Using precision agriculture to tackle challenges

SNAPSHOT

Growers: Daniel and Lora Adams

Location: Cockaleechie, South Australia

Farm size: 900 hectares

Annual average rainfall: 415mm

Soil types: Heavy red clay, sandy loam and acidic grey sand

Soil pH: 4.5-8

Crop program (2020): Cereals 60% (Vixen(ф) and Scepter(ф) wheat, Hindmarsh(ф) and Maximus(ф) CL barley) canola 30% (Pioneer 44Y94 CL), legumes 10% (Hurricane(ф) XT lentils)

Rotation: wheat-canola-barley-lentils

Photo: Daniel Adams

Daniel Adams and daughter Dimity.

Soil variability, ryegrass weed pressure and a relatively small cropping area are just three of the challenges Daniel Adams wanted to tackle when he began exploring precision agriculture methods almost 20 years ago.

Daniel and his wife Lora, farm 900ha across two properties at Cockaleechie, north east of Cummins, on South Australia's Eyre Peninsula.

The rolling hills, with crests 80m above the flatlands, strongly influence the movement of rainwater as it flows through a range of soils that vary from heavy red clay to good loam and acidic grey sand.

"There's a fair mix of soil types to work with," Daniel said. "We can have some of the best soils only 50-100m away from some of our poorest. The higher parts are generally heavier, but we've done a lot of soil mapping and it's quite variable over a lot of the farm."

The primary cereal crop is wheat and canola is the main break crop. Barley and lentils are also included in the rotation depending on soil type and the history of waterlogging in particular paddocks.

The 20-year average yield for wheat is 4.29 tonnes per hectare and 4.72t/ha for barley.

"That's probably 40 per cent up on a lot of our neighbours," Daniel said. "However, we are the smallest land holding around here. Most of the neighbours would have 50 per cent more land than us. So, we've got a smaller scale but we're focusing on the detail more, and with variable rate we're achieving some pretty big results off our land."

How it started

Yield mapping began in 2002 with an AFS yield monitor-equipped Case IH 2388, but problems with data collection, transfer and storage, and a lack of IT support meant they were unable to start using maps for decision making until 2008. That was the year Daniel bought a John Deere GS2 2600 autosteer system with rate and section control for the Hardie boom spray.

Added impetus came from a sudden spike in the price of fertilisers in 2008 when nitrogen reached more than $600/t and diammonium phosphate (DAP) peaked at $1220/t.

"That was the start for us on our variable rate journey," Daniel said. "The biggest gains we've made have probably been in that space. We had considerable cost savings from going to a replacement phosphorous strategy."

In 2009 the GS2 was used to yield map and steer a new John Deere 9750 header. Daniel also fitted a Topcon X20 console to the John Deere 8420 tractor and added a seed rate interface kit to the Simplicity 12000 seeder.

This enabled application of DAP at variable rates across four zones based on phosphorous removal indicated in the yield map from the previous season.

The 2010 crops were VR sown and pre-emergent herbicides applied VR using yield maps from high weed pressure years. Monoammonium phosphate (MAP) was VR applied across five zones with a long-term history of phosphorous removal.

Soil tests from high, medium and low production zones in a number of fields in 2011 delivered several findings. They indicated straight phosphorous replacement wasn't

Applying fungicide to flowering canola in 2020. Photo: Daniel Adams

enough for the higher production zones and some of the poorer zones contained high reserves. They also identified critically low pH levels in almost all the lower yielding zones.

"We'd already done a bit of lime spreading in the past, but it highlighted that we still had an issue there," Daniel said. "We've since pH mapped both our farms and I've tried to address the pH with lime and gypsum."

A John Deere GS3 2630 and ISOBUS Vicon section control linkage spreader bought in 2012 enabled VR nitrogen and the Gason spreader was converted for VR lime and gypsum in 2014. After using Satamap satellite imagery to create zones, Daniel began VR urea application in 2016 and now VR herbicides and seed rates as well. He achieved full controlled traffic farming in 2018.

"Looking at our farm as a whole, ryegrass has been our largest limiting factor," Daniel said. "It's always been an issue, but since we've been continuous cropping – which we've been doing for 25 years now – ryegrass and herbicide resistance has definitely emerged as a huge problem. It seems to be growing on some of the wetter areas of our farm, where it gets waterlogged, and just keeps growing when the crops tend to fade around it."

VR application of pre-emergent herbicides was initially informed by yield maps, but Daniel now marks and maps the presence of ryegrass patches on the GIS smartphone app, Map Plus.

"When I'm going across the paddock or out scouting in the field, I'll mark a waypoint, give it a value of one to five for how bad I think the ryegrass is there and then I can import that into our software," he said. "It's a bit clunky, but it works, and you've always got a phone with you or an iPad. It's been quite effective."

A Seed Terminator helps take care of weeds and weed seed at the end of the season.

The benefits

Daniel estimates he's saved as much as 20 per cent on his fertiliser bill by changing from flat rates of 100-120kg/ha of DAP to an average of 70-80kg/ha across the farm, applying from as little as 30kg/ha to as much as 120kg/ha to match production. Harder to quantify are the benefits that accrue from on-farm trials of different varieties, nitrogen rates, plant growth regulators and other new products.

"Since we started using PA, there was a step up in water use efficiency and wheat yield, which has really kicked in the last few years," he said. "It's hard to know what's down to variable rates and

Photo: Daniel Adams

Checking the progress of crops in 2020.

Photo: Daniel Adams

Spreading in-crop nitrogen.

Photo: Daniel Adams

Ryegrass waypoints marked on a map.

test strips but we certainly have been improving considerably over time."

A combination of deep ripping and gypsum application appears to be getting results in soils with compacted layers which cause problems in wet years and short seasons.

Daniel's philosophy has been to tick off the bigger items first, then look for opportunities to make smaller scale incremental improvements.

He bought a drone to use for creating maps but found the process too slow. Fortunately, Sentinel 2 satellite imagery became available around the same time and it has been useful for monitoring Normalised Difference Vegetation Index (NDVI) and measuring biomass as a guide to VR urea application during the season.

A single soil moisture probe in a spot that's considered representative of the better soils has provided valuable support for decisions about in-crop nitrogen.

"Certainly a couple of years ago, a lot of people were thinking they had huge crops, which were looking pretty good on top, but I could see there was nothing underneath," he said. "It takes some of the guesswork out. And this year, with the late rains last year and a bit of summer rain, we're actually sitting on the most soil moisture that we have for a long time at this time of year, which gives us just a little bit of added confidence for the season ahead."

What's next

Daniel said he's particularly interested to see where robotics leads, since autonomous units would be beneficial for slower or time-consuming tasks such as spraying and deep ripping.

"Keeping on learning is the main thing that I'm looking to do," he said.

MORE INFORMATION

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