

Quantifying the carbon gains from mixed cropping systems.

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RiverinePlains



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Aim

- Evaluating plant-based opportunities to increase soil carbon in cropping systems
- Plant based solutions to improve soil performance through rhizosphere modification



National
Landcare
Program



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4 Key Messages

- Cover crops are opportunistic
- Cover crops can increase your risk
- Trial plots are as exposed to the elements as your farms
- Carbon isn't a lonely warrior

Site Layout

Location: Burramine – 20km West of Yarrawonga

Treatments	2019
Control (wheat–canola)	Wheat
Pulse–canola–wheat	Field Peas
Brown manure (pulse)	Field Peas
Brown manure (mix)	Field Peas, tillage radish
Intercrop	Wheat
Temporary intercrop	Wheat, subclover
Cover crop mix 1	Wheat
Cover crop mix 2	Wheat
Maximum diversity	Wheat



Crop Rotation



Treatments	2019 winter crop	2020 summer cover crop	2020 winter crop	2021 summer cover crop	2021 winter crop	2022 summer cover crop	2022 winter crop	2023 summer cover crop
Control (wheat–canola)	Wheat	-	Canola		Wheat		Canola	
Pulse–canola–wheat	Field peas	-	Canola		Wheat		Canola	
Brown manure (pulse)	Field peas	-	Canola		Wheat		Canola	
Brown manure (mix)	Field peas + Tillage Radish	-	Canola		Wheat)		Canola	
Intercrop	Wheat	-	Canola + Field pea (peola)		Wheat		Canola	
Temporary intercrop	Wheat + sub-clover	-	Canola		Wheat + vetch		Canola	
Cover crop mix 1	Wheat	Medic and buckwheat	Canola	Medic and buckwheat	Wheat	Medic and buckwheat	Canola	Medic and buckwheat
Cover crop mix 2	Wheat	Sorghum, millet forage rape and Tillage Radish	Canola	Sorghum, millet forage rape and Tillage Radish	Wheat	Sorghum, millet forage rape and Tillage Radish	Canola	Sorghum, millet forage rape and Tillage Radish
Maximum diversity	Wheat	Sorghum, millet forage rape and Tillage Radish	Canola + peas (peola)	Sorghum, millet forage rape and Tillage Radish	Wheat + Common vetch	Sorghum, millet forage rape and Tillage Radish	Canola	Sorghum, millet forage rape and Tillage Radish

Summer Cover Crop



Season	Cover crop biomass (kg/ha)	
	Medic / Buckwheat	Sorghum / Millet / Forage rape / Radish
2020	561 ± 54	731 ± 119
2021	434 ± 70	463 ± 70
2022	2300 ± 28	3260 ± 13

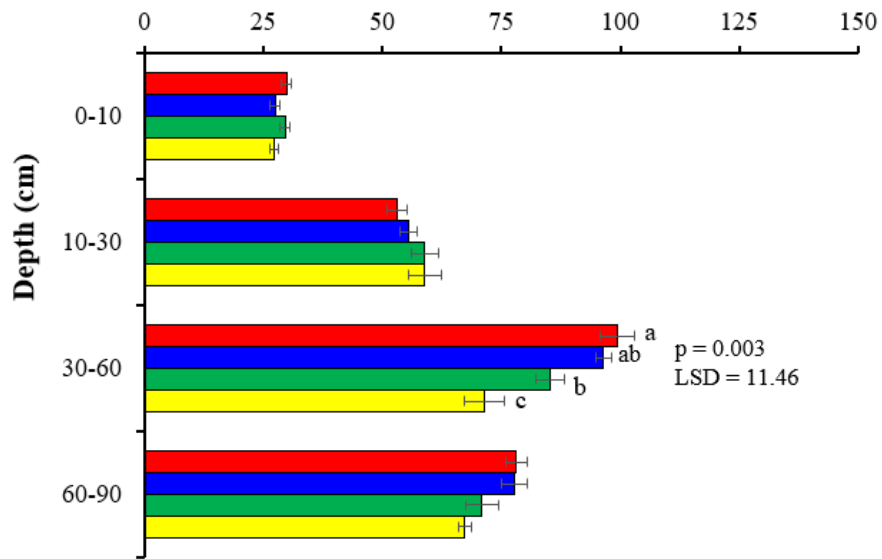




Results – Soil Water

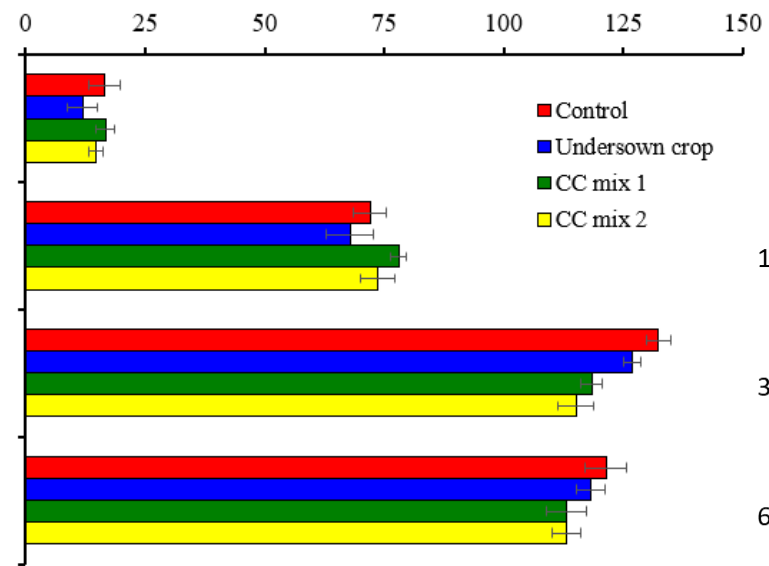
a) 2020

Soil water at sowing (mm)



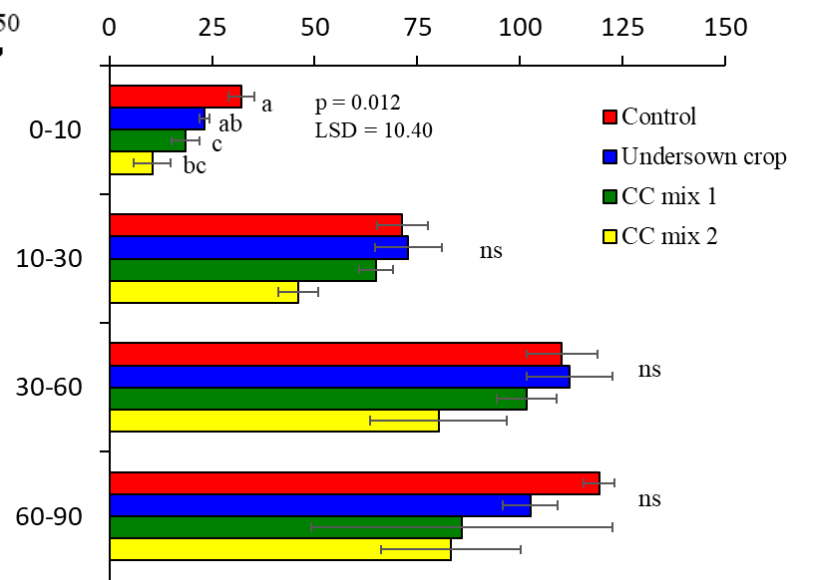
b) 2021

Soil water at sowing (mm)



c) 2022

Soil water at sowing of cash crop (mm)



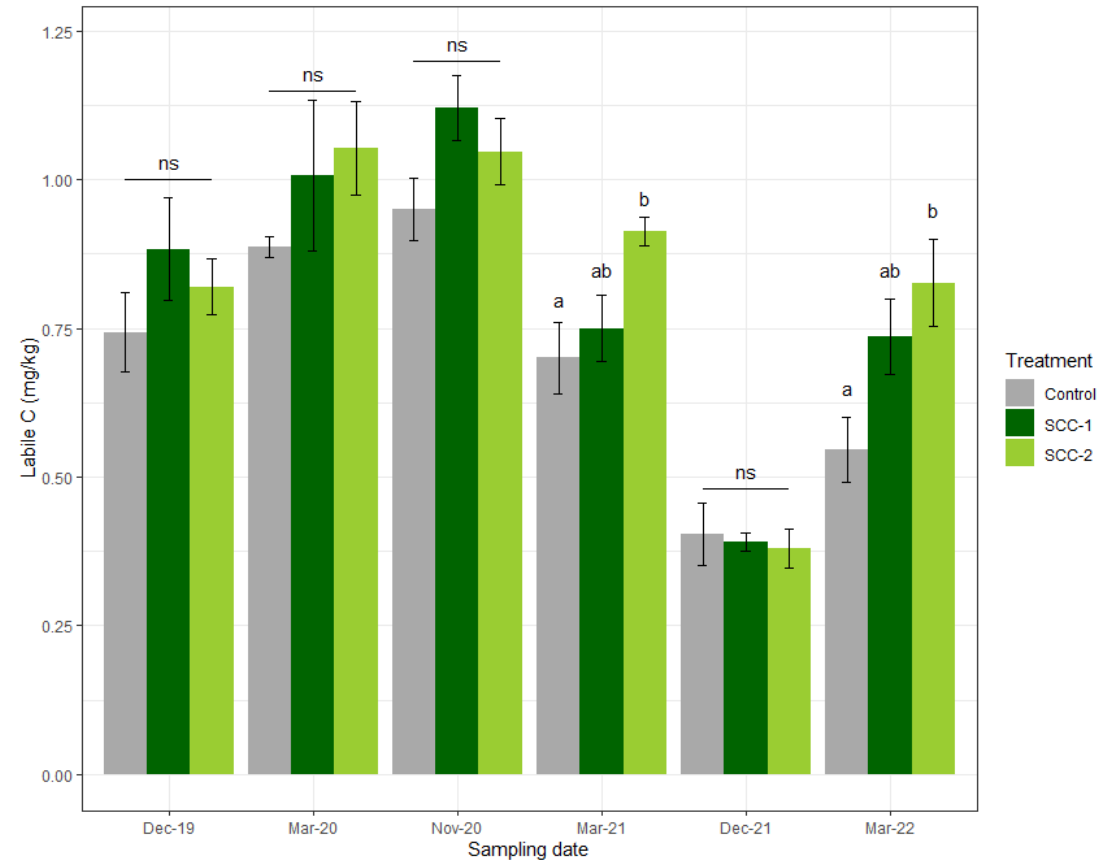
Results



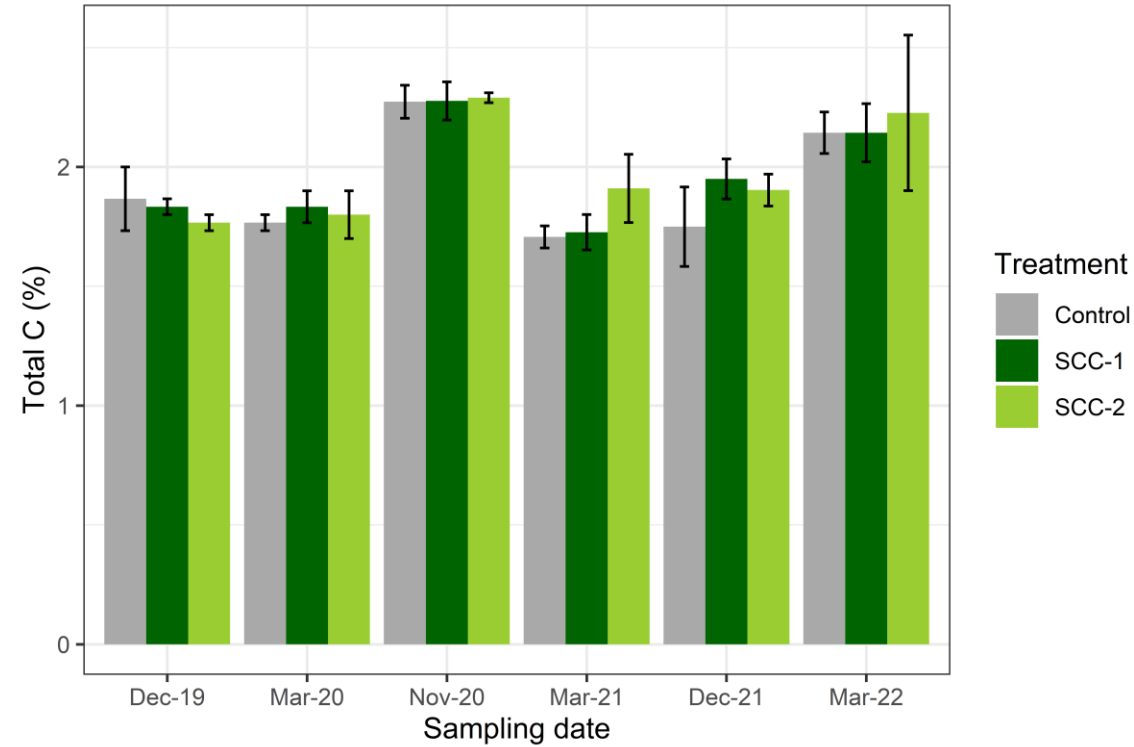
Integrated plant species treatments within the wheat/canola rotation				
Treatment	1	6	7	8
Rotation	Control (2019: wheat, 2020: canola 2021: wheat)	Intercrop-undersown wheat (2019: wheat undersown with sub- clover 2020: canola, 2021: wheat undersown with vetch)	Cover crop mix 1 (2019: wheat, 2020: CC mix 1, 2020: canola, 2021: CC mix 1, 2021: wheat, 2022: CC mix 1)	Cover crop mix 2 (2019: wheat, 2020: CC mix 2, 2020: canola, 2021: CC mix 2, 2021: wheat, 2022: CC mix 2)
2020 season (canola)				
Water at sowing (mm) (P = 0.05)	261 b	257 b	245 ab	225 a
Mineral N at sowing (kg N/ha) (P = 0.21)	119 a	137 a	124 a	105 a
Emergence (plants/m ²) (P= 0.22)	24 a	27 a	26 a	21 a
Canola biomass at flowering (t/ha) (P= 0.28)	4.5 a	4.5 a	5.7 a	3.1 a
Canola yield (t/ha) 2020 season (P = 0.12)	1.76 a	1.74 a	1.85 a	1.48 a
2021 season (wheat)				
Emergence (plants/m ²) (P = 0.06)	81a	65 (wheat) b 56 (vetch)	83 a	86 a
Water at sowing (mm) (P = 0.41)	342 a	325 a	326 a	316 a
Mineral N at sowing (kg N/ha) (P = 0.22)	72 a	65 a	55 a	49 a
Wheat biomass at anthesis (t/ha) (P=0.76)	6.22 a	6.69 a	6.86 a	6.56 a
Wheat yield (t/ha) 2021 season (P = 0.28)	4.28 a	3.57 a	4.20 a	4.33 a

Results – Labile Carbon

- Labile Carbon is a portion of total carbon
- Breaks down relatively quickly
- Impacts soil microbiology
- Increasing Total Carbon %by 0.1 = 1000mg/kg



Results – Total Carbon



Key Messages

- Prospects for summer cover crops in southern Australian semi-arid cropping systems – Paper by Rose et al.
 - Opportunities to sow crops in hot dry summer are limited
 - Tactical use of summer crops in targeted situations may be warranted
- Using summer crops with livestock in the system is potentially financially beneficial.
- Opportunistic
- Increase risk – due to potential water deficit



Thank- you

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