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Impact of Crop Type and Stubble Load on Fallow Water Efficiency and Crop Performance

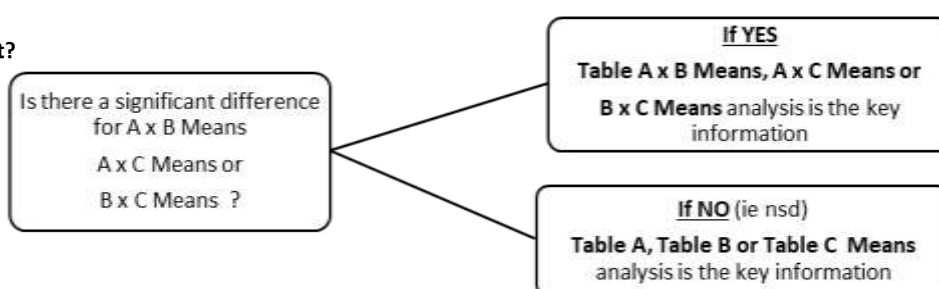
Trial ID: BB1901B Location: Goondiwindi Trial Year: 2020
Investigator: Brendan Burton

Objectives:	To evaluate the impact of crop type and stubble amount on fallow water efficiency NB Trial site established in winter 2019 and evaluated the impact of planter type on crop performance (BB1901)	
Crop Types:	2019 - Barley, Durum, Wheat, Chickpea 2020 – Planet Barley	
Planter Types:	2019 - Boss Double Disc, Janke tyne with press wheel Both on 32 cm row spacing 2020 - Janke tyne with press wheel on 32 cm row spacing	
Target Populations:	2019 - Low, Medium, Standard and High Cereals: 30, 60, 90 and 120 plants/m ² Chickpeas: 10, 20, 30 and 40 plants/m ² 2020 – Planet Barley: 90 plants/m ² (50 kg/ha seed)	
Planting Dates:	22/05/2019 (DP1)	9/06/2020 (DP2)
Harvest Dates:	25/10/2019	29/10/2020
Keywords:	Wheat, barley, durum, chickpeas, disc, tyne, plant population, fallow efficiency, yield	

NB: Trial designed and analysed as a Strip Plot

	In Simple Terms
Table of A Means:	Mean of 'Crop' performance with ALL 'Planter Type' treatments and 'Population' treatments
Table of B Means:	Mean of 'Planter Type' performance with ALL 'Crop' treatments and 'Population' treatments
Table of C Means:	Mean of 'Population' performance with ALL 'Crop' treatments and 'Planter Type' treatments
Table of A x B Means:	'Crop' performance with EACH 'Planter Type' treatment
Table of A x C Means:	'Crop' performance with EACH 'Population' treatment
Table of B x C Means:	'Planter Type' performance with EACH 'Population' treatment
Table of A x B x C Means:	'Crop' performance with EACH 'Planter Type' treatment and EACH population

How to interpret?



Key analyses highlighted in grey

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Assessment Date		25/10/2019	28/11/2019	22/01/2020	18/03/2020	14/04/2020
Assessment Type		PAW	PAW	PAW	PAW	PAW
Assessment Unit		mm	mm	mm	mm	mm
Plant-Evaluation Interval		156 DP1	190 DP1	245 DP1	301 DP1	328 DP1
Trt No.	2019 Treatment					
TABLE OF A MEANS (Crop)						
1	Barley	30b	51bc	57b	103b	101b
2	Durum	31b	53b	57b	101b	100b
3	Wheat	28b	50c	55b	100b	98b
4	Chickpea	51a	74a	83a	123a	119a
TABLE OF B MEANS (Planter Type)						
1	Disc	36-	57-	62-	107-	105-
2	Tyne	35-	57-	64-	107-	104-
TABLE OF C MEANS (Population)						
1	Low	36-	58-	65-	107-	105-
2	Medium	35-	57-	63-	107-	104-
3	Standard	35-	57-	63-	108-	106-
4	High	34-	56-	62-	105-	103-

NB: No interactions presented, as no significant differences were apparent

Crop		Barley cv. Planet	
Assessment Date		26/06/2020	29/10/2020
Assessment Type		EMERGENCE	YIELD
Assessment Unit		/m ²	t/ha
Plant-Evaluation Interval		17 DP2	142 DP2
Trt No.	2019 Treatment		
TABLE OF A MEANS (Crop)			
1	Barley	65-	2.26-
2	Durum	63-	2.15-
3	Wheat	61-	2.13-
4	Chickpea	61-	2.29-
TABLE OF B MEANS (Planter Type)			
1	Disc	62-	2.24-
2	Tyne	63-	2.18-
TABLE OF C MEANS (Population)			
1	Low	63-	2.24-
2	Medium	63-	2.20-
3	Standard	63-	2.21-
4	High	62-	2.17-
TABLE OF A x B MEANS (Crop x Planter Type)			
1a	Barley, Disc	62bc	2.33-
1b	Barley, Tyne	68a	2.19-
2a	Durum, Disc	62bc	2.11-
2b	Durum, Tyne	65ab	2.18-
3a	Wheat, Disc	63abc	2.14-
3b	Wheat, Tyne	60c	2.13-
4a	Chickpea, Disc	63bc	2.37-
4b	Chickpea, Tyne	60c	2.21-

NB: A x C, B x C and A x B x C interactions not presented, as no significant differences were apparent

DP2 = Days after Planting 2

Means followed by same letter do not significantly differ (P=.05, LSD)

Mean comparisons performed only when AOV Treatment P (F) is significant at mean comparison OSL.

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Crop Assessment Date Assessment Type Assessment Unit Plant-Evaluation Interval		Barley cv. Planet 30/10/2020			
		PROTEIN % 143 DP2	TEST WEIGHT kg/hL 143 DP2	RETENTION % 143 DP2	SCREENINGS % 143 DP2
Trt No.	2019 Treatment				
TABLE OF A MEANS (Crop)					
1	Barley	14-	62c	43c	14a
2	Durum	14-	63b	47b	12b
3	Wheat	14-	62bc	47bc	12b
4	Chickpea	14-	64a	56a	7c
TABLE OF B MEANS (Planter Type)					
1	Disc	14-	63-	49-	11-
2	Tyne	14-	62-	48-	12-
TABLE OF C MEANS (Population)					
1	Low	14-	63-	51a	10b
2	Medium	14-	63-	48ab	11ab
3	Standard	14-	62-	48bc	12a
4	High	14-	62-	46c	12a

NB: No interactions presented, as no significant differences were apparent

DP2 = Days after Planting 2

Means followed by same letter do not significantly differ (P=.05, LSD)

Mean comparisons performed only when AOV Treatment P (F) is significant at mean comparison OSL.

COMPLETE SPLIT-PLOT AOV Fallow water mm to 1.5m 25/10/2019 PAW mm 156 DP1						
Source	DF	Sum of Squares	Mean Square	F	Prob.(F)	LSD (.05)
Total	95	17761.575481				
R	2	8008.790301	4004.395150	1253.228	0.0001	
A	3	8235.966534	2745.322178	34.972	0.0003	6
ERROR A	6	471.009348	78.501558			
B	1	16.654366	16.654366	5.212	0.0518	1
AB	3	7.360915	2.453638	0.768	0.5434	2
ERROR B	8	25.562118	3.195265			
C	3	64.179982	21.393327	1.689	0.1819	2
AC	9	65.451479	7.272387	0.574	0.8115	4
BC	3	34.098993	11.366331	0.897	0.4495	3
ABC	9	224.433235	24.937026	1.968	0.0642	6
ERROR C	48	608.068213	12.668088			

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COMPLETE SPLIT-PLOT AOV						
Fallow water mm to 1.5m						
28/11/2019						
PAW mm 190 DP1						
Source	DF	Sum of Squares	Mean Square	F	Prob.(F)	LSD (.05)
Total	95	18132.793030				
R	2	7049.464188	3524.732094	655.596	0.0001	
A	3	9459.545477	3153.181826	43.344	0.0002	6
ERROR A	6	436.486769	72.747795			
B	1	5.801026	5.801026	1.079	0.3293	1
AB	3	7.164525	2.388175	0.444	0.7280	2
ERROR B	8	43.011006	5.376376			
C	3	67.276339	22.425446	1.420	0.2484	2
AC	9	53.105213	5.900579	0.374	0.9421	5
BC	3	40.722316	13.574105	0.860	0.4685	3
ABC	9	212.329258	23.592140	1.494	0.1773	7
ERROR C	48	757.886912	15.789311			

COMPLETE SPLIT-PLOT AOV						
Fallow water mm to 1.5m						
22/01/2020						
PAW mm 245 DP1 T15						
Source	DF	Sum of Squares	Mean Square	F	Prob.(F)	LSD (.05)
Total	95	23231.708818				
R	2	7629.124530	3814.562265	195.854	0.0001	
A	3	12358.811302	4119.603767	27.391	0.0007	9
ERROR A	6	902.396735	150.399456			
B	1	35.146935	35.146935	1.805	0.2160	2
AB	3	36.144084	12.048028	0.619	0.6223	4
ERROR B	8	155.812812	19.476601			
C	3	109.052504	36.350835	1.191	0.3233	3
AC	9	193.649694	21.516633	0.705	0.7015	6
BC	3	32.382882	10.794294	0.354	0.7868	5
ABC	9	313.568360	34.840929	1.141	0.3536	9
ERROR C	48	1465.618980	30.533729			

COMPLETE SPLIT-PLOT AOV						
Fallow water mm to 1.5m						
18/03/2020						
PAW mm 301 DP1 T7						
Source	DF	Sum of Squares	Mean Square	F	Prob.(F)	LSD (.05)
Total	95	21796.244429				
R	2	8661.838122	4330.919061	336.084	0.0001	
A	3	8553.425040	2851.141680	15.429	0.0032	10
ERROR A	6	1108.777435	184.796239			
B	1	2.588030	2.588030	0.201	0.6659	2
AB	3	37.807226	12.602409	0.978	0.4498	3
ERROR B	8	103.091244	12.886406			
C	3	99.683336	33.227779	0.651	0.5862	4
AC	9	307.629328	34.181036	0.670	0.7318	8
BC	3	61.362261	20.454087	0.401	0.7531	6
ABC	9	410.280558	45.586729	0.893	0.5384	12
ERROR C	48	2449.761850	51.036705			

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COMPLETE SPLIT-PLOT AOV Fallow water mm to 1.5m 14/04/2020 PAW mm 328 DP1 T4						
Source	DF	Sum of Squares	Mean Square	F	Prob.(F)	LSD (.05)
Total	95	18808.189312				
R	2	7391.674290	3695.837145	613.356	0.0001	
A	3	6883.133537	2294.377846	13.039	0.0049	9
ERROR A	6	1055.756695	175.959449			
B	1	17.988956	17.988956	2.985	0.1223	1
AB	3	17.435768	5.811923	0.965	0.4553	2
ERROR B	8	48.204763	6.025595			
C	3	63.903552	21.301184	0.402	0.7521	4
AC	9	350.847660	38.983073	0.736	0.6741	8
BC	3	129.098136	43.032712	0.812	0.4933	6
ABC	9	307.545666	34.171741	0.645	0.7529	12
ERROR C	48	2542.600289	52.970839			

COMPLETE SPLIT-PLOT AOV Barley cv. Planet 26/06/2020 EMERGENCE /m² 17 DP2						
Source	DF	Sum of Squares	Mean Square	F	Prob.(F)	LSD (.05)
Total	95	5171.279907				
R	2	6.561279	3.280640	0.128	0.8814	
A	3	206.375122	68.791707	1.970	0.2199	4
ERROR A	6	209.503174	34.917196			
B	1	9.180705	9.180705	0.359	0.5657	2
AB	3	380.325317	126.775106	4.955	0.0313	5
ERROR B	8	204.671224	25.583903			
C	3	32.221476	10.740492	0.166	0.9188	5
AC	9	418.116252	46.457361	0.718	0.6903	9
BC	3	90.611776	30.203925	0.466	0.7070	7
ABC	9	505.803426	56.200381	0.868	0.5596	13
ERROR C	48	3107.910156	64.748128			

COMPLETE SPLIT-PLOT AOV Barley cv. Planet 29/10/2020 YIELD t/ha 142 DP2						
Source	DF	Sum of Squares	Mean Square	F	Prob.(F)	LSD (.05)
Total	95	12.687753				
R	2	3.229740	1.614870	50.479	0.0001	
A	3	0.441032	0.147011	0.417	0.7475	0.42
ERROR A	6	2.116390	0.352732			
B	1	0.090370	0.090370	2.825	0.1313	0.08
AB	3	0.214495	0.071498	2.235	0.1615	0.17
ERROR B	8	0.255927	0.031991			
C	3	0.060853	0.020284	0.213	0.8869	0.18
AC	9	0.598330	0.066481	0.698	0.7074	0.36
BC	3	0.085513	0.028504	0.299	0.8258	0.25
ABC	9	1.022952	0.113661	1.193	0.3211	0.51
ERROR C	48	4.572150	0.095253			

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COMPLETE SPLIT-PLOT AOV Barley cv. Planet 30/10/2020 Protein % 143 DP2						
Source	DF	Sum of Squares	Mean Square	F	Prob.(F)	LSD (.05)
Total	95	11.352396				
R	2	2.105833	1.052917	16.121	0.0016	
A	3	0.197812	0.065937	0.460	0.7203	0
ERROR A	6	0.860000	0.143333			
B	1	0.065104	0.065104	0.997	0.3473	0
AB	3	0.273646	0.091215	1.397	0.3128	0
ERROR B	8	0.522500	0.065312			
C	3	0.243646	0.081215	0.708	0.5519	0
AC	9	0.789271	0.087697	0.765	0.6489	0
BC	3	0.291146	0.097049	0.846	0.4754	0
ABC	9	0.498438	0.055382	0.483	0.8789	1
ERROR C	48	5.505000	0.114688			

COMPLETE SPLIT-PLOT AOV Barley cv. Planet 30/10/2020 Test Weight kg/hL 143 DP2						
Source	DF	Sum of Squares	Mean Square	F	Prob.(F)	LSD (.05)
Total	95	107.333333				
R	2	9.225833	4.612917	4.858	0.0416	
A	3	44.823333	14.941111	20.542	0.0015	1
ERROR A	6	4.364167	0.727361			
B	1	0.481667	0.481667	0.507	0.4966	0
AB	3	1.701667	0.567222	0.597	0.6344	1
ERROR B	8	7.596667	0.949583			
C	3	0.843333	0.281111	0.502	0.6825	0
AC	9	6.413333	0.712593	1.273	0.2759	1
BC	3	0.948333	0.316111	0.565	0.6409	1
ABC	9	4.068333	0.452037	0.808	0.6114	1
ERROR C	48	26.866667	0.559722			

COMPLETE SPLIT-PLOT AOV Barley cv. Planet 30/10/2020 Screenings % 143 DP2						
Source	DF	Sum of Squares	Mean Square	F	Prob.(F)	LSD (.05)
Total	95	1438.923224				
R	2	137.687777	68.843889	7.405	0.0151	
A	3	613.373053	204.457684	40.361	0.0002	2
ERROR A	6	30.394281	5.065714			
B	1	3.780234	3.780234	0.407	0.5415	1
AB	3	19.071928	6.357309	0.684	0.5865	3
ERROR B	8	74.370675	9.296334			
C	3	90.533736	30.177912	4.518	0.0072	2
AC	9	36.706118	4.078458	0.611	0.7818	3
BC	3	16.409828	5.469943	0.819	0.4898	2
ABC	9	95.991726	10.665747	1.597	0.1432	4
ERROR C	48	320.603867	6.679247			

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COMPLETE SPLIT-PLOT AOV Barley cv. Planet 30/10/2020 Retention % 143 DP2						
Source	DF	Sum of Squares	Mean Square	F	Prob.(F)	LSD (.05)
Total	95	4962.143041				
R	2	528.922956	264.461478	19.987	0.0008	
A	3	2236.050170	745.350057	24.866	0.0009	4
ERROR A	6	179.850177	29.975030			
B	1	47.166084	47.166084	3.565	0.0957	2
AB	3	22.341628	7.447209	0.563	0.6545	3
ERROR B	8	105.854800	13.231850			
C	3	353.635936	117.878645	5.875	0.0017	3
AC	9	254.836018	28.315113	1.411	0.2100	5
BC	3	6.684645	2.228215	0.111	0.9532	4
ABC	9	263.730626	29.303403	1.460	0.1900	7
ERROR C	48	963.070000	20.063958			

Assessment Type

PAW = Plant available water (mm)

DP1 = Days after Planting 1

DP2 = Days after Planting 2

Conclusions:

This trial was initially established to evaluate the impact of planter type on crop growth and yield of barley, durum, wheat and chickpeas. All crops were planted with both a Boss double disc and a Janke tyne planter with press wheels in June 2019 with harvest in late October.

Assessment at 2019 harvest showed chickpea plots started the fallow period with an average of ~20mm more plant available water (PAW) than the cereal treatments. EM38 assessments were conducted at five timings during the fallow period, with ~400mm of fallow rainfall recorded. The final EM38 measurement was taken at planting in June 2020 and showed significantly higher soil PAW for the chickpea treatments compared to all three winter cereals. The magnitude of difference was ~19mm of extra plant available water, nearly identical to the starting difference at the 2019 harvest. There was no clear difference between the winter cereals. Assessment of fallow water efficiency showed no apparent difference between crop types, stubble load (2019 plant populations) or 2019 planter type used in this trial with all treatments increasing by ~70mm of PAW. Fallow water efficiency was ~17%.

Planet barley was sown in June 2020 with a small plot tyne planter. Emergence counts showed a significant interaction between crop type and planter type used in 2019. Significantly larger emergence counts were recorded in plots that were planted in 2019 to barley with a tyne planter compared to plots planted to barley with a disc planter. No other differences in emergence were evident with mean plant population ~63 plants/m².

No significant differences were recorded for NDVI (not presented), yield or grain protein. Although there were no significant differences in yield, significant impacts on test weight, retention and screenings were apparent. Treatments planted into 2019 chickpea stubble recorded significantly improved quality for all traits compared to the winter cereals.

In addition, treatments planted into stubble from the 'Low' plant population treatments in 2019 resulted in significant improvements for both retention and screenings compared to the 'Standard' and 'High' plant population treatments.

Surprisingly, these results showed no significant difference in fallow efficiency between the crops or stubble loads throughout the fallow period. Despite the additional water in chickpea plots from 2019, there was no impact on grain yield or protein but there were clear impacts on grain size assessments.