Variable Rate Technology Farming (VRT)

Background

VRT allows farmers to be more efficient in fertiliser and seed application, boost production on some soil types and better manage risk. In the Mallee VRT has great potential due to the highly variable nature of soil types within paddocks and across farms.

Soil types can vary greatly in their capacity to hold plant available water and nutrients and this can set the limit to crop production. Targeting inputs that best suit the production zone provides the best use of a fertiliser budget and reduces risk.

The main aim of this project was to develop and refine VRT techniques best suited to the Mallee and work with farmers to remove the various barriers to adoption. Many farmers have the capacity to VRT, but just need some help, whether it be with the process, soils, mapping, computer hardware or software, machinery, data analysis or confidence.

Farmers are also unsure as to the cost effectiveness of investing in and applying VRT. Testing VRT on a small scale on farm aims to inform them of the advantages of the technology.

The method

28 farmers from fifteen farm businesses took part in the project. Each business had a different level of experience with precision agriculture, VRT farming, as well as different cropping systems and VRT machinery.

However, each went through a similar process to establish production zones and determine the inputs that would be trialled to measure the best return.

The method is outlined below:

- Paddocks surveyed using EM38 mapping and zones identified.
- Deep soil testing in each of the zones and soils analysed for texture, fertility, moisture and constraints.
- Soil testing results analysed and yield potential estimated using the "Your Soils Potential" and "Mallee Calculator" programs.
- Discussions with the farmer on the best seeding and fertiliser rates in each zone based on the estimated potential, risks and resources.
- Paddock input maps devised with test strips for high and low inputs and information translated to data maps suitable for farmer's machinery.
- Mid season monitoring and assessments to determine if post emergent nitrogen application is required
- Yield maps analysed against soil zones, EM38 ranges, trial strips and input costs to determine economic benefits.
- Results are used to make adjustments to VRT plans for future seasons.

Farmers applied seed and fertiliser rates according to paddock plans developed at the beginning of the season. This also included post nitrogen application and paddock test strips using their own equipment.

The economic analysis was based on the yield results versus the high and low fertiliser input trialled across all production zones.

The results

The equipment and VRT capability of each farm business was different but despite this the results always showed economic advantages to targeting different rates into different soil zones.

The advantage of VRT over flat rate fertilizer was often $10-30/ha but in some situations was $100/ha better off.

The mid slope sands responded best with higher fertilizer inputs at seeding, giving a consistently better return on investment.

Higher upfront nitrogen on sandier soils consistently lifted yields but was not often economic to do so.

Heavy loams with subsoil constraints and shallow stony soils gave the best results with lower seed and fertilizer inputs.

Deciding on the optimal inputs for the different zones was due to many factors including the farming system, attitude to risk, equipment capabilities and budget.

The EM38 has generally worked well as a basis for mapping soils, however there can be problems where stony soils can give readings like deep sand or heavy flats.

Therefore, ground truthing is really important to help identify the production zones. Farmer knowledge was as important as EM38 mapping and soil testing.

VRT was more beneficial in systems with intensive cereal rotations. Benefits were less obvious in paddocks following a legume crop.

For mapping and data capture it was best to use new USB or cards every year to minimize the chance of losing information, particularly when dealing with older machinery.

Recommendations

This project identified several key elements that need to be right to successfully VRT.

These include:

- Zoning based on understanding where soils vary enough to warrant treating differently.
- Working out the fertilizer rates for each zone based on the soil yield potential, crop needs, and season and fertilizer budget.
- Getting the spatial information into the correct data format for the farm machinery.
- Applying test strips to the different zones to determine the best rates for the soil types.
- When analyzing yield results from paddock strips it's important to make comparisons with the paddocks strips directly alongside the treatment otherwise the comparison could be unreliable.

Conclusion

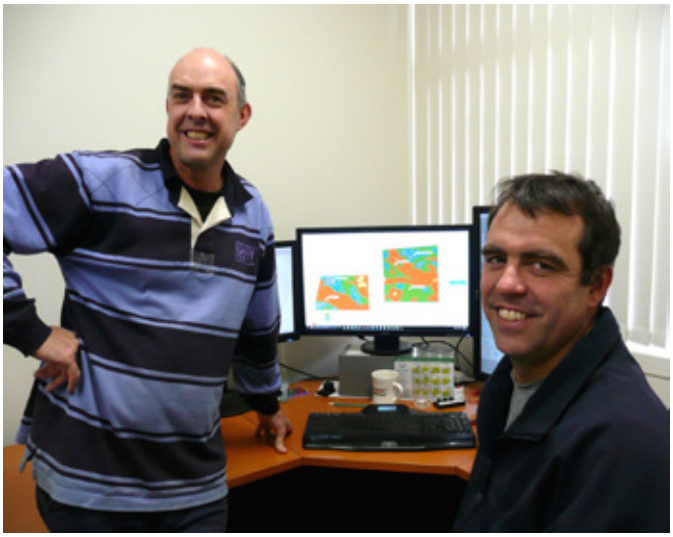
VRT farming in the Mallee has many benefits and can improve fertiliser utilisation and efficiency. While there have been some farmers that have successfully implemented their own VRT within their farming systems, there are many more that could significantly benefit from:

- Reducing input costs in low yielding, high risk or highly infertile areas,
- Improving yields in other areas through targeting higher inputs into soil zones with inadequate nutrition to reach their higher potential,
- Clearly analysing harvest results to better identify and manage key areas of opportunity and risk.

Providing farmers with soil and agronomy support as well as technical data management assistance for their machinery can rapidly increase adoption of VRT.

The project team

Technical data management support was provided by Scott Gillett, Wisdom Data and Mapping, while Chris McDonough, Insight Extension for Agriculture, assisted with soils, agronomy and analysis.



Chris McDonough (Left) worked with farmers to interpret the soil reports and agronomic information and Scott Gillett (Right) assisted with mapping and data management.

Paul Rudiger

Paul and his wife Briony farm 2,500ha on the south eastern edge of Loxton. This year's enterprise is 94% cropping, running Murray Grey cows and operating a cattle feedlot with hay and grain produced on farm.

Paul with sowing monitor controlled by tractor GPS

Farmer experience with VRT

As a sole operator, with help from son Brycen, Paul focuses on efficiency in order to get everything completed on time. This year 30% of the cropped area will be sown to pulses, for grass control and to help improve nutrition levels. 2016 will be the year of the pulse with five different legumes grown. A typical rotation being, a legume crop followed by a wheat and then a barley.

Paul has owned a no-till seeder with VRT capability for 12 years. He operates with 3.8cm accuracy to sow between stubble rows, but had not been using the VRT function. This was primarily because of issues with the tractor GPS not connecting with the air seeder GPS, despite the fact that the seed box was DGPS compatible. This is why Paul was keen to join the project, right from the start in order to have the technical support to work through the system issues.

Paul acknowledges that people can struggle with the move to VRT farming because systems don't always 'talk' to each other. In Paul's case the project team were able to resolve the problem with a cable that connected the tractor GPS monitor to the air seeder monitor. Paul commented that, "Before the VRT project came along I did not understand the process involved in getting VRT working. It sounds simple to purchase a cable but the technical support from Chris McDonough to create zones and rates for paddocks and Scott Gillett`s ability to draw the zones and provide the correct file to load into the tractor's console, is also very important".

Paul's experience is common and highlights the real benefits of the project. Adoption is rapid when the barriers are removed.

Paul has upgraded his harvester to the latest IntelliView IV monitor; this system records yield mapping and data. The IntelliView IV monitor operates auto section control and records paddock data in the sprayer. Yield maps were used in conjunction with EM38 maps to determine the three production zones on Paul's property. Soil test results, and Chris McDonough's experience helped to determine fertiliser rates in each zone. However, Paul's knowledge of how the paddocks performed was just as valuable and helped to fine-tune inputs.

Inter-row sowing on 3.8cm accuracy

During seeding time Paul commented that it was great to finally see the unit working. "It's exciting to see the rates changing and knowing that the system works. I can see the benefits of putting fertiliser where it's needed most". Fertiliser, at seeding, is going on the more productive sections of the paddock, which are generally the mid-slopes, with less on the flats and sand hills, which either don't need it or don't perform as well. Although the season remains an unknown, Paul is confident he can manage for better yields with post emergent top-dressing of urea.

Spraying monitor with auto section in operation.

Paul currently uses his air seeder box to spread urea and SOA and would like to upgrade to a specialised spreader to variable rate post emergent nitrogen.

Now that Paul has the system running he will work on using VRT across the entire farm, whilst seeking assistance from Scott Gillett and Chris McDonough to interpret the mapping and results.

Paul reflects on his experience with getting his VRT equipment to work. He makes the point that when buying equipment it's important to ask the right questions. He adds, "Usually the decision to buy a machine is based on other features and the technology is secondary. If you want to be VRT farming, the technology needs to be a primary consideration". The back- up technical support can be hard to find when buying second hand equipment.

Paul has made a conscious decision to stay with New Holland machinery to ensure everything is compatible, but he admits the technology is improving all the time and compatibility between different makes is also improving.

Paul can highly recommend the project to other farmers wanting to get into VRT, and urges others not to be put off if they don't have all the machinery. The project team provided excellent support to make VRT work in each situation, even if manually varying the rate of post emergent urea across zones.

"It's exciting what the technology can do", Paul adds. "It really keeps farming interesting and motivates me to see where it could all go."

Comments from Chris McDonough

Of Paul's 3 trial paddocks, the most significant gains from VRT management were $40-50/ha over where flat rates were applied. This was achieved by targeting higher inputs into the midslope sands and lower inputs into the heavy constrained flats in a consecutive cereal rotation. There was far less impact of varying rates in the wheat following a vetch crop.

Leon and Troy Braun

Leon, his wife Angela and son Troy farm a 4000ha property on the south east side of Paruna. Each year approximately 60% of the farm is sown to cereal on a two-year rotation. Some vetch is also sown for feed.

In the pasture phase grasses are sprayed early with a selective herbicide and then spray-topped in spring for successful no-till seeding in the cropping phase.

The Brauns own a John Deere Conserva Pak airseeder with VRT capability and had tried VRT in the past. Their tractors and harvester are also John Deere and they found that having the compatibility made it easier to get the system up and running.

Leon and Troy wanted to be involved in the project to get back into VRT and to give them the confidence that they were on the right track. Troy is very keen on using the technology and Leon wanted to make sure the methods they were using were correct.

In the past Leon and Troy had used yield and elevation maps to determine their soil zones, but Leon admits that this can fool you particularly in a dry finish where the sands may yield better than the good flats.

EM38 mapping and soil sampling added an extra dimension to what they were doing and they uncovered the heavy ground was low in phosphorous.

The heavy ground usually grows the best crops and had been removing too much phosphorous and there was more phosphorous available on the sand hills due to less production. It was clear VRT at seeding would be beneficial to get the balance of fertiliser inputs right in the different soil zones.

Troy and Leon Braun

Post emergent fertiliser application was the opposite story. More nitrogen was required on the sand hills than on the flats so VRT top-dressing was just as beneficial.

This finding encouraged the Braun's to invest in a dry rate controller to variable rate with the super spreader, a decision they say has been very worthwhile.

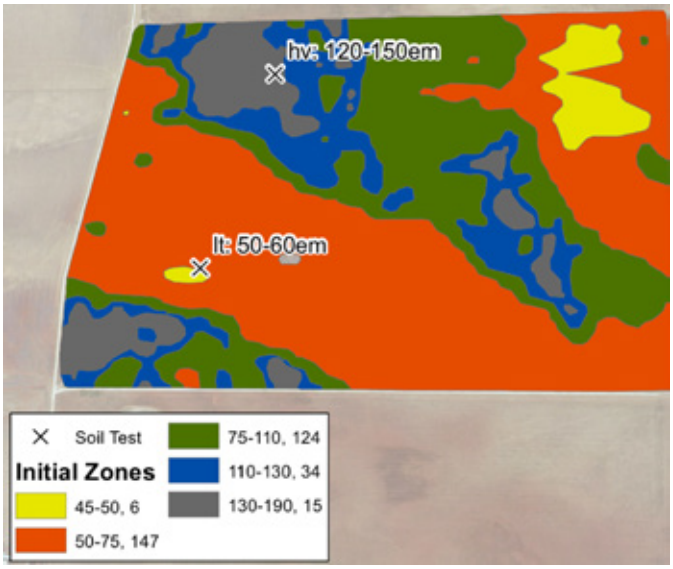
The test strips were visible at different times throughout the season. The extra 50kg sulphate of ammonia was too much extra nitrogen for the heavy ground but worked well on the lighter country and proved that VRT is really worthwhile in their country.

The stand out for Leon has been variable rate top-dressing. He commented, "It has been the best outcome of the project for us. The money we spent on the rate controller we easily saved in fertiliser that did not need to be spread on some of the country".

Leon found the EM38 mapping interesting and it was useful to have it done in the project paddock. He was also happy to learn that with his own experience he was able to draw paddock zones that mirrored the EM38 maps. "I may get EM38 maps done again in the future but I know I can do my own maps after 30 years of farming these paddocks", said Leon. "The program has given me the confidence to know what we were doing is right".

Soil testing is still important to the Braun's and they will continue to sample paddocks periodically.

Leon says the next step is to keep doing what they are doing. VRT is now embedded in their farming operation and they will continue to trial test strips and adjust rates to suit their rotation and the seasons.



An EM38 map of Braun's paddock

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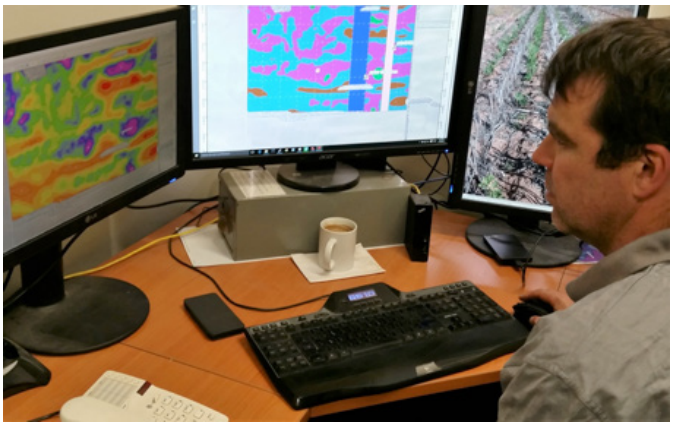
Comments from Chris McDonough

Analysis of Leon's trial paddocks revealed that if the optimal VRT fertiliser application had been used across the whole area it would have increased paddock gross margins by more than $50/ha over the flat rates that had been used.

It was also interesting that the initial VRT rates for the heaviest soils reduced rates by too much for the good rainfall season that Leon and Troy experienced. This emphasised the importance of using high and low rate test strips across zones to help refine and improve the VRT strategies that best suit each farm situation, from year to year.



Acknowledgments

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