1970

Results of Field Experiments 1970

M D. Carroll

DEPARTMENT OF AGRICULTURE

PLANT RESEARCH DIVISION

RESULTS OF FIELD EXPERIMENTS 1970

M.D. CARROLL

1. 70M17 The Effects of Cultivation on Soil Nitrogen and Wheat Production.

To investigate the effect of cultivation on the mineralisation of soil nitrogen and on wheat yield, "chemical ploughing" or the "spray-seed" minimum tillage method of cereal cropping was compared with conventional cultivation and seeding on Merredin red sandy clay loam. All seeding was by combine and weeds were chemically controlled on all plots.

During the early part of the season, mineral nitrogen levels (nitrate + ammonium) were higher in the top 10 cms of cultivated plots than uncultivated "spray-seed" plots (Table 1.1). This trend continued until leaching from heavy rains in late June, and reduced mineralisation, due to low temperatures, depressed mineral nitrogen levels on all plots to a uniform low value.

Table 1.1

Inorganic Soil Nitrogen (0-10 cm)
(ppm)

Weeks after sowing seed	0 3/6	1 10/6	2 17/6	3 24/6	5 9/7
"Spray-seed"	19.6	13.8	17.9	9.7	8.6
Conventional seed	21.7	21.7	23.5	8.5	8.8

Colour ratings in July, August and September indicated that plants in "spray-seed" plots were consistently paler than those on cultivated plots. Vegetative cuts in July, September and October also showed reduced growth in "spray-seed" plots (Table 1.2)

Table 1.2

Vegetative Yield and Grain Yield

Date	lb/ac			bus/ac
	30/7	2/9	1/10	
Spray seed - sown early	397	1,455	2,430	22.7
Conventional - " "	516	1,680	2,715	27.1
Spray seed - sown late	145	885	2,145	19.5
Conventional - " "	226	1,405	2,700	27.0

Plant analyses for nitrogen content in the tops are not yet available. Results obtained in 1969 from similar treatments indicated reduced uptake of nitrogen on "spray-seed" plots. Grain yield was lower on "spray-seed" than conventionally sown plots (Table 1.2).

It should be pointed out that this experiment gives no indication of the merits of the treatments for weed control, only of a beneficial effect of cultivation per se. Supporting information suggests this may be due at least in part to increased mineralisation after cultivation but other possible physical and chemical factors cannot be ruled out at this stage. Weed control

../2.

experiments conducted by G.A. Pearce (Biological Services Division) consistently show lower yields with chemical ploughing compared with cultivation treatments.

2. <u>69N11 and 69ES30 Soil Nitrogen Build-up under Various Legumes at Different Plant Densities.</u>

To obtain some information on the effect of legume cultivars and plant density on nitrogen fixation, four legumes at four plant densities were established in small plot trials at Newdegate and Esperance. All species appeared to nodulate well except for some Daliak plants at low seeding rates.

Dry matter yield and nitrogen content of the tops was related to the increase in soil nitrogen. Nitrogen accretions at the lower seeding rates are erratic, a reflection of the difficulty in adequately soil sampling under a thin stand. At Newdegate, Geraldton sub. clover had a lower nitrogen concentration than Daliak or Rose clover but produced more top growth and increased soil nitrogen more than the other cultivars (Table 2.1). Beenong cupped clover had the lowest nitrogen content and gave the lowest increment in soil nitrogen. Soil nitrogen accretion was highest at the highest seeding rate. At this seeding rate Geraldton gave the greatest increase in soil nitrogen equivalent to 83 lb/ac. (Table 2.1). Increase in soil nitrogen was not proportional to seeding rate (plant density).

Table 2.1

Newdegate

	Yield (lb/ac)	Plant N %	N in tops (lb/ac)	Net increase in soil N (lb/ac)
Geraldton @ 7 lb/ac	525	3.1	16.3	116
21 "	1,025	2.8	28.7	6
63 "	1,100	2.7	29.7	43
189 "	1,450	3.0	43.5	83
Daliak @ 7 "	350	3.0	10.5	13
21 "	775	3.3	25.6	13
63 "	950	3.2	30.4	36
189 "	1,075	3.9	41.9	63
Beenong @ 7 "	350	2.6	9.1	- 14
21 "	425	2.6	11.1	- 4
63 "	775	2.3	17.8	10
189 "	1,100	2.3	25.3	26
Kondinin Rose @ 7 "	150	3.3	5.0	- 17
21 "	575	3.4	19.6	- 3
63 "	1,000	3.1	32.0	16
189 "	1,150	3.3	38.0	56

At Esperance, Yarloop and Seaton Park sub. clovers gave highest yields but Bacchus Marsh had a much higher nitrogen content and gave the greatest increase in soil nitrogen, equivalent to 76 lb/ac at the highest plant density (Table 2.2).

../3.

Table 2.2

Esperance

	Yield (lb/ac)	Plant N %	N in tops (lb/ac)	Net increase in soil N (lb/ac)
Seaton Park @ 7 lb/ac	875	2.8	24.6	13
21 "	1,450	2.9	41.9	3
63 "	1,533	2.8	43.5	20
189 "	1,675	2.9	49.4	60
Daliak @ 7 "	415	3.0	12.5	6
21 "	858	3.1	26.3	13
63 "	1,058	3.3	35.2	10
189 "	1,208	3.3	39.6	50
Bacchus Marsh @ 7 "	333	3.1	10.3	33
21 "	808	3.2	26.0	36
63 "	1,183	3.3	38.6	63
189 "	1,558	3.2	50.0	76
Yarloop @ 7 "	793	2.4	18.9	20
21 "	950	2.4	23.1	43
63 "	1,518	2.5	38.6	46
189 "	1,783	2.6	46.5	50

It is apparent that the build-up of soil nitrogen in the first year on these virgin soils is related to the density and productivity of the stand and, other things being equal, the nitrogen concentration in the plants.

In the second year (1970) lower density plots had largely caught up with the higher seeding rate plots in total growth. Analyses are not yet available for soil nitrogen in the second year.

3. 70N021 (R.N. Glencross) Rates of Copper and Zinc on Daliak Sub. Clover.

A factorial experiment with four rates each of copper and zinc was established on first year Daliak on a yellow brown gravelly sand (Quailing erosional surface) east of Bakers Hill. Colour and growth responses to both copper and zinc were apparent early in the season. All plots were sampled at flowering to obtain further information on critical levels of copper and zinc and on any interaction between these two elements.

Highest yields were obtained with 5 lb copper sulphate and 1½ lb zinc oxide per acre (Table 3.1). Higher levels of zinc depressed yield at all rates of copper. There was a response above 5 lb copper sulphate per acre only where yields were depressed by rates of zinc above 1½ lb zinc oxide per acre. Aerophos without trace elements yielded much less than plain super without trace elements and ærophos plus 5 lb copper sulphate and 1½ lb zinc oxide yielded below the comparable treatment with plain super.

Table 3.1

Yield (lb/ac) Sept.

Zn \ Cu	0	2½	5	7½	Mean
0	415	770	833	778	699
1½	770	945	1,105	1,003	956
3	660	883	863	973	845
4½	585	803	858	915	790
Mean	608	850	915	917	823

With aerophos

Zn \ Cu	0	5	Mean
0	228	310	270
1½	413	770	590
Mean	320	540	

Zinc concentration in the plant increased with increasing rates of zinc fertiliser but at a diminishing rate (Table 3.2) and was highest where growth was restricted by copper deficiency. Rates of copper above 2½ lb copper sulphate per acre reduced zinc concentration in the plant. This was partly due to dilution with increased growth in response to copper and partly due to reduced zinc up take at the higher copper levels (Table 3.3). It should be noted that this effect was no worse with 7½ lb than with 5 lb per acre copper sulphate.

Table 3.2

Zinc Concentration (ppm)

Zn \ Cu	0	2½	5	7½	Mean
0	7.2	8.7	8.5	8.7	8.3
1½	15.0	17.9	14.0	15.7	15.6
3	25.5	20.5	18.6	17.8	20.6
4½	27.0	25.5	21.6	20.3	23.8
Mean	18.7	18.2	15.6	15.6	

With Aerophos

Zn \ Cu	0	5	Mean
0	8.3	8.2	8.3
1½	21.9	11.2	16.6
Mean	15.1	9.7	

Table 3.3

Zinc Uptake (g/ac)

Zn \ Cu	0	2½	5	7½	Mean
0	1.34	3.01	3.19	3.05	2.64
1½	5.19	7.61	7.04	7.06	6.71
3	7.57	8.14	7.22	7.79	7.68
4½	7.11	9.21	8.34	8.36	8.26
Mean	5.30	6.99	6.45	6.56	6.32

Copper concentration in the plant increased with increasing rates of copper fertiliser to the highest rate with no evidence of tapering off (Table 3.4). Zinc fertiliser tended to depress the concentration of copper at all rates of copper. At 1½ lb zinc oxide per acre this effect was partly due to dilution with increased growth in response to zinc and partly to reduced uptake. At rates above 1½ lb zinc oxide per acre, both growth and copper concentration were reduced to give consistently lower copper uptake figures (Table 3.5).

Table 3.4

Copper Concentration (ppm)

Zn \ Cu	0	2½	5	7½	Mean
0	0.5	1.9	2.1	2.4	1.7
1½	0.7	1.0	1.2	2.2	1.3
3	0.7	1.1	1.6	2.0	1.3
4½	0.8	1.1	1.1	1.7	1.2
Mean	0.7	1.3	1.5	2.1	

With Aerophos

Zn \ Cu	0	5	Mean
0	2.4	5.1	3.8
1½	1.5	1.9	1.7
Mean	2.0	3.5	

../5.

Table 3.5

Copper Uptake (g/ac)

Zn \ Cu	0	2½	5	7½	Mean
0	0.10	0.66	0.79	0.84	0.60
1½	0.24	0.43	0.60	0.99	0.57
3	0.21	0.44	0.62	0.88	0.54
4½	0.21	0.40	0.42	0.70	0.43
Mean	0.19	0.48	0.61	0.85	

It appears that within this range of treatments, the rate of application of zinc is much more critical than that of copper, since the level needed to correct zinc deficiency without inducing a copper deficiency is within the range of 0 to 3 lb zinc oxide per acre. The optimum level may lie either side of 1½ lb per acre but is unlikely to be much below this since the corresponding zinc concentration in the plant at 14 ppm is probably not much above the critical level for zinc deficiency. On the other hand, the detrimental effect of 3 lb zinc oxide per acre on yield is quite pronounced indicating that some effect would be produced by rates of application between 1½ and 3 lb per acre.

Whilst the adverse effect of copper on zinc uptake did not generally affect yields in this experiment, there is a suggestion that rates above 5 lb/ac copper sulphate may reduce yield at low rates of zinc application. The results suggest that the copper and zinc requirements on this soil are in delicate balance.

The experiment has also been sampled for seed production but results are not yet available.

5th March, 1971.
MDC:LMM.