2016 CFIG Non-wetting Demonstration Site

By Veronika Crouch, CFIG.

Introduction

The aim of this project is for the Corrigin Farm Improvement Group (CFIG) to identify the best method to increase soil and crop performance in non-wetting soils in the Corrigin area.

This project was funded through the Wheatbelt NRM Sustainable Agriculture Trials and Demonstrations Project during the 2016 season.

Background to the project

There are more than 2 million hectares of non-wetting sandy soils in western and southern Australia. Water repellence in soils causes uneven water infiltration, poor crop and pasture germination and leaves the soil prone to wind and water erosion.

Non-wetting soils are a significant constraint in the Corrigin area, with water repellence resulting in poor germination of crops and pastures. The Corrigin Farm Improvement Group has identified non-wetting soil as a major issue for their members and have been exploring cost effective ways in which growers are able to manage these soil to reduce water repellence and improve crop and pasture vigour.

Objectives

This demonstration compared how differing tillage practices, soil wetter applications and seeding depths affected the yield on non-wetting soils.

Methodology

The 2016 non-wetting demonstration plots were sown, sprayed and harvested using local grower sourced machinery.

The Chamberlain plough and spading plots were worked in during April 2016. Soil tests were conducted in in April. The plots were sown to Mace wheat in May and plant establishment counts were taken in June to coincide with crop establishment. Each plot was harvested in December for yield and grain quality.

This paddock was in clover based pasture 2015 and Mace wheat 2014 with an average yield of 2t/ha. The paddock was also limed at 1/t/ha during 2011.

Trial Layout

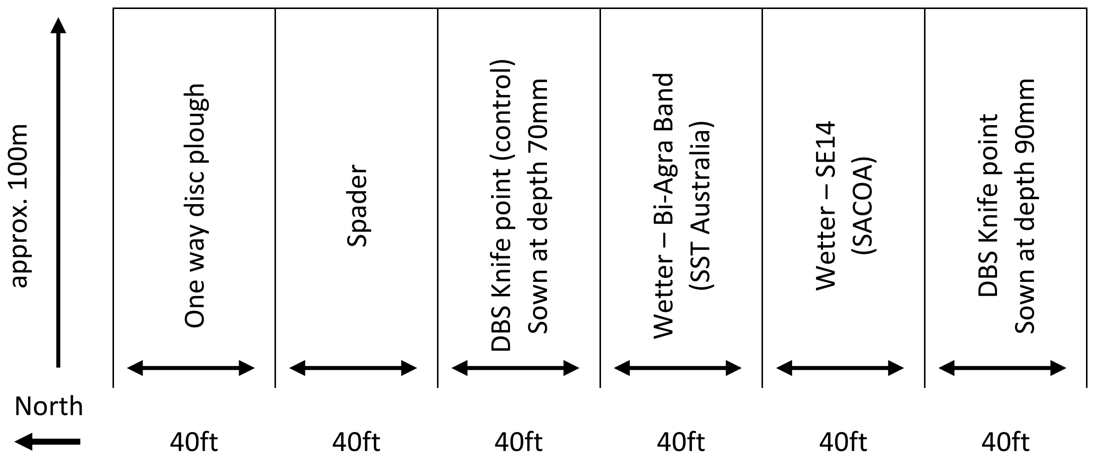

Figure 1. Layout of the Corrigin non-wetting demonstration site 2016.

Trial Details

Location: -32.383802, 117.644226
Sown: 18th May 2016
Machine: 40ft BDS Bar with press wheel and close plate on 10 inch row spacing's, liquid placement bottom of seed.
Seeding rate: 60kg/ha
Variety: Mace Wheat

Table 1. Paddock Record of herbicide, fertiliser and insecticide applications.

Date	Chemical	Item	Rate
6th Feb 2016	Herbicide	Glyphosate	1L/ha
	Herbicide	Ester 680	400ml/ha
	Fertiliser	Ammonium sulfate	25kg/4500L
	Adjuvant	Enhance	0.5%
23rd April 2016	Herbicide	Glyphosate	1.5L/ha
	Herbicide	Ester 680	400ml/ha
	Fertiliser	Ammonium sulfate	25kg/4500L
	Adjuvant	Enhance	0.5%
18th May 2016 *(seeding)*	Herbicide	Gramoxone	1L/ha
	Herbicide	Treflan	1.8L/ha
	Herbicide	Diuron	220g/ha
	Insecticide	Alpha Forte	45ml/ha
	Fertiliser	K-Till Extra	100kg/ha
	Adjuvant	Bi-Agra Band	2L/ha
	Adjuvant	SE14	2L/ha
2nd July	Herbicide	Jaguar	700ml/ha
	Herbicide	MPCA LVE 600	350ml/ha
	Insecticide	Alpha 100	150ml/ha
	Fertiliser	Flexi N	40L/ha
26th July	Fertiliser	Flexi N	20L/ha

Photo 1. DBS seeding bar and liquid cart used to seed demonstration site on the 18th May 2016.

Observations

Rainfall

The total rainfall (Jan to Dec 2016) was 431mm which is above average when compared to the long term average at Corrigin weather station of 372mm. The growing season rainfall (April to Oct 2016) of 257mm was below average when compared to the long term average of 288mm at Corrigin (Figure 2).

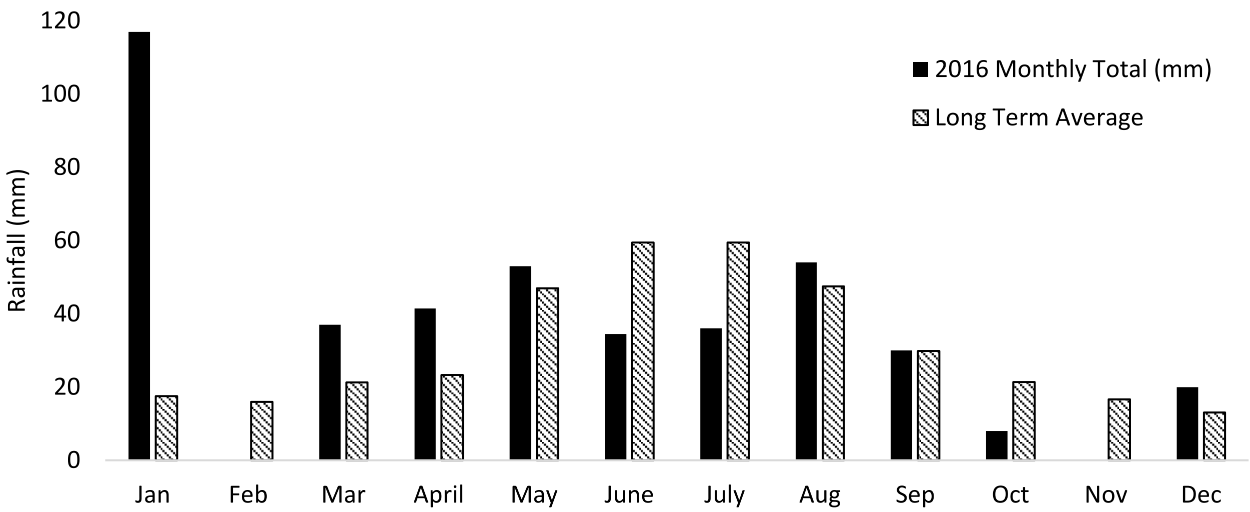

Figure 2. Spread of rainfall over 2016. Total Rainfall: 431mm. Growing Season Rainfall (April to October) 257mm

Plant establishment

Plant establishment counts were taken on the 22nd June (Table 2). Plant establishment and all 6 plots were well above the desired density target of 160 plants/m^2. All 5 treatments sown at 70mm depth had an average plant density above 210 plants/m^2, whilst the seeding at 90mm has an average of 170 plants/m^2. These establishment rates are indicative of the wet start to the 2016 season evident in figure 2.

Photo 2. Demonstration Site 22nd June 2016.

NDVI readings

Normalized Difference Vegetative Index (NDVI) is commonly used to measure plant health and vigour. NDVI readings were taken on the 19th August 2016. The results indicate there is minimal difference between farmer practices and the N Rich strip that was sprayed across all 6 treatments (Figure 3). This is likely due to the wet start to the season, enabling good plant establishment and not early mineralisation.

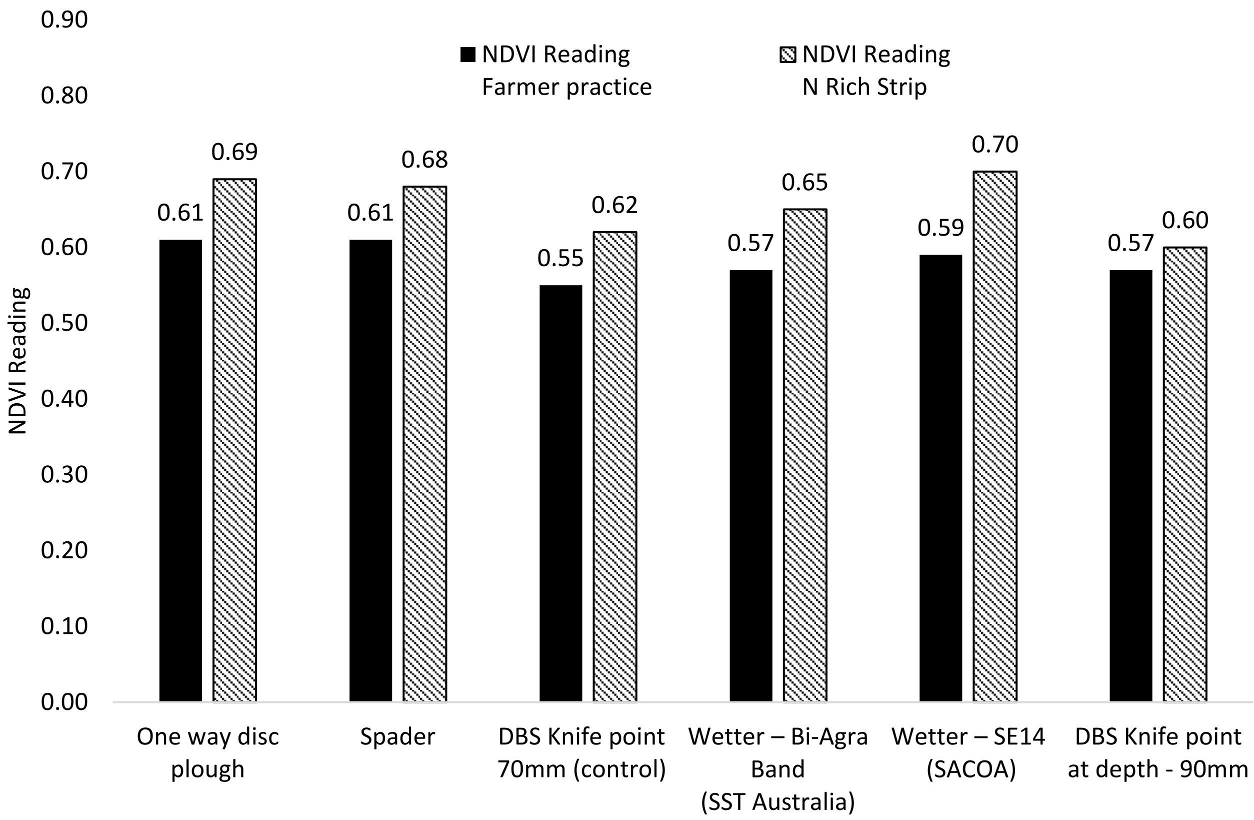

Figure 3. NDVI readings comparing farmer practice to the N Rich strip taken on 19th August 2016.

Soil Tests

Soil tests were sampled 0-10cm, 10-20cm and 20-30cm. The results from the samples indicated pH levels at this site are good, however pH at depth 20-30cm should be monitored to ensure pH levels don't drop stay above 4.5. Nitrogen is low due to poor clover growth and previous wheat crop. For the 2016 season it was recommended to apply N at recommended rates of 80kg/ha K-Till Extra at seeding, 50L/ha Flexi N post emergent and Flexi N 30L/ha at tillering depending on seasonal conditions. Phosphorus levels are also low at this site. Potassium levels are adequate, and Sulphur levels are marginal (Figure 4 and Figure 5).

Observations

There was initially no significant variation in the wheat sown across all plots. This was supported by even plant establishment over the site at early growth stages (Table 2). Even though there was an initial response to the N Rich Strip, later in the season there was no visible difference in crop vigour between the farmer practice and N Rich strip areas.

Wild Oats were present at the southern end of the demonstration site; across both the wetter and knife point at depth plots, although they did not impact on the grain quality sample (Table 2). There was evidence of frost damage across the site; again this did not influence the grain quality grade.

Paddock:	7 Bell Rock Soak (104.0 ha)	7 Bell Rock Soak (104.0 ha)	7 Bell Rock Soak (104.0 ha)
Site:	7 BRS 3 (- ha)	7 BRS 3 (- ha)	7 BRS 3 (- ha)
Lab Number:	SUS16025	SUS16027	SUS16030
Sample Depth:	0-10 cm	20-30 cm	10-20 cm
pH [1:5 soil/CaCl2] (4B1)	6.0 ok	4.5 <	4.8 <
pH [1:5 soil/water] (4A1)	6.6	5.3	5.5
EC [1:5] (dS/m) (3A1)	0.086 ok	0.038 ok	0.042 ok
Organic C [W&B] (%) (6A1)	0.76 <	0.24 <<	0.22 <<
Nitrogen	marginal	low	low
NO3-N [KCl] (mg/kg) (7C1c)	16.4	6.6	9.1
NH4-N [KCl] (mg/kg) (7C1a)	6.9	1.0	1.0
P [Colwell] (mg/kg) (9B1)	16 marginal	13 low	13 marginal
PBI+ColP (9I2a)	12 <<	18 <	13 <<
K [Colwell] (mg/kg) (18A1)	107 sufficient	59 marginal	52 marginal
S [KCl-40] (mg/kg) (10D1)	5 low	4 low	3 low

low marginal sufficient high excess << < ok > >>

NOTE: Only low, marginal and excess values have been shaded here.

Figure 4. 2016 Interpretation results from soil sample 1, 7 Bell Rock Soak, (Source; CSBP).

Paddock:	7 Bell Rock Soak (104.0 ha)	7 Bell Rock Soak (104.0 ha)	7 Bell Rock Soak (104.0 ha)
Site:	7 BRS 4 (- ha)	7 BRS 4 (- ha)	7 BRS 4 (- ha)
Lab Number:	SUS16028	SUS16026	SUS16029
Sample Depth:	0-10 cm	10-20 cm	20-30 cm
pH [1:5 soil/CaCl2] (4B1)	5.2 <	4.3 <<	4.6 <
pH [1:5 soil/water] (4A1)	5.9	5.1	5.5
EC [1:5] (dS/m) (3A1)	0.075 ok	0.035 ok	0.032 ok
Organic C [W&B] (%) (6A1)	0.83 <	0.30 <<	0.27 <<
Nitrogen	low	low	low
NO3-N [KCl] (mg/kg) (7C1c)	18.0	4.1	4.3
NH4-N [KCl] (mg/kg) (7C1a)	1.2	1.0	1.0
P [Colwell] (mg/kg) (9B1)	12 marginal	10 low	4 low
PBI+ColP (9I2a)	14 <<	19 <	32 <
K [Colwell] (mg/kg) (18A1)	111 sufficient	87 sufficient	109 sufficient
S [KCl-40] (mg/kg) (10D1)	6 marginal	7 marginal	8 marginal

low marginal sufficient high excess << < ok > >>

NOTE: Only low, marginal and excess values have been shaded here.

Figure 5. 2016 Interpretation results from soil sample 2, 7 Bell Rock Soak, (Source; CSBP).

Results and Discussion

The spaded plot had the highest wheat yield of 3.667t/ha (Figure 6). Both soil amelioration treatments yielded higher than the inclusion of wetters or seeding at depth 90mm. There was only a 95kg difference between the wetter plot yields; the Bi-Agra Band plot yield was 2.872t/ha and SE14 plot yield was 2.777t/ha. The difference between the highest and lowest treatment yields was 890kg/ha.

Even though the site did appear even at establishment, it would have been beneficial to have more than one control plot throughout the site. This could have determined if the decrease in yield and protein at the southern end of the site was due to mineralisation from the soil amelioration treatments, or if there was limiting Nitrogen availability or soil constraints. However there was not a significant difference between NDVI readings which suggests that early vigour was not due to early mineralisation on the ploughed and spaded plots. The yield response was more likely due to more plant available moisture.

Given the start to the 2016 season and seeding date, the wetter results would not be a true indication of potential yield, thus running this demonstration over multiple seasons could indicate significantly different yield results.

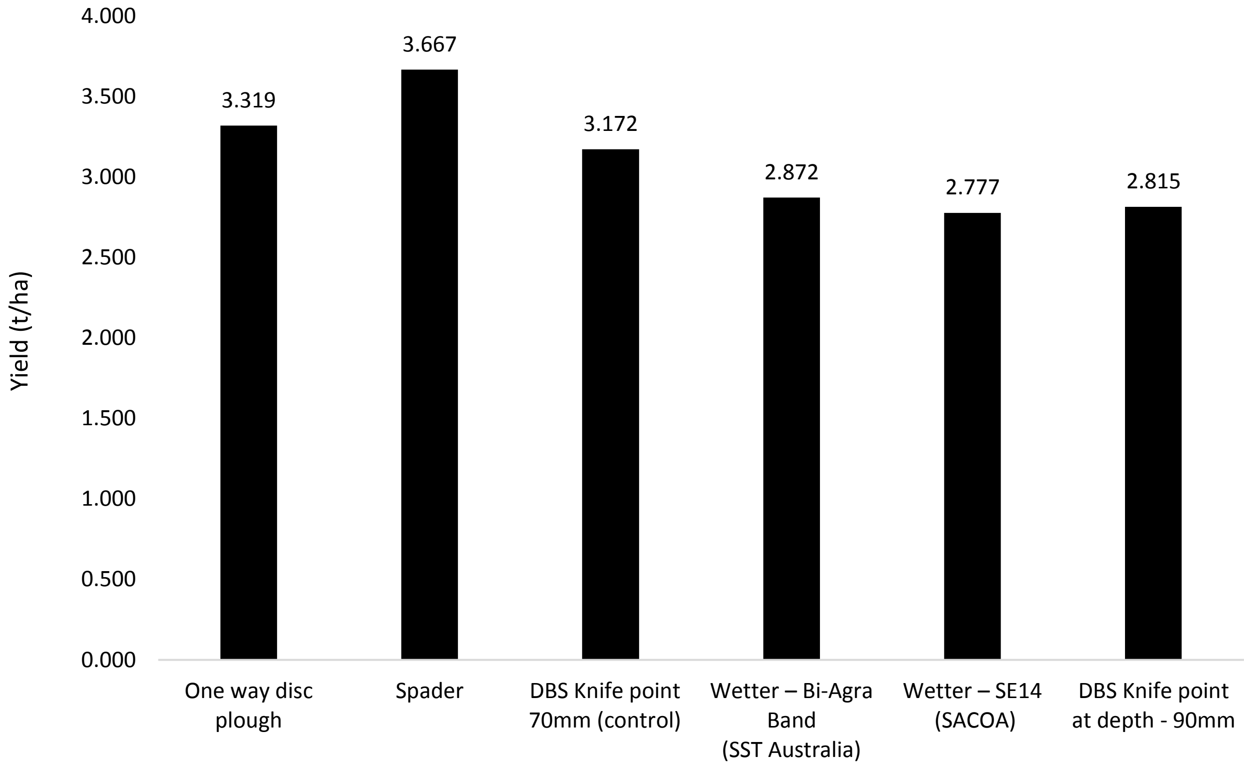

Figure 6. Yield (t/ha) of Mace wheat for each treatment for 2016.

Table 2. Grain yield and quality sample results taken from each non-wetting treatment.

	One way disc plough	Spader	DBS Knife point 70mm (control)	Wetter Bi-Agra Band	Wetter SE14	DBS Knife point 90mm
Establishment (plant/m2)	218	226	224	208	228	172
Yield (t/ha)	3.319	3.667	3.172	2.872	2.777	2.815
Grade	APW2	APW1	APW2	APW2	ASW1	ASW1
Protein	10.2	10.7	10.4	10.0	9.9	9.6
Hectolitre weight (g)	399.30	396.30	395.50	396.80	399.10	400.40
Hectolitre weight (Kg/hl)	79.86	79.26	79.10	79.36	79.82	80.08
Screenings (g)	12.10	10.70		12.00	8.60	10.80
Screenings (%)	3.03	2.69		3.02	2.15	2.69
Frost damage seeds	2	2	1		4	1

2016 Gross Margin

The Gross Returns (Income less Input Costs) for this demonstration using 2016 wheat prices for APW1, APW2 and ASW1 indicate that farmer practice (control) had the highest return of $443.61/ha (Figure 7 and Table 3). The second highest return was the spaded treatment at $442.11/ha.

All the treatments made a profit during 2016 between $303.13/ha to $443.61/ha. For a season such as 2016 where there was sufficient rainfall for plant establishment and growth, wetters may not be required at seeding which would reduce input costs.

Results generated using an average wheat price of $250/t over all treatments indicates that farmer practice (control) would still have the highest return of $465.81/ha, whilst the ploughed treatment would have the second highest return of $462.52/ha (Figure 8 and Table 4). All treatments would make a profit over $353.11/ha.

Over both scenarios the Gross Return ranking trend remained similar, with the soil amelioration treatments bringing a greater return than the wetters and DBS knife point at depth. There is a larger $/h return difference between the two wetter treatments when comparing the 2016 wheat prices due to the grade of the grain (Table 2); $52.55/ha for 2016 wheat price and $22.67/ha for average $250 price.

It would be interesting to see how all plots at this site perform under a range of seasonal conditions. A multi year Gross Returns analysis could indicate a change in the $/ha return ranking trend in seasons where wetters have a greater influence on plant establishment. This analysis may also present significant return on investment for the soil amelioration treatments in the second and third year crops.

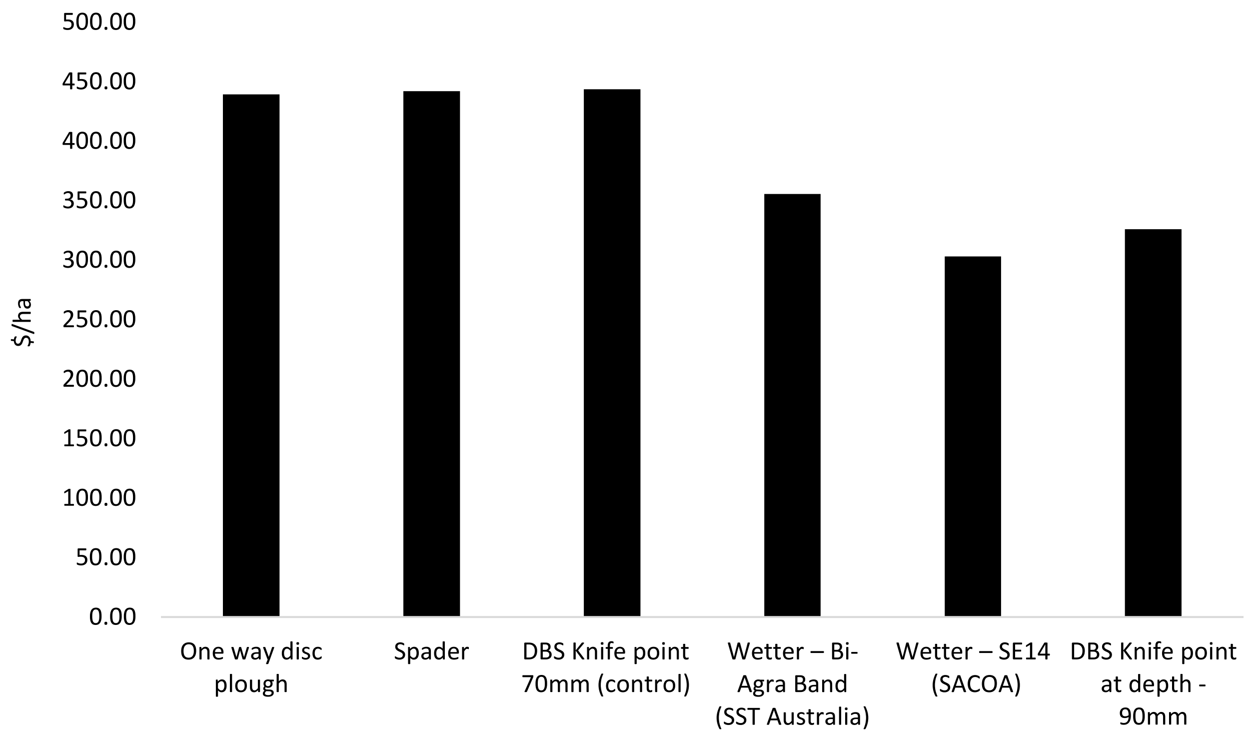

Figure 7. Ranking of Gross Return ($/ha) using 2016 Wheat prices at harvest.

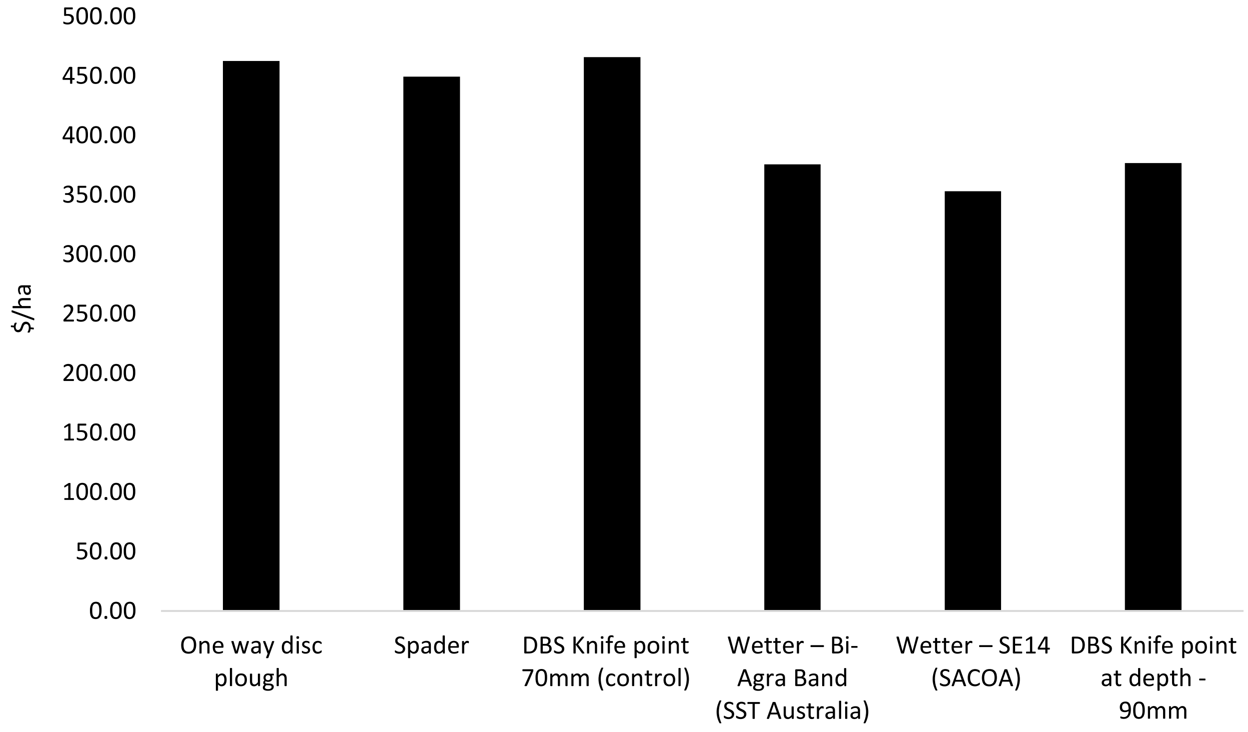

Figure 8. Ranking of Gross Return ($/ha) using an average price of $250/t across all site treatments.

Table 3. Demonstration Yield and Gross Returns using 2016 Wheat price at harvest

Treatment	Yield (t/ha)	Price ($/t)	Income ($/ha)	Seed Costs ($/ha)	Contractor Rates ($/ha)	*Seeding, Harvest, Spraying ($/ha)	Herbicide Costs ($/ha)	Fert, Chem Costs ($/ha)	Freight, Handling Charges ($/t)	Total Input costs ($/ha)	Gross Return ($/ha)
One way disc plough	3.32	243.00	806.51	18.00	40.00	105.00	45.68	115.54	43.00	367.22	**439.29**
Spader	3.67	248.00	909.33	18.00	140.00	105.00	45.68	115.54	43.00	467.22	**442.11**
DBS Knife point 70mm (control)	3.17	243.00	770.83	18.00		105.00	45.68	115.54	43.00	327.22	**443.61**
Wetter Bi-Agra Band	2.87	243.00	697.90	18.00		105.00	45.68	130.54	43.00	342.22	**355.68**
Wetter SE14	2.78	232.00	644.25	18.00		105.00	45.68	129.44	43.00	341.12	**303.13**
DBS Knife point at depth - 90mm	2.82	232.00	653.17	18.00		105.00	45.68	115.54	43.00	327.22	**325.95**

** Cost of seed, fertiliser, contract seeding, harvest and spraying rates are the same for all treatments included. Contract rates and chemical costs change across the trial, as well as Wheat price.*

Table 4. Demonstration Yield and Gross Returns using an average Wheat price of $250/t.

Treatment	Yield (t/ha)	Price ($/t)	Income ($/ha)	Seed Costs ($/ha)	Contractor Rates ($/ha)	*Seeding, Harvest, Spraying ($/ha)	Herbicide Costs ($/ha)	Fert, Chem Costs ($/ha)	Freight, Handling Charges ($/t)	Total Input costs ($/ha)	**Gross Return ($/ha)**
One way disc plough	3.32	250.00	829.74	18.00	40.00	105.00	45.68	115.54	43.00	367.22	**462.52**
Spader	3.67	250.00	916.67	18.00	140.00	105.00	45.68	115.54	43.00	467.22	**449.45**
DBS Knife point 70mm (control)	3.17	250.00	793.03	18.00		105.00	45.68	115.54	43.00	327.22	**465.81**
Wetter Bi-Agra Band	2.87	250.00	718.00	18.00		105.00	45.68	130.54	43.00	342.22	**375.78**
Wetter SE14	2.78	250.00	694.23	18.00		105.00	45.68	129.44	43.00	341.12	**353.11**
DBS Knife point at depth - 90mm	2.82	250.00	703.85	18.00		105.00	45.68	115.54	43.00	327.22	**376.63**

** Cost of seed, fertiliser, contract seeding, harvest and spraying rates are the same for all treatments included. Only contract rates and chemical costs change across the trial.*

Conclusion

Due to the wet start to the 2016 season results from the Corrigin non-wetting demonstration did not align as strongly with initial predictions. Further investigation is needed to determine which treatment will be more profitable and improve non-wetting conditions on a larger scale across Tony’s property. It would be beneficial to run a multi-year Gross Return analysis across all treatments, and the level of improvement of non-wetting in the soil. Ideally the treatments would be replicated to minimise any variation across treatments due to season conditions and soil constraints. Tony would also like to compare each treatment with twin points, and if there is a significant difference between knife points and twin points on his property with the use of wetter or soil amelioration.

Acknowledgments

This project received funding from Wheatbelt NRM through the Sustainable Agriculture Trials and Demonstrations Project. Wheatbelt NRM Project Number: SA00762SA1.

Thanks to local Corrigin growers Clint Pitman, Kevin Ling and Kim Wilkinson for the use of their machinery for the site; including spader, plough and DBS bar with liquid cart. To host grower Tony Guinness and to local agronomist Angus Sellars for their assistance through the trial. Lastly to SACOA and SST Australia for the donation of wetters SE14 and Bi-Agra Band to the demonstration.