I started looking at going back to school and eventually landed a master's degree in organic plant breeding at Oregon State University.

Hannah Senior:

Mmmhmmm [Affirmative]

Laurie McKenzie:

And I had gotten to know some of the folks who worked at Organic Seed Alliance when I was working with Frank because they are friends and collaborators. And Frank was actually on the board of Organic Seed Alliance. So I knew of the organization and through my graduate work, I got to know more of the organization and more people. And particularly this woman, Michaela Coley, who is now my boss, I was very enamored with her. She's a very, just poised and powerful and intelligent person. And I just was a little starry eyed.

Laurie McKenzie:

And as I finished my master's degree, I really didn't know what my ideal job was. I could have told you, I want to work with plant breeders. I'm not sure I want to be a plant breeder. I don't want to be in the lab. I want to be in the field, actually working with, and touching plants. I want to be able to do some sort of teaching, but I don't want to be in a classroom. So I just, I didn't know what that job was. So shortly after that, I was sort of job hunting. I had posted on social media. I had gotten an interview and I was going to fly out to New York for an extension position with Cornell University. And I believe I'm remembering right that Michaela saw that post and called me and said, "Hey, I'd really love it if you could come work with OSA, I don't really have a position, but I could offer you a six month internship." I knew that OSA would be a good fit for me. And, um, I didn't really want to move to New York. I wanted to stay close to home. So it worked out.

Hannah Senior:

Tell me, what is the organic seed Alliance? How does it work?

Laurie McKenzie:

Great question. Organic Seed Alliance is an organization that works on three main areas. We're a nonprofit organization and we work on advocacy, education and research. I would say our overarching goal is really to help farmers and growers be successful and to see more organic and sustainable seed produced in the world. And then we also collaborate with a lot of universities, public breeders, other organizations on research. So we work a lot with Cornell University, Purdue University in Indiana, University of Wisconsin, Madison. Washington State University, Oregon State University. And those are universities that have pretty solid, either organic or sustainably focused programs.

Hannah Senior:

And you're breeding crops specifically to be grown in organic systems. Does that sit under the research element?

Laurie McKenzie:

Yeah. It sits under both the research and the education elements of the Organic Seed Alliance. The education element and go to a lot of conferences and present both on the research that we do and also on plant breeding and how to grow seed and how to clean and store and produce quality, high yielding, robust seed.

Hannah Senior:

The thing I'm itching to ask you, is the question that I asked myself when you presented at the National Association of Plant Breeding meeting a few years back, which is why do you need breeding specifically for the organic system?

Laurie McKenzie:

Yeah!

Hannah Senior:

Because at the time I was like "Oh! I've never thought about that before." So, that would be a good place to dig things.

Laurie McKenzie:

Yeah, well, there's a lot of layers to that, I would say. Genetics are really important and having the appropriate genetics for the farming system and the challenges that you're facing in your production system is key to your success. In the United States, as I assume is probably true in much of the world, the vast majority of our agriculture is conventional and organic is a growing and burgeoning fraction of that, but it's still relatively small. But the main, one of the big differences that I see is that conventional systems have all of these chemical and synthetic options for fertility and crop protection, pest protection that you don't have available in organic systems. And organic systems then tend to use a wide array of options to meet those fertility and crop and pest challenge issues. So, you know, some farms use animals and manure and compost. And what that does is create a really wide breadth of diversity across all organic farms.

Laurie McKenzie:

Whereas conventional systems tend to be more similar farm to farm in comparison to organic. So you're dealing with kind of a wider range. I think of, environments and challenges and the system in organic sustainable resilient agriculture tends to be more biologically complex because instead of providing the needs for nutrition and protection with chemicals and inputs you are relying on this natural ecosystem to provide those services to the plants and therefore the plants need to use sort of different amounts of their energy or different amounts of their genetics to be successful.

Hannah Senior:

Can you give me an example?

Laurie McKenzie:

One example that I think really shows that very clearly is Lori Hoagland. Who's a researcher at Purdue University. I saw her present once on some research about soybeans and soybean breeding in the modern era, under conventional conditions where you have a lot of synthetic nitrogen available.

Laurie McKenzie:

So those modern soybean varieties, because they have been provided all this nitrogen, they actually haven't needed to be putting energy into attracting, uh, microorganisms that distill and provide nitrogen in the soil. So, you know, why put energy into something you don't need is the theory. Whereas in organic systems, you're not providing all of that synthetic easily available, you know, just suck it right up nitrogen. So those plants need to be able to do that for themselves. So they need to be able to make these associations with the mycorrhiza that provide them with the nitrogen. So our breeding and the environment that we do our breeding in does shape the genetics and the ability of these plants to perform in these different systems.

Hannah Senior:

So if you're breeding for this range of environments in the organic system, does that mean you need to do a lot more trials to establish whether a variety is going to thrive in order to do organic breedings? Is that an example of a difference between an organic breeding program and a conventional one.

Laurie McKenzie:

Um, my instinct is to say "Yes, but...". What you're breeding for are resilient, capable plants, and that those plants are capable of accessing nutrients. Uptaking them efficiently being able to withstand both biotic and antibiotic stressors. And then if you have a strong, resilient plant, it is more likely to be able to do well over a range of environments. That said, yeah, when you are trying to create a variety that is broadly adapted to a wide range of differences and, you know, not all those differences are huge. Certainly a wider trialing that is going to give you more confidence and more information that, that, that variety, that crop, is capable of producing well across a wide range. And I think that's honestly in conventional and organic systems, now a lot of what we talk about in a lot of what we prioritize in our breeding work and our education work are certainly the same things that are prioritized in conventional breeding.

Laurie McKenzie:

You know, everybody wants productivity, yield, disease, resistance, pest resistance, drought tolerance, salt tolerance, those things are always going to be important regardless of what kind of system you're breeding for. We tend to think of conventional and organic as being at odds with each other or, you know, kind of set against each other. And I think there's actually a lot of compliment territory there. You know, we're, we're all trying to feed people. We're all trying to do good work. And in my view, the more collaboration and kind of the more we can learn from each other, the better we're all going to be.

[Theme music fades up]

Hannah Senior:

You're listening to Plant Breeding Stories, brought to you by PBS International, world leaders in pollination control. We're exploring the personal stories behind people who have dedicated their careers to plant breeding, helping us to more productive plants, greater food security and more sustainable agriculture. Now, back to the podcast.

[Theme music fades out]

Hannah Senior:

Are there any differences in the way that you go about the breeding in an organic program compared to a conventional one. You know, if you sort of described a lot of the breeding objectives are very consistent, albeit, the environment in which those varieties are going to be grown has differences, but the way you go about it, are there differences?

Laurie McKenzie:

The main difference between conventional and certainly certified organic breeding work are the techniques that you can use. In certified organic breeding you are not allowed to use any genetic engineering. And there are discussions about what that means. You know, sometimes it's very clear which tools and techniques fit under this sort of ethos and system of organic and there are definitely some gray areas and there are definitely varieties out there that have been bred and created with techniques that are not as clearly...or are debatably genetic engineering. You know, kind of the general line in the sand is, could this happen naturally? Is this a technique that is respecting natural reproductive barriers? If we weren't here, is this a combination that could somehow get together and produce itself with no human intervention? Uh, that's kind of a first level line in sand, but then of course it does get much more nuanced as you dig down into a bunch of the tools.

Laurie McKenzie:

But I would say that's the biggest difference. Both conventional and organic breeders are going to be using some combination of field-based techniques and tools and observations and lab based work. Molecular markers is a great example. That's used

both in organic breeding and conventional breeding. It's a great way to assess disease and important resistance factors. At Organic Seed Alliance we don't have any of our own lab equipment or lab breeding work. We do all of our breeding work as field-based work. It's referred to often as "classical breeding", where essentially you're going out in the field and you're looking at the plants and you're choosing ones that you like and taking out ones that you don't and moving the genetics forward with the plants that you've selected. And there's a number of different approaches that we take to do that.

Hannah Senior:

What crops do you work with?

Laurie McKenzie:

I am really lucky. I get to work with a lot of different crops. Some of that is based on the grant work that we do and what our grant partners are experts at. And some of that is based on what farmers want and need and have come and asked us to do or asked for collaboration. Currently, I'm working on cabbage purple sprouting broccoli, carrots, sweetcorn, dried corn, swiss chard, onions, spinach, and a little bit on tomatoes.

Hannah Senior:

That is quite a diversity of crops.

Laurie McKenzie:

Yeah and I'm sure I'm forgetting something.

Hannah Senior:

And you said it was, it was dictated by the research grants and the needs of farmers. So how do the seeds, or the varieties, that you produce get into the hands of those farmers?

Laurie McKenzie:

Mostly it's through seed companies. We don't actually produce any commercial seed. We don't sell any seed to anyone directly. You do commercial release with a number of seed companies in the US and every year we send out a list to the seed companies that are in our database, essentially, and say, "These are the varieties, and these are the seeds that we have available this year for you to try and take a look at." And then they come back to us and say, "Hey, we're really interested in X, Y, and Z. We would really like to commercialize this one." And then we kind of proceed from there.

Hannah Senior:

And how do their needs and preferences get fed back into the programs that you're working on?

Laurie McKenzie:

One of the ways we do that every five years, we do a big survey and the big report called "The State of Organic Seed" where we survey thousands of farmers across the nation and do listening sessions and gather a bunch of data about how organic seed is being used and what organic farmers need for organic seed. And, and that informs a lot of our work. We also do listening sessions and have, you know, regular meetings with our regional groups of farmers in areas where we have staff and ask them and send out surveys about what crops do you feel like need attention, and what are the qualities and what are the areas that you see a lack in, or what do you want improved.

Hannah Senior:

And the range of crops that you mentioned, there's a lot of vegetable crops in there, sweetcorn and peppers and things like that. Does that mean that when you're doing the work, you're thinking about the sort of sensory aspects? Previously, you mentioned a list of breeding targets in terms of yield and disease resistance and drought resistance and all those things. But are you also putting more focus on the sensory properties, the

appearance, or the flavor, and so on, and the texture of the, of the crops that you're breeding. And does that feed through that cycle of distribution as well?

Laurie McKenzie:

It's not a conventional versus organic difference, but maybe a large industrial versus smaller medium scale. And that's what we tend to breed towards. Shelf life, shipability, those things take less of a priority, and we can put a higher priority on flavor, culinary quality, texture, more of the eating experience.

Hannah Senior:

Ah I see, that's really interesting.

Laurie McKenzie:

A bit of a side note, as we get more into assessing culinary quality and including that in our breeding work, we learn that there are a lot of different ways to use these foods that we work. Carrots is one of my favorites and it's also in the forefront of my mind, because I'm about to go to a winter nursery trip for harvest, which is one of my favorite trips of the year. And especially with the colored carrots, you know, there are a lot of cultural uses of colored carrots that are just really widely variable and different

Hannah Senior:

Oh right? Like what?

Laurie McKenzie:

Well, we have a collaborator who's sort of a new collaborator from the University of California - Davis, I believe, Jaspreet Sidhu. And she's from India. And she has a lot of just personal, family experience with red carrots, and red carrots and Indian cuisine. And carrots in Indian cuisine are often cooked and they're used in a lot of desserts and they're just, they're used differently than the way we use carrots in this country. In the US we tend to use carrots as fresh raw, we do cook them, but primarily they tend to be

raw in salads. And there's just a lot more you can do with them. And, and with the colored carrots, they have just gotten less breeding time and attention because a lot of the breeding expertise in our country has gone towards orange carrots. Cause that's what we primarily eat.

Laurie McKenzie:

So the colored carrots tend to have different flavor profiles than the orange carrots. Orange carrots, I would say, have generally been bred to be very sweet and very crisp. And the red carrots and the purple carrots in particular tend to be kind of Piney, not as crisp, denser in texture, more variable. But those could actually be really good qualities for cooking and for roasting and those flavor profiles change when you cook them in various different ways. So it's a long way of saying there's also a lot of education opportunities to teach people new and different ways to think about flavor profiles and culinary uses and cooking versus not cooking. So, I think that's true of a lot of crops and I think there's really a lot of opportunity and energy there. And I think people, especially now in COVID times when you're home more, you're trying not to go out to the store as much. Maybe people are a little more creative, they're online a lot more. So there's this opportunity to really, I don't know, dig a little deeper into some new and creative ways to prepare our food.

Hannah Senior:

Different ways of doing things.

Laurie McKenzie:

Yeah.

Hannah Senior:

You talked earlier about complementary territory between conventional and organic agriculture. And although I would argue there is an increasing convergence between these two systems, I think there is often a temptation to put them at odds with each

other. And yet I'm struck that some of the things that you've talked about, perhaps the underlying ethos, does sound rather different to more conventional breeding programmes. Do you see this as a difference of emphasis or something more fundamental?

Laurie McKenzie:

Yeah, I do think that it's a different approach to ultimately the same goal. I feel like I've heard or encountered a lot in the broader scope of things that people who are conventionally focused say organic will never feed the world. You know, the yields aren't anywhere near what we would need to feed the world. I don't think we want any one system to be the only way that we grow and produce food. I think we need a diversity of genetics, of approaches, of systems, understandings, you know. Fundamentally diversity is what keeps everything on our planet alive and thriving. Right? I do want to believe, and I do believe, that anyone who is breeding and growing food and seeds is doing a good thing. They're trying to feed people and do it in a way that keeps the environment and people thriving. And I agree, I think that setting them at odds just really sets all of us back. If we can find ways to find those points of convergence and find those points of connection that we can learn from each other and we can share it.

Laurie McKenzie:

I think another highlight that's pretty distinct between the conventional and organic worlds, if you will, is intellectual property protection. You see a lot more restrictive intellectual property protection in commodity crops. I don't know, in the conventional world, what kind of discussions are going on around intellectual property, but there are a lot of discussions, at least in my world, the organic world, there are discussions about what's appropriate. Intellectual property production in and of itself is not a bad thing, right. If you breed a variety that takes a lot of time and a lot of resources and a lot of energy, and you deserve to have some sort of protection that allows you to recoup that and, and to make a living off of that. And at the same time, I think that us at the Organic Seed Alliance, and also a lot of the discussions that I hear in the broader organic world, is "how do we do this in a way that's ethical and still provide the opportunity for farmers

and breeders to share and collaborate” because really sharing genetics, being able to make crosses and make new selections. That's how we create new things and how we move forward with both things that are new and inspiring and things that are new to meet new challenges.

Laurie McKenzie:

And the more that those genetics get tied up and restricted, and the less we can do that, the harder it's going to be for all of us, that's where I see the biggest sticking point. There's a lot more sort of trade secrets, intellectual property protection and less transparency, I think, in the conventional world compared to the organic world.

Hannah Senior:

That also begs the question for me about what you use as your starting material? I mean, where do you get the germplasm from to even begin the journey? Given there is a lot of intellectual property protection around plant varieties and given a lot of the existing advanced varieties were developed for a conventional system - what do you use to start a breeding program in organic?

Laurie McKenzie:

We are really lucky to have a lot of collaborators. And I would say a lot of the material for the projects that we're currently working on comes from university and public breeding programs. Some of the material I inherited from predecessors who brought it with them. We also sometimes access the GRIN system, which in the United States is that public germplasm repository system. We actually have a trial in the field right now, some cabbage that came from the French seed bank. So there's a lot of interesting material there. Those are public collections that are not always, or necessarily modern varieties. Some of them are landraces. Some of them are pretty wild. So it's really important to do some variety trialing and looking at them. So it's widely variable.

Hannah Senior:

Mmmmhhhmm [Affirmative] No one answer

Laurie McKenzie:

Yeah. No one answer.

Hannah Senior:

Tell me, what are you most proud of so far in your career

Laurie McKenzie:

Crop wise the thing that I'm most proud of are the simply the carrots that we are working with. Several years ago, I got to go to this winter nursery in Southern California with Dr. Phil Simon. And I got to see this breadth of incredible, amazing carrot material that is unlike anything I've ever seen. You know, where to start. We're seeing more colored carrots on the market than we were 10 years ago, for sure. But he has material that is yellow and pink and purple and purple, yellow and purple and yellow with purple cores. And it's incredibly beautiful and also tastes good. And I really got inspired to dig in on that and get some more of that material into our projects, into our trials, into our breeding work. And we have one, it's still pretty early generation population, but we've sent it out to several seed companies who are really excited about it.

Hannah Senior:

Does it have a name?

Laurie McKenzie:

Right now it's just called PYP populations - that stands for purple yellow purple. [They both laugh] It does not have a name yet. But it just, it produces some really beautiful carrots that tastes good. And I speak not only to the palette, but to the imagination. And it's kind of like romanesco cauliflower comes to mind, you know, it's just, it's so pretty. You almost don't want to eat it. Sometimes Swiss chard is like that, the stems of chard can just be so vibrantly beautiful. So I'm really excited that I think that that will be out in the marketplace soon. Maybe even sooner than I was anticipating.

Hannah Senior:

That's really exciting. You'll have to send me a photograph afterwards.

Laurie McKenzie:

I have hundreds.

Hannah Senior:

Oh! [Chuckling]

Laurie McKenzie:

The first year I went down to the research station. That team, doctor Simon's team, were all just giggling at me because I would cut open these carrots and literally just laugh out loud. And just say, "Oh my gosh! Oh my gosh! It's so beautiful!". I had 600 pictures the first day.

[They both laugh]

Hannah Senior:

That's really quite, quite enthusiastic.

Laurie McKenzie:

Yes my enthusiasm was a little off the charts. And, and six years later, we're about to go back next week. I still feel that way. They're astonishing to me. And I just, I can't wait to share that more broadly with consumers at large, I guess.

Hannah Senior:

Well, on that note, it feels like a good place to wrap things up. So thank you very much for your time today. Lori McKenzie of the Organic Seed Alliance.

Laurie McKenzie:

You're most welcome. Thank you so much, Hannah. It's been an absolute pleasure chatting with you.

[Theme music fades up]

Hannah Senior:

You've been listening to Plant Breeding Stories by PBS International and I'm your host, Hannah Senior. Plant breeding is a pretty specialist podcast topic, which can make it difficult for people who share our interest in this kind of thing to find it. So if you enjoyed the podcast, recommend it to your friends and colleagues, and please help others in the plant science community to find it by rating this episode and subscribing to the series. I'd love to hear from you if you would like to suggest people to interview. You can contact me on Twitter @PBSInt or on Instagram at @PBS_Int. Until next time, stay well.

[Music fades out]