## DAFWA eConnected Project Decision Tools Update – July 2016

The target paddock with moisture probe (yet to be installed) and weather station was sown on 18th May to Mace wheat at 60kg/ha with 40kg DAP and 40L of Flexi N. It has since had 40L of Flexi N applied (18th June).

The decision making tools currently under investigation in the project include:

- Yield Prophet
- Flower Power
- iPaddock Yield
- Productionwise Crop Tracker
- Broken Stick – Modified French and Shultz by Yvette Oliver
- Rainfall & Rainfall to Date
- Soil Water App
- N Broadacre
- NUlogic – Nitrogen model
- Spectur camera

**Soil test data**

| Depth (cm) | pH Ca Cl2 | Colwell P | PBI | Colwell K | Nitrate | Ammonium | Exchangeable Sodium % |
|---|---|---|---|---|---|---|---|
| 0-10 | 5.8 | 30 | 15 | 136 | 7 | 1 | 1.1 |
| 10-20 | 5.5 | 38 | 18 | 135 | 3 | 1 | 4.7 |
| 20-30 | 6.1 | 30 | 19 | 154 | 1 | 1 | 15.7 |
| 30-50 | 7.0 | 32 | 28 | 257 | 1 | 0 | 29.6 |
| 50-70 | 8.0 | 5 | 39 | 435 | 1 | 0 | 34.7 |
| 70-100 | 7.8 | 2 | 40 | 448 | 2 | 1 | 37.0 |
| | | **Total N available to 1m:** | | | **19** | **kg/ha** | |
| | | **Total N available to 30cm:** | | | **14** | **kg/ha** | |

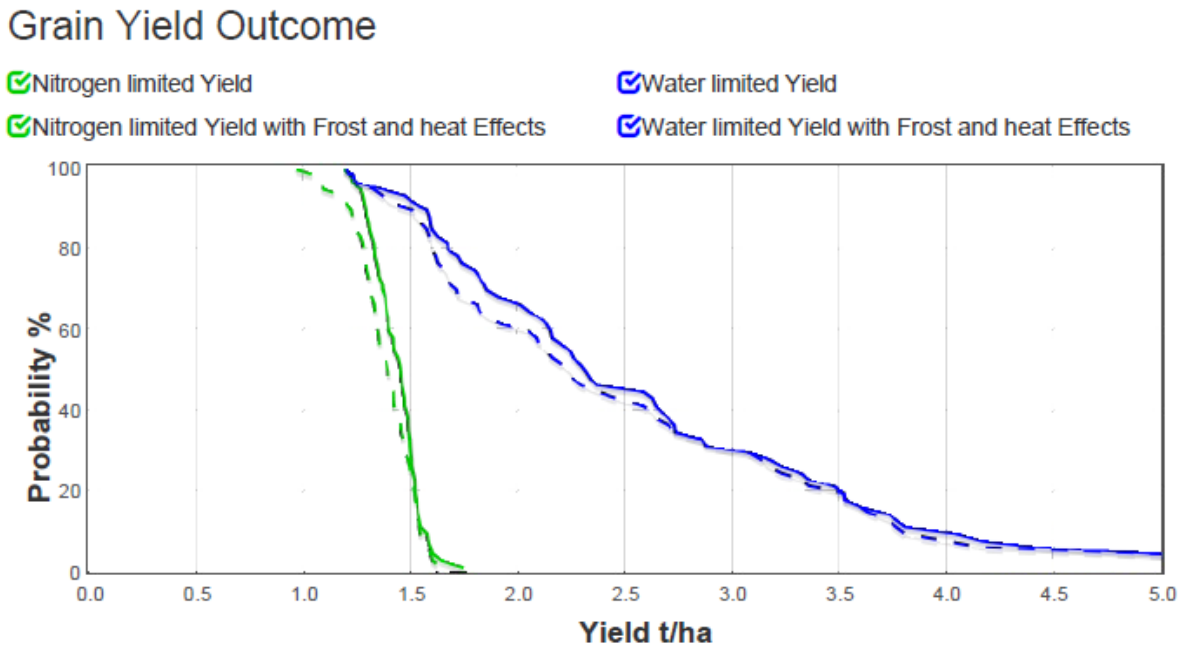
pH- is good and high at depth
P levels are good in the topsoil and also very high in subsurface layers
N – 14kg N was available to 30cm at soil sampling. The site was sampled 4th of April so 25mm of April will have mineralised some extra N prior to seeding. Top soil organic Carbon is only 0.48% so the addition may be small.
Exchangeable sodium percentage is high at depth. Kim and Jason's experience is that there is a layer that holds water up at depth. This sodic subsoil would drain only slowly.

**On Farm N response trial**

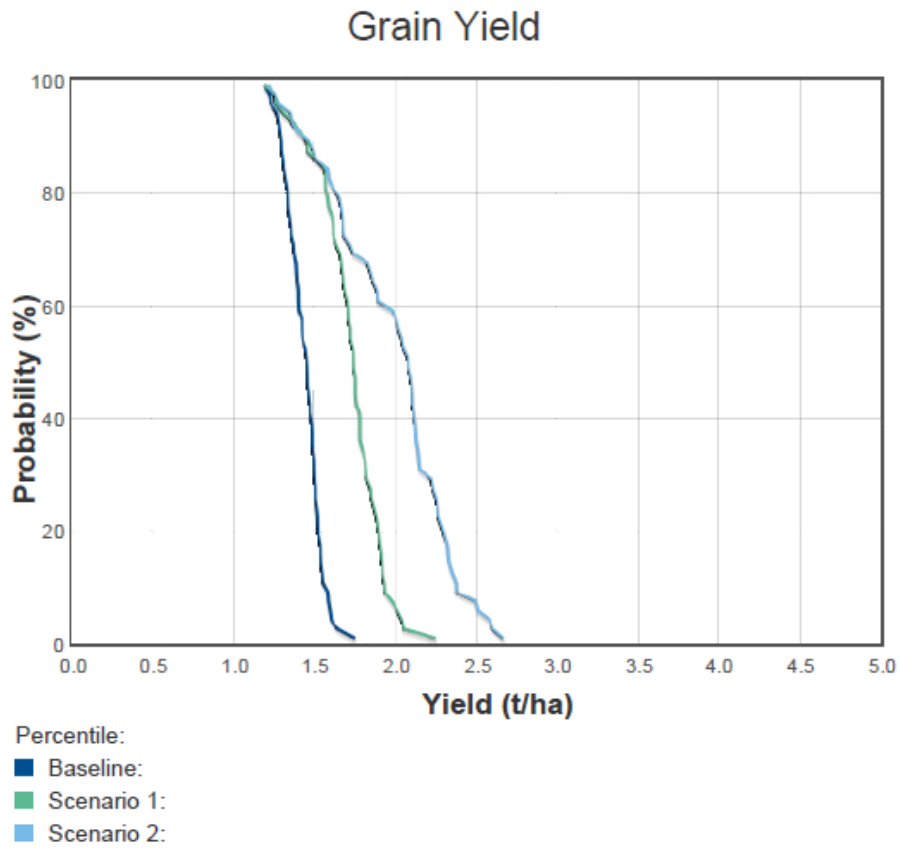
Rates applied as 40kg DAP plus 0, 40, or 70L (max for orifice plate used) of Flexi N at seeding. Every treatment was topped up with 40L Flexi N (17N) on 18th June. High treatment was topped up with an additional 40L Flexi N on 8th July.

| Trial Treatment | Seeding 18th May | 18th June | 8th July | Total N |
|---|---|---|---|---|
| Compound N + 40L UAN post | 7 | 17 | - | 24 |
| Low N | 24 | 17 | - | 41 |
| Medium N | 36.5 | 17 | - | 53.5 |
| High N | 36.5 | 17 | 17 | 70.5 |

**Yield Prophet** login Username: yfig  Password: yfig
The yield forecast for Battens paddock is below. Yield potential with 41kg/ha of N is about 1.4 t/ha at 50% probability. Yield Prophet is still predicting higher yields if nitrogen is non-limiting. This should be interpreted with caution. The nitrogen response trial in this paddock will confirm if more N was beneficial.

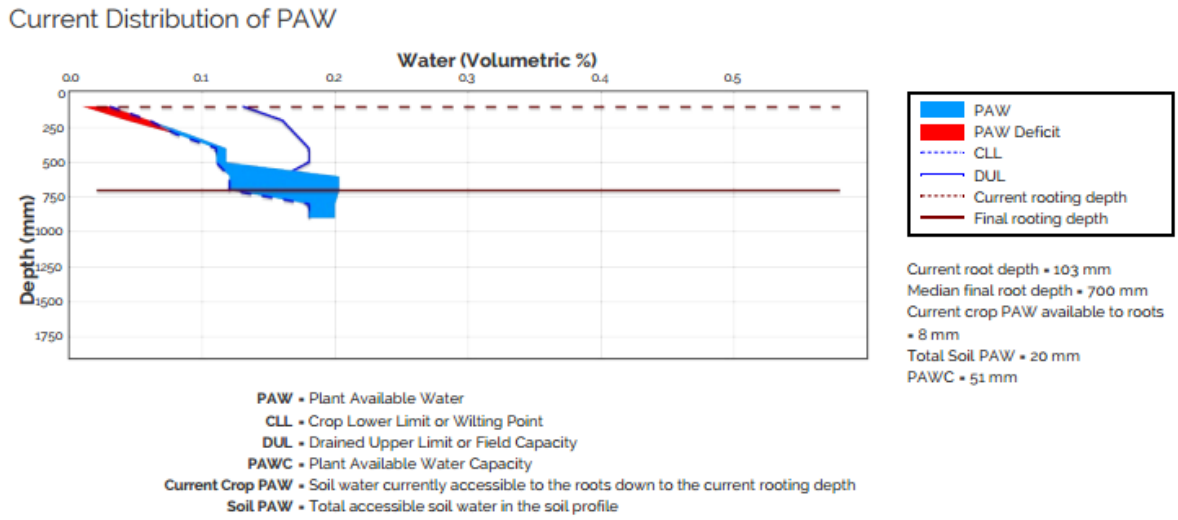


Yield Prophet can be used to model the effect of different timing and amount of nitrogen applications on yield. The below graph models the likely yield of three N scenarios. The baseline is 41 of N. Scenario 2 has 53.5N applied and scenario 3 has 71 N applied. The corresponding yields at 50% probability are 1.45 t/ha, 1.75 t/ha, and 2.1 t/ha. You can also run a Nitrogen Profit report in Yield Prophet which estimates likely returns of different N scenarios.

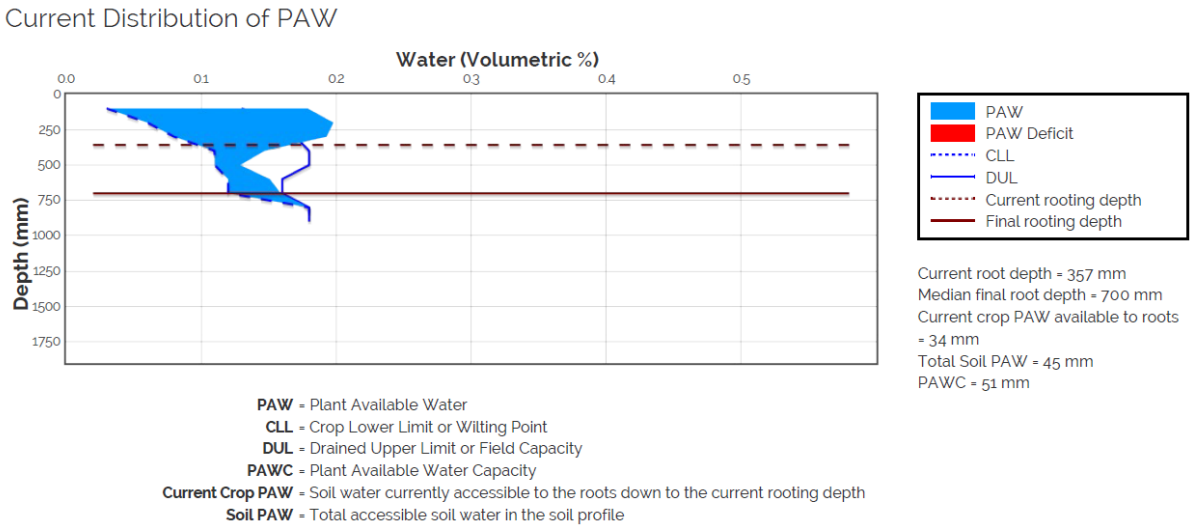



Yield Prophet also models soil water dynamics. Good winter rainfall is modelled to have recharged the entire profile. The Soil Water App models the 'bucket' as being less full, and less absolute Plant available water than Yield Prophet. See Soil Water App section.

Mid May graph

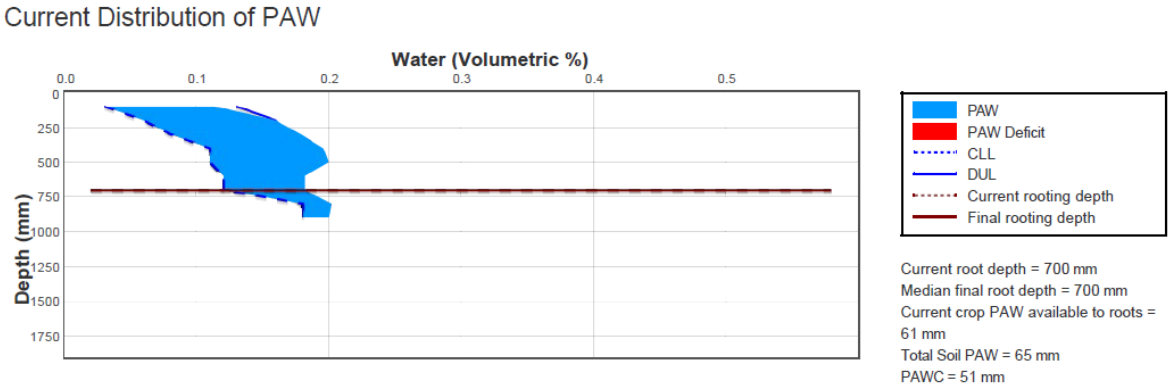


Mid June graph




**PAW** = Plant Available Water
**CLL** = Crop Lower Limit or Wilting Point
**DUL** = Drained Upper Limit or Field Capacity
**PAWC** = Plant Available Water Capacity
**Current Crop PAW** = Soil water currently accessible to the roots down to the current rooting depth
**Soil PAW** = Total accessible soil water in the soil profile

End July graph

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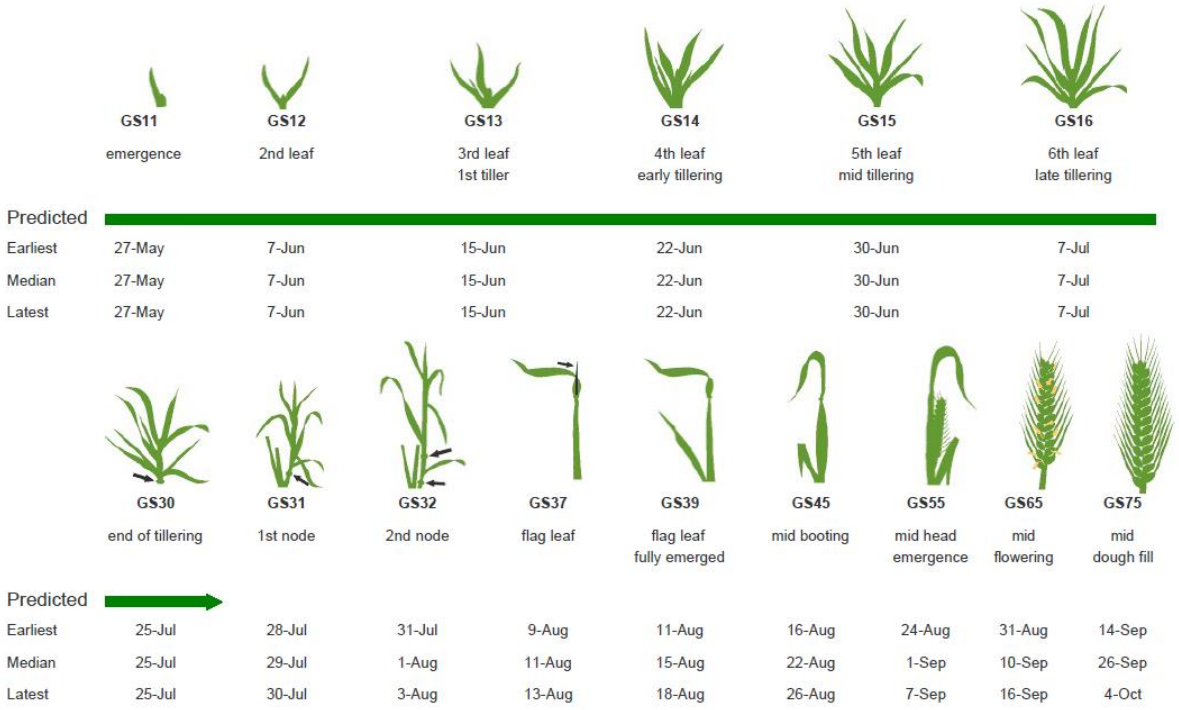
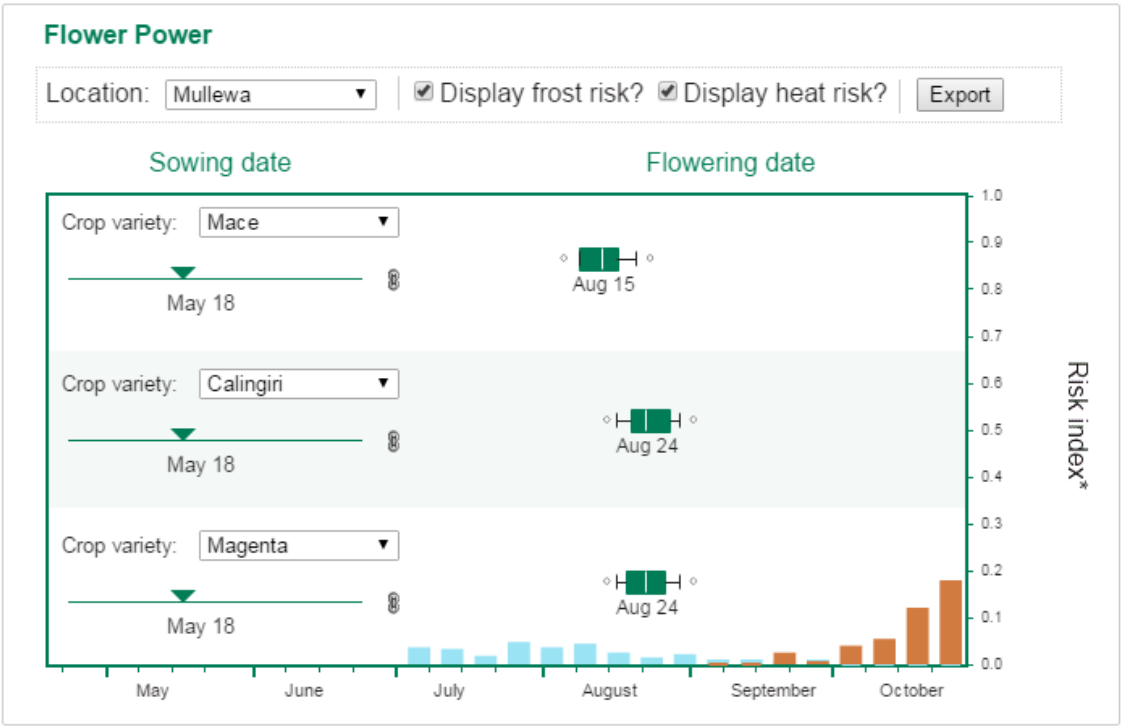
Phenology

Yield Prophet models phenology to help predict yield and N requirements. We saw in the time of sowing trials last year that it is not very good at predicting development of early sown crops. It is suggesting the crop should be at 1st Node on Friday (29th July).




**Flower Power**

DAFWAs Flower Power Tool can also be used to predict flowering dates – though it does not provide information on any other growth stages. It is suggesting that Battens paddock (Mace sown 18th May) will be mid-flowering on the 15th August with a low risk of frost and heat stress. In contrast Yield Prophet is predicting flowering to occur on the 10th September. This is very unlikely. Flower Power is much more likely to be correct as it is developed based on local observation of flowering times in the field. Yield Prophet is predicting a moderate risk of heat stress due to this late flowering date.



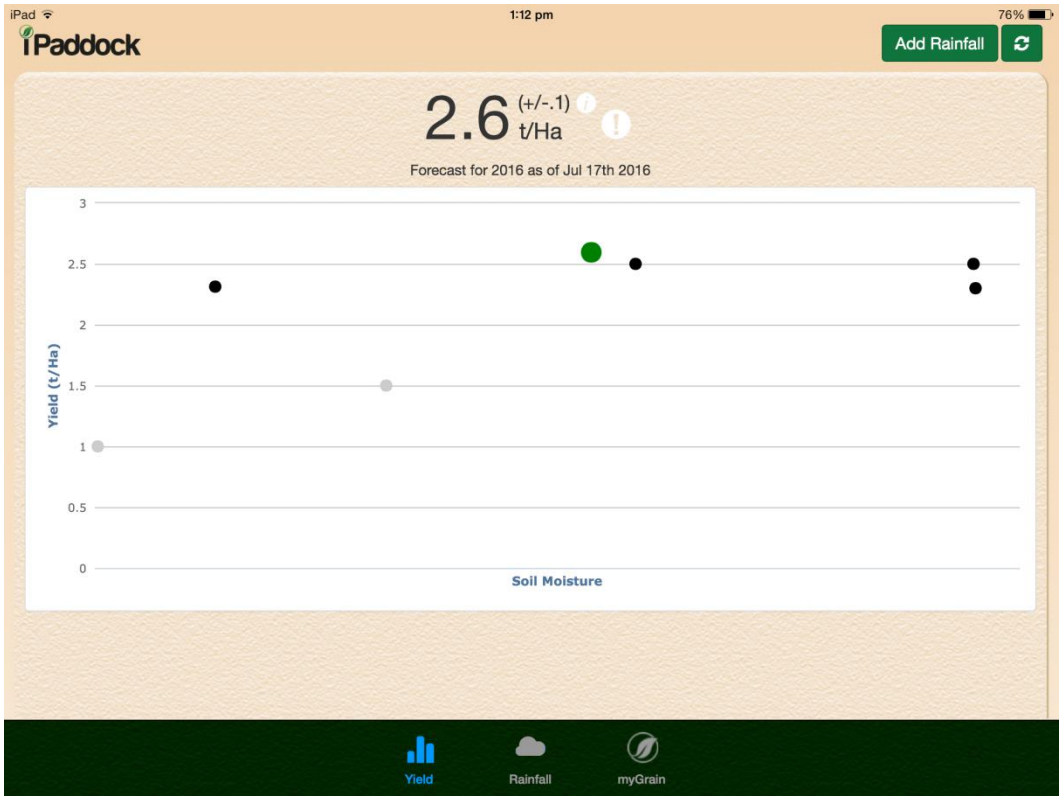
**iPaddock Yield**

iPaddock Yield was developed by Esperance grower Mic Fels to provide an easy to use yield prediction tool based on historical rainfall and how well your farming system/soil has converted that to yield. You need to enter your yield and rainfall data. Kim has removed some of the lower yielding years from the May to June graphs below which has 'improved' the predictive ability. The scatter of data in the mid May graph suggests that iPaddock yield may not be the best tool to predict yield in this environment. In less variable yield environments ie. Where historical data forms a more linear relationship iPaddock yield is likely to work better.

Mid May


Mid June

End July

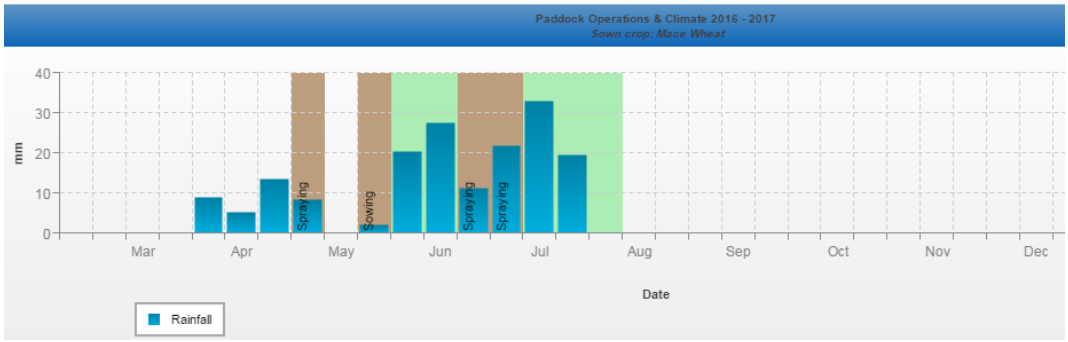



**Productionwise**

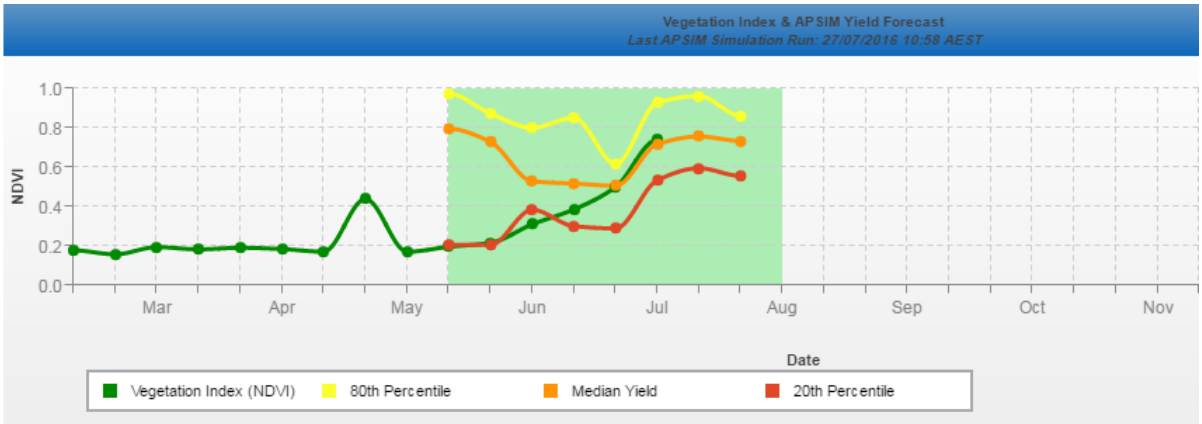
Productionwise is a paddock management software much like Agworld or Back Paddock. It is both a web platform and an App and growers and agronomists can plan, recommend, and record paddock activities. The basic functionality of the platform is free. In addition to the basic functions are some more involved tools – of interest here is the Crop Tracker. Paddock inputs are used as the inputs to APSIM (the model behind Yield Prophet) to generate paddock by paddock yield predictions. In addition frequent large pixel biomass imagery is averaged over the paddock and displayed over time. Crop Tracker is a paid annual subscription that Grain Growers have kindly waived for this project.

You can logon via the web or download and login to the iPad App (Crop Tracker doesn't seem to be available on the App). You can even create a new farm and enter data for a paddock or two of your own to see how it might work for your business. Username: Batten_Farms Password: yfigyfig

Below is rainfall and paddock operations for Farrell's Mailbox Paddock this year. (Rainfall from Yuna)



NDVI in early July was 0.74. APSIM based yield predictions are 1.55t/ha in the best 20% of years, 1.32t/ha in 50% of years and 1t/ha in the bottom 20% of years.




**Broken Stick**

The Broken Stick model has been created as an excel model by several people based on the work of Yvette Oliver to modify the French and Shultz equation to better predict yield, especially when infrequent large rainfall events saturate the profile and water is lost below the crops rooting depth. It requires you to estimate a bucket size based on soil type and rooting depth, and enter your summer and winter rain so far as well as an expectation of rainfall for the rest of the growing season. An advantage of this method is like iPaddock Yield it works off your farms rainfall, not the nearest weather station with historical data, and unlike most other models you can enter your expected rainfall or different rainfall scenarios.

The output below utilises rainfall to date for Batten's paddock combined with average rainfall for the last 16 years as the expected rainfall for the rest of the season. In this rainfall scenario altering the bucket size has no influence on yield as the profile is never predicted to reach its Plant Available Water Capacity (Full Bucket). This model is predicting a yield of 1.92t/ha at this point in time. This is a significant increase on earlier modelling (1.4t/ha) due to rainfall in June & July being well above the last 16 years average rainfall for these months that was used as expected rainfall. These values are displayed in the next section.

| 1. | Bucket Size? | mm/m |
|---|---|---|
| | Enter appropriate value in the gray box | |
| | Soil Type | 60 |
| | Sand | 40 |
| | Sandy Loam | 60 |
| | Duplex | 80 |
| | Clay | 100 |
| | | m |
| | Rooting Depth (m) | 0.8 |
| | Bucket Size (mm) | 48 |

| 2. | Stored Summer Moisture | |
|---|---|---|
| | Enter values for rainfall events greater than 15mm only | |
| Months | Rainfall > 15mm | Stored (mm) |
| Nov/Dec | 0 | 0 |
| Jan/Feb | 0 | 0 |
| Mar/Apr | 0 | 0 |
| SUM | 0 | 0 |

| 3. | Rainfall to date (mm) |
|---|---|
| May | 20.8 |
| June | 56 |
| July | 47 |
| August | 26 |
| September | 20 |
| SUM | 169.8 |

| | |
|---|---|
| **RF actual** | Actual rainfall, and expected future rainfall. Same values as entered in 3. |
| **RF max** | Maximum rainfall that can be held in the 'bucket', plant root zone (ie. without leaching below) in that month |
| **RF used** | Amount of rain from that month that has been added to the 'bucket' |
| **PAW end** | Plant available water at the end of the month. mm in the 'bucket' |

| | RF actual | RF max | RF used | PAW end |
|---|---|---|---|---|
| **May** | 21 | 77 | 21 | -8 |
| **June** | 56 | 95 | 56 | 9 |
| **July** | 47 | 82 | 47 | 13 |
| **August** | 26 | 84 | 26 | -10 |
| **September** | 20 | 94 | 20 | -26 |
| SUM | 169.8 | | 169.8 | |
| | **Total Plant Available Rainfall** | | 80 | |
| | **Yield (t/ha)** | **Wheat** | **1.92** | |

**Rainfall**

Not a model, but what has been used for years to predict crop yield – and it's changing. The data presented below is rainfall for Wandana (Batten homestead). The full data set averages are from 1960 to present. Only years since 2000 are displayed in the screen shot below. There has been a clear decline in average rainfall mainly in May, June, and July, and a moderate increase in March. April to August rainfall has declined by a massive 68mm or 32% to an average of only 142mm over the last 16 years. Using the original French and Shultz equation 142 mm growing season rainfall, minus 110mm of evaporation, times 20 kg/mm equates to a wheat yield of a little over 600kg. Luckily this relationship does not hold true in low rainfall and no till farming.

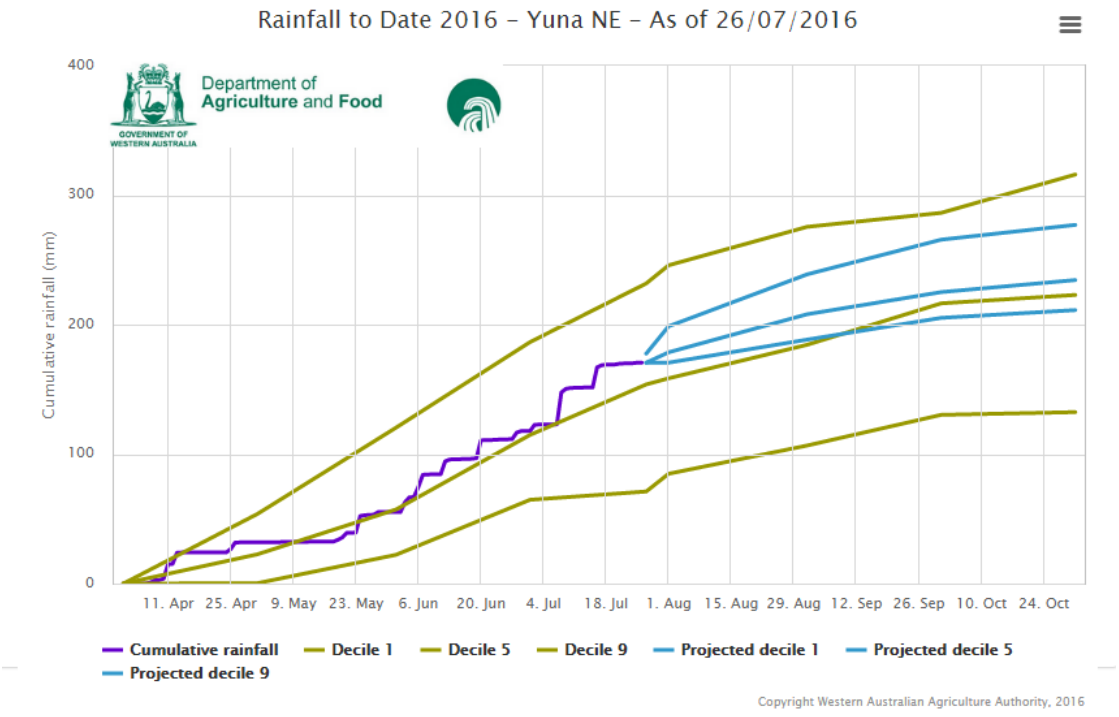
| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual | | Oct-March | Apr-Aug |
| 42 | 2000 | 18 | 3 | 188 | 11 | 5 | 19 | 39 | 29 | 9 | 14 | 0 | 3 | 337 | | 275 | 102 |
| 43 | 2001 | 16 | 29 | 0 | 8 | 30 | 20 | 46 | 19 | 30 | 79 | 17 | 0 | 293 | | 62 | 122 |
| 44 | 2002 | 41 | 3 | 0 | 12 | 31 | 28 | 28 | 22 | 15 | 8 | 2 | 0 | 190 | | 139 | 122 |
| 45 | 2003 | 1 | 3 | 3 | 11 | 41 | null | 32 | 57 | 37 | 4 | 48 | 0 | 238 | | 17 | 142 |
| 46 | 2004 | 0 | 9 | null | 47 | 41 | 30 | 41 | 20 | 41 | 3 | 1 | 6 | 239 | | 61 | 179 |
| 47 | 2005 | 0 | 12 | 11 | 25 | 69 | 69 | 12 | 32 | 24 | 9 | 2 | 0 | 264 | | 33 | 207 |
| 48 | 2006 | 39 | 54 | 3 | 38 | 19 | 19 | 13 | 17 | 26 | 0 | 0 | 22 | 250 | | 106 | 107 |
| 49 | 2007 | 14 | 5 | 0 | 0 | 6 | 28 | 38 | 7 | 9 | 2 | 1 | 34 | 143 | | 41 | 79 |
| 50 | 2008 | 0 | 127 | 47 | 23 | 9 | 39 | 65 | 12 | 18 | 7 | 2 | 9 | 357 | | 210 | 147 |
| 51 | 2009 | 0 | 7 | 0 | 0 | 22 | 64 | 72 | 19 | 19 | 4 | null | 6 | 213 | | 25 | 177 |
| 52 | 2010 | 0 | 0 | 9 | 6 | 25 | 39 | 39 | 69 | 8 | 1 | 0 | 79 | 275 | | 18 | 178 |
| 53 | 2011 | 45 | 107 | 0 | 1 | 53 | 56 | 62 | 38 | 8 | 33 | 1 | null | 406 | | 233 | 211 |
| 54 | 2012 | 21 | 41 | 0 | 13 | 9 | 69 | 8 | 20 | 21 | 0 | 7 | 5 | 213 | | 96 | 119 |
| 55 | 2013 | 13 | 19 | 28 | 5 | 30 | 3 | 15 | 20 | 18 | 12 | 0 | 0 | 162 | | 72 | 73 |
| 56 | 2014 | 0 | 0 | 0 | 66 | 48 | 13 | 12 | 10 | 41 | 18 | 0 | 0 | 208 | | 12 | 150 |
| 57 | 2015 | 10 | 27 | 196 | 37 | 7 | 28 | 56 | 26 | 0 | 0 | 13 | 0 | 400 | | 251 | 154 |
| 58 | 2016 | 14 | 0 | 8 | 25 | | | | | | | | | | | 35 | 25 |
| 59 | | | | | | | | | | | | | | | | | |
| 60 | Average | 17 | 22 | 21 | 26 | 45 | 56 | 52 | 31 | 20 | 12 | 8 | 9 | 325 | | | 210 |
| 61 | 16 year Avg | 14 | 28 | 32 | 19 | 28 | 35 | 36 | 26 | 20 | 12 | 6 | 11 | 258 | | | 142 |
| 62 | | | | | | | | | | | | | | | | | |
| 63 | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | | | |
| 64 | | | | | | | | | | | | | | | | | |

Rainfall for 2016 has been: May: 20.8mm June: 56mm July: 47mm

**Rainfall to Date**

DAFWA's rainfall to date tool visually displays rainfall received against historical rainfall deciles, and the influence of different decile rainfall from today's date to the end of the season. It shows how different 2016 has been to the previous 3 years with relatively frequent rainfall events maintaining rainfall at or above decile 5 since the end of May.

| Period | Cumulative rain(mm) | Decile |
|---|---|---|
| Summer 01/11/2015 to 31/03/2016 | 35.4 | 4 |
| Growing Season 01/04/2016 to 26/07/2016 | 170.6 | 7 |

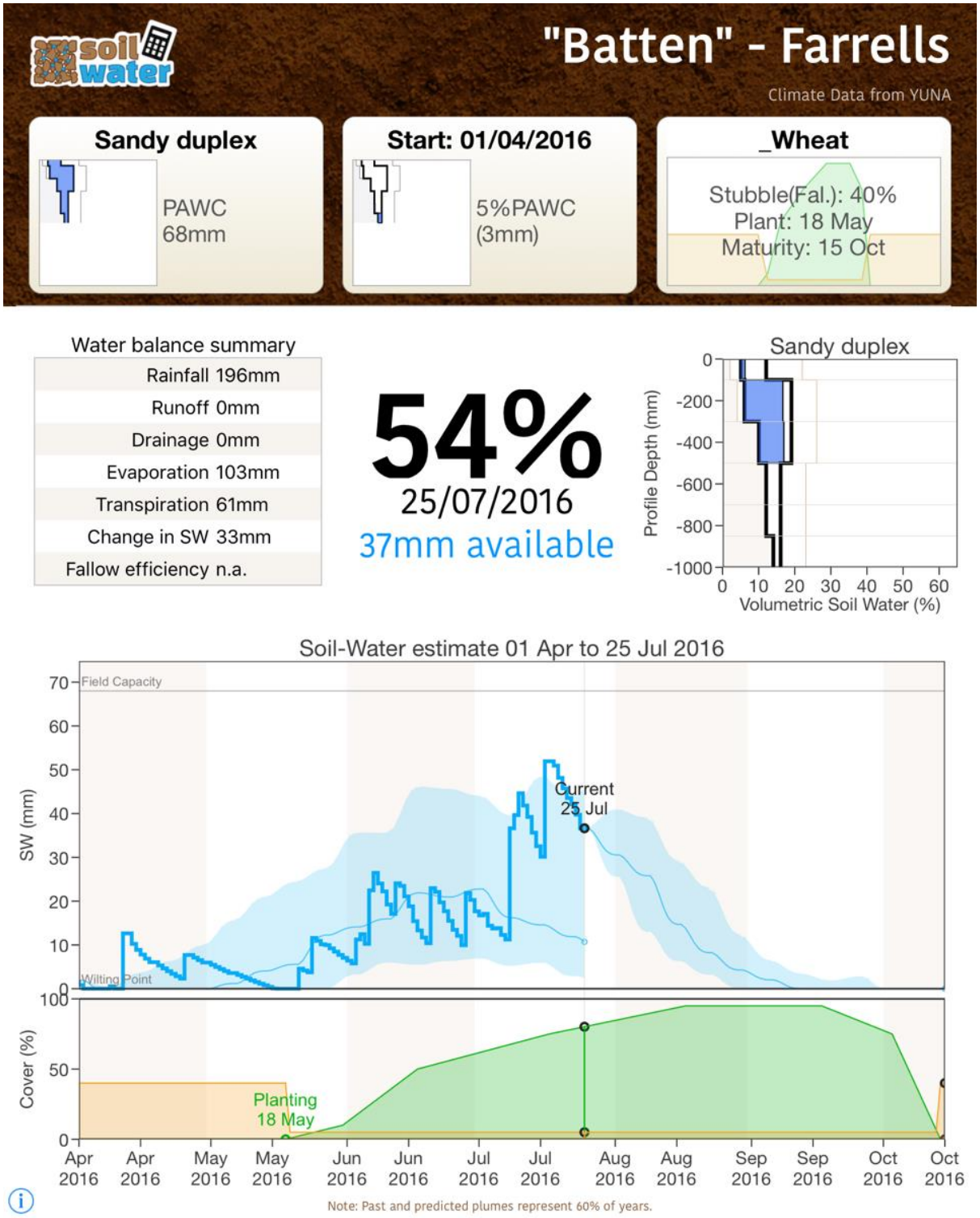



**Soil Water App**

This App was developed as a very simple to use way to model soil water. You select a soil type that suits your needs, then estimate how full the bucket was at a certain date – this can be when you have measured it, taken a soil core to have a look, or just a rough estimate. It also asks for the distribution of that starting moisture in the profile. You can chose from a range of crops (or fallow) and their growing season length. The app then takes rainfall and other weather information from your selected weather stations and models how much plant available water there was from the start of the year until today, and visually displays a range of possible scenarios for the future.

Below is a snapshot for the paddock at Batten's from the 27th July. On the 12th May there was 3mm of available water, so the bucket was only 4% full. Things have improved greatly since then with 24mm, or 36% on the 13th June, and now after good winter rainfall there is 37mm available and the bucket is expected to be 54% full. It is evident from the light blue 'plumes' which represent 60% of years that the soil moisture status is well above what was expected.

Yield Prophet is modelling 61mm of Plant Available Water, compared to 37mm for the soil water app. Yield Prophet is using rainfall data from the new Yuna NE DAFWA rainfall gauge, whilst Soil Water App can only access data from the Yuna weather station.


"Batten" - Farrells
Climate Data from YUNA
Sandy duplex
PAWC
68mm
Start: 01/04/2016
5%PAWC
(3mm)
_Wheat
Stubble(Fal.): 40%
Plant: 18 May
Maturity: 15 Oct
Water balance summary
Rainfall 196mm
Runoff 0mm
Drainage 0mm
Evaporation 103mm
Transpiration 61mm
Change in SW 33mm
Fallow efficiency n.a.
54%
25/07/2016
37mm available
Sandy duplex
Profile Depth (mm)
0
-200
-400
-600
-800
-1000
0 10 20 30 40 50 60
Volumetric Soil Water (%)
Soil-Water estimate 01 Apr to 25 Jul 2016
Field Capacity
Wilting Point
SW (mm)
Current
25 Jul
Cover (%)
Planting
18 May
Apr 2016
Apr 2016
May 2016
May 2016
Jun 2016
Jun 2016
Jul 2016
Jul 2016
Aug 2016
Aug 2016
Sep 2016
Sep 2016
Oct 2016
Oct 2016
Note: Past and predicted plumes represent 60% of years.

**N Broadacre**

N broadacre is an iPad app that helps make nitrogen requirement decisions with lots or only a little data available to you.

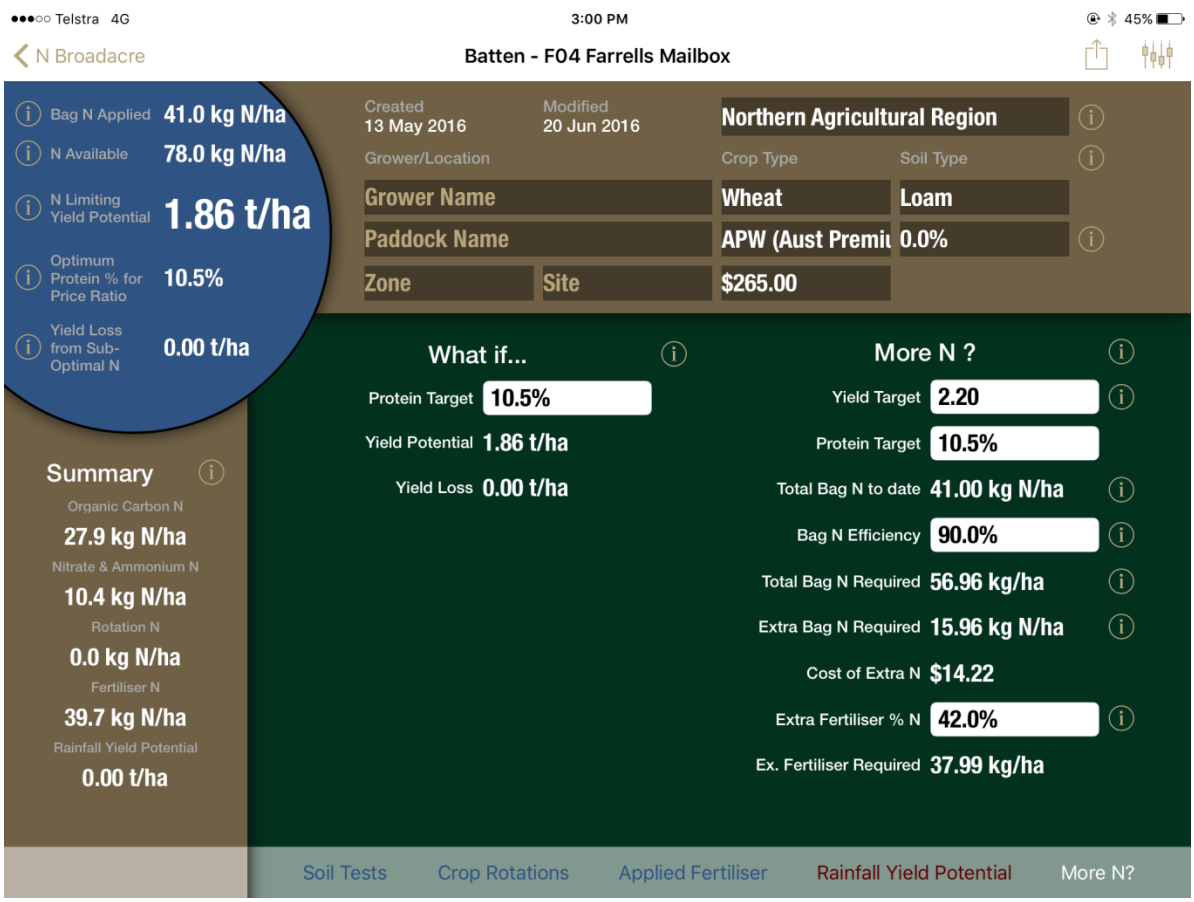
You can enter:

- nitrogen soil test results
- soil organic carbon
- previous rotations
- current fertiliser applications (or intended)
- yield and protein level you are targeting
- your rainfall – yield prediction tool
- Scope to customise the model by altering the efficiency of different soil N pools, and applied fertiliser, or you can keep it really simple.

Without the addition of any fertiliser the expected yield potential for Batten's paddock is 0.91t/ha. Below is a table of N recommendations for different yield targets from N broadacre.

| Yield Target t/ha | N Broadacre recommendation (N kg/ha) |
|---|---|
| 1 | 4 |
| 1.5 | 27 |
| 2 | 51 |
| 2.5 | 74 |


Telstra 4G
3:00 PM
45%
N Broadacre
Batten - F04 Farrells Mailbox
Bag N Applied 41.0 kg N/ha
N Available 78.0 kg N/ha
N Limiting Yield Potential 1.86 t/ha
Optimum Protein % for Price Ratio 10.5%
Yield Loss from Sub-Optimal N 0.00 t/ha
Created 13 May 2016
Modified 20 Jun 2016
Northern Agricultural Region
Grower/Location
Crop Type
Soil Type
Grower Name
Wheat
Loam
Paddock Name
APW (Aust Premiu
0.0%
Zone
Site
$265.00
Organic Carbon
Nitrate & Ammonium
0.48% % 17.7 kg N/ha
< 10 cm 8.00 ppm 7.2 kg N/ha
0.26% % 7.2 kg N/ha
10-20 cm 4.00 ppm 2.4 kg N/ha
0.12% % 3.1 kg N/ha
20-30 cm 2.00 ppm 0.6 kg N/ha
30-50 cm 1.00 ppm 0.2 kg N/ha
50-100 cm 0.00 ppm 0.0 kg N/ha
27.9 kg N/ha Total 16.00 ppm 10.4 kg N/ha
Summary
Organic Carbon N
27.9 kg N/ha
Nitrate & Ammonium N
10.4 kg N/ha
Rotation N
0.0 kg N/ha
Fertiliser N
39.7 kg N/ha
Rainfall Yield Potential
0.00 t/ha
Soil Tests
Crop Rotations
Applied Fertiliser
Rainfall Yield Potential
More N?


Telstra 4G
3:00 PM
45%
N Broadacre
Batten - F04 Farrells Mailbox
Bag N Applied 41.0 kg N/ha
N Available 78.0 kg N/ha
N Limiting Yield Potential 1.86 t/ha
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Yield Loss from Sub-Optimal N 0.00 t/ha
Created 13 May 2016
Modified 20 Jun 2016
Northern Agricultural Region
Grower/Location
Crop Type
Soil Type
Grower Name
Wheat
Loam
Paddock Name
APW (Aust Premiu
0.0%
Zone
Site
$265.00
What if...
Protein Target 10.5%
Yield Potential 1.86 t/ha
Yield Loss 0.00 t/ha
More N ?
Yield Target 2.20
Protein Target 10.5%
Total Bag N to date 41.00 kg N/ha
Bag N Efficiency 90.0%
Total Bag N Required 56.96 kg/ha
Extra Bag N Required 15.96 kg N/ha
Cost of Extra N $14.22
Extra Fertiliser % N 42.0%
Ex. Fertiliser Required 37.99 kg/ha
Summary
Organic Carbon N
27.9 kg N/ha
Nitrate & Ammonium N
10.4 kg N/ha
Rotation N
0.0 kg N/ha
Fertiliser N
39.7 kg N/ha
Rainfall Yield Potential
0.00 t/ha
Soil Tests
Crop Rotations
Applied Fertiliser
Rainfall Yield Potential
More N?

**NUlogic**

Nulogic is CSBPs soil and tissue test recommendation model. In this instance we are interested in the N recommendation part of the model. It uses nitrogen data from your soil test and recent crop rotations combined with a yield target and expected efficiency of N use to determine crop demand for N, soil supply of N, and the requirement for fertiliser N to supplement soil supply. In this instance given we are working on red loam and a low rainfall environment scenarios are presented for 60% and 70% efficiency of soil and fertiliser N conversion to the crop.

In the table below N Broadacre and Nulogic recommendations are presented. Below that are expected yields from Yield Prophet for three N scenarios.

| Yield Target t/ha | N Broadacre recommendation (N kg/ha) | Nulogic - 60% efficiency (N kg/ha) | Nulogic - 70% efficiency (N kg/ha) |
|---|---|---|---|
| **1** | 4 | 0 | 0 |
| **1.5** | 27 | 15 | 7 |
| **2** | 51 | 35 | 24 |
| **2.5** | 74 | 54 | 40 |

**How much N?**

Above are outputs from N broadacre and Nulogic. Below is the amount of N applied (or to be applied) in Battens trial, plus expected Yield Prophet expected yield from that N.

As you can see the amount of N recommended varies significantly between models. All these models should be viewed through the lens of your farm, soil, rainfall and typical N responses. N rich strips, or trials like this are a great way to calibrate how your farm sits in respect to decision making tools.

| Trial Treatment | N applied in Battens Trial (kg/ha) | Yield Prophet Yield Expectation t/ha |
|---|---|---|
| Compound N + 40L UAN post | 24 | ? |
| Low N | 41 | 1.45 |
| Medium N | 53.5 | 1.75 |
| High N (56.5) | 70.5 | 2.1 |

**Spectur Camera** login: Batten password: batten123

As part of the project a camera has been installed in the paddock to take daily photos of the crop to allow remote monitoring of approximate crop growth stage and appearance and as a record for later reference. Something we wish was part of last season's Time of Sowing trial.

14th June


27th July