Cool Soil Initiative

AIM

- The Cool Soil Initiative aims to increase the long-term sustainability and yield stability of the grain-producing regions of southern New South Wales and north-east Victoria, through the adoption of innovative agronomic strategies to increase soil health and related function.

Project title	Cool Soil Initiative
Project partners	FarmLink, Food Agility, AgriSci, Charles Sturt University, Riverine Plains, Central West Farming Systems, Sustainable Food Lab.
Funding partners	Food Agility, Charles Sturt University, Mars Petcare, Kelloggs, Manildra Group, Allied Pinnacle
Trial Site Locations	FarmLink Region
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INTRODUCTION

This program was the first of its kind in Australia, connecting farmers with end users in support of the industry. Riverine Plains and Central West Farming Systems (CWFS) farming groups provided the connection through to farmers within the drawing arc of supply to the Mars Petcare Bathurst and Wodonga factories. There was a steep learning curve over the first three years as we learnt how to effectively communicate this program to farmers and industry, how to improve our collection and interpretation of farmer input data, and how to support on-ground practice change, while providing more value back to farmers.

In 2020 the program evolved again to become the Cool Soil Initiative, with Kellogg's, Manildra Group and Allied Pinnacle joining the project, in partnership with Charles Sturt University and the Food Agility Cooperative Research Centre (CRC). As such, this project connects across the supply chain in a unique framework of corporate investment to provide benefit across the cropping industry, through pre-competitive partnerships.

The reach of farmer engagement has also increased, with FarmLink Research joining the program in 2020, and the Irrigation Research and Extension Committee (IREC) coming on board in 2021 to support irrigated farmers in the MIA/CIA. The emphasis in dryland systems is still on wheat production, as that is a commodity shared by all partners, while the irrigated systems of the MIA/CIA are focused on maize and soft wheat production. In 2022 Corson joined the program, expanding reach into maize production on the Darling Downs, while the addition of PepsiCo in 2023 has enabled an expansion into canola in the Riverina..

Farmer engagement is a key component of the project. Each farming group supports a number of farmers to participate in the project, while acting as their advocate to ensure that the project continues to deliver benefits back to the farmers involved. Furthermore, while each farming group knows which farmers are participating in the project, this information is not passed on through the project, with all on-farm information anonymised.

In 2018 there were 20 farmers participating in the project across the regions, expanding to 185 in 2022.

METHODOLOGY

45 growers in the Riverine Plains region participated in the Cool Soil Initiative in 2021/22 with an additional 10 participating in the Maize part of the program.

All participating growers identified up to five wheat paddocks each season for inclusion in the project, with GPS-located soil tests (0–10 cm) taken for each paddock.

Each soil sample was air-dried and analysed for a range of soil properties, including soil pH ($CaCl_2$), soil organic carbon (SOC) percentage, cation exchange capacity (CEC) and nutrients. Soil samples were taken from specific locations in each paddock based on ease of access and the known location of representative soil types.

Anonymised soil test results, farm input data and yields will be captured in a simple database and processed through the Cool Farm Tool, which generated predictions of greenhouse gas emissions for each paddock.

The wet season of 2022 made soil sampling quite difficult. As a result, not all sampling results were available at time of publishing. The combination of a delayed, wet harvest and a rebuild of the data entry system has meant that data collection from the 2022 season has been delayed until after sowing, 2023.

How are Emissions Calculated?

There are two ways to consider GHG emissions on-farm. The first is to consider the whole farming system, which is highly complex, and considers the emission footprints required to grow crops, cut hay, grow livestock, feed grain to livestock, tree plantings etc. At present there are no straightforward tools available for farmers to generate this information, so this is still a future focus.

The second way is to consider the energy/emission footprint required to grow each commodity, which considers the energy and related emissions connected to each input. This method is used for any supply chain reporting, whereby farmers can demonstrate that the commodity is produced with a low emission footprint. This is the approach taken in the Cool Soil Initiative, with farmers provided with the emission footprint for their grain grown on a per tonne, and per hectare basis. This approach is internationally recognised, with standardised methods.

The emission footprint of grain (or any commodity) is reported on a CO_2e basis (carbon dioxide equivalents), which is based on the GHG emissions related to the manufacture and use of all crop inputs (fertiliser, crop protection, weed control), energy/diesel usage and soil disturbance. Nitrogen usage is of particular interest, as (i) the manufacture process for urea is highly energy intensive (with high GHG emissions), (ii) addition of urea results in N_2O and CO_2 losses from the soil, and (iii) and urea is generally the single largest input – all of which means that urea application is a significant driver of emissions.

So, while accurate on-farm emission reporting for Australia is a moving target, the Cool Soil Initiative is contributing to refinement of the methods and calculations, to improve the relevance and accuracy of internationally relevant emission calculations for the Australian systems. As new learnings are generated over the coming years, all on-farm emission calculations will be re-run, to ensure farmers have access to the best numbers available.

RESULTS

GHG Emissions

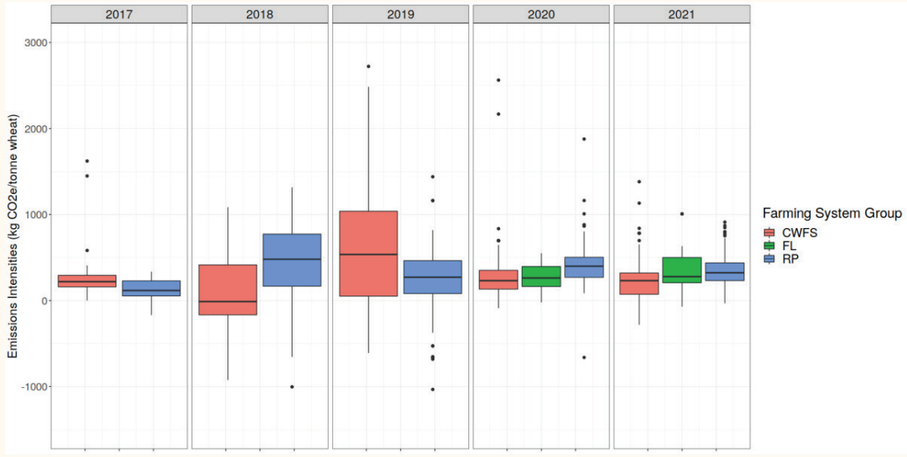

Figure 1. GHG emissions per tonne (CO_2e/t) for wheat grown in the Riverine Plains, FarmLink and Central West Regions.

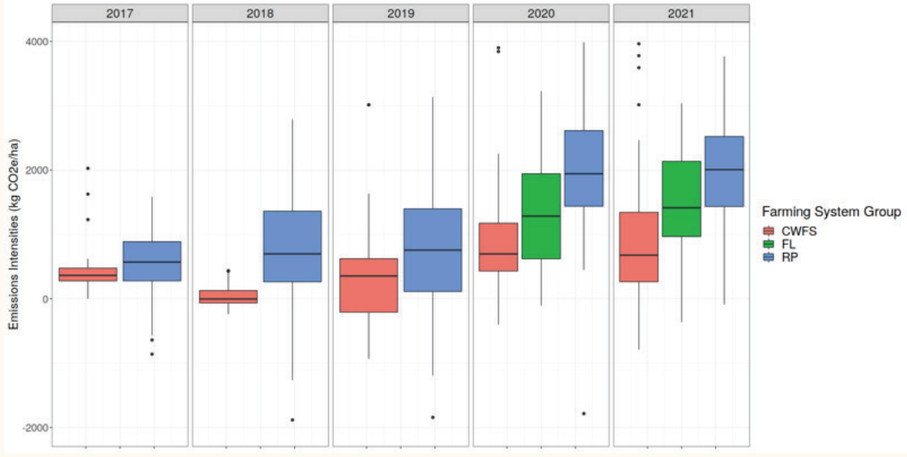

Figure 2. GHG emissions per hectare (CO_2e/ha) for wheat grown the Riverine Plains, FarmLink and Central West Regions.

Figure 1 displays the emission intensities per tonne of wheat grown, while figure 2 shows GHG emissions per hectare. The data is represented as box plots, the centre line in each box showing the median, the box showing 50% of the values, and the lines and dots showing the degree of variance. If a value is below 0, the emissions associated with the production of that crop are less than the offsets.

RESULTS

Soil Carbon Values

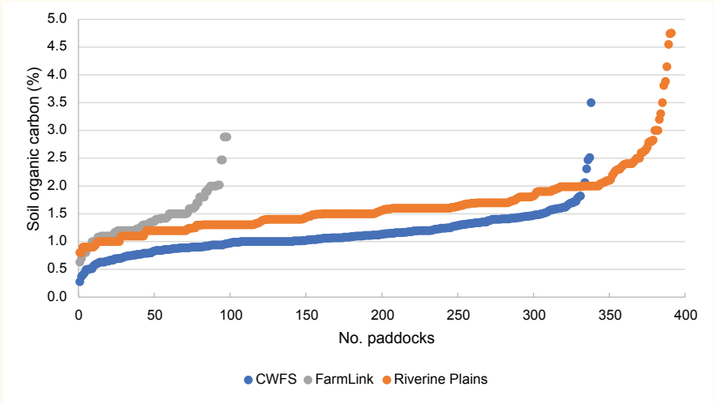

Figure 3. Soil organic carbon (SOC) (%) values (0-10cm depth) from 827 paddocks across three regions, sampled from 2018 – 2021. Median values for each region are: Riverine Plains SOC = 1.51%, FarmLink SOC = 1.36%, Central West Farming Systems (CWFS) SOC = 1.07%.

Soil carbon values are an important parameter in the emission calculation, providing significant offsets. However, more importantly, they are an important consideration in understanding the resilience of the farming system, as higher carbon values mean higher amounts of soil organic matter, which means greater nutrient cycling, greater water-holding capacity, and greater diversity of microbes.

The range of soil carbon values measured in this program far exceeded expectations. As these values are GPS-referenced, they represent measurements at a single point in the paddock, rather than averaged samples taken from across the paddock. This also means that they can be tracked over time.

As shown in Figure 3, the soil carbon values vary significantly both within, and between regions. As each value on the graph represents a paddock that has been entered into the program, the crop-data relating to each value can be used to understand if there are any similarities between points. This data has been assessed to specifically understand if there are any relatively simple similarities between the points at the high end of each curve.

While the ongoing economics component of the program will continue to pull out more detailed relationships, the key similarities that came out from each region are listed here:

Riverine Plains: 35 paddocks had SOC > 2%. Of these, 26 had a history of a pulse or pasture phase. All yielded well in 2021, unless they experienced waterlogging.

FarmLink: 12 paddocks had SOC > 2%. Of these, nine had a history of lucerne, clover-based pasture or pulses. Only one paddock had a pH value < 4.8.

CWFS: 20 paddocks had SOC > 1.5%. Of these, 15 had a history of lucerne or clover-based pasture, only 1 with pH <4.8 and good yields in 2021 (unless flooded).

The role of legumes in the system were also well highlighted. When farmers grew a legume in 2019 in both CWFS and Riverine Plains, the wheat yield in 2020 was consistently high, with a tighter range of yields, compared to a broad spread of yields when they did not. This trend was not clear in 2021, likely due to yield penalties due to the wet harvest, and less legumes grown in 2020 due to likely emphasis on crops with strong commodity pricing, to recoup the poor returns of the drought years.

The common themes from this very basic assessment, is that there is a strong connection between the background soil fertility, SOC values and yields. This is a key area of interest for the program, which we will continue to explore further.

CONCLUSION

The Cool Soil Initiative is a pre-competitive, collaborative approach to understanding the key drivers to on-farm emissions, while supporting the food industry partners in learning more about the farming systems from which they purchase their grain. Farmer engagement and feedback is pivotal to the success of this program, with farming system groups providing strong support and advocacy for participating farmers. This means the Cool Soil Initiative is continuing to learn and grow, in order for the program to provide on-ground benefit, supporting farmers in the sustainable production of food from productive, profitable farming systems.

Acknowledgement

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