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Long term minimum tillage investigations.

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Title: Long term minimum tillage investigations

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Ron Jarvis and Leigh Smith

77M13 Red Sandy Clay Loam (Salmon Gum, Gimlet)

This site was in wheat in 1975 and 1976 before the treatments commenced on continuous wheat in 1977.

Date	Operation
	Stubble grazed over summer and fire harrowed on 7/3/90.
13/3/90	Tr 2 scarified 3 cm deep.
21/3	1 L/ha 24D ester plus 0.5 L/ha Roundup.
30/4	2.0 L/ha Spray.Seed across site.
12/6	Sown with 50 kg/ha Gutha and 60 kg/ha super with yellow trash seeder, 5" points. Narrow point treatment was 4" points with wings cut off to 2". Surface just damp, wet to depth. Ideal conditions.
20/6	Nitrogen treatment hand topdressed.
30/7	1.5 L/ha Hoegrass + 0.25% wetter. Resistant small patches of wild oats remained.

Tillage treatment*		Wheat yield (kg/ha)			Average	
		0	Gyp 1983	Sub Treatment 15N 0**		
1.	DD combine (2" points)	1426	1454	1574	1454	1476
2.	Cult/combine	1176	1278	1343	1306	1273
3.	DD combine	1324	1333	1482	1306	1359
Average		1307	1354	1462	1355	

* Tr 1 previously DD/TDD, Tr 2 previously cult/TDD (to 1986).

** 34N/year last applied in 1981.

Tillage treatments were significant, $P = 0.045$, 5% LSD = 155. The sub treatments were significantly different, $p < 0.001$, 5% LSD = 74 kg/ha. There was a response to applied N, but not to the residual effect of the previously applied N nor to 1983 applied gypsum. The interaction of tillage and sub-treatments was not significant.

In 1987 it was decided to change the old "District Practice" treatment because of its low yields and acceptance of the fact that cultivation is no good for this soil. The treatment was direct drilled with a combine and will continue to be so to monitor changes in soil structure. New gypsum application was applied to two subplots. Sub-treatments are now zero N; gypsum 1983 (both these as before); new gypsum (7/4/1987 5 t/ha) on the sub plots which had 34 N each year until 1981; and new gypsum and 15 kg/ha N, with the N applied every year.

Whereas DP has always yielded less than the other treatments each year, the first years direct drilling of the plots in 1987 resulted in no significant difference between all four main treatments in the zero N and gypsum 83 subplots (the only ones where the 4 main treatments can be compared). Gypsum response was small but significant, $p < 0.001$, 5% LSD = 31. Interaction N.S. Yields were around two thirds of a t/ha. In 1988 yields were 1.9 t/ha, and there were no significant differences between the four main treatments in zero N and gypsum 83 subplots and no response to gypsum. Previous DP had 8.9% protein whereas DDC had 8.1%. Nitrogen did not significantly increase protein.

In 1989 there were no significant difference between treatments for the third consecutive year and the response to gypsum was 130 kg/ha (9%). Protein was again only 8%.

	DDC (2" points)	Cult/comb.	DDC	DDC (previousDP)	Ave
0 GYP	1426	1176	1324	1176	1273
GYP 1983	1454	1278	1333	1306	1342
Average	1440	1227	1328	1241	1307

The interaction of gypsum and tillage treatment was not significant, however, in 1990 the tillage treatments were significantly different for the first time since DP became DDC, $P = 0.03$, S% LSD = 147 with an advantage of narrow points for direct drilling. The residual gypsum effect was significantly, $P = 0.02$, 5% LSD = 57.

In 1988 within Tr 4 (DDC where previously DP), the four sub-treatments were significant, $p = 0.003$, 5% LSD = 162. Gypsum 87 + N each year since 1977 yielded best. A similar result occurred in 1989.

1990 RESULTS

	0	1983 GYP	1987 GYP 34 N to 1981	15 N every year
New DDC yields	1176	1306	1370	1519

Results significant, $p < 0.001$; 5% LSD = 137. This was the 16th year of continuous wheat.

Additional Measurements

Germination ratings - all treatments excellent.
Header samples for grain protein, total P, 1000 gr. wt.

Summary

One cultivation or the residual of previous years cultivation reduced yields this year. Narrow points for direct drilling are showing a yield advantage over wide points. The residual value of gypsum is similar in its effect on yield (7 years later) for all cultivation treatments.

77M56 Red Sandy Clay Loam - Salmon Gum, Gimlet

Sited alongside 77M13 with the same paddock history. Commenced the wheat/pasture rotation after wheat in 1975 and 1976.

Date	Operation
31/1/90	Scarified Tr 4 10 cm deep and Tr 2 5 cm deep.
27/2 & 14/3	24D ester plus Roundup
30/4	Spray.Seed @ 2.0 L/ha across whole site.
12/6	Tr 4 worked back 6 cm deep IBS. Seeded Gutha @ 50 kg/ha and Super @ 60 kg/ha.
30/7	5 g/ha Ally
20/6	(Pasture) 0.5 L/ha Fusilade + 0.2% wetter

Treatment**		Wheat yield (kg/ha)		gY
		No gypsum	Gypsum*	
1.	DD combine (2" points)	1648	1957	309
2.	Cult/combine	1710	1948	238
3.	DDC	1604	2046	442
4.	DP	886	1556	670
Average		1462	1877 (28%)	415

* Applied April 1985 and April 1986 for the block cropped in odd or even years. 5 t/ha applied.

1988

Main treatments were not significant. Gypsum improved yield by 540 kg/ha ($p < 0.001$) and the interaction was also significant ($p = 0.048$). In the presence of gypsum DP outyielded Tr 2 and 3 but with no gypsum treatments were not different.

1989

The effect of gypsum was significant, $p = 0.04$, 5% LSD = 108 kg/ha. Main treatments were not different despite more drought tipping in DP on September 20. All treatments had barley grass problems.

1990

Main tillage treatments were significant, $p = 0.041$, 5% LSD = 453 kg/ha. Gypsum was significant, $p < 0.001$, 5% LSD = 155 kg/ha. Interaction n.s. ($p = 0.19$). The pasture was manipulated with fusilade in 1989 and the crop only had patches of doublegee and medic which were sprayed out at the end of July.

Some subplots varied in establishment in patches and overall, however, final yields did not correlate with these ratings of July 27.

86M79

Chemical and cultivated fallow in a pasture/wheat rotation on heavy land

At Merredin on salmon gum/gimlet soil. Pasture treatments and soil moisture measurements were conducted in 1990. Wheat 1991.

87NA80, 81, 82, 83

Direct drilling with modified combines compared with cultivation for pasture/wheat rotations with grass control treatments in the pasture year

These trials commenced in 1986 (with Me numbers) on the property of Peter Copestake - Corrigin. Peter does the cultivation and seeding treatments with his own machinery at normal speeds.

87NA80-83 pasture/wheat rotation. 87NA80,83 in crop in even years, 87NA81,82 in crop in odd years. 87NA80, 81 grey sand/clay, 87NA82, 83 yellow loamy sand with gravel in NA82.

Date	Operation
23/4/90	Tickle treatment with 15 cm points on wide line, and cultivation 10 cm deep scarifier treatment with 15 cm points.
14/5	Scarify treatment work back at 8 cm with 15 cm points.
20/5	Sites sprayed with 1.4 L/ha Spray.Seed, 300 ml/ha 2,4-D ester, 32 g logran, plus Dominex insecticide.
26/5	Sown with 130 kg/ha Agras 1 and 50 kg/ha Tincurrin.

No post-emergence herbicides were required.

Pasture

7/6/90	350 mL/ha Fusilade and 1.4 kg/ha Kerb treatments were applied by R. Madin (Fusilade rate his recommended rate on the day).
4/10	500 mL/ha Gramoxone treatment.

Seeding Machinery

Previous years work on these sites have demonstrated the advantage of cultivation compared with direct drilling with a standard combine. Peter now has a 700 series J. Deere combine which he has further modified to cultivate deep while seeding shallow. This was also used to seed the cultivated treatments. Front 3 ranks had 2.5 inch Anders knock-on points working 12 cm deep. Fertilizer down boots on 3 ranks with 5 inch points, offset to front 3 ranks, working 8 cm deep. Wheat was sown through International boots held back on an angle from the fertilizer tines so that seed was around 4 cm deep above the banded fertilizer, and covered with finger harrows. In 87NA83 an additional treatment had the fertilizer tines in-line with the front deep digging tines and fitted with minimal disturbance lucerne points, with the seed tubes still held back over these rows. Seeding speed was around 12 km/h.

Wheat yields (kg/ha) 87NA80

Cultivation/ seeding treatments	1989 pasture treatment				Average
	Nil	Tickle pre-crop	Gramoxone 0.5 L/ha 4/10/89	Fusilade 0.75 L/ha + Simazine 0.75 L/ha 7/6/89	
Direct Drill (modified combine)	2007	1938	2018	2462	2106
Cultivated	2182	1946	2214	2272	2153
Average	2094	1942	2116	2367	2129

Establishment was more patchy on the cultivated plots, however, growth was better by the end of July.

Final yields were equal for the two seeding methods with a response to the pasture manipulation where the crop was direct drilled.

Wheat yields (kg/ha) 87NA83

Cultivation/ seeding machine float	1989 pasture treatment				Average
	Nil	Tickle pre-seed	Gramoxone 0.5 L/ha	Fusilade 0.75 L/ha + Simazine 0.75 L/ha	
DD offset float	1972	1790	1892	2023	1919
Cult/seed offset	2224	2172	2126	2284	2202
DD in-line	1852	2267	2142	1907	2042
Cult/seed in-line	2171	2355	2346	2183	2264
Average	2054	2146	2126	2099	2106

The in-line and offset comparisons are in separate blocks across the 1989 pasture treatments.

The yields were very good considering there was only 179 mm rain in the May-October growing season. There was, however, heavy summer rains, mainly in January. Growth ratings in late July indicated cultivated plots had the best growth, and the offset float, giving extra soil disturbance, was better than the in-line float (even on the cultivated ground). Final yields showed the advantage of cultivation, however, when direct drilling, the in-line float was slightly better than the off-set.

85SG28 Grey-brown Calcareous Earth - Kumari - SGRS

A long term trial comparing direct drill with a combine to 2 cultivations prior to seeding, under three rotations (continuous wheat, wheat/pasture, wheat/fallow). Chemical and cultivated fallow. Site history - fallow 82, wheat 83, pasture 84 consisting of barley grass, goldfields burr medic, cyprus medic and wild mustard. Pasture plots sown with Serena medic in rotation in 1985 and 1986.

Date	Operation
26/5/89	2.0 L/ha Spray.Seed fallow (both the spray and the cultivated).
29/5	Fallow cultivated.
4/8	Fallows sprayed with Hoegrass and Brominil M.
9/4/90	Stubble burnt on all plots.
23/4	10 cm deep scarifying on continuous wheat and wheat after pasture.
22/5	All plots to be cropped received Spray.Seed.
24/5	Cultivated plots worked back 6 cm deep.
30/5	All plots combine sown with 64 kg/ha Aroona, 100 super after 1 L/ha Spray.Seed on DD plots.
5/7	All fallows sprayed with 1 L/ha Roundup + 10 g/ha Glean.
18/7	Cultivated fallow scarified.

1988

Rotation treatments and the tillage method were both significant ($P = 0.008$ and 0.003 respectively). 5% LSD for rotation 162 kg/ha, for tillage 92 kg/ha. Although the interaction was not significant ($p = 0.17$), the largest advantage of the cultivation compared with the DD was in the fallow/wheat rotation. The trial design is such that in this rotation DD is on spray fallow and cultivated is on cultivated fallow. Unlike this year, in 1987 the cultivated fallow was the better. Overall, DD outyielded cultivation (the reverse of 1987 result).

Fallow produced the best yield of 1.7 t/ha. Continuous wheat was lower yielding (1.3) than wheat after pasture (1.5) but this was not significant. The continuous wheat did look slightly N deficient early in the year.

Grain protein averaged 11.2% and was highest in cultivate after pasture (12.6%) and lowest in both continuous wheat (10.1%).

1989

On July 19 fallow looked much better than pasture which was better than continuous wheat. By the Field Day on October 5 the crop after pasture was badly tipped (droughted), the continuous wheat was affected slightly and the crop after fallow was still very green.

On July 19, DD looked best in the pasture/crop rotation (three out of four reps) but ratings were not clear cut in the other two rotations.

Final yields - DD was 2.2 t/ha (200 kg/ha better than cultivated). Continuous wheat 2.1 t/ha, pasture/wheat 1.8, F/W 2.6 t/ha.

Grain weight on the header sample was lowest in cultivate after pasture (the lowest yield, more hayed off treatment) although it was still 35 mg whereas the highest was continuous wheat 38 mg.

1990 Results

Rotation	Wheat yield (kg/ha)		Average
	Direct drill	Cultivated	
Continuous wheat	920	755	837
Fallow/wheat	1211	1226	1218
Pasture/wheat	315	290	302
Average	815	757	786

Rotation treatments were significant, $p < 0.001$, 5% LSD = 249 kg/ha. The extremely dry finish showed the advantage of fallow and the big disadvantage of soil N from the pasture rotation.

Additional Measurements

Grain protein + 1000 grain weight.

88EB12 Direct drilling and scarifying - Duplex soil

Paddock was in lupins (poor) 1987. Site is gritty sand over clay at variable depth 20-35 cm, average 25 cm. Wheat 1988, lupins 1989, wheat 1990

Date	Operation
Autumn 90	0.5 L/ha Roundup C.T.
5/6	2.0 L/ha Spray.Seed and sown with 20 run combine, Aroona 50 kg/ha, plain super 150 kg/ha and 255 kg/ha, cultivation treatment 12 cm deep
13/6	60 kg/ha urea topdressed
30/7	Diuron at 0.5 L/ha and 24D at 0.25 L/ha

Cultivation and phosphate (kg/ha super)		Wheat yield (kg/ha)
1	DDC No super	2015
2	DDC 255	2505
3	Cultivated, drilled 150	2644
4	Cultivated, drilled 255	2687
5	Cultivated, banded *150	2403
6	Cultivated, banded 255	2516

* The super was banded on 18 cm spacings, 12 cm deep while cultivating; the seed being sown with no super.

Yields were statistically different $p < 0.001$, 5% LSD = 234 kg/ha.

Soil P test was 27 ppm HCO_3 , 160 ppm total.