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84/W/WW/3 Soil Compaction and Yield - W. Wheat

Rothamsted Research

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84/W/WW/3

WINTER WHEAT

SOIL COMPACTION AND YIELD

Object: To study the effects of disrupting a compact layer in a sandy soil on the physiology, growth and yield of winter wheat - Woburn, Butt Close III.

Sponsors: P.J. Welbank, F.V. Widdowson.

Associate sponsors: K.J. Parkinson, J.E. Leach, A.H. Weir, P.B. Barraclough.

Design: A single replicate of 2^5 + 12 extra plots.

Whole plot dimensions: 2.75 x 14.8.

Treatments: All combinations of:-

Whole plots

1. CULTIVTN Cultivations:

WYE DIG Deep cultivation with Wye double-digger
PLOUGH Normal cultivation with mouldboard plough

Sub plots

2. IRRIGATN Irrigation:

NONE None
FULL Full (175 mm) to lessen a deficit of 25 mm to 12.5 mm

3. WINTER N Amounts of nitrogen fertilizer applied on 30 Nov, 1983 and
31 Jan, 1984 (kg N) as urea:

0
35+35

4. SPRING N Amounts of nitrogen fertilizer applied in spring (kg N) as
'Nitro-Chalk':

115
185

5. N TIME Times of applying spring fertilizer:

EARLY All except 40 kg N on 8 Mar; remainder on 2 May
LATE All except 40 kg N on 3 Apr; remainder on 15 May

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plus all combinations of the following all given irrigation, winter nitrogen, and spring nitrogen timed early:-

Whole plots

1 CULTIVNX Cultivations:
 WYE DIG Deep cultivations with Wye double-digger
 PLOUGH Normal cultivations with mouldboard plough

Sub plots

2. SPRNG NX Amounts of nitrogen fertilizer applied in spring (kg N) as 'Nitro-Chalk':

 80
 150
 220

Plus 2 nil nitrogen plots (given irrigation) and 4 root sampling plots (given winter nitrogen and 185 kg N applied late)

EXTRA

WY NO I Deep cultivation, irrigated
PL NO I Normal cultivation, irrigated
RWY N5 I Deep cultivation, irrigated
RWY N5 0 Deep cultivation
RPL N5 I Normal cultivation, irrigated
RPL N5 0 Normal cultivation

NOTES: (1) Deep cultivation was done with the Wye double-digger which turned a furrow with a conventional plough share to a depth of 25 cm and at the same time rotary cultivated the bottom of the adjacent furrow, in this case to a further depth of 23 cm.
(2) Normal cultivation was by mouldboard plough to a depth of 20 cm.

Irrigation treatment was applied as follows (mm water):

4 May	12.5	10 July	12.5
8 May	25	11 July	12.5
10-11 May	25	20 July	25
17 May	12.5	31 July	12.5
21 June	12.5	1 Aug	12.5
22 June	12.5		
		Total	175

Basal applications: Manures: (0:18:36) at 310 kg. Weedkiller: Chlortoluron at 3.5 kg in 280 l. Fungicides: Triadimefon at 0.06 kg with carbendazim at 0.13 kg in 280 l on two occasions, with the pirimicarb on the second. Insecticide: Pirimicarb at 0.14 kg. Nematicide: Aldicarb at 5.4 kg.

Seed: Avalon, sown at 170 kg.

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Cultivations, etc.:-

Cultivation treatments applied: 8-9 Sept, 1983. PK and nematicide applied, spring-tine cultivated: 19 Sept. Rotary cultivated, seed sown: 20 Sept. Weedkiller applied: 6 Oct. Fungicides applied: 4 May, 1984. Fungicides with insecticide applied: 27 June. Harvested by hand: 10 Aug. Previous crops: Oats 1982, potatoes 1983.

- NOTES: (1) Measurements were made of plant and shoot numbers, dry weight of tops and ears, leaf area and N contents during growth, photosynthetic rates, stomatal resistance and plant water potential.
 (2) Measurements of soil water, soil water potential and soil temperature were made.
 (3) Soil samples were taken at intervals for determinations of N content.
 (4) Straw for yield was cut at ground level.

GRAIN TONNES/HECTARE

***** TABLES OF MEANS *****

IRRIGATN	NONE	FULL	MEAN
CULTIVTN			
WYE DIG	9.63	9.51	9.57
PLOUGH	8.68	9.48	9.08
MEAN	9.15	9.49	9.32
WINTER N	0	35+35	MEAN
CULTIVTN			
WYE DIG	9.64	9.50	9.57
PLOUGH	8.97	9.19	9.08
MEAN	9.31	9.34	9.32
WINTER N	0	35+35	MEAN
IRRIGATN			
NONE	9.20	9.11	9.15
FULL	9.41	9.57	9.49
MEAN	9.31	9.34	9.32
SPRING N	115	185	MEAN
CULTIVTN			
WYE DIG	9.34	9.80	9.57
PLOUGH	8.62	9.54	9.08
MEAN	8.98	9.67	9.32
SPRING N	115	185	MEAN
IRRIGATN			
NONE	8.74	9.56	9.15
FULL	9.21	9.77	9.49
MEAN	8.98	9.67	9.32

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GRAIN TONNES/HECTARE

***** TABLES OF MEANS *****

SPRING N	115	185	MEAN	
WINTER N				
0	8.84	9.77	9.31	
35+35	9.12	9.56	9.34	
MEAN	8.98	9.67	9.32	
N TIME	EARLY	LATE	MEAN	
CULTIVTN				
WYE DIG	9.42	9.72	9.57	
PLOUGH	8.57	9.59	9.08	
MEAN	8.99	9.65	9.32	
N TIME	EARLY	LATE	MEAN	
IRRIGATN				
NONE	8.64	9.67	9.15	
FULL	9.35	9.64	9.49	
MEAN	8.99	9.65	9.32	
N TIME	EARLY	LATE	MEAN	
WINTER N				
0	8.94	9.67	9.31	
35+35	9.04	9.64	9.34	
MEAN	8.99	9.65	9.32	
N TIME	EARLY	LATE	MEAN	
SPRING N				
115	8.76	9.20	8.98	
185	9.23	10.11	9.67	
MEAN	8.99	9.65	9.32	
IRRIGATN	NONE		FULL	
WINTER N	0	35+35	0	35+35
CULTIVTN				
WYE DIG	9.60	9.66	9.69	9.33
PLOUGH	8.79	8.56	9.14	9.81
IRRIGATN	NONE		FULL	
SPRING N	115	185	115	185
CULTIVTN				
WYE DIG	9.13	10.13	9.55	9.47
PLOUGH	8.36	9.00	8.88	10.07
WINTER N	0		35+35	
SPRING N	115	185	115	185
CULTIVTN				
WYE DIG	9.20	10.09	9.48	9.51
PLOUGH	8.48	9.46	8.76	9.61

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GRAIN TONNES/HECTARE

***** TABLES OF MEANS *****

WINTER N	0		35+35										
SPRING N	115	185	115	185									
IRRIGATN													
NONE	8.69	9.70	8.80	9.42									
FULL	8.99	9.84	9.44	9.71									
IRRIGATN	NONE		FULL										
N TIME	EARLY	LATE	EARLY	LATE									
CULTIVTN													
WYE DIG	9.50	9.76	9.34	9.68									
PLOUGH	7.77	9.58	9.36	9.59									
WINTER N	0		35+35										
N TIME	EARLY	LATE	EARLY	LATE									
CULTIVTN													
WYE DIG	9.55	9.74	9.29	9.70									
PLOUGH	8.34	9.60	8.80	9.58									
WINTER N	0		35+35										
N TIME	EARLY	LATE	EARLY	LATE									
IRRIGATN													
NONE	8.55	9.84	8.72	9.50									
FULL	9.34	9.49	9.37	9.78									
SPRING N	115		185										
N TIME	EARLY	LATE	EARLY	LATE									
CULTIVTN													
WYE DIG	9.47	9.21	9.37	10.23									
PLOUGH	8.05	9.18	9.08	9.99									
SPRING N	115		185										
N TIME	EARLY	LATE	EARLY	LATE									
IRRIGATN													
NONE	8.48	9.01	8.79	10.33									
FULL	9.04	9.39	9.66	9.89									
SPRING N	115		185										
N TIME	EARLY	LATE	EARLY	LATE									
WINTER N													
0	8.63	9.04	9.25	10.29									
35+35	8.89	9.35	9.20	9.93									
SPRNG NX	80	150	220	MEAN									
CULTIVNX													
WYE DIG	8.74	9.20	10.31	9.41									
PLOUGH	9.55	10.73	10.14	10.14									
MEAN	9.14	9.96	10.22	9.78									
EXTRA	WY	NO I	PL	NO I	RWY	N5 I	RWY	N5 0	RPL	N5 I	RPL	N5 0	MEAN
		2.99		7.69		10.54		*		12.11		*	8.33

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GRAIN TONNES/HECTARE

***** STANDARD ERRORS OF DIFFERENCES OF MEANS *****

SED APPLY TO MAIN FACTORIAL PLOTS ONLY

MARGINS OF TWO FACTOR TABLES	0.236
TWO FACTOR TABLES	0.334
THREE FACTOR TABLES	0.472

***** STRATUM STANDARD ERRORS AND COEFFICIENTS OF VARIATION *****

STRATUM	DF	SE	CV%
WP	6	0.668	7.2

GRAIN MEAN DM% 83.3

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STRAW TONNES/HECTARE

***** TABLES OF MEANS *****

IRRIGATN	NONE	FULL	MEAN
CULTIVTN			
WYE DIG	11.95	12.66	12.30
PLOUGH	9.63	10.44	10.03
MEAN	10.79	11.55	11.17
WINTER N	0	35+35	MEAN
CULTIVTN			
WYE DIG	11.68	12.92	12.30
PLOUGH	9.49	10.58	10.03
MEAN	10.59	11.75	11.17
WINTER N	0	35+35	MEAN
IRRIGATN			
NONE	10.50	11.09	10.79
FULL	10.68	12.42	11.55
MEAN	10.59	11.75	11.17
SPRING N	115	185	MEAN
CULTIVTN			
WYE DIG	11.59	13.02	12.30
PLOUGH	9.79	10.28	10.03
MEAN	10.69	11.65	11.17
SPRING N	115	185	MEAN
IRRIGATN			
NONE	10.63	10.95	10.79
FULL	10.74	12.35	11.55
MEAN	10.69	11.65	11.17
SPRING N	115	185	MEAN
WINTER N			
0	10.20	10.98	10.59
35+35	11.18	12.33	11.75
MEAN	10.69	11.65	11.17
N TIME	EARLY	LATE	MEAN
CULTIVTN			
WYE DIG	12.73	11.87	12.30
PLOUGH	9.81	10.26	10.03
MEAN	11.27	11.07	11.17

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STRAW TONNES/HECTARE

***** TABLES OF MEANS *****

N TIME	EARLY	LATE	MEAN	
IRRIGATN				
NONE	10.17	11.41	10.79	
FULL	12.37	10.72	11.55	
MEAN	11.27	11.07	11.17	
N TIME	EARLY	LATE	MEAN	
WINTER N				
0	10.65	10.53	10.59	
35+35	11.89	11.61	11.75	
MEAN	11.27	11.07	11.17	
N TIME	EARLY	LATE	MEAN	
SPRING N				
115	10.82	10.55	10.69	
185	11.72	11.58	11.65	
MEAN	11.27	11.07	11.17	
IRRIGATN	NONE		FULL	
WINTER N	0	35+35	0	35+35
CULTIVTN				
WYE DIG	11.64	12.26	11.73	13.58
PLOUGH	9.35	9.92	9.62	11.25
IRRIGATN	NONE		FULL	
SPRING N	115	185	115	185
CULTIVTN				
WYE DIG	11.60	12.29	11.57	13.74
PLOUGH	9.66	9.61	9.91	10.96
WINTER N	0		35+35	
SPRING N	115	185	115	185
CULTIVTN				
WYE DIG	11.29	12.08	11.89	13.95
PLOUGH	9.10	9.87	10.47	10.70
WINTER N	0		35+35	
SPRING N	115	185	115	185
IRRIGATN				
NONE	10.14	10.85	11.12	11.05
FULL	10.25	11.10	11.23	13.60
IRRIGATN	NONE		FULL	
N TIME	EARLY	LATE	EARLY	LATE
CULTIVTN				
WYE DIG	11.84	12.05	13.62	11.70
PLOUGH	8.49	10.78	11.13	9.74

84/W/WW/3

STRAW TONNES/HECTARE

***** TABLES OF MEANS *****

WINTER N	0		35+35	
N TIME	EARLY	LATE	EARLY	LATE
CULTIVTN				
WYE DIG	12.03	11.34	13.44	12.40
PLOUGH	9.27	9.71	10.35	10.81

WINTER N	0		35+35	
N TIME	EARLY	LATE	EARLY	LATE
IRRIGATN				
NONE	9.71	11.28	10.62	11.55
FULL	11.58	9.77	13.17	11.66

SPRING N	115		185	
N TIME	EARLY	LATE	EARLY	LATE
CULTIVTN				
WYE DIG	12.20	10.97	13.26	12.78
PLOUGH	9.43	10.14	10.18	10.38

SPRING N	115		185	
N TIME	EARLY	LATE	EARLY	LATE
IRRIGATN				
NONE	10.65	10.62	9.69	12.21
FULL	10.99	10.49	13.76	10.95

SPRING N	115		185	
N TIME	EARLY	LATE	EARLY	LATE
WINTER N				
0	10.50	9.89	10.79	11.16
35+35	11.13	11.22	12.66	12.00

SPRNG NX	80	150	220	MEAN
CULTIVNX				
WYE DIG	11.15	10.82	12.20	11.39
PLOUGH	12.87	13.34	12.11	12.77
MEAN	12.01	12.08	12.16	12.08

EXTRA	WY NO I	PL NO I	RWY N5 I	RWY N5 O	RPL N5 I	RPL N5 O	MEAN
	4.10	8.25	12.63	*	12.63	*	9.40

STRAW MEAN DM% 57.4

PLOT AREA HARVESTED 0.00392 (MEAN)