DAFWA eConnected Project – Final Update – September 2017

Summary

Over the last two years we have covered a number of digital tools, primarily in relation to a single paddock/site at the Battens farm. Most of these tools covered are decision support, or information provision tools. They can be broken down into several categories - and the relevant tools:

Yield Prediction – French & Shultz, Broken Stick, N Broadacre, Planfarm Bankwest Benchmark WUE, iPaddock Yield, Yield Prophet (including Productionwise)
Nitrogen – N Broadacre, Nulogic, Yield Prophet
Soil Water – Soil Moisture Probe, Soil Water App
Weather – DAFWA Weather station & App, Rainfall to Date, Extreme Weather, CliMATE
Phenology – Flower Power, Yield Prophet
Monitoring – Spectur Camera, USee Camera

There are a very limited number of tools we have covered that are in a ready state to be adopted by the majority of growers. Factors I consider to be important determinants of adoption are listed below.

- Of significant benefit to the user
- Easy to use (no, or limited training required)
- Limited information input required (or easy acquisition of this information for entry)

Unfortunately few of the tools we have covered in the project meet the above three criteria particularly well. Some effort spent improving the limiting aspects of these tools would go a long way to improving their rates of adoption. In the following report each category and relevant tools are discussed.

Two areas that this project has not covered, but which have shown their importance through this project are Connectivity – the reliability of internet access both at the main Homestead/Office, and distributed throughout the farm; and software to allow easy collation of data from multiple sources for consideration and storage for future reference. The government has spent significant amounts of money on the installation of four new mobile towers in the Yuna area over the last few years. This has highlighted that current mobile communication technology is not likely to provide the widespread coverage or access to the amount of data required by current technologies (let alone future technology) any time in the near future. Investigation should be conducted into alternative options that allow data transfer across the farm (eg. Wi-Fi), and connection of the farm network to a fast reliable internet source that can be upgraded over time.

There are a myriad of useful tools currently available to growers (many of which can be improved) but whilst each tool may be simple and useful in its own right, the sheer number means that the amount of information, all offered in different ways, makes the information provided often more

overwhelming than helpful. There is a clear place for software that can provide a dashboard for the information/tools that each individual finds useful to be collated, and stored for historical reference in the one place.

Yield Prediction

In 2016 the most accurate yield prediction tools come the end of the season were iPaddock Yield, N Broadacre, and the Planfarm Bankwest Benchmark WUE method (See Table 1).
In 2017 the predictions vary much more than in 2016, as at mid-September (See Table 2). Battens estimate that the crop would most likely have yielded 1.6-1.7t/ha, however the crop has been hail damaged so we will not get an accurate final yield.

iPaddock Yield appears to be an accurate prediction tool – this is because it uses the farmers own historical data for prediction. It has also shown to be effective in studies by other grower groups. Because of its accuracy it is one of the most useful tools to adopt. It is also quite easy to use after the initial time and data intensive setup when historical yield and rainfall for the farm must be entered. Its biggest downside is that it can only be used for one scenario, therefore a grower with farms receiving significantly different rainfall, distinct soil type yield differences, or wanting to predict the yield of other major crops (eg canola) cannot use it more than one way. It also makes it impossible for advisors to use with multiple clients.

N Broadacre and the **Planfarm Bankwest Benchmark** method both rely on using Water Use Efficiency, which can introduce a fudge factor, but with a little effort users can become familiar with their typical WUE by soil type, and seasonal conditions. Most farm management consultants will calculate WUE as part of their business analysis. N Broadacre provides an easy to use app format, whilst the **Planfarm Bankwest Benchmark** doesn't, but it is a simple calculation - One third of Summer Rainfall + Two thirds of GSR multiplied by WUE (kg/mm/ha).

Broken Stick is an improved version of the **Original French & Schultz** model that can be useful due to its simulation of bucket size (and hence yield restriction when very large rainfall events occur in a single month), but is not available in an app or readily useable format.

Yield Prophet predicted yield poorly in 2016. It seems this is most likely due to a mismatch between the crops phenology and the phenology predicted by Yield Prophet – the crop flowered much earlier than predicted which meant it escaped drought and heat at the end of the season, which Yield Prophet expected to reduce yield. This poor match could be due to inappropriate temperature input (Yuna weather station), as well as model inaccuracy. The large amount of information required to setup Yield Prophet, and the complexity of the output information limits the number of growers and advisers who find it a suitable tool – however, for these few it has been a valuable tool.

Table 1. Yield Prediction Tools 2016 – Final harvested yield was 2.48t/ha.

Tool	Predicted end of season yield (t/ha)	Diff. to Actual	Data intensity
Original French & Shultz	2.11	-0.37	Low
Broken Stick	2.25	-0.23	Moderate
N Broadacre @ 15kg/mm WUE	2.28	-0.20	Moderate
Planfarm Bankwest Benchmark @ 15kg/mm WUE	2.28	-0.20	Moderate
iPaddock Yield	2.3 +/- 0.5	-0.18	Moderate
Yield Prophet	1.2	-1.28	High

Table 2. Predicted yield for 2017 as at mid-September.

Tool	Predicted end of season yield (t/ha)
Original French & Shultz	0.12
Broken Stick	1.2
N Broadacre @ 15kg/mm WUE	1.6
Planfarm Bankwest Benchmark @ 15kg/mm WUE	1.77
iPaddock Yield	1.7 +/- 0.5
Yield Prophet	????

Nitrogen

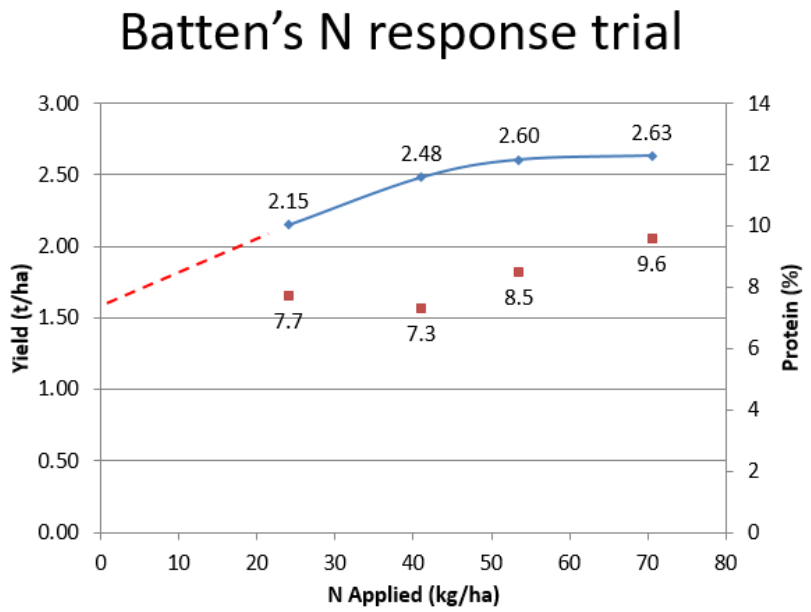
In 2016 the soft cool spring led to low protein in many crops. This confuses the N predictions somewhat. However using both N Broadacre and Nulogic and accounting for the final yield (2.5t/ha) and low protein (7.3%) of Battens Paddock where 41 kg/ha of N was applied both models gave a fairly accurate recommendation of about 40kg N in this scenario. The nitrogen response curve from the field experiment in 2016 (Figure 1) indicates that trying to achieve APW grade via application of more N would have required about 85-90 kg/ha of applied N total, and the increased return from selling APW wheat would not have covered the extra nitrogen cost.

N Broadacre is the only grower accessible tool (**Nulogic** is reserved for a group of advisors) and it offers an easily accessible app platform for minimal cost that can save multiple different scenarios. Along with Nitrogen predictions it includes a yield potential tool (discussed in previous section). The

downside for growers using N Broadacre is that the full capacity of the program is on display to all users, meaning there is an overwhelming number of boxes and efficiency adjustments on display that will not be understood by the occasional user with limited understanding of N budgeting. The option to toggle between a 'lite' version (including the bare essential options) and the full version may make this a more appealing app for growers, whilst allowing the retention of complex functionality for more frequent/advanced users.

The ability to adjust the efficiency of each individual pool of N makes the app infinitely customisable, but challenges it's usability when most advisors work on broader pools of overall N efficiency – ie. Soil to plant efficiency as a whole, or efficiency of fertiliser vs. organic vs. mineral sources of N. Some provision for these sorts of across the board adjustments would improve usability for advisors and growers.

Figure 1. Results from Battens N response trial on Mace wheat in 2016. Red dotted line indicates expected yield with less nitrogen applied.



Soil Water

In this project we have looked at two main methods of assessing soil water. One is a free and easy to use app that models soil water dynamics with limited setup required. The other is soil moisture probes, which can only be setup at one location, and which have significant costs.

The **soil moisture probe** at the eConnected site was installed in July 2016 and anyone can access the data at http://tiny.cc/grdc_probes or via the YFIG website. It shows that the Crop Lower Limit was achieved in late September 2016. Summer rainfall in February 2017 recharged the profile somewhat - primarily the 25-45cm layers. It was not until significant rainfall in August that the soil layers deeper than the topsoil were again recharged by rainfall. This water was rapidly used by the crop during grain filling - briefly halted by rainfall events in late September (Figure 2).

The soil moisture probe gives a useful indication of where in the profile recharge from rainfall has occurred, and where crop roots are drawing water from. It can tell us a lot about the soil water dynamics that we are otherwise just guessing at, or requires digging a hole. However there are serious limitations including; cost, reliability of equipment, each probe is a single point of data, and there is a lack of software to easily and effectively interpret the large amount of information generated by a probe.

The **Soil Water App** is a useful tool that is quite easy to use for displaying soil water dynamics. It appeared to over estimate evaporation after the February 2017 rainfall when comapared to the moisture evident when digging a hole at the site, and indicated via the soil moisture probe. However on the whole it gives an interesting perspective on how much moisture is remaining in the soil. One improvement may be to add a grower estimated yield option to the crop being grown/modelled to increase/decrease the modelled water use approriate to the quality of the crop.
In the image below (Figure 3) the rainfall used is based on Yuna weather station – the app has the functionality to use Yuna NE (and other DAFWA stations) but had a server error at time of writing.

Figure 2. Soil Moisture probe readout from October 1016 to September 2017

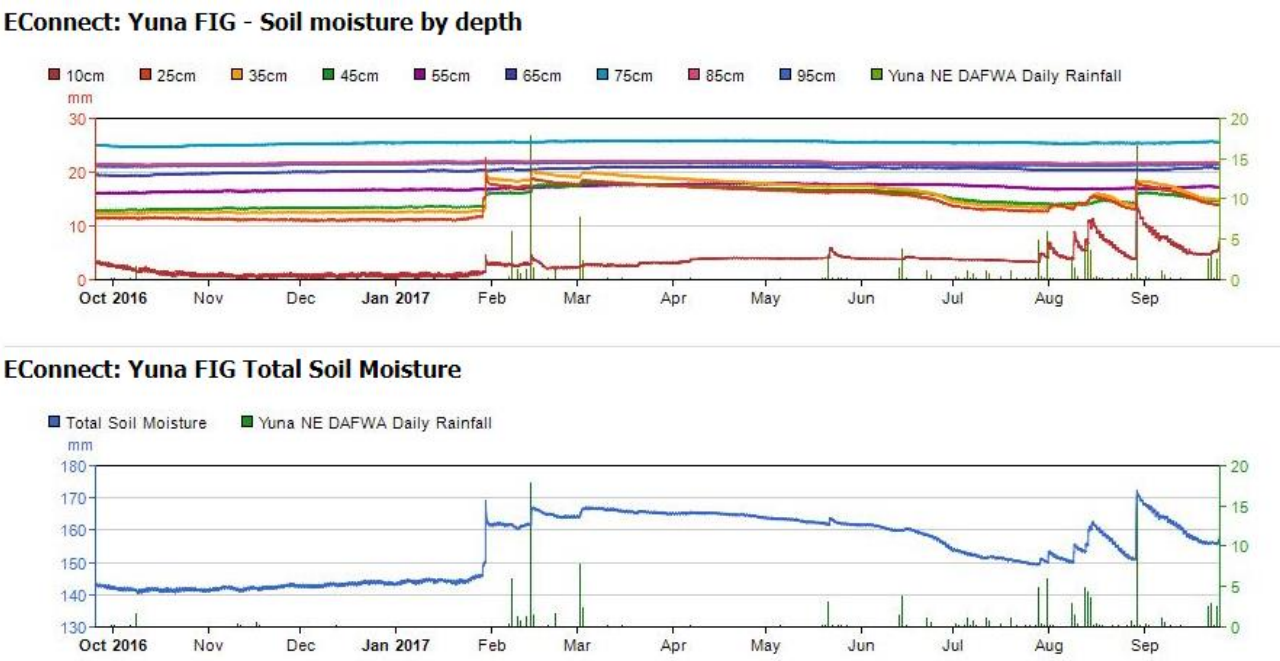
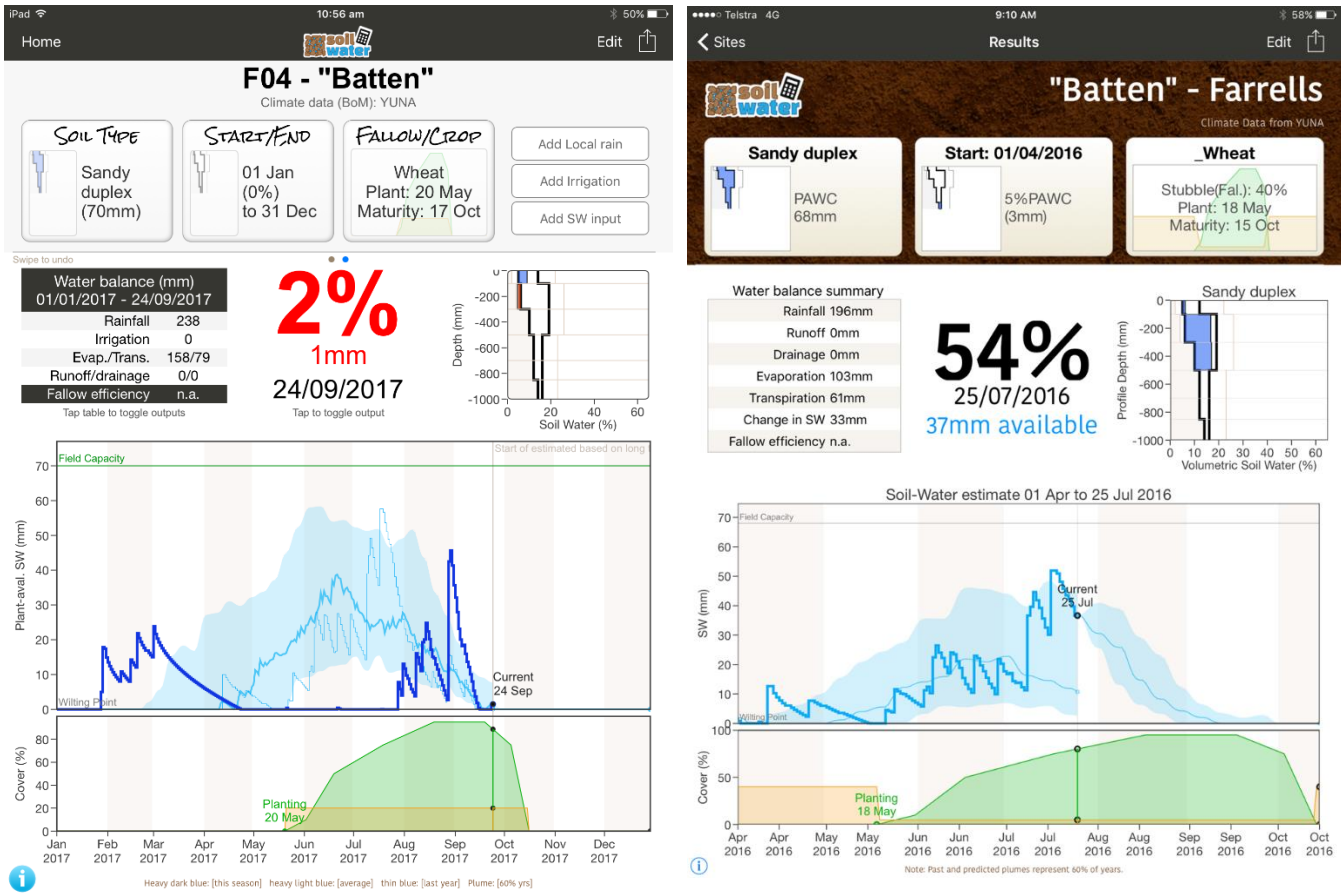


Figure 3. Soil Water App output from 24th Septeber 2017 (left) showing the modelled drawndown of moisture after February summer rain and during the growing season. In contrast an output from July 2016 (right) showing moddelled water use during a wet season.



Weather

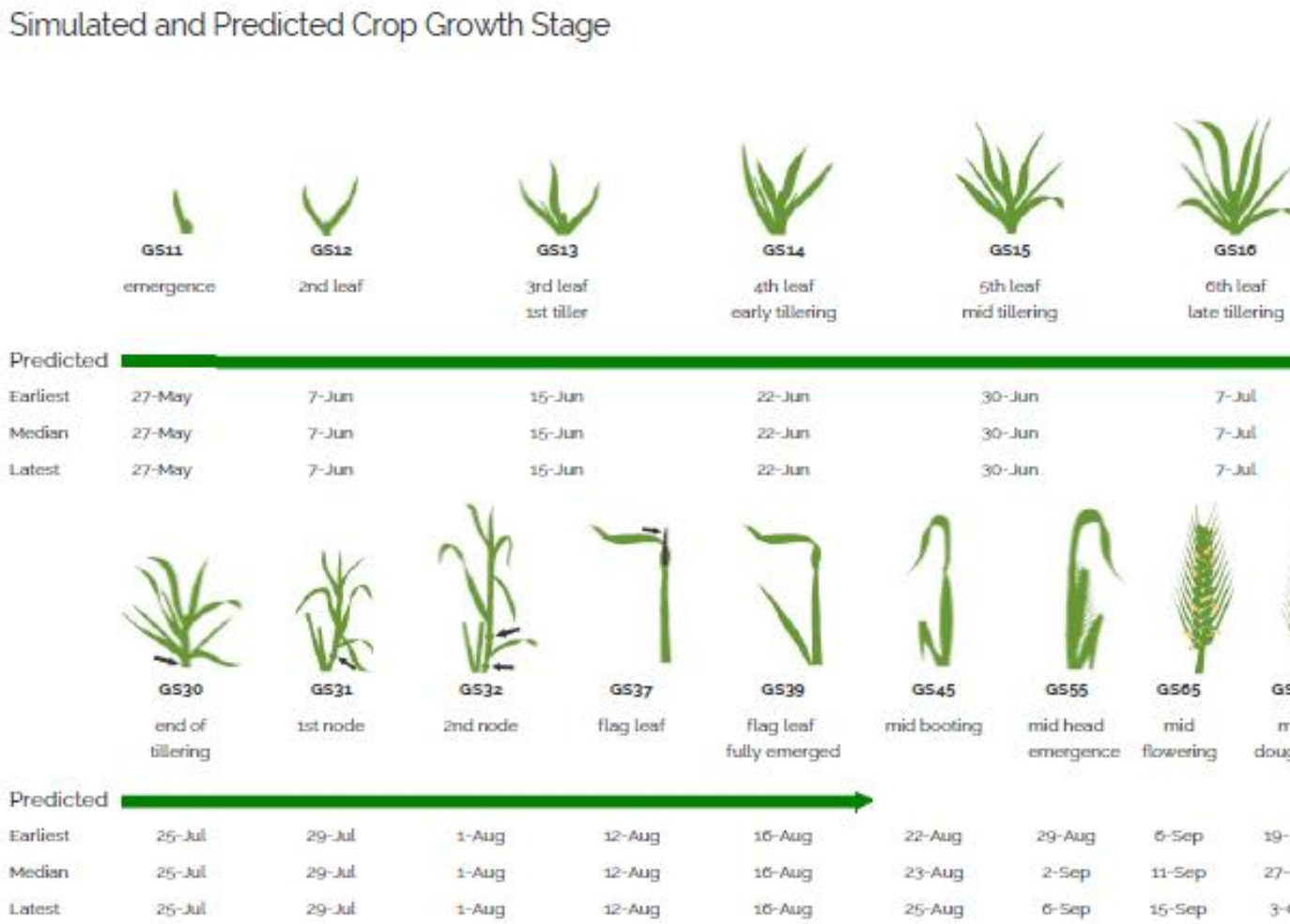
There are a range of weather related apps available, and DAFWA offers some useful tools, including the App that accesses data from their weather stations, and the rainfall to date and extreme weather events tools. They are all quite useful tools but are poorly packaged. They ought to be combined into a single app (with no login required; as well as a web based option) with money spent on good design, and an intenisve testing and feedback process with a range of farmers and advisors. Currently most DAFWA tools are underutilised because of their poor interfaces.

CliMATE is a good example of an app that provides very useful information and interogation tools and has been well designed for ease of usability. In fact it would be ideal for DAFWA to work with CliMATE on integrating their Rainfall to Date and Extreme Weather event approaches into the CliMATE App. CliMATE presents a range of climatic data in a variety of formats, with tools to make enquiries of the vast datbase of information stored within it – if you haven't used it yet I recommend trying it out.

Phenology

Phenology of crops is one area where our general industry awareness and understanding is quite low. The tools available to help describe crop phenology are limited to **Yield Prophet** which is quite complex, and **Flower Power** which predicts flowering time only and is based on historical observations and modelling. As such in 2016 when Yield Prophet predicted a late flowering crop, Flower Power predicted earlier flowering by nearly a month, and the true flowering date lay between both estimates. Late winter and spring was cooler than usual in the area – this would have been a large determinant of why actual flowering date was later than Flower Power predicted. Flower Power does not respond to in season conditions, just historical observations of time of sowing trials and some modelling, and as such will be accurate when seasonal temperatures are close to normal.

Figure 4. An example of Yield Prophet's growth stage information.



Monitoring

During the project we have tried two different monitoring options. The **Spectur Camera**, which is a security video/still camera that has a motion sensor that will trigger recording of a video segment. It also provides a live stream of intermittent photos. We believed the camera was able to take photos at a specific time each day, but these were not accessible via the website.

In 2017 a **uSee Camera** was trialled. uSee was founded by a pastoralist in north QLD, and the cameras are distributed locally by Matt Carrick, Dongara. The image is of a lower quality than the Spectur camera, but images are set to be recorded at specific times of day, and these are all available in a stream on the website. In addition a request for an image can be sent from the website, and a current photo will be taken. The camera is fairly easy to move from place to place - ensuring it is unbolted from the star picket prior to hammering into the ground. It could have use in crops in the winter and at troughs/tanks/dams during summer. Reasonable mobile signal is still required, which will limit the usefulness to some growers.

Figure 5. uSee camera website dashboard.