COOL SOILS INITIATIVE RESULTS AND CASE STUDIES FROM THE RIVERINE PLAINS

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KEY POINTS

Analysis of soil samples from 183 paddocks participating in the Cool Soils Initiative project showed soil organic carbon (SOC) levels ranging from 0.70–4.75 per cent.

Analysis of 183 surface (0 –10cm) soil samples taken as part of the project showed that pH ranged from 4.2–7.3 (CaCl2).

Knowing what is in your soil is key to utilising nutrients, understanding limiting factors and growing sustainable yields.

Aim

The *Cool Soils 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.

Background

Increasing SOC has been globally recognised as a key driver in reducing emissions, through sequestration of atmospheric carbon dioxide (CO2) while increasing system resilience through increased water storage and nutrient cycling. All these factors then potentially contribute to increased sustainability and yield stability. This project focuses on the adoption of on-farm practices that may increase soil carbon while maintaining production and profitability. It will do this by 45 growers selecting up to 5 paddocks each (225 sites) across the Riverine Plains region, measuring Soil and pH for inputting into the Cool Farm tool. The result from this tool is their calculated greenhouse gas emission per hectare and per tonne of wheat produced.

During 2018, Riverine Plains and Central West Farming Systems partnered with Mars Petcare to develop an industry program, the *Australian Cool Farm Initiative*, to quantify greenhouse gas emissions (GHG) from wheat production, as well as to identify avenues to support farmers in reducing emissions, with a focus on soil health.

In 2020, the program took another leap forward, being recognised as a program of value across the industry, 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).

Also during 2020, the name of the program changed to the Cool Soil Initiative to reflect the importance of soil health as a key driver mitigating GHG emissions on-farm, while supporting increased system resilience across variable seasonal conditions. During 2021 the project has expanded into the irrigated cropping sector, with an increased focus on corn production.

The program aims to create a framework for the food industry to support grain growers through the adoption of innovative agronomic strategies to increase soil health and related function, resulting in reducing greenhouse gas (GHG) emissions, leading to increased long-term sustainability and yield stability.

To support farmers in practice change, innovation paddocks have been established. The innovation paddocks will be used to showcase different management practices, such as liming, incorporation, amendments and using pulses in the system to either increase soil health or as a greenhouse gas mitigation strategy. The paddocks provide an avenue for farmers to trial a practice and can be measured.

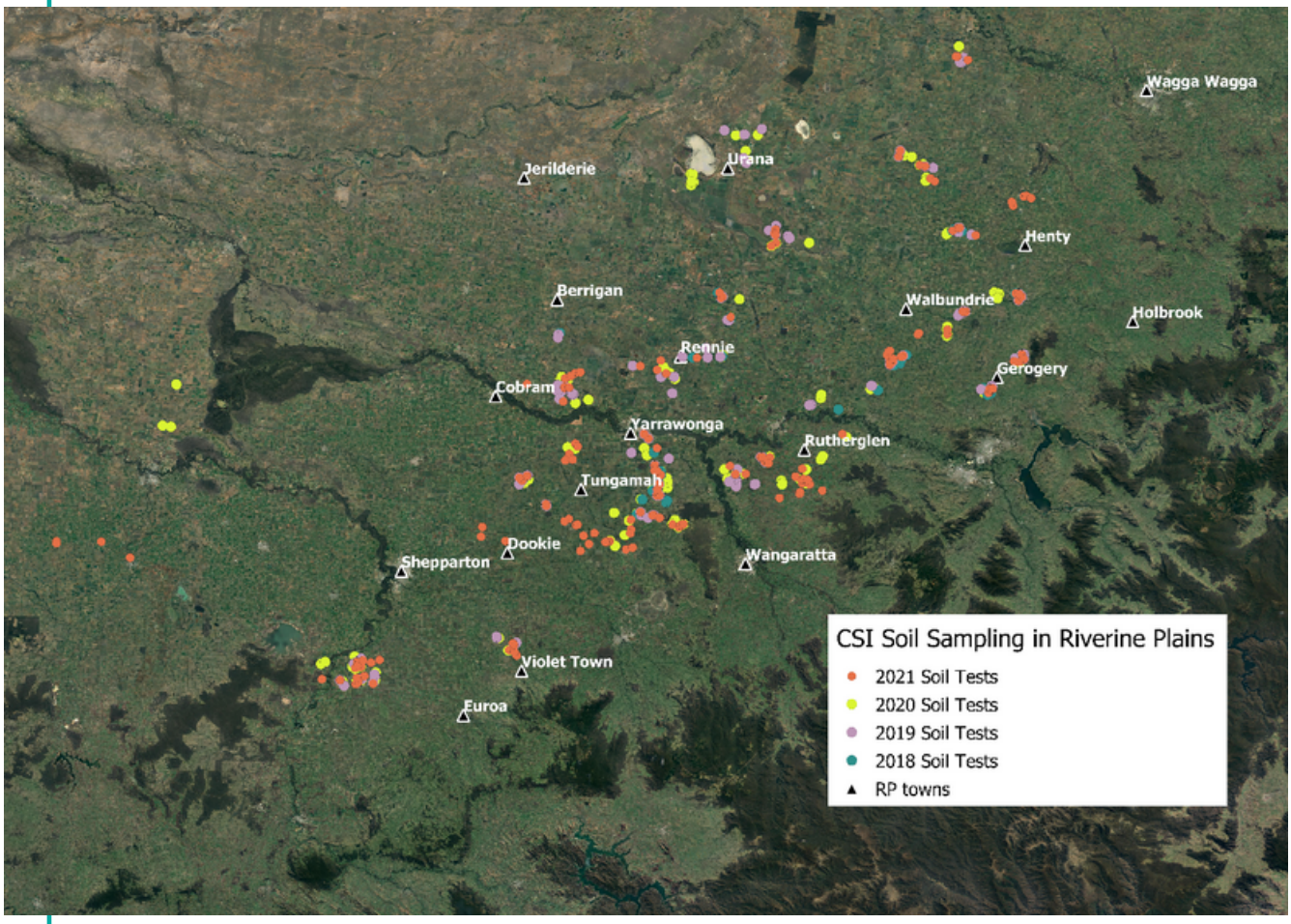
Method

During 2019, 30 growers from both the Riverine Plains and Central West Farming Systems (CWFS) region (a region centred in Condobolin and covers 14million hectares.) provided data on up to 5 wheat paddocks to participate in the project. During 2020, the number of growers participating across the project increased to 85 farmers, which included new participants from the area managed by FarmLink (An area encompassing southern NSW). There were 40 participant farmers from the Riverine Plains region during 2020, and this grew to 45 in 2021 with an additional 10 participating in the Maize part of the program. This report will focus primarily on the results of measured soil carbon for paddocks sown into wheat in the 2021 season.

The participating growers in the Cool Soil Initiative were required to identify up to five wheat paddocks each season for inclusion in the project, where GPS-located soil tests (0–10 cm) were taken for each paddock. Figure 1 shows the locations of all samples taken from across the Riverine Plains during 2018, 2019, 2020 and 2021.

Each soil sample was air-dried and analysed for a range of soil properties, including soil pH (CaCl2), soil organic carbon (SOC) percentage, cation exchange capacity (CEC) and nutrients. Soil samples were taken from specific locations in

Figure 1: Location of paddocks across the Riverine Plains area participating in the CSI project, incorporating the use of the Cool Farm Tool (CFT), during 2018–21



each paddock based on ease of access and the known location of representative soil types.

The anonymised soil test results, farm input data and yields are inputted into a simple database where it is processed through the Cool Farm Tool, generating predictions of greenhouse gas emissions for each paddock. Results are then communicated to growers as they became available, giving them accurate and update estimates of CO2 equivalence emissions per tonne of wheat produced and per hectare. Due to the late harvest of season 2021 results from the Cool Farm Tool had not yet been processed at the time of submitting this article.

During the 2021 season, farmers in the project were encouraged to test an innovative farming practice on one of their paddocks and were provided with support for additional soil sampling and measurement throughout the season. Some examples of practises being trialled included growing beans and canola, applying manure, testing stubble management (burning, mulching and direct sowing), growing summer cover crops, applying biosolids and liming incorporation. It is hoped that it will be possible to compare GHG emissions between these practises and allow farmers to make better decisions based on the results.

The project will continue with existing participants during 2022 season, however with an increased focus on getting results extracted from the Cool Farm Tool for sample sites and innovation paddocks.

Results

Rainfall

The 2021 growing season varied greatly across the Riverine Plains region, with regular and timely rains contributing to high winter crop yields. High rainfalls at the beginning of the season in some areas caused issues, while late season rains flooded crops and delayed harvest in other regions. During 2021, annual rainfall across the region ranged from 377 mm to 1064 mm, while growing season rainfall (GSR) from April to October, ranged from 224 - 348 mm. (Figure 2).

Soil organic carbon

In early spring 2021, 183 wheat paddocks were sampled, with 35% of these having been previously sampled. There are now 417 paddocks that have been sampled, 74.8 % once, 21.8% over two years, 2.8% over 3 years and 2 paddocks have been measured every year since the project started in 2018.

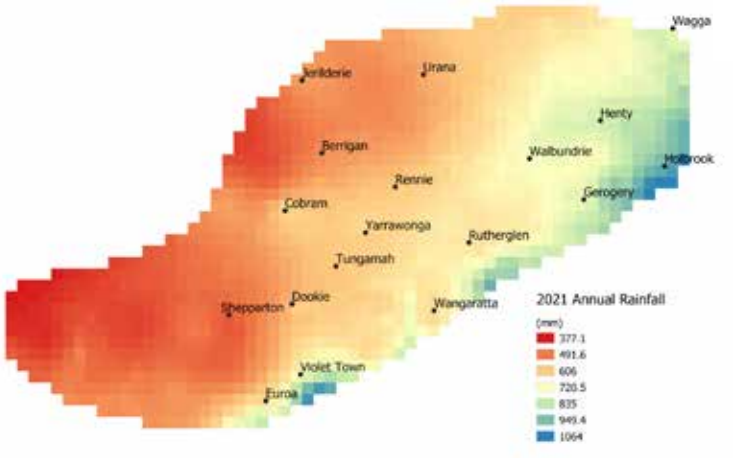


Figure 2a: Annual Rainfall for the Riverine Plains region during 2021

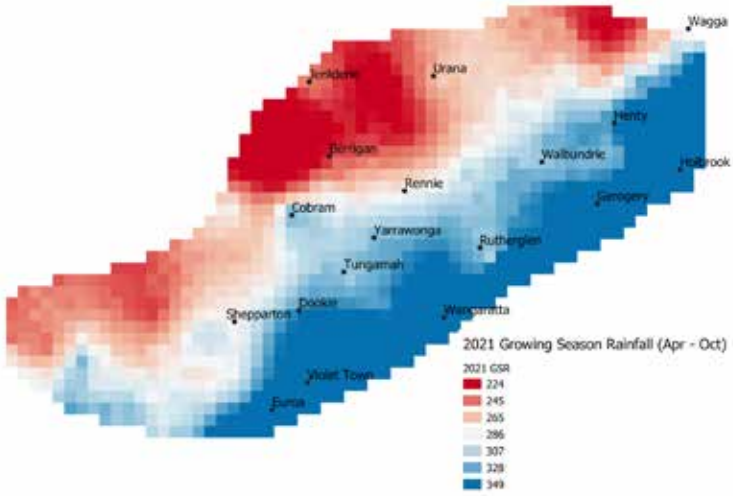
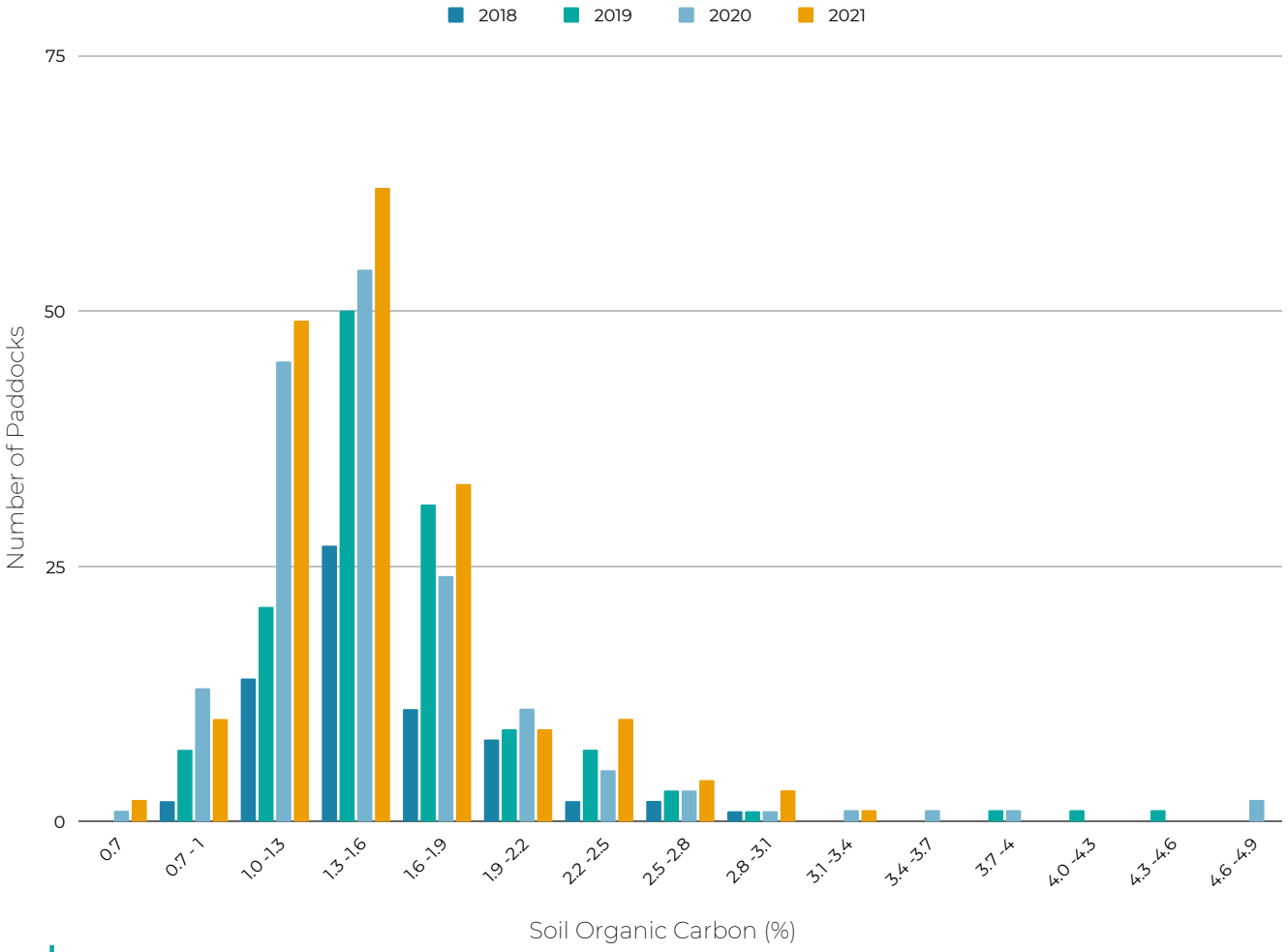


Figure 2b: Growing Season Rainfall for the Riverine Plains region during 2021

Analysis of the 2021 soil sampling results show that SOC values ranged from 0.7– 3.3 per cent across the paddocks tested (Figure 3). SOC values between 1.6 – 1.9 accounted for 34% of all soil tests. The highest value (3.3 per cent) was recorded in a paddock that has a history of grazing, with low inputs. The distribution of results from the 2021 samples was similar to those sampled in previous years.

Due to the late harvest of season 2021, yield data was not available at time of publishing.

Figure 3: Soil organic carbon distribution across paddocks sampled as part of the ACFI 2018–19 summer sampling program, ACFI 2019, CSI 2020 wheat sampling program and 2021 wheat sampling program for the Riverine Plains region



pH (CaCl2)

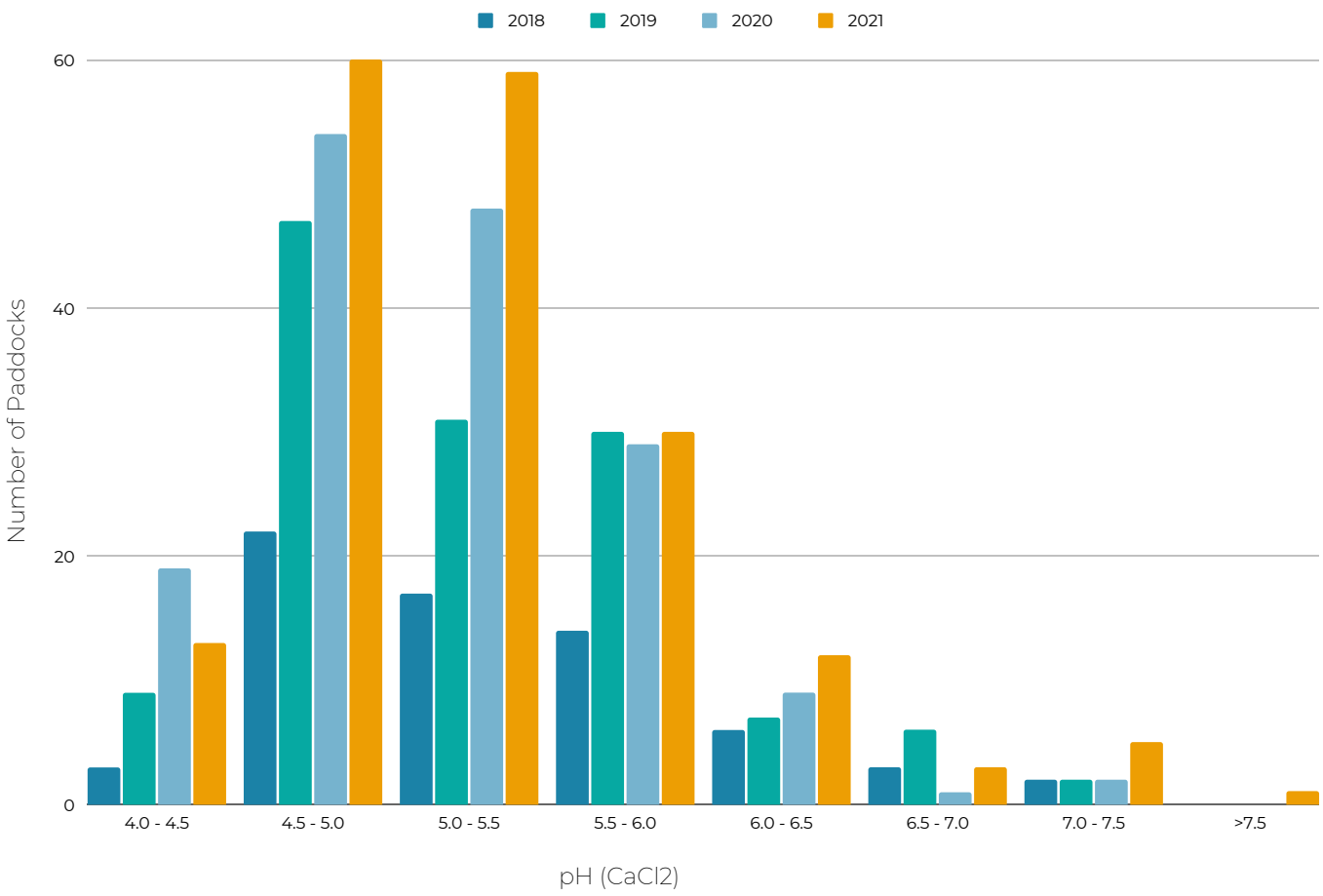
The Riverine Plains region has a diverse range of soil types. This is reflected in the pH values seen across the area, with soils ranging from naturally acid to alkaline. Soil pHCaCl2 values of greater than 5.2 is the level in which nutrient availability is not limited, high enough to ensure aluminium (Al) toxicity is not an issue. Plant toxicity effects due to increased aluminium solubility are generally seen when the aluminium saturation of cation exchange sites exceeds 6%, although different plant species have differing tolerance to aluminium.

The soil pHCaCl2 in the surface (0–10cm) soil samples taken during 2021 showed a wide range of pH CaCl2 levels ranging from pH CaCl2 4.2–7.8 (Figure 5). The four years of results (2018–21) show a similar distribution of soil pH CaCl2. A detailed analysis of paddock history and management data collected as part of the project in 2021 (data not presented) suggests that this wide range of pH values is likely to reflect the use of amendment practices being used in the region. Practices such as applying lime, can take a long time to show a response in the soil profile contributing also to the variation. The number of paddocks with pH CaCl2 less than 4.5 has decreased from 12% in 2020 to 7% in 2021 is likely to be a result of more lime is being applied.

Greenhouse gas emissions

Data from each paddock will be analysed to determine the greenhouse gas emissions per hectare (kg CO2e/ha) as well as greenhouse emissions per tonne of grain produced (kg Co2e/tonne wheat) using the Cool Farm Tool. This analysis however was not completed at time of printing.

Figure 4: pH (CaCl2) distribution across paddocks sampled as part of the ACFI project 2018–19, 2020 and 2021 CSI project.



Observations and comments

During 2021, the *Cool Soils Initiative* project in the Riverine Plains area involved 45 participants in the wheat program and 10 Maize growers, who collectively managed an area of over 130 000 hectares.

The Cool Soil Initiative continues to evolve, whereby better access and interpretation of paddock scale spatial data, reviewing of the GHG emission calculators, and understanding the economic value of practice change to increase soil health will be key to its success.

There is now 4 years of GPS referenced soils data that can be compared and analysed along with paddock data. Understanding the emissions created by these paddocks and the impacts each farming practice has is the next step.

The 2021 emissions data will be published in the 2023 trial book article.

Acknowledgements

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