Interest in Intercropping: A summary of intercrop monitoring in 2021.

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Key Points:

- The paddock monitoring point data indicates intercropping did not impact on grain production per ha compared to monoculture.
- The intercropping demonstrations were all successfully sown, managed, and harvested with the farmers current machinery.
- Preliminary soil monitoring established an initial benchmark for both soil pathogens and beneficials. To understand the systems benefits of intercropping further sampling and ongoing work is required.

Method:

In 2021, three commercial farmer paddocks were established as intercropping demonstration sites. The primary purpose of the sites was to facilitate discussion and exchange of technical information on how to properly sow, manage and harvest an intercrop. In all cases, the paddocks included the main component species of the intercrop sown as a sole crop for a comparison (Table 1).

In addition to hosting discussions groups during the season, these paddocks were monitored at key times throughout the growing season to assess the benefits of intercropping. Measurements included Predicta B and soil nutrition, production measurements (biomass and grain yield), and observations of pest, disease, and weeds (Figure 1, 2 & 3). Data is presented as the average value for each measurement for each of the six monitoring points (A-F) per paddock.

Soil cores were taken pre-seeding. Two cores were taken for each monitoring point and bulked for the following depths: 0-10; 10-30; 30-60; 60-90 cm. Samples were sent to a commercial laboratory and a comprehensive soil test undertaken.

Plant numbers were undertaken 8-10 weeks post sowing or when plants were at the 2-4 node growth stage. A quadrat was randomly placed within each monitoring point area and plant number per quadrat recorded, this was undertaken 5 times at each monitoring point and averaged.

Weed counts were undertaken twice during the season, at early plant assessment and at 50% flowering of the pulse. A quadrat was randomly placed within each monitoring point area and plant number per quadrat recorded, this was undertaken 5 times at each monitoring point and averaged.

Biomass was taken at 50% flowering of the pulse. Five samples were taken at each monitoring point using a random place quadrat, the samples were then dried and processed. Biomass data presented is the average of the 5 samples.

Grain yield was taken at crop maturity. Five samples were taken at each monitoring point using a random place quadrat, the samples were then dried and processed. Grain yield data presented is the average of the 5 samples taken at each monitoring point.

Predicta B soil samples were taken early 2022 from each monitoring point, following the sampling protocol for the Southern and Western Regions (https://pir.sa.gov.au/research/services/molecular_diagnostics/predicta_b). Predicta B samples were tested for soil pathogens and beneficials using a modified testing suite.

Nutrition soil samples were taken early 2022, two cores were taken for each monitoring point and bulked for the following depths: 0-10; 10-30; 30-60. Samples were sent to a commercial laboratory and tested Ammonium Nitrogen, Nitrate Nitrogen, Phosphorus Colwell, and Potassium Colwell.

Figure 1. Early season assessments Left & Middle: soil coring at Karoonda Right: plant establishment at Paskeville, in 2021.

Figure 2. In crop assessments included weed counts and biomass at each monitoring point, Left: Karoonda, Middle & Right: Wirrabara, in 2021.

Figure 3. Harvest assessments included soil nutrition and grain yield, Paskeville, in 2021.

Table 1. Details of commercial paddocks monitored in 2021.

Location	Rainfall Zone	Intercrop Species	Sole Species	pH ($CaCl_2$) 0-10 cm	pH ($CaCl_2$) 10-30 cm	pH ($CaCl_2$) 30-60 cm	pH ($CaCl_2$) 60-90 cm
Karoonda	Low	Lupin – Field pea	Field pea	7.2	7.1	7.5	8.2
Paskeville	Medium	Lentil – Linseed	Lentil	7.4	7.8	8.1	8.4
Wirrabara	High	Faba bean - Vetch	Faba bean	5.9	7.2	7.4	7.9

Seasonal observations:

The focus paddock at Wirrabara received favourable growing season conditions, with the farmer reporting a paddock grain yield of 4.43 t/ha faba bean. The plant numbers per m^2 were close to the recommended target 24 plants/m^2 (Table 2). The faba bean establishment was better at the intercrop monitoring points than the sole crop. The paddock located at Paskeville had herbicide damage to the lentil crop caused by off-site application, with the average paddock grain yield of 2.06 t/ha. The plant density at this site was around half of the recommend 120 plants per m^2 for lentil (Table 3). The low rainfall zone site at Karoonda experienced well below average rainfall (210 mm total annual rainfall) and a late season break with 10 mm received over the 7 days of 2 to 8th June. Plant numbers per m^2 were well below the recommended plant density for narrow leaf lupin of 40-45 plants/m^2, this and the subsequent poor seasonal rainfall resulted in crop failure at several monitoring points, limiting the value of the data collected (Table 4).
At each of the focus paddocks, a field day was conducted to step through all aspects of managing an intercrop; from seeding to harvest (Fig 4).

Figure 4. Field days at each of the sites stepped through the intercropping process.

For all focus paddocks, the growing season conditions were not conducive to foliar disease, with no foliar disease observed at any of the monitoring points (data not shown). Similarly, no pest insects were observed during in-season visits (data not shown). Weed levels were low at the Paskeville site, however early season weed control caused by off-site application caused crop damage (Table 3). There were both broadleaf and grass weed recorded at Wirrabara early in the growing season, in-crop weed control used was effective with no weeds recorded in subsequent visits (Table 2). There were high levels of weed, both grasses and broadleaf, at the Karoonda site. Seasonal conditions made repeated applications of herbicides un-economical, this is reflected in the weed observations both early season and at crop flowering (Table 4).

For both Paskeville and Wirrabara, the intercrop grain yields were similar to that of the sole crop, suggesting intercropping did not impact the overall productivity of the paddock. Grower reported yields for the paddock harvested at Paskeville was 2.08 t/ha, this was consistent with the lentil grain yields from paddock sampling points between 2.06 and 2.39 t/ha (Table 3). The reported farmer grain yields at Wirrabara were 4.43 t/ha for sole faba beans, with the intercrop bean yield 4.15 t/ha and vetch grain yield 0.95 t/ha (a total combined intercrop yield of 5.1 t/ha). The measured grain yield from each monitoring point was higher than the overall farmer paddock yields and is likely to be explained by paddock variability impacting on grower mean yields, soil pH in the 0-10 cm layer ranged from 5.0 ($CaCl_2$) to 7.7 ($CaCl_2$). The intercrop monitoring points were all in areas with acid topsoil (0-10cm layer), with two of the three monoculture monitoring points in areas with a neutral to alkaline topsoil layer (Appendix A). Due to crop failure across much of the paddock at Karoonda limited information is available.

For all three paddocks there were no notable negative effects of intercropping on soil nutrition (Figure 5 & 6) or soil pathogens (Table 5 and Figure 7, 8 & 9). The level of variation in the soil nutrition and soil pathogen results between the six monitoring points in each paddock indicates more intensive sampling would be required to understand any negative or beneficial changes. The presence of soil beneficials were also tested, again the results are consistent across both monoculture and intercrop sampling points, and further sampling would be beneficial to understand if the smaller differences in the data sets are as a result of natural variation or a result of the crop treatment (Figure 10, 11 & 12). At both Paskeville and Wirrabara the presence of Rhizobia groups E & F was both present at the start of the follow year in 2022 (Figure 13 & 14). There were no Group G & S Rhizobia present at the start of 2022 (required for lupin) where lupin was grown as sole crops, however, was present at low levels at two of three intercropping monitoring points (Figure 15).

Table 2. Growing season crop assessments, presented as the average value for each monitoring point, of faba bean-vetch intercrop and monoculture lentil at Wirrabara, in 2021.

		Crop Establishment			**Crop flowering**			**Crop maturity**			
Focus Point	Treatment	Faba bean (plants/m^2)	Vetch (plants/m^2)	Weeds (plants/m^2)	Faba bean biomass (kg/ha)	Vetch biomass (kg/ha)	Weeds (plants/m^2)	Faba bean biomass (kg/ha)	Vetch biomass (kg/ha)	Faba bean grain yield (kg/ha)	Vetch grain yield (kg/ha)
C	Intercrop	23	6	55	1930	281	0	12532	3256	4819	1677
D	Intercrop	21	2	28	2458	208	0	8116	5750	4884	2688
E	Intercrop	19	5	4	1780	365	0	11002	2441	6377	1070
A	Monoculture	19	-	22	3155	-	0	12097	-	7419	-
B	Monoculture	15	-	19	3501	-	0	12532	-	7489	-
F	Monoculture	17	-	18	2674	-	0	10507	-	6543	-

Table 3. Growing season crop assessments, presented as the average value for each monitoring point, of lentil-linseed intercrop and monoculture lentil at Paskeville, in 2021.

		Crop Establishment			**Crop maturity**			
Focus Point	Treatment	Lentil (plants/m2)	Linseed (plants/m2)	Weeds (plants/m2)	Lentil biomass (kg/ha)	Linseed biomass (kg/ha)	Lentil grain yield (kg/ha)	Linseed grain yield (kg/ha)
B	Intercrop	58	6	0				
C	Intercrop	49	6	3	4696	466	2391	135
D	Intercrop	66	7	2				
A	Monoculture	58	-	2		-		
E	Monoculture	56	-	3	4418	-	2213	-
F	Monoculture	62	-	0	4025	-	2062	-

Table 4. Growing season crop assessments, presented as the average value for each monitoring point, of lupin-field pea intercrop and monoculture lupin at Karoonda, in 2021.

		Crop Establishment			**Crop flowering**			**Crop maturity**			
Focus Point	Treatment	Lupin (plants/m^2)	Field pea (plants/m^2)	Weeds (plants/m^2)	Lupin biomass (kg/ha)	Field pea biomass (kg/ha)	Weeds (plants/m^2)	Lupin biomass (kg/ha)	Field pea biomass (kg/ha)	Lupin grain yield (kg/ha)	Field pea grain yield (kg/ha)
A	Intercrop	4	2	58	445	310	7	0	112	10	50
B	Intercrop	3	5	498	0	35	*	0	0	0	0
C	Intercrop	6	4	34	292	382	24	418	688	165	265
D	Monoculture	7	N/A	110	14	N/A	4	0	N/A	0	N/A
E	Monoculture	10	N/A	6	633	N/A	0	1934	N/A	867	N/A
F	Monoculture	2	N/A	14	397	N/A	6	853	N/A	414	N/A

*Medic had achieved 100% ground cover at this monitoring point.

N/A = not applicable for treatment

Table 5. Modified PREDICTA B soil test suite of soil pathogens that all recorded as 0, taken early 2022 at Wirrabara, Paskeville, and Karoonda.

	Wirrabara	Paskeville	Karoonda
CCN eggs /g soil	0	0	0
Stem nematode nematodes/100 g soil	0	0	0
Gga pgDNA/g Sample	0	0	0
F. pseudograminearum test 2 pgDNA/g Sample	0	0	0
Eutiarosporella tritici-australis kDNA copies/g Sample	0	0	0
Eutiarosporella darliae/pseudodarliae kDNA copies/g Sample	0	0	0
Eyespot kDNA copies/g Sample	0	0	0
Pratylenchus penetrans nematodes /g soil	0	0	0
Pratylenchus quasitereoides nematodes/g soil	0	0	0
Phytophthora medicaginis kDNA copies/g Sample	0	0	0
Phoma Koolunga pgDNA/g Sample	0	0	0
Phoma rabiei kDNA copies/g Sample	0	0	0
Rhab1 kDNA copies/g Sample	0	0	0
Tylen3 kDNA copies/g Sample	0	0	0
AMFa2 kDNA copies/g Sample	0	0	0
AMFc2 kDNA copies/g Sample	0	0	0
AMFe kDNA copies/g Sample	0	0	0

Figure 5. Pre-seeding and post-seeding A. Ammonium Nitrogen (mg/kg), B. Nitrate Nitrogen (mg/kg), C. Phosphorus Colwell (mg/kg), D. Potassium Colwell (mg/kg) for each sampling point A to F and for depths 0-10 cm, 10-30 cm and 30-60 cm at Paskeville, 2021.

Figure 6. Pre-seeding and post-seeding A. Ammonium Nitrogen (mg/kg), B. Nitrate Nitrogen (mg/kg), C. Phosphorus Colwell (mg/kg), D. Potassium Colwell (mg/kg) for each sampling point A to F and for depths 0-10 cm, 10-30 cm and 30-60 cm at Wirrabara, 2021.

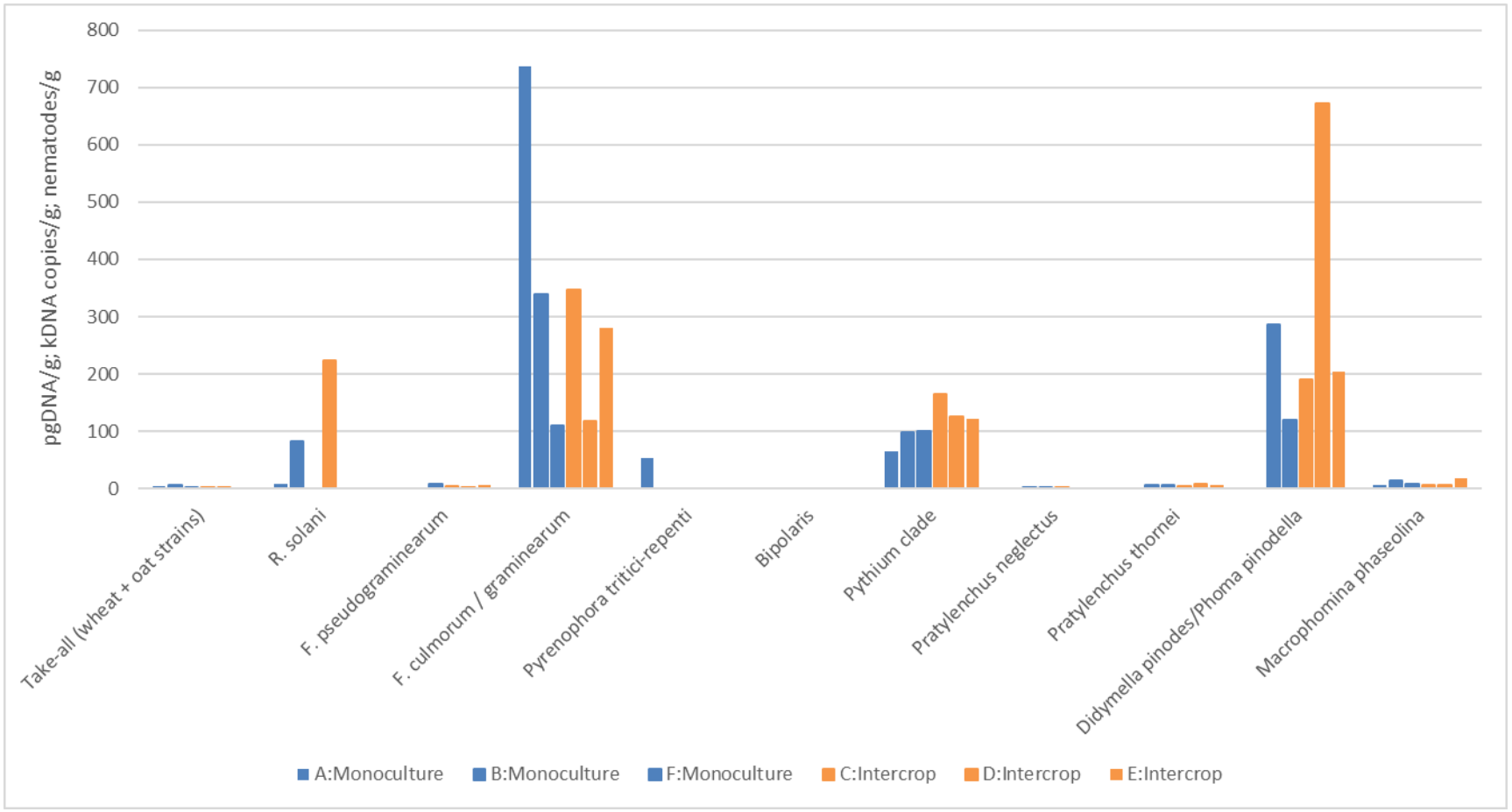

Figure 7. Modified PREDICTA B soil test suite of soil pathogens from samples taken early 2022 at Wirrabara.

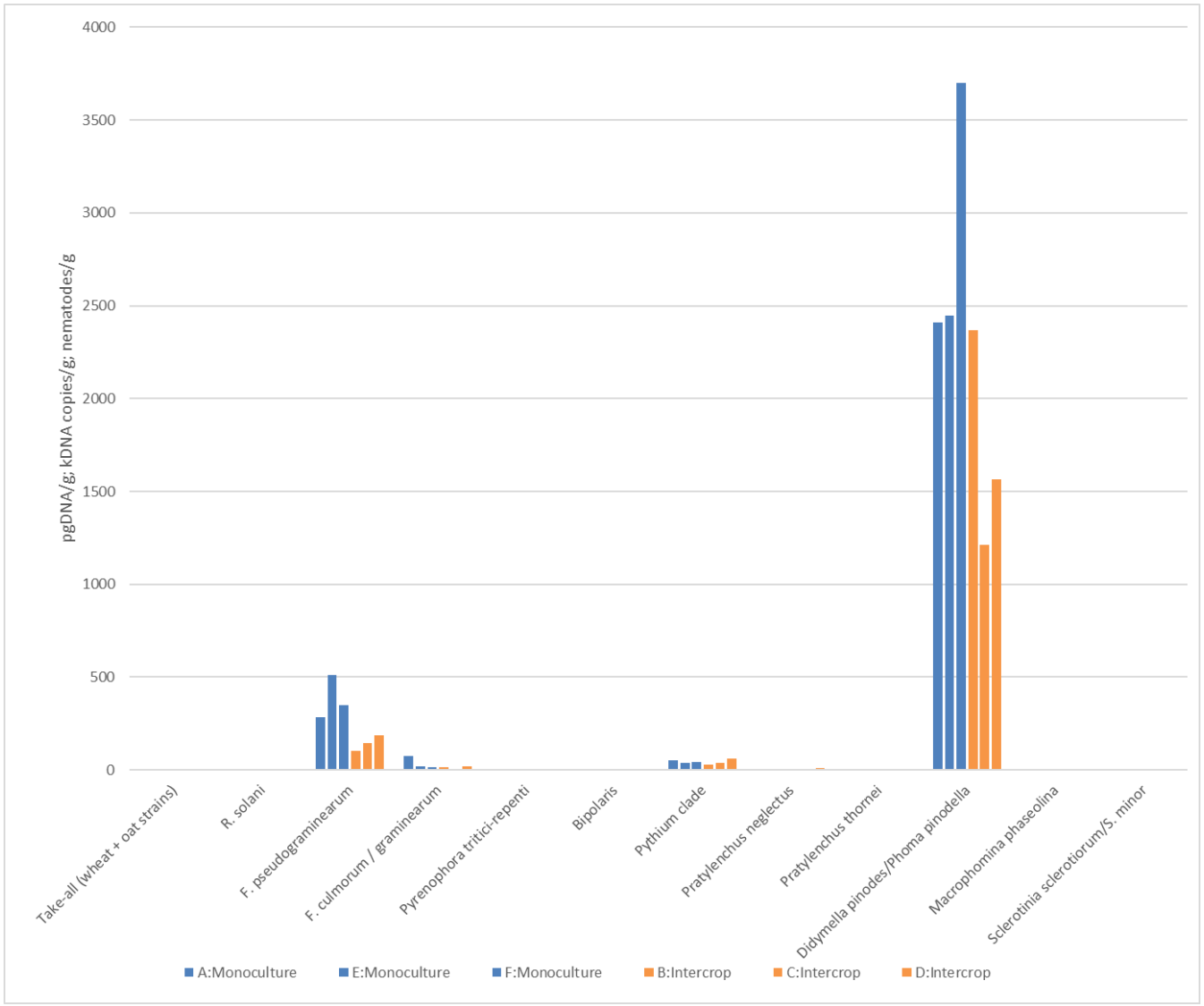

Figure 8. Modified PREDICTA B soil test suite of soil pathogens taken early 2022 at Paskeville.

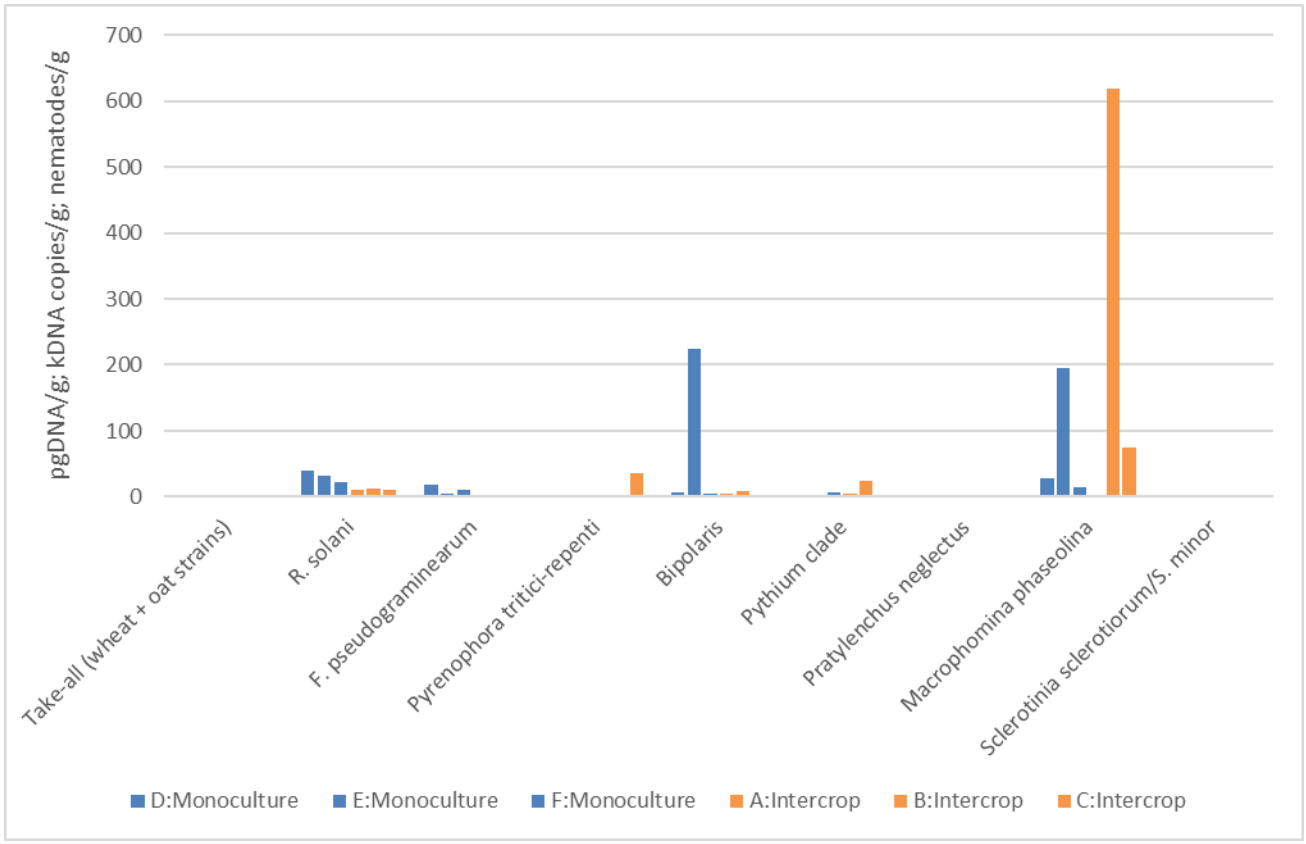

Figure 9. Modified PREDICTA B soil test suite of soil pathogens taken early 2022 at Karoonda.

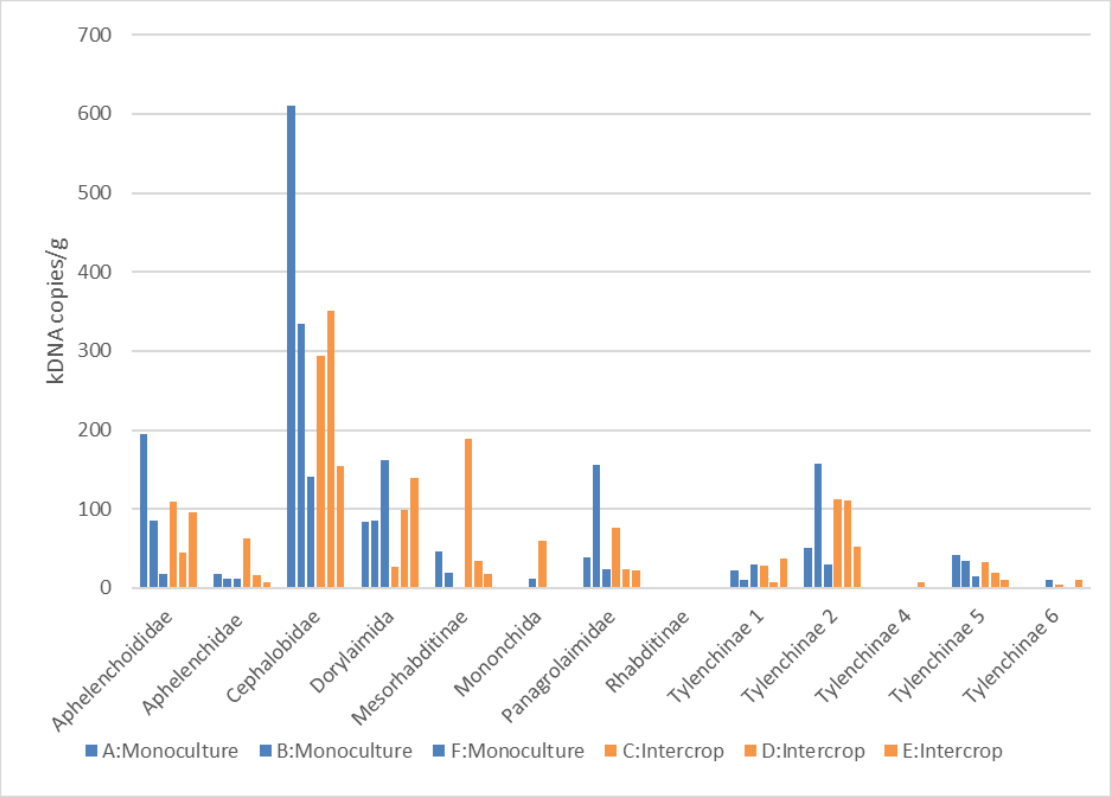

Figure 10. Modified PREDICTA B soil test suite of soil beneficials, free living nematodes, taken early 2022 at Wirrabara.

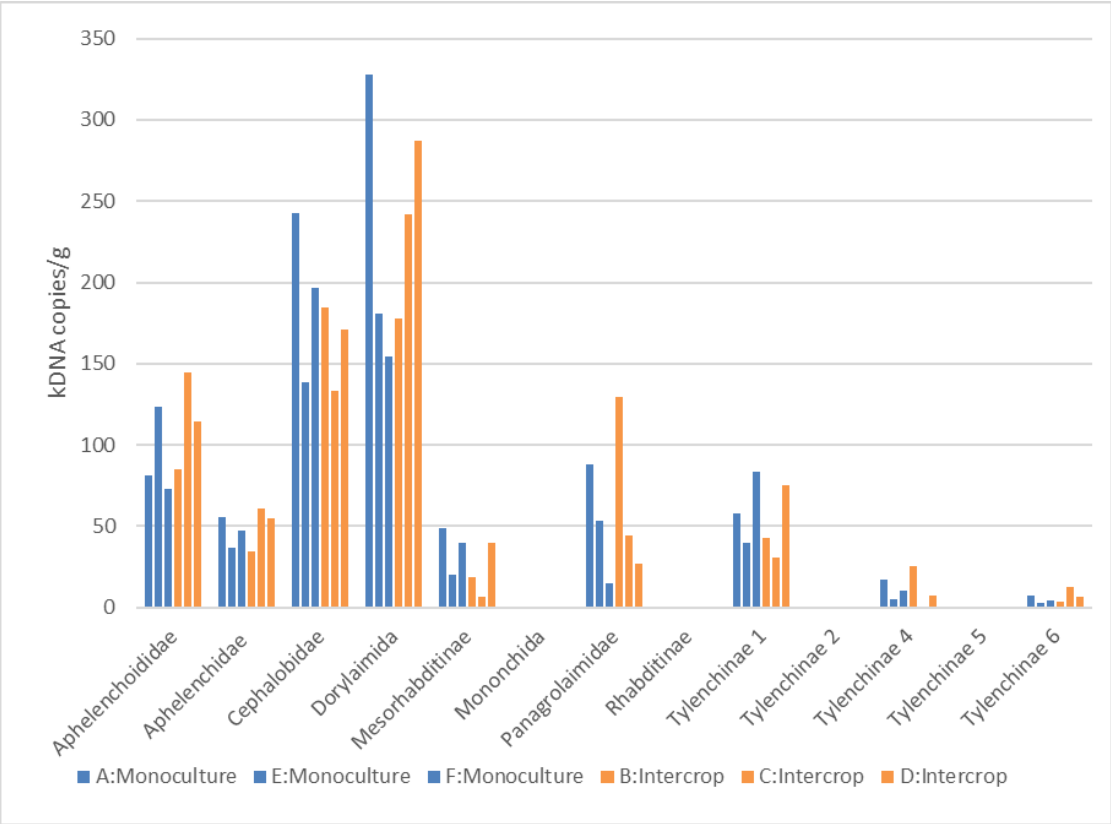

Figure 11. Modified PREDICTA B soil test suite of soil beneficials, free living nematodes, taken early 2022 at Paskeville.

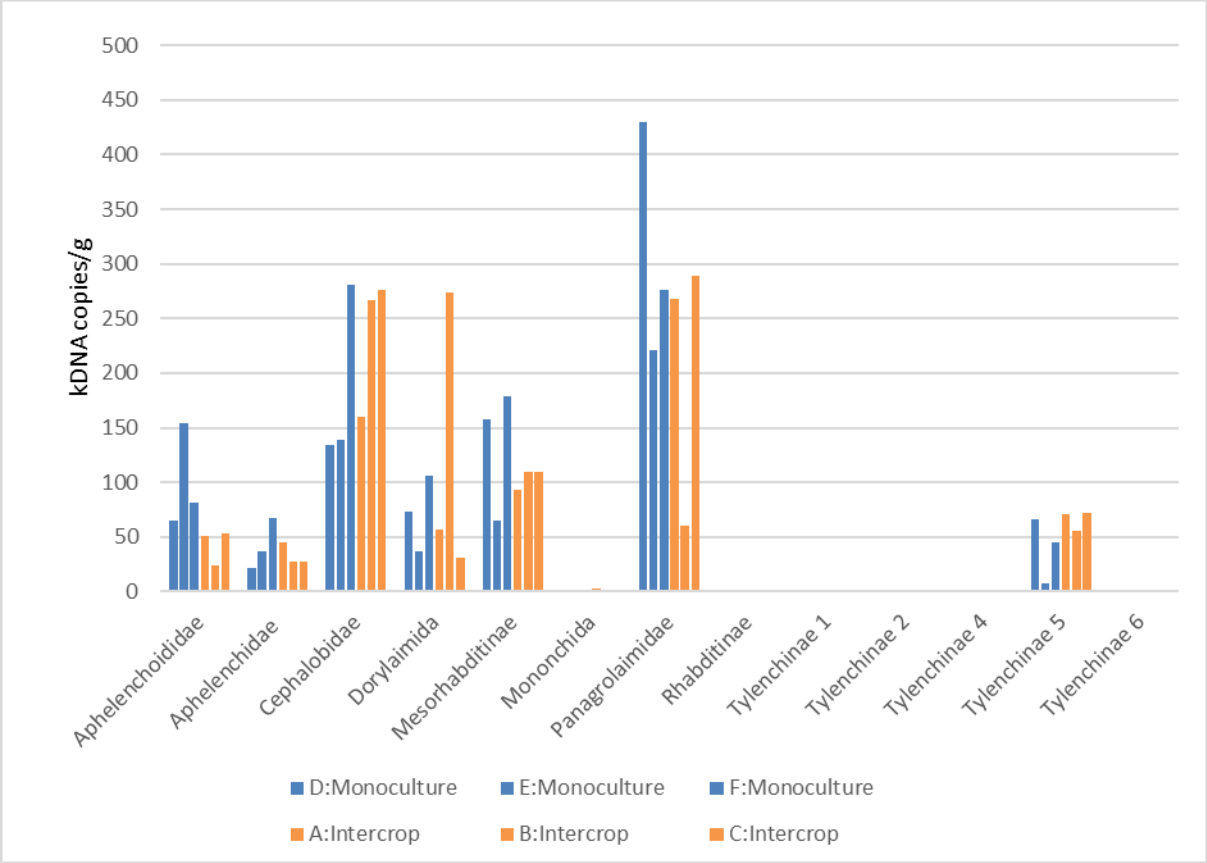

Figure 12. Modified PREDICTA B soil test suite of soil beneficials, free living nematodes, taken early 2022 at Karoonda.

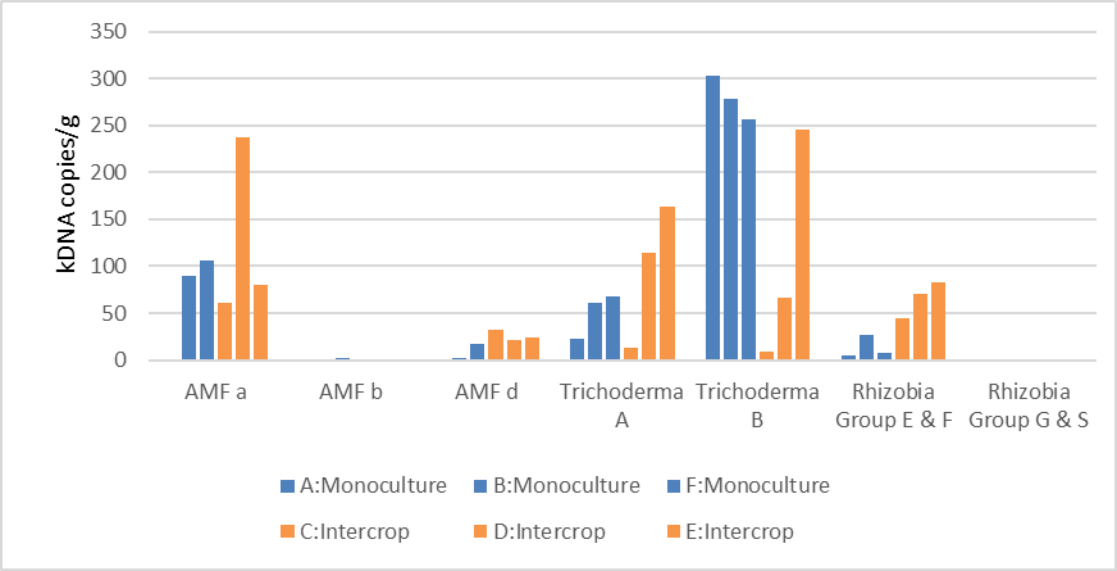

Figure 13. Modified PREDICTA B soil test suite of soil beneficials, fungi and Rhizobia, taken early 2022 at Wirrabara.

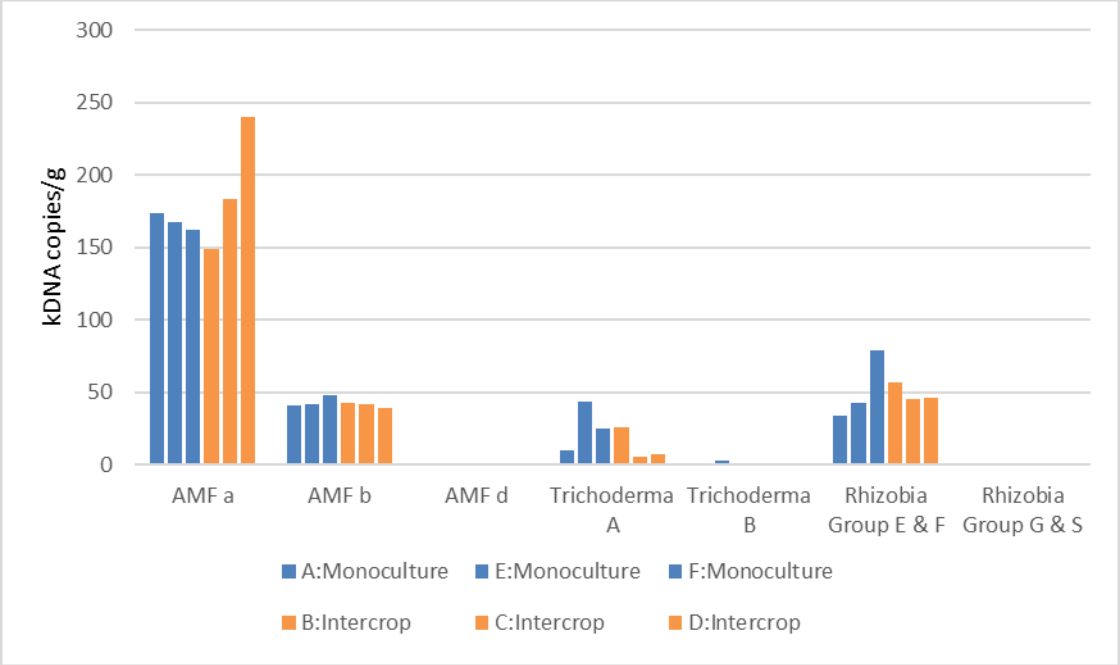

Figure 14. Modified PREDICTA B soil test suite of soil beneficials, fungi and Rhizobia, taken early 2022 at Paskeville.

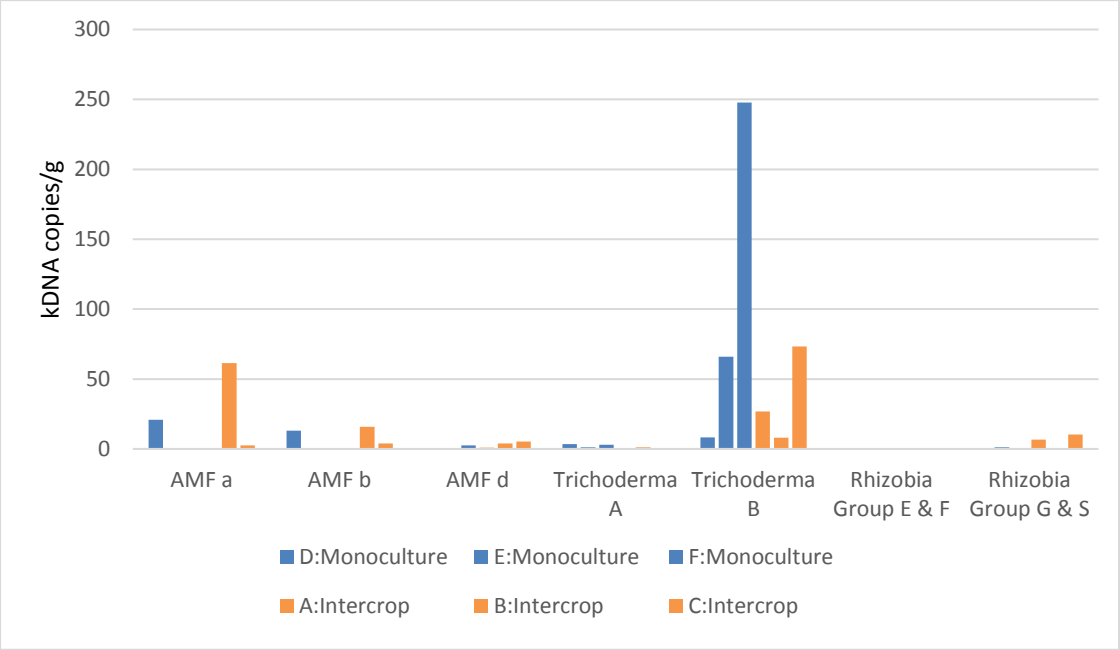

Figure 15. Modified PREDICTA B soil test suite of soil beneficials, fungi and Rhizobia, taken early 2022 at Karoonda.

Acknowledgements

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The paddock monitoring undertaken as part of these projects was made possible by the contribution of the SARDI Agronomy team at Clare. Special thanks to farmers, Craig Woolford (Wirrabara), Grant Pontifex (Paskeville) and Paul Roberts (Karoonda).

Appendix A. Pre-seeding comprehensive soil report for Wirrabara intercropping focus paddock, 2021.

	Depth	Gravel	Texture	Ammonium Nitrogen	Nitrate Nitrogen	Phosphorus Colwell	Potassium Colwell	Sulfur	Organic Carbon	Conductivity	pH Level ($CaCl_2$)	pH Level (H_2O)
	cm	%		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	dS/m		
Wirrabara A	0-10	0	2.5	3	45	20	293	11.7	2.46	0.195	5.1	5.9
Wirrabara A	10-30	0	3.0	< 1	7	7	232	5.9	0.76	0.114	7.1	8.0
Wirrabara A	30-60	0	3.5	1	6	5	173	8.1	0.43	0.168	7.3	8.1
Wirrabara A	60-90	5	3.0	2	14	5	64	28.3	0.50	0.223	7.9	8.7
Wirrabara B	0-10	0	2.5	2	16	60	194	15.1	1.22	0.331	7.4	7.9
Wirrabara B	10-30	0	3.5	2	4	8	156	5.1	0.69	0.167	7.3	8.5
Wirrabara B	30-60	0	3.5	2	2	3	135	17.8	0.48	0.388	7.8	9.3
Wirrabara B	60-90	0	3.5	2	2	3	111	108.9	0.22	0.749	7.9	9.4
Wirrabara C	0-10	5	2.5	4	19	32	285	5.3	2.09	0.133	5.4	6.4
Wirrabara C	10-30	0	3.5	2	3	5	152	4.6	0.72	0.209	7.5	8.3
Wirrabara C	30-60	0	3.5	3	2	< 2	139	5.8	0.52	0.188	7.4	8.7
Wirrabara C	60-90	0	3.5	3	2	< 2	120	8.6	0.27	0.254	7.7	9.3
Wirrabara D	0-10	0	2.5	4	37	42	312	10.3	2.28	0.149	5.5	7.0
Wirrabara D	10-30	0	3.0	2	6	7	361	5.8	0.69	0.237	7.3	8.2
Wirrabara D	30-60	5	3.0	2	3	3	218	12.8	0.40	0.222	7.4	8.8
Wirrabara D	60-90	5	2.5	2	4	4	104	58.3	0.24	0.351	8.0	9.4

Wirrabara E	0-10	0	2.5	5	37	49	256	10.2	1.83	0.168	5.0	6.0
Wirrabara E	10-30	0	2.5	3	7	18	298	5.7	0.69	0.131	7.0	7.8
Wirrabara E	30-60	0	3.0	1	5	5	228	10.5	0.46	0.210	7.3	8.8
Wirrabara E	60-90	0	3.0	2	6	4	77	20.4	0.28	0.276	8.3	9.7
Wirrabara F	0-10	0	2.5	3	27	19	296	6.1	1.70	0.141	6.7	7.7
Wirrabara F	10-30	0	3.0	2	5	7	185	3.9	0.76	0.070	7.2	8.0
Wirrabara F	30-60	0	3.0	2	3	4	131	11.0	0.47	0.175	7.3	8.4
Wirrabara F	60-90	5	2.5	2	6	4	63	33.5	0.32	0.208	7.6	9.1
	Depth	**DTPA Copper**	**DTPA Iron**	**DTPA Manganese**	**DTPA Zinc**	**Exc. Aluminium**	**Exc. Calcium**	**Exc. Magnesium**	**Exc. Potassium**	**Exc. Sodium**	**Boron Hot $CaCl_2$**	
	cm	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**meq/100g**	**meq/100g**	**meq/100g**	**meq/100g**	**meq/100g**	**mg/kg**	
Wirrabara A	0-10	0.85	96.60	7.97	3.90	0.010	9.81	1.10	0.66	0.27	1.26	
Wirrabara A	10-30	0.84	25.10	2.58	0.56	0.030	9.83	1.63	0.53	0.15	1.18	
Wirrabara A	30-60	0.98	11.30	1.29	0.19	0.040	15.88	2.74	0.47	0.29	1.68	
Wirrabara A	60-90	0.44	12.80	0.97	0.77	0.030	11.59	1.83	0.16	0.48	0.87	
Wirrabara B	0-10	0.84	97.20	3.99	3.25	0.020	11.42	1.79	0.40	0.72	0.82	
Wirrabara B	10-30	1.15	35.20	4.67	0.24	0.060	14.73	6.81	0.46	2.41	1.72	
Wirrabara B	30-60	1.25	24.90	3.53	0.17	0.080	16.06	8.61	0.46	4.60	4.54	
Wirrabara B	60-90	0.75	23.60	3.60	0.14	0.050	12.56	6.36	0.33	5.73	5.51	

Wirrabara C	0-10	2.04	85.70	15.66	2.30	0.030	11.32	3.06	0.77	0.33	1.29
Wirrabara C	10-30	2.11	36.10	7.09	0.22	0.030	19.73	5.43	0.48	0.59	1.41
Wirrabara C	30-60	2.21	30.60	5.01	0.07	0.030	19.78	7.89	0.46	1.42	3.08
Wirrabara C	60-90	1.57	20.90	2.03	0.06	0.030	15.12	7.68	0.38	2.43	4.68
Wirrabara D	0-10	0.82	195.90	10.92	3.08	0.030	6.89	1.59	0.68	0.31	0.96
Wirrabara D	10-30	0.93	39.50	3.17	0.34	0.060	14.40	4.76	0.95	1.03	1.84
Wirrabara D	30-60	0.86	20.40	1.31	0.14	0.040	15.80	5.09	0.61	1.59	3.18
Wirrabara D	60-90	0.49	12.30	0.76	0.26	0.030	10.29	3.27	0.25	2.05	2.04
Wirrabara E	0-10	0.85	140.80	16.18	3.28	0.130	5.00	0.99	0.56	0.23	0.82
Wirrabara E	10-30	0.81	36.60	4.66	0.34	0.020	10.31	2.71	0.75	0.48	1.44
Wirrabara E	30-60	0.68	11.50	1.43	0.13	0.030	14.27	4.12	0.64	1.16	2.88
Wirrabara E	60-90	0.49	8.10	0.83	0.26	0.030	8.39	2.64	0.20	1.70	1.25
Wirrabara F	0-10	0.95	58.20	8.40	3.44	0.030	8.74	0.87	0.72	0.17	0.88
Wirrabara F	10-30	1.05	29.20	7.22	0.53	0.050	9.09	1.84	0.41	0.28	0.94
Wirrabara F	30-60	0.93	14.40	2.70	0.20	0.050	14.29	3.50	0.37	0.89	1.85
Wirrabara F	60-90	0.62	7.70	0.84	0.37	0.020	9.57	1.58	0.16	0.90	1.49

Appendix B. Pre-seeding comprehensive soil report for Paskeville intercropping focus paddock, 2021.

	Depth	Gravel	Texture	Ammonium Nitrogen	Nitrate Nitrogen	Phosphorus Colwell	Potassium Colwell	Sulfur	Organic Carbon	Conductivity	pH Level ($CaCl_2$)	pH Level (H_2O)
	cm	%		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	dS/m		
Paskeville A	0-10	0	2.5	2	22	19	535	5.8	1.51	0.282	7.3	8.5
Paskeville A	10-30	5	3.0	2	32	9	243	10.7	0.79	0.481	7.9	9.1
Paskeville A	30-60	0	3.0	1	26	4	255	54.1	0.43	0.902	8.1	9.5
Paskeville A	60-90	0	3.0	1	14	< 2	288	132.0	0.30	1.303	8.2	9.4
Paskeville B	0-10	0	3.0	4	16	21	426	5.4	2.03	0.246	7.0	8.1
Paskeville B	10-30	5	3.0	2	20	12	201	6.1	0.91	0.430	7.7	9.3
Paskeville B	30-60	5	3.0	1	14	4	217	34.7	0.33	0.849	8.1	9.7
Paskeville B	60-90	0	3.0	1	7	2	295	98.5	0.14	0.520	8.2	10.2
Paskeville C	0-10	5	3.0	4	26	41	636	12.1	1.78	0.291	7.5	8.7
Paskeville C	10-30	0	3.0	2	25	19	248	9.1	1.14	0.454	7.8	9.2
Paskeville C	30-60	0	2.5	2	17	5	173	56.8	0.38	0.879	8.1	9.5
Paskeville C	60-90	0	3.0	< 1	8	< 2	206	113.6	0.14	1.252	8.4	9.7
Paskeville D	0-10	5	3.0	4	27	20	326	5.9	1.25	0.274	7.5	8.7
Paskeville D	10-30	5	3.0	4	27	25	275	6.5	1.10	0.358	7.6	9.1
Paskeville D	30-60	5	3.0	2	21	6	200	28.3	0.33	0.804	8.1	9.7
Paskeville D	60-90	0	3.0	1	12	2	248	96.0	0.15	1.233	8.4	9.7
Paskeville E	0-10	0	3.0	4	26	31	480	5.1	1.48	0.230	7.4	8.5
Paskeville E	10-30	0	3.0	1	16	6	154	3.9	0.54	0.344	7.8	9.1
Paskeville E	30-60	0	3.0	1	15	4	161	28.8	0.28	0.729	8.0	9.5
Paskeville E	60-90	0	2.5	< 1	10	2	226	128.9	0.17	1.447	8.4	9.7
Paskeville F	0-10	0	3.0	2	26	18	483	5.9	1.11	0.350	7.8	8.8
Paskeville F	10-30	0	3.0	3	43	8	225	12.5	0.67	0.781	8.0	9.1
Paskeville F	30-60	0	3.0	2	23	6	263	75.1	0.35	1.321	8.4	9.6
Paskeville F	60-90	0	3.5	1	10	< 2	293	152.2	0.14	0.678	8.5	10.1
	Depth	DTPA Copper	DTPA Iron	DTPA Manganese	DTPA Zinc	Exc. Aluminium	Exc. Calcium	Exc. Magnesium	Exc. Potassium	Exc. Sodium	Boron Hot CaCl2	
		mg/kg	mg/kg	mg/kg	mg/kg	meq/100g	meq/100g	meq/100g	meq/100g	meq/100g	mg/kg	
Paskeville A	0-10	0.92	12.70	2.19	1.26	0.060	29.06	6.77	1.52	1.81	2.93	

Paskeville A	10-30	1.00	15.00	1.86	0.64	0.060	21.25	10.09	0.86	5.32	7.59
Paskeville A	30-60	1.18	18.30	1.31	0.25	0.060	13.76	14.21	0.84	12.24	26.73
Paskeville A	60-90	1.17	20.60	1.38	0.16	0.060	11.22	14.54	0.97	17.82	42.38
Paskeville B	0-10	0.94	11.20	3.02	1.00	0.030	29.18	6.55	1.34	1.42	3.64
Paskeville B	10-30	1.10	15.60	2.78	0.61	0.030	21.46	8.44	0.68	4.06	7.76
Paskeville B	30-60	1.02	17.40	1.19	0.08	0.040	10.18	11.44	0.76	10.66	29.69
Paskeville B	60-90	0.81	12.10	1.03	0.21	0.050	6.31	11.42	0.98	16.87	50.47
Paskeville C	0-10	0.80	11.40	3.07	1.98	0.040	28.94	6.94	1.84	1.67	3.23
Paskeville C	10-30	0.74	11.60	2.49	0.89	0.040	21.78	9.61	0.83	3.99	4.52
Paskeville C	30-60	0.78	13.40	1.14	0.20	0.040	12.80	13.15	0.61	9.42	15.55
Paskeville C	60-90	0.60	11.20	0.74	0.19	0.050	8.36	12.92	0.70	12.98	29.58
Paskeville D	0-10	0.94	15.30	3.09	1.16	0.050	28.71	5.61	1.05	1.60	2.95
Paskeville D	10-30	1.11	15.00	3.10	1.20	0.050	23.85	6.97	0.91	3.72	3.63
Paskeville D	30-60	1.23	18.30	1.25	0.25	0.050	13.69	9.80	0.72	10.20	16.40
Paskeville D	60-90	1.02	15.50	0.85	0.07	0.050	9.46	9.70	0.83	14.64	32.61
Paskeville E	0-10	0.98	11.60	3.52	1.80	0.040	27.86	4.42	1.42	0.88	3.72
Paskeville E	10-30	0.87	14.50	4.08	0.27	0.030	16.07	5.03	0.55	3.38	5.72
Paskeville E	30-60	0.92	15.50	1.80	0.08	0.030	11.72	8.06	0.59	8.86	19.26
Paskeville E	60-90	0.84	12.20	0.90	0.09	0.040	9.60	9.57	0.82	15.87	31.15
Paskeville F	0-10	0.93	16.80	2.31	0.99	0.050	26.48	6.69	1.36	3.08	4.88
Paskeville F	10-30	1.03	20.30	1.85	0.49	0.060	21.29	9.69	0.79	8.09	8.21
Paskeville F	30-60	1.20	21.90	1.65	0.32	0.040	12.19	11.79	0.85	15.32	36.70
Paskeville F	60-90	0.77	16.30	0.74	0.10	0.060	7.70	11.65	0.95	20.57	57.35

Appendix C. Pre-seeding comprehensive soil report for Karoonda intercropping focus paddock, 2021.

	Depth	Gravel	Texture	Ammonium Nitrogen	Nitrate Nitrogen	Phosphorus Colwell	Potassium Colwell	Sulfur	Organic Carbon	Conductivity	pH Level ($CaCl_2$)	pH Level (H_2O)
	cm	%		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	dS/m		
Perponda A	0-10	0	1.5	6	10	32	232	5.6	0.57	0.084	6.6	7.1
Perponda A	10-30	0	1.5	< 1	7	15	178	2.5	0.31	0.045	6.2	6.8
Perponda A	30-60	0	2.0	< 1	3	3	241	4.2	0.31	0.103	8.1	9.1
Perponda A	60-90	5-10	2.0	< 1	4	5	620	5.0	0.21	0.230	8.1	9.7
Perponda B	0-10	5-10	1.5	2	14	29	276	6.8	0.72	0.112	8.0	8.8
Perponda B	10-30	15-20	1.5	< 1	5	8	241	7.1	0.63	0.110	7.9	9.0
Perponda B	30-60	35-40	1.5	< 1	3	7	203	7.5	0.54	0.116	8.1	9.2
Perponda C	0-10	0	1.5	1	6	30	221	3.5	0.33	0.107	7.7	8.5
Perponda C	10-30	0	1.5	< 1	2	8	175	1.3	0.16	0.053	7.7	8.7
Perponda C	30-60	0	2.0	< 1	2	2	222	3.3	0.12	0.081	8.1	9.1
Perponda C	60-90	0	2.0	< 1	< 1	3	117	2.1	0.15	0.080	8.3	9.4
Perponda D	0-10	0	2.0	2	12	36	218	7.7	0.69	0.118	7.7	8.6
Perponda D	10-30	0	2.0	< 1	6	17	188	8.8	0.56	0.137	8.2	9.2
Perponda E	0-10	0	2.0	2	10	40	151	8.3	0.29	0.043	6.0	6.6

Perponda E	10-30	0	2.0	< 1	7	22	150	3.2	0.18	0.031	5.8	6.6
Perponda E	30-60	0	2.0	< 1	4	19	145	2.4	0.13	0.025	5.9	7.1
Perponda E	60-90	0	1.5	< 1	3	6	172	2.3	0.16	0.060	7.9	8.9
Perponda F	0-10	0	1.5	4	9	26	159	7.1	0.40	0.118	7.2	7.9
Perponda F	10-30	0	1.5	< 1	5	13	139	2.9	0.24	0.041	6.7	7.6
Perponda F	30-60	0	2.0	< 1	4	5	141	2.3	0.17	0.044	7.2	8.3
Perponda F	60-90	5-10	2.0	< 1	2	4	176	2.6	0.13	0.102	8.3	9.3

	Depth	**DTPA Copper**	**DTPA Iron**	**DTPA Manganese**	**DTPA Zinc**	**Exc. Aluminium**	**Exc. Calcium**	**Exc. Magnesium**	**Exc. Potassium**	**Exc. Sodium**	**Boron Hot $CaCl_2$**
	cm	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**meq/100g**	**meq/100g**	**meq/100g**	**meq/100g**	**meq/100g**	**mg/kg**
Perponda A	0-10	0.23	35.60	4.16	1.04	0.030	2.68	0.64	0.47	0.03	0.37
Perponda A	10-30	0.21	14.90	2.79	0.18	0.040	2.56	0.59	0.37	0.03	0.28
Perponda A	30-60	0.24	6.40	2.26	0.12	0.030	9.40	1.60	0.56	0.25	1.27
Perponda A	60-90	0.43	5.30	1.02	0.18	0.040	9.41	5.56	1.59	1.75	4.87
Perponda B	0-10	0.25	3.50	3.04	0.70	0.010	9.60	0.89	0.62	0.05	0.90
Perponda B	10-30	0.29	2.90	2.31	0.39	0.010	12.46	1.27	0.61	0.09	1.30
Perponda B	30-60	0.32	5.20	2.39	0.22	0.010	11.91	2.87	0.50	0.16	2.58
Perponda C	0-10	0.18	16.20	1.33	0.44	0.040	3.75	0.75	0.45	0.03	0.36

Perponda C	10-30	0.23	8.70	0.58	0.18	0.040	3.18	0.70	0.38	0.03	0.30
Perponda C	30-60	0.17	6.60	0.84	0.06	0.080	6.71	1.32	0.49	0.06	0.71
Perponda C	60-90	0.24	2.90	0.67	0.20	0.050	7.58	1.96	0.28	0.06	0.82
Perponda D	0-10	0.18	6.00	2.09	0.63	0.020	6.66	1.13	0.44	0.06	0.85
Perponda D	10-30	0.29	5.80	1.24	0.26	0.020	10.90	2.58	0.41	0.24	2.14
Perponda E	0-10	0.17	19.60	3.00	0.83	0.020	2.10	0.51	0.27	0.03	0.30
Perponda E	10-30	0.17	16.70	2.20	0.25	0.030	1.50	0.40	0.28	0.02	0.23
Perponda E	30-60	0.16	9.90	1.99	0.14	0.040	1.57	0.36	0.26	0.02	0.29
Perponda E	60-90	0.18	6.10	1.54	0.52	0.050	4.27	0.59	0.35	0.03	0.59
Perponda F	0-10	0.20	15.70	2.05	1.27	0.030	4.03	0.73	0.30	0.04	0.31
Perponda F	10-30	0.25	8.00	1.15	0.66	0.040	2.16	0.57	0.26	0.03	0.28
Perponda F	30-60	0.18	3.70	0.82	0.47	0.020	2.84	0.67	0.30	0.04	0.40
Perponda F	60-90	0.19	1.00	0.62	0.45	0.040	6.98	2.32	0.42	0.12	1.18