Controlled Traffic and Precision Agriculture at Scaddan, Western Australia

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INTRODUCTION

We are a family farming operation in the mallee region of Esperance Western Australia. The farm is in partnership with parents Neil and Mary Wandel, brother Scott and myself. We farm two properties covering a total area of 15,600ha. One farm is at Mt Ridley and its area is 10,400ha and has an annual average rainfall of 350-400mm. The other farm is at Scaddan and its area and average annual rainfall are respectively 5,200 ha and 425-450mm. Both farms are continuously cropped. We also have a grain handling business in Esperance, Esperance Quality Grains, which comprises a 3,500 tonne elevated storage capacity with drying and cleaning facilities.

I manage the Scaddan operation with my wife Hayley and our 3 children. The soil types are mainly loams through to grey clays. Surface soil pH ranges from 5.5-8.0 and its depth ranges from 10-30cm. The subsoil is clay. The cropping rotation consists of a standard rotation for our region of;

- Legume crop (either faba beans, field peas or vetch)
- Wheat
- Canola
- Wheat
- Barley

CONTROLLED TRAFFIC SYSTEM

Controlled traffic operations were begun in 2004. At the time we saw controlled traffic as the next step to improving our profitability and sustainability. We could not see the point of driving all over the paddocks and damaging all the soil structure that we had worked hard to build up through no- till crop establishment practices. The system that was decided on was the 9m width-3m track width system, which includes

- A 18m wide seeder which plants rows 300mm apart
- Boomsprays that are 36m wide
- A harvester with 9m front
- A 9m wide self-propelled swather with deck shift that allows swath rows to be laid 18m apart in the same direction.
- A combined 9m wide-row seeder and shielded sprayer (want to go to 18m width).
- Spreaders with 9m and 18m spreading widths, for spreading gypsum, lime and super
- All the machines are on 3m wide wheel centres
- All the steering is done with John Deere RTK Base Station that has 2cm accuracy

FARM PLANNING

We were very lucky that all the blocks of land were surveyed on a north-south orientation, and so we came up with the plan of having one set of run lines for the whole 5,200ha at the Scaddan property, which is set on 180 degrees. This ensures workings are simple for operators, there is need to change run lines between blocks and mistakes are eliminated. Most of our laneways are east west through the farms which works well for access, and we drive on these during all operations. Some we have even realigned to ensure they run directly east-west.

RESULTS

We have been very happy with the results, and the improvements gained have occurred quicker than was first imagined. Some benefits are:

- The soil has become softer, more uniform and easier to work.
- Less horsepower and fuel are needed to pull implements.
- The soil appears to have an increased water holding capacity.
- There is substantially improved traffic-ability in wet conditions.
- Inter-row seeding has improved trash handling and crop establishment.
- We now have an increased number of opportunities to control weeds during the growing season.
- Our header trails every 18meters are burnt, and the tramlines act as fire breaks.

Controlled traffic has opened up many more opportunities to improve our farming system and I think there are a lot more to find. For instance, controlled traffic has given us (i) the opportunity to establish crops on less rainfall, and (ii) the ability to do operations exactly where we want to do them, and this improves overall efficiencies.

PROBLEMS

As with everything, controlled traffic farming has its problems. Some that we have encountered are:

- Getting the old man's head around it so it can all happen;
- Ryegrass weed infestation in tramlines, BUT this is reducing as tramlines get more compacted and hostile for plant establishment and growth;
- Rutting and water ponding in tramline depressions or in wet areas of the heavy clays.
- Improving the management of what is now uncontrolled traffic on our headlands;
- Trying to get everything to fit on tramlines for the minimum amount of expenditure;
- Swathing barley with the direction of seeding and trying to stop it from collapsing in to the space between the rows (we used to go at 45degrees to seeding direction); and
- Educating casual staff on what we are trying to achieve (i.e. don't drive everywhere, drive only on the tracks).

Some of the tactics we have applied to overcome these problems are:

- *Ryegrass in tramlines:* We have fitted shields on the front of sprayer to separately knock out the ryegrass in tramlines while spraying rest of paddock.
- *Controlling the traffic on headlands:* We are in the process of setting up run lines on the headlands so we will also have tramlines on the headlands in every block.
- *Swathing barley:* Seeding barley in the inter-row space of previous year's wheat stubble leaving so that the standing and largely undisturbed stubble supports the swaths.
- *Rutting:* At this stage we are continuing to drive straight through them. (We are still working on a solution to this problem.)
- *Educating casual staff:* We now have a 'code of conduct' that explains what and how operations are done in particular ways and why.

WHERE TO FROM HERE WITH CTF ?

The on-going improvements we plan are:

- Increase the width of the shielded spraying unit to 18m;
- To configure the spray nozzles to allow on-row and inter-row spraying with 150 mm nozzle spacing;
- Catching weed seeds out the back of the headers and place them on the tramlines where we know they are and can be managed; and
- Try and spread straw uniformly over an 18 meter span.

Wide row agronomy of Faba Beans

Dad has been growing Faba Beans since the 1980s at Scaddan they are good legume suited to the clay soil types and higher pH values particularly of our subsoils. We have had good and bad results with faba beans over the years. Our major problems occur after canopy closure, when good control of diseases and broad leaf weeds has proved to be very difficult. However, our best wheat yields have been obtained after faba bean crops.

We wanted to continue growing beans in a profitable way and were noticing that where plants grew without close neighbouring plants they set more pods and had less disease. This got us thinking about the viability of seeding faba beans in widely spaced rows.

In 2004 a wide row seeder and shielded sprayer was put into the farm operating plan. Out came the welder and it was built. It consisted of 750mm row spacings over a 9m width. An area of 400 ha was planted with this machine in the first year. Our goals when we first started with this system were to:

- reduce disease occurrence and incidence;
- improve podding by allowing more light to penetrate the crop canopy;
- reduce the need to use grass-selective herbicides; and
- improve the efficiency use of fungicides and other pesticide inputs.

Now, after 4 years our wide row system consists of seeding an 800ha program of beans seeded at 900mm row spacing. We have converted our Deep Blade Seeder® (DBS) with a second air seeder hose system which requires lifting two of every three tines out of the ground. We are using a 9m shielded sprayer and

are looking to purchase a 18m wide one. Currently, 73% of the paddock is being sprayed between the rows: 40% is being sprayed over the row. Harvesting with a 9m flex front. Our management stratagie is as follows:

i) Seed in or as soon as possible after the 3rd week of April at 80kg/ha.

ii) Six weeks after seeding, spray for grasses over the rows, with glyphosate between the rows.

iii) Spray fungicide, insecticide and trace elements over rows using banding nozzles with our JD4920 self-propelled sprayer.

iv) When the first flowers appear, which is normally 3- 4 weeks later, spray fungicide over the row with three nozzles at 120 l/ha of water and glyphosate, or Sprayseed® gramoxone between the rows.

v) Four weeks later, or before a rain event and canopy closure, spray broad acre with the JD4920 sprayer, applying fungicide at a minimum of 200 l/ha water rate.

vi) Again, 3-4 weeks later, depending on weather and growth conditions, spray broad acre with fungicide and insecticide at a minimum water rate of 200 l/ha.

vii) Pre-harvest, spray-top beans with gramoxone.

viii) Harvest as early as possible, in cool weather.

Experience has taught us that by applying fungicides earlier and via band spraying they are more cost effective. This successfully keeps diseases pressure down. We apply fungicides earlier before we see any sign of disease because they are really preventative, not a curative in their actions, and the high water rates are used to get superior coverage to protect the leaf.
Our wide rows and improved agronomy for faba beans has increased our average yields, mainly by taking the bottom out of the yields. It has also:

- Improved flower set, through more light penetration as flowers face towards the sun
- Helped them finish in dry springs probably because they can access moisture between rows
- Reduced disease pressure, through improved efficiency and effectiveness of fungicides
- Improved weed control through an increased in weed control options
- Decreased pressure on grass selective herbicides because of option to use knock down herbicides between the rows (but this has increased the pressure on knock down herbicides)
- Increased our average gross margins

ELECTROMAGNETIC SURVEYS

Managing sodicity

EM surveys are being used to map soil types across the farm. We have EM surveyed 20% of the farm at this point in time and are still discovering and working with what we can do with this information. Our first and most easy application from this data has been to map our exchangeable sodium percentage (ESP). We have found that as our EM reading increases the sodicity level in the profile is increasing, and this is a strong relationship with a R squared value of 0.81.

Through soil coring and soil testing we have mapped areas according to their gypsum requirement. These range from areas that need no gypsum through to some that require 20t/ha to correct the sodicity level.
In the past we would normally spread 1.0 to 2.5t/ha of gypsum every 5-6 years based on an average value for the soils in particular paddocks. Now we have divided the paddocks into around 6 zones and determined the rates of gypsum needed to correct the sodicity over time through the use of variable rate control on the spreader. Most rates vary from 0.4 to 5.0t/ha and we believe it will take 4-5 applications to achieve our outcomes. So, for us, gypsum applications are giving us the quickest return on investment in this technology.

Managing weeds

We have also been able to map the soil types on which ryegrass is more prevalent, such as buck shot gravel country, which has a shallow topsoil and a sodic clay subsoil. In consequence, it becomes wet very quickly and dries-out quickly. This rapid wetting and drying behaviour seems to favour ryegrass as populations on these are high. This year these areas have been targeted by applying higher rates of herbicide in a canola crop, and the level of weed control achieved has been excellent.

Future use of EM surveys

In the future, I believe EM surveys be done of the whole farm to map soil types according to their water holding capacity, nutrient requirements, soil constraints, weed problems and whatever else we can think of to gain efficiencies in managing the farm as soil-type-zones rather than paddocks.

Biomass NDVI imagery

The use of biomass NDVI imagery is an area that I feel has a fit for in-crop management of inputs. I am currently looking at different ways to cost effectively access these data when we need them, whether by satellite imagery to 1m resolution, Green Seeker® sensors, aerial imagery, or other real time sensors when operations are being carried out in the paddock. I am keen to improve on zone specific management for:

- applications for nitrogen, and manganese and zinc deficiencies;
- the control of waterlogging and water deficit stress;
- Faba bean biomass to yield ratio (I believe that when some of our beans grow too much in some seasons and forget to pod, there may be some gains to be had by applying variable rates of growth regulators).

CONCLUSIONS

Gathering zone specific information, ground truthing it and then obtaining an interpretation of it that translates into practices that work in the paddock are the main challenges confronting farmers contemplating an investment in this technology.

Controlled traffic farming has been a rewarding and challenging transformation of our farming practices. We are still refining it and finding more innovative ways to use it. Our next step is into precision agriculture and zone farming, which I see as an evolution that is as challenging, if not more so, than CTF. It will require ground truth surveys, computers, data analysis programs and a great deal of intelligence and experience in putting all the information into a usable form that get it into the field and working.