Grower's Attitudes and Practices towards Soil Health in the Liebe Area

2010 Survey results

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Executive summary

In mid 2010 twenty broadacre farmers in the shires of Coorow, Dalwallinu, Perenjori and Wongan-Ballidu were surveyed in order to get an understanding of their farming practices regarding soil moisture conservation, soil carbon and soil amelioration. The results, in conjunction with previously collected data, has formed a baseline from which the GRDC funded and Liebe Group administered project 'Improved stubble and soil management practices for sustainable farming systems in the Liebe area' will be evaluated. A concluding survey will be conducted in mid 2012 to evaluate how successful the project was at increasing grower knowledge of soil health and adoption of associated practices.

Results from this study indicate that conserving soil moisture is extremely important to 90% of surveyed growers. The main method for conserving soil moisture is retention of stubble and minimum tillage techniques.

Increasing soil organic carbon levels is important to 95% of growers. Growers are keen to see their knowledge in this area improve; particularly if a carbon trading scheme is developed. Increasing grower knowledge about soil organic carbon presents an important research, development and extension opportunity for the Liebe group.

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Introduction

This study was undertaken to help identify the research, development and extension priorities of the Liebe groups' members with regard to soil amelioration, soil moisture conservation and soil carbon. These agronomic topics are the focus of the GRDC funded project '*Improved stubble and soil management practices for sustainable farming systems in the Liebe area'* and this survey (in collaboration with other data) will form the baseline from which the project is evaluated. This survey was primarily designed to fill in the gaps in data from a survey the Liebe group conducted in 2009 (Peterson 2009).

The growers surveyed are predominantly mixed crop and livestock producers in the Northern Agricultural Region of Western Australia. A majority of the respondents are from the Coorow, Dalwallinu, Perenjori and Wongan-Ballidu shires.

This survey will be repeated in mid 2012 so that comparisons can be made and the projects progress monitored.

Methods

Twenty growers were contacted and interviewed by the researcher at their home properties in a relaxed discussion format. The 20 growers surveyed were a subset of 60 farmers surveyed in the previous technical audit (Petersen, 2009). The number was constrained by the time available to the interviewer and the farmers. Interviewees are broad-acre farmers in the shires of Coorow, Dalwallinu, Perenjori and Wongan-Ballidu and full members of the Liebe Group. The average arable area farmed by respondents is 4,767ha with 74% of that area cropped. Average rainfall is 323mm and respondents have been farming for 26 years on average (Petersen, 2009). Full demographic details can be obtained from technical audit (Petersen, 2009).

The survey was broken into three parts: soil moisture, soil carbon and use of lime and gypsum (see Appendix 1 for interview guide). The soil moisture section consisted of open-ended questions about approaches to managing the farming system to maximise soil moisture infiltration and storage. Ratings were also obtained for importance for conserving soil moisture and techniques for conserving soil moisture. In the soil carbon section open-ended questions were asked about the importance of carbon to the farming system and approaches to managing carbon. Ratings were also obtained about knowledge and importance of soil carbon. The use of lime and gypsum section consisted of open-ended questions regarding the growers liming and gypsum program. Growers were also asked to rate the importance of liming for farm productivity.

Some surveys were recorded while other answers were written. Interviews took about 1 to 1.5 hours. Quantitative rating scales were entered into Microsoft Excel 2007 spreadsheet. Qualitative responses were entered into a Word document and answers were categorised. Totals, means and percentages were calculated for quantitative data.

Results

Soil moisture management

Moisture is the number one priority and we actively manage it. (Farmer, East Maya).

The two key techniques respondents identified as important for conserving moisture were retaining stubble (95%) and using knife points and press wheels (90%) (Table 1). Other factors growers mention were: not overgrazing, ameliorating soil constraints and using wider row spacing. These methods are designed to harvest, improve plant access to and retain water, which gives a yield advantage, particularly in a dry season. Growers believe minimum tillage can conserve water and increase yield that equates to an inch of rainfall or conserves 40% more rainfall than conventional tillage (full cut with multiple passes). Observations from growers include:

> *In a good year, an old combine would do as good a job as a flash new minimum till bar- but in a dry season the knife points and press wheels are miles in front.* (Farmer, East Maya).

Table 1. Techniques used for managing soil moisture

Technique	% of responses	% of respondents
Retain stubble	43	95
Knife points & Press wheels	41	90
Soil amelioration/Soil health	11	25
Not overgrazing	5	10
Total percentage	100	220
Total responses	44	20

% of respondents: % of the number of people interviewed. Participants were able to give more than one answer therefore % of responses represents how many times that response was given.

In the eyes of majority of the growers surveyed the use of minimum tillage has '*revolutionised farming'*. There was however two growers that preferred to use a full cut cultivation in order to get a good weed control (amongst other reasons). Both growers said that water harvesting was not a priority in their farming system. Interestingly, these two growers were in a more reliable rainfall area than a majority of the respondents.

When discussing minimum tillage systems respondents identified two main challenges; weed control and sowing the crop through previous stubble. A majority of growers are managing trash flow by using seeder bars with higher clearance and wider row spacing. The average row spacing was 10 inches (Table 2). The trend amongst those surveyed appears to indicate wider row spacings are preferable. Three growers who had just brought new seeder bars changed to wider rows on the new equipment for better trash management and water conservation. Two of the grower's surveyed are considering changing from a tyne seeder to a disc seeder for easier trash management.

Table 2. Row spacing (inches) on seeding equipment of growers in Liebe area

	Average row spacing	Seeder bar row spacing's and number of respondent to each						
		3"	7"	8"	9"	10"	11"	12"
Seeding bar row spacing	9.3	1	2	1	5	8	0	3

Weed control is a big challenge on farms and 7 out of 20 growers specifically mentioned having to compromise water conservation to get good weed control. High stubble loads (desirable for moisture conservation) can sometimes reduce the effectiveness of herbicides and therefore compromise weed control. One grower was so concerned about herbicide effectiveness that he prefers to reduce stubble cover and use a full cut cultivation, at the expense of water conservation.

Narrow windrow burning has become extremely popular in the Liebe area. Of the growers surveyed, 40% mentioned windrow burning and based on anecdotal evidence the district average is expected to be even higher. Windrow burning allows a physical weed control method while retaining stubble cover on paddocks. Growers acknowledge burning is detrimental to moisture conservation (Table 4), however burning a narrow strip of the paddock is considered a good compromise because it allows for weed control while leaving stubble cover on the bulk of the paddock. Many of the growers surveyed reported better germination and crop growth under the previous year's windrow and attributed this to extra moisture conservation, however current scientific research attributes the increased growth to increased nutrients in the ash.

Participants identified the main methods of monitoring soil moisture as digging around in the soil (35%) and monitoring rainfall (100%). Knowledge regarding how soil types behave, general experience and gut feel also rated highly (Table 5). None of the growers surveyed use soil moisture probes or moisture logging systems. A reason limiting the use of such equipment is that soil type has a large impact on plant available water and soil can vary considerably across a single paddock. Although not specifically mentioned, expense and difficulty in setting up equipment could also be barriers to adoption.

Soil carbon

The survey indicated that soil organic carbon is important to the farming system of ninety-five percent of growers as it contributes to soil health. Beyond retaining stubble and using minimum tillage the growers feel it is difficult to increase soil organic carbon because rainfall, crop growth and soil type influence the amount of carbon that can be produced and stored. Some growers feel they can see the difference soil organic carbon makes to their paddocks while others are not seeing any production improvements from attempts to increase soil organic carbon.

> *Carbon helps to grow good crops so all carbon is good but whether it comes into consideration and decision making is debatable.* (Farmer, Wubin).
>
> *Poor paddocks have low organic carbon but they can't grow anything so it's hard to build carbon in that area. Would be good to have a product or source which we could easily spread on the paddock* (Farmer, Buntine).
>
> *Soil carbon is a secondary thing, main aim is to improve soil health and increase water holding capacity, chasing carbon is not a driver* (Farmer, East Dalwallinu).

Fifty-five percent of growers said they actively try and build their organic carbon levels through minimum tillage and stubble retention. The term 'active' in the questioning resulted in different responses for different farmers, some that said they did not 'actively' monitor soil carbon but retain stubble and look at organic carbon percentage in soil tests, other farmers in the same circumstances considered these actions as 'active'.

Five growers mentioned the government's emission trading scheme, and indicated that if they were paid to store carbon, then maintaining or increasing the storage of soil carbon would be a more important priority.

The survey indicated a gap in knowledge regarding how soil organic carbon can be increased and how this increase will improve farm productivity. Half of the growers surveyed did not know what their organic carbon levels were, of those who knew their current organic carbon levels none seemed to know the upper limit or potential for organic carbon in their soil type. Growers desire to increase their knowledge regarding soil carbon (Table 3) but continually mention a lack of target levels for soil organic carbon and lack of methods to achieve increases. This gap in knowledge provides a R,D&E opportunity for the Liebe Group.

> *Wish we knew what OC levels we were aiming for* (Farmer, Dalwallinu).

Table 3. Growers rating of their knowledge to soil organic carbon and how it relates to farm productivity

Question	Average rating	Rating percentages*						
		1	2	3	4	5	6	7
How do you rate your current knowledge of soil carbon?	3.3	6	18	35	12	29	0	0
Do you want to increase knowledge?	6.0	0	0	0	0	25	44	31
How important is increasing knowledge to farm productivity?	4.8	6	0	6	28	28	28	6

* 1= not important 7=very important; Percentages are of 20 respondents

Lime and gypsum

All the growers surveyed apply lime to their soil and consider the practice very important to the farming system. Rates of lime applied ranges from 0.8 to 2 t/ha and frequencies range from once every 2-10 years. Liming requirements are generally determined by soil tests. Growers are confident that liming to overcome top soil acidity is a good economic decision. However, overcoming subsoil acidity (Low pH soil at below 20cm) is more of a challenge as surface applied lime can take up to 7 years to ameliorate the subsoil. A third of growers indicated they plough the lime in for faster incorporation with the soil.

Its good, it works, it's important and it's cheap (Farmer, Wubin).

Gypsum is more commonly used as a source of sulphur fertiliser (35% of growers) than a soil ameliorant (25% of growers). Five growers indicated they had used gypsum as a soil ameliorant in the past but were no longer using it because: a) minimum tillage has reduced the need for gypsum; b) did not see a yield response.

Implications for research, development and extension

Opportunities exist for the Liebe group to demonstrate and validate tools that assess soil moisture such as subsurface moisture probes and yield prophet. Currently growers use their past experience, visual observations and intuition to assess soil moisture rather than new technologies. The Liebe group has recently purchased sub-surface moisture probes and set up yield prophet sites across the district, which will be used to assist growers in making more informed decisions about time of sowing and nitrogen applications.

Liebe growers have a strong desire to increase their knowledge regarding soil organic carbon and its influence of the farm production system. This desire presents an R,D&E opportunity for the Liebe group. The growers are seeking a clear target for soil organic carbon levels (depending on soil type and climate constraints) and a clear understanding of how increasing organic carbon will increase farm productivity and profitability. As stated by one grower "*It's only important if you can make money from it, economics are the drivers not preventative measures"*. Once these two challenges are addressed the growers will then require a clear mechanism to increase organic carbon in a practical and economic way.

It is possible that there is some confusion regarding the difference between lime and gypsum as growers are implying the two products are interchangeable, as evident in the following quotes.

> *We will use gypsum again once we run out of lime*
>
> *Have tried it [gypsum] as a soil ameliorant but think lime does a better job*

As lime and gypsum treat two different soil constraints clearing up this confusion may present an extension opportunity for the Liebe Group. However, overall the level of knowledge and adoption is high for these soil amelioration practices.

Conclusion

Ninety percent of the growers actively try and conserve soil moisture by using minimum tillage and retaining stubble. This conservation of rainfall gives a yield advantage, particularly in dry years. Despite the documented advantages of retaining stubble and minimum tillage, growers will undertake practices that could be damaging to soil moisture such as burning or multipass cultivation to control weeds.

Increasing soil organic carbon is important to 95% of growers despite a lack of research to indicate what organic carbon levels are optimal and how best to increase these levels. This gap in knowledge represents a research, development and extension opportunity for the Liebe Group.

The use of lime and gypsum as soils ameliorants is a well established practice in the Liebe area and considered very important for the farming system. Over the years the Liebe group has conducted many lime and gypsum which has contributed to a high level of grower knowledge. However soil acidity is still major soil constraint and development and extension should continue into the future.

Acknowledgments

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References

Peterson,E. (2009) *Evaluating the implementation of new technologies in the Northern Agricultural region of Western Australia Technical Audit-Phase 2 (Exit Survey)*. Buntine, WA. The Liebe Group Inc.

Appendix 1: Interview guide

Soil moisture

1. What is your approach to actively manage your farming system to maximise soil moisture and moisture infiltration

-What management techniques are you using
In what situations?
Seeding machinery, row spacing, press wheals
Weed management
Soil structure- non wetting soils and hard pans

- Heights of stubble cut
- How much ground cover do you aim to leave
- How much moisture do you think is harvested from knife points and press wheels
- Is there a critical level of stored soil moisture you need
- Row spacing

2. Would you like to be doing more to store soil moisture? How could we do more and what constraints need to be overcome?

3. How do you measure and monitor soil moisture

4. What are the implications of the following stubble management techniques on stored soil moisture conservation? Please rank each technique: 1 being very detrimental to moisture conservation, 7 being very beneficial to moisture conservation.

Burning	1	2	3	4	5	6	7
Cultivation	1	2	3	4	5	6	7
Stubble retention, minimum till- cut high/ low residue	1	2	3	4	5	6	7
Stubble retention, minimum till- cut low/high residue	1	2	3	4	5	6	7
Fallow	1	2	3	4	5	6	7
Rolled Stubble	1	2	3	4	5	6	7
Grazing	1	2	3	4	5	6	7

4. How important is conserving soil moisture relative to other agronomic issue
Rank the importance of the following issues

Soil moisture
Weeds
Disease
Management of stubble for ease of seeding

5. How do you make your decisions about nitrogen in regards to soil moisture. If there is stored soil moisture at seeding are you confident to put more nitrogen upfront. What tools do you use to make that decision.

Soil Carbon

7. How important is carbon in your farming system
8. Do you actively try to build and monitor soil carbon in the soil, **how** do you do this.
Limitations
What is stopping you from retaining stubble year after year
9. how much carbon do you estimate is in your soil- how much can your soil hold, and does that vary across soil types.

10. Do you want to increase your knowledge about soil carbon?
What research is needed

Your current knowledge on soil carbon and its effect on crop production	1	2	3	4	5	6	7
Do you want to increase your knowledge	1	2	3	4	5	6	7

On a scale of 1 to 7 how important is increasing soil carbon to your farming system?

How important is increasing soil carbon to farm productivity	1	2	3	4	5	6	7

Soil amelioration

Do you lime ? Could you tell me about your liming program
How frequently do you lime a paddock
Rate / Results/ problems
How important is incorporating lime to depth

How important is liming for your farm productivity	1	2	3	4	5	6	7

Do you apply gypsum, in what situations ?
Rates , frequency Results/ problems

Appendix 2: Additional results

Table 4. Rankings of stubble management technique on implications for soil moisture conservation

Stubble management technique	Mean	Mode
Stubble retention- min till cut low/ high residue	6.2	6
Stubble retention- min till cut high/low residue	5.4	6
Fallow	5.2	6
Rolled Stubble	5.0	6
Grazing	3.5	4
Cultivation	2.0	2
Burning	1.8	1

1 = practice is very detrimental to soil moisture 7 = practice is very beneficial to soil moisture

Table 5. Method used by growers to monitor soil moisture

Method used for monitoring soil moisture	% of respondents	% of responses
Dig hole	65	35
Monitor rainfall	40	21
Learned experience/ gut feel	20	10
Know your soil type	25	13
Visual crop assessment	25	13
Calculated indicators (WUE, Yield predictions)	10	5

Survey participants were able to give more than one answer therefore % of respondents indicated how many growers n=20 chose that response. % of responses is how many times that response was mentions n=37.

Table 6. Importance of liming in the farming system to growers in the Liebe area

Question	Average response	Rating percentages*						
		1	2	3	4	5	6	7
How important is liming to your farming system	6.4	0	0	0	0	0	56	44

* 1= not important 7=very important; Percentages are of 20 respondents

Table 7. Stubble height after harvest of growers in Liebe area

Stubble height	High	Low	Variable
Number of growers	3	10	1

Low= 200 mm or less and high = above 200mm.