Crop updates 2015 – Maximising profits using the latest soil water and weather tools

Convenor – *Yvette Oliver (CSIRO)*
Facilitator - *Julianne Hill (RCSN)*
Presenters - Meredith Guthrie and Tim Scanlon (*DAFWA climate),* Jeremy Lemon (*DAFWA tools evaluation),* Fiona Evans (*DAFWA climate and tool integration),* Brett Robinson (*Uni of Southern Queensland - CliMate and SOILWATER app),* Ben White (*Kondinin Group),* Frank D'Emden (*Precision Agronomics Australia),* Craig Topham (*Agrarian),* Dave Stead (*Anasazi Agronomy),* Mic Fels (*iPaddock)*

The session was focussed on climate and soil water tools which can assist farmers make informed management decisions. The session was divided into 3 sections entitled ;1) How have our seasons changed?, 2) Tools, options and the future and 3) Putting it into Practice. At the start if the session, participants were asked to consider: How the tools works (what they do, variability, errors, cost, up-scaling from a point to the farm) and how could they use this information to make a management decision.

Key conclusions
Understanding your soil water, climate is important for determining crop yield. We showed how it could be used for hindsight analysis to understand the yield gap and how your farm is performing. Real-time measurements or predictions of climate and soil water were shown to assist with in-season yield forecasts and management decision such as fertiliser or marketing.

A growing array of cropping decision support tools and measurement devices are available to growers and advisers. In the past, decision support tools have had limited uptake due to complexity, tedious data entry and being limited to computers. With increased mobile computing power and phone/data coverage, apps are being developed with a focus on the user. While there can be complex computing in the background, outputs are becoming easier to read and interpret. There remains a trade-off between complexity and utility of these tools where some users are interested in complexity and capability while others are more interested in quick, more qualitative answers. The 'lumpy' yes or no decision such as to sow or don't sow the paddock, add more nitrogen or no further in-crop N may not need the high accuracy of some tools. However for determining rates of top-up fertiliser or estimated crop yield for marketing a more accurate tool may be required. Both decisions have to be made knowing there is a large spatial variability across paddocks and zones and uncertainty of the remaining season. The strength of tools is to explore likely outcomes in different season types in order to capitalise on opportunities while managing downside risk.

The sharing of ideas and information in the planning and during the session by the speakers and participants was an excellent example of the type of collaborations that are possible between farmers, consultants and various agencies. The goodwill and linkages formed are illustrated by offers of sharing data to further develop the range of tools.

What actions need to be taken:
The session provided useful information on the tools and their use, but further discussion or information is required to:

1. Assess the use and value of these tools in decision making e.g. by documenting more examples of how farmers have (or could) use these tools for decisions.
2. Understand the scale of the tool's measured or estimate values relative to the scale or time frame of the decision e.g. spatial variability of soils
3. Assess the value of the learning's and insights these tools provide, even though they may not directly affect a management decision through use of these tools.

Reflecting on this Crop Update session, it would be good to see some case studies written about the tools; not just describing them but also highlighting the learning's that they provided, the impact their use had, as well as any problems in usage or application (i.e. not just great tool stories). Maybe this is something RCSN and DAFWA could consider.

Session summary

How have our seasons changed?

The Focus Session scene was set by a presentation by Meredith Guthrie and Tim Scanlon from DAFWA about the drying climate. They showed how the climate has changed in two recent periods, 1975 and again in 2000 by plotting the difference in temperature compared to the temperature in 1975 for each year (Fig 1). We can see the sea surface temperature increasing over the last 40 years, more so over the last 15 years. The sea surface temperature is important as it drives the climate and rainfall in WA.

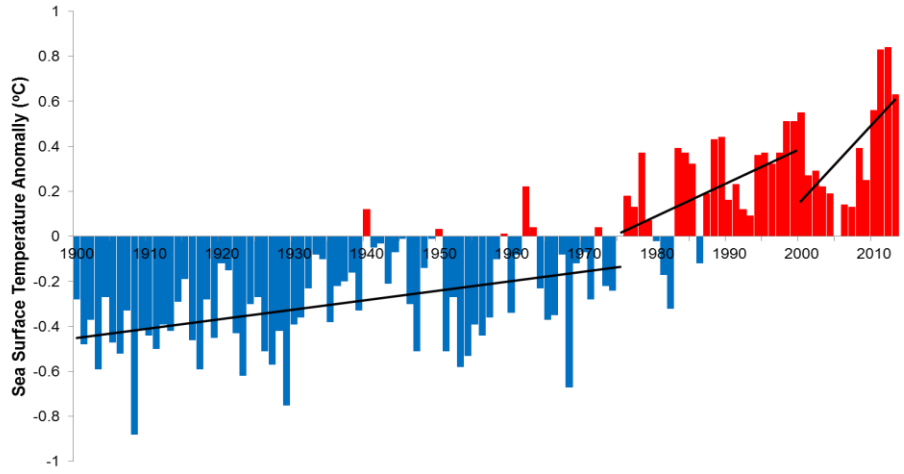

Fig 1. Sea surface anomaly, compare to 1975 sea surface temperature, over 1900 to 2014. The blue indicating colder than 1975, and the red indicating hotter than 1975.

Observed trends in the historical records of rainfall and temperature in Western Australia include

- Growing season rainfall has decreased between 20 and 45mm mostly due to a reduction in May and June rainfall.
- Summer rainfall increased in East (30-50mm with 2-4 extra rain day)
- Autumn rainfall decreased in South-west (-40mm 2-4 rain days less)
- Winter rainfall decreased in West and Esperance (-40mm with 2-8 less rain days)
- Spring rainfall unchanged
- Break of season later in central and southern areas (by up to 12 days)
- Hot days in September increased in Mullewa
- Frost risk increased in already frost prone areas

The annual rainfall may remain the same due to gains in rainfall over the summer were similar to the losses in rainfall over the winter. However the increased temperature over the summer means the additional water over the summer may not offset the losses of the winter rainfall.

Tools, options and the future

Jeremy Lemon from DAFWA provided an overview of soil water and yield tools, distinguishing those for predicting yield and those for predicting or measuring soil water. The only tool to integrate the two is Yield Prophet. Forecast crop yields are valuable for assessing season progress and likely outcomes. With forecast crop yield, decisions on nitrogen amount and timing can be refined. Grain marketing (forward selling), crop insurance and harvest logistics can also be managed with greater confidence. The attributes of four fairly readily available yield forecasting tools are listed for comparison in Table 1.

Predicting Yield

Yield Prophet® is probably the most widely known even if not the most widely used commercially. Yield Prophet uses the APSIM model to simulate growth of the crop on a daily basis depending on available resources. It is sophisticated, able to provide a variety of reports on demand including nitrogen responses and returns, soil water and nitrogen budgets, crop growth stages, effect of sowing date and can be used to compare soil types, varieties, sowing time and provide seasonal outlook information. However, Yield Prophet® requires good measurements or estimates of soil plant available water capacity as well as starting soil water and nitrogen to be able to predict the yield at a point in a paddock well.

Other models such as PYCAL and N Broadacre use modifications of the French and Schultz water used efficiency approach. PYCAL generates potential yields without taking account of soil constraints or rainfall distribution and estimates yield for a range of decile season finishes as a way of introducing the concept of yield probability. N Broadacre has a yield forecasting component based monthly rainfall to date and averages for months to come. The user can adjust the WUE value to account for different performance of crops based on their own experience.

Mic Fels, a farmer from Esperance, explained that the complex tools for predicting yield and soil water were great for learning and good for scientists but did not give him what he needed. This led him to develop iPaddockYield, as a tool that can forecast yield 'quickly, easily and cheaply' which uses 7-10 years of historic rainfall and average yields for a farm. It then generates a farm specific yield forecast based on your season so far. Mic showed an example from his own farm, where in July 2014 iPaddockYield forecast the yield with to within 10% of the final farm yield (Fig 2). He has great confidence in iPaddockYield as he has been able to predict the average farm yield for 11 IPaddock users in 2014 (r^2 =0.76).

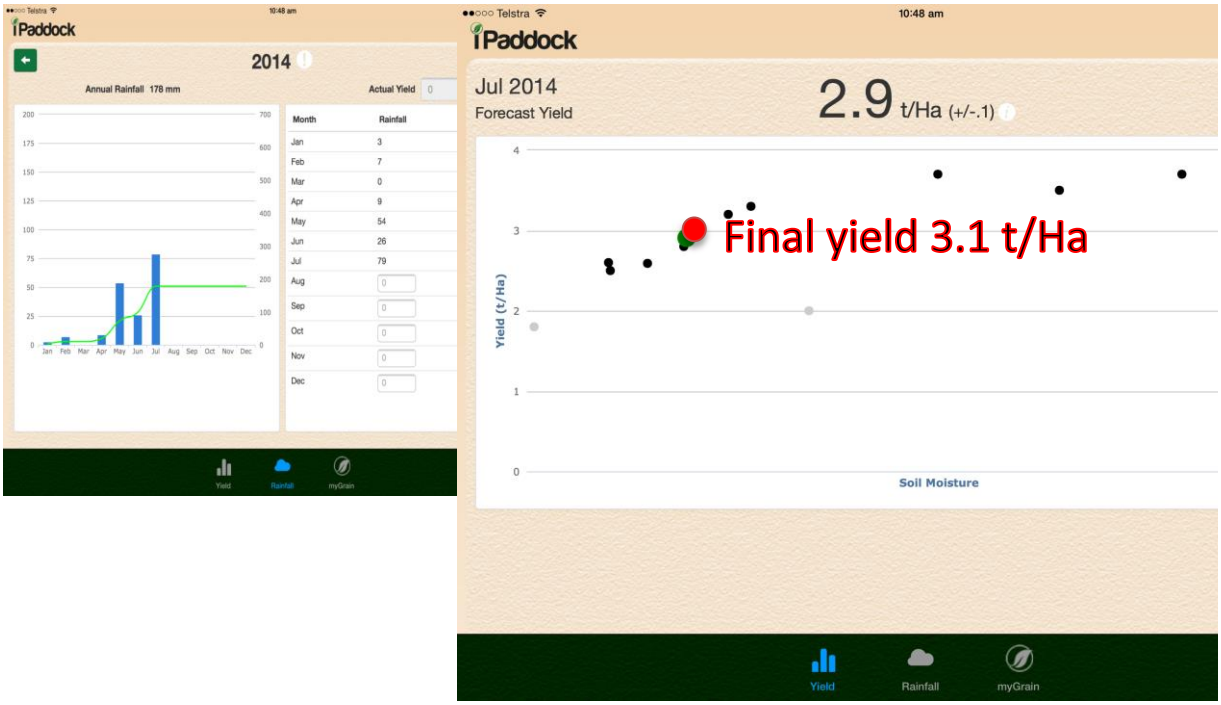

Fig2. Screen shots from iPaddockYield for 2014 with rainfall up to July (Mic Fels,iPaddockYield)

Table 1: Summary of readily available crop yield forecasting tools (Jeremy Lemon, DAFWA).

	Yield Prophet	PYCAL	N Broadacre	iPaddock Yield
Yield estimates	Full simulation to give cumulative probability curves	Modified French & Schultz for range of deciles	Modified F&S, current rainfall plus averages	Calibration of past farm performance
Potential yield	By probability	Modified F&S	Modified F&S	Yes
Y output	Cumulative yield probability with lots of supporting data	Table of yield deciles	Single potential yield figure	Expected single yield with small range
Nitrogen decision support	Yes by simulation	No	Yes empirical	No
Scale	Point represents paddock or zone	Farm/district	Farm/paddock	Farm/paddock
Cost	$200 subscript'n & $350+ for soil sampling/analysis	Free	$25	$70
Strengths	Wide set of outputs and adjustments	Can manipulate parameters for calibration	Can vary WUE for calibration	Simplicity and ownership with own data
Weaknesses	Need to get soil right. N management outputs need care. Not strong on canola.	Manual entry of daily rainfall. Potential yield only and need to fudge certain events, decile tables are dated	Just a side issue in the app. Needs user calibration to get credible results	Manual entry of monthly rainfall. One figure for whole farm and scale paddocks from average. Only one rainfall site.
Frequency of data updates	Daily	Determined by user enthusiasm	Determined by user enthusiasm	Determined by user enthusiasm
Data input/upload	Automatic weather data and manual soil and management	Manual daily rain	Manual monthly rain	Manual monthly rain
Ease of use	Fair	Poor	Fair	Good
Overall utility	Fair	Poor	Fair	Fair

Measuring or estimating soil water

There is a lot of interest in measuring and estimating soil water and some available tools are shown in Table 2. The value of understanding soil plant available water holding capacity (PAWC) and current soil water content is to help in inform: which paddocks to sow, how much water is available for crop growth during the growing season, how long before a crop becomes water stressed if there is an extended dry periods. Availability of stored water gives confidence to sow crops and invest in further nitrogen fertiliser. Direct measurement (e.g. soil water probes or coring) and simulation based on weather data and soil surface description (e.g. DAFWA's seasonal climate information) can be used alone or in combination with yield prediction as Yield Prophet® does.

Ben White from the Kondinin group had studied the advantages and disadvantages of soil moisture monitoring technology through an Esperance RCSN funded project. The full article is available in the Feb 2015 issue of Farming Ahead. Ben noted there are several different types of technologies available, including Frequency Domain Reflectometry (FDR) – Capacitance, Time Domain Reflectometry (TDR), Impedance arrays, Time Domain Transmission (TDT), Neutron moderation, Gypsum block and granular matrix. More information on the types of sensors, brands of sensors, what they measure, sensor spacing, costs, installation methods, logger compatibility and supplier contacts for the probes can be found in the article.

Ben outlined some of the considerations for selecting soil water measurement technology, including suitability to permanent installation, sampling volume, installation requirements (disturbance issues

etc.), calibration, soil type suitability (stony soil issues) and telemetry integration. Ben found the best option currently available was capacitance probe which are suited to permanent installation and are easily integrated into telemetry and combined with weather. However capacitance probes require careful calibration for accuracy and careful installation to avoid errors & disturbance. Direct measurement of soil water by layer using live probe data can be a valuable learning tool to assess drained upper limit and crop lower limit as well as observing the increasing depth to which roots can extract water.

There are over 50 soil water probes installed in the Western Australian wheatbelt by farmers, RCSN projects and grower groups. Frank D'Emden from Precision Agronomics Australia explained that data from 22 soil moisture probes can be access by the public (Fig 3). This data can be accessed via internet on: http://precisionag.com.au/services/moisture-probes-project/, which shows real time plant available soil water. The data is checked weekly to ensure the probes are working correctly. The RCSN project installed the probes between 3 weeks prior to sowing and immediately after sowing in 2014. A Tekbox sensor was inserted in the topsoil to measure the soil water in the 0-10cm layer. The water in the subsoil was measured using an Enviropro capacitance probe, which were buried at 25cm depth and were either 40 or 80cm in length depending on the soil depth. These probes have sensors spaced at 10cm intervals, providing estimates of soil water content to 65cm or 105cm depending on probe length.

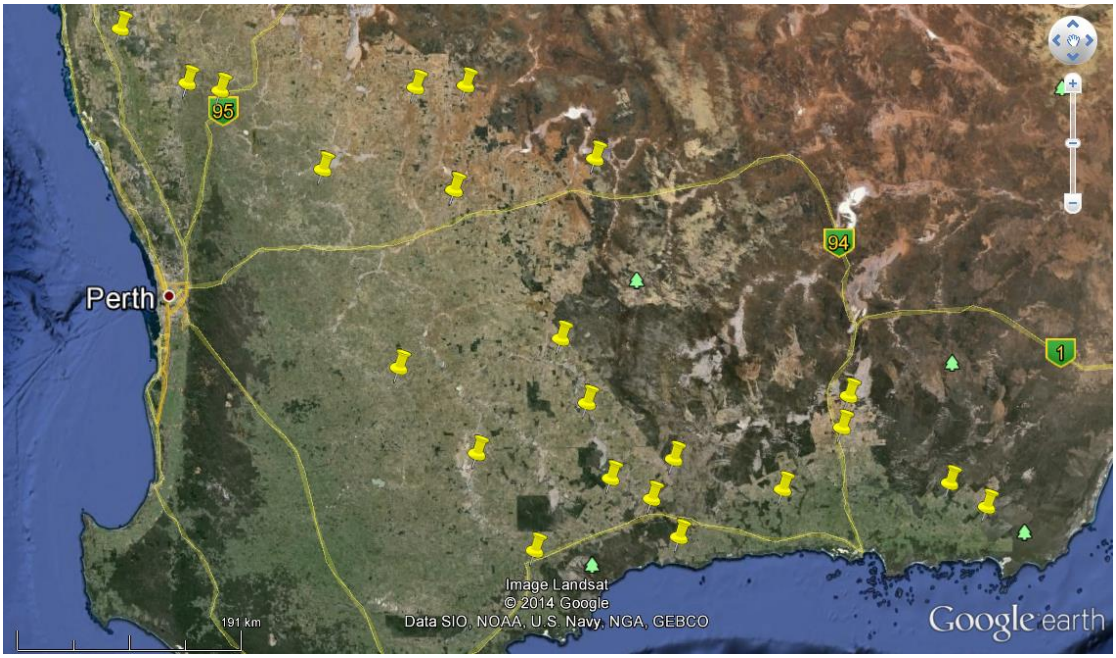

Figure 3. Map of Southwest WA Wheatbelt indicating soil moisture probe sites (Frank D'Embden).

The soil water app is a way of looking at your soil water over the season based on rainfall. A Soil Water App for smartphones (SWApp) has been developed and is ready for testing by users over the next 12 months. SWApp uses rainfall inputs from Bureau of Meteorology sites, a local rain gauge - or a wireless rain gauge being developed in the project. A number of soil water sensors are being trialled whose readings can be entered manually or added wirelessly. Growers and consultants will be able to track soil moisture during a fallow and up to anthesis in a crop for any number of paddocks (Fig 4).

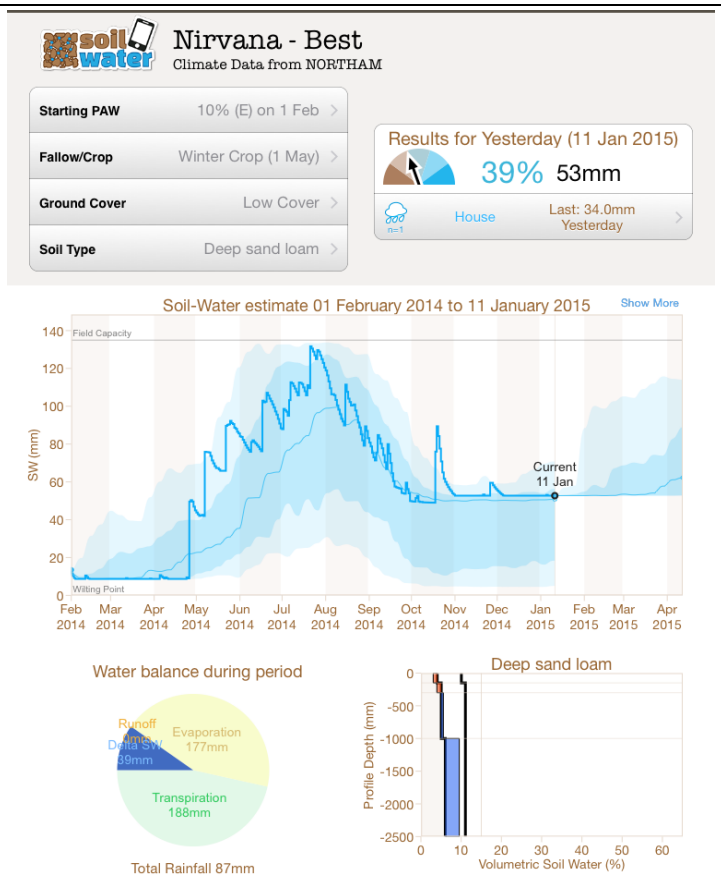

Fig 4. Screen shot SoilWater App.

The App estimates today's soil water content (% of full and mm of rainfall stored) and recent changes in soil water content (solid line). This is shown against the range of conditions estimated from the weather in past years (the shaded areas).

Fiona Evans showed how seasonal forecasts could add value to DAFWA's rainfall to date and soil water tools. The soil water at a date could be determined from measurements (soil water probes or coring), or predicting from rainfall (Soilwater APP). The range of likely soil water in the future can be estimate using historic rainfall (soil water App, Yield Prophet®). This can be improved by included seasonal forecasts. DAFWA has produced new tools which integrate the rainfall to date with the DAFWA seasonal rainfall forecasts and a soil water model (Fig 5). This provides better soil water projected values than using historical climatologically projections. Fiona showed examples of these new tools which are in the testing phase and asked participant if they found this useful.

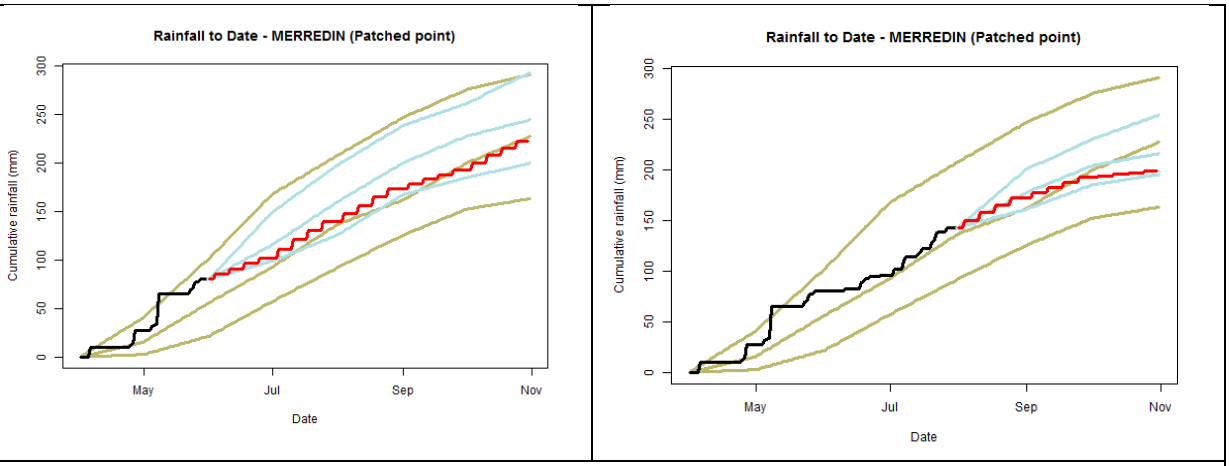

Figure 5: Rainfall to date with cumulative rainfall forecasts from 1 June 2014 and 1 August 2014. Cumulative rainfall is shown in black, climatological deciles in khaki, projected climatological deciles in blue and forecasts in red.

Table 2: Features of readily available farm and paddock scale soil water tools (Jeremy Lemon, DAFWA).

	Soil water probes your own farm	RCSN soil water probe shared network	DAFWA soil water	CliMate - HowWet	Yield Prophet	Soil water app
More info www.	farmlinkrural.com outpostcentral.com.au	precisionag.com.au outpostcentral.com.au	agric.wa.gov.au climate pages	australianclimate.net.au	yieldprophet.com.au	soilwaterapp.net.au
Cost	From $6000 plus annual fee	Free online	Free on line	Free online or app.	$120 soil analysis, $100 sampling and $180 subscription	Free to download -by invitation for test version
Accessibility	Live on line, password	Free access, password to outpost central site	Free access	Free access	Run reports by password	Free access when developed
Need for support	Needs technical support	Part of the project	Not required	Not required	Best with consultancy support	Not required
Data update frequency	Near live data	Live soil water and weather data	To be updated daily for 2015 grow season	Run on demand using data up to two days ago	Weather data daily, optional rainfall as entered	Run on demand using data up to two days ago
Plant available water	Need to calibrate probe for DUL, CLL and mm water	Live graphic display same as soil water probes	Estimates by simulation	Estimates by simulation	Estimates by simulation	Estimates by simulation
Transpiration	Included as direct measure	Included as direct measure	No - bare soil simulation	No - bare soil simulation	Included by simulation	Included by simulation
Linked to yields	Yield not included except Yield Prophet (by subscription)	Some Yield Prophet reports on website	No	No	Yields displayed by probability distributions	No
Links to crop management decisions	No	some Yield Prophet reports on website	No	No	good integration with sowing time, N tactics	No - user intuition
Water by profile layer	Yes	Yes	No	No	Yes	Yes
Accuracy	Needs soil calibrated and actual PAWC, Separate probe for top 20 cm	Still need good siting and calibration	Acceptable	Will vary with site and season	Simulation after initial sampling, need to pick right soils, user skill can make it better	Fair, will be calibrated with local probes (if they are accurate!)
Other data	Rainfall included and extra weather data for extra cost	Rainfall and a little additional weather data	DAFWA state weather station coverage	BoM/SILO weather station for main weather variables	Rain to date, N and water balances, crop development, BoM outlook	Just soil water
Locations	Specific location and soil type on one/each paddock	Locations as budget allows, widely spaced for now	General for selected soil type at nearby station	General for limited selection of uniform soil profiles	Specific to site or zone chosen	Wide range of patch point weather stations
Weaknesses	Cost, potential errors, specific location, need mobile signal for telemetry. Chance of malfunction.	Short term project dependent on funding. Reflects current paddock use and management	General as a bare soil model, transpiration and current issues being addressed by 2015	Water only and very general, bare soil model, no transpiration	Difficult to get soils right without experience, N simulations poor for WA. Limited soil sampling services	Fixed long green season when choosing crop cover
Strengths	Live data, optional weather parameters for cost, reflects actual paddock management, developing link to Yield Prophet	Live data, optional weather parameters for cost, reflects actual paddock management, developing link to Yield Prophet	Soil type selection, Season outlook on same portal	Available as app, comprehensive climate parameter analyses in same app or website more comprehensive. App runs off line	Fully integrated soil, soil water, season, crop development and management responses. Water and N budgets	Can simulate over user defined periods, WA soil type menu

Putting it into Practice

This section shows some examples of how some of the tools were used by farmers and consultants to provide information and learning's, which lead to management decisions.

Probes and Prophet (Frank D'Emden Precision Agronomics Australia)
A RCSN funded project, run by Frank D'Emden of Precision Agronomics Australia, is using both soil water probes and Yield. Some of the aims include:

- Improve the understanding of how soil moisture probes and Yield Prophet® can be used to complement each other
- Increase the range of APSoil soil type selections in Yield Prophet® by modifying existing soil types based on the probe data,
- Provide growers with access to real-time soil moisture data and periodic Yield Prophet® reports from soil types and cropping scenarios that are representative of their area, and
- Cross-validate soil moisture probe data with Yield Prophet® soil moisture modelling

Through the project, Frank found that both soil water probes and Yield Prophet® require careful calibration which requires significant time and effort. The soil water probes required some careful calibration and understanding of installation and soil chemistry. The effect of residual soil moisture from the slurry used at installation influenced the first year of data from the soil moisture probes, particularly on heavier soils such as those found at Ravensthorpe, Lake Grace South, Merredin and Coomberdale. High subsoil EC at some sites has influenced the moisture readings and further investigations are underway at those sites (i.e. Southern Cross and Merredin).

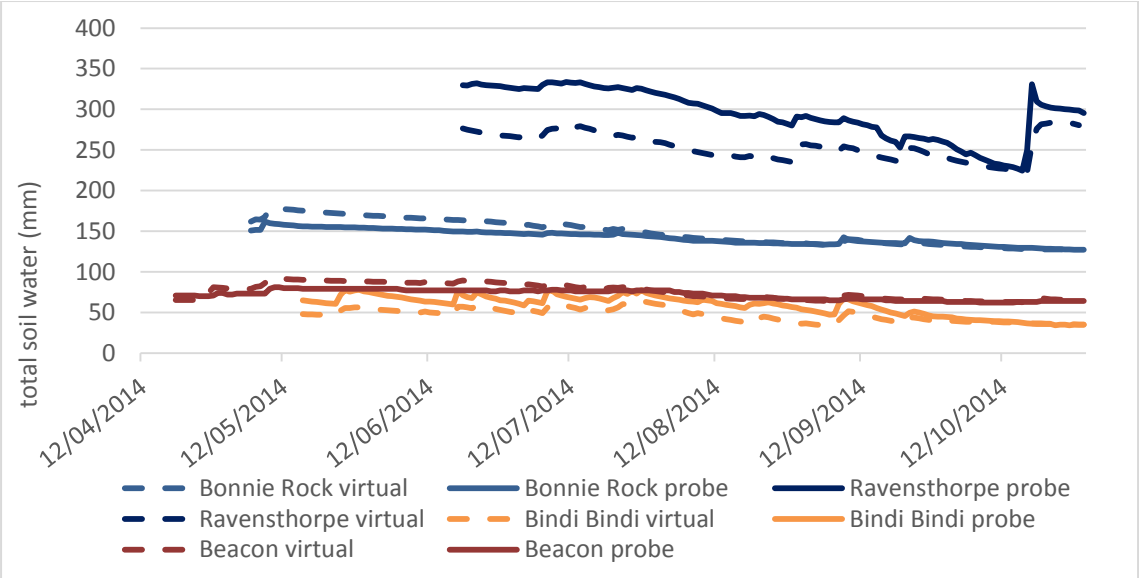

Figure 6. Comparisons of estimated total soil water (mm) between soil moisture probes and Yield Prophet® ('virtual') modelling.

Frank explained it was essential for Yield Prophet® to have a good soil water characterisation including understanding the subsoil constraints and rooting depth. When Yield Prophet was correctly set-up the predicted and actual yields were good. The soil water in each layer was compared between yield prophet and the probes with similar trends in water use shown, but the actual numbers for soil water were different (Fig 6). Growers and agronomists have commented that the sites provided useful supporting information when making top-up nitrogen decisions, with the soil moisture probes providing additional confidence in the model's output.

Profit from soil water tools – Craig Topham (Agrarian)

Craig Topham of Agrarian believes there is profit from knowledge of soil water by measuring and management change. Craig uses Yield Prophet®, soil water probes and other tools to increase knowledge to aid in his decisions. Craig talked of two ways he uses soil water information 1) soil PAWC and Water Use Efficient (WUE) to manage crops and 2) soil water probes for in-season management decisions. He has been using the CropManager, an online and mobile platform, to view the soil water probe information, rainfall and other information (Fig 8). He uses the probes and weather station with CropManager output to see the "live data" of soil water, how full is the bucket, weather and now includes and estimate of crop phenology.

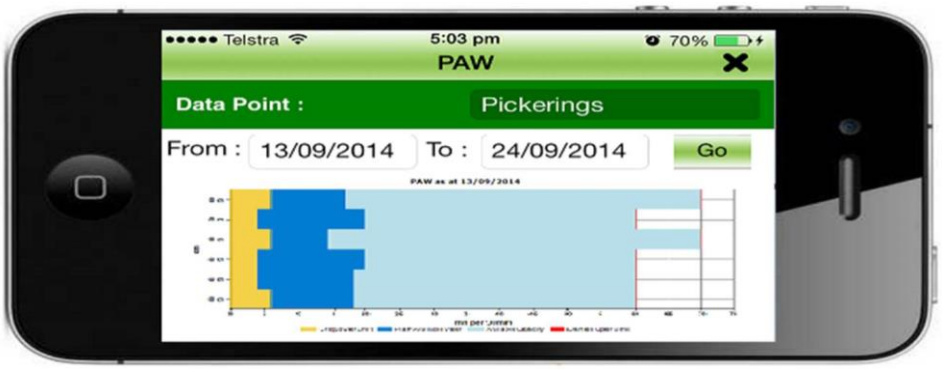

Fig 8. PAWC on the mobile phone from Craig Topham

Craig showed an example across a paddock which he has compared WUE between soil types (Fig 7). He has trials using probes in the 3 different soil types to determine the most efficient nutrition strategy. He found with understanding of the soil PAWC, the probe could provide good information about daily water use and remaining water in the bucket which differed greatly between the soils. This information could assist with the nitrogen decision and forward selling of grain. He found using the probes and CropManager to monitor rooting depth, determine crop stress levels and project water usage was very valuable.

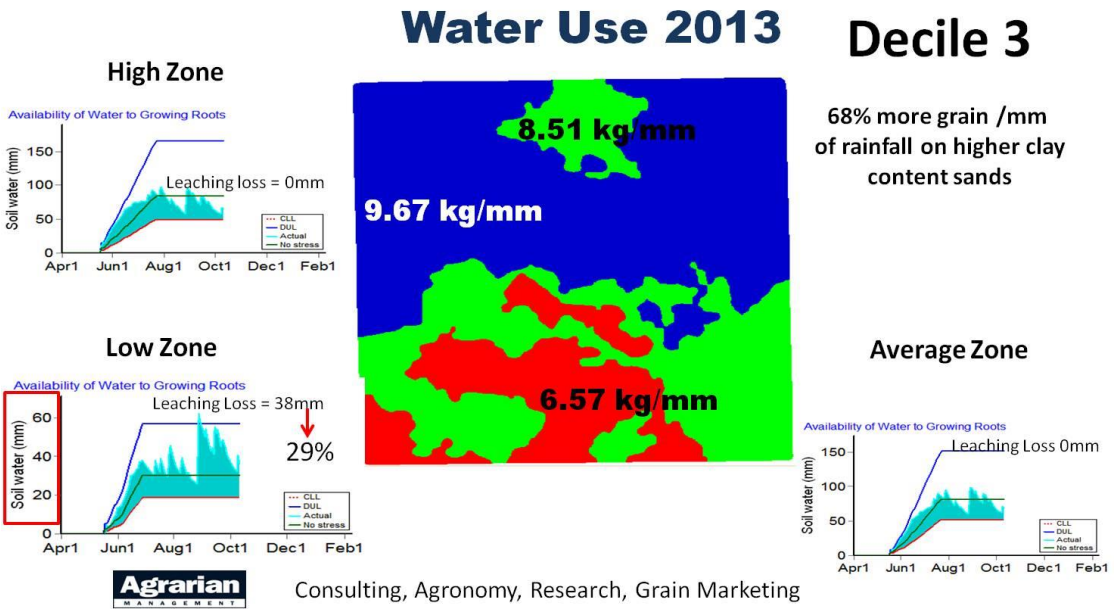

Fig 7. Slide from Craig Topham presentation about variable water use across a paddock linked with understanding of soil water capacity and soil water availability.

Consolidating data from decisions which benefits growers – Dave Stead (Anazasi Agronomy)
Dave Stead, from Anazasi Agronomy, has also been using Yield Prophet and soil water probes with the CropManger interface. He would like to compare notes with other users to see if there is an easy way to overlay or consolidate the data using a range of tools include SoilWat App. Yield Prophet® has been the preliminary driver of consolidating data but there are many other tools available. Dave Stead posed some interesting questions about how we can use this information to make a practical decision. Dave said "that with technology ramping up and going at that mega pace, the biggest challenge that we have is to differentiate between all these mega data gathering devices and what we are doing on the day by day on the farm". He questioned how we could consolidate the data into practical useable information which will make us money and separate out the rest of the stuff that we don't have to worry about. Generally these tools leave it up to the advisors, and some farmers, to make the margin call on the big ticket items. For broad acre farming these may only about 3 times a year and further east even less. He wanted to make sure these tools are going to be a benefit for the growers.

Production is vanity: Profit is sanity - Mic Fels (IPaddock Yield developer and farmer)
Mic Fels, iPaddockYield developer, believes you only needed to know some simple information, soil N and Yield to make farm management decisions. Mic uses iPaddockYield, to forecast his yield quickly, easily and cheaply. He uses the yield forecast for input management, N, P and fungicide, which has made him the most money. He also uses it for grain marketing so he does not over or under hedge the market as well as for harvest logistics. He has had a number of farmers use iPaddockYield in 2014 that overwhelming responded favourably to the tool and found it very reliable for predicting yield.

Mic believes it all about getting the protein right and that nitrogen management is not rocket science. The nitrogen decision required a yield target and an N decision tool such as NKS rich strips with Greenseeker tool, "Nbroadacre" tool developed by Planfarm, the DAFWA Topcrop N wheel or the 20:40:60 rule which means units of N in dry year, average year and wet year respectively. Mic found that if you get within +/- 15N you will be ok. He said "If your protein is under 10%, or over 12% you are burning profit!"(See Fig 9). Mic found by getting the N right for the predicted yield he could keep the protein at the target 11% on his farm. This meant over his 6000ha cropping program he saved $90K in 2011 and $120K in 2014 by not over fertilising and having the high protein which was apparent in the rest of the Esperance port zone (Fig 10). The closing remark from Mic was "Production is vanity: Profit is sanity".

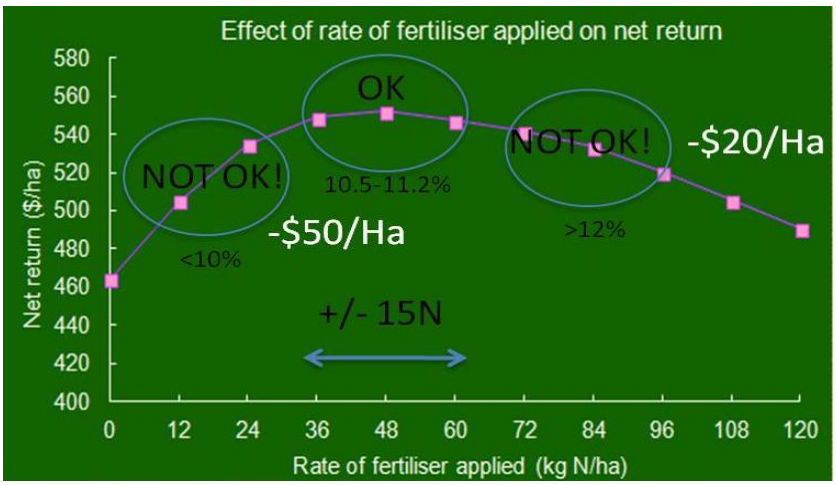

Fig 9. Effect of rate of fertiliser applied on net return

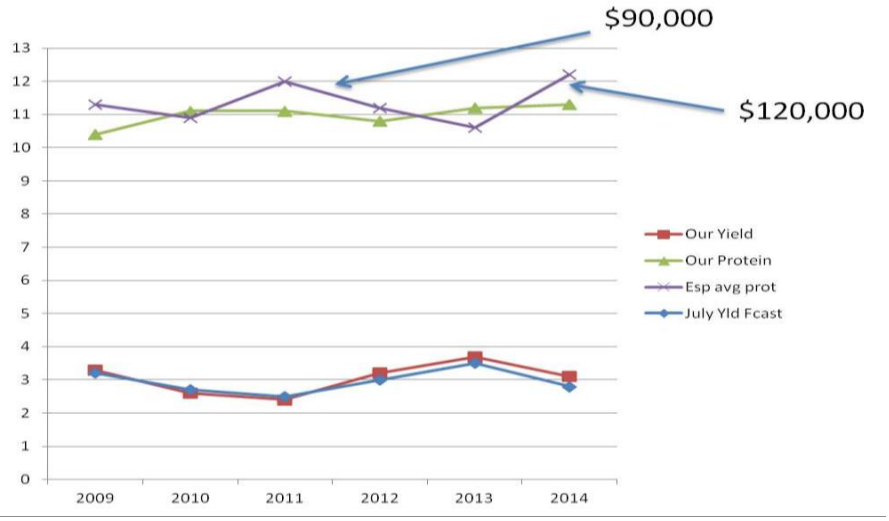

Fig 10. Value of iPaddockYield to Mic Fels business (6000ha Crop)

Discussion

Climate section
Are you comfortable with these climate projections? Meredith Guthrie, DAFWA, explained these are not climate model projections but graphs and maps showing what changes have occurred in the past. It is up to us to determine if we think this drying trend will continue.

Why was the 1975 and 2000 break in season chosen, are there other periods to use? Tim Scanlon, DAFWA, explained there was a complex analysis was performed to look at a range of periods but there were no other significant breaks or windows.

What is the sea surface temperature and how does it work? Meredith explained it is an amalgam of sea surface temperature in the Indian Ocean. Fiona Evans, DAFWA, explained why a rise is sea surface temperature produces opposite effect than we think. Originally we think a rise in temperature in the ocean would cause more ocean water to evaporate which would lead to higher rainfall on the land. However the weather systems are shifting further south, so the rains are falling on the southern ocean instead of our Wheatbelt.

So what about the climate drying climate, how does this affect decision? Tim Scanlon discussed how even with these changes in rainfall and temperature farmers are managing well. For example last year hottest year on record with wet harvest and hail in south but it was bumper year. There is a lot to be learnt from the Eastern Wheatbelt farmers who have adapted to reduced rainfall by utilising technology available and managing the situation. The eastern Wheatbelt has not had a yield loss even though there was a greater than 20% decline in growing season rainfall which should have shown translated to a 400kg yield loss. Tim believed some of these new tools that are becoming available will help with the drying climate decisions, so not a dome and gloom scenarios.

Tool section
There are different direction and funding sources and common goals – what mechanisms see best to synergise rather than paralyse?
Julianne Hill explained that we are trying to do through soil water champions, which although meet face-to-face infrequently. The champion's role is to connect those who are doing this work and to

use each other as a resource of knowledge. An example of how we work together is this Crop-updates session.

There is a good trend of collaboration and open data in WA with all these tools, rainfall networks, soil water data and agencies data so freely accessible.
Julianne Hill thought we are luck that this data is available, even one year ago the soil water probe data require a password for access. Yvette hoped with this availability of data, we can have better and simpler collaboration and testing of tools.

How can we better use these tools ?
Frank D'Emden thought there were lots of data but is data accurate? He discussed that the key to work with those with soil water expertise to improve the calibration on probe network, but to talk DAFWA in Econnect Wheatbelt, the Yield prophet modelling and Fiona's work to further improve and validate crop yields. Modelling and all models have something in common is that they are wrong (only if you have data… David Freebairn). Frank believes the key thing is bring grower along from the ride to see keep them informed about where we are at in term of making these things more accurate and useable, and getting their feedback on these tools that can help them make decisions. Fiona Evans explained that while the different model is similar in pattern of yield and soil water, the number may be different. She thought that we need to decide where the numeric value have to be perfect, and so do we require the precision of some of these tools? Fiona believes the goal is not to have the perfect answer but have a useful tool to help make decision.

What model behind the soil water app and has it been test?
Brett Robinson explained the SoilWater APP has a basis similar to APSIM (Soilwat as the soil water movement model) but they are testing the model alongside APSIM, Ritchie two layer model, Howet in simple situation like fallow. Fiona's model is also similar and based on the Ritchie two layer model.

At end of day farmers are going to be face with Bens 50 sensor and lots of tools (which may become toys – Jeremy). What about evaluation and learn which bits work?
Julianne comment that that was part of brief for evaluation the soil water sensors.
Yvette Oliver explained that we are trying to address this in the next section. However the hard part is that there are so many toys and tools and farmers make decisions differently but what we need to ask ourselves about the tools is 1) do farmers care, 2) did they need to know this, 3) when did they need to know this, and 4) was it important for a particular management decision for a part of your farm or over the whole farm. We are scientist and we love our toys but want to know 'is it useful'.

Use of tools section
Farmer do not know what their yields are and he has trouble getting good yield data – how are you going to collect it to use with these tools.
Mic still struggles with yield data even for his model which uses whole of farm average yield not individual paddock and zone, but would like to do that down the track. As a farmer, the whole of business where he gets more value, and he already has some idea about some paddocks better than others. Mic suggested using CBH records as guide if you don't have farm paddock or farm yield records. He is still shocked that some farmers do not know there rainfall and yields which may mean some farmers are not be ready for these tools. He think by starting off on the simplistic tools, which don't require much effort there are some big gains to be made.

What if have a major management change do they not use that data in ipaddockYield?
Mic said that outliers get removed when understood the reason. Benchmarking against his own data to try to determine what he did differently.

There were many more questions about the tools, but unfortunately we ran out of question time.

GRDC Project Numbers

CSP00170 “Measuring and managing soil water in Australian Agriculture
USQ 00014 “New tools to measure and monitor soil water”
RCSN project western region project (2012)– Understanding soil and water relationships for optimising crop management in variable seasons - southern Albany RCSN area and Kwinana East RCSN area
RCSN project western region project (2012) - Information days for farmers and agribusiness to understand Yield Prophet® and other soilwater tools – Esperance area
RCSN project western region project (2013) - Plant Available Water (PAW) Information and Tools for better crop management decisions for Albany and Esperance RCSN Zone consultants and farmers
PNS00014 – ipaddock Yield