# GRDC PODCAST TRANSCRIPT

**Applied N under irrigation – what’s the magic number?**

[00:00:12] **Prue Adams** More is not always better when it comes to adding nitrogen to your irrigated wheat crop. That's one of the key messages from a GRDC investment investigating profitable farming systems. Hello there, I'm Prue Adams. Strategic use of nitrogen throughout the growing season can certainly maximise grain yield and quality. But there is a tipping point at which it no longer makes sense to keep applying urea. And GRDC-funded research in trial plants and on-farm is conclusively showing, you need to know what nitrogen is already in your farming system before you start applying more. It all comes back to you can't manage what you don't measure. So let's drill down deeper and find out what that tipping point is. Today I speak with a researcher, an agronomist, and a South Australian farmer to get the lowdown on nitrogen use to maximise yield. First up, Nick Poole is the Managing Director of FAR Australia and he's overseeing the research project of the GRDC-funded Investment facilitated action groups to support profitable irrigated farming systems in the northern and southern farming regions. It's a bit of a mouthful. So how does it work?

[00:01:33] **Nick Poole** What we've looked at is principally over 60 field trials a year, taking place across the irrigated farming systems of the southeast of Australia. And we've looked at trials under surface irrigation. We've looked at trials being run under overhead pivots or lateral irrigation. And within those farming systems we've been looking at the agronomy, whether it be nutrition, disease management, all of the questions around what are the metrics, what are the inputs associated with farming the most profitable crops under irrigation. How do we do that? For those non-legume crops, a particular focus was just how much nitrogen do we need to get good high yielding crops of durum wheat, canola or, down here in southeast South Australia, milling wheat.

[00:02:35] **Prue Adams** So just how much nitrogen do you need. That's the million dollar question, isn't it?

[00:02:41] **Nick Poole** The million dollar question. Exactly. One of the things, I suppose, that when we set out with this project, there was perhaps the feeling that in some of our experiments in grain maize, for example, we've been taking nitrogen levels to over 500 kilos of nitrogen per hectare. That's a lot of N, that's N, not urea. So that's over a thousand kilos, a tonne of urea a hectare. But what we found in all of these irrigated crops is that we seemed to get good efficiency of the nutrients we apply. And we've actually found in canola, durum here in South Australia, milling bread wheats, and grain maize, that very rarely does our optimum level of nitrogen for profitability exceed any more than 250 kilos of N, absolute tops. And that's to achieve both good yield and where we need it, good protein in the case of, say, the durum wheat where we are paid on that protein.

[00:03:54] **Prue Adams** So how important is it to know how much nitrogen you've actually got in your system to start with before you start actually laying on the urea, for instance?

[00:04:06] **Nick Poole** It's of paramount importance because there's this common saying that we can't manage what we haven't measured. And one of the things that I think is important in whatever, whether it's irrigated or dryland farming systems, is to have a gauge as to how much nitrogen is in the soil before you start that soil bank, or the nitrogen that's already in the soil is actually what you're interacting with when you're applying your fertiliser. Have you got a very big nitrogen bank, a very fertile farming system, or have actually you got a very depleted nitrogen bank? Those are important in terms of the rates of nitrogen that you apply, and also the timing of nitrogen to interact with that nitrogen you've already got in the soil. So very important that we know how much is there at the start of the growing season. And then increasingly what we're trying to do is to be able to visualise the part of the nitrogen balance that's much more difficult for us to get a really good handle on, and that is that the nitrogen from its organic reserves mineralises nitrogen as we go through the season. With irrigation, that water enables us to make the soil wetter at warmer times of year. And if we've got good fertile farming systems, it will instinctively release those nutrients from the soil in a more predictable way than we could with dryland, where we're at the mercy of how much soil moisture we have to activate the system.

[00:05:56] **Prue Adams** So from that, you can have a certain amount of nitrogen available at the beginning of the season. But that doesn't necessarily equate entirely to what the plants are going to take up. And that's where irrigation can also have an implication.

[00:06:11] **Nick Poole** Exactly. So when we carry out any kind of nitrogen budget, we may have a target yield in mind. And what irrigation does is it not only perhaps makes some of our nitrogen applications more efficient, i.e the amount of nitrogen we recover in that season is perhaps greater than it would be in a dryland sense. The other thing is it takes some of the risk away.

[00:06:39] **Prue Adams** We talked a little bit about the amount of nitrogen that is a maximum. Is there a tipping point as such?

[00:06:46] **Nick Poole** Yes, there's a tipping point is to a point beyond which you get no more yield. And like I say that generally speaking, we found to be a maximum of 200 - 250 kilos of nitrogen. But in many scenarios, if you have a fertile farming system, the optimum level of nitrogen may be way less than that. And we had a great example of that with the Francis group here, where the research showed that in 2021, we needed 250 kilos of N to achieve an 8-8.5 tonne crop of milling wheat Rockstar of the right protein level. In the following year, we got an almost identical yield, but it was achieved with the same quality with only 100 kilos of nitrogen. And the difference was that in those two years, the amount of nitrogen we had at the start was way different. As such, that in 2022 we had 180 kilos of nitrogen sat the soil to help us in the quest for that yield and quality, whereas the year before we had less than 70kg.

[00:07:59] **Prue Adams** How can growers use the information in a practical way, or how are they already using this information in a practical way?

[00:08:09] **Nick Poole** I think it'd be fair to say that growers are already aware of timings and what they should be doing in terms of measuring soil nitrogen. They're aware of some of those things. I think the project's done is that perhaps at the beginning of the project, it was felt that there was no limit to this upper end in terms of how much nitrogen you could apply. And 300, 400 kilos of N would just get us there. Whereas what we've actually found is that you can grow big crops under irrigation, but probably the best scenarios are where you're growing big crops in fertile farming systems, whereby when that soil gets wet, warm with irrigation, you're helping to mineralise what you've already got in your nitrogen bank that supplements what you're applying as fertiliser. And here is the interaction with timing. Because when you have more fertile farming systems, too much fertiliser applied early in the tillering stages for cereals, for example, can actually be a disadvantage to that crop. In other words, it becomes too thick too lush that encourages disease. It encourages the crop if it's not a stiff straw variety to potentially lodge. So in those fertile farming systems, there's a requirement for placing your nitrogen, perhaps at slightly later timings than a dryland grower would be able to reliably go for, reliably go for, because in a dryland scenario, you're always looking at the forecast as to when's the next rain front to take my nitrogen into the crop. Whereas with irrigation, you know that at some stage as the season and the spring progresses, you will be activating that nitrogen with your irrigation water, and this has been particularly relevant with milling wheat and durum wheat, where we seem that we've got more control over timings that are that bit later in the season by later, we're talking about up to that flag leaf stage, flag leaf emergence with cereals, we can get good reliability, good yield effects, but also good protein effects from that.

[00:10:43] **Prue Adams** So to join the research up with real world on-farm practices, there were irrigation discussion groups, which also meant growers could help steer the research in the direction they wanted and needed. Brendan Wallace works for Pinion Advisory, and his role in the Optimising Irrigated Grains project was as facilitator of the Francis's irrigation discussion group in South Australia's southeast.

[00:11:10] **Brendan Wallace** Initially, we held a first meeting which involved Nick Poole from FAR Australia to discuss the research trials that are going to be happening, and it was early on in the project where we identified a need within the Francis region to incorporate bread wheat into the trial, which was initially excluded. So we're able to get that variation from farmers input to incorporate bread wheat in the irrigation research. And it's an integral part of a lot of the rotations in the Francis area.

[00:11:48] **Prue Adams** What are the focus paddocks? Tell me about those and what's the methodology there and how growers are involved when it comes to those focus paddocks.

[00:11:55] **Brendan Wallace** Okay. So the focus paddocks come about to be farmer-led demonstrations on a larger scale, where we can take the information and research from the agronomy team and the agronomy research by FAR, and also the economic research and implement that in a controlled environment, just on a larger scale, where growers can take a few more risks and we can do that where they might not necessarily have done that if it was something they're going to do over a whole paddock.

[00:12:26] **Prue Adams** So how do you identify those focus paddocks?

[00:12:29] **Brendan Wallace** So the focus paddocks, there was a lot of discussion and talk about the need for more information around nitrogen and what level of nitrogen needs to be applied to maximise grain yield. So we took that and we use that in our focus paddocks, applying rates of nitrogen from zero kilograms per hectare of urea right up to 600 kilos of urea per hectare, which is a significant amount of nitrogen. And trying to identify at what point are we maximising yield. And if we talk in terms of units of nitrogen around that 250kg of nitrogen, that's a combination of applied nitrogen and what we're starting with from our deep soil nitrogen, was where we were able to maximise our yield within the focus paddocks.

[00:13:21] **Prue Adams** So the results from the focus paddocks are very much in line with the trial results. Aren't they?

[00:13:25] **Brendan Wallace** Definitely in line with what we've been seeing at a small plot level. We've also seen an additional from going higher than our 250 units of nitrogen, that we did see increases in grain protein. However, it comes back to an economic standpoint, particularly with bread wheat. Durum wheat's a little bit different because you do get paid for your extra protein, but in bread wheat, do you get an economic return when you maximise yield from just increasing grain protein? In the last few years, with that grade spread's paying maybe $5 to $10 a tonne more for hard wheat. The additional investment in nitrogen hasn't been worth it to achieve the higher protein in the grain sample. One of the critical elements is what have we actually got in the system? So what is our starting level of nitrogen within the soil? It can be tricky to measure at times because we do have varying sow types and soil depths even within a paddock. But we need to form some form of base level and understand what's our starting nitrogen level, because if we're not measuring it, we can't manage it. And we don't want to be applying additional nitrogen when it might not be required or utilised by the crop to maximise growing you.

[00:14:46] **Prue Adams** Then what can growers do to improve?

[00:14:49] **Brendan Wallace** Some things that farmers can practically do is alongside their agronomist, get some deep soil samples done at the beginning of the season to fully understand what is there at the beginning, and then you can calculate your nitrogen budgets around that. Because I think one of the biggest inefficiencies is, going out unknown with what those levels are, and increased levels of nitrogen that are applied with the view that more nitrogen equals more grain when that isn't necessarily the case.

[00:15:22] **Prue Adams** Brendan Wallace talked there about focus paddocks on farming properties. Wayne Hawkins farms at Francis along the SA/VIC border. He has nine centre pivots, growing a variety of cereal and legume crops under irrigation. I sat down to chat with him during a very wet winter, where there was so much water on the ground, it was difficult to get spreaders in to distribute urea. He'd had two focus paddocks under trial.

[00:15:50] **Wayne Hawkins** Most years we get asked whether we can have trials from SARDI and GRDC, and we're pretty keen to do that sort of thing because we all got to learn. So it's great to make a spot for them and also get a few results at the other end.

[00:16:03] **Prue Adams** So tell me about the focus paddocks. What did you have in and what did you learn?

[00:16:08] **Wayne Hawkins** Well, they were mainly wheat and some barley on two irrigated circles. And what we learned was that anything that had plenty of nitrogen had big yields. It was just a matter of all the numbers that added that up. And we found that it makes such a big difference. It's like putting a turbo on a crop, you know, it just takes off and you start putting plenty of urea at it. But the numbers have got to stack up too, that’s the big thing at the other end.

[00:16:31] **Prue Adams** Did you find, which is what the research found is, though, that there was a tipping point, that it wasn't just put more and more on and you get better and better, that it gets to a point where actually it now doesn't make sense for it anymore.

[00:16:45] **Wayne Hawkins** It was plenty of that there in that trial site. And, you know, years like last year when it was over $1,000 a tonne. Well, those numbers really stood out that you just can't go too hard.

[00:16:54] **Prue Adams** What do you normally do to achieve the maximum you when it comes to nitrogen?

[00:16:58] **Wayne Hawkins** Well, we've been mucking around with nitrogen for a while. I think when you go back, the big thing is to have the natural nitrogen crops, your sub clovers or your legume crops before your cereals, and that's your base. And then the urea is just a top up at the other end, because if you try and rely on it on too much, you're probably trying to put too much out.

[00:17:19] **Prue Adams** To what extent do you know what's in your system before the season starts in terms of nitrogen? Do you test?

[00:17:26] **Wayne Hawkins** We do deep N tests and we get results out of those, but they give us a guide. But we try to make it simple and have a blanket thing rather than chop and change too much.

[00:17:35] **Prue Adams** I think what's coming out of this research, among a whole lot of other things, is that, you know, you can't manage what you haven't tested, like if you don't know what's there to start with. So is that something that would change your way of doing things, or are you already doing that anyway?

[00:17:50] **Wayne Hawkins** Well, I think we've probably got to do more of it. When we test as a guide, but we've got a blanket system now, going back to Mr. Guru, you know Nick, he's taught us a lot of things, and we tried to do what his practices were. But the weather here sort of upsets us during the winter gets too wet. And when we're supposed to put it on growth size 32. You can't get into the crops are wet, they're losing colour and you got to have aeroplanes in. And it's no good putting area on water. So what we do now is get the crops in early, have a blanket covering as soon as the crops are emerged and then we walk away. But a year like this year, you know, there's a lot of question marks about prices and everything, and I'm keen to put another little dose on there. And that'll be Nick's talking now. But we winged a lot of it. But the big thing is to get the crops in early and get that urea out early.

[00:18:37] **Prue Adams** Would you put into a nutshell what you have learned from this project?

[00:18:41] **Wayne Hawkins** I think if you want to grow great crops, nature will determine what we do, but we've got to go for the medium run all the way through and nitrogen is the key on cereal crops.

[00:18:59] **Prue Adams** So to summarise, there's a tipping point with nitrogen application on irrigated wheat of around 200-250kg per hectare. Although location, weather and other conditions will of course make a difference to that number. Application timing is critical and know your nitrogen bank and yield goal before you do anything. Getting back to the old saying you can't manage what you don't measure. Many thanks to Nick Poole, Brendan Wallace, and Wayne Hawkins. This is a GRDC podcast. I'm Prue Adams. Thanks for listening.

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\*Note – this podcast was recorded in July 2023