# GRDC PODCAST TRANSCRIPT

**Impact of investment in Australia’s lentil industry**

[00:00:05] **Intro** This is a GRDC podcast.

[00:00:12] **Fiona Fagan** Hello, I'm Fiona Fagan. Australia's lentil industry was virtually non-existent before the 1990s, but now it's worth hundreds of millions of dollars, with GRDC investment playing a significant role in that growth. I recently got the chance to visit the new state of the art glasshouses, at the Grains Innovation Park in Horsham in the Wimmera region of Victoria. There, I caught up with the facility's acting research director, Dr. Garry Rosewarne from Agriculture Victoria. Garry, what impact has GRDC investment had on lentil breeding in Australia in general terms?

[00:00:58] **Dr Gary Rosewarne - Agriculture Victoria** So GRDC has been funding the lentil breeding program since the 1990s, combined with funding from Agriculture Victoria here in Horsham. And so essentially that bilateral arrangement has established the lentil industry within Australia.

[00:01:14] **Fiona Fagan** So explain the journey for lentil production in Australia. Where did it start, what year and what geographical areas?

[00:01:22] **Dr Gary Rosewarne - Agriculture Victoria** So in the early 1990's, that's when we first started the lentil breeding program here in Horsham was working with one of the key farmers in the district, Peter Blair from PBSeeds, and they were trying to grow this new crop lentils and they were imported lines from the Middle East or from Canada to see how they were adapted and they could kind of make them work, but they weren't real game changers back then. The plants were very short and squat, particularly in our environments, they were hard to harvest, you really had to go to your best paddocks to get any sort of production coming back. And so the breeding program came in and started to look at what traits needed to be changed. Getting the right sort of flowering and maturity windows coming through to suit our environments. But then also one of the big ones has been to select for taller plants, more biomass and we've done a great job in that over the years. And so that's then the germplasm that we have seen, has to be fairly naturally adapted to the Wimmera area, which is with the rainfall patterns and the soil types and also down onto Yorke Peninsula and Yorke Peninsula is probably the major lentil growing place in Australia.

[00:02:22] **Fiona Fagan** Last night I had the pleasure of visiting the new glasshouses and seeing them under lights, they're quite impressive. Tell us about the new glasshouses that have been built?

[00:02:32] **Dr Gary Rosewarne - Agriculture Victoria** So they're a real game changer for us. Again, GRDC had financial support in that for us, they're six-million-dollar glasshouses that you were looking at last night. They come with a whole range of bells and whistles from the LED lighting that you would have seen to automated shade screen, automated irrigation and fertigation systems all controlled by a building management system. And that quality control that we have on the glasshouse is really changed the way we can grow plants in controlled environments. The old 50 year old glasshouses, they weren't too good, they just weren't up to standard. They couldn't hold temperature down in summer, they would just get too hot, so really, we really struggled to grow anything other than what would happen in a normal sort of growth cycle, so we'd be growing plants in the old glasshouses, and it could take anywhere from four to six months, depending on what time of year we grew them. These new glasshouses, just by having to be able to extend the day length with those quality LED lights and have good temperature control, so 22 to 24 degrees enables us to go through a whole lifecycle of a lentil plant within as little as two months, and that's an absolute game changer.

[00:03:39] **Fiona Fagan** So how does the work being done here in the glasshouses relate to speed breeding and genomic selection?

[00:03:46] **Dr Gary Rosewarne - Agriculture Victoria** In the old days we would, you know, grow plants in the glasshouse. We might be able to grow their progeny in the summer cycle. So that'd be two generations in one year. And then we're into a yearly cycle after that for another two years before we can even get new lines that could start to go out for field testing under yield conditions or against diseases. Now we can do it down as little as two months, so certainly we can get that same outcome that would have taken us four years before, we can certainly do that easily within one year. So that's sort of hinting at this speed breeding capability, but speed breeding is more than just rapidly generating new lines or rapid generation advancement. It's also how you can use computational genomics to help select your lines and also design your parents. And so what we're doing in the breeding program now, again, with good support from Agriculture Victoria and GRDC, we have implemented a strategy called genomic selection. So in genomics we can take a leaf sample from a plant, a newly developed plant in the glasshouse, we scan its genome, its DNA on what we call a snip chip, and we get, you know, 10,000 different markers or more on that. And that covers the whole genome. And we can associate those markers with specific phenotypic traits. So for example, one of the major diseases we have is Ascochyta blight in lentils. And so now we can look at the genome of a plant and predict how it will perform when it's confronted by this Ascochyta blight disease. And even though the plant has never seen the disease, we know how it's going to perform to some level of accuracy. And so we've got these genomic predictions for a whole range of traits. We've got yield in a couple of different environments; we've got Ascochyta blight resistance as I mentioned to a couple of different patho types. We've also got botrytis resistance to Botrytis grey mould (BGM). We can also predict how the plants will perform if they go into a high boron on soil or a high salt soil, and we can even look at traits such as seed size and seed shape. And we're working on more traits all the time, the current ones that I really want to get to are around vigour, plant height and the flowering time of maturity. And so we should have them all mapped out within the next six months or so. And we can look at all of these and predict what parents we want to make as the next crosses coming through. So when we go back to the rapid cycling, what we can do is we can do a across within two months get the progeny from that cross, probably grow it up for another generation, then genotype those progeny and then pick out the very, very best lines from those progeny. So we might be making two to 5000 progeny in any given cycle. We might pick out the best 10 or 15 of those lines and put them back into the crossing cycle straight away. So we call that continuous crossing. And so that's also feeding in obviously intimately involved with the speed breeding because we can do that whole process quite quickly. Additionally, to that too, with the genomics, we do what we call computational breeding. So we've got, you know, thousands of lines in our breeding program. We've got them all genotyped. And so in this computational breeding, we theoretically make tens of thousands of crosses in silico on the computer, and then the computer spits out to us a list of crosses that we think are the very best of those, so out of tens of thousands of crosses, we only want to do 200. So we can really just really target the very best crosses for a specific target product concept that we want to put out there.

[00:07:05] **Fiona Fagan** Dr. Arun Shanmugam is a lentil breeder at Agriculture Victoria. He says the pink lights in the new greenhouses offer huge economic benefits for the breeding program and for growers.

[00:07:20] **Dr Arun Shanmugam - Agriculture Victoria** So the basic methodology is mimicking day length, extra light in the glasshouses. By using these LED lighting technology, you can precisely control the irrigation, the fertigation, the shading and humidity and lighting all around a year so that we can have a plants in the glasshouses throughout the year. So that's an economic benefit for the breeding program, also for the farmers when we released varieties earlier.

[00:07:49] **Fiona Fagan** What are the objectives of the glasshouse trials? How much longer will they continue?

[00:07:54] **Dr Arun Shanmugam - Agriculture Victoria** So the major aim of the glasshouses trials or the breeding trials is breeding better varieties faster. So that is what we are trying to achieve through these glasshouses. So can we get the varieties faster to the farmers paddock? And can they reap the economic advantages by getting them yearly to the farmers paddock? That's the major objective of the breeding program and we are trying to address that by running, crossing blocks, by running abiotic assays called biotic assays in their glasshouses and combining that with speed breeding methodologies and genomic assisted breeding. So we can take the leaf samples of 10,000 to 20,000 germplasm that we generate in a year and put them through computational breeding exercises and combine them with regular breeding activities to bring better varieties faster to the market.

[00:08:47] **Fiona Fagan** How will the research outcomes from the glasshouse trials potentially affect lentil growers in Australia?

[00:08:54] **Dr Arun Shanmugam - Agriculture Victoria** So the major objective of the glasses trial, I'm going to pin this down with what we call the breeders equation. Can we increase the genetic gain of the lentil breeding program faster? Is the question we asked and with these glasshouses is we can grow more plants, we can grow more plants quicker and we can grow better, adapted plants quicker. So we have increased the selection intensity, selection accuracy, and by that we have also achieved greater genetic gains quicker. And these glasshouses trials are helping us to generate 10,000 new germplasm every year that can get into field trial testing subsequent years, and the farmers will reap the benefits of new release varieties faster.

[00:09:41] **Fiona Fagan** And what can you tell me about the advances of genomic breeding?

[00:09:45] **Dr Arun Shanmugam - Agriculture Victoria** So genomic breeding has helped us a lot in recent years in terms of lentil breeding. We start off with computational breeding exercises. We genotype all our newly developed germplasm using what we call SNP technology, and we predict the performances for different traits like yield, abiotic stresses like boron and salinity, biotic stresses like Ascochyta blight in Botrytis grey mould. And we can also predict their performances for quality traits like seed sizes and diameter and plumpness. And by using all these genomic predictive values, you don't have to test those varieties in the paddock, you could have your performances evaluated even before they hit the paddock, so that's the advantage we have by using genomic assisted breeding as part of the regular breeding program.

[00:10:43] **Fiona Fagan** Dr. Garry Rosewarne says the lentil breeding program is also benefiting from the use of Uncrewed Aerial Vehicles. UAV technologies, what can you tell us about UAV technologies?

[00:10:57] **Dr Garry Rosewarne - Agriculture Victoria** So we've been deploying the Uncrewed Aerial Vehicles (UAV's) for a couple of years now. And again, once we genotype lines, we want to throw as many traits at these lines as we can. And so these enable us to get access to more traits and so we can fly these UAV's over thousands of plots at a time at a field trial site. And these UAV's come equipped with multi-spectral sensors. And from those sensors, we can get a range of different indices that can show us different attributes of the plots. And so some of the attributes that we can accurately predict from these UAV's are early vigour in the beginning of the season. If there are any disease epidemics come through, we can get accurate disease scores more accurate than the human eye can get. We can also determine maturity; we can also determine maximum plant height and inferred biomass from that as well. We can get ground cover measures and we can also get height at harvest. And so height at harvest is obviously important because that's what the grower needs to be able to make sure the plant stands up well. So all of those traits together, we can then throw them to our computational people and they can pull that data apart and develop these new genomic prediction equations. I guess one thing that I didn't touch on with the computational side of things is that we have our staff base down in Melbourne at Bundoora, La Trobe University, and they have access to a supercomputer down there, so we wouldn't be able to do this work without that backing as well.

[00:12:20] **Fiona Fagan** Okay. So looking into the future, what opportunities are there for growers, especially in those newer markets in New South Wales and Western Australia?

[00:12:30] **Dr Garry Rosewarne - Agriculture Victoria** Yeah, so I talked about the main production areas of the Wimmera and in Victoria and Yorke Peninsula in South Australia. But there is growing interest in lentils and seeing how far we can push them. There's a good grower group around Esperance in Western Australia, but also up through the main wheat belt of Western Australia as well, and up into New South Wales, there's some quite proactive growers up there as well, so they're interested in looking at different sorts of pulse crops to put into their rotations. Lentils are high value, that's why they're grown so much. And so what we're doing with the most recent round of funding from GRDC, we've been able to significantly expand our footprint beyond those confines of the Wimmera and Yorke Peninsula. And so we now have four trials over in Western Australia, quite extensive trial sites in Western Australia, one down in Esperance and three more up through the main wheat belt and similar sort of footprint in New South Wales. And so if we grow these lines in those different areas, we can see how they respond specifically to those environments. So you might say, well, Western Australia, the soils are very different, they're sandy soils over there. You can get a bit acidity up through the main wheat belt, also acidity in New South Wales as well. There can be boron constraints and so forth, so we can really breed for those environments and hopefully start to produce lines that are better adapted to those expansion regions.

[00:13:43] **Fiona Fagan** Dr Garry Rosewarne, thank you for joining me today.

[00:13:46] **Dr Garry Rosewarne - Agriculture Victoria** Great. You're welcome. Thanks very much.

[00:13:53] **Fiona Fagan** That was Dr Garry Rosewarne from Agriculture Victoria, who is currently the acting research director at Grains Innovation Park in Horsham. Earlier I spoke to lentil breeder Dr Arun Shanmugam, also from Agriculture Victoria. This is a GRDC podcast. I'm Fiona Fagan. Thanks for listening.