

# Innovative Carbon Storage and Nitrogen Management Strategies in the WA Wheatbelt



Lilly Martin, Research and Extension Agronomist, Liebe Group

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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 (N) 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 (C) 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

C 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 plant available forms, increasing soil pH buffering capacity, increasing cation exchange capacity, stabilisation of soil structure and the degradation of soil pollutants.

Building soil C 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 C 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 C is lower (upper limit) or higher (lower limit) than the input of new C inputs.

The challenge for our farming system is to find ways that can push our current C 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 C, centring on 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 C 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 Action on the Ground program. The project commenced in July 2012 and will be completed by January 2016.

## **Project Activities**

### **1. Practice for Profit Trial - Mills Property, east Dalwallinu**

The long term Practice for Profit trial compared high and low fertiliser use under the following crops; wheat, canola, volunteer pasture and field peas. Total C will be measured under different rotations. The trial will demonstrate the profitability of using legumes and low levels of N fertiliser in the farming system. To take seasonal variability and rotation effects into account the trial will run from 2014 to 2016 inclusive. The information provided from this research will allow growers to better manage the use of N fertiliser leading to improved gross margins.

### **2. Demonstration of Perennial Legume Teder - Martin Property, north Watheroo**

The project will demonstrate how using perennial legumes can increase carbon stored in the soil. To achieve this, teder seeds and seedlings were planted in low fertility soils which the host grower has prioritised for C management. The demonstration ran from 2014 to 2015 inclusive.

### **3. Soil Amendment Trials - Buntine, north Miling and Wubin**

A series of soil amendment trials were conducted to amend soil issues with the physical, chemical and biological status of the soil, in turn increasing productivity and C cycling on that soil. The demonstrations ran from 2014 to 2015 inclusive.

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

### **4. Biochar Trial - Long Term Research Site, west Buntine**

The project will investigate if biochar is a suitable option for storing C in WA's Wheatbelt and how it affects crop yield and C storage. The trial ran from 2014 to 2015 inclusive.

### **5. Crop Manuring Trial - Long Term Research Site, west Buntine**

The Liebe Group's Soil Biology Trial will be utilised to assess how crop manuring can be used to increase the amount of C 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. Soil C levels, biomass and the economic and agronomic factors of how crop manuring fits into the farming system will be recorded. The trials ran from 2014 to 2015 inclusive, this trial will continue to be monitored as part of the Soil Biology Trial.

## **Collaboration with Other Projects**

The Liebe Group has also collaborated 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 involved 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 to 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 C from a sequestration vs. production perspective. These trials began in 2013.

### *"Does Increasing Soil Carbon in Sandy Soils Increase Soil Nitrous Oxide Emissions from Grain Production?" - University of Western Australia*

This project investigated if varying soil organic matter content and quality alters the crop response to applied N fertiliser. The field sites included 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

was be measured to determine the influence of soil organic matter on N fertiliser response and estimate changes in nitrogen use efficiency. The project also measured nitrous oxide emissions in response to the changing soil organic matter and applied nitrogen regime.

**Further Reading**

Previous trial results available from;

<http://www.liebegroup.org.au/innovative-carbon-storage-and-nitrogen-management-strategies-in-the-western-australian-wheatbelt/>

**Contact**

Lilly Martin, Liebe Group

[lilly@liebegroup.org.au](mailto:lilly@liebegroup.org.au)

(08) 9661 0570