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# Yields of the Field Experiments 1983

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## 83/W/CS/245 Minimum Cultivation and Deep P K - W. Wheat, W. Barley

### Rothamsted Research

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83/W/CS/245

MINIMUM CULTIVATION AND DEEP PK

Object: To study the effects of thorough subsoil disturbance and the incorporation of P and K into the subsoil on w. wheat and w. barley either sown conventionally or direct drilled - Woburn Warren Field I and II.

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The fourth year, w. wheat and w. barley.

For previous years see 80-82/W/CS/245.

Column plot dimensions: 4.27 x 57.6.

Design: 3 series each of 20 x 4 criss cross.

Treatments: All combinations of:-

Series:

1. SER CROP      Series, crops and previous cropping:
  - SER1 WW1      Series I, w. wheat in rotation after w. barley, w. oilseed rape
  - SER2 WW6      Series II, w. wheat, sixth cereal after a break crop
  - SER3 WB6      Series III, w. barley, sixth cereal after a break crop

Column plots: All combinations (duplicated) of:

2. PK SUB      Extra PK and subsoil treatments:
  - None, mouldboard ploughed
  - S           None, subsoiled
  - PKS           PK to subsoil
3. YEAR        Years of applying PK SUB:
  - 1980           In autumn 1979
  - 1983           In autumn 1979 and in autumn 1982
4. DRILL       Drills and associated cultivations:
  - CNVNTIAL      Mouldboard ploughed, conventionally drilled
  - DIRECT        Direct drilled (duplicated) (conventionally drilled in years when factor 2 involves autumn ploughing)

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Row plots:

5. N. PATH Nitrogen fertilizer in spring, and pathogen control:

75 ENHD	75 kg N	enhanced pathogen control
150 ENHD	150 kg N	enhanced pathogen control
225 ENHD	225 kg N	enhanced pathogen control
150 STND	150 kg N	standard pathogen control

plus two extra column plot treatments, in all combinations with row plots above:-

EXTRA

TPK 80 D	PK applied to topsoil and mouldboard ploughed in autumn 1979, direct drilled since
TPK 80 C	PK as above, mouldboard ploughed, conventionally drilled each year

- NOTES: (1) Rates of extra P and K were 500 kg P<sub>2</sub>O<sub>5</sub>, as superphosphate, 250 kg K<sub>2</sub>O as muriate of potash.
- (2) Subsoiling was done with the Wye double-digger which turns a furrow with a conventional plough share, to a depth of 23 cm, and at the same time rotary cultivates the bottom of the adjacent furrow to a further depth of 15 cm. When applying P and K this was distributed ahead of the rotary cultivator.
- (3) The topsoil PK dressing was equally divided before and after ploughing.
- (4) Standard pathogen control was conventional seed dressings and methiocarb pellets at sowing. Enhanced pathogen control had in addition prochloraz at 0.4 l in 250 l on 5 May and propiconazole at 0.12 kg in 250 l on 10 June.

Basal applications:

Series I and II, w. wheat, series III w. barley: Manures: N at 20 kg as 'Nitro-Chalk', (5:14:30) at 340 kg combine drilled. Molluscicide: Methiocarb (as 'Draza' pellets at 5.6 kg). Weedkillers: Glyphosate at 1.4 kg in 250 l (Series I). Paraquat at 0.56 kg ion in 280 l. Chlortoluron at 5.6 l, mecoprop with bromoxynil and ioxynil (as 'Brittox' at 3.5 l) in 250 l (Series II). Growth regulator: Chlormequat at 1.7 kg (Series I and II).

Seed: Series I and II, w. wheat: Avalon, with methiocarb pellets, sown at 200 kg.  
Series III w. barley: Igri, with methiocarb pellets, sown at 170 kg.

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Cultivations, etc.:-

Series I: W. Wheat: Glyphosate applied: 10 Aug, 1982. Discd: 16 Aug. Ploughed and subsoil treatments applied: 27 Aug. These treatments discd: 28 Aug, 30 Aug.

Series II: W. wheat: Discd: 30 Aug, 1982. Ploughed and subsoil treatments applied: 13 Sept. These treatments discd: 15 Sept, 17 Sept. 'Brittox' applied: 15 Apr, 1983.

Series I and II: W. wheat: Paraquat applied to DIRECT plots: 18 Sept. N applied: 28 Sept. Paraquat applied to all plots: 15 Oct. Seed sown, spring-tine cultivated: 27 Oct. Chlortoluron applied: 29 Oct. N treatments applied, growth regulator applied: 29 Apr, 1983. Combine harvested: 11 Aug.

Series III: W. barley: Discd: 30 Aug, 1982. Ploughed treatment applied: 16 Sept. Subsoil treatment applied: 15-16 Sept. These treatments discd: 17 Sept, 20 Sept. Paraquat applied to DIRECT plots: 18 Sept. N applied: 28 Sept. Paraquat applied to all plots: 15 Oct. Seed sown, spring-tine cultivated: 19 Oct. Chlortoluron applied: 29 Oct. N treatments applied: 29 Apr, 1983. Combine harvested: 21 July.

NOTE: Plant establishment counts were made. Observations on diseases were made during the season.

83/W/CS/245 WINTER WHEAT SERIES I

GRAIN TONNES/HECTARE

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

PK SUB	---	--S	PKS	MEAN
N PATH				
75 ENHD	8.75	8.79	9.17	8.90
150 ENHD	9.25	9.65	9.43	9.44
225 ENHD	9.47	9.61	9.82	9.63
150 STND	8.60	8.45	9.02	8.69
MEAN	9.02	9.12	9.36	9.17

YEAR	1980	1983	MEAN
N PATH			
75 ENHD	8.18	9.62	8.90
150 ENHD	9.38	9.50	9.44
225 ENHD	9.79	9.48	9.63
150 STND	8.25	9.13	8.69
MEAN	8.90	9.43	9.17

YEAR	1980	1983	MEAN
PK SUB			
---	8.82	9.21	9.02
--S	8.84	9.41	9.12
PKS	9.05	9.68	9.36
MEAN	8.90	9.43	9.17

DRILL	CNVNTIAL	DIRECT	MEAN
N PATH			
75 ENHD	9.23	8.74	8.90
150 ENHD	9.65	9.34	9.44
225 ENHD	9.72	9.59	9.63
150 STND	9.10	8.49	8.69
MEAN	9.43	9.04	9.17

DRILL	CNVNTIAL	DIRECT	MEAN
PK SUB			
---	9.25	8.90	9.02
--S	9.51	8.93	9.12
PKS	9.53	9.28	9.36
MEAN	9.43	9.04	9.17

DRILL	CNVNTIAL	DIRECT	MEAN
YEAR			
1980	9.42	8.64	8.90
1983	9.43	9.43	9.43
MEAN	9.43	9.04	9.17

83/W/CS/245 WINTER WHEAT SERIES I

GRAIN TONNES/HECTARE

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

N PATH	75 ENHD	150 ENHD	225 ENHD	150 STND	MEAN		
EXTRA							
TPK 80 D	7.92	9.71	10.41	8.42	9.11		
TPK 80 C	8.54	9.52	9.68	9.12	9.22		
MEAN	8.23	9.62	10.04	8.77	9.17		
PK SUB	---		--S		PKS		
YEAR	1980	1983	1980	1983	1980	1983	
N PATH							
75 ENHD	8.14	9.36	7.85	9.73	8.56	9.78	
150 ENHD	9.38	9.11	9.68	9.62	9.09	9.77	
225 ENHD	9.61	9.33	9.82	9.40	9.94	9.70	
150 STND	8.17	9.04	8.01	8.90	8.59	9.46	
	PK SUB	---		--S		PKS	
	DRILL	CNVNTIAL	DIRECT	CNVNTIAL	DIRECT	CNVNTIAL	DIRECT
N PATH							
75 ENHD		8.82	8.71	9.27	8.54	9.60	8.96
150 ENHD		9.75	8.99	9.78	9.58	9.42	9.43
225 ENHD		9.62	9.39	9.89	9.47	9.65	9.91
150 STND		8.80	8.51	9.08	8.14	9.43	8.82
	YEAR	1980		1983			
	DRILL	CNVNTIAL	DIRECT	CNVNTIAL	DIRECT		
N PATH							
75 ENHD		9.05	7.75	9.41	9.73		
150 ENHD		9.83	9.16	9.47	9.52		
225 ENHD		9.96	9.70	9.48	9.48		
150 STND		8.83	7.97	9.38	9.01		
	YEAR	1980		1983			
	DRILL	CNVNTIAL	DIRECT	CNVNTIAL	DIRECT		
PK SUB							
---		9.20	8.63	9.29	9.17		
--S		9.64	8.43	9.37	9.43		
PKS		9.41	8.86	9.64	9.70		
	YEAR	1980		1983			
	DRILL	CNVNTIAL	DIRECT	CNVNTIAL	DIRECT		
N PATH	PK SUB						
75 ENHD	---		8.59	7.91	9.04	9.51	
	--S		9.19	7.17	9.34	9.92	
	PKS		9.37	8.16	9.83	9.76	
150 ENHD	---		9.70	9.22	9.81	8.77	
	--S		10.21	9.41	9.34	9.75	
	PKS		9.59	8.84	9.25	10.03	
225 ENHD	---		9.76	9.53	9.49	9.25	
	--S		10.26	9.60	9.53	9.33	
	PKS		9.88	9.97	9.43	9.84	
150 STND	---		8.76	7.87	8.83	9.15	
	--S		8.91	7.56	9.25	8.72	
	PKS		8.81	8.47	10.06	9.16	
GRAND MEAN	9.17						

83/W/CS/245 WINTER WHEAT SERIES I

GRAIN TONNES/HECTARE

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

TABLE	EXTRA	PK SUB	YEAR	DRILL	
SED	0.502	0.205	0.167	0.177	
TABLE	N PATH* PK SUB	N PATH* YEAR	PK SUB YEAR	N PATH* DRILL	
SED	0.306	0.250	0.290	0.306	MIN REP
				0.265	MAX-MIN
				0.217	MAX REP
TABLE	PK SUB DRILL	YEAR DRILL	N PATH* EXTRA	N PATH* PK SUB YEAR	
SED	0.355	0.290			MIN REP
	0.307	0.251	0.750	0.433	MAX-MIN
	0.251	0.205			MAX REP
TABLE	N PATH* PK SUB DRILL	N PATH* YEAR DRILL	PK SUB YEAR DRILL	N PATH* PK SUB YEAR DRILL	
SED	0.531	0.433	0.502	0.750	MIN REP
	0.459	0.375	0.434	0.650	MAX-MIN
	0.375	0.306	0.355	0.531	MAX REP

\* WITHIN THE SAME LEVEL OF N PATH ONLY

DRILL  
 MIN-REP CNVNTIAL  
 MAX-REP DIRECT  
 MAX-MIN DIRECT V CNVNTIAL

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

STRATUM	DF	SE	CV%
WP1	6	0.355	3.9
WP1.WP2	18	0.456	5.0

GRAIN MEAN DM% 86.4

SUB PLOT AREA HARVESTED 0.00341

83/W/CS/245 WINTER WHEAT SERIES II

GRAIN TONNES/HECTARE

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

PK SUB	---	--S	PKS	MEAN
N PATH				
75 ENHD	6.62	6.97	7.30	6.96
150 ENHD	7.67	7.18	7.71	7.52
225 ENHD	7.91	8.85	8.63	8.46
150 STND	7.17	7.24	7.79	7.40
MEAN	7.34	7.56	7.86	7.59
YEAR	1980	1983	MEAN	
N PATH				
75 ENHD	6.52	7.40	6.96	
150 ENHD	6.89	8.15	7.52	
225 ENHD	8.20	8.73	8.46	
150 STND	6.94	7.86	7.40	
MEAN	7.14	8.04	7.59	
YEAR	1980	1983	MEAN	
PK SUB				
---	6.86	7.82	7.34	
--S	7.08	8.05	7.56	
PKS	7.47	8.24	7.86	
MEAN	7.14	8.04	7.59	
DRILL	CNVNTIAL	DIRECT	MEAN	
N PATH				
75 ENHD	7.35	6.77	6.96	
150 ENHD	8.25	7.16	7.52	
225 ENHD	8.63	8.38	8.46	
150 STND	7.93	7.14	7.40	
MEAN	8.04	7.36	7.59	
DRILL	CNVNTIAL	DIRECT	MEAN	
PK SUB				
---	7.64	7.19	7.34	
--S	7.97	7.35	7.56	
PKS	8.50	7.54	7.86	
MEAN	8.04	7.36	7.59	
DRILL	CNVNTIAL	DIRECT	MEAN	
YEAR				
1980	8.14	6.64	7.14	
1983	7.94	8.09	8.04	
MEAN	8.04	7.36	7.59	



83/W/CS/245 WINTER WHEAT SERIES II

GRAIN TONNES/HECTARE

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

N PATH	75 ENHD	150 ENHD	225 ENHD	150 STND	MEAN		
EXTRA							
TPK 80 D	5.19	6.34	7.88	5.93	6.33		
TPK 80 C	7.54	8.12	9.37	7.63	8.16		
MEAN	6.36	7.23	8.62	6.78	7.25		
PK SUB	---		--S		PKS		
YEAR	1980	1983	1980	1983	1980	1983	
N PATH							
75 ENHD	6.11	7.12	6.60	7.35	6.86	7.75	
150 ENHD	7.23	8.11	6.26	8.10	7.17	8.25	
225 ENHD	7.28	8.54	8.77	8.94	8.54	8.71	
150 STND	6.84	7.51	6.67	7.81	7.32	8.26	
PK SUB	---		--S		PKS		
DRILL		CVNVTIAL	DIRECT	CVNVTIAL	DIRECT	CVNVTIAL	DIRECT
N PATH							
75 ENHD		6.92	6.46	7.16	6.88	7.98	6.96
150 ENHD		7.91	7.55	8.27	6.63	8.56	7.29
225 ENHD		8.14	7.79	8.60	8.98	9.14	8.37
150 STND		7.61	6.95	7.87	6.92	8.30	7.54
YEAR	1980		1983				
DRILL		CVNVTIAL	DIRECT	CVNVTIAL	DIRECT		
N PATH							
75 ENHD		7.51	6.03	7.20	7.51		
150 ENHD		8.21	6.22	8.28	8.09		
225 ENHD		8.75	7.92	8.51	8.84		
150 STND		8.10	6.37	7.76	7.91		
YEAR	1980		1983				
DRILL		CVNVTIAL	DIRECT	CVNVTIAL	DIRECT		
PK SUB							
---		7.80	6.40	7.49	7.98		
--S		7.95	6.64	7.99	8.07		
PKS		8.67	6.87	8.32	8.21		
YEAR	1980		1983				
DRILL		CVNVTIAL	DIRECT	CVNVTIAL	DIRECT		
N PATH	PK SUB						
75 ENHD	---		7.12	5.61	6.73	7.32	
	--S		7.09	6.36	7.22	7.41	
	PKS		8.31	6.13	7.64	7.80	
150 ENHD	---		8.05	6.83	7.78	8.27	
	--S		8.15	5.31	8.38	7.95	
	PKS		8.44	6.53	8.68	8.04	
225 ENHD	---		8.24	6.79	8.03	8.79	
	--S		8.53	8.89	8.66	9.07	
	PKS		9.46	8.08	8.82	8.66	
150 STND	---		7.78	6.37	7.44	7.54	
	--S		8.04	5.99	7.71	7.86	
	PKS		8.48	6.75	8.12	8.33	
GRAND MEAN	7.55						

83/W/CS/245 WINTER WHEAT SERIES II

GRAIN TONNES/HECTARE

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

TABLE	EXTRA	PK SUB	YEAR	DRILL	
SED	1.715	0.700	0.572	0.606	
TABLE	N PATH* PK SUB	N PATH* YEAR	PK SUB YEAR	N PATH* DRILL	
SED	0.776	0.634	0.990	0.776	MIN REP
				0.672	MAX-MIN
				0.549	MAX REP
TABLE	PK SUB DRILL	YEAR DRILL	N PATH* EXTRA	N PATH* PK SUB YEAR	
SED	1.213	0.990			MIN REP
	1.050	0.858	1.901	1.098	MAX-MIN
	0.858	0.700			MAX REP
TABLE	N PATH* PK SUB DRILL	N PATH* YEAR DRILL	PK SUB YEAR DRILL	N PATH* PK SUB YEAR DRILL	
SED	1.344	1.098	1.715	1.901	MIN REP
	1.164	0.951	1.486	1.647	MAX-MIN
	0.951	0.776	1.213	1.344	MAX REP

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

STRATUM	DF	SE	CV%
WP1	6	1.213	16.0
WP1.WP2	18	0.670	8.8

GRAIN MEAN DM% 86.7

SUB PLOT AREA HARVESTED 0.00341

83/W/CS/245 WINTER BARLEY SERIES III

GRAIN TONNES/HECTARE

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

PK SUB	---	--S	PKS	MEAN
N PATH				
75 ENHD	6.47	6.28	7.06	6.60
150 ENHD	7.91	7.37	7.84	7.71
225 ENHD	8.02	7.85	8.35	8.08
150 STND	6.99	6.83	7.28	7.04
MEAN	7.35	7.08	7.63	7.36
YEAR	1980	1983	MEAN	
N PATH				
75 ENHD	5.60	7.61	6.60	
150 ENHD	7.27	8.15	7.71	
225 ENHD	7.46	8.69	8.08	
150 STND	6.08	7.99	7.04	
MEAN	6.60	8.11	7.36	
YEAR	1980	1983	MEAN	
PK SUB				
---	6.99	7.70	7.35	
--S	5.86	8.31	7.08	
PKS	6.95	8.32	7.63	
MEAN	6.60	8.11	7.36	
DRILL	CNVNTIAL	DIRECT	MEAN	
N PATH				
75 ENHD	7.62	6.10	6.60	
150 ENHD	8.05	7.53	7.71	
225 ENHD	8.45	7.89	8.08	
150 STND	7.36	6.87	7.04	
MEAN	7.87	7.10	7.36	
DRILL	CNVNTIAL	DIRECT	MEAN	
PK SUB				
---	7.45	7.30	7.35	
--S	7.73	6.76	7.08	
PKS	8.44	7.23	7.63	
MEAN	7.87	7.10	7.36	
DRILL	CNVNTIAL	DIRECT	MEAN	
YEAR				
1980	7.85	5.98	6.60	
1983	7.90	8.21	8.11	
MEAN	7.87	7.10	7.36	

83/W/CS/245 WINTER BARLEY SERIES III

GRAIN TONNES/HECTARE

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

N PATH EXTRA	75 ENHD	150 ENHD	225 ENHD	150 STND	MEAN
TPK 80 D	6.18	7.40	6.53	5.25	6.34
TPK 80 C	6.36	6.95	8.37	6.99	7.17
MEAN	6.27	7.17	7.45	6.12	6.75

PK SUB YEAR	---	---	--S	---	PKS	---
N PATH	1980	1983	1980	1983	1980	1983
75 ENHD	5.84	7.10	4.79	7.77	6.17	7.95
150 ENHD	8.07	7.76	6.28	8.46	7.45	8.23
225 ENHD	7.58	8.47	6.85	8.86	7.96	8.75
150 STND	6.49	7.49	5.53	8.13	6.23	8.34

N PATH	PK SUB DRILL	---	---	--S	---	PKS	---
		CNVNTIAL	DIRECT	CNVNTIAL	DIRECT	CNVNTIAL	DIRECT
75 ENHD		6.92	6.24	7.16	5.84	8.77	6.20
150 ENHD		7.72	8.01	7.92	7.10	8.52	7.50
225 ENHD		7.96	8.06	8.48	7.54	8.92	8.07
150 STND		7.18	6.90	7.37	6.56	7.54	7.16

N PATH	YEAR	1980	---	---	1983	---
	DRILL	CNVNTIAL	DIRECT	CNVNTIAL	DIRECT	
75 ENHD		7.61	4.59	7.62	7.60	
150 ENHD		8.43	6.68	7.68	8.39	
225 ENHD		8.36	7.01	8.54	8.77	
150 STND		6.97	5.64	7.75	8.10	

PK SUB	YEAR	1980	---	---	1983	---
	DRILL	CNVNTIAL	DIRECT	CNVNTIAL	DIRECT	
---		7.51	6.73	7.38	7.87	
--S		7.46	5.07	8.00	8.46	
PKS		8.56	6.15	8.31	8.32	

N PATH	PK SUB	YEAR	1980	---	---	1983	---
		DRILL	CNVNTIAL	DIRECT	CNVNTIAL	DIRECT	
75 ENHD	---		6.68	5.41	7.16	7.07	
	--S		6.95	3.71	7.36	7.98	
	PKS		9.21	4.65	8.34	7.76	
150 ENHD	---		8.39	7.91	7.06	8.10	
	--S		7.87	5.49	7.97	8.71	
	PKS		9.04	6.65	8.01	8.34	
225 ENHD	---		7.93	7.41	7.99	8.71	
	--S		8.21	6.16	8.74	8.92	
	PKS		8.95	7.47	8.89	8.67	
150 STND	---		7.05	6.21	7.31	7.59	
	--S		6.80	4.90	7.93	8.22	
	PKS		7.06	5.82	8.01	8.50	

GRAND MEAN 7.30

83/W/CS/245 WINTER BARLEY SERIES III

GRAIN TONNES/HECTARE

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

TABLE	EXTRA	PK SUB	YEAR	DRILL	
SED	0.908	0.371	0.303	0.321	
TABLE	N PATH* PK SUB	N PATH* YEAR	PK SUB YEAR	N PATH* DRILL	
SED	0.415	0.339	0.524	0.415	MIN REP
				0.359	MAX-MIN
				0.293	MAX REP
TABLE	PK SUB DRILL	YEAR DRILL	N PATH* EXTRA	N PATH* PK SUB YEAR	
SED	0.642	0.524			MIN REP
	0.556	0.454	1.016	0.586	MAX-MIN
	0.454	0.371			MAX REP
TABLE	N PATH* PK SUB DRILL	N PATH* YEAR DRILL	PK SUB YEAR DRILL	N PATH* PK SUB YEAR DRILL	
SED	0.718	0.586	0.908	1.016	MIN REP
	0.622	0.508	0.786	0.879	MAX-MIN
	0.508	0.415	0.642	0.718	MAX REP

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

STRATUM	DF	SE	CV%
WP1	6	0.642	8.7
WP1.WP2	18	0.372	5.1

GRAIN MEAN DM% 84.3

SUB PLOT AREA HARVESTED 0.00341