**Transcript: Plant Breeding Stories Podcast**
**S2E2 Plant Breeding Stories - Rita Mumm**

[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 have with me Professor Rita Mumm. She is a Professor Emerita at the University of Illinois, presently serving as Education and Training Lead for the USA soybean innovation lab, as well as director of the UC Davis African Plant Breeding Academy and Principal at GeneMax Services. So you can already see that there is a lot for us to talk about today, and I'm really excited to be chatting with Professor Mumm.

**Hannah Senior:** So Rita, would you like to begin by just telling us a little bit about yourself, maybe where you grew up or whether you had an interest in plants from an early age, just, just help us set the scene.

**Rita Mumm:** Well, thank you for inviting me today. I appreciate it, Hannah. So I grew up in the city of Chicago in Illinois and the US. Kind of an unlikely place for the beginnings of a plant breeder. But my dad introduced me to gardening as a child, in fact, being one of six kids, I was the only one that had interest in raising plants, but the tomatoes from

our backyard were so good. And I had the chance as an adult, as a young wife and mother living in the outskirts of the Chicago metro area to start a garden for my own family. And I was able to rent one acre of ground right next to my house and decided to start organic gardening and producing all of the vegetables for my family for the whole year. Kind of ambitious. You could tell that I needed something to keep me busy, right at home with three small kids. And so I took out a subscription to organic gardening, had a farmer come down and turn over that acre of ground and ordered away to Burpee Seeds, to get all kinds of vegetables to grow in the garden. And it was an amazing summer.

**Hannah Senior:** And already I can see that you are no stranger to hard work because taking on an acre of land to grow vegetables whilst are having…. did you say three small children...? [It] Is a lot of work by anybody's standards!

**Rita Mumm:** No, it was really a great opportunity for not only myself, but for my family, because my kids were just as involved in the garden as I was. Planting, harvesting, preparing the food to either eat directly or freeze or can. So they got a really good education about how food is produced too.

**Hannah Senior:** I understand it was because of your garden that you did a little plant breeding before you really knew that plant breeding could be a career?

**Rita Mumm:** Yes! With my organic garden, I would plant one-third of the acre every year to peas because peas fixed nitrogen in the soil. And in Illinois, the peas are done in June so it allows for a double crop to take place. And so the first year, one third of an acre of bush peas came in all in two days [Hannah laughs] I was ill prepared for this bountiful harvest and had to recruit all my family members and as many of my friends and neighbors as would tolerate me and everyone was picking peas, shelling peas, helping me to freeze peas. And so I realized that I wasn't going to be able to rely on people that same way every year, I'd better get my act together and split that pea harvest.

**Rita Mumm:** So I ordered a later variety of peas, but unfortunately that later variety was too late for Illinois because as soon as it gets warm in June, the pea vines dry up. So I needed, actually, a variety that was intermediate. The catalog didn't offer that. I decided to go to the library and figure out how to make a cross between the later pea variety and the earlier pea variety to try and get something intermediate. My sister thought I had completely gone geek in going to the library to figure out how to make a cross between plants! But it really got me interested in the fact that genetically you can actually make crosses to modify and create new varieties.

**Hannah Senior:** And how did that experience awaken you to the idea of plant breeding? How did getting hands on and growing your own food make you think about how those varieties came to be?

**Rita Mumm:** It made me appreciate in a way that I hadn't before how important and central nutritious food is to every family, to every person. And I was really glad to be able to deliver that to my family. So when I had a chance to go to college, I qualified for a scholarship that I decided to pursue as a single parent. And when I started school, I asked them what they were noted for. And one of the things they were noted for is agriculture. And when I heard about the jobs that were available in agri-business and agri-research with the AS level of training, BS level, master's level, PhD level, I thought all the jobs sounded very interesting. And one particularly stuck out to me, and that was PhD plant breeder. And learning that these were the people that derive the improved varieties, and they were the people that created the varieties that were available to me in the Burpee catalog and providing all different kinds of varieties that fit certain niches.

**Hannah Senior:** You can immediately see the benefit when you've been in that situation.

**Rita Mumm:** Absolutely!

**Hannah Senior:** I'm going to fast forward a bit. You worked your way to a PhD in plant breeding and after that your studies took you to a job at DeKalb Genetics. Tell me how that came about because when you joined the company it was a really interesting moment in time for plant breeding wasn't it?

**Rita Mumm:** It was. I had the opportunity to work with Dr. John Dudley doing a project related to use of molecular markers, which were just on the horizon as a new technology that might have application to plant breeding. It was really an exciting time and also put me in a really good position when I began looking for a job. And DeKalb Genetics offered me a position having to do with all things biotech. So molecular markers, transgenic product development. DeKalb Genetics was just getting that area so I think they thought a new graduate and somebody out of John Dudley's program would probably be a good bet. And so I went to work for them and immediately I could see that there were some new value added product traits in the pipeline. So herbicide tolerance for corn, insect resistance for corn, and when I asked my boss "What are we going to do with these things besides back cross them and move these traits into elite lines?" And he said, "Rita, that's what we hired you to find out!" And so he said, "Go figure it out".

**Hannah Senior:** [Laughing] No small task!

[They both laugh]

**Rita Mumm:** It was a really exciting time. I had a great team working with me. We designed a testing program that enabled evaluation of different sources of value added traits. And we were able to get to market four value added traits in four years.

**Hannah Senior:** It's incredible.

**Rita Mumm:** Yeah, it was really...it was really exciting and very fun and moved DeKalb up on the visibility scale quite a bit. So much so that they were purchased by Monsanto Corporation.

**Hannah Senior:** It must have been a fascinating landscape with the technology and regulatory framework and commercial landscape all developing at the same time. How did that influence you?

**Rita Mumm:** It was a very dynamic landscape. So with the first value added traits coming to market, there was no formula on how do we evaluate these for safety, although USDA, EPA, because some of these were involving control of pests, like weeds, like insects, and then FDA, all need to weigh in on new types of products like this that are hitting the food chain. And so it was very interesting at DeKalb, which was a small family owned business that had no experience with regulatory compliance. We were a seed company. And so it was very interesting to see how people across the company stepped up to the plate, developed these regulatory data packages to show the safety of the products and comply with all the the testing necessary to show that the products were safe, they were solving a problem, and actually they were a good option for the particular scenarios for which they were designed; controlling important insect pests in corn and giving farmers good environmentally friendly options for herbicides.

**Hannah Senior:** And how did you know what the farmers were looking for or what would be a value?

**Rita Mumm:** Well, we used to have field days every summer and farmers would come in from all across the county and it would be a time of exchange where the farmers would actually share what they feel they needed on their farms to be productive, to be profitable. And we would gather that feedback and incorporate it into product targets at DeKalb. European corn borer, for example, was a devastating pest. And it wasn't even realized how devastating it was until there were options to control it. So it was really a very much of a give and take with the farmers, really pulling to market these traits that we were developing at the same time as “Roundup Ready” corn was being developed and corn that was resistant to glufosinate herbicide, Liberty herbicide for example,

farmers were being moved away from herbicides, like Atrazine that would get into the groundwater and other herbicides that would have a very long half-life in the soil. So they were very attracted to these environmentally friendly herbicides that also offered a lot more control over application.

**Hannah Senior:** Mmhhmm [affirmative]

**Rita Mumm:** So these herbicides could be applied post planting rather than pre-planting.

**Hannah Senior:** Right. You had a very close dialogue with the farmers about the problems they were facing, what they were looking for, and that helped to guide the traits that you were able to develop.

**Rita Mumm:** Absolutely.

**Hannah Senior:** And then you took a big step after that and went out on your own if I remember rightly so tell me, tell me a little bit about that. You know, that's a big change. What did you set out in doing that? You know, what were your objectives and how did that feel?

**Rita Mumm:** Yeah, well, when DeKalb Genetics was purchased by Monsanto, I decided that it was a good time to branch out on my own. So with the experience in transgenic product development, and also at DeKalb I had led a group focused on genomic applications of molecular markers in plant breeding. And that group was involved with not only creating the genotypic data, but also the management of data that were coming from the lab, from the field, and bringing those data together for analysis association with phenotype and genotype. And there were a lot of statistics involved. There was a lot of movement on that front, as computing power was growing in parallel plant breeders were actually taking advantage of those advances in computing power and in statistical methodologies to be able to make those associations. And so I could see a

need for that, not only in corn where we had practiced it at DeKalb, but I could see that it had utility across all crops in agriculture, actually. And so branching out and establishing GeneMax Services was the next step for me in 1999.

**Hannah Senior:** And that was, I think, you sort of intimated this, but that was going beyond row crops and then reaching out into things like vegetables as well was it?

**Rita Mumm:** Yeah, I had the good fortune to work with small companies, medium companies, large companies and, of course, different goals, different commercial targets with each. So I had a chance to branch out and work in actually quite a few crops.

**Hannah Senior:** We've already established that you're no strangers to hard work, but was entrepreneurship something you had identified as a career goal or did it just make sense at the time?

**Rita Mumm:** Well that's a good question. It seemed like the innovation that was required to put these new technologies to work was really prime for entrepreneurship. And I really enjoy actually working with the plant breeders and strategizing. So rather than an administrative role where it's all coordination, I actually like to be involved in doing the work. And so it was a great middle of the road kind of thing, and also very challenging because as you move across different crops and different companies, of course there's different targets and different needs. And so it really was a challenge in terms of problem solving. Which I just happened to love. [Rita laughs]

[Theme music plays]

**Hannah Senior:** You're listening to plant rating stories brought to you by PBS international world leaders in pollination control. We're exploring the personal stories behind people. Who've 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]

**Hannah Senior:** Let's expand on problem-solving because that's a really important piece of the way you approach your work. So tell me a little bit about how you think about problem solving and how did that come to be a key skill of yours?

**Rita Mumm:** To me, the fact that you're able to take science, scientific knowledge and apply it to a problem and solve that problem is exciting and I think it's fun. And you're also… It appeals to that efficiency side of me, where you're actually utilizing the information for some constructive thing. [They both laugh] It just kind of all comes together for me with thinking of plant breeding and crop improvement in general, as problem-solving.

**Hannah Senior:** It's so interesting to hear about how all these pieces came together and it was a really transformative time in plant breeding, in agriculture more generally. But down the line, there was pushback. And I think that was probably imported to the U.S. from Europe, although it may also have developed within the U.S. So I'm curious how that impacted you. You know, this has been something you've dedicated huge amounts of time and energy to developing these new varieties using biotechnology. And then there was a lot of pushback from various quarters. So could you tell me a little bit about how that affected you and what your perspective is on those consumer and environmental concerns?

**Rita Mumm:** Yeah. I was actually very surprised when in the late 1990s, there was pushback from the public on some of these, what I felt were great problem solving ideas like BT corn for example. So BT corn takes a gene from soil bacteria, *Bacillus Thuringiensis,* and inserts that into the corn genome where the BT protein is expressed. And when a lepidopteran Caterpillar starts to feed on the plant it ingests this protein that

binds to its stomach wall and creates what I call a fatal case of indigestion. To me this is genius! Because there's no insecticide involved. You know and most insecticides, they work on the nervous system of the insect, and they have a mode of action in mammals, including humans, and can work on our nervous systems as well. Whereas BT has absolutely no mode of action. No mode of action whatsoever in human beings, in any mammals, in any birds. Actually it only affects lepidopteran species in the Caterpillar stage. So it's, it's so specific and everything that's happening there, the mode of action is taking place in that Caterpillar's stomach, you know, it's not affecting, the broader biosphere.

**Rita Mumm:** And so to me, this was a great idea, a brilliant idea to solve this problem of yield being robbed by European Corn Borer from the farmer's field. And so with the pushback from the public thinking that GM traits are somehow unhealthy, they're dangerous, they're some kind of invention like Frankenstein would create. It was astonishing to me because even though I had started out as an organic gardener with my family garden, you know, it was easy for me to see that this was a solution that was healthy for humans, healthy for the environment, healthy for the farmer. And so it was a little bit of a surprise to me that people didn't consider all the facts. And so it really brought to my attention and also to the attention of many of us that were in trait development in plant breeding, that we had not done a good job with preparing the public. You know, we had interfaced with the farmer who was very keen to get these new products in their hands and experience the benefits of them. But we really didn't so much look to the public as to what their thoughts would be about this. And I think whether it was the influence of Europe, whether it was just emotionalism about food, not quite sure, but it really brought to light the importance of having trusted voices.

**Hannah Senior:** Mmhhmm [affirmative]

**Rita Mumm:** And I mean, this is just one of a zillion different scientific issues in which the public is not necessarily well-informed, but who do they look to to be their trusted voice?

**Hannah Senior:** And we've seen that a lot this last 12 months, haven't we, with the COVID pandemic, you know, who is the trusted voice. And yet that potentially opens the door to a greater level of understanding of biotechnology because it's been used to produce vaccines. Do you think that's an opportunity?

**Rita Mumm:** I think it's an opportunity, but I've also seen some stumbling on this front with COVID. People will say follow the science, but then they don't follow the science!

**Hannah Senior:** Mmhhmm [affirmative]

**Rita Mumm:** And I think sometimes it's a matter of scientists, like myself, are very precise about everything, and we're very careful about how we word things. Whereas, you know, a lay person reporter comes along and condenses a whole conversation into a few lines, and it's not exactly scientifically right anymore. And so I think there, I think as a society, we really need to consider how to inform the public so that they feel comfortable with scientific advances, whether that's on the medical front, whether that's on the food front. I mean, these are all important issues that affect every one of our daily lives.

**Hannah Senior:** So you had this very successful career in the private sector but then you moved into academia can you tell me how that came about?

**Rita Mumm:** Yeah. Thank you. The University of Illinois, my Alma mater reached out to me in 2007 because they were quite concerned about the dwindling number of students that were applying to plant breeding programs and pursuing plant breeding as a career. Not just at the University of Illinois, but this was actually a trend across the United States and across Europe as well.

**Hannah Senior:** Mmhhmm [affirmative]

**Rita Mumm:** And those two continents being the primary trainers of plant breeders around the world. And so in exploring the reasons for the diminishing number of students entering these programs, interested in these programs. I knew about the shortage of plant breeders, but I didn't really realize its significance or think too much about its impact on the future. But my analysis showed that half of the plant breeders in the United States were in my age bracket, which at the time was 10 to 15 years away from retirement. And yet there isn't that next generation coming in, in sufficient numbers to take on the role, also deal with the new technologies and put them into play. So when I proposed some solutions to this, to the university of Illinois, they asked me to come on board and establish the Illinois plant breeding center at the university to raise the visibility of plant breeding as a career. And so I couldn't say no to my Alma mater and just seeing the importance of the next generation of plant breeders I decided to accept that challenge, [and] join the faculty. It was a very different working environment for me. I had always been in the private sector so this was a completely new arena for me, but a rewarding one. And I could tap the network that I had developed in private industry to draw companies into the training of the next generation of plant breeders. Because almost all the students that graduated at the university of Illinois go to work for the private sector. It was easy to show that they needed to be involved in the training because they would be benefiting directly.

**Hannah Senior: Y**ou've done a huge amount of work to make plant breeding a more attractive career for young people that you've just described. But I'm also curious, do you think there've been any changes in the priorities and expectations of young people coming through education now that has also made it more attractive? I'm thinking about, you know, how a lot of people these days are more driven by a sense of mission or a sense of purpose. Do you think that's having an impact in people choosing to do plant breeding in larger numbers than 15 years ago?

**Rita Mumm:** Most definitely. Just in the U.S. alone there's 50,000 students graduating every year with BS degrees in biology. I think personally there's great attraction to being able to apply math and science, to something as important as food supply for mankind and showing students, BS graduates in biology. I mean, they've been well-trained in

science and math. You can teach someone agriculture. It's hard at the graduate level to teach someone the math and science background that they really need to know in order to be able to apply the new technologies that are coming through now, but it is very possible to train a talented person in aspects of agriculture and agronomy. And so trying to draw those people in was not only a matter of showing that here's a job where you can actually apply the theory and the facts that you've learned, but for many of these people it was the first time they had heard of the job of plant breeder. So just raising the visibility that here's a career in science, that's very important. And you know, one could say at the foundation of the food supply.

**Hannah Senior:** That's a really pithy explanation of why it's such an awesome area! Why we really need to raise the profile of plant breeding. Okay. So I would like to now talk about the African Plant Breeding Academy, of which you're a director and it is fascinating. So can you tell me about how that organization got started and how you came to be involved in it?

**Rita Mumm:** Yes. After five years with the Illinois plant breeding center and we had achieved all of our goals, tripling the number of plant breeding students, attracting companies to collaborate in research so that students were working on real life problems in the problem solving kind of a mode. And so I decided to step down from that role of directing the Illinois Plant Breeding Center. And when I did UC Davis reached out to me and talked about the possibility of starting a professional development program for scientists in Africa as a part of the African orphaned crop consortium. So the African orphan crop consortium is focused on raising nutritional security in Africa. So not just food security, but nutritional security, recognizing that nutrition is a really important part of food security. It's not enough to just simply have the calories.

**Hannah Senior:** You're using the term "orphan crop" there. Can you define what you mean by that in this context?

**Rita Mumm:** An orphaned crop in general is a crop that is grown, used perhaps on family farms in a particular area, but for which there's been almost no plant breeding, and no scientific study, genetically of the crop. The African Orphan Crop Consortium surveyed across the continent of Africa to identify 101 crops that could significantly impact nutritional security and economic growth in Africa.

**Hannah Senior:** Could you give an example?

**Rita Mumm:** Yeah. Some of these 101 crops I had to Google. [They both laugh] I had not ever heard of them. Ethiopian Mustard for example. Enset, which is similar to plantain. Breadfruit, jackfruit, Maringa, uh, amaranth, which we consider in the United States to be a weed.

**Hannah Senior:** Okay!

[They both laugh]

**Hannah Senior:** That's fascinating, isn't it? 'Cause you were already talking about an interesting challenge because these are crops that aren't well characterized by science and haven't had a lot of plant breeding. So, what does the Academy do in relation to these crops and the plant breeders who participate in the programs and, and is it focused in a particular part of Africa?

Speaker 2: So with these 101 crops, one goal is to DNA sequence and make available that sequence for scientists that are working on crop improvement for that crop.

**Hannah Senior:** Mmhhmm [affirmative]

**Rita Mumm:** Realizing that if the DNA sequence is going to be important in developing improved varieties, plant breeders really need to understand a know-how and have the skills and tools to apply that information in their breeding programs. And so the African

Orphan Crop Consortium sponsors The African Plant Breeding Academy that basically trains scientists from all across Africa. We try to touch as many countries on the continent as we can. So far 29 countries have had a scientist represented in one of the cohorts.

**Hannah Senior:** Wow.

**Rita Mumm:** We have 112 scientists who have completely finished the course. 40 are now beginning cohort five. So of these 150 scientists, nearly 40% are women, almost 90% are PhDs.

**Hannah Senior:** Mmhhmm [affirmative]

**Rita Mumm:** So these are people that have tremendous influence. Most of them are from national programs in their countries. So they're working hard to produce improved varieties for the farmers and consumers in their country.

**Hannah Senior:** In general terms how are the needs of farmers and plant breeders in Africa different from those in higher income continents like North America or Europe? I imagine it's very different?

**Rita Mumm:** Absolutely. And the markets are very different. So when the stakeholders in the value chain really need to be considered for their needs. So for example, in Africa, even a crop like maize might not be machine harvested, right? It might be hand harvested, it might be hand planted. Perhaps it would be best to plant it before the rainy seasons and then harvest it when the rainy season stops. So obviously, plant breeders are really gearing the development of improved varieties to what their farmers, their consumers, their stakeholders need. And that can be really different than the way that maize breeding programs operate for the United States where it's big farms, not the one hectare, two hectare farms in Africa.

**Hannah Senior:** And am I right in thinking that it's probably... the needs are quite different even across the continent, you know, different locations, even within a country, there's probably quite a wide diversity of needs.

**Rita Mumm:** There is a wide diversity of needs and it's also... the African continent is geographically really diverse. Even within a country, altitude, right? You're going to have a need for different varieties for high altitude versus low altitude.

**Hannah Senior:** Mmhhmm [affirmative]

**Rita Mumm:** Rainy season versus dry season. And so all of these things are very important and a plant breeder would take considerable notice of these things and incorporate them into him or hers product targets. But one thing that we see at the African Plant Breeding Academy is that when these scientists come together from all different countries, oftentimes they are the only scientists working to improve their crop in their country. So when they come together, now they're meeting with another person that is, you know, working on cashew in their country. And so they can start to exchange ideas about ways to improve their plant breeding programs. And there's as much learning that happens from each other, as from instructors in the course. And the dynamic with the collaborations that develop because of the Academy is just amazing. What's the alumns have accomplished through the collaboration and networks of the people they've met at the Academy

**Hannah Senior:** Is there anything that you're most proud of so far?

**Rita Mumm:** I'm proud of contributions that I've made to more bountiful and higher quality food. I'm proud of the public service aspects of my career, you know, particularly serving as president of an NAPB, the National Association of Plant Breeders. Serving as trustee of CIMMYT - I chaired the program committee for CIMMYT for a number of years [and] served as trustee for more than 6 years. So having an impact on plant breeding focused on the developing world has been something I'm proud of, but actually

I am most proud of the students and mentees that I've interacted with and that are flying their talents, their smarts, their skills, to feeding the world and providing nutrition for everyone. You know, this next generation of plant breeders to me, they are an inspiring group and one that I have full confidence in that they will solve nutritional security for the world.

**Hannah Senior:** That feels like an excellent place to leave things. Professor Rita Mumm, it has been a real pleasure talking to you. Thank you for sharing your plant breeding story.

**Rita Mumm:** Thank you so much Hannah.
[Theme music plays]

**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've 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 want to suggest people you'd like me to interview, you can contact me on twitter @PBSInt or on Instagram @PBS_Int. Until next time, stay well.

[Theme music fades]