

Transcript: Plant Breeding Stories Podcast
S2E3 Plant Breeding Stories - Dr Mike Jackson



[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.

Hannah Senior: 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: As the name suggests we normally talk to plant breeders but from time to time we take a little side step to adjacent areas to plant breeding which are critical in the pursuit of new and improved varieties. So in this episode I talk to Dr Mike Jackson about his long and varied career in genetic resources management - a critical resource for plant breeders. We get into what genes banks are, why we need them, how they operate, and crucially how they are funded. Mike started his career working at the International Potato Centre in Peru, became a lecturer in genetic resources at the University of Birmingham, and spent 20 years working with genetic resources at the International Rice Research Institute in the Philippines. He has a wealth of insights to share and I hope you enjoy the podcast.

Hannah Senior: So, Dr Mike Jackson, thank you very much for joining us on Plant Breeding Stories. A good place to start would be to ask you to introduce yourself.

Mike Jackson: Hello Hannah, nice to meet you. I originally come from Cheshire, but I grew up on the edge of the glorious North Staffordshire Moorlands and I spent many hours as I was growing up, walking over those moorlands birdwatching. And for quite a

long time, I had an idea that I'd like to get into ornithology as a career. And as I went through school, I didn't actually study biology until I went into A-Levels, and plants just grabbed me. Plants as a career, grabbed my attention more. I saw more opportunities.

Hannah Senior: So as I understand you did an undergraduate degree at Southampton in botany and geography and then you applied to study an Msc at Birmingham University on a new course in genetic resources. But you mentioned that you didn't quite achieve the marks you needed for admission - and yet you did study there - so how did that come about?

Mike Jackson: I must have made some sort of impression on the course leader, Professor Jack Hawkes, who was one of the leading lights in the genetic resources conservation movement of the 1960s and 1970s, because he said, well, that doesn't matter I will try and find you a grant. And just before the course was due to start in September, 1970, he phoned me up and said, I've got a grant. It's not a huge amount of money, but it'll keep you alive and it will pay your tuition fees.

Hannah Senior: Genetic Resources was a very new concept in an emerging field at the time. Can you tell me what it is and how it relates to plant breeding?

Mike Jackson: Modern plant breeding has really only been in existence maybe for 150 years, but in order for plant breeders to make progress, they need sources of genetic variation. Either to increase yields, increase productivity, bring in resistance to a pest or disease. And whether they are old varieties, farm of varieties that farmers have been growing for millennia or wild species, these are the genetic resources that have become so critical for the survival of crop agriculture around the world. And since the 1960s, there was a recognition that unless something was done to save these genetic resources, the new varieties that were being developed as part of the green revolution thrust at that time, the new varieties were likely to be adopted and farmers would stop growing their old varieties.

Hannah Senior: And while we're laying the foundations - I wanted to ask about the terminologies around genetic resources like gene banks, germplasm collections, seed banks etc. Can you tell me what these terms mean, or how they are different from each

other?

Mike Jackson: Um, they're essentially the same. A gene bank is both the physical structure and the collection of material within it. A seed bank is a particular type of gene bank because not all gene banks have plants in them that reproduce by seeds. So for instance, at the international potato center in Peru, there is a potato genebank that is maintained in the field every year, the tubers are planted and harvested and stored over and replanted. There are some crops that are maintained entirely in the field, and we refer to those as field gene banks. So a gene bank is a generic term for a collection of plants that is being conserved for genetic resources purposes.

Hannah Senior: So you were studying your MSc at Birmingham under Professor Jack Hawkes, but then you moved to Peru! Tell me how that happened?

Mike Jackson: Since I'd been a young boy, I'd always wanted to travel. I used to spend a lot of time pouring over atlases and I particularly wanted to go to South America and the continent of South America just fascinated me. And I thought if I can get there one day, that would be fabulous. Anyway, Jack convinced F.A.O. and others that a course was needed to train professionals in the emerging field of genetic resources conservation. So that the plans that he and other experts had put together could be brought to fruition. Jack was also one of the world's leading potato taxonomists and in December, 1970, he and his Danish colleague had an expedition to Bolivia and they sought the support of the International Potato Center. Jack returned from Bolivia in February, 1971. And within, I think almost the same day that he got back, he phoned me at my apartment and he said, there's a job going in Peru in September for one year. Are you interested? I said, when can I have the ticket?

[They both laugh]

Hannah Senior: [Humorously] Am I ever!?

Mike Jackson: And the director general of the newly founded International Potato Center was wanting to send one of his Peruvian staff to Birmingham for training and was looking for somebody who could fill in the gap as it were for a year. My departure

for Peru actually got delayed 15 months. I didn't actually land in Peru until the beginning of January, 1973. But by that time, I had begun a PhD under Jack's supervision and was able to continue that work in Peru while at the same time working for the center for things that they wanted me to do - go around Peru collecting potatoes, which was a fantastic opportunity for somebody who was only 24 years old!

Hannah Senior: That Sounds like an amazing opportunity and the right time of life to be disappearing off to the other side of the world on such an adventure.

Mike Jackson: It was!

Hannah Senior: If I understand correctly there's a particularly diverse set of land races or, or ancestors in potatoes. As consumers of the humble spud you could be forgiven for not appreciating that. Am I correct?

Mike Jackson: Oh yeah, there must be four or five thousand different varieties of potato. Every shape, size, and color you can imagine the most exquisite flavors as well.

Hannah Senior: How long were you there for? How long were you in Peru for?

Mike Jackson: I was only in Peru for a little under three years, but I was with the International Potato Center, which is known by Spanish acronym, CIP. I was actually with them for eight and a half years because I completed that stint of three years in Peru, completing my PhD and come back to the UK, presented my thesis. Then went back to Lima and almost immediately was told to go to Costa Rica for five years and set up a regional sub office to look at the adaptation of the potato to the lowland tropics.

Hannah Senior: I take it your Spanish was pretty good by this point?

Mike Jackson: By the time I left Costa Rica it was pretty good!

[They both laugh]

Mike Jackson: So I moved completely away from my other work on genetic resources at that time, and went much more directly into potato agriculture, and supporting national programs throughout the region, because I was working in the region from Mexico down to Panama and out into the Caribbean, in support of national potato programs. And so that was also a great opportunity to do something different, to learn about how to grow a crop.

Hannah Senior: And when you came back to the UK and went into academia and that was before you went to IRRI is that correct?

Mike Jackson: That's correct. Yeah. At the end of 1980, I became aware that a new lectureship in genetic resources was going to be advertised at Birmingham.

Hannah Senior: Was that the only one in the UK at the time?

Mike Jackson: Yes. In fact, it was the only course that ever really succeeded worldwide.

Hannah Senior: Ahh right, OK!

Mike Jackson: So I threw my hat in the ring and I was offered the position and there I remained for 10 years.

Hannah Senior: And you mentioned that the genetic resources course no longer runs. I think you said it stopped in 2004. So I'm curious why that would be the case because there is still a need and perhaps in many ways, an even more pressing need now to conserve genetic resources.

Mike Jackson: Well, I mean, obviously hundreds of professionals from around the world were trained. The course ran each natural life as it were within the department. There was no longer the demand coming in or the financial support to bring students in or provide the resources within the school of bio sciences.

Hannah Senior: And perhaps, I suppose a question... A question dressed up as speculation! [She laughs] Perhaps there are more centers of expertise around the world, more gene banks, more germplasm collections in different locations than they were in the 1960s?

Mike Jackson: That's certainly the case. Because at Birmingham we didn't have a gene bank. But we did have people who had expertise in genetic resources conservation and the fields around it. And of course in those days, IBPGR, the International Board had grown out of and was still was based within the food and agriculture organization headquarters in Rome.

Hannah Senior: So let's leap forward then to the work that you did at IRRI, because you were with IRRI for many years, weren't you? In different roles. So maybe let's start with, tell me a little bit about the International Rice Research Center. What did they do? And then, then we can talk about the genetic resources center within that.

Mike Jackson: IRRI was the first of the international centers to be founded in 1960. So it's just celebrated 60 years. It works exclusively on rice and ensuring that rice, the world's most important food crop, is available to all who need it to increase the productivity, to increase the availability, to produce varieties that are more productive, disease resistant, to understand the agricultural systems and the people within those systems. It produced the first of the short straw rices in the mid 1960s with the release of a variety called IR8, which was a cross between a short straw variety from Taiwan and a long straw variety from Indonesia. And essentially that was the launch of years, decades of plant breeding at the Institute and the release of variety after variety. Some varieties have been grown over millions of hectares. And that in itself is a cause for concern in that farmers who make the decisions - they're not forced to make the decision - to adopt a new variety and perhaps stop growing their old varieties. And therefore you get what we call genetic loss or genetic erosion and that's where the people like me and a gene bank come in - "what can we do to ensure that these varieties are not lost forever?" The gene bank at IRRI is one of the oldest and one of the largest gene banks in its own right. And certainly for rice, it is the largest, most genetically diverse and most important gene bank worldwide.

Hannah Senior: Right. And that begs an interesting question. If you have all these different varieties of rice in one location how do you maintain the distinct identity of all those varieties? How do you avoid there being genetic mixing over time. Clearly if it's seeds in a jar in a vault somewhere, you can see how that's going to stay preserved for as long as those seeds become viable, but once you have live plants or you're producing new seeds, there is always that risk. So tell me a little bit about that?

Mike Jackson: Okay. The gene bank has currently over 132,000 samples. I couldn't tell you how many distinct varieties that encompasses, but it must be at least half, probably three quarters are unique varieties. And to some extent, although it was a huge gene bank, to some extent, conserving rice was relatively straightforward because rice is a self fertilizing inbreeding plant. There is, sometimes, under the right environmental conditions, opportunities for out-crossing, but predominantly rice is inbreeding.

Hannah Senior:

So it's easier for some crops than for others. [They laugh]

Mike Jackson:

I'm glad I was not faced with the challenges that my friend and colleague, Dr. Dave, Ashley, who was head of the vegetable genebank at Wellesbourne, now the University of Warwick because he was working on brassicas, and they had to be grown in isolation, cages, and bringing in insects to pollinate them - I didn't have any of that.

Hannah Senior: Ahh yes, pollination control tents we know all about that at PBS!

Mike Jackson: It was just the scale. If you can imagine thousands of varieties having to be planted out each year, their identity maintained in the field, harvested carefully packaged and cleaned and sorted, and all the things that go around taking a seed to a plant, to a seed back into a genebank.

Hannah Senior: And all the risk of human error that could crop up in that process.

Mike Jackson: Yes. And one of the reasons that a change in leadership of the gene bank at IRRI was to bring in somebody who would, as it were, revitalize and bring those operations up to the 21st century. Almost everything that we did had to be looked at to make sure that we were able to reach internationally agreed and acceptable standards of genebank.

Hannah Senior: So that was a big piece of your work there then, was just getting the processes, the operations really nailed down so that that stayed fit?

Mike Jackson: We built a data management system, but we had some fundamental issues where different elements of the collection had the same types of data, but they'd been coded in different ways.

Hannah Senior: Ahh right.

Mike Jackson: So we then had to do, as you can imagine, a lot of configurations or reconfigurations to bring everything into one unity as it were.

[Theme music plays]

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'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: So in a gene bank you have a... living...well quite literally a living, breathing collection.... to which presumably varieties are added and resources used for breeding programs and other purposes. Can you tell me how that is managed - where do the additions come from, who's using them and so on?

Mike Jackson: National entities donate material to the gene bank. For them it's a safety duplication as well. But in the mid 1990s, I was fortunate to raise a considerable sum of money from the Swiss government to do three things. One was to try and complete the collection of germplasm in areas that had been under-explored until that date. Second was to research this whole area of on farm conservation and what it meant in terms of the genetic integrity of crops long term. And thirdly, to provide training for professionals in national programs. Primarily in Asia, but elsewhere. And we collected it over 20 countries, alongside partners from the national programs, the most important component being from The Laos People's Democratic Republic - Laos, that had never been collected. We placed a member staff there because we the Institute had another country-based program. We stayed there for five years and collected nearly 14,000 samples of rice. It actually became probably one of the most diverse and largest components of the whole gene bank collection.

Hannah Senior: Wow.

Mike Jackson: Incredible, fascinating range of, of diversity. But we also collected in Africa mainly wild species and some in, in South and central America, again wild species.

Hannah Senior:

Is there any particular common thread to where these hotspots of diversity are? You mentioned Laos, you know, Africa - but I guess that's also localized. Is there any common thread to that?

Mike Jackson: I mean for Eastern India, for instance, in an area that grows rice under what's known as rain fed lowland rice, it's in puddled water, but the supply of water is through rainfall. So in Eastern India, many farmers are still growing the varieties that their families have been growing for generations. And you find those pockets all over, all over Asia. And when we set up the program in '95 to collect, we looked very carefully at the records of what we had in the gene bank, from these different countries. And we're able to identify areas that were underrepresented and they had not been visited for a whole slew of reasons. I mean, some places had civil conflict and it might've been

difficult to travel around anyway. And so this was an opportunity for bringing all these countries together with a common purpose to save their national germplasm. So after the collections were made, the material was essentially divided with half remaining in a national facility and half going to IRRI and added to the International Rice genebank collection. And at the time that I joined IRRI the politics of germplasm were changing. And in fact it's one of the reasons why by 2001, I was quite happy to move on to another challenge at IRRI. The politics had become almost all consuming. My successor, another British scientist, really spent a lot of his time in the international politics of germplasm conservation.

Hannah Senior: Can you give me a flavor of that? What kind of thing was - without naming names [Hannah chuckles] - but what kind of issues were coming up?

Mike Jackson: Well at the time, um, if you remember in 1992, the convention on biological diversity came into force, it was ratified and came into force. But at the same time, it hadn't really covered agricultural biodiversity, which in a sense was the purview of the food and agriculture organization. And in fact, my introduction to the political side was before I actually joined IRRI I was asked to attend a meeting of the FAO commission on plant genetic resources for food and agriculture to discuss the policies around the acquisition and access to genetic resources. And this of course eventually led to a number of agreements placing the international center genebanks under the auspices of FAO. And then of course, that led to the negotiation and ratification of the international treaty on plant genetic resources for food and agriculture, the secretary of which resides within FAO. And this has set the ground rules for access to the collection, the benefit sharing from the use of the materials in the collection, et cetera.

Hannah Senior: That's an interesting topic to touch on. So how does somebody go back understanding what's there? Accessing it? What does that do for rights? Can you tell me a little bit about that side of things? I realize that's a big subject.

Mike Jackson: Whew!

[They both laugh]

Mike Jackson: The material in the international gene banks is open to anybody and everybody, but obviously the genebanks aren't able to supply seed in the quantity that a farmer could grow. I mean, normally the distribution from the International Rice Research Institute for example, was 10 grams. That's several hundred seeds, but it's only 10 grams. And if every farmer in the world asked for seeds, there wouldn't be enough seeds to go around. So the idea is that the seeds would go back to the programs from which they came or to other research programs around the world, plant breeders, et cetera. When somebody requests material, it's accompanied by a material transfer agreement, which spells out how the material can be used. Now we could talk for hours about whether or not the system is working. Ultimately it aims to bring back the benefits of the use of the germplasm to the countries where the material originated.

Hannah Senior: Benefits like what?

Mike Jackson: Three decades ago when I started people were thinking in terms, it would be monetary benefits, but obviously benefits can be in kind. If you get a new variety that is much more productive and it is provided free of charge then that is also a benefit from the exploitation of germplasm in plant breeding, which has involved perhaps an investment of 10 or 15 years. I mean, the international centers have got major plant breeding programs. And the material that goes out from those programs is free of charge. You know, the benefits are the time and the efforts of highly qualified scientists conserving, studying, understanding the genetic diversity, and then putting it into a package that somebody can grow and ultimately eat

Hannah Senior: Conserving genetic resources is a long-term proposition and breeding programs are long-term projects. So that raises a question about who funds the conservation and how do you ensure you get long-term funding for the timeframes that this needs to go on for? I mean, it's indefinite, isn't it?

Mike Jackson: Yeah. That's one of the biggest paradoxes. You've got a total mismatch of the long-term necessity because we're conserving these materials forever. And the short-term funding windows that funders provide. Now, the international centers have been supported since their foundation by donor governments. So in the case of the UK,

that would be the Department for International Development. But we know what was announced just recently, they're going to cut back their support from 0.7 of GDP, to 0.5! And we've seen how that is already impacting on research projects that are already underway here in the UK. The Swiss, the Germans, USAID in the States, et cetera, these all make annual commitments. And over the years interest in some cases and their ability to provide funding at the same levels has gone down. A decade ago, a little over a decade ago, the Bill and Melinda Gates Foundation stepped in and has been providing quite substantial sums of money to support projects in the international centers, not necessarily into the gene banks, but the overall programs. For many years the gene banks had to fight, as it were, amongst the other commitments within the centers' programming budget.

Hannah Senior: I'm curious because you said the support for international agricultural research has declined over time. But at the same time there is a realization, and a much stronger commitment to recognizing that climate change is real and it's going to be a major threat for agriculture and we need to do something about it. So how does that reconcile, do you think gene banks will become more important again?

Mike Jackson: Well, the CG itself has been going through many, many years of what I might call navel gazing as to what their relevance is today. And obviously climate change is now quite an important focus of the work of the centers. And it's clear that access to and use of the genetic resources and the gene bank is going to be a very important component of any response to climate change and adaptation to climate change, to be able to provide the genetic diversity that plant breeders are going to need to increase productivity, produce new varieties, et cetera. What has changed in the funding situation and really is very important for the gene banks came some time ago with the founding of the Crop Trust and they have also taken over a responsibility for managing what is called the gene bank platform among the centers. And they provide substantial funding for I think all but two of the gene banks. IRRI was the first gene bank to receive a grant in perpetuity.

Hannah Senior: Oh, so there is some long-term funding arrangements now?

Mike Jackson: But it's not 100%.

Hannah Senior: Mmhmm [affirmative].

Mike Jackson: You've got a long term programmatic commitment and you've got short term funding commitments in general. Certainly the role of the crop trust has become one of the major developments in recent years. It's estimated that they need an endowment fund of about \$500 million to provide annually the amount of money to run the international genebanks. But the international collections in the CG gene banks rely not on national government funds, like say the vegetable genebank in the UK - that is a national commitment. The international gene banks need that broader support. And if that support is found wanting it has serious implications.

Hannah Senior: You had this long career where you were actively involved in gene bank operations, politics, funding and all the many other aspects of this kind of work. And then the final role in your career was Director of Programme Planning and Communications - which is a different orientation of a similar theme - tell me about that?

Mike Jackson: Out of the blue in early 2001, I had a phone call from the secretary of the director general asking me to come over for a chat. And I was a bit surprised when I walked into his office, there were the other deputy directors general and they sat me down and they said, "We'd like you to give up the genebank and we'd like you to join the Senior Management team to help us revamp our whole funding strategy." I always remember the director general saying, "if a donor came to me tomorrow and offered us \$5 million, I wouldn't want to refuse it." He said, "I have no idea how it would impact our program, where we would put it, how we would spend it." He said, "We need somebody who can bring some order to what is essentially a funding chaos". And then by that time, the institute had unfortunately got rather a poor reputation amongst the donors for not ever reporting back on how they had spent all this taxpayer's money. Funnily enough, running an office like that was not too dissimilar from running a gene bank. A gene bank has lots of different elements to it. You've got the field operations, regeneration, multiplication, seed cleaning, seed conservation, et cetera. The success is bringing

those together to operate seamlessly with people involved, talking to each other. And you have a genebank that operates efficiently. In my role as director for program planning, we had lots and lots of projects. I discovered there were 60 projects.

Hannah Senior: Mmhmm [affirmative].

Mike Jackson: These were my genebank accessions. And each of those had a lot of information around them that was not brought together. It wasn't integrated and it wasn't integrated internally between scientists and the finance office. It wasn't integrated with what the donors understood. And of course there were no mechanisms - exchange of information - internally and externally. And that was the task I was given. And we set up a system within the Institute that eventually got us up to, well, within a relatively short time, within nine or 10 months, we'd restored our reputation with the donors. And by the time I left the Institute in 2010, uh, donor income was approaching 60 million. So you left it in good shape. I like to think that I left the gene bank in better shape than I found it. And I certainly left the funding situation and the management of the funding situation in a better shape than I found it.

Hannah Senior: And that's the kind of legacy we all want. Isn't it to leave things in a better state than when we found them. [Laughing] So you've had this fabulously, rich and varied career in genetic resource conservation, across multiple crops and multiple countries and standing where you are now, I'm curious, what concerns do you have for the future and what opportunities do you see for the future for people who are taking things on from here?

Mike Jackson: The most important thing about genetic resources conservation, the first or the most important thing that you have to take on board is that the germplasm has to be safe. In a lot of gene banks around the world that is not the case. Not enough attention is given to how it can be safely conserved, safely regenerated and all of those. So that is the number one thing that has to be done, make the germplasm safe, make sure that the data that accompanies that germplasm is reliable. And then again, there are many deficiencies, not just at IRRI, but worldwide in the quality of data. But the big opportunities that we are just getting into is the application of molecular biology and

particularly genomics to understand the diversity that exists in the collections. That to me was almost the Holy grail. Now we have the tools and we can afford the fact that work has been going on for quite a number of years at IRRI and in many genebanks around the world. Our understanding of the genetic diversity and where the hotspots say for disease resistance, the varieties that can be better - that has just multiplied in a way that we couldn't have imagined a decade ago. And that is the really exciting bit. Questions we can ask now we could only imagine a couple of decades ago.

Hannah Senior: There is this need to preserve the resources, make sure you understand what's in those collections, but if that's done correctly, the opportunity to use those collections productively has vastly improved as a result.

Mike Jackson: When I was applying to IRRI and I went for interview I did actually lay down one condition to accept the job. And that was, they had to let me have a research program because in the initial advert, it was just, as it were, a managerial role. I said, "No, no, we're not just maintaining a stamp collection." You know, just putting things in and taking things out. We have to understand what's there. We've got to make it a living collection in an area which we call pre-breeding. You then make that information available to breeders who could say, "well, I can use that. I can't use that or what are the chances of using particular..." and adding that into our complete range of knowledge about the material in the collection.

Hannah Senior:

It's been so interesting talking to you today. Thank you very much for your time, Dr. Mike Jackson, just, um, for anybody who's interested in knowing more, how can people find out about you?

Mike Jackson:

You're welcome.

[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]