# GRDC PODCAST TRANSCRIPT

**New genetics for improved canola establishment**

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

[00:00:12] **Deborah Bishop** Some exciting work is being done around improving the establishment potential of Australian canola and its suitability to be sown deeply, by introducing overseas varieties that feature long, hypocotyls and enhanced seedling vigour. Key genetic factors associated with improved canola establishment as well as suitability for deep sowing. Hello, I'm Deborah Bishop. Crop establishment, even in favourable conditions, remains an issue for canola growers in Australia. Unreliability of the establishment can lead to difficult weed control and reduced yield potential. In 2019 with GRDC investment, CSIRO began a genetic solutions project using international varieties to help Australian canola breeders develop varieties that better establish in grower's paddocks. I spoke to CSIRO's Dr. Matt Nelson about the work to understand genetic traits that might contribute to successful canola establishment, and selection tools to accelerate the breeding of varieties with greater reliability around establishment potential.

[00:01:21] **Dr Matt Nelson - CSIRO** Canola is such an important crop for our system here in Australia, so it's worth a lot directly to the growers. But the problem is, of about 100 good seeds that are sown, only 50 on average across Australia result in a plant that's established and goes on to develop the grain and this can be a big problem, if it's really poor establishment, we end up having limits to our yield potential, the weeds take off, sometimes we need to re sow. So this project's all about trying to improve the genetics of canola so that it does that less and establishes better.

[00:01:58] **Deborah Bishop** So you're effectively trying to help canola breeders develop varieties that will establish better in their paddocks?

[00:02:04] **Dr Matt Nelson - CSIRO** That's right. So currently fifty per cent with this project, we're aiming to improve that by twenty five per cent by 2030. That's the goal.

[00:02:11] **Deborah Bishop** So tell us about the methodology of this, how’s the research being undertaken?

[00:02:15] **Dr Matt Nelson - CSIRO** Yeah, So this is a genetics project where we're looking at diversity from across the world. So we went overseas and looked for collections from 21 countries as it happened. We brought in 255 different varieties and they came from Europe, Canada, Asia, main growing areas. So what we then did was, we wanted to understand how were they behaving, what traits are really useful for improving the establishment in the field. Some of them were even rapeseed types, so not canola quality, some of them were swedes and fodder kale types. So Brassica napus, are really diverse species, and canola is the main type of course that we are interested in. But there's lots of genetic diversity we can get from these related types. So what we did was we brought those in, we needed to screen all of them for their genetic potential for establishment, but that's very hard to do in the field straight away. So what we did was we developed some really efficient lab based methods for screening for genetic vigour at different points at germination at cotyledon width, once it's emerged and then at four leaf stage, biomass. So that was one set of measurements and another key one was how long did the hypocotyls grow? If we grow them in the dark, at a steady temperature, for a certain number of days and then measure them. And we found a huge variation in the length of hypocotyl length. And curiously, when we compared to the best of the international varieties to what we have currently in Australia, was those long international hypocotyl varieties were much, much longer than the current Australian. So what that was telling us is that Australian genetics is not there for long hypocotyls and we need to bring it in. The next we had to test, is long hypocotyl really going to help us in the field? So that's where we went to our field validation step over 2 years in New South Wales and Western Australia and we grew the seeds out at two different depths, 2 centimeters, the more standard depth and then a deeper sowing at 5 centimetres. So we included 20 of the extreme varieties, good and bad, from overseas. We also compared to current Australian varieties. What we found was that those long hypocotyl varieties that we'd picked out in the lab, all of them did better than the shorter hypocotyls in the field. So it's a really strong prediction of how well a plant will emerge is how long hypocotyls are when we measure them in the lab. So that's great because it's much easier to measure hypocotyls in the lab than it is to measure lots of different types in the field. So we've now got a tool for selecting the things that have better genetic potential to come from deep sowing. We also discovered that one of the measures of figure that we measured in the lab called germination index that was really very good at predicting how vigorous the plants are in the field as well. So similarly, we could measure 100's in the lab, but we could only measure easily 20 in the field. So that's the kind of difference that we're getting when we have these efficient methods and so now we've got confidence to give breeders these tools for selecting for high vigour and long hypocotyls.

[00:05:27] **Deborah Bishop** Right? So that is really interesting information. Are you able to take us through the key genetic factors contributing to successful canola establishment?

[00:05:35] **Dr Matt Nelson - CSIRO** We knew that these traits had a strong genetic control, but we didn't know how it was happening. So what we did was we went through what's called a genome wide association study, where we look for parts of the genome that are controlling the traits that we're after. So in this case, hypocotyl length and seed vigor. What we found was for both traits they were controlled by quite a few genes. Each have moderate effect so that one particular gene might affect the trait by ten, fifteen, twenty per cent. And then you get a series of smaller ones. And so what we need to get a handle on next is just how many do we need to make of those smaller genes to make a variety long. And we are very excited to be able to bring in, these genes from overseas varieties into a background where we can really see if we can transform Australian canola so it can have longer hypocotyls, even more vigorous and be able to emerge better from deeper sowing. That's the goal.

[00:06:32] **Deborah Bishop** Can you give us some key learnings from this GRDC investment for growers and for the industry as a whole?

[00:06:38] **Dr Matt Nelson - CSIRO** So some of the key findings were that long hypocotyls like the long coleoptile wheat, long hypocotyl canola emerges better from the ground. Second key learning, that we're finding that we had was that those long hypocotyl genes are not currently in Australian varieties, but they are in varieties from Europe, from Canada, from Japan even, so we need to have the tools to go in and bring those genes out from those overseas varieties into Australia. During the project we've developed those tools. One is the selection, so we were able to phenotype in the lab very efficiently in a way that breeding companies can adopt and bring in those traits into the Australian material. Secondly is we've made the first genetic markers progress. That still is a work in progress, but we've already discovered markers that explain about thirty or forty per cent of the trait variation for long hypocotyl and seed vigour. Those are tools that the breeders will be able to use in this next phase.

[00:07:37] **Deborah Bishop** Now the project finishes around the middle of this year. Is that the projection of work, that that's where you'll be heading after the project winds up?

[00:07:45] **Dr Matt Nelson - CSIRO** Yes, our hope and plan is that we'll have a genetic crossing program where we systematically bring in this diversity from Japan, from Canada, from Europe, where we are bringing it into Australia and vigorous genetic backgrounds, we'll then do more intensive genetics and really nail down those markers and get really useful selectable markers for breeding. It will also be in a genetic background where we can grow them out and really prove that the long hypocotyl trait in an Australian background will emerge better and that's something that growers can then in future, if they have those varieties, have confidence that when they're sowing it will be able to emerge from at least five centimeters depth.

[00:08:25] **Deborah Bishop** In WA, canola is a very popular crop obviously and those yellow fields, we see them everywhere. We have bumper crops regularly. Is this research looking at making those bumper crops even more bumper crops, or is it something else that we're trying to develop better here at that genetic level?

[00:08:42] **Dr Matt Nelson - CSIRO** So what we're looking for here primarily, I think, is reliability. So when we have good years or if we're growing in a really reliable rainfall zone, then maybe this isn't a trait that is as useful. But the problem is, of course, we know that our environment is very variable. Some years are much better than others. We want to have canola no matter the year, will emerge and establish reliably, so we're trying to make canola a less risky crop.

[00:09:08] **Deborah Bishop** And is this research project, is it nationally applicable?

[00:09:11] **Dr Matt Nelson - CSIRO** Yes. This is something that has a place across the country, especially in the lower to medium rainfall zones. But even in the high rainfall zone, some growers have unreliable establishment in canola. So this is, I think, something for everyone. It's probably especially those in less reliable environments. And another thing also is that sowing deeper like the long coleoptile story, if you're able to sow deeper and you have had summer rainfall, you're going to be able to tap into that moisture that's stored in the soil much more effectively than conventional canola at the moment.

[00:09:47] **Deborah Bishop** Matt, thank you very much for talking to us today. And you've been listening to Dr Matt Nelson from CSIRO. More information can be found on the GRDC website. I'm Deborah Bishop and thanks for listening.