Innovative Carbon Storage and Nitrogen Management Strategies in the WA Wheatbelt

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Aim

This project has two main objectives:

1) To demonstrate innovative on-farm practices that can reduce nitrous oxide emissions, through the rotational use of leguminous crops in order to reduce the use of nitrogenous based fertilisers whilst maximising net primary production (biomass).

2) The project will trial and demonstrate innovative on-farm practices that can increase the sequestration of carbon in soil, through the use of biochar, soil amendments, biological amendments and use of additional composting materials to develop economically viable farming practices that sustainably store and build soil carbon.

Background

Carbon is an important part of maintaining soil health and the productivity of the soil. It provides an energy source for many functions considered important for soil biological health, including: the transformation of nutrients to more plant available forms, increasing soil pH buffering capacity, increasing cation exchange capacity, stabilisation of soil structure and the degradation of soil pollutants.

Building soil carbon is a product of soil type, climate and management factors. The soil organic content that can be achieved depends not only on the potential of the soil to protect C but also on the productivity of the crop or pasture. Theoretically, there is a soil carbon upper and lower limit in all soils. Previous research conducted by the Liebe Group shows that in the low rainfall environment in the Northern wheatbelt of Western Australia, over time the upper and lower limits of soil carbon will reach an equilibrium, that is where the microbial decomposition of organic carbon is lower (upper limit) or higher (lower limit) than the input of new carbon inputs.

The challenge for our farming system is to find ways that can push our current carbon storage equilibrium more towards the upper limit and thus improve the soils potential and keep it at that equilibrium.

Hoyle, Baldock & Murphy (2009), indicate that there are a number of management options for farmers to sequester soil carbon, centring around increasing inputs of soil C, improving soil structure and supplying adequate amounts of nutrients to the soil. This project aims to demonstrate practices that cover all three of these areas.

In the area of addition of soil C, growing more biomass such as perennial pastures, eliminating fallow or adding biochar to the soil, all present a viable way to add soil C. Improving soil structure, through improved stubble management and reducing wind erosion through cover cropping, decreases the loss of organic residues from the soil and thus the loss of soil C from the soil. Finally, by supplying nutrients through brown manuring crops, utilising the N fixing ability of leguminous crops and adding organic soil amendments, ensures that crop biomass and root growth is maximised, thus increasing carbon in the soil. As organic materials decompose, nutrients can be released (mineralised) or taken up (immobilised) by soil organisms.

This project is funded by the Australian Government Department of Agriculture, Fisheries and Forestry as part of its Carbon Farming Futures – Action on the Ground program. The project commenced in July 2012 and will be completed by June 2015.

Project Activities

1. Soil Quality Monitoring

10 grower paddocks which were sampled for soil carbon 5 years ago as part of the soilquality.org program, will be re sampled and analysed. By investigating the paddocks management history (crop rotation, tillage practices and liming applications) growers will be able to increase their knowledge about how different management strategies alter soil C under the specific climatic conditions of the WA wheatbelt. Through collaboration with the Department of Agriculture and Food, WA, the results from these 10 Liebe sites will be added to the database on www.soilqulaity.org.au

2. Practice for Profit Trial - Mills Property, east Dalwallinu

The long term Practice for Profit trial will be continued through this project to compare high and low fertiliser use under the following crops; wheat, canola, volunteer pasture and field peas. Total carbon will be measured under different rotations. The trial will demonstrate the profitability of using legumes and low levels of nitrogenous fertiliser in the farming system. To take seasonal variability and rotation effects into account the trial will run from 2012 to 2014 inclusive. Key messages and conclusions will be presented in 2015. The information provided from this research will allow growers to better manage the use of nitrogenous fertiliser and thus reduce nitrous oxide emissions and increase plant biomass.

3. Demonstration of Perennial Legume Tedera - Martin Property, north Watheroo

The project will demonstrate how using perennial legumes can increase nitrogen carbon stored in the soil. To achieve this, shrubs were planted in low fertility soils which the host grower has prioritised for carbon management.

4. Soil Amendment Trials - Buntine, north Miling and Wubin

A series of soil amendment trials will be conducted to amend soil issues with the physical, chemical and biological status of the soil, in turn increasing productivity and carbon cycling on that soil.

- Growing cereal rye - Pearse Property, west Wubin
- Removing soil compaction - Dodd Property, west Buntine
- Incorporating bentonite clay - Seymour Property, north Miling

5. Biochar Trial - Long Term Research Site, west Buntine

The project will investigate if biochar in a pelletised form is a suitable option for storing carbon in WA's wheatbelt. The Liebe Group will develop pellets for use in demonstrations using grower machinery to examine, how biochar can be practically applied to the soil including maximum rates achievable with standard grower equipment as well as the effect on crop yield and carbon storage.

4. Crop Manuring Trial - Long Term Research Site, west Buntine

An on farm demonstration run in conjunction with the existing Liebe Group's Soil Biology Trial will assess how crop manuring can be used to increase the amount of carbon in the soil. Manuring refers to sacrificing a crop in order to put organic matter back into the soil to improve soil health, weed control and subsequent crop yield. A site will be set up in 2012 and monitored for two growing season. Soil carbon levels, amount of biomass grown; and the economic and agronomic factors of how crop manuring fits into the farming system will be recorded.

Collaboration with Other Projects

The Liebe Group is also collaborating with other organisations on projects funded through the Australian Government's Carbon Farming Futures program. These projects are summarised below.

"Economies of Managing Soil Organic Carbon" – Department of Agriculture and Food, WA

This project involves field-based and grower managed demonstration sites implementing innovative methods for improving both soil organic carbon (SOC) stores in conjunction with their production base; and monitoring of previously established soil quality sites will provide information to landholders on beneficial/perverse outcomes associated with changing SOC levels in grain production systems. This will enable landowners to determine the profitability and risk of managing carbon from a sequestration vs. production perspective. These trials will begin in 2013.

Does increasing soil carbon in sandy soils increase soil nitrous oxide emissions from grain production?" - University of Western Australia

This project will investigate if varying soil organic matter content and quality alters the crop response to applied N fertiliser. The field sites will include the Liebe Group's long term Soil Biology Trial where there is a gradient of soil organic matter. The crop and soil response to different N fertiliser rates would be measured to determine the influence of soil organic matter on N fertiliser response and estimate changes in nitrogen use efficiency. The project will also measure Nitrous Oxide emissions in response to the changing soil organic matter and applied Nitrogen regime. Preliminary results of this work can be found on page 114 of this booklet.

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