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| COGGO | Final ReportCOGGO Research Fund for projects finishing at the end of 2015 |
| Council of Grain Grower Organisations LimitedACN 091 122 039 | A project completion report covering the project. The acceptance of a satisfactory report against the objectives of the project, and agreement on the sharing of any commercial returns and/or IP will trigger payment within 4 weeks, by COGGO for any outstanding payments. |

This Final Report should be completed with reference to the Research and Intellectual Property Agreement (the Research Agreement) signed between the proponent and COGGO Pty Ltd.

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| Project information |  |

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| Project title | **Measuring,monitoring and understanding soil water holding propertiesto increase risk management, grower confidence and grain yield improvement, resulting in increased returns to grain growers.**  |
| Commencement Date | January 2015 |
| Completion Date | January 2016 |

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|  Name of Proponent | Mingenew Irwin Group |
| ACN/Legal Name or ABN | ABN 71984417649 |
| Mailing Address | Po box 6 Mingenew WA 6522 |

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| Project results | This section provides a final report against the Project Aim and the Planned Outputs for the Project. |

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| Achievement of the Project Aim  | Brief statement of achievement in relation to the aim of the project |
| The aim of the project is to develop a concept that growers can easily implement and access during the growing season. Throughout the year the development of the data interpretation platform Crop Manager has progressed to a stage where growers can login online or through an app on their phone and see how full their soil moisture bucket is and how the soil water is dispersed throughout the soil profile. This is real time data and growers can then allocate nutritional inputs and market their grain based on informed knowledge.This project will develop the ability to characterize the soil water holding properties of 3 soil types. This has been completed. Crop Lower limit (CLL) (maximum amount of soil water that can be extracted by a particular crop) and Drained Upper limit (DUL) (maximum amount of water that a soil can hold) parameters for each of the soils for wheat have been calculated and are included in the full trial report. Further funding will be required for a second season to test the figures from the first season and enable an accurate data base of CLL and DUL figures to be developed for the 3 soil types. The data generated from this project is able to be used for developing a better understanding of the ability of wheat to extract soil water as well as take into account the change in CLL values, or increased soil water extraction over time with the implementation of soil remediation practices such as liming. This work will be included in future project proposals. The introduction of lower cost soil moisture probes, data transfer systems and live web based data hosting platforms, has enabled real time crop monitoring to become a reality. This project has further developed the platform to deliver critical crop monitoring information direct to growers and improve the ability of growers to react to seasonal conditions on a real time basis. The next peace of the jigsaw is to know what the likely final yield will be. Yield Estimation tools such as Yield Prophet, iPaddock Yield and the old water use efficiency calculators such as French & Shultz equations are all useful tools in predicting final yield. As part of this research an evaluation of these tools has been conducted. In the evaluation the models were run retrospectively based on the previous 10 years of rainfall and paddock yield data for each research paddock in the project. A yield estimate was produced from each model as at the 31st July, for each of the 10 years in the historical data. Yield estimate accuracy was calculated and below are estimate accuracy figures from the Duane site. 1. Yield Prophet (APSIM) 58% accuracy
2. French & Shultz (Brocken Stick) 62% accuracy
3. iPaddock Yield 72% Accuracy

The more accuracy / confidence we have in the final yield estimate, the greater the ability to play the season with Nitrogen applications and maximize grain yield and profitability in any given season. Each season is different so an understanding of soil water holding capacity and plant available moisture in the soil throughout the season is essential to be able to estimate yield and tailor nitrogen applications. The knowledge and accuracy, thus confidence, that we have in this area is increasing rapidly.  |

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| Project Outputs | Please provide a report on the achievement, or otherwise, of the project outputs as per the planned outputs provided in the Project Proposal. |
| 1 | - | Output 1 (from Project proposal)2 intensive community workshops in each year of the project1 workshop will be conducted within the MIG region and one outside to extend the research to growers outside the region. The workshops will aim to demonstrate how the soil water data can be recorded, interpreted and used to predict yield. |
|  |  | Comment:Workshops were held in Mingenew and Morawa (MFIG) to extend the research to growers. Yvette Oliver (CSIRO) and Wayne Pluske (Equii) were engaged throughout the project to assist with set up of the soil data and presentation at the intensive community workshops. The workshops were made up of a site visit and a presentation. Feed back at each of the workshops was very positive and growers expressing an interest in applying the principles to their own soil to improve their paddock management. Over 20 growers and researchers attended each workshop.  |
| 2 | - | Output 2 (from Project proposal)MIG Spring Field DayInitial project findings will be extended to growers at the MIG spring field day with a presentation on the focus area |
|  |  | Comment:A presentation was made by Craig Topham (AM) and Debbie Gillam (MIG) at the MIG spring field day. It focused on the information we have now and were it will take us in the future in terms of confident yield predictions and using real time soil moisture data to make in season management decisions.  |
| 3 | - | Output 3 (from Project proposal)Project CommunicationA full project report for the initial findings in year 1. |
|  |  | Comment:Full report attached with this final report |

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| Project results | Please provide brief statements on the results of the Project  |

Below are a summary of the results from the trial component of the project, full details are included in the attached trial report.

Section C. Evaluation of Nitrogen Usage

Table 8. Duane harvest data and Nitrogen use efficiency

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Treatment | Yield t/ha | Protein % | Weight kg/hl | Screenings % | Returns$/ha | **Returns – N Costs $/ha**  | Recovery of Fertiliser N (%) | PNB (N) |
| **0N** | **3.33** | **11.43** | **77.5** | **3.6** | **APW1 $996** | **$996** |  |  |
| **20N** | **3.42** | **12.53** | **78.1** | **2.81** | **H2 $1028** | **$1,003** | **41.38** | **0.38** |
| **40N** | **3.40** | **11.73** | **77.2** | **6.15** | **AUH2 $985** | **$934** | **7.65** | **0.17** |
| **60N** | **3.38** | **11.77** | **77.8** | **3.34** | **APW1 $1011** | **$935** | **5.02** | **0.12** |
| **80N** | **3.29** | **11.93** | **78.1** | **3.77** | **APW1 $983** | **$881** | **2.52** | **0.09** |
| **100N** | **3.42** | **12.8** | **77.5** | **3.7** | **H2 $1028** | **$901** | **9.90** | **0.08** |
| **P Value** | **0.41** | **0.308** | **0.9** | **0.548** |  |  |  |  |
| **CV%** | **0.15** | **1.401** | **2.004** | **3.967** |  |  |  |  |
| **l.s.d 5%** | **2.00** | **0.4** | **0.5** | **4.5** |  |  |  |  |

* This site had 90 kg/ha Amsul (19 units) applied pre seeding

Table 9. Holmes harvest data and Nitrogen use efficiency

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Treatment | Yield t/ha | Protein % | Weight kg/hl | Screenings % | Returns $/ha | **Returns – N****Cost $/ha** | Recovery of Fertiliser N (%) | PNB (N) |
| **0N** | **2.17** | **12.63** | **72.73** | **8.29** | **AUH2 $628** | **$628** |  |  |
| **20N** | **2.27** | **12.6** | **73.83** | **6.79** | **AUH2 $659** | **$634** | **11.23** | **0.25** |
| **40N** | **2.27** | **13.3** | **73.87** | **8.98** | **AUH2 $657** | **$606** | **12.17** | **0.13** |
| **60N** | **2.22** | **13.3** | **72.53** | **7.95** | **AUH2 $645** | **$569** | **6.44** | **0.09** |
| **80N** | **2.27** | **13.8** | **71.4** | **9.24** | **AUH2 $659** | **$557** | **8.77** | **0.07** |
| **100N** | **2.32** | **14.17** | **71.93** | **9.85** | **AUH2 $671** | **$544** | **9.53** | **0.06** |
| **P Value** | **0.17** | **0.007** | **0.462** | **0.696** |  |  |  |  |
| **CV%** | **0.12** | **0.777** | **3.125** | **4.387** |  |  |  |  |
| **l.s.d 5%** | **2.00** | **2.5** | **1.7** | **20.7** |  |  |  |  |

Table 10. Kupsch harvest data and Nitrogen use efficiency

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Treatment | Yield t/ha | Protein % | Weight kg/hl | Screenings % | Returns$/ha | **Returns – N Cost $/ha** | Recovery of Fertiliser N (%) | PNB (N) |
| **0N** | **1.56** | **11.37** | **75.43** | **4.74** | **AGP1 $423** | **$423** |  |  |
| **20N** | **1.76** | **11.3** | **75.77** | **4.84** | **AGP1 $479** | **$454** | **19.46** | **0.17** |
| **40N** | **1.81** | **11.33** | **75** | **5.18** | **AGP1 $493** | **$442** | **12.46** | **0.09** |
| **60N** | **1.86** | **11.7** | **76.33** | **4.00** | **H2 $560** | **$482** | **11.95** | **0.06** |
| **80N** | **1.90** | **11.43** | **75.3** | **4.36** | **AGP1 $516** | **$414** | **8.75** | **0.05** |
| **100N** | **1.80** | **11.7** | **73.97** | **4.87** | **AUH2 $491** | **$364** | **6.00** | **0.04** |
| **P Value** | **0.009** | **0.351** | **0.117** | **0.018** |  |  |  |  |
| **CV%** | **0.168** | **0.510** | **1.638** | **0.609** |  |  |  |  |
| **l.s.d 5%** | **6.9** | **1.2** | **0.5** | **7.4** |  |  |  |  |

 **Price Notes:** All prices net delivered Geraldton and GST Exclusive

Recovery of Fertiliser N (%): A measure of the % of Nitrogen recovered from additional fertilizer, 40 – 60% recovery is ideal

PNB (N): Removal to use ratio – quantifies the amount of N being removed in the produce relative to the amount supplied. A PNB less than 0.5, indicates that more N is being applied than is being removed. When PNB is above 1.0, more N is being removed than is being supplied.

Comments:

* The trial component of the project was set up to develop a nitrogen response curve with rates from 0 units to 100 units of applied N. Well below average rainfall (decile 1) at all sites in 2015 resulted in soil moisture, rather than nitrogen supply, being the major limitation to grain yield at each site.
* There was very little response to applied nitrogen. The exception was the 20 units of N treatment at Duane’s with the largest recovery percentage of 41%. From the PNB calculation of nutrient use efficiency, at each site more N was applied than was removed by the crop.
* The red loamy earth at Holmes’s had the greatest plant available water capacity for wheat plant roots, the biggest soil water bucket.
* iPaddock yield looks at long term water use efficacy and uses a line of best fit analysis to predict yield based on rainfall received during the season at a specific time within the season . It is a comparison of previously achieved yields with a range of soil moisture levels at the same time within the season. It predicts yield based on actual farmer / paddock performance taking into account current management, soil constraints and rainfall patterns. The more historical yield and rainfall information entered into the model, the greater the accuracy will be. Essentially, past performance is utilized to predict the future yield estimates and in this project iPaddock yield has shown to have the least variation of all models between actual yields achieved in the paddock.
* The in season nitrogen recommendations indicated that there was adequate soil N to achieve the following yields – Kupsch – 1.6t/ha, Holmes 1.3t/ha, Duane 1.7t/ha in 2015.
* The Equii soil test model utilized within this project indicated that there would be no economic benefit from applied nitrogen until the yield at each site exceeded the stated figures above.
* The nitrogen recommendation graph generated pre sowing indicated steep responses to applied nitrogen but only if the yield was to exceed the 0 N estimate. Note that the Duane site had 19 units of N applied prior to sowing trial.
* At the time of the post Nitrogen application the following yields were predicted Kupsch – 2.7T/ha, Holmes 2.0T/Ha & Duane 2.5T/ha
* Modeled Nitrogen recommendations for the predicted yield on July 3rd at the time when top up post emergent nitrogen would be applied was - Kupsch 45 units, Holmes 35 units, Duane 55 units.
* The most economic rate of Nitrogen to apply at the Duane site was 20 units producing a net return of $1003/ ha. Note that this site had 19units of N applied pre sowing across all treatments so the 20 units was actually 40 units of applied N which the fertilizer model recommended to produce 2.2 T/Ha, the final yield was 3.4T/Ha. At this site the additional 1.2T/ha yield came from the 54 units of soil N identified in the profile down to 80cm with the pre sowing soil test. This shows the importance of deep soil Nitrogen testing to identify how much deep soil N is likely to be available pre sowing and then adjusting the in season nitrogen recommendations accordingly. Because the exact rooting depth and amount of soil N that can be accessed is not always known, an estimate of the amount of soil N that can be utilized is required, the amount of which will vary from season to season depending on the rainfall patterns.
* At the Holmes site 20 units of applied N produced a partial GM of $634/Ha, whilst increasing the applied N to 40 units dropped the GM to $606/Ha as there was no yield increase above 20 units of applied N at this site. At this site 52 units of soil N was identified in the top 80cm at sowing restricting the response to applied N with the decile 1 rainfall and very dry hot finish to the season.
* 60 units of applied N was the most profitable treatment at the Kupsch site returning a GM of $482/ ha with a yield of 1.86T/ha. The 40 units of N treatment resulted in a very similar yield to the 60 units of N treatment but was downgraded to GP due to high screenings and low protein thus reducing final GM.
* Maximum N recovery was achieved at 20 units at the Kupsch site, 20 units at the Duane site, while at the Holmes site it was at 40 units, after this point at each site the additional yield generated from each additional unit of applied N declined.
* The point at which maximum N recovery is achieved is not generally the most economic rate to apply N. The point shows that the crop is still very responsive to additional N, and this forms the N response curve. The most economic point on this curve will be were the curve flattens out. At this point, additional profit from one extra unit of applied N is equal to two times the value of that unit applied N.
* To further ground truth the calculations and findings from this research it is recommended that further research is required and the soil water usage of different crop types can also be compared.
* These results will be presented at the MIG updates and any other updates as requested.

This section should cover aspects identified in *Section 7.3* of the Research Agreement

* the results of the Project, including discoveries made and other achievements (including any Project IP and Project Confidential Information);
* the potential application of the outputs of the Project to the Western Australian grains industry and broader community;
* the actual or potential economic benefits flowing to the Western Australian grains industry and broader community from the Project;
* the difficulties encountered;
* the conclusions reached;
* the Researcher's recommendations for any further research;
* a list of scientific papers or publications resulting from the Project; and
* attach copies of any photos, diagrams or other artworks (including, if requested by COGGO, negatives, bromides or the like) which the Researcher has and which may be of assistance to COGGO in the dissemination of information concerning the Project to COGGO’s stakeholders.

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|  Project resources | This section describes use of the funding listed in the initial plan and any refunds due to COGGO |

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| **Expenditure of funds requested from COGGO** | $ Total funds budgeted | $Total funds expended (actual) | $Total funds requested from COGGO\* | $Total COGGO funds expended | $Refund due to COGGO of any unexpended COGGO funds |
| Salary/Contractors | 35,000 |  |  |  |  |
| Operating costs | 14,775 |  |  |  |  |
| Capital | In Kind |  |  |  |  |
| TOTAL | **49,775** |  |  |  |  |

 \*Funding provided by COGGO.

IMPORTANT: Return of unused funds to COGGO is required as per *Clause 3.3* of the Research Agreement.

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| Commercialisation | Insert details of the proposed commercialisation process,as applicable, with reference back to the planned commercialisation plan in the project proposal) for any outputs from the project.This should include recommendations for the commercialisation of the results of the project and the registration or other protection of Project IP and Project Confidential Information as per the Research Agreement. |

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|  | Not applicable |

It is understood that this may require further discussion and agreement with COGGO via its’ agent GIWA, as per the undertakings given and terms agreed, in the project proposal. This can be the subject of an appended letter and attachments. In all cases such discussion and subsequent agreements need to be governed by *Section 8 Project IP, Improvements and Project Confidential information* of the Research Agreement.

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| Communication/Extension | Insert details of how the communication and extension of the project outcomes has been achieved to date and recommendations for future activities to disseminate and promote adoption of the results of the Project. |
| In advance of the two workshops held in July, an article was run in the Farm Weekly to make growers aware of the project and the upcoming presentations.  | Articles were also published post workshop and have been included in the MIG Newsletter and on the MIG website. A link to the program “Crop Manager” has been on the MIG website and promoted through Facebook and Twitter to allow growers to see how real time data is being interpreted and gain an understanding of how it can be applied. The results will be presented at the MIG trials review day in March and are available for any other interested groups.  |

#### Note: As per *Clause 7.3 (b) (ii)* of the Research Agreement COGGO may require the Researcher to produce an edition of the Final Report in a form suitable for general distribution. If so required by COGGO, the Researcher must produce a non-confidential version of the Final Report within 28 days of receiving a request to that effect from COGGO.

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|  Certification |  |
| The Project Supervisor and the Research Organisation certify that all information contained in, and forming part of, this final project report is complete and accurate. The project supervisor and research organisation further warrant that the project complied with all the relevant guidelines affecting the conduct of research, for example in relation to ethics, bio-safety, environmental legislation, GMAC or National Health and Medical Research Council Codes.Project Supervisor’s signature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Name (in Capitals) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:Research Organisation signature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Name and title of authorised signatory (in Capitals) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Date: |

**Completed Final Project reports**

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For any further enquiries please email questions to coggoresearchfund@giwa.org.au

Or phone (08) 6262 2128

## COGGO representative

For the purpose of this Project agreement contract, COGGO will be represented by Grains Industry Association of Western Australia (GIWA), or such other representative that is nominated by COGGO as authorised to operate on behalf of COGGO.