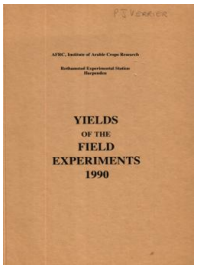
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ROTHAMSTED RESEARCH

Yields of the Field Experiments 1990

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Rothamsted Experimental Station
Harpenden

YIELDS OF THE FIELD EXPERIMENTS 1990

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Harpenden

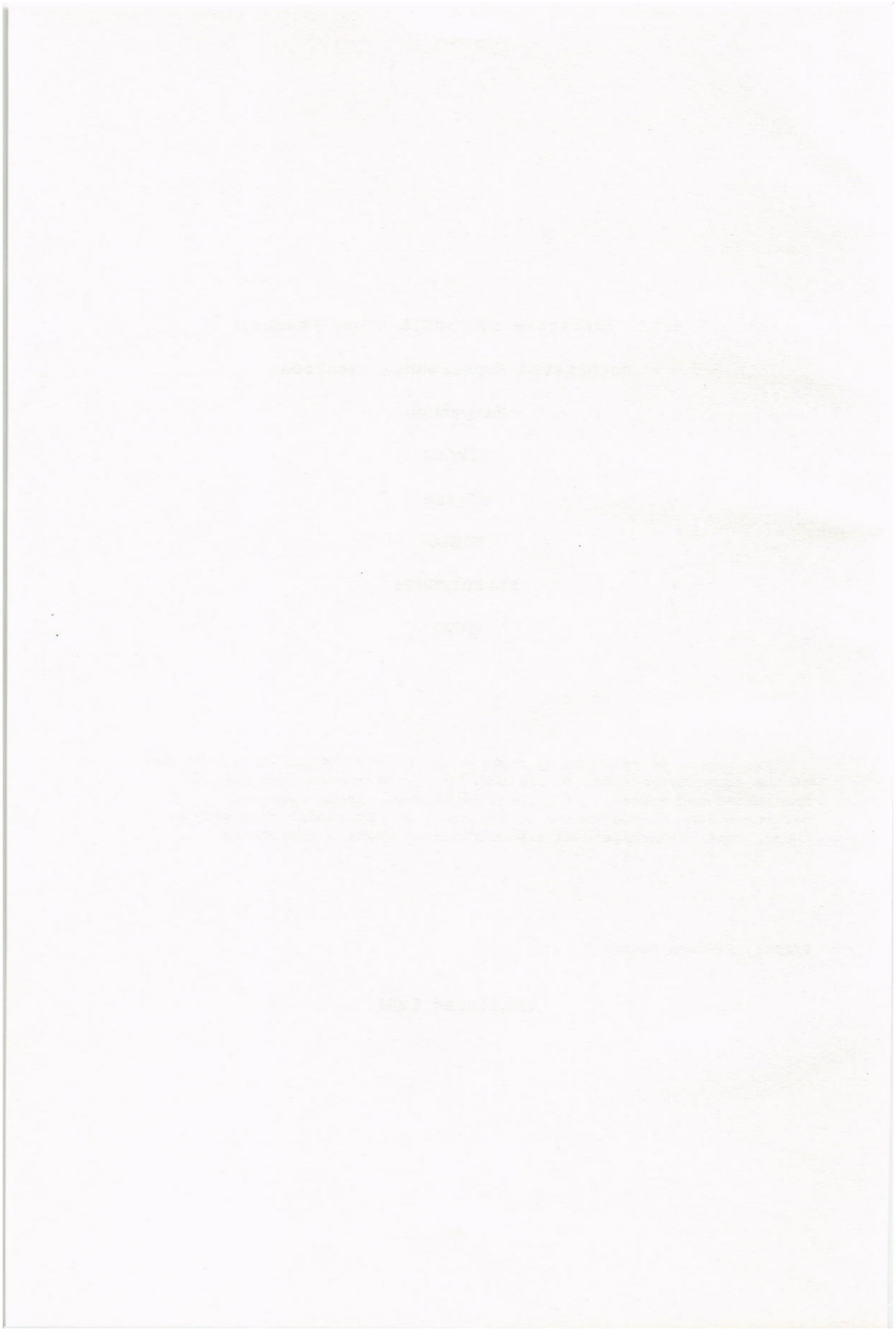
YIELDS of the FIELD EXPERIMENTS 1990

This report is produced by members of the Statistics Department and of the Agronomy Section. It includes only experiments conducted at Rothamsted and Woburn. Only those experiments which have the determination of crop yields as an object are included. For many of these, other determinations are of equal or greater importance.

Price: Fifteen pounds.

Published 1991

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MISCELLANEOUS DATA

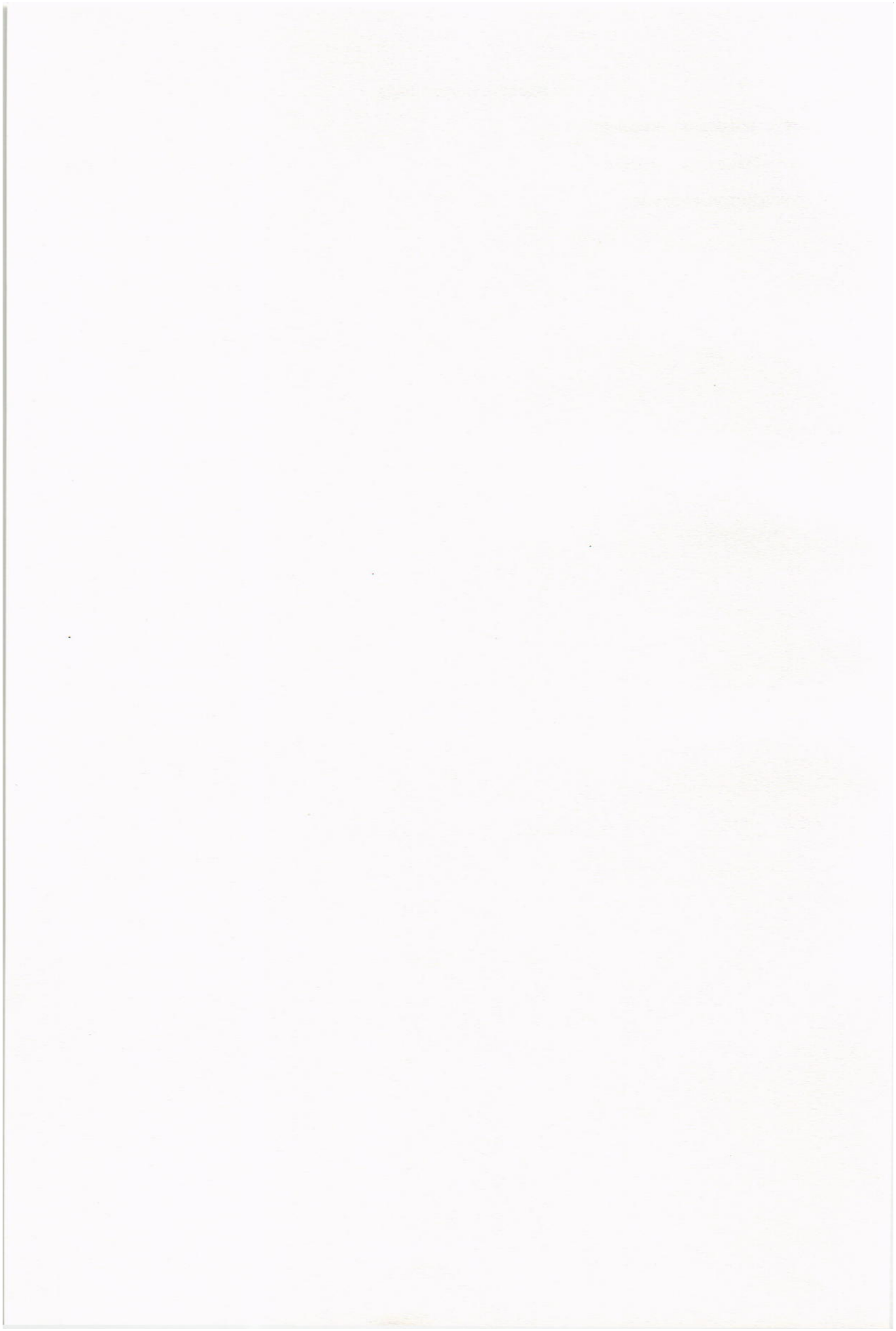
METEOROLOGICAL RECORDS

Rothamsted, & Woburn 175

CONVERSION FACTORS

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CONVENTIONS 1990

For each experiment current treatments are shown, together with the factor and level names which are used in the tables. The program used for the analyses of these experiments limits level names to eight characters, and factor names similarly, though a suffix of up to 3 digits in brackets may be appended.

For each experiment, other than annuals, references are given to previous years. These refer to the '(Numerical)(Results) Yields of the Field Experiments' - (t) indicates a year when treatments were described. Since 1973 treatments have been described annually for all experiments and (t) is not used for these years.

For the classical and some long-term experiments reference is made to 'Details' - separate publications, giving full descriptions of treatments until 1967 & 1973, with full titles 'Details of the Classical and Long Term Experiments up to 1967' and 'Details of the Classical and Long Term Experiments up to 1973'.

The following conventions are observed unless otherwise stated.

All areas are in hectares. All plot dimensions are in metres.

All seed rates, rates of application of fertilizers, sprays etc. are per hectare.

All yields and plant numbers are per hectare.

The following abbreviations are used in variate headings:

Wheat, barley, oats, beans etc.

Grain:	Grain (at 85% dry matter)
Straw:	Straw (at 85% dry matter)

Sugar beet

Roots:	Roots (washed)
Sugar %:	Sugar percentage of washed roots

All crops

Mean D.M. %:	Mean dry matter % as harvested

For any other crop, details of abbreviations are given as necessary.

'Nitro-Chalk' refers to the grade containing 27.5% N unless otherwise stated. 'Nitram' contains 34.5% N.

Compound fertilizers indicated thus - (20:10:10) = compound fertilizer (20% N, 10% P205, 10% K20), granular unless otherwise stated.

Treatment of cereal seed with organomercury and/or gamma HCH should be assumed in this report, exceptions are noted.

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Harvest areas for cereals

On most of those cereal experiments which are harvested by combine the 'blank-row' technique is used to distinguish the areas taken for yield from the discard areas. For example when seed is drilled in 3 m wide plots in rows 12 cm apart appropriate coulters are prevented from sowing and 17 central rows are left for yield between pairs of blank rows. If the row-spacing is other than 12 cm a similar arrangement is used but with a different number of rows.

The ends of plots are separated from each other or from headlands by 1m fallow paths made after the crop has established.

The 'Area harvested' in the 'Yields', when the blank-row technique is used, is the product:-

number of rows harvested x distance between rows x length of rows.

If no rows are left blank and the plot is wider than the combine harvester so that discards are left uncut, the 'Area harvested' is the product:-

width of cutter bar x length of rows.

If the plot is narrower than the combine so that the whole area between paths is cut, the 'Area harvested' is the product:-

number of rows x distance between rows x length of rows.

We do not apply the adjustment used by some workers who take the harvested areas as width x length where each is measured to the centre of 'paths' up to a maximum of about 50 cm.

Tables of means

Tables of means are presented directly from computer output. Both factor and level names are presented in upper case characters. Vertical and horizontal lines are omitted e.g.:-

FACTOR C	LEVEL C1		LEVEL C2		LEVEL C3	
FACTOR B	LEVEL B1	LEVEL B2	LEVEL B1	LEVEL B2	LEVEL B1	LEVEL B2
FACTOR A						
LEVEL A1	*	*	*	*	*	*
LEVEL A2	*	*	*	*	*	*

Standard errors

NOTES: (1) This report gives standard errors of differences, not of means.
(2) Annotations (e.g. * min rep, max-min, max rep) to S.E.Ds are only explained the first time they occur in any experiment.

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90/R/BK/1

BROADBALK

Object: To study the effects of organic and inorganic manures on continuous w. wheat. From 1968 two three-year rotations were included: potatoes, beans, w. wheat and fallow, w. wheat, w. wheat. In 1979 the first rotation was changed to fallow, potatoes, w. wheat. In 1980 the second rotation reverted to continuous w. wheat. Since 1985 part of the second rotation has been added to the first to extend the rotation to fallow, potatoes, w. wheat, w. wheat, w. wheat.

The 147th year, w. wheat, fallow, potatoes.

For previous years see 'Details' 1967 and 1973, Station Report for 1966, pp. 229-231, Station Report for 1968, Part 2, and 74-89/R/BK/1.

Areas harvested:

	Section	
Wheat:	0	0.00311
	1	0.00572
	2,3,6 and 7	0.00473
	8 and 9	0.00497
Potatoes:	4	0.00348

Treatments:

Whole plots

PLOT	Plot	Fertilizers and organic manures:- Treatments until 1967	Treatments from 1968	Treatments from 1985
01DN4PK	01	-	D N2 P K	D N4 P K
21DN2	21	D	D N2	D N2
22D	22	D	D	D
030	03	None	None	None
05F	05	P K Na Mg	P K (Na) Mg	PK Mg
06N1F	06	N1 P K Na Mg	N1 P K (Na) Mg	N1 P K Mg
07N2F	07	N2 P K Na Mg	N2 P K (Na) Mg	N2 P K Mg
08N3F	08	N3 P K Na Mg	N3 P K (Na) Mg	N3 P K Mg
09N4F	09	N*1 P K Na Mg	N4 P K (Na) Mg	N4 P K Mg
10N2	10	N2	N2	N2
11N2P	11	N2 P	N2 P	N2 P
12N2PNA	12	N2 P Na	N2 P Na	N2 P Na
13N2PK	13	N2 P K	N2 P K	N2 P K
14N2PKMG	14	N2 P Mg	N2 P K Mg	N2 P K Mg
15N5F	15	N2 P K Na Mg	N3 P K (Na) Mg	N5 P K Mg
16N6F	16	N*2 P K Na Mg	N2 P K (Na) Mg	N6 P K Mg
17N1+3FH	17	N2(A)	N2 1/2(P K (Na) Mg)	N1+3 1/2(PK Mg)+
18N0+3FH	18	P K Na Mg(A)	N2 1/2(P K (Na) Mg)	N0+3 1/2(PK Mg)+
19C	19	C	C	C
20NKMG	20	N2 K Na Mg	N2 K (Na) Mg	N2 K Mg

(A) Alternating

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90/R/BK/1

\+ This change since 1980. Treatments shown are those to w. wheat; autumn N alternates. Potatoes receive N3 1/2 (PK Mg) on both Plots 17 and 18.

N1,N2,N3,N4,N5,N6: 48, 96, 144, 192, 240, 288 kg N (as sulphate of ammonia until 1967, except N* which was nitrate of soda. All as 'Nitro-Chalk' in spring from 1968 to 1985, as 'Nitram' since 1986.)

N0+3; N1+3: None in autumn + 144 kg N in spring; 48 kg N in autumn + 144 kg N in spring

P: 35 kg P as single superphosphate until 1987, triple superphosphate in 1974 and since 1988

K: 90 kg K as sulphate of potash

Na: 55 kg Na as sulphate of soda

(Na): 16 kg Na as sulphate of soda until 1973

Mg: 30 kg Mg annually to Plot 14, 35 kg Mg every third year to other plots since 1974. All as kieserite since 1974, previously as sulphate of magnesia annually

D: Farmyard manure at 35 tonnes

C: Castor meal to supply 96 kg N until 1988, none since

F: P K (Na) Mg H: Half rate

Strips of sub plots: Until 1967 wheat alone was grown on the experiment, with some bare fallowing on strips of sub plots. From 1968, ten sub plots were started with the following cropping:-

				70, 71, 72, 73, 74, 75, and and and													
SECTION	Section	68	69	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
0/39B	0*	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W
1/24B	1	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W
2/2B	2	BE	W	P	BE	W	F	P	W	F	P	W	W	W	F	P	W	W
3/3B	3	W	W	F	W	W	F	W	W	W	W	W	W	F	P	W	W	W
POTATOES	4	W	P	BE	W	P	P	W	F	P	W	F	P	W	W	W	F	P
-	5	W	F	W	W	F	W	W	W	W	W	W	F	P	W	W	W	F
6/13B	6**	F	W	W	F	W	W	W	W	W	W	W	W	W	W	W	W	W
6/13S	6**	F	W	W	F	W	W	W	W	W	W	W	W	W	W	W	W	W
7/1B	7	P	BE	W	P	BE	W	F	P	W	F	P	W	W	W	F	P	W
7/1S	7	P	BE	W	P	BE	W	F	P	W	F	P	W	W	W	F	P	W
8/2B	8+	W	W	W	W	W	W	W	F	W	W	W	W	W	W	F	W	W
9/32B	9	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W
9/32S	9	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W

W = w. wheat, P = potatoes, BE = s. beans, F = fallow

* Straw incorporated since 1987. ** No sprays except weedkillers since 1985. + No weedkillers.

B = Brimstone, S = Squareheads Master

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90/R/BK/1

NOTES: (1) For a fuller record of treatments see 'Details' etc.
(2) From autumn 1975 to autumn 1986, chalk was applied at 2.9 t each autumn to all plots in sets of Sections on a three-year cycle. Year 1: Sections 1,2,3. Year 2: Sections 6,7,8,9. Year 3: Sections 0,4,5. Since autumn 1988 a five-year cycle has been used. Year 1: Sections 1,3. Year 2: Sections 2,8. Year 3: Sections 7,9. Year 4: Sections 4,6. Year 5: Sections 0,5.

Standard applications:

W. wheat: Manure: Chalk at 2.9 t (to sections 2 and 8 only). Weedkillers: Glyphosate at 1.4 kg in 200 l (except to sections 7 and 8). Isoproturon at 1.7 kg with mecoprop at 2.0 kg in 200 l (except to section 8). Mecoprop at 2.2 kg, bromoxynil at 0.28 kg and ioxynil at 0.28 kg in 200 l (to sections 0, 1, 2 and 3). Mecoprop at 3.6 kg, bromoxynil at 0.45 kg and ioxynil at 0.45 kg in 200 l (to sections 6, 7 and 9). Fluroxypyr at 0.40 kg in 200 l (except to section 8). Fungicides (except to section 6): Prochloraz at 0.40 kg applied with the growth regulator in 200 l. Chlorothalonil at 1.0 kg with fenpropimorph at 0.75 kg in 200 l. Propiconazole at 0.12 kg with carbendazim at 0.25 kg and maneb at 1.6 kg in 200 l. Growth regulator (except to section 6): Chlormequat chloride at 1.6 kg.

Potatoes: Weedkillers: Glyphosate at 1.4 kg in 200 l. Linuron at 1.6 kg in 200 l. Fungicides: Maneb at 0.96 kg and zinc oxide at 0.022 kg applied with the insecticide in 200 l. Maneb at 0.96 kg and zinc oxide at 0.022 kg with a wetting agent, 'Bond' at 0.20 l, in 200 l. Mancozeb at 1.0 kg in 200 l on two occasions. Fentin hydroxide at 0.27 kg in 200 l on two occasions. Insecticide: Demeton-S-methyl at 0.24 kg in 200 l.

Fallow: Weedkiller: Glyphosate at 1.4 kg in 200 l.

Seed: W. wheat: Brimstone, dressed fonofos, and Squarehead's Master, both sown at 180 kg.
Potatoes: Pentland Crown.

Cultivations, etc.:-

All Sections:
K, Na and Mg applied: 14 Sept, 1989. P applied: 15 Sept. FYM applied: 27 Sept. Ploughed: 28 Sept. Spiked rotary cultivated: 7 Oct. Spiked rotary cultivated, rotary harrowed: 9 Oct.

Cropped Sections:
W. wheat: Straw chopped (section 0): 16 Aug, 1989. Glyphosate applied (except to sections 7 and 8): 29 Aug. Chalk applied (sections 2 and 8): 13 Sept. Autumn N treatments applied: 15 Sept. Rotary harrowed, all seed sown. 11 Oct. Isoproturon with mecoprop applied (except to section 8): 17 Nov. Spring N treatments applied: 9 Apr, 1990. Prochloraz with the growth regulator applied (except to section 6): 24 Apr. Mecoprop, bromoxynil and ioxynil applied to sections 0, 1, 2 and 3 and separately to sections 6, 7 and 9: 25 Apr. Chlorothalonil with fenpropimorph (except to section 6) and fluroxypyr (except to section 8) applied: 17 May. Propiconazole with carbendazim and maneb applied (except to section 6): 14 June. Combine harvested: 8 Aug.

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90/R/BK/1

Cultivations, etc.:-

Potatoes: Glyphosate applied: 29 Aug, 1989. Deep-tine cultivated: 24 Nov. N treatments applied, rotary harrowed, potatoes planted, rotary ridged: 5 Apr, 1990. Linuron applied: 6 Apr. Maneb and zinc oxide with demeton-S-methyl applied: 15 June. Mancozeb applied: 29 June and 13 July. Maneb and zinc oxide with the wetting agent applied: 27 July. Fentin hydroxide applied: 13 Aug and 28 Aug. Haulm mechanically destroyed: 6 Sept. Lifted: 21 Sept.

Fallow: Glyphosate applied: 29 Aug, 1989. Deep-tine cultivated: 24 Nov. Heavy spring-tine cultivated: 23 Apr, 1990. Cultivated by rotary grubber: 17 May. Heavy spring-tine cultivated: 29 June and 17 July.

W.WHEAT

GRAIN TONNES/HECTARE

***** Tables of means *****

SECTION / PLOT	7/1B	7/1S	2/2B	8/2B	3/3B	6/13B	6/13S	1/24B	9/32B	9/32S	0/39B
01DN4PK	9.43	*	9.08	*	7.25	8.39	*	*	*	*	*
21DN2	10.02	*	9.17	5.25	7.45	8.36	*	7.22	8.21	*	7.23
22D	7.94	*	6.91	5.38	6.05	6.29	*	5.64	6.44	*	5.88
030	2.70	2.18	1.62	1.67	1.15	1.36	1.39	1.12	1.06	1.33	1.60
05F	1.71	1.38	1.70	2.64	1.75	1.63	1.43	1.41	1.72	1.24	1.88
06N1F	5.52	4.12	5.13	4.61	4.22	4.12	2.77	3.26	4.72	3.48	5.05
07N2F	8.51	5.09	6.99	6.35	4.94	6.55	3.88	5.45	6.36	4.50	6.37
08N3F	9.49	5.26	8.10	7.35	6.44	7.72	4.31	6.74	7.84	4.69	7.36
09N4F	9.42	4.72	8.41	7.77	6.56	7.48	4.25	6.74	6.96	4.80	6.98
10N2	6.99	4.58	6.73	4.71	4.64	4.85	3.30	4.73	4.70	3.01	5.28
11N2P	8.28	5.75	7.10	5.58	5.87	5.19	3.77	4.87	5.37	3.41	5.87
12N2PNA	8.55	5.65	7.58	6.14	6.76	5.51	3.98	6.81	6.26	3.54	7.18
13N2PK	7.67	5.22	7.35	5.69	5.83	4.44	3.48	6.55	6.46	4.20	6.62
14N2PKMG	8.25	5.31	7.28	6.02	6.40	5.40	3.43	6.76	6.60	4.22	7.08
15N5F	9.19	5.05	9.11	7.12	7.19	8.00	4.03	7.60	7.16	4.34	8.07
16N6F	9.53	4.74	9.20	7.43	7.70	8.32	3.76	7.03	8.27	4.38	6.63
17N1+3FN	9.59	5.16	9.04	6.91	6.70	8.15	4.35	7.59	7.82	5.00	7.66
18N0+3FN	9.79	5.35	8.49	6.65	5.48	7.58	4.23	7.33	7.41	4.61	7.78
19C	3.64	3.43	2.71	1.57	1.52	2.14	1.81	2.58	1.84	1.94	2.12
20NKMG	*	*	*	*	*	*	*	3.82	*	*	4.52

GRAIN MEAN DM% 89.7

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90/R/BK/1 W.WHEAT

STRAW TONNES/HECTARE

***** Tables of means *****

SECTION PLOT	7/1B	7/1S	1/24B
01DN4PK	6.71	*	*
21DN2	6.28	*	4.65
22D	2.57	*	2.66
030	0.49	1.23	0.39
05F	0.25	0.67	0.39
06N1F	1.44	2.28	1.24
07N2F	2.50	5.05	2.53
08N3F	3.87	7.07	2.68
09N4F	2.87	7.59	2.75
10N2	1.71	4.61	1.82
11N2P	2.11	4.69	1.82
12N2PNA	2.73	4.97	2.52
13N2PK	1.81	4.95	1.79
14N2PKMG	2.24	4.23	2.20
15N5F	3.19	7.16	2.83
16N6F	5.13	8.04	2.75
17N1+3FN	3.44	7.00	2.18
18N0+3FN	3.73	7.27	2.30
19C	0.68	1.72	0.57
20NKMG	*	*	1.22

STRAW MEAN DM% 88.9

POTATOES

***** Tables of means *****

PLOT	TOTAL TUBERS TONNES/ HECTARE	% WARE 3.81 CM (1.5 INCH) RIDDLE
01DN4PK	14.5	71.8
21DN2	20.5	89.1
22D	19.6	87.4
030	3.7	41.4
05F	7.2	53.6
06N1F	13.7	79.8
07N2F	12.4	74.9
08N3F	17.9	85.2
09N4F	18.9	86.4
10N2	5.1	59.7
11N2P	6.0	64.9
12N2PNA	7.1	64.5
13N2PK	9.4	73.2
14N2PKMG	16.9	82.8
15N5F	20.9	86.9
16N6F	20.9	86.7
17N3FH	7.1	64.2
18N3FH	14.0	82.3
19C	6.2	55.3

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90/R/HB/2

HOOS BARLEY

Object: To study the effects of organic and inorganic manures on continuous s. barley. From 1968 to 1978 a rotation of potatoes, beans and s. barley was practised. The rotation was discontinued in 1979 and the experiment reverted to continuous s. barley.

The 139th year, s. barley.

For previous years see 'Details' 1967 and 1973, Station Report for 1966 and 74-89/R/HB/2.

Treatments: All combinations of:-

1. **MANURE** Fertilizers and organic manures:

	Form of N 1852-1966	Additional treatments 1852-1979	Changes since 1980
---	None	-	-
-P-	None	P	-
--K	None	K(Na)Mg	-
-PK	None	PK(Na)Mg	-
A--	A	-	-
AP-	A	P	-
A-K	A	K(Na)Mg	-
APK	A	PK(Na)Mg	-
N----	N	-	-
NP---	N	P	-
N-K--	N	K(Na)Mg	-
NPK--	N	PK(Na)Mg	-
N--S-	N	Si	Si omitted
NP-S-	N	P Si	"
N-KS-	N	K(Na)MgSi	"
NPKS-	N	PK(Na)MgSi	"
N---S	N	-	Si added
NP--S	N	P	"
N-K-S	N	K(Na)Mg	"
NPK-S	N	PK(Na)Mg	"
N--SS	N	Si	-
NP-SS	N	P Si	-
N-KSS	N	K(Na)MgSi	-
NPKSS	N	PK(Na)MgSi	-
C(--)	C	-	PKMg omitted
C(P-)	C	P	"
C(-K)	C	K(Na)Mg	"
C(PK)	C	PK(Na)Mg	"
D	None	D	-
(D)	(D)	-	-
(A)	(Ashes)	-	-
-	None	-	-

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90/R/HB/2

Form of N: A, sulphate of ammonia: N, nitrate of soda - each to supply 48 kg N: C, castor meal to supply 96 kg N
P: 35 kg P as single superphosphate (triple superphosphate in 1974, 1988 and 1989)
K: 90 kg K as sulphate of potash
(Na): 16 kg Na as sulphate of soda until 1973
Mg: 35 kg Mg, as kieserite every third year since 1974 (sulphate of magnesia annually until 1973)
Si: Silicate of soda at 450 kg
D: Farmyard manure at 35 tonnes. (D): until 1871 only
(Ashes): Weed ash 1852-1916, furnace ash 1917-1932, none since

2. **N** Nitrogen fertilizer (kg N), as 'Nitro-Chalk' (27% N in 1990), since 1968 (cumulative N applications until 1973, on a cyclic system since 1974):

0
48
96
144

Plus extra plots testing all combinations of:-

1. **MANURE** Fertilizers other than magnesium:

551AN2PK	Plot 551 AN2PK
561--PK	Plot 561 --PK
571NN2--	Plot 571 NN2
581NN2--	Plot 581 NN2

N2: 96 kg N as 'Nitro-Chalk' since 1968. Other symbols as above.

2. **MGNESIUM** Magnesium fertilizer (kg Mg) as kieserite every third year since 1974:

0
35

NOTE: For a fuller record see 'Details' etc.

Basal applications: Weedkillers: Glyphosate at 1.4 kg in 200 l. Mecoprop at 1.6 kg, bromoxynil at 0.20 kg and ioxynil at 0.20 kg applied with the fungicide in 200 l. Fungicide: Fenpropimorph at 0.75 kg. Insecticide: Demeton-s-methyl at 0.24 kg in 200 l.

Seed: Triumph, seed dressed triadimenol and fuberidazole, sown at 160 kg.

Cultivations, etc.:- Glyphosate applied: 2 Oct, 1989. P and silicate of soda applied: 29 Nov. K applied: 30 Nov. FYM applied: 4 Dec. Ploughed: 6 Dec. Spring-tine cultivated three times, seed sown: 5 Mar, 1990. N applied: 10 Apr. Insecticide applied: 10 May. Remaining weedkillers applied with the fungicide: 14 May. Combine harvested: 6 Aug.

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90/R/HB/2

MAIN PLOTS

GRAIN TONNES/HECTARE

***** Tables of means *****

N	0	48	96	144	Mean
MANURE					
---	0.84	0.88	1.49	1.35	1.14
-P-	1.87	2.19	2.08	1.82	1.99
--K	1.70	2.38	2.40	2.26	2.19
-PK	1.89	3.50	3.58	3.84	3.20
A--	1.38	1.04	1.53	1.38	1.33
AP-	1.80	1.88	1.97	1.88	1.88
A-K	1.60	2.07	2.06	2.07	1.95
APK	2.52	3.68	4.48	4.39	3.77
N----	1.52	1.74	0.93	1.46	1.41
NP---	1.82	2.65	2.96	2.56	2.50
N-K--	1.94	2.24	2.20	2.04	2.11
NPK--	2.61	3.97	4.24	4.43	3.81
N--S-	1.59	2.13	2.47	1.71	1.98
NP-S-	2.30	3.05	2.48	2.56	2.60
N-KS-	2.38	2.75	3.16	2.99	2.82
NPKS-	2.08	3.89	4.31	4.36	3.66
N---S	1.86	1.99	1.85	1.92	1.91
NP--S	1.90	2.81	3.08	2.84	2.66
N-K-S	2.13	2.52	2.89	2.97	2.63
NPK-S	2.88	3.91	4.71	4.33	3.96
N--SS	1.93	1.53	1.85	1.78	1.77
NP-SS	1.79	2.32	3.06	2.50	2.42
N-KSS	2.20	2.88	3.22	2.91	2.80
NPKSS	3.03	3.90	4.67	4.23	3.96
C(--)	1.89	2.41	2.64	2.25	2.30
C(P-)	1.94	2.79	3.40	2.94	2.77
C(-K)	2.22	3.03	3.19	3.02	2.87
C(PK)	2.62	3.75	4.49	3.89	3.69
D	5.71	6.34	6.00	6.39	6.11
(D)	2.15	2.28	3.90	2.48	2.70
(A)	1.38	2.40	2.06	1.82	1.91
-	1.43	1.56	2.09	1.72	1.70
Mean	2.09	2.70	2.98	2.79	2.64

GRAIN MEAN DM% 86.7

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90/R/HB/2

STRAW TONNES/HECTARE

***** Tables of means *****

N	0	48	96	144	Mean
MANURE					
---	0.26	0.30	0.57	0.40	0.38
-P-	0.61	0.83	0.87	0.84	0.79
--K	0.60	0.97	0.92	1.04	0.88
-PK	0.52	1.17	1.56	1.39	1.16
A--	0.43	0.17	0.47	0.40	0.37
AP-	0.71	0.66	0.74	0.75	0.72
A-K	0.56	0.72	0.58	0.73	0.65
APK	0.65	1.48	1.52	1.17	1.20
D	2.61	2.86	2.67	2.44	2.64
(D)	0.78	1.08	1.75	1.00	1.15
(A)	0.49	0.81	0.83	0.65	0.70
-	0.66	0.49	0.80	0.53	0.62
Mean	0.74	0.96	1.11	0.94	0.94

STRAW MEAN DM% 84.1

PLOT AREA HARVESTED 0.00154

EXTRA PLOTS

GRAIN TONNES/HECTARE

***** Tables of means *****

MANURE	551AN2PK	561--PK	571NN2--	581NN2--	Mean
MGNESIUM					
0	3.85	1.22	2.88	1.59	2.39
35	4.13	1.26	2.76	1.55	2.43
Mean	3.99	1.24	2.82	1.57	2.41

GRAIN MEAN DM% 85.3

PLOT AREA HARVESTED 0.00329

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90/R/WF/3

WHEAT AND FALLOW

Object: To study the effects of fallowing on unmanured w. wheat - Hoosfield.

The 135th year, w. wheat.

For previous years see 'Details' 1967, 1973 and 74-89/R/WF/3.

Whole plot dimensions: 9.60 x 211.

Treatments:
Each year there are two plots, one is sown to w. wheat, one is fallow; they alternate in successive years.

Seed: Brimstone, dressed fonofos, sown at 180 kg.

Cultivations, etc.:-
Wheat plot: Heavy spring-tine cultivated, rotary harrowed, seed sown: 12 Oct, 1989. Combine harvested: 9 Aug, 1990.
Fallow plot: Ploughed: 8 Dec, 1989. Heavy spring-tine cultivated: 23 Apr, 1990. Cultivated by rotary grubber: 15 June. Cultivated with 'thistle bar': 17 July.

GRAIN AND STRAW TONNES/HECTARE

	GRAIN	STRAW
YIELD	1.94	0.61
MEAN DM%	88.8	84.7
PLOT AREA HARVESTED	0.04309	

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90/R/EX/4

EXHAUSTION LAND

Object: To study the residual effects of manures applied 1876-1901, and of additional phosphate applied since 1986, on the yield of continuous s. barley - Hoosfield.

The 135th year, s. barley.

For previous years see 'Details' 1967, 1973 and 74-89/R/EX/4.

Treatments: All combinations of:-

Whole plots

1. **OLD RES** — Residues of manures applied annually 1876-1901:

O	None
D	Farmyard manure at 35 tonnes
N	96 kg N as ammonium salts
P	34 kg P as superphosphate
NPKNAMG	N and P as above plus 137 kg K as sulphate of potash, 16 kg Na as sulphate of soda, 11 kg Mg as sulphate of magnesia

2. **P** — Phosphate applied annually from 1986 as superphosphate until 1987, triple superphosphate since:

O	None
P1	44 kg P
P2	87 kg P
P3	131 kg P

plus all combinations of:-

1. **OLD RES** — Residues of manures applied annually 1876-1901:

O	None
D	Farmyard manure at 35 tonnes
N*	96 kg N as nitrate of soda
PK	34 kg P as superphosphate, 137 kg K as sulphate of potash
N*PK	N, P and K as above

2. **N90** — Nitrogen fertilizer (kg N) as 'Nitro-Chalk' until 1985, as 'Nitram' since 1986 (basal until 1975, on a cyclic system since 1976):

0
48
96
144

NOTE: All plots of the combination OLD RES, P were given N at 144 kg as 'Nitram' and K at 83 kg as muriate of potash.

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90/R/EX/4

Basal applications: Weedkillers: Glyphosate at 1.4 kg in 200 l. Mecoprop at 1.6 kg, bromoxynil at 0.20 kg and ioxynil at 0.20 kg applied with the fungicide in 200 l. Fungicide: Fenpropimorph at 0.75 kg. Insecticide: Demeton-s-methyl at 0.24 kg in 200 l.

Seed: Triumph, seed dressed triadimenol and fuberidazole, sown at 160 kg.

Cultivations, etc.:- Glyphosate applied: 2 Oct, 1989. P and K applied: 1 Dec. Ploughed: 8 Dec. Spring-tine cultivated twice, rotary harrowed, seed sown: 9 Mar, 1990. N applied: 11 Apr. Insecticide applied: 10 May. Remaining weedkillers applied with the fungicide: 14 May. Combine harvested: 3 Aug.

PHOSPHATE PLOTS

GRAIN TONNES/HECTARE

***** Tables of means *****

P	0	P1	P2	P3	Mean
OLD RES					
0	1.91	3.79	3.90	4.42	3.50
D	3.42	4.35	4.66	4.10	4.13
N	1.97	3.96	4.53	4.45	3.73
P	2.96	4.19	4.17	4.07	3.85
NPKNAMG	2.90	3.96	4.62	4.29	3.94
Mean	2.63	4.05	4.38	4.26	3.83

GRAIN MEAN DM% 87.1

STRAW TONNES/HECTARE

***** Tables of means *****

P	0	P1	P2	P3	Mean
OLD RES					
0	0.36	1.30	1.31	1.30	1.07
D	1.20	1.40	1.60	1.59	1.45
N	0.46	1.31	1.41	1.40	1.15
P	0.93	1.68	1.40	1.77	1.45
NPKNAMG	1.11	1.48	1.79	1.49	1.47
Mean	0.81	1.44	1.50	1.51	1.32

STRAW MEAN DM% 93.2

PLOT AREA HARVESTED 0.00589

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90/R/EX/4

NITROGEN PLOTS

GRAIN TONNES/HECTARE

***** Tables of means *****

N90	0	48	96	144	Mean
OLD RES					
O	1.18	1.39	1.23	0.82	1.16
D	1.92	2.40	2.26	2.33	2.23
N*	1.57	1.74	1.75	1.47	1.63
PK	2.26	2.13	2.68	2.48	2.39
N*PK	1.80	2.06	2.64	2.35	2.22
Mean	1.75	1.95	2.11	1.89	1.92

GRAIN MEAN DM% 86.1

STRAW TONNES/HECTARE

***** Tables of means *****

N90	0	48	96	144	Mean
OLD RES					
O	0.29	0.28	0.28	0.28	0.28
D	0.65	0.65	0.66	0.75	0.68
N*	0.57	0.56	0.47	0.37	0.49
PK	0.56	0.56	0.93	0.83	0.72
N*PK	0.47	0.75	0.75	0.74	0.68
Mean	0.51	0.56	0.62	0.59	0.57

STRAW MEAN DM% 93.7

PLOT AREA HARVESTED 0.00589

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90/R/PG/5

PARK GRASS

Object: To study the effects of organic and inorganic manures and lime on old grass (for hay).

The 135th year, hay.

For previous years see 'Details' 1967 and 1973 and 74-89/R/PG/5.

Treatments: Combinations of:-

Whole plots

1. **MANURE** Fertilizers and organic manures:

N1	Plot 1	N1
O(D)	Plot 2	None (D until 1863)
O/PLOT3	Plot 3	None
P	Plot 4/1	P
N2P	Plot 4/2	N2 P
N1MN	Plot 6	N1 P K Na Mg
MN	Plot 7	P K Na Mg
PNAMG	Plot 8	P Na Mg
MN(N2)	Plot 9/1	P K Na Mg (N2 until 1989)
N2MN	Plot 9/2	N2 P K Na Mg
N2PNAMG	Plot 10	N2 P Na Mg
N3MN	Plot 11/1	N3 P K Na Mg
N3MNSI	Plot 11/2	N3 P K Na Mg Si
O/PLOT12	Plot 12	None
D/F	Plot 13	D/F
MN(N2*14)	Plot 14/1	P K Na Mg (N2* until 1989)
N2*MN	Plot 14/2	N2* P K Na Mg
MN(N2*15)	Plot 15	P K Na Mg (N2* until 1875)
N1*MN	Plot 16	N1* P K Na Mg
N1*	Plot 17	N1*
N2KNAMG	Plot 18	N2 K Na Mg
D	Plot 19	D
D/N*PK	Plot 20	D/N*P K

N1, N2, N3:	48, 96, 144 kg N as sulphate of ammonia
N1*, N2*:	48, 96 kg N as nitrate of soda (30 kg N to Plot 20, only in years with no farmyard manure)
P:	35 kg P (15 kg P to Plot 20, only in years with no farmyard manure) as single superphosphate until 1986, triple superphosphate in 1974, and since 1987
K:	225 kg K (45 kg K to Plot 20, only in years with no farmyard manure) as sulphate of potash
Na:	15 kg Na as sulphate of soda
Mg:	10 kg Mg as sulphate of magnesia
Si:	Silicate of soda at 450 kg
D:	Farmyard manure at 35 tonnes every fourth year
F:	Fish meal every fourth year to supply 63 kg N
MN:	P K Na Mg

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90/R/PG/5

Sub plots

2. **LIME** Liming:

A	a Ground chalk applied as necessary to achieve pH7
B	b Ground chalk applied as necessary to achieve pH6
C	c Ground chalk applied as necessary to achieve pH5
D	d None

NOTE: Lime was applied regularly, and at the same rate, to all a and b sub plots of Plots 1 to 17 (except 12) from 1924. Differential liming started in 1965 on certain b and c sub plots (except on Plot 12) and in 1976 on certain a sub plots (including Plot 12) and 12b. Liming ceased on plots 9/1 and 14/1 after 1989.

Chalk applied 1990 (tonnes CaCO3):

Plot	A	B	C
1	8.7	5.9	6.7
2	6.4	-	1.0
3	6.5	4.7	1.1
4/1	4.5	-	-
4/2	7.6	5.4	3.8
6	4.6	-	-
7	4.1	-	2.3
8	4.0	-	-
9/2	9.5	6.4	4.3
10	4.4	3.3	2.7
11/1	3.8	8.5	3.7
11/2	6.2	4.2	3.2
12	3.2	4.3	-
13	5.1	-	-
14/2	0.9	-	-
15	2.9	-	-
16	2.0	-	-
17	4.0	-	-
18	7.3	-	9.4

Additional sub plots (Plots 18, 19 and 20 only) (tonnes CaCO3 applied every fourth year 1920-1964):

N2KNAMG0	18-1	None
N2KNAMG2	18-2	13.5
N2KNAMG1	18-3	7.9
DO	19-1	None
D2	19-2	6.3
D1	19-3	1.1
D/N*PK0	20-1	None
D/N*PK2	20-2	5.6
D/N*PK1	20-3	1.1

Since 1965 Plot 18-1 has been split into two for treatments 'c' and 'd' above and Plot 18-3 split into two for treatments 'a' and 'b'. The remaining sub plots of Plots 18, 19 and 20 are treated as 'a'.

NOTE: For a fuller record of treatments see ' Details' etc.

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90/R/PG/5

Cultivations, etc.:- P applied: 5 Dec,1989. K, Na, Mg and Si applied: 8 Jan, 1990. Chalk applied: 12 Jan - 2 Mar. N applied: 9 Apr. Cut: 2 July, 20 Nov.

1ST CUT (2/7/90) DRY MATTER TONNES/HECTARE

***** Tables of means *****

LIME / MANURE	A	B	C	D	MEAN
N1	2.18	1.77	0.76	0.20	1.23
O(D)	1.56	1.96	0.99	1.14	1.41
O/PLOT3	1.40	1.73	0.82	0.88	1.21
P	2.03	2.02	1.44	1.40	1.72
N2P	2.62	2.45	1.87	1.35	2.07
N1MN	4.27	4.45			4.36
MN	3.83	3.73	2.61	1.97	3.03
PNAMG	1.46	1.72	1.88	2.04	1.77
MN(N2)	2.21	2.09	0.96	1.07	1.58
N2MN	4.00	4.33	2.32	1.48	3.03
N2PNAMG	2.77	2.77	2.09	1.01	2.16
N3MN	5.21	4.99	5.03	3.71	4.74
N3MNSI	4.75	4.45	3.23	4.15	4.15
O/PLOT12	1.27	1.14	0.89	0.94	1.06
D/F	4.54	3.35	2.53	2.48	3.22
MN(N2*14)	2.51	3.71	3.37	3.34	3.23
N2*MN	4.99	5.59	4.12	4.82	4.88
MN(N2*15)	4.29	2.70	2.03	2.25	2.82
N1*MN	5.12	4.68	3.10	3.20	4.02
N1*	1.99	2.20	2.58	2.67	2.36
N2KNAMG0			0.17	0.06	0.12
N2KNAMG2	2.55				2.55
N2KNAMG1	2.46	2.17			2.31
D0	2.87				2.87
D2	3.35				3.35
D1	2.76				2.76
D/N*PK0	3.56				3.56
D/N*PK2	3.83				3.83
D/N*PK1	4.32				4.32

1ST CUT MEAN DM% 32.5

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90/R/PG/5

2ND CUT (20/11/90) DRY MATTER TONNES/HECTARE

***** Tables of means *****

LIME / MANURE	A	B	C	D	MEAN
N1	0.95	0.54	0.38	0.13	0.50
O(D)	0.36	0.41	0.29	0.55	0.40
O/PLOT3	0.31	0.45	0.31	0.49	0.39
P	0.65	0.33	0.39	0.78	0.54
N2P	0.72	0.56	0.38	0.46	0.53
N1MN	0.21	0.23			0.22
MN	0.30	0.27	0.19	0.19	0.24
PNAMG	0.10	0.13	0.30	0.25	0.20
MN(N2)	0.05	0.09	0.06	0.05	0.06
N2MN	0.08	0.23	0.10	0.30	0.18
N2PNAMG	0.22	0.51	0.22	0.37	0.33
N3MN	0.70	0.33	0.30	0.37	0.42
N3MNSI	0.91	0.51	0.38	0.48	0.57
O/PLOT12	0.14	0.14	0.14	0.19	0.16
D/F	1.05	0.74	0.30	0.37	0.61
MN(N2*14)	0.22	0.25	0.25	0.34	0.27
N2*MN	0.56	0.57	0.48	0.39	0.50
MN(N2*15)	0.26	0.15	0.11	0.18	0.18
N1*MN	0.54	0.56	0.34	0.43	0.47
N1*	0.25	0.26	0.28	0.54	0.33
N2KNAMG0			0.00	0.00	0.00
N2KNAMG2	0.42				0.42
N2KNAMG1	0.10	0.10			0.10
D0	0.23				0.23
D2	0.23				0.23
D1	0.13				0.13
D/N*PK0	0.28				0.28
D/N*PK2	0.28				0.28
D/N*PK1	0.39				0.39

2ND CUT MEAN DM% 27.0

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90/R/PG/5

TOTAL OF 2 CUTS DRY MATTER TONNES/HECTARE

***** Tables of means *****

LIME / MANURE	A	B	C	D	MEAN
N1	3.12	2.31	1.14	0.33	1.73
O(D)	1.93	2.37	1.29	1.68	1.82
O/PLOT3	1.72	2.18	1.13	1.37	1.60
P	2.69	2.35	1.83	2.18	2.26
N2P	3.35	3.01	2.24	1.80	2.60
N1MN	4.48	4.68			4.58
MN	4.13	3.99	2.80	2.16	3.27
PNAMG	1.56	1.85	2.18	2.29	1.97
MN(N2)	2.26	2.18	1.01	1.11	1.64
N2MN	4.08	4.56	2.41	1.78	3.21
N2PNAMG	2.99	3.28	2.30	1.38	2.49
N3MN	5.91	5.32	5.32	4.08	5.16
N3MNSI	5.67	4.96	3.61	4.64	4.72
O/PLOT12	1.41	1.28	1.04	1.13	1.22
D/F	5.59	4.09	2.82	2.84	3.84
MN(N2*14)	2.73	3.96	3.62	3.67	3.50
N2*MN	5.55	6.16	4.59	5.21	5.38
MN(N2*15)	4.55	2.85	2.14	2.43	2.99
N1*MN	5.65	5.23	3.44	3.63	4.49
N1*	2.24	2.46	2.86	3.22	2.69
N2KNAMG0			0.17	0.06	0.12
N2KNAMG2	2.97				2.97
N2KNAMG1	2.56	2.27			2.41
D0	3.10				3.10
D2	3.58				3.58
D1	2.89				2.89
D/N*PK0	3.84				3.84
D/N*PK2	4.12				4.12
D/N*PK1	4.71				4.71

TOTAL OF 2 CUTS MEAN DM% 29.7

PLOT AREA HARVESTED 0.00002

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90/R/AG/6

AGDELL

Object: To study, the residual values of phosphate and potash applied in the period 1848-1951 and further dressings since 1964.

The 21st year of revised scheme, ley.

For previous years see 'Details' 1967 and 1973, and 74-89/R/AG/6.

NOTE: Yields were not taken and no new treatments were applied.

Basal applications: Manures: 'Nitram' at 350 kg and later at 220 kg.

Cultivations, etc.:- First N applied: 6 Mar, 1990. Cut: 30 May.
Second N applied: 8 June. Cut: 1 Aug.

NOTE: The experiment ended after the second cut.

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90/R/BN/7

BARNFIELD

Object: The experiment was designed to study the effects of organic and inorganic manures on continuous root crops. It was progressively modified to study effects on other crops.

Sections 1 and 2 the seventh year of grass/clover. The 16th year of grass on the rest of the experiment.

For previous years see 'Details' 1967 and 1973 and 74-89/R/BN/7.

Plot dimensions: 10.7 x 55.9.

Treatments to grass: All combinations of:-

Whole plots

1. **MANURE** Fertilizers and organic manures:

D	D
DPK	D P K
PKMG	P K (Na) Mg
P	P
PK	P K
PMG	P (Na) Mg
0	0

P: 35 kg P as single superphosphate until 1987, triple superphosphate since and in 1974
K: 225 kg K as sulphate of potash
(Na): 90 kg Na as sodium chloride until 1973
Mg: 90 kg Mg as kieserite every fourth year since 1974 (sulphate of magnesia until 1973)
D: Farmyard manure at 35 tonnes (until 1975).

Quarter plots

2. **N PERCUT** Nitrogen fertilizer in 1990 (kg N per cut) as 'Nitram', cumulative to previous dressings, and residues of forms of N previously each supplying 96 kg N per annum:

75	75, previously nitrate of soda, section 3
100	100, previously sulphate of ammonia, section 4
125	125, previously sulphate of ammonia + castor meal, section 5
150	150, previously castor meal, section 6

Castor meal last applied 1961, nitrate of soda and sulphate of ammonia until 1959.

Plus one plot **MANURE** KMG 100

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90/R/BN/7

Treatments to grass/clover, sections 1 and 2 (not given nitrogen fertilizer):

MANURE Fertilizers and organic manures as for grass above, excluding KMG.

NOTES: (1) P K and D treatments were applied to Sections 1 and 2 until 1980. None were applied subsequently until the resumption of P and K treatments, only, from 1985.
(2) Yields were not taken from section 2.

Cultivations, etc.:-
All sections: P and K applied: 6 Dec, 1989. Mg applied: 7 Dec. Cut: 1 June, 1990 and 16 Nov.
Grass (Sections 3, 4, 5 and 6) only: N applied: 1 Mar, 1990 and 4 June.

GRASS

1ST CUT (1/6/90) DRY MATTER TONNES/HECTARE

***** Tables of means *****

N PERCUT / MANURE	75	100	125	150	Mean
D	5.49	5.53	6.14	6.15	5.83
DPK	5.17	5.49	5.09	5.94	5.42
PKMG	4.28	5.30	5.44	4.84	4.96
P	1.38	1.47	1.95	1.78	1.64
PK	3.76	3.95	3.40	3.46	3.64
PMG	1.24	1.80	1.91	1.67	1.66
0	0.91	1.18	1.74	1.46	1.32
Mean	3.17	3.53	3.67	3.62	3.50

MANURE KMG 100 3.92

Grand mean 3.51

1ST CUT MEAN DM% 36.7

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90/R/BN/7

2ND CUT (16/11/90) DRY MATTER TONNES/HECTARE

***** Tables of means *****

N PERCUT MANURE	75	100	125	150	Mean
D	1.57	1.72	2.18	1.90	1.84
DPK	1.54	1.79	1.73	2.29	1.84
PKMG	1.27	1.34	1.43	1.60	1.41
P	0.70	0.16	0.23	0.29	0.35
PK	1.24	1.03	0.94	1.75	1.24
PMG	0.35	0.18	0.18	0.46	0.29
0	0.50	0.20	0.39	0.60	0.42
Mean	1.02	0.92	1.01	1.27	1.06

MANURE KMG 100 1.27

Grand mean 1.06

2ND CUT MEAN DM% 24.3

TOTAL OF 2 CUTS DRY MATTER TONNES/HECTARE

***** Tables of means *****

N PERCUT MANURE	75	100	125	150	Mean
D	7.07	7.25	8.32	8.06	7.67
DPK	6.71	7.28	6.82	8.22	7.26
PKMG	5.55	6.63	6.87	6.44	6.37
P	2.08	1.63	2.18	2.07	1.99
PK	5.00	4.98	4.34	5.21	4.88
PMG	1.59	1.98	2.09	2.14	1.95
0	1.41	1.38	2.13	2.07	1.74
Mean	4.20	4.45	4.68	4.89	4.55

MANURE KMG 100 5.19

Grand mean 4.58

TOTAL OF 2 CUTS MEAN DM% 30.5

PLOT AREA HARVESTED 0.00568

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90/R/BN/7

GRASS/CLOVER

1ST CUT (1/6/90) DRY MATTER TONNES/HECTARE

***** Tables of means *****

MANURE	D	DPK	PKMG	P	PK	PMG	0	Mean
	2.32	2.33	0.98	0.48	0.65	0.62	0.41	1.11

1ST CUT MEAN DM% 39.5

2ND CUT (16/11/90) DRY MATTER TONNES/HECTARE

***** Tables of means *****

MANURE	D	DPK	PKMG	P	PK	PMG	0	Mean
	0.45	0.33	0.13	0.18	0.20	0.17	0.27	0.25

2ND CUT MEAN DM% 37.2

TOTAL OF 2 CUTS DRY MATTER TONNES/HECTARE

***** Tables of means *****

MANURE	D	DPK	PKMG	P	PK	PMG	0	Mean
	2.77	2.66	1.11	0.65	0.86	0.79	0.67	1.36

TOTAL OF 2 CUTS MEAN DM% 38.3

PLOT AREA HARVESTED 0.00568

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90/R/GC/8

GARDEN CLOVER

Object: To study yields and pathogens of red clover grown continuously - Manor Garden.

The 137th year, red clover.

For previous years see 'Details' 1967 and 1973, and 74-89/R/GC/8.

Design: 2 blocks of 2 plots.

Whole plot dimensions: 1.00 x 1.40.

Treatments:

FUNG RES	Residual effects of fungicide to control Sclerotinia trifoliorum:
NONE	None
BENOMYL	Benomyl sprays during previous winters including applications at 0.60 kg in 800 l on 13 Oct, 1989 and on 13 Nov

Basal applications: Manures: Chalk at 1.25 t. (0:18:36) at 420 kg. Mg at 50 kg, as Epsom Salts.

NOTE: Additional K was applied to replace that removed by the crop in 1989. **FUNG RES** NONE required 411 and 303 kg K2O to the first and second blocks respectively, **FUNG RES** BENOMYL 410 and 290 kg K2O. This was applied as muriate of potash, one third to the seedbed in 1990 and one third after the first and second cuts.

Seed: Hungaropoly, sown at 30 kg on 27 Mar, 1990.

Cultivations, etc.:- Chalk, PK and Mg applied: 25 Oct, 1989. Hand dug, root stumps carted: 14 Mar, 1990. K applied: 23 Mar. Cut and K applied: 23 July, 4 Sept.

NOTE: Irrigation was appplied as follows (mm water):

30 Mar	10
9 May	10
24 May	10
24 July	10
8 Aug	10
	--
Total	50

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90/R/GC/8

1ST CUT (23/7/90) DRY MATTER TONNES/HECTARE

***** Tables of means *****

FUNG RES	NONE	BENOMYL	Mean
	2.12	2.19	2.16

1ST CUT MEAN DM% 28.3

2ND CUT (4/9/90) DRY MATTER TONNES/HECTARE

***** Tables of means *****

FUNG RES	NONE	BENOMYL	Mean
	1.55	1.33	1.44

2ND CUT MEAN DM% 18.3

TOTAL OF 2 CUTS DRY MATTER TONNES/HECTARE

***** Tables of means *****

FUNG RES	NONE	BENOMYL	Mean
	3.68	3.52	3.60

TOTAL OF 2 CUTS MEAN DM% 23.3

PLOT AREA HARVESTED 0.00010

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90/R/RN/1 and 90/R/RN/2

LEY ARABLE

Object: To study the effects of three-year leys on the fertility of the soil as measured by a sequence of three arable test crops - Highfield and Fosters.

Sponsor: P.R. Poulton.

The 42nd year, old grass, leys, s. oats, w. wheat.

For previous years see 'Details' 1967 and 1973 and 74-89/R/RN/1 and 2.

The experiment is duplicated on:-

HIGHFIELD — A site with much organic matter initially (ploughed out from permanent grass) (90/R/RN/1)

FOSTERS — A site with little organic matter initially (90/R/RN/2)

ROTATION — Treatments: The experiment originally tested four six-course rotations, with all phases present each year. For many years these rotations were:-

	Treatment crops	Test crops
LUCERNE	LU, LU, LU	W, P, B
CLOGRA	LC, LC, LC	W, P, B
GRASS	LN, LN, LN	W, P, B
ARABLE	H, SB, O	W, P, B

LU = lucerne, LC = clover-grass ley, no nitrogen fertilizer, LN = all-grass ley with nitrogen fertilizer, H = 1-year seeds hay, SB = sugar beet, O = s. oats, W = w. wheat, P = potatoes, B = s. barley.

From 1983 the test crops have been W, W, W.

RESEEDED — On both fields in the first three years other plots were sown with long-term reseeded grass

OLDGRASS — On Highfield plots of the old turf were left initially unploughed, for comparison with the three-year leys

In 1962 and 1963 some of the old and reseeded grass plots were divided for management identical to:-

C — Clover-grass ley
N — All-grass ley

From 1968 only two phases on each field continued in the six-course rotation (the museum blocks). The four other phases (the new sequence blocks) were used for studies on take-all (Gaeumannomyces graminis) in wheat. These studies ended in 1985 and these phases are no longer included in the experiment.

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90/R/RN/1 and 90/R/RN/2

Additional treatments to 3rd test crop w. wheat:-

Sub plots

FYMRES70 Farmyard manure residues, last applied 1970:

NONE None
FYM 30 tonnes on each occasion

Sub plots

N Nitrogen fertilizer in 1990 (kg N) as 'Nitram':

0
50
100
150

Standard applications:

3rd Treatment crops:

Lucerne: Manures: (0:24:24) at 940 kg.

All-grass ley: Manures: (0:24:24) at 620 kg. (25:0:16) at 300 kg on two occasions.

Clover-grass ley: Manures: (0:24:24) at 620 kg.

S. oats: Manures: (20:10:10) at 350 kg. Weedkillers: Mecoprop at 1.6 kg, bromoxynil at 0.20 kg and ioxynil at 0.20 kg with the fungicide in 200 l. Fungicide: Fenpropimorph at 0.75 kg.

3rd Test crop:

W. wheat: Weedkillers: Isoproturon at 1.7 kg in 200 l. Mecoprop at 2.2 kg, bromoxynil at 0.28 kg and ioxynil at 0.28 kg with the fungicide in 200 l. Fungicide: Prochloraz at 0.40 kg.

Reseeded grass and old grass: Manures: (0:24:24) at 620 kg. All-grass half plots: (25:0:16) at 300 kg in spring and after each cut except the last.

Seed: S. oats: Dula, sown at 190 kg.
W. wheat: Avalon, sown at 180 kg.

Cultivations, etc.:-

3rd Treatment crops:

Lucerne: PK applied: 28 Nov, 1989 (Highfield), 29 Nov (Fosters). First cut: 31 May, 1990. Second cut: 10 July.

All-grass ley and clover-grass ley: PK applied: 28 Nov, 1989 (Highfield), 29 Nov (Fosters). NK applied to all-grass ley: 1 Mar, 1990 and 4 June. Cut: 31 May, 10 July.

S. oats: Ploughed: 4 Jan, 1990. Spring-tine cultivated twice, rotary harrowed, seed sown: 9 Mar. NPK applied: 12 Apr. Weedkillers with the fungicide applied: 14 May. Combine harvested: 7 Aug.

3rd Test crop w. wheat: Ploughed: 29 Aug, 1989. Rotary harrowed: 3 Oct. Rotary harrowed, seed sown: 4 Oct. Isoproturon applied: 23 Nov. N treatments applied: 11 Apr, 1990. Remaining weedkillers with the fungicide applied: 25 Apr. Combine harvested: 9 Aug.

Reseeded grass and old grass: PK applied: 28 Nov, 1989 (Highfield), 29 Nov (Fosters). NK applied to all-grass half plots: 1 Mar, 1990 and 4 June. Cut: 31 May, 14 Nov.

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90/R/RN/1 and 90/R/RN/2

DRY MATTER: TONNES/HECTARE

***** Tables of means *****

	HIGHFIELD	FOSTERS
CLOVER-GRASS LEY		
TOTAL OF 2 CUTS	4.25	3.45
MEAN DM%	28.8	29.5
ALL-GRASS LEY		
TOTAL OF 2 CUTS	4.47	4.28
MEAN DM%	29.9	29.0

	HIGHFIELD	FOSTERS
LUCERNE		
TOTAL OF 2 CUTS	2.85	10.29
MEAN DM%	25.3	21.9

	HIGHFIELD	
OLD GRASS		
TOTAL OF 2 CUTS	C	N
42ND EXPTL YEAR		
BLOCKS 1 & 4	1.69	6.31
BLOCK 2	1.78	5.63
MEAN DM%	31.3	29.9

RESEEDED GRASS

TOTAL OF 2 CUTS		**HIGHFIELD**			**FOSTERS**	
	BLOCKS	C	N	BLOCKS	C	N
42ND EXPTL YEAR	1 & 4	1.76	6.48	1 & 3	1.65	4.51
42ND EXPTL YEAR (SEEDED 1949 RESEEDED 1973)	2 & 3	1.95	6.42	2 & 4	2.08	4.72
MEAN DM%		31.3	29.5		28.4	27.8

WINTER OATS: TONNES/HECTARE

	HIGHFIELD	FOSTERS
GRAIN	3.77	3.80
MEAN DM%	82.8	83.8

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90/R/RN/1 HIGHFIELD W.WHEAT (3RD TEST CROP)

GRAIN TONNES/HECTARE

***** Tables of means *****

FYMRES70	NONE	FYM	Mean
ROTATION			
LUCERNE	4.21	4.50	4.36
CLOGRA	4.11	4.15	4.13
GRASS	4.44	4.40	4.42
ARABLE	3.25	3.23	3.24
Mean	4.00	4.07	4.04

N	0	50	100	150	Mean
ROTATION					
LUCERNE	2.41	4.24	4.79	6.00	4.36
CLOGRA	2.49	4.08	4.81	5.14	4.13
GRASS	2.40	4.18	5.45	5.63	4.42
ARABLE	1.52	3.34	3.47	4.63	3.24
Mean	2.20	3.96	4.63	5.35	4.04

N	0	50	100	150	Mean
FYMRES70					
NONE	2.16	4.02	4.61	5.22	4.00
FYM	2.25	3.90	4.65	5.48	4.07
Mean	2.20	3.96	4.63	5.35	4.04

N	0	50	100	150
ROTATION	**FYMRES70**				
LUCERNE	NONE	2.32	3.72	5.06	5.76
	FYM	2.50	4.75	4.51	6.24
CLOGRA	NONE	2.46	4.84	4.41	4.74
	FYM	2.52	3.31	5.20	5.55
GRASS	NONE	2.26	4.32	5.32	5.84
	FYM	2.54	4.05	5.58	5.42
ARABLE	NONE	1.61	3.18	3.63	4.56
	FYM	1.42	3.49	3.31	4.70

GRAIN MEAN DM% 90.3

PLOT AREA HARVESTED 0.00571

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90/R/RN/2 FOSTERS W.WHEAT (3RD TEST CROP)

GRAIN TONNES/HECTARE

***** Tables of means *****

FYMRES70	NONE	FYM	Mean
ROTATION			
LUCERNE	3.80	3.53	3.67
CLOGRA	3.91	3.96	3.93
GRASS	3.57	3.86	3.72
ARABLE	3.66	3.66	3.66
Mean	3.74	3.75	3.75

N	0	50	100	150	Mean
ROTATION					
LUCERNE	2.21	3.59	3.85	5.02	3.67
CLOGRA	2.18	3.76	4.58	5.20	3.93
GRASS	2.08	3.48	4.52	4.79	3.72
ARABLE	1.83	3.81	4.27	4.73	3.66
Mean	2.08	3.66	4.31	4.94	3.75

N	0	50	100	150	Mean
FYMRES70					
NONE	2.19	3.45	4.40	4.92	3.74
FYM	1.97	3.87	4.22	4.96	3.75
Mean	2.08	3.66	4.31	4.94	3.75

N		0	50	100	150
ROTATION	**FYMRES70**				
LUCERNE	NONE	2.87	3.34	4.16	4.85
	FYM	1.55	3.84	3.54	5.19
CLOGRA	NONE	2.25	3.75	4.86	4.78
	FYM	2.12	3.78	4.31	5.63
GRASS	NONE	1.59	3.32	4.33	5.04
	FYM	2.58	3.63	4.72	4.53
ARABLE	NONE	2.04	3.39	4.23	4.99
	FYM	1.62	4.23	4.31	4.47

GRAIN MEAN DM% 90.4

PLOT AREA HARVESTED 0.00571

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90/W/RN/3

LEY/ARABLE

Object: To compare the effects on soil fertility of rotations with or without leys - Woburn Stackyard D.

Sponsor: P.R. Poulton.

The 53rd year, leys, w. beans, w. wheat, s. barley.

For previous years see 'Details' 1967 & 1973 and 74-89/W/RN/3.

Design: 5 series of 8 plots, split for treatments other than rotations.

Whole plot dimensions: 8.53 x 40.7.

Treatments: All phases of four five-course rotations were originally present:

ROTATION

LEY	Clover/grass ley:	L, L, L, P, W
CLO	All legume ley:	SA, SA, SA, P, W until 1971 then CL, CL, CL, P, W
A	Arable with roots:	P, R, C, P, W until 1971 then P, B, B, P, W
A H	Arable with hay:	P, R, H, P, W until 1971 then P, B, H, P, W

P = potatoes, R = w. rye, C = carrots, W = w. wheat, B = s. barley, H = hay, L = clover/grass ley, SA = sainfoin ley, CL = red clover ley

Rotations themselves followed different cycles:

On four plots in each block the rotations were repeated

On four plots in each block arable rotations alternated each five years with ley rotations

From 1976 all the rotations were changed on all phases except for the first and second test crops in 1976:

LN 3	(Previous LEY) LN, LN, LN, W, B
LC 3	(Previous CLO) LC, LC, LC, W, B
AF	(Previous A) F, F, BE, W, B
AB	(Previous A H) B, B, BE, W, B

LN1 to LN3 = three year grass ley with N, 1st year to 3rd year, LC = clover/grass ley no N, BE = beans (s. oats until 1980), F = fallow

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90/W/RN/3

Plots hitherto in alternating rotations were changed to test eight-year leys:

LLN	LN, LN, LN, LN, LN, LN, LN, LN, W, B
LLC	LC, LC, LC, LC, LC, LC, LC, LC, W, B

LLN1 to LLN8 = eight year grass ley with N, first year to eighth year, similarly for LLC

The new scheme started by sowing these new leys in spring 1976 on four phases and in spring 1977 on the fifth phase (2nd test crop in 1976).

Yields are taken only from the leys and the test crops.

Treatments to first test crop w. wheat, all combinations of:

Whole plots

1. **ROTATION** Rotations:

   LN 8
   LN 3
   LC 8
   LC 3
   AF
   AB

1/2 plots

2. **FYMRES64** Farmyard manure residues, last applied 1964:

   NONE None
   FYM 38 tonnes on each occasion

1/8 plots

3. **N** Nitrogen fertilizer (kg N) as 'Nitro-Chalk' (27% N):

   0
   70
   140
   210

Treatments to second test crop s. barley, all combinations of:

Whole plots

1. **ROTATION** Rotations:

   LN 8
   LN 3
   LC 8
   LC 3
   AF
   AB

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90/W/RN/3

1/2 plots

2. **FYMRES63** Farmyard manure residues, last applied 1963:

NONE	None
FYM	38 tonnes on each occasion

1/8 plots

3. **N** Nitrogen fertilizer (kg N) as 'Nitro-Chalk' (27% N):

0
60
120
180

Treatments to leys:

FYM RES Farmyard manure residues:

NONE	None
FYM	38 tonnes on each occasion, last applied 1962 to 1st and 6th year leys, 1966 to 2nd and 7th year leys, 1965 to 3rd and 8th year leys, 1964 to 4th year leys, 1963 to 5th year leys

Corrective K dressings (kg K2O) as muriate of potash, applied to first test crop w. wheat and long-term leys in the wheat block:

Continuous rotations	No FYM half plots	FYM half plots
LN	125	145
LC	0	0
AF	200	220
AB	155	155
Ex-alternating rotations		
LN 8 ploughed for w. wheat	0	0
LN 8 not ploughed	60	120
LC 8 ploughed for w. wheat	0	0
LC 8 not ploughed	20	0

Standard applications:-

Grass ley and clover/grass ley, 1st year: Manures: (0:18:36) at 420 kg. (25:0:16) at 300 kg to grass ley in spring and after the first cut. K2O at 54 kg to clover/grass ley in spring and after the first cut.

Grass ley, 2nd, 3rd, 4th, 5th, 6th, 7th and 8th years: Manures: Chalk at 5.0 t to 5th year only. (25:0:16) at 300 kg in spring and after the first cut. (0:24:24) at 620 kg.

Clover/grass ley, 2nd, 3rd, 4th, 5th, 6th, 7th and 8th years: Manures: Chalk at 5.0 t to 5th year only. K2O at 54 kg in spring and after the first cut. (0:24:24) at 620 kg.

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90/W/RN/3

Standard applications:-

S. barley, 1st and 2nd treatment crops: Manures: (20:10:10) at 400 kg. Weedkillers: Bromoxynil at 0.24 kg and clopyralid at 0.05 kg with mecoprop at 1.7 kg in 220 l. Fungicide: Fenpropimorph at 0.75 kg in 220 l.

W. beans, 3rd treatment crop: Manures: (0:24:24) at 170 kg. Mn at 0.19 kg in 220 l and later at 0.096 kg in 220 l. Weedkillers: Propyzamide at 0.85 kg with simazine at 0.85 kg in 220 l. Fungicide: Fenpropimorph at 0.75 kg in 220 l. Insecticide: Deltamethrin at 7.5 g in 220 l applied on two occasions.

Fallow, 1st and 2nd treatment years: No applications.

W. wheat, 1st test crop: Manures: (0:24:24) at 260 kg. Weedkillers: Glyphosate at 1.4 kg in 220 l. Bromoxynil at 0.34 kg and clopyralid at 0.07 kg, with isoproturon at 2.1 kg and with fluroxypyr at 0.15 kg in 220 l. Fungicides: Propiconazole at 0.12 kg with chlorothalonil at 0.50 kg in 300 l. Insecticide: Carbofuran at 7.5 kg.

S. barley, 2nd test crop: Manures: Chalk at 5.0 t. (0:24:24) at 260 kg. Weedkillers: Bromoxynil at 0.24 kg and clopyralid at 0.05 kg with mecoprop at 1.7 kg in 220 l. Fungicide: Fenpropimorph at 0.75 kg in 220 l. Insecticide: Carbofuran at 7.5 kg.

Seed: Grass ley: Climax timothy at 15 kg and meadow fescue at 15 kg, mixture sown at 30 kg.

Clover/grass ley: Climax timothy at 15 kg, meadow fescue at 12 kg and Huia white clover at 3.4 kg, mixture sown at 30 kg.

S. barley: Klaxon, dressed triadimenol and fuberidazole, sown at 160 kg.

W. beans: Banner, sown at 18 seeds per square metre.

W. wheat: Mercia, sown at 150 kg.

Cultivations, etc.:-

Treatment crops:

Grass ley and clover/grass ley, 1st year: Ploughed: 31 Aug, 1989. Rolled: 1 Sept. PK applied: 6 Sept. Rotary cultivated with crumbler attached, seed sown: 7 Sept. NK applied to grass ley and K applied to clover/grass ley: 2 March, 1990 and 15 June. Cut: 6 June.

Grass ley and clover/grass ley, 2nd, 3rd, 4th, 5th, 6th, 7th and 8th years: Corrective K applied to 4th year only: 16 Feb, 1990. NK applied to grass ley and K applied to clover grass ley: 2 Mar and 15 June. PK applied: 6 Mar. Cut: 6 June.

S. barley, 1st and 2nd treatment crops: Ploughed: 5 Mar, 1990. NPK applied, rotary harrowed with crumbler attached, seed sown and harrowed: 7 Mar. Weedkiller applied: 23 May. Fungicide applied: 24 May. Combine harvested: 2 Aug.

W. beans, 3rd treatment crop: Subsoiled with vibrating tines 50 cm apart and 40 cm deep: 14 Sept, 1989. PK applied: 19 Sept. Disced twice: 11 Oct. Seed broadcast by drill then ploughed: 13 Oct. Rolled: 14 Oct. Weedkillers applied: 15 Oct. Mn applied: 5 Apr, 1990 and 30 Apr. Insecticide applied: 23 Apr and 18 May. Fungicide applied: 11 July. Combine harvested: 10 Aug.

Fallow, 1st and 2nd treatment years: Ploughed: 5 Mar, 1990. Spring-tine cultivated: 9 May. Cultivated with thistle bar: 21 June.

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90/W/RN/3

Cultivations, etc.:-
Test crops:
W. wheat, 1st test crop: Glyphosate applied: 1 Sept, 1989. Subsoiled with vibrating tines 50 cm apart and 40 cm deep: 13 Sept. Disced twice: 15 Sept. PK applied, ploughed: 19 Sept. Carbofuran applied, rotary harrowed with crumbler attached: 25 Sept. Seed sown: 26 Sept. Corrective K applied: 16 Feb, 1990. N treatments applied: 23 Mar. Remaining weedkillers applied: 24 Apr. Fungicides applied: 22 May. Combine harvested: 7 Aug.
S. barley, 2nd test crop: Chalk applied: 16 Jan, 1990. Ploughed: 5 Mar. PK applied: 6 Mar. Carbofuran applied, power harrowed with crumbler attached, seed sown and harrowed: 7 Mar. N treatments applied: 14 Mar. Weedkillers applied: 23 May. Fungicide applied: 24 May. Combine harvested: 2 Aug.

LEYS

1ST AND ONLY CUTTING OCCASION (6/6/90) DRY MATTER TONNES/HECTARE

***** Tables of means *****

FYM RES LEY	NONE	FYM	Mean
LC1	2.93	2.58	2.76
LC2	5.21	4.79	5.00
LC3	1.23	1.84	1.54
LN1	4.09	3.39	3.74
LN2	5.89	5.10	5.49
LN3	2.81	1.90	2.35
LLC1	2.97	2.58	2.78
LLC2	5.31	5.13	5.22
LLC3	2.63	2.05	2.34
LLC4	1.81	1.21	1.51
LLC5	1.39	1.09	1.24
LLC6	2.56	2.61	2.58
LLC7	4.50	3.51	4.01
LLC8	2.68	2.13	2.41
LLN1	3.39	3.56	3.47
LLN2	5.96	4.37	5.17
LLN3	4.13	3.18	3.65
LLN4	1.95	2.45	2.20
LLN5	3.18	3.43	3.31
LLN6	3.65	3.37	3.51
LLN7	5.09	4.77	4.93
LLN8	4.03	4.11	4.07
Mean	3.52	3.14	3.33

1ST CUT MEAN DM% 27.3

PLOT AREA HARVESTED 0.00200

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90/W/RN/3

W.WHEAT 1ST TEST CROP

GRAIN TONNES/HECTARE

***** Tables of means *****

FYMRES64	NONE	FYM	Mean
ROTATION			
LN 8	4.36	5.01	4.69
LN 3	4.43	4.71	4.57
LC 8	6.11	5.62	5.87
LC 3	6.12	5.52	5.82
AF	4.80	4.49	4.65
AB	5.01	4.27	4.64
Mean	5.14	4.94	5.04

N	0	70	140	210	Mean
ROTATION					
LN 8	2.62	5.79	5.08	5.25	4.69
LN 3	1.73	4.94	5.43	6.17	4.57
LC 8	3.31	6.51	6.65	6.99	5.87
LC 3	3.59	6.06	7.20	6.42	5.82
AF	1.38	5.72	6.30	5.18	4.65
AB	1.47	4.94	5.83	6.33	4.64
Mean	2.35	5.66	6.08	6.06	5.04

N	0	70	140	210	Mean
FYMRES64					
NONE	2.27	5.94	6.07	6.27	5.14
FYM	2.43	5.39	6.09	5.84	4.94
Mean	2.35	5.66	6.08	6.06	5.04

N		0	70	140	210
ROTATION	FYMRES64				
LN 8	NONE	2.07	5.47	5.56	4.35
	FYM	3.17	6.12	4.59	6.15
LN 3	NONE	1.67	4.71	4.82	6.51
	FYM	1.79	5.18	6.03	5.83
LC 8	NONE	3.42	7.04	6.92	7.08
	FYM	3.21	5.99	6.38	6.91
LC 3	NONE	3.44	6.44	7.56	7.02
	FYM	3.74	5.69	6.85	5.82
AF	NONE	1.21	5.89	5.77	6.34
	FYM	1.55	5.56	6.83	4.01
AB	NONE	1.84	6.09	5.79	6.32
	FYM	1.09	3.78	5.86	6.34

GRAIN MEAN DM% 90.1

PLOT AREA HARVESTED 0.00183

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90/W/RN/3

S.BARLEY 2ND TEST CROP

GRAIN TONNES/HECTARE

***** Tables of means *****

FYMRES63	NONE	FYM	Mean
ROTATION			
LN 8	3.01	3.09	3.05
LN 3	3.50	3.83	3.66
LC 8	3.60	3.85	3.72
LC 3	2.50	2.96	2.73
AF	2.73	2.75	2.74
AB	1.40	1.66	1.53
Mean	2.79	3.02	2.91

N	0	60	120	180	Mean
ROTATION					
LN 8	2.14	3.29	3.43	3.34	3.05
LN 3	2.64	4.08	3.65	4.29	3.66
LC 8	2.52	4.01	4.39	3.99	3.72
LC 3	1.47	2.91	3.20	3.33	2.73
AF	0.92	2.78	3.61	3.64	2.74
AB	0.55	1.79	2.29	1.50	1.53
Mean	1.71	3.14	3.43	3.35	2.91

N	0	60	120	180	Mean
FYMRES63					
NONE	1.60	3.06	3.28	3.22	2.79
FYM	1.81	3.23	3.57	3.47	3.02
Mean	1.71	3.14	3.43	3.35	2.91

N		0	60	120	180
ROTATION	**FYMRES63**				
LN 8	NONE	1.79	3.56	3.31	3.37
	FYM	2.49	3.02	3.55	3.30
LN 3	NONE	2.56	3.61	3.67	4.15
	FYM	2.72	4.55	3.62	4.43
LC 8	NONE	2.31	3.95	4.29	3.83
	FYM	2.72	4.06	4.48	4.15
LC 3	NONE	1.61	2.75	2.49	3.15
	FYM	1.33	3.08	3.90	3.50
AF	NONE	0.80	2.96	3.72	3.42
	FYM	1.04	2.61	3.50	3.85
AB	NONE	0.52	1.51	2.20	1.38
	FYM	0.57	2.08	2.37	1.62

GRAIN MEAN DM% 90.2

PLOT AREA HARVESTED 0.00183

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90/R/RN/8

CULTIVATION/WEEDKILLER

Object: To study the long-term effects of different methods of primary cultivation on a sequence of crops; weedkillers were also tested until 1981 - Great Harpenden I.

Sponsor: R. Moffitt.

The 30th year, w. barley.

For previous years see 'Details' 1967 and 1973 and 74-89/R/RN/8.

Design: 2 randomised blocks of 12 plots.

Whole plot dimensions: 12.8 x 12.2.

Treatments: All combinations of:-

Whole plots

1. **CLT CHOP** — Primary cultivations annually; straw chopped since 1985:

PLOUGH	Ploughed: 17 Aug, 1989
ROTA DIG	Cultivated by rotary digger: 17 Aug
DEEPTINE	Deep-tine cultivated, twice: 17 Aug

2. **SUBSOIL[82]** — Subsoiling in September 1982:

NONE	None
CNVNTIAL	Conventional vertical tine
PARAPLOW	'Paraplow'

XTR BURN — plus three extra treatments with straw burnt since 1985, direct drilled until 1984, heavy spring-tine cultivated on 19 July, 1989, in addition to basal cultivating, differing in subsoiling in September 1982:

NONE	None
CNVNTIAL	Conventional vertical tine
PARAPLOW	'Paraplow'

NOTES: (1) Straw was chopped on 18 July, 1989 and was burnt on XTR BURN on 19 July.
(2) The conventional vertical tine subsoiler had tines 76 cm apart and worked at a depth of about 50 cm.
(3) The 'Paraplow' had rigid tines set at a 45 degree angle. The tip of each tine was in line with the attachment of an adjacent tine. The tines were 51 cm apart and worked at a depth of about 38 cm.

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Basal applications: Manure: 'Nitram' at 460 kg. Weedkillers: Glyphosate at 0.27 kg in 200 l. Isoproturon at 1.7 kg with mecoprop at 2.0 kg in 200 l. Mecoprop at 2.2 kg, bromoxynil at 0.28 kg and ioxynil at 0.28 kg applied with the carbendazim and prochloraz in 200 l. Fungicides: Carbendazim at 0.15 kg and prochloraz at 0.40 kg. Propiconazole at 0.12 kg in 200 l. Insecticide: Deltamethrin at 5.0 g in 200 l.

Seed: Magie, sown at 160 kg.

Cultivations, etc.:- Glyphosate applied: 14 Sept, 1989. Heavy spring-tine cultivated, rotary harrowed twice, (CLT CHOP - PLOUGH plots rotary harrowed three times), seed sown: 26 Sept. Isoproturon with mecoprop applied: 17 Nov. Deltamethrin applied: 23 Nov. N applied: 22 Mar, 1990. Mecoprop, bromoxynil, ioxynil with carbendazim and prochloraz applied: 9 Apr. Propiconazole applied: 4 May. Combine harvested: 24 July.

GRAIN TONNES/HECTARE

***** Tables of means *****

SUBSOIL[82]	NONE	CNVNTIAL	PARAPLOW	Mean
CLT CHOP				
PLOUGH	7.19	6.82	6.47	6.83
ROTA DIG	7.73	7.07	7.61	7.47
DEEPTINE	7.53	7.49	7.46	7.49
Mean	7.49	7.13	7.18	7.26

XTR BURN	NONE	CNVNTIAL	PARAPLOW	Mean
	8.14	7.75	7.25	7.71

Grand mean 7.38

*** Standard errors of differences of means ***

XTR BURN	**CLT CHOP**	**SUBSOIL[82]**	**CLT CHOP SUBSOIL[82]**
0.370	0.214	0.214	0.370

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	11	0.370	5.0

GRAIN MEAN DM% 89.5

PLOT AREA HARVESTED 0.00280

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90/W/RN/12

ORGANIC MANURING

Object: To study, from crop yields and soil analyses, the effects of a range of types of organic matter - Woburn, Stackyard B.

Sponsor: P.R. Poulton.

The 26th year, w. wheat, w. beans.

For previous years see 'Details' 1973 and 74-89/W/RN/12.

Design for each crop: 2 blocks of 8 plots split into 6

Whole plot dimensions: 8.53 x 30.5.

Treatments: From 1966 to 1971 the experiment had a preliminary period designed to build up organic matter, derived from different sources. An arable rotation was started on two blocks in 1972 and the remaining two blocks in 1973. After a period of testing the residues built up, a further period of accumulation was started; on two blocks (which included ley sown in 1979) in 1981 and on the other two (which included ley sown in 1980) in 1982. On the first pair leys were ploughed for 1st test crop in 1987, on the second pair for 1st test crop in 1988.

3rd test crop w. wheat, after w. wheat 1988, potatoes 1989, tested all combinations of:

Whole plots

1. **TREATMNT** Previous treatments:

LC 8 GM	Eight-year clover/grass ley until 1987, green manure in the preliminary period
LC 8 PT	As above, peat in the preliminary period
LC 6 LC	Six-year clover/grass ley until 1987, clover/grass ley in the preliminary period
LC 6 LN	As above, grass ley with N in the preliminary period
FYM	Farmyard manure annually 1981 to 1986 and in the preliminary period
STRAW	Straw in both periods
FERT-FYM	Fertilizers only in both periods, rates of P, K & Mg equivalent to amounts in FYM
FERT-STR	Fertilizers only in both periods, rates of P, K & Mg equivalent to amounts in straw (+P)

Sub plots

2. **N** Nitrogen fertilizer in 1990 (kg N) as 'Nitro-Chalk':

0
50
100
150
200
250

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90/W/RN/12

4th test crop w. beans, after w.wheat 1987, potatoes 1988, w. wheat 1989, tested all combinations of:

Whole plots

1. **TREATMNT** Previous treatments:

LC 8 GM	Eight-year clover/grass ley until 1986, green manure in the preliminary period
LC 8 PT	As above, peat in the preliminary period
LC 6 LC	Six-year clover/grass ley until 1986, clover/grass ley in the preliminary period
LC 6 LN	As above, grass ley with N in the preliminary period
FYM	Farmyard manure annually 1981 to 1985 and in the preliminary period
STRAW	Straw in both periods
FERT-FYM	Fertilizers only in both periods, rates of P, K and Mg equivalent to amounts in FYM
FERT-STR	Fertilizers only in both periods rates of P, K and Mg equivalent to amounts in straw (+P)

Sub plots

2. **N RES** Residues of nitrogen fertilizer to w. wheat in 1989 (kg N):

(0)
(50)
(100)
(150)
(200)
(250)

Standard applications:

3rd test crop:

W. wheat: Manures: (0:18:36) at 560 kg. Weedkillers: Bromoxynil at 0.34 kg and clopyralid at 0.07 kg with isoproturon at 2.1 kg and fluroxypyr at 0.15 kg in 220 l. Fungicides: Propiconazole at 0.12 kg with chlorothalonil at 0.50 kg in 300 l. Insecticide: Carbofuran at 7.5 k. Molluscicide: Methiocarb at 0.20 kg applied with seed.

4th test crop:

W. beans: Manures: (0:24:24) at 420 kg. Muriate of potash at 170 kg. Manganese at 0.19 kg in 220 l. Weedkillers: Paraquat at 0.80 kg ion in 220 l. Propyzamide at 0.85 kg with simazine at 0.85 kg in 220 l. Fungicide: Fenpropimorph at 0.75 kg in 220 l. Insecticide: Deltamethrin at 7.5 g in 220 l applied on two occasions.

Seed: W. wheat: Mercia, sown at 180 kg with methiocarb pellets.
W. beans: Banner, sown at 18 seeds per square metre.

Cultivations, etc.:-

W. wheat: Ploughed: 20 Oct, 1989. Carbofuran applied, spring-tine cultivated: 30 Oct. PK applied: 31 Oct. Seed sown: 1 Nov. N applied: 27 Mar, 1990. Weedkillers applied: 24 Apr. Fungicides applied: 22 May. Combine harvested: 3 Aug.

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90/W/RN/12

Cultivations, etc.:-
W. beans: Subsoiled with tines, 50 cm apart and 40 cm deep: 13 Sept, 1989. Disced: 15 Sept. PK and K applied: 19 Sept. Paraquat applied: 10 Oct. Disced: 11 Oct. Seed broadcast by drill, ploughed in and rolled: 13 Oct. Propyzamide and simazine applied: 15 Oct. Mn applied: 5 Apr, 1990. Deltamethrin applied: 23 Apr and 18 May. Fenpropimorph applied: 11 July. Combine harvested: 10 Aug.

NOTES: (1) W. wheat. Because of bird damage and errors in harvesting, the yields of one whole plot and 2 sub plots were lost, with treatment combinations **TREATMNT** FERT-STR **N** 100 FERT-STR 150 and FERT-FYM whole plot (6 sub plots) Estimated values were used in the analysis.
(2) W. beans. Because of bird damage the yields of one block were treated as lost. The means presented are those of the remaining block.

W.WHEAT

GRAIN TONNES/HECTARE

***** Tables of means *****

N / **TREATMNT**	0	50	100	150	200	250	Mean
LC 8 GM	3.00	4.53	5.65	4.95	5.53	5.68	4.89
LC 8 PT	3.11	5.47	7.02	6.63	6.38	6.53	5.86
LC 6 LC	3.65	5.65	7.00	6.41	6.28	6.63	5.94
LC 6 LN	3.72	5.88	6.70	6.79	6.37	6.32	5.96
FYM	3.23	5.17	5.02	6.13	6.02	5.25	5.14
STRAW	3.18	5.20	6.25	6.63	6.08	6.23	5.59
FERT-FYM	2.99	4.62	5.97	6.81	5.10	5.61	5.18
FERT-STR	2.53	4.87	5.15	4.74	6.38	5.68	4.89
Mean	3.18	5.17	6.09	6.14	6.02	5.99	5.43

*** Standard errors of differences of means ***

TREATMNT	**N**	**TREATMNT** **N**
0.419	0.150	0.570

Except when comparing means with the same level(s) of **TREATMNT** 0.424

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	6	0.419	7.7
BLOCK.WP.SP	33	0.424	7.8

GRAIN MEAN DM% 90.4

SUB PLOT AREA HARVESTED 0.00183

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90/W/RN/12

W.BEANS

GRAIN TONNES/HECTARE

***** Tables of means *****

N RES TREATMNT	(0)	(50)	(100)	(150)	(200)	(250)	Mean
LC 8 GM	5.60	4.87	4.61	4.48	5.64	4.32	4.92
LC 8 PT	5.43	5.38	4.74	4.64	4.75	5.31	5.04
LC 6 LC	4.98	4.58	3.83	5.10	3.56	4.41	4.41
LC 6 LN	3.72	5.63	5.58	3.25	4.43	4.65	4.54
FYM	3.73	3.14	3.60	2.30	1.99	3.56	3.05
STRAW	4.41	2.46	2.57	3.79	2.30	2.31	2.97
FERT-FYM	4.51	3.88	4.46	3.68	4.41	3.52	4.08
FERT-STR	6.05	3.67	3.61	3.16	1.78	2.10	3.40
Mean	4.80	4.20	4.13	3.80	3.61	3.77	4.05

GRAIN MEAN DM% 89.7

SUB PLOT AREA HARVESTED 0.00202

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90/W/RN/13

INTENSIVE CEREALS

Object: To study the effects of leys of different duration, following prolonged intensive cereal cropping, on a sequence of arable crops - Woburn Stackyard I.

Sponsor: J. McEwen.

The 25th year, w. beans.

For previous years see 'Details' 1973 and 74-89/W/RN/13.

Design: 4 randomised blocks of 6 plots split into 6.

Treatments: Until 1977 the experiment tested all phases of the five-course rotation: ley, potatoes, cereal, cereal, cereal and continous cereal. From 1977 to 1980 all phases were cropped with cereal. The experiment was in two halves, one in which the cereal was w. wheat, sown on part of the site of the classical continuous wheat experiment 1877-1954 and one in which the cereal was s. barley, sown on part of the site of the classical continuous barley experiment 1877-1954. From 1981 the experiment was used to establish grass/clover leys of different durations for tests on w. wheat in 1987. Plots not in ley were sown to w. wheat on both halves of the experiment. All leys were ploughed for 1987 and the site sown to w. wheat. This was followed by potatoes in 1988, w. wheat in 1989, and by w. beans in 1990, testing all combinations of the following treatments:

Whole plots

1. **LEY AGE** Length of ley (until ploughing in summer 1986):

   1 YEAR
   2 YEARS
   3 YEARS
   4 YEARS
   5 YEARS
   6 YEARS

Sub plots

2. **N RES** Residues of nitrogen fertilizer to w. wheat in 1989 (kg N):

   (0)
   (50)
   (100)
   (150)
   (200)
   (250)

Basal applications: Manures: (0:24:24) at 420 kg. Muriate of potash at 170 kg. Manganese at 0.19 kg in 220 l. Weedkillers: Paraquat at 0.80 kg ion in 220 l. Propyzamide at 0.85 kg with simazine at 0.85 kg in 220 l. Fungicide: Fenpropimorph at 0.75 kg in 220 l. Insecticide: Deltamethrin at 7.5 g in 220 l applied on two occasions.

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90/W/RN/13

Seed: Banner sown at 18 seeds per square metre.

Cultivations, etc.:- Subsoiled with tines 50 cm apart and 40 cm deep: 15 Sept, 1989. PK and K applied: 19 Sept. Paraquat applied: 10 Oct. Disced: 11 Oct. Seed broadcast by drill, ploughed in and rolled: 12 Oct. Propyzamide and simazine applied: 15 Oct. Mn applied: 5 Apr, 1990. Deltamethrin applied: 23 Apr and 18 May. Fenpropimorph applied: 11 July. Combine harvested: 11 Aug.

GRAIN TONNES/HECTARE

***** Tables of means *****

N RES / LEY AGE	(0)	(50)	(100)	(150)	(200)	(250)	Mean
1 YEAR	4.41	4.12	4.26	3.80	3.42	4.35	4.06
2 YEARS	4.96	4.17	4.48	4.03	4.87	5.06	4.60
3 YEARS	5.11	4.41	4.46	4.81	4.51	4.35	4.61
4 YEARS	5.02	4.11	4.62	4.51	4.31	4.51	4.51
5 YEARS	5.33	5.09	4.81	5.18	4.50	4.68	4.93
6 YEARS	4.83	4.58	4.55	4.47	4.23	4.41	4.51
Mean	4.94	4.41	4.53	4.47	4.31	4.56	4.54

*** Standard errors of differences of means ***

LEY AGE	N RES	LEY AGE N RES
0.270	0.148	0.428

Except when comparing means with the same level(s) of **LEY AGE** 0.364

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	15	0.382	8.4
BLOCK.WP.SP	90	0.514	11.3

GRAIN MEAN DM% 89.9

SUB PLOT AREA HARVESTED 0.00132

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90/R/CS/10 and 90/W/CS/10

LONG TERM LIMING

Object: To study the effects of different amounts of lime and phosphate on the yields and compositions of a sequence of crops – Rothamsted (R) Sawyers I and Woburn (W) Stackyard C.

Sponsors: S.P. McGrath, J. McEwen, D.P. Yeoman.

The 29th year, s. beans.

For previous years see 'Details' 1967, 1973 and 74-89/R&W/CS/10.

Design: 2 randomised blocks of 16 plots split into 2.

Whole plot dimensions: 6.40 x 18.3.

Treatments: All combinations of:-

Whole plots

1. **CHALK** Residual effects of ground chalk (tonnes CaCO3) (total applied 1962-87):

		Rothamsted total		Woburn total	
R	W	1962-78	1982-87	1962-78	1982-87
0	0	0	0	0	0
15	9	7	8	6	3
24.5	25.5	15	9.5	14	11.5
52.5	45.5	30	22.5	23	22.5

2. **P** Residual effects of P fertilizer applied:

	Until 1978	1981	1982	1983		1988	
	R & W	R & W	R & W	R	W	R	W
0	0	0	0	0	0	0	0
P1	0	P1	P1	0	P2	P1	P1
P2	P	P1	0	P2	P2	P1	P1
P3	P	P3	P1	P2	P4	P3	P3

Rates 1981-83 P1, P2, P3, P4 = 25, 50, 75, 100 kg P as superphosphate

Sub plots

3. **MANGNESE** Manganese in 1990, cumulative to earlier applications:

0	None
MN	Manganese sprays

NOTES: (1) Until 1978 test P was applied cumulatively, rates varied with crop, none in 1979 and 1980. K was also applied cumulatively, to P1 and P3 plots.
Since 1981 K has been applied basally (none in 1986, 1987, 1989 and 1990).
(2) Manganese was applied at 0.19 kg Mn, as 'Vytel', in 200 l on 30 Apr, 1990 (R), at 0.096 kg Mn in 220 l on 30 Apr (W) repeated at 0.096 kg Mn in 200 l on 5 June (R).

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90/R/CS/10 and 90/W/CS/10

Basal applications:

Sawyers I (R): Weedkillers: Simazine at 0.17 kg and trietazine at 1.2 kg in 200 l. Insecticides: Phorate at 2.2 kg. Deltamethrin at 7.5 g in 200 l applied on two occasions. Pirimicarb at 0.14 kg in 200 l.

Stackyard C (W): Weedkillers: Glyphosate at 1.4 kg in 220 l. Simazine at 0.14 kg and trietazine at 0.97 kg in 220 l. Paraquat at 0.60 kg ion. Insecticide: Phorate at 1.8 kg.

Seed: Alfred, sown at 260 kg (R), 250 kg (W).

Cultivations, etc.:-

Sawyers I (R): Tine cultivated with vibrating tines 60 cm apart, 45 cm deep: 23 Aug, 1989. Ploughed: 24 Nov. Spring-time cultivated: 5 Mar, 1990. Rotary harrowed, phorate applied, rotary harrowed, seed sown, harrowed and rolled: 6 Mar. Simazine and trietazine applied: 12 Mar. Deltamethrin applied: 2 and 17 May. Pirimicarb applied: 5 June. Combine harvested: 15 Aug.

Stackyard C (W): Glyphosate applied: 1 Sept, 1989. Ploughed: 5 Jan, 1990. Phorate applied, power harrowed with crumbler attached, seed sown: 5 Mar. Simazine and trietazine applied: 13 Mar. Paraquat applied: 25 May.

NOTES: (1) At Woburn the crop established poorly as a result of bird damage. The few remaining plants were destroyed with weedkiller in May.

(2) At Rothamsted leaf samples were taken just after pod set to measure nutrient contents.

(3) At Rothamsted the components of yield were measured at maturity.

(4) At Rothamsted, most **CHALK** 0 plots failed and yields of the rest of these plots were negligible. They have been omitted from the analysis.

90/R/CS/10 SAWYERS I (R)

GRAIN TONNES/HECTARE

***** Tables of means *****

P / **CHALK**	0	P1	P2	P3	Mean
15	1.64	1.82	1.93	2.27	1.91
24.5	2.10	2.74	2.66	2.79	2.57
52.5	2.52	3.07	3.21	3.38	3.05
Mean	2.09	2.54	2.60	2.81	2.51

MANGNESE / **CHALK**	O	MN	Mean
15	2.01	1.82	1.91
24.5	2.59	2.56	2.57
52.5	3.10	3.00	3.05
Mean	2.56	2.46	2.51

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90/R/CS/10 SAWYERS I (R)

GRAIN TONNES/HECTARE

***** Tables of means *****

MANGNESE P	O	MN	Mean
0	2.15	2.02	2.09
P1	2.62	2.46	2.54
P2	2.61	2.60	2.60
P3	2.88	2.75	2.81
Mean	2.56	2.46	2.51

CHALK	MANGNESE P	O	MN
15	0	1.71	1.57
	P1	1.87	1.76
	P2	1.95	1.92
	P3	2.49	2.05
24.5	0	2.15	2.05
	P1	2.83	2.64
	P2	2.57	2.75
	P3	2.81	2.78
52.5	0	2.59	2.45
	P1	3.16	2.99
	P2	3.30	3.11
	P3	3.33	3.43

*** Standard errors of differences of means ***

CHALK	P	MANGNESE	CHALK P
0.156	0.180	0.056	0.311

CHALK MANGNESE	P MANGNESE	CHALK P MANGNESE
0.170	0.196	0.340

Except when comparing means with the same level(s) of

CHALK	0.097
P	0.112
CHALK.P	0.193

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	11	0.311	12.4
BLOCK.WP.SP	12	0.193	7.7

GRAIN MEAN DM% 68.7

SUB PLOT AREA HARVESTED 0.00200

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90/R/CS/140

CHEMICAL REFERENCE PLOTS

Object: To study the persistence in soil of agricultural chemicals applied annually, singly and in combination and their effects on soil microflora and on yield of continuous s. barley - Long Hoos V 3.

Sponsors: R.H. Bromilow, A.A. Evans, P.H. Nicholls.

The 17th year, s. barley.

For previous years see 74-89/R/CS/140.

Design: Single replicate of 32 plots.

Whole plot dimensions: 4.06 x 4.57.

Treatments, applied cumulatively every year except as stated:

All combinations of:-

1.	**WEEDKLLR**	Weedkiller in autumn:
	NONE	None
	GLYPHOS	Glyphosate at 1.4 kg to barley stubble each autumn from 1979 to 1984, at 0.72 kg in 1985, at 0.54 kg in 1986, at 1.3 kg in 1987 and at 1.5 kg in 1988 and 1989.
2.	**FUNGCIDE[1]**	Fungicide in autumn:
	NONE	None
	TRIADIM	Triadimefon at 0.25 kg in autumn 1981, 1982, 1984 to 1989, 0.28 kg in autumn 1983
3.	**FUNGCIDE[2]**	Fungicide in spring:
	NONE	None
	BENOMYL	Benomyl at 4 kg to seedbed
4.	**INSCTCDE**	Insecticide:
	NONE	None
	CHLORFEN	Chlorfenvinphos at 2 kg to the seedbed
5.	**NEMACIDE**	Nematicide:
	NONE	None
	ALDICARB	Aldicarb at 6 kg to the seedbed

NOTE: Glyphosate and triadimefon were applied in 220 l on 3 Oct, 1989. Other treatments were applied on 13 Mar, 1990.

Basal applications: Manures: 'Nitram' at 440 kg. Muriate of potash at 520 kg. Weedkillers: Bromoxynil at 0.20 kg, ioxynil at 0.20 kg and mecoprop at 1.6 kg in 220 l.

Seed: Klaxon, seed not dressed, sown at 160 kg.

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90/R/CS/140

Cultivations, etc.:- K applied: 24 Aug, 1989. Ploughed: 28 Nov. Spring-tine cultivated, N applied: 12 Mar, 1990. Rotary harrowed, seed sown: 13 Mar. Rolled: 14 Mar. Weedkillers applied: 23 May. Combine harvested: 1 Aug.

GRAIN TONNES/HECTARE

***** Tables of means *****

FUNGCIDE[1] / **WEEDKLLR**	NONE	TRIADIM	Mean
NONE	4.45	4.43	4.44
GLYPHOS	4.50	4.41	4.45
Mean	4.47	4.42	4.45

FUNGCIDE[2] / **WEEDKLLR**	NONE	BENOMYL	Mean
NONE	4.44	4.44	4.44
GLYPHOS	4.40	4.51	4.45
Mean	4.42	4.48	4.45

FUNGCIDE[2] / **FUNGCIDE[1]**	NONE	BENOMYL	Mean
NONE	4.51	4.44	4.47
TRIADIM	4.33	4.52	4.42
Mean	4.42	4.48	4.45

INSCTCDE / **WEEDKLLR**	NONE	CHLORFEN	Mean
NONE	4.55	4.34	4.44
GLYPHOS	4.46	4.45	4.45
Mean	4.50	4.39	4.45

INSCTCDE / **FUNGCIDE[1]**	NONE	CHLORFEN	Mean
NONE	4.46	4.49	4.47
TRIADIM	4.54	4.30	4.42
Mean	4.50	4.39	4.45

INSCTCDE / **FUNGCIDE[2]**	NONE	CHLORFEN	Mean
NONE	4.41	4.43	4.42
BENOMYL	4.60	4.36	4.48
Mean	4.50	4.39	4.45

NEMACIDE / **WEEDKLLR**	NONE	ALDICARB	Mean
NONE	4.42	4.47	4.44
GLYPHOS	4.36	4.55	4.45
Mean	4.39	4.51	4.45

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90/R/CS/140

GRAIN TONNES/HECTARE

***** Tables of means *****

NEMACIDE	NONE	ALDICARB	Mean
FUNGCIDE[1]			
NONE	4.41	4.54	4.47
TRIADIM	4.36	4.48	4.42
Mean	4.39	4.51	4.45

NEMACIDE	NONE	ALDICARB	Mean
FUNGCIDE[2]			
NONE	4.39	4.44	4.42
BENOMYL	4.38	4.58	4.48
Mean	4.39	4.51	4.45

NEMACIDE	NONE	ALDICARB	Mean
INSCTCDE			
NONE	4.53	4.47	4.50
CHLORFEN	4.24	4.55	4.39
Mean	4.39	4.51	4.45

FUNGCIDE[1]	NONE		TRIADIM	
WEEDKLLR FUNGCIDE[2]	NONE	BENOMYL	NONE	BENOMYL
NONE	4.42	4.48	4.46	4.40
GLYPHOS	4.60	4.39	4.19	4.63

FUNGCIDE[1]	NONE		TRIADIM	
WEEDKLLR INSCTCDE	NONE	CHLORFEN	NONE	CHLORFEN
NONE	4.54	4.36	4.56	4.31
GLYPHOS	4.39	4.61	4.53	4.29

FUNGCIDE[2]	NONE		BENOMYL	
WEEDKLLR INSCTCDE	NONE	CHLORFEN	NONE	CHLORFEN
NONE	4.43	4.45	4.67	4.22
GLYPHOS	4.39	4.40	4.53	4.49

FUNGCIDE[2]	NONE		BENOMYL	
FUNGCIDE[1] INSCTCDE	NONE	CHLORFEN	NONE	CHLORFEN
NONE	4.44	4.58	4.49	4.39
TRIADIM	4.38	4.27	4.71	4.32

FUNGCIDE[1]	NONE		TRIADIM	
WEEDKLLR NEMACIDE	NONE	ALDICARB	NONE	ALDICARB
NONE	4.39	4.51	4.44	4.43
GLYPHOS	4.43	4.57	4.28	4.54

FUNGCIDE[2]	NONE		BENOMYL	
WEEDKLLR NEMACIDE	NONE	ALDICARB	NONE	ALDICARB
NONE	4.54	4.34	4.29	4.59
GLYPHOS	4.25	4.55	4.47	4.56

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90/R/CS/140

GRAIN TONNES/HECTARE

***** Tables of means *****

	FUNGCIDE[2]	NONE		BENOMYL	
FUNGCIDE[1]	NEMACIDE	NONE	ALDICARB	NONE	ALDICARB
NONE		4.47	4.55	4.35	4.53
TRIADIM		4.31	4.34	4.41	4.62

	INSCTCDE	NONE		CHLORFEN	
WEEDKLLR	NEMACIDE	NONE	ALDICARB	NONE	ALDICARB
NONE		4.65	4.45	4.19	4.48
GLYPHOS		4.42	4.50	4.29	4.61

	INSCTCDE	NONE		CHLORFEN	
FUNGCIDE[1]	NEMACIDE	NONE	ALDICARB	NONE	ALDICARB
NONE		4.54	4.39	4.28	4.69
TRIADIM		4.53	4.56	4.20	4.40

	INSCTCDE	NONE		CHLORFEN	
FUNGCIDE[2]	NEMACIDE	NONE	ALDICARB	NONE	ALDICARB
NONE		4.40	4.42	4.39	4.47
BENOMYL		4.67	4.53	4.09	4.62

*** Standard errors of differences of means ***

Margins of two factor tables	0.061
Two factor tables	0.086
Three factor tables	0.122

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
WP	6	0.173	3.9

GRAIN MEAN DM% 85.4

PLOT AREA HARVESTED 0.00073

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90/R/CS/212

SEASONAL EFFECTS OF TAKE-ALL

Object: To study the incidence of take-all (Gaeumannomyces graminis) in continuous w. wheat and in first, second and third w. wheats after a break - Great Harpenden I.

Sponsors: D. Hornby, R.J. Gutteridge.

The 13th year, s. beans, w. wheat.

For previous years see 78-89/R/CS/212.

Design: 3 randomised blocks of 8 plots.

Whole plot dimensions: 5.33 x 10.0.

Treatments:

PREVCROP Previous crops before w. wheat 1990:

	78	79	80	81	82	83	84	85	86	87	88	89
W12	W	W	W	W	W	W	W	W	W	W	W	W
BE2 W3	W	BE	W	W	BE	W	W	BE	BE	W	W	W
BE1 W3	W	W	W	W	W	W	W	W	BE	W	W	W
BE1 W5	BE	W	W	BE	W	W	BE	W	W	W	W	W
BE1 W6	W	W	BE	W	W	BE	W	W	W	W	W	W
BE1 W1	W	BE	W	W	BE	W	W	BE	W	W	BE	W
BE1	W	W	BE	W	W	BE	W	W	BE	W	W	BE

BE = s. beans, W = w. wheat

NOTE: One additional crop sequence was in s. beans 1990, yields not taken.

Standard applications:

W. wheat: Manure: 'Nitram' at 410 kg. Weedkillers: Isoproturon at 1.7 kg in 200 l. Fluroxypyr at 0.15 kg with bromoxynil at 0.24 kg, clopyralid at 0.05 kg applied with the prochloraz in 200 l. Fungicides: Prochloraz at 0.40 kg. Propiconazole at 0.12 kg with carbendazim at 0.25 kg and maneb at 1.6 kg in 200 l. Insecticide: Deltamethrin at 6.2 g in 200 l.

Seed: W. wheat: Avalon, sown at 180 kg.
S. beans: Alfred, sown at 260 kg.

Cultivations, etc.:-

Both crops: Ploughed: 31 Aug, 1989. Rotary harrowed twice: 2 Oct. Rotary harrowed: 3 Oct.

W. wheat: Seed sown: 4 Oct, 1989. Isoproturon applied: 20 Nov. Insecticide applied: 22 Feb, 1990. N applied: 17 Apr. Remaining weedkillers with prochloraz applied: 25 Apr. Remaining fungicides applied: 14 June. Combine harvested: 10 Aug.

S. beans: Spring-tine cultivated, rotary harrowed, seed sown: 6 Mar, 1990. Combine harvested: 16 Aug.

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90/R/CS/212

NOTE: Plant and soil samples were taken frequently during the season to assess take-all. Additional soil samples were taken to measure the suppressiveness of the soil to the take-all fungus.

GRAIN TONNES/HECTARE

***** Tables of means *****

PREVCROP

W12	4.15
BE2 W3	3.65
BE1 W3	4.19
BE1 W5	4.05
BE1 W6	4.27
BE1 W1	4.71
BE1	5.98
Mean	4.43

*** Standard errors of differences of means ***

PREVCROP
0.286

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	12	0.350	7.9

GRAIN MEAN DM% 89.2

PLOT AREA HARVESTED 0.00220

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90/R/CS/302

EYESPOT RESISTANCE TO MBC

Object: To study the development of resistance to MBC fungicides in eyespot and the ability of resistant strains to survive, spread and infect - Meadow.

Sponsor: G.L. Bateman.

The sixth year, w. wheat.

For previous years see 85-89/R/CS/302.

Design: 2 randomised blocks of 4 plots split into 6.

Whole plot dimensions: 12.0 x 24.0.

Treatments: All combinations of:-

Whole plots

1. **FUNGCIDE** Fungicides applied cumulatively to 1985, 1986, 1987, 1988 and 1989 treatments:

NONE	None
CARB	Carbendazim at 0.25 kg
PRO	Prochloraz at 0.40 kg
CARB+PRO	Carbendazim at 0.15 kg + prochloraz at 0.40 kg

Sub plots

2. **EYE INOC** Eyespot inoculum, applied in first year only:

NATURAL	Natural background population (duplicated)
W 19R 1S	Inoculated with wheat strains in proportion 19 resistant to one sensitive
W 1R 19S	As above but one resistant to 19 sensitive
R 19R 1S	Inoculated with rye strains, 19 resistant to one sensitive
R 1R 19S	As above but one resistant to 19 sensitive

NOTES: (1) Fungicide treatments were applied in 200 l on 24 Nov, 1989 and 30 Mar, 1990.
(2) The eyespot inoculum was colonised on oat seed and this was broadcast in October, 1984.

Basal applications: Manure: 'Nitram' at 580 kg. Weedkillers: Glyphosate at 0.27 kg in 200 l. Chlorotoluron at 3.0 kg with cyanazine at 0.75 kg in 200 l. Fluroxypyr at 0.15 kg with bromoxynil at 0.34 kg and clopyralid at 0.07 kg in 200 l. Insecticide: Deltamethrin at 6.2 g in 200 l.

Seed: Avalon, sown at 180 kg.

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90/R/CS/302

Cultivations, etc.:- Heavy spring-tine cultivated: 22 Aug, 1989. Glyphosate applied: 14 Sept. Ploughed: 22 Sept. Rotary harrowed twice, seed sown: 3 Oct. Chlorotoluron with cyanazine applied: 23 Nov. Deltamethrin applied: 22 Feb, 1990. N applied: 18 Apr. Fluroxypyr, bromoxynil and clopyralid applied: 30 Apr. Combine harvested: 10 Aug.

NOTE: Eyespot and sharp eyespot were assessed at fortnightly intervals from May - July on the EYE INOC NATURAL plots only.

GRAIN TONNES/HECTARE

***** Tables of means *****

EYE INOC / **FUNGCIDE**	NATURAL	W 19R 1S	W 1R 19S	R 19R 1S	R 1R 19S	Mean
NONE	5.03	5.03	4.23	4.87	5.07	4.88
CARB	4.74	4.53	4.50	4.64	4.99	4.69
PRO	4.66	4.26	4.79	4.57	4.69	4.60
CARB+PRO	4.89	4.70	4.80	4.91	4.88	4.84
Mean	4.83	4.63	4.58	4.75	4.91	4.75

*** Standard errors of differences of means ***

EYE INOC	**FUNGCIDE*** **EYE INOC**	
0.191	0.381	min.rep
0.165	0.330	max-min

	EYE INOC
max-min	NATURAL v any of the remainder
min.rep	any of the remainder

* Within the same level of **FUNGCIDE** only

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP.SP	24	0.381	8.0

GRAIN MEAN DM% 90.1

SUB PLOT AREA HARVESTED 0.00138

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90/R/CS/309 and 90/W/CS/309

LONG-TERM STRAW INCORPORATION

Object: To study the effects of mixing and depths of incorporation of straw on straw decomposition, soil nitrogen content, soil physical condition, pests, diseases and on the establishment, growth and yield of w. wheat - Rothamsted (R) Great Knott III and Woburn (W) Far Field I.

Sponsors: R.D. Prew, E.T.G. Bacon, D.G. Christian, R.J. Gutteridge, J.F. Jenkyn, B.R. Kerry, W. Powell, A.D. Todd.

Associate sponsor: D.S. Powlson.

The sixth year, w. wheat.

For previous years see 85-89/R&W/CS/309.

Design: 4 randomised blocks of 12 plots (R).
2 randomised blocks of 12 plots (W).

Whole plot dimensions: 9.0 x 28.0 (R).
9.0 x 30.0 (W).

Treatments, applied cumulatively in successive years: All combinations of:-

1. **STRAW** Treatments to straw from previous wheat:

BURNT	Burnt
CHOPPED	Chopped and spread (duplicated)

2. **CULTIVTN** Cultivations:

TINE 10	Tine cultivated to 10 cm depth
TN10PL20	Tine cultivated to 10 cm depth, ploughed to 20 cm
TN10TN20	Tine cultivated to 10 cm depth and again to 20 cm
PLOUGH20	Ploughed to 20 cm depth

NOTES: (1) Straw was chopped by trailed straw chopper and spread on 8 Aug, 1989 (R), 22 Aug (W) and burnt, 9 Aug (R), 24 Aug (W).
(2) A heavy spring-tine cultivator was used to cultivate to 10 cm depth, on 15 Aug (R), 30 Aug and 21 Sept (W). A chisel plough was used to cultivate to 20 cm depth, on 16 Aug (R) and a deep-tine cultivator to 20 cm on 11 and 21 Sept (W).
(3) Ploughed plots were ploughed to 20 cm depth, on 15 Aug (R), 11 Sept (W).

Basal applications:
Great Knott III (R): Manures: 'Nitram' at 120 kg, followed by 580 kg. Weedkillers: Paraquat at 0.40 kg ion with a wetting agent, 'Enhance' at 100 ml, in 200 l. Chlorotoluron at 3.0 kg with cyanazine at 0.75 kg in 400 l. Isoproturon at 2.1 kg in 200 l. Fluroxypyr at 0.20 kg with fenoxaprop-ethyl at 0.18 kg in 200 l. Fungicides: Chlorothalonil at 1.0 kg with propiconazole at 0.12 kg in 200 l.

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90/R/CS/309 and 90/W/CS/309

Basal applications:

Far Field I (W): Manures: 'Nitram' at 120 kg, followed by 560 kg. Weedkillers: Glyphosate at 0.36 kg in 220 l. Isoproturon at 1.5 kg with isoxaben at 0.075 kg in 220 l. Metsulfuron-methyl at 6.0 g in 220 l. Fungicides: Chlorothalonil at 0.50 kg with propiconazole at 0.12 kg in 300 l.

Seed: Pastiche, sown at 180 kg.

Cultivations, etc.:-

Great Knott III (R): Paraquat and wetting agent applied: 2 Oct, 1989. Rotary harrowed: 4 Oct. Seed sown: 5 Oct. Harrowed and rolled: 6 Oct. Chlorotoluron and cyanazine applied: 22 Nov. Isoproturon applied: 23 Feb, 1990. N applied: 2 Mar and 12 Apr. Fluroxypyr and fenoxaprop-ethyl applied: 30 Apr. Fungicides applied: 31 May. Combine harvested: 13 Aug.

Far Field I (W): Subsoiled with vibrating tines 50 cm apart and 40 cm deep, glyphosate applied: 6 Oct, 1989. Rotary harrowed with crumbler attached, seed sown: 7 Oct. Isoproturon and isoxaben applied: 11 Dec. N applied: 23 Feb, 1990 and 5 Apr. Metsulfuron-methyl applied: 24 Apr. Fungicides applied: 22 May. Combine harvested: 6 Aug.

NOTES: (1) Small yields from CHOPPED TINE 10 and CHOPPED TN10TN20 at Rothamsted were attributed to the much smaller plant populations occuring on these treatments following the application of the weedkillers on 22 Nov.

(2) Establishment counts were made in autumn and total dry matter was measured in spring.

(3) Pests and fungal diseases were assessed at intervals during the season.

(4) Components of yield were measured and numbers of volunteer ears counted.

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90/R/CS/309 GREAT KNOTT III (R)

GRAIN TONNES/HECTARE

***** Tables of means *****

CULTIVTN	TINE 10	TN10PL20	TN10TN20	PLOUGH20	Mean
STRAW					
BURNT	6.72	6.35	6.00	6.32	6.35
CHOPPED	3.47	6.22	4.83	6.18	5.18
Mean	4.55	6.26	5.22	6.23	5.57

*** Standard errors of differences of means ***

STRAW	**CULTIVTN**	**STRAW CULTIVTN**	
		0.529	min.rep
0.229	0.305	0.458	max-min
		0.374	max.rep

	STRAW
min.rep	BURNT only
max-min	BURNT v CHOPPED
max.rep	CHOPPED only

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	37	0.748	13.4

GRAIN MEAN DM% 90.3

PLOT AREA HARVESTED 0.00621

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90/W/CS/309 FAR FIELD I (W)

GRAIN TONNES/HECTARE

***** Tables of means *****

CULTIVTN / STRAW	TINE 10	TN10PL20	TN10TN20	PLOUGH20	Mean
BURNT	5.69	3.45	5.84	3.87	4.71
CHOPPED	4.67	4.82	5.54	4.26	4.82
Mean	5.01	4.36	5.64	4.13	4.79

*** Standard errors of differences of means ***

STRAW	CULTIVTN	STRAW CULTIVTN	
		0.637	min.rep
0.276	0.368	0.552	max-min
		0.451	max.rep

	STRAW
min.rep	BURNT only
max-min	BURNT v CHOPPED
max.rep	CHOPPED only

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	15	0.637	13.3

GRAIN MEAN DM% 90.7

PLOT AREA HARVESTED 0.00638

https://doi.org/10.23637/ERADOC-1-42

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90/R/CS/311

EFFECTS OF SHALLOW STRAW INCORPORATION

Object: To study the effects of shallow straw incorporation on straw decomposition, toxin production, pests and diseases and on the establishment, growth and yield of winter wheat - West Barnfield I.

Sponsors: R.D. Prew, D.G. Christian, R.J. Gutteridge, E.T.G. Bacon, J.F. Jenkyn, B.R. Kerry, R. Moffitt, W. Powell, A.D. Todd.

The sixth year, w. wheat.

For previous years see 85-89/R/CS/311.

Design: Single replicate of 3 x a half replicate of 2 x 2 x 2 x 2 x 2.

Whole plot dimensions: 9.0 x 57.0.

Treatments: Combinations of:-

Whole plots

1. **STRAW**		Treatments to straw of previous wheat:
	BURNT	Burnt on 16 Aug, 1989
	BALED	Baled and removed on 16 Aug
	CHOPPED	Chopped on 16 Aug
2. **CULTTIME**		Time of cultivation, to 10 cm depth:
	EARLY	Cultivated by rotary grubber on 16 Aug, 1989
	LATER	Cultivated by rotary grubber on 30 Aug

Sub plots

3. **AUTN RES**		Residues of autumn N last applied autumn 1988, kg N per annum:
	(0)	
	(50)	
4. **FUNGCIDE**		Fungicides:
	O	None
	FULL	Full programme:- Triadimefon at 0.12 kg and carbendazim at 0.25 kg in 200 l on 24 Nov, 1989. Prochloraz at 0.40 kg and carbendazim at 0.15 kg in 200 l on 9 Apr, 1990 Propiconazole at 0.125 kg in 200 l on 17 May Propiconazole at 0.125 kg with carbendazim at 0.25 kg and maneb at 1.6 kg in 200 l on 14 June
5. **INSCTCDE**		Insecticides:
	O	None
	CYP+PIR	Cypermethrin at 25 g in 200 l on 1 Nov, 1989 Pirimicarb at 0.14 kg in 200 l on 14 June

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90/R/CS/311

6. **MOLLCIDE** Molluscicide:

0	None
METHCARB	Methiocarb at 0.22 kg on 6 Oct, 1989

NOTE: STRAW BURNT plots were disced the same day after burning.

Basal applications: Manures: 'Nitram' at 120 kg and later at 580 kg. Weedkillers: Glyphosate at 0.27 kg in 200 l. Chlorotoluron at 3.0 kg with cyanazine at 0.75 kg in 200 l. Bromoxynil at 0.34 kg and clopyralid at 0.07 kg with fluroxypyr at 0.15 kg in 200 l.

Seed: Pastiche, sown at 200 kg.

Cultivations, etc.:- Glyphosate applied: 21 Sept, 1989. Rotary harrowed, seed sown: 5 Oct. Chlorotoluron with cyanazine applied: 10 Nov. First N applied: 2 Mar, 1990. Second N applied: 12 Apr. Remaining weedkillers applied: 3 May. Combine harvested: 11 Aug.

NOTE: Growth was measured and incidence of pests and diseases was assessed at intervals during the season. Ears of volunteers were counted prior to harvest and components of yield were measured.

GRAIN TONNES/HECTARE

***** Tables of means *****

CULTTIME	EARLY	LATER	Mean
STRAW			
BURNT	7.48	7.91	7.69
BALED	6.29	6.87	6.58
CHOPPED	5.55	7.01	6.28
Mean	6.44	7.27	6.85

AUTN RES	(0)	(50)	Mean
STRAW			
BURNT	7.73	7.65	7.69
BALED	6.50	6.66	6.58
CHOPPED	6.28	6.29	6.28
Mean	6.84	6.87	6.85

AUTN RES	(0)	(50)	Mean
CULTTIME			
EARLY	6.44	6.44	6.44
LATER	7.23	7.30	7.27
Mean	6.84	6.87	6.85

FUNGCIDE	O	FULL	Mean
STRAW			
BURNT	7.65	7.74	7.69
BALED	6.50	6.66	6.58
CHOPPED	6.27	6.30	6.28
Mean	6.81	6.90	6.85

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90/R/CS/311

GRAIN TONNES/HECTARE

***** Tables of means *****

FUNGCIDE	O	FULL	Mean
CULTTIME			
EARLY	6.40	6.48	6.44
LATER	7.21	7.32	7.27
Mean	6.81	6.90	6.85

FUNGCIDE	O	FULL	Mean
AUTN RES			
(0)	6.83	6.85	6.84
(50)	6.79	6.95	6.87
Mean	6.81	6.90	6.85

INSCTCDE	O	CYP+PIR	Mean
STRAW			
BURNT	7.47	7.92	7.69
BALED	6.50	6.67	6.58
CHOPPED	5.92	6.65	6.28
Mean	6.63	7.08	6.85

INSCTCDE	O	CYP+PIR	Mean
CULTTIME			
EARLY	6.11	6.77	6.44
LATER	7.14	7.39	7.27
Mean	6.63	7.08	6.85

INSCTCDE	O	CYP+PIR	Mean
AUTN RES			
(0)	6.63	7.05	6.84
(50)	6.63	7.11	6.87
Mean	6.63	7.08	6.85

INSCTCDE	O	CYP+PIR	Mean
FUNGCIDE			
O	6.63	6.98	6.81
FULL	6.62	7.18	6.90
Mean	6.63	7.08	6.85

MOLLCIDE	O	METHCARB	Mean
STRAW			
BURNT	7.68	7.71	7.69
BALED	6.55	6.62	6.58
CHOPPED	6.22	6.35	6.28
Mean	6.81	6.89	6.85

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90/R/CS/311

GRAIN TONNES/HECTARE

***** Tables of means *****

MOLLCIDE	O	METHCARB	Mean
CULTTIME			
EARLY	6.37	6.51	6.44
LATER	7.26	7.27	7.27
Mean	6.81	6.89	6.85

MOLLCIDE	O	METHCARB	Mean
AUTN RES			
(0)	6.83	6.85	6.84
(50)	6.80	6.94	6.87
Mean	6.81	6.89	6.85

MOLLCIDE	O	METHCARB	Mean
FUNGCIDE			
O	6.70	6.91	6.81
FULL	6.93	6.87	6.90
Mean	6.81	6.89	6.85

MOLLCIDE	O	METHCARB	Mean
INSCTCDE			
O	6.52	6.73	6.63
CYP+PIR	7.10	7.05	7.08
Mean	6.81	6.89	6.85

*** Standard errors of differences of means ***

AUTN RES	FUNGCIDE	INSCTCDE	MOLLCIDE
0.072	0.072	0.072	0.072

STRAW*	CULTTIME*	STRAW*	CULTTIME*
AUTN RES	AUTN RES	FUNGCIDE	FUNGCIDE
0.125	0.102	0.125	0.102

AUTN RES	STRAW*	CULTTIME*	AUTN RES
FUNGCIDE	INSCTCDE	INSCTCDE	INSCTCDE
0.102	0.125	0.102	0.102

FUNGCIDE	STRAW*	CULTTIME*	AUTN RES
INSCTCDE	MOLLCIDE	MOLLCIDE	MOLLCIDE
0.102	0.125	0.102	0.102

FUNGCIDE	INSCTCDE
MOLLCIDE	MOLLCIDE
0.102	0.102

* Within the same level of **STRAW**, **CULTTIME** or **STRAW.CULTTIME** only

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90/R/CS/311

GRAIN TONNES/HECTARE

**** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
WP.SP	20	0.250	3.6

GRAIN MEAN DM% 90.5

SUB PLOT AREA HARVESTED 0.00276

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90/R/CS/323

CEREAL SEQUENCES AND TAKE-ALL

Object: To study the effects on take-all (Gaeumannomyces graminis) and yield of including triticale in cereal sequences - West Barnfield II.

Sponsors: R.J. Gutteridge, D. Hornby, R.D. Prew.

The third year, w. barley, w. oats, w. triticale, w. wheat, s. barley.

For previous years see 88-89/R/CS/323

Design: 3 randomised blocks of 26 plots.

Whole plot dimensions: 3.0 x 10.0.

CROPSEQ	Crop sequences (1988, 1989 and 1990 respectively):
SB WB SB	S. barley, w. barley, s. barley
WW WW SB	W. wheat, w. wheat, s. barley
WB WB WB	W. barley, w. barley, w. barley (duplicated)
WB WO WB	W. barley, w. oats, w. barley
WO WB WB	W. oats, w. barley, w. barley
WT WT WB	W. triticale, w. triticale, w. barley
WW WW WB	W. wheat, w. wheat, w. barley
WB WB WO	W. barley, w. barley, w. oats
WT WT WO	W. triticale, w. triticale, w. oats
WW WW WO	W. wheat, w. wheat, w. oats
WB WB WT	W. barley, w. barley, w. triticale
WT WB WT	W. triticale, w. barley, w. triticale
WT WO WT	W. triticale, w. oats, w. triticale
WO WT WT	W. oats, w. triticale, w. triticale
WT WT WT	W. triticale, w. triticale, w. triticale (duplicated)
WW WW WT	W. wheat, w. wheat, w. triticale
WB WB WW	W. barley, w. barley, w. wheat
WW WB WW	W. wheat, w. barley, w. wheat
WW WO WW	W. wheat, w. oats, w. wheat
WO WW WW	W. oats, w. wheat, w. wheat
WT WT WW	W. triticale, w. triticale, w. wheat
WW WT WW	W. wheat, w. triticale, w. wheat
WW WW WW	W. wheat, w. wheat, w. wheat (duplicated)

Standard applications: Manures: (0:18:36) at 300 kg. N at 30 kg to all cereals followed by N at 120 kg (s. barley), 170 kg (w. wheat), 150 kg (w. barley), 120 kg (w. triticale and w. oats), all as 'Nitram'. Weedkillers: Glyphosate at 0.27 kg in 200 l. Methabenzthiazuron at 1.6 kg in 200 l. Fluroxypyr at 0.20 kg with metsulfuron-methyl at 6.0 g in 200 l. Fungicides: Fenpropimorph at 0.75 kg in 200 l. Prochloraz at 0.40 kg in 200 l (to w. wheat only). Propiconazole at 0.12 kg with carbendazim at 0.25 kg and maneb at 1.6 kg in 200 l (to w. wheat and s. barley only).

SEED: W. barley: Magie, sown at 150 kg.
W. oats: Image, sown at 190 kg.
W. triticale: Lasko, sown at 180 kg.
W. wheat: Mercia, sown at 180 kg.
S. barley: Klaxon, sown at 160 kg.

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90/R/CS/323

Cultivations, etc.:- PK applied: 30 Aug, 1989. Heavy spring-tine cultivated: 1 Sept. Glyphosate applied: 14 Sept. Ploughed: 21 Sept. Rotary harrowed twice: 14 Oct. Rotary harrowed, w. cereals sown: 16 Oct. Methabenzthiazuron applied: 19 Oct. First N applied: 2 Mar, 1990. Second N (to s. barley only), rotary harrowed twice, seed sown (s. barley only): 7 Mar. Second N (to w. cereals) applied: 18 Apr. Fluroxypyr with metsulfuron-methyl applied: 27 Apr. Fenpropimorph applied: 1 May. Prochloraz (to w. wheat only) applied: 8 May. Propiconazole, carbendazim and maneb (to w. wheat and s. barley only) applied: 14 June. Combine harvested: 24 July (w. barley), 26 July (s. barley, w. oats and w. triticale) and 7 Aug (w. wheat).

NOTE: Plants were sampled in April, June and July to assess take-all, eyespot and sharp eyespot. Soil cores were taken after harvest to assess take-all infectivity.

W.WHEAT, W. BARLEY, S. BARLEY, W.TRITICALE, W.OATS

GRAIN TONNES/HECTARE

***** Tables of means *****

CROPSEQ	
SB WB SB	5.54
WW WW SB	5.73
WB WB WB	7.09
WB WO WB	7.85
WO WB WB	7.81
WT WT WB	7.19
WW WW WB	6.69
WB WB WO	7.32
WT WT WO	7.02
WW WW WO	6.96
WB WB WT	7.39
WT WB WT	7.34
WT WO WT	7.72
WO WT WT	7.49
WT WT WT	7.02
WW WW WT	6.65
WB WB WW	9.05
WW WB WW	8.67
WW WO WW	9.09
WO WW WW	8.90
WT WT WW	7.29
WW WT WW	6.89
WW WW WW	6.91
Mean	7.33

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90/R/CS/323

GRAIN TONNES/HECTARE

*** Standard errors of differences of means ***

CROPSEQ	
0.393	min.rep
0.340	max-min
0.278	max.rep

	CROPSEQ
max.rep	WB WB WB v WT WT WT or WW WW WW
min.rep	any of the remainder
max-min	WB WB WB or WT WT WT or WW WW WW v any of the remainder

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	53	0.481	6.6

GRAIN MEAN DM% 88.8

PLOT AREA HARVESTED 0.00228

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90/R/CS/326 and 90/W/CS/326

AMOUNTS OF STRAW

Object: To study the effects of a range of amounts of straw incorporated into the soil on w.wheat - Rothamsted (R) Great Knott III, Woburn (W) Far Field I.

Sponsors: D.G. Christian, J.F. Jenkyn, E.T.G. Bacon, R.D. Prew.

The fourth year, w. wheat.

For previous years see 87-89/R&W/CS/326.

Design: 4 randomised blocks of 4 plots (R).
3 randomised blocks of 4 plots (W).

Whole plot dimensions: 3.0 x 13.5 (R).
3.0 x 14.5 (W).

Treatments:

STRAW Amounts of straw incorporated into seedbed (t per ha 85% DM), cumulative to previous annual dressings:

		R	W
NONE	None	-	-
NORMAL	Normal	5.1	6.5
2 NORMAL	Twice normal	10.2	13.0
4 NORMAL	Four times normal	20.4	26.0

NOTES: (1) Straw treatments were applied on 9 Aug, 1989 (R) and (W) and chopped by trailed straw chopper and spread on 16 Aug (R), 22 Aug (W).
(2) At Rothamsted straw was incorporated by plough on 22 Aug. At Woburn it was heavy-tine cultivated in to 10 cm on 30 Aug, and rotary cultivated on 21 Sept.

Basal applications:
Great Knott III (R): Manures: 'Nitram' at 120 kg followed by 580 kg. Weedkillers: Paraquat at 0.40 kg ion with a wetting agent, 'Enhance' at 100 ml, in 200 l. Chlorotoluron at 3.0 kg with cyanazine at 0.75 kg in 400 l. Isoproturon at 2.1 kg in 200 l. Fluroxypyr at 0.20 kg with fenoxaprop-ethyl at 0.18 kg in 200 l. Fungicides: Chlorothalonil at 1.0 kg with propiconazole at 0.12 kg in 200 l.
Far Field I (W): Manures: 'Nitram' at 120 kg followed by 560 kg. Weedkillers: Glyphosate at 0.36 kg in 220 l. Isoproturon at 1.5 kg with isoxaben at 75 g in 220 l. Metsulfuron-methyl at 6.0 g in 220 l. Fungicides: Chlorothalonil at 0.50 kg with propiconazole at 0.12 kg in 300 l.

Seed: Pastiche, sown at 180 kg.

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90/R/CS/326 and 90/W/CS/326

Cultivations, etc.:-

Great Knott III (R): Ploughed: 22 Aug, 1989. Paraquat and wetting agent applied: 2 Oct. Rotary harrowed: 4 Oct. Seed sown: 5 Oct. Harrowed and rolled: 6 Oct. Chlorotoluron and cyanazine applied: 22 Nov. Isoproturon applied: 23 Feb, 1990. N applied: 2 Mar and 12 Apr. Fluroxypyr and fenoxaprop-ethyl applied: 30 Apr. Fungicides applied: 31 May. Combine harvested: 13 Aug.

Far Field I (W): Heavy-tine cultivated: 30 Aug, 1989 and 11 Sept. Rotary cultivated: 21 Sept. Subsoiled with vibrating tines 50 cm apart and 40 cm deep, glyphosate applied: 6 Oct. Rotary harrowed with crumbler attached, seed sown: 7 Oct. Isoproturon and isoxaben applied: 11 Dec. N applied: 23 Feb, 1990 and 5 Apr. Metsulfuron-methyl applied: 24 Apr. Fungicides applied: 22 May. Combine harvested: 6 Aug.

NOTES: (1) Establishment counts were made in autumn. Shoot numbers and dry weight at growth stage 30, fertile ear numbers after anthesis and harvest index were measured.

(2) Foot and root rots were assessed in summer.

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90/R/CS/326 GREAT KNOTT III (R)

GRAIN TONNES/HECTARE

***** Tables of means *****

STRAW	
NONE	6.48
NORMAL	6.66
2 NORMAL	6.26
4 NORMAL	7.04
Mean	6.61

*** Standard errors of differences of means ***

STRAW
0.310

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	9	0.439	6.6

GRAIN MEAN DM% 90.2

PLOT AREA HARVESTED 0.00305

90/W/CS/326 FAR FIELD I (W)

GRAIN TONNES/HECTARE

***** Tables of means *****

STRAW	
NONE	6.76
NORMAL	6.54
2 NORMAL	6.37
4 NORMAL	6.40
Mean	6.52

*** Standard errors of differences of means ***

STRAW
0.506

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	6	0.620	9.5

GRAIN MEAN DM% 89.9

PLOT AREA HARVESTED 0.00318

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90/R/CS/327

CONTROL OF STEM NEMATODE

Object: To study the effects of rates of carbofuran and row spacings on the incidence of stem nematode (Ditylenchus dipsaci) and yield of four varieties of lucerne - Long Hoos IV 3.

Sponsor: A.G. Whitehead.

The third year, lucerne.

For previous years see 88-89/R/CS/327.

Design: 2 randomised blocks of 20 plots.

Whole plot dimensions: 1.22 x 8.84.

Treatments: All combinations of:-

1. **VARIETY** Varieties:

   EUROPE
   EUVA
   VELA
   VERTUS

2. **CARBRATE** Rates of carbofuran (kg) in first year only:

   0.0
   1.5

3. **ROWSPACE** Spacings between rows (cm):

   15 15 (6 inches)
   30 30 (12 inches)

plus four extra treatments:

CA3 RO15 Varieties, given 3 kg carbofuran, on 15 cm row spacing, in first year only:

EUROPE
EUVA
VELA
VERTUS

NOTE: Carbofuran was applied to lucerne on 7 Apr, 1988 at sowing.

Basal applications: Manures: (0:18:36) at 500 kg.

Cultivations, etc.:- PK applied: 23 Nov, 1989. Cut: 15 May, 1990, 27 June, 16 Aug and 14 Nov.

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90/R/CS/327

1ST CUT (15/5/90) DRY MATTER TONNES/HECTARE

***** Tables of means *****

CARBRATE	0.0	1.5	Mean
VARIETY			
EUROPE	2.69	2.41	2.55
EUVA	3.72	2.92	3.32
VELA	1.73	1.88	1.81
VERTUS	4.60	4.60	4.60
Mean	3.18	2.95	3.07

ROWSPACE	15	30	Mean
VARIETY			
EUROPE	2.85	2.25	2.55
EUVA	3.38	3.26	3.32
VELA	1.82	1.79	1.81
VERTUS	5.12	4.08	4.60
Mean	3.29	2.85	3.07

ROWSPACE	15	30	Mean
CARBRATE			
0.0	3.32	3.05	3.18
1.5	3.26	2.64	2.95
Mean	3.29	2.85	3.07

	ROWSPACE	15	30
VARIETY	CARBRATE		
EUROPE	0.0	2.72	2.65
	1.5	2.98	1.85
EUVA	0.0	3.95	3.48
	1.5	2.80	3.04
VELA	0.0	1.40	2.05
	1.5	2.25	1.52
VERTUS	0.0	5.20	4.01
	1.5	5.03	4.16

CA3 RO15	EUROPE	EUVA	VELA	VERTUS	Mean
	2.51	3.59	2.76	4.70	3.39

GRAND MEAN 3.13

*** Standard errors of differences of means ***

CA3 RO15	VARIETY	CARBRATE	ROWSPACE
0.474	0.237	0.168	0.168

VARIETY CARBRATE	VARIETY ROWSPACE	CARBRATE ROWSPACE	VARIETY CARBRATE ROWSPACE
0.335	0.335	0.237	0.474

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90/R/CS/327

1ST CUT (15/5/90) DRY MATTER TONNES/HECTARE

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	19	0.474	15.1

1ST CUT MEAN DM% 17.3

2ND CUT (27/6/90) DRY MATTER TONNES/HECTARE

***** Tables of means *****

CARBRATE	0.0	1.5	Mean
VARIETY			
EUROPE	2.70	2.42	2.56
EUVA	3.57	3.48	3.52
VELA	1.72	1.78	1.75
VERTUS	4.45	4.64	4.55
Mean	3.11	3.08	3.10

ROWSPACE	15	30	Mean
VARIETY			
EUROPE	2.79	2.33	2.56
EUVA	3.87	3.17	3.52
VELA	1.92	1.58	1.75
VERTUS	4.88	4.21	4.55
Mean	3.37	2.82	3.10

ROWSPACE	15	30	Mean
CARBRATE			
0.0	3.21	3.01	3.11
1.5	3.52	2.64	3.08
Mean	3.37	2.82	3.10

	ROWSPACE	15	30
VARIETY	**CARBRATE**		
EUROPE	0.0	2.74	2.66
	1.5	2.84	2.00
EUVA	0.0	3.65	3.48
	1.5	4.09	2.87
VELA	0.0	1.76	1.68
	1.5	2.09	1.48
VERTUS	0.0	4.71	4.20
	1.5	5.05	4.23

CA3 RO15	EUROPE	EUVA	VELA	VERTUS	Mean
	2.45	3.68	2.45	4.31	3.22

GRAND MEAN 3.12

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90/R/CS/327

2ND CUT (27/6/90) DRY MATTER TONNES/HECTARE

*** Standard errors of differences of means ***

CA3 RO15	VARIETY	CARBRATE	ROWSPACE
0.383	0.191	0.135	0.135

VARIETY CARBRATE	VARIETY ROWSPACE	CARBRATE ROWSPACE	VARIETY CARBRATE ROWSPACE
0.271	0.271	0.191	0.383

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	19	0.383	12.3

2ND CUT MEAN DM% 19.2

3RD CUT (16/8/90) DRY MATTER TONNES/HECTARE

***** Tables of means *****

CARBRATE / VARIETY	0.0	1.5	Mean
EUROPE	3.36	2.75	3.05
EUVA	3.86	4.01	3.94
VELA	2.01	1.90	1.96
VERTUS	4.27	4.71	4.49
Mean	3.38	3.34	3.36

ROWSPACE / VARIETY	15	30	Mean
EUROPE	3.31	2.80	3.05
EUVA	4.20	3.67	3.94
VELA	1.91	2.00	1.96
VERTUS	4.58	4.40	4.49
Mean	3.50	3.22	3.36

ROWSPACE / CARBRATE	15	30	Mean
0.0	3.50	3.26	3.38
1.5	3.51	3.18	3.34
Mean	3.50	3.22	3.36

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90/R/CS/327

3RD CUT (16/8/90) DRY MATTER TONNES/HECTARE

***** Tables of means *****

VARIETY	ROWSPACE / CARBRATE	15	30
EUROPE	0.0	3.31	3.42
	1.5	3.31	2.18
EUVA	0.0	4.49	3.24
	1.5	3.91	4.11
VELA	0.0	1.85	2.18
	1.5	1.98	1.82
VERTUS	0.0	4.34	4.21
	1.5	4.82	4.59

CA3 RO15	EUROPE	EUVA	VELA	VERTUS	Mean
	3.85	4.54	2.71	3.72	3.70

GRAND MEAN 3.43

*** Standard errors of differences of means ***

CA3 RO15	VARIETY	CARBRATE	ROWSPACE
0.603	0.301	0.213	0.213

VARIETY CARBRATE	VARIETY ROWSPACE	CARBRATE ROWSPACE	VARIETY CARBRATE ROWSPACE
0.426	0.426	0.301	0.603

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	19	0.603	17.6

3RD CUT MEAN DM% 27.5

4TH CUT (14/11/90) DRY MATTER TONNES/HECTARE

***** Tables of means *****

CARBRATE / VARIETY	0.0	1.5	Mean
EUROPE	0.63	0.39	0.51
EUVA	0.66	0.70	0.68
VELA	0.19	0.14	0.17
VERTUS	0.72	0.82	0.77
Mean	0.55	0.51	0.53

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4TH CUT (14/11/90) DRY MATTER TONNES/HECTARE

***** Tables of means *****

ROWSPACE	15	30	Mean
VARIETY			
EUROPE	0.63	0.40	0.51
EUVA	0.81	0.54	0.68
VELA	0.14	0.19	0.17
VERTUS	0.73	0.80	0.77
Mean	0.58	0.48	0.53

ROWSPACE	15	30	Mean
CARBRATE			
0.0	0.60	0.51	0.55
1.5	0.56	0.46	0.51
Mean	0.58	0.48	0.53

	ROWSPACE	15	30
VARIETY	CARBRATE		
EUROPE	0.0	0.68	0.59
	1.5	0.58	0.20
EUVA	0.0	0.95	0.37
	1.5	0.68	0.71
VELA	0.0	0.15	0.24
	1.5	0.13	0.14
VERTUS	0.0	0.61	0.82
	1.5	0.85	0.78

CA3 RO15	EUROPE	EUVA	VELA	VERTUS	Mean
	0.70	0.89	0.23	0.54	0.59

GRAND MEAN 0.54

*** Standard errors of differences of means ***

CA3 RO15	VARIETY	CARBRATE	ROWSPACE
0.287	0.144	0.101	0.101

VARIETY CARBRATE	VARIETY ROWSPACE	CARBRATE ROWSPACE	VARIETY CARBRATE ROWSPACE
0.203	0.203	0.144	0.287

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	19	0.287	52.9

4TH CUT MEAN DM% 24.4

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TOTAL OF 4 CUTS DRY MATTER TONNES/HECTARE

***** Tables of means *****

CARBRATE	0.0	1.5	Mean
VARIETY			
EUROPE	9.38	7.97	8.68
EUVA	11.81	11.11	11.46
VELA	5.65	5.70	5.68
VERTUS	14.05	14.76	14.40
Mean	10.22	9.89	10.05

ROWSPACE	15	30	Mean
VARIETY			
EUROPE	9.57	7.78	8.68
EUVA	12.26	10.65	11.46
VELA	5.80	5.55	5.68
VERTUS	15.31	13.50	14.40
Mean	10.74	9.37	10.05

ROWSPACE	15	30	Mean
CARBRATE			
0.0	10.63	9.82	10.22
1.5	10.85	8.92	9.89
Mean	10.74	9.37	10.05

ROWSPACE		15	30
VARIETY	CARBRATE		
EUROPE	0.0	9.44	9.33
	1.5	9.71	6.24
EUVA	0.0	13.04	10.57
	1.5	11.49	10.73
VELA	0.0	5.16	6.14
	1.5	6.44	4.97
VERTUS	0.0	14.86	13.24
	1.5	15.75	13.76

CA3 RO15	EUROPE	EUVA	VELA	VERTUS	Mean
	9.50	12.70	8.16	13.27	10.91

GRAND MEAN 10.22

*** Standard errors of differences of means ***

CA3 RO15	VARIETY	CARBRATE	ROWSPACE
1.532	0.766	0.542	0.542

VARIETY CARBRATE	VARIETY ROWSPACE	CARBRATE ROWSPACE	VARIETY CARBRATE ROWSPACE
1.083	1.083	0.766	1.532

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TOTAL OF 4 CUTS DRY MATTER TONNES/HECTARE

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	19	1.532	15.0

TOTAL OF 4 CUTS MEAN DM% 22.1

PLOT AREA HARVESTED 0.00045

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90/R/CS/331

TAKE-ALL INOCULATION

Object: To compare a range of methods of artificially inoculating take-all (Gaeumannomyces graminis) and to relate amounts of disease established to the yield and grain quality of w. wheat - Great Harpenden I.

Sponsors: D. Hornby, G.L. Bateman, R.J. Gutteridge.

The second year, w. wheat.

For previous year see 89/R/CS/331

Design: 4 randomised blocks of 9 plots.

Whole plot dimensions: 3.0 x 22.0.

Treatments:

INOCMETH	Methods of inoculating take-all to w. wheat in the first year, none to w. wheat in 1990:
NONE(O)	None (w. oats in the first year)
NONE(W)	None (w. wheat in the first year)
I PRE PL	Infective inoculum applied to soil surface pre-ploughing
N PRE PL	Non-infective inoculum applied to soil surface pre-ploughing
I PRE SO	Infective inoculum applied by fertilizer drill to 10 cm depth before rotary harrowing and sowing wheat
N PRE SO	Non-infective inoculum applied as above
I CD	Infective inoculum combine drilled with the seed
N CD	Non-infective inoculum combine drilled with the seed

NOTES: (1) Inoculum was prepared on autoclaved oat seed.
(2) The sequence of cultivations in the first year was identical for all treatments: Plough to 23 cm, cultivate to level, traverse with fertilizer drill to 10 cm, rotary harrow to 10 cm and sow wheat with combine drill. In the second year the cultivations, all basal, were: Ploughed on 31 Aug, 1989, rotary harrowed twice on 2 Oct and rotary harrowed and seed sown, 4 Oct.
(3) An additional treatment, required for comparisons in future years, was sown with w. oats.

Basal applications: Manure: 'Nitram' at 580 kg. Weedkillers: Isoproturon at 1.7 kg in 200 l (wheat only). Fluroxypyr at 0.15 kg with bromoxynil at 0.24 kg, clopyralid at 0.05 kg applied with the prochloraz in 200 l. Fungicides: Prochloraz at 0.40 kg. Propiconazole at 0.12 kg with carbendazim at 0.25 kg and maneb at 1.6 kg in 200 l. Insecticide: Deltamethrin at 6.2 g in 200 l.

Seed: W. wheat: Mercia, sown at 180 kg.
W. oats: Image, sown at 190 kg.

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90/R/CS/311

Cultivations, etc.:- Isoproturon (wheat only) applied: 20 Nov, 1989. Deltamethrin applied: 22 Feb, 1990. N applied: 12 Apr. Remaining weedkillers with prochloraz applied: 25 Apr. Remaining fungicides applied: 14 June. Combine harvested: 11 Aug.

NOTE: Plants were sampled on six occasions between mid-March and mid-July to assess take-all. Quality assessments were made on the grain. Soil cores were taken after harvest to assess take-all infectivity.

W.WHEAT

GRAIN TONNES/HECTARE

***** Tables of means *****

INOCMETH	
NONE(O)	8.02
NONE(W)	7.48
I PRE PL	6.98
N PRE PL	7.50
I PRE SO	6.85
N PRE SO	7.87
I CD	7.59
N CD	7.39
Mean	7.46

*** Standard errors of differences of means ***

INOCMETH
0.413

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	21	0.583	7.8

GRAIN MEAN DM% 88.9

PLOT AREA HARVESTED 0.00500

W.OATS

GRAIN TONNES/HECTARE 7.37

MEAN DM% 88.0

PLOT AREA HARVESTED 0.00506

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90/W/CS/336

SET-ASIDE STUDY

Object: To compare different treatments of land temporarily withdrawn from arable cropping and to study their effects on nitrate leaching and on subsequent wheat crops - Woburn Horsepool.

Sponsors: R.D. Prew, E.T.G. Bacon, M.V. Hewitt, D.P. Yeoman, J.F. Jenkyn, R.J. Gutteridge, W. Powell, J. Ashby.

Associate sponsors: D.L.O. Smith, I. Shield.

The second year, w. wheat.

For first year see 89/W/CS/336.

Design: 3 randomised blocks of 7 plots split into 7 sub plots.

Whole plot dimensions: 10.0 x 24.0.

Treatments: All combinations of:-

Whole plots

1. **LAND TRT**		Land treatment in 1989, after s. wheat 1988 (all treatments ploughed in autumn 1989 before w. wheat):
	CA WW	Cultivated in autumn, sown to w. wheat
	CA RA	Cultivated in autumn, sown to ryegrass in autumn, topped in spring
	SA CA FA	Straw chopped and spread in autumn, cultivated in autumn, sown to forage rape in autumn, topped in spring
	CA CS	Cultivated in autumn, cultivated in spring
	SA CS	Straw chopped and spread in autumn, cultivated in spring
	WT	Weeds topped
	WT CS TS	Weeds topped, cultivated in spring, trefoil sown in spring, topped

Sub plots

2.	**N**	Nitrogen fertilizer (kg N) as 'Nitro-Chalk':
	0	
	37	
	56	
	73	
	92	
	110	
	128	

NOTES: (1) An additional fallow sub plot was present, systematically arranged on one side of each whole plot.
(2) Rates of N shown were those used in error for the intended N scale of 0, 80, 120, 160, 200, 240, 280.

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Standard applications: W. wheat: Weedkillers: Isoproturon at 2.1 kg with isoxaben at 75 g in 220 l. Isoproturon at 2.1 kg with fluroxypyr at 0.15 kg in 220 l. Fungicides: Propiconazole at 0.12 kg with chlorothalonil at 0.50 kg in 300 l. Insecticide: Deltamethrin at 6.2 g in 220 l.

Seed: W. wheat: Mercia, sown at 170 kg.

Cultivations, etc.:- Straw chopped on CA WW plots: 21 Aug, 1989. Ploughed: 31 Aug. Rolled: 1 Sept. Rotary cultivated with crumbler attached: 28 Sept. Seed sown: 29 Sept. Isoproturon and isoxaben applied: 11 Dec. Insecticide applied: 23 Feb, 1990. N applied: 27 Mar. Isoproturon and fluroxypyr applied: 24 Apr. Fungicides applied: 22 May. Fallow rotary cultivated: 12 June. Wheat combine harvested: 8 Aug.

NOTE: Amounts of soil and plant dry matter were measured in autumn, spring and summer. Assessments of plant cover were made in autumn and spring.

GRAIN TONNES/HECTARE

***** Tables of means *****

NITROGEN	0	37	56	73	92	110	128	Mean
LAND TRT								
CA WW	3.34	4.72	5.50	5.11	5.94	6.21	6.26	5.30
CA RA	3.13	5.24	5.80	5.06	5.54	6.13	6.56	5.35
SA CA FA	4.51	5.90	6.59	6.20	6.70	6.24	6.30	6.06
CA CS	5.65	6.91	7.10	7.58	7.93	8.09	8.51	7.40
SA CS	5.27	6.84	7.05	7.47	7.77	7.33	7.87	7.08
WT	3.67	5.93	6.63	6.84	6.98	7.09	7.15	6.33
WT CS TS	5.04	5.64	5.70	5.93	6.39	6.32	6.51	5.93
Mean	4.37	5.88	6.34	6.31	6.75	6.77	7.02	6.21

*** Standard errors of differences of means ***

LAND TRT	**NITROGEN**	**LAND TRT NITROGEN**
0.671	0.171	0.791
Except when comparing means with the same level(s) of **LAND TRT**		0.452

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	12	0.822	13.2
BLOCK.WP.SP	84	0.553	8.9

GRAIN MEAN DM% 89.6

SUB PLOT AREA HARVESTED 0.00199

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90/R/CS/337

PREVIOUS CROPS AND N

Object: To study the effects of a range of crops on the nitrogen requirements, quality and yield of a subsequent w. barley crop - Webbs.

Sponsors: D.G. Christian, N.L. Carreck.

The second year, w. barley.

For first year see 89/R/CS/337.

Design: 3 randomised blocks of 5 plots split into 6 sub plots.

Whole plot dimensions: 21.0 x 20.0.

Treatments: All combinations of:-

Whole plots

1. **PREVCROP** Crops in 1989, all w. barley in 1990:

W BARLEY	W. barley
W BEANS	W. beans
W OATS	W. oats
RAPE	W. oilseed rape, resown to s. oilseed rape
POTATOES	Potatoes

Sub plots

2. **N** Nitrogen fertilizer (kg N) as 'Nitro-Chalk' (27% N):

0
50
75
100
125
150

Basal applications: Weedkillers: Glyphosate at 0.27 kg in 200 l. Isoproturon at 1.7 kg in 200 l. Mecoprop at 2.0 kg in 200 l. Bromoxynil at 0.28 kg, ioxynil at 0.28 kg and mecoprop at 2.2 kg with the prochloraz in 200 l. Fungicides: Prochloraz at 0.60 kg. Propiconazole at 0.12 kg in 200 l.

Seed: Halcyon, sown at 160 kg.

Cultivations, etc.:- Glyphosate applied: 14 Sept, 1989. Ploughed: 16 Sept. Rotary harrowed: 20 Sept. Rotary harrowed, seed sown: 21 Sept. Isoproturon applied: 29 Nov. Mecoprop applied: 4 Jan, 1990. Bromoxynil, ioxynil and mecoprop with prochloraz applied: 9 Apr. Propiconazole applied: 3 May. Combine harvested: 24 July.

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NOTES: (1) Soil samples taken in November and March were analysed for nitrate and ammonium contents.
(2) Plant samples taken from November to May were analysed for nitrate-N contents.
(3) Crop samples were taken from March to maturity to measure plant and shoot numbers, dry weights and nitrogen uptakes.
(4) Components of yield were measured at maturity.

GRAIN TONNES/HECTARE

***** Tables of means *****

N	0	50	75	100	125	150	Mean
PREVCROP							
W BARLEY	3.03	4.59	4.97	5.61	5.80	6.22	5.04
W BEANS	3.77	5.43	6.18	6.70	7.02	7.54	6.11
W OATS	3.43	5.28	5.96	6.52	7.05	7.32	5.93
RAPE	3.61	5.26	5.57	6.66	6.81	7.25	5.86
POTATOES	4.40	6.46	6.55	7.67	7.73	7.71	6.75
Mean	3.65	5.40	5.85	6.63	6.88	7.21	5.94

*** Standard errors of differences of means ***

	PREVCROP	**N**	**PREVCROP N**
	0.278	0.116	0.366
Except when comparing means with the same level(s) of **PREVCROP**			0.260

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	8	0.341	5.7
BLOCK.WP.SP	50	0.318	5.4

GRAIN MEAN DM% 89.3

SUB PLOT AREA HARVESTED 0.00204

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90/W/CS/339

SULPHUR AND NITROGEN

Object: To study the effects of differing amounts of sulphur on rates of sulphur uptake and on the yield of w. oilseed rape and the extent to which responses are affected by amounts of nitrogen fertilizer - Woburn, Butt Close II.

Sponsor: S.P. McGrath.

The second year, w. oilseed rape.

For first year see 89/W/CS/339.

Design: 3 randomised blocks of 12 plots.

Whole plot dimensions: 4.0 x 10.0.

Treatments: All combinations of:-

1. **S** Rates of sulphur (kg S) as calcium sulphate cumulative to 1989 applications:

   0
   10
   20
   40

2. **N** Rates of nitrogen (kg N) as 'Nitro-Chalk' (27% N) cumulative to 1989 applications:

   0
   180
   230

Basal applications: Weedkillers: Benazolin at 0.38 kg with clopyralid at 0.062 kg in 220 l. Insecticides: Deltamethrin at 6.2 g in 220 l. Triazophos at 0.42 kg applied with the fungicide. Fungicide: Iprodione at 0.50 kg in 300 l. Irrigation: 25 mm divided equally between two occasions.

Seed: Libravo, sown at 6.0 kg.

Cultivations, etc.:- Wheat straw removed: 24 Aug, 1989. Subsoiled, ploughed and rolled: 1 Sept. Rotary harrowed with crumbler attached, seed sown: 8 Sept. Rolled: 9 Sept. Irrigated: 28 Sept and 4 Oct. Weedkillers applied: 23 Feb, 1990. N and S applied: 9 March. Deltamethrin applied: 5 Apr. Iprodione and triazophos applied: 24 May. Combine harvested: 27 July.

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90/W/CS/339

GRAIN (AT 90% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

N S	0	180	230	Mean
0	0.16	0.35	0.29	0.27
10	0.19	0.37	0.76	0.44
20	0.14	0.19	0.39	0.24
40	0.17	0.29	0.43	0.30
Mean	0.16	0.30	0.47	0.31

*** Standard errors of differences of means ***

S	N	S N
0.083	0.072	0.143

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	22	0.175	56.2

GRAIN MEAN DM% 78.1

STRAW (AT 90% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

N S	0	180	230	Mean
0	0.55	1.54	1.05	1.04
10	0.50	1.51	2.31	1.44
20	0.56	1.01	1.33	0.97
40	0.33	1.67	1.28	1.09
Mean	0.49	1.43	1.49	1.14

STRAW MEAN DM% 80.4

PLOT AREA HARVESTED 0.00120

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90/W/CS/342

CATCH CROPS

Object: To compare a range of catch crops for their ability to take up N during the autumn, to measure rates of mineralization of N after incorporating them in spring and to measure their effects on the yield of a subsequent spring barley crop - Woburn, Road Piece.

Sponsors: D.S. Powlson, D.G. Christian.

The first year, clover, forage rape, Phacelia, ryegrass, rye, mustard, w. wheat, s. barley.

Design: 3 randomised blocks of 11 plots split into 2 sub plots criss cross.

Whole plot dimensions: 8.0 x 10.0.

Treatments: All combinations of:-

Whole plots

1. **CROPS** Catch crops and subsequent crops:

Sown 11 Aug, 1989, ploughed in on 6 Mar, 1990, s. barley sown 8 Mar:

AL CL SB	Alsike clover
FA CU SB	Fallow, cultivated to keep soil bare
FA UC SB	Fallow, uncultivated, weeds and volunteers allowed to grow
FO RA SB	Forage rape
PH TA SB	Phacelia tanacetifolia
RY GR SB	Ryegrass
RYE SB	Rye
WH MU SB	White mustard
WM+RY SB	White mustard + rye

Sown 5 Oct, 1989, ploughed in on 6 Mar, 1990, s. barley sown 8 Mar:

WW SB	Winter wheat

Sown 5 Oct, 1989, taken to normal maturity:

W WHEAT	Winter wheat

Sub plots

2. **N** Nitrogen fertilizer on 8 Mar, 1990 (kg N) as 'Nitro-Chalk' (27% N):

0
50

Standard applications: Manure, to w. wheat taken to maturity: 150 kg N as 'Nitro-Chalk'. Weedkillers to all w. wheat: Glyphosate at 0.36 kg in 200 l. Isoproturon at 1.5 kg with isoxaben at 75 g in 220 l.

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90/W/CS/342

Basal applications: Weedkillers: Bromoxynil at 0.24 kg and clopyralid at 0.05 kg with mecoprop at 1.8 kg in 220 l. Fungicide: Fenpropimorph at 0.75 kg in 220 l.

Seed: Alsike clover: Sown at 10 kg.
Forage rape: Giant, sown at 30 kg.
Phacelia tanacetifolia: Sown at 12 kg.
Ryegrass: Contessa, sown at 25 kg.
Rye: Halo, sown at 180 kg.
White mustard: Sown at 30 kg.
White mustard + rye: Sown at 30 and 180 kg respectively.
W. wheat: Mercia, sown at 180 kg.
S. barley: Blenheim, seed dressed triadimenol and fuberidazole, sown at 160 kg

Cultivations, etc.:-
All crops except w. wheat: Rotary cultivated twice, except on uncultivated fallow, seeds sown: 11 Aug, 1989. Deep-tine cultivated fallow only: 21 Sept. Ploughed: 6 Mar, 1990. Treatment N applied, rotary harrowed with crumbler attached, s. barley sown: 8 Mar. Weedkillers applied: 23 May. Fungicide applied: 24 May. Combine harvested: 9 Aug.
W. wheat: Rotary cultivated twice: 26 Sept, 1989. Glyphosate applied: 4 Oct. Seed sown and rolled: 5 Oct. Isoproturon and isoxaben applied: 11 Dec. Wheat not taken to maturity ploughed: 6 Mar, 1990. Remaining wheat, test N applied: 8 Mar, standard N applied: 6 Apr, bromoxynil, clopyralid and mecoprop applied: 23 May, fungicide applied: 24 May, combine harvested: 7 Aug.

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90/W/CS/342

GRAIN TONNES/HECTARE

***** Tables of means *****

N	0	50	Mean
CROP			
AL CL SB	2.38	3.04	2.71
FA CU SB	2.78	3.65	3.21
FA UC SB	2.87	4.01	3.44
FO RA SB	3.19	3.47	3.33
PH TA SB	3.45	1.96	2.71
RY GR SB	2.33	2.61	2.47
RYE SB	2.87	2.64	2.76
WH MU SB	2.42	3.23	2.82
WM+RY SB	2.49	3.94	3.21
WW SB	2.72	3.77	3.25
W WHEAT	5.34	5.38	5.36
Mean	2.99	3.43	3.21

*** Standard errors of differences of means ***

CROP	CROP* N
0.531	0.75

* Within the same level of N only

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCKN.BLOCK.WP	40	0.919	28.7

GRAIN MEAN DM% *

SUB PLOT AREA HARVESTED 0.00003

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90/W/CS/346

SET-ASIDE STUDY

Object: To compare different treatments of land temporarily withdrawn from arable cropping and to study their effects on nitrate leaching and on subsequent wheat crops - Woburn, White Horse.

Sponsors: R.D. Prew, E.T.G. Bacon, M.V. Hewitt, D.P. Yeoman, J.F. Jenkyn, R.J. Gutteridge, W. Powell, J. Ashby.

Associate sponsors: D.L.O. Smith, I. Shield, M.D. Helps.

The first year, w. wheat, forage rape, ryegrass, trefoil.

Design: 3 randomised blocks of 7 plots.

Whole plot dimensions: 10.0 x 24.0.

Treatments:

1. **LAND TRT**	Land treatment, after w. wheat 1989:	
	CA WW	Cultivated in autumn, sown to w. wheat
	CA RA	Cultivated in autumn, sown to ryegrass in autumn, topped in spring
	SA CA FA	Straw chopped and spread in autumn, cultivated in autumn, sown to forage rape in autumn, topped in spring
	CA CS	Cultivated in autumn, cultivated in spring
	SA CS	Straw chopped and spread in autumn, cultivated in spring
	WT	Weeds topped
	WT CS TS	Weeds topped, cultivated in spring, trefoil sown in spring, topped

NOTE: Yields were taken only from CA WW.

Standard applications, seed and cultivations, etc.:-

CA WW: W. wheat straw baled and carted: 22 Aug, 1989. Ploughed: 29 Aug. Rolled: 1 Sept. Rotary harrowed with crumbler attached, Mercia wheat seed sown at 150 kg: 2 Oct. Weedkillers: Isoxaben at 75 g with isoproturon at 1.5 kg in 200 l applied: 11 Dec. Bromoxynil at 0.34 kg, clopyralid at 0.07 kg with fluroxypyr at 0.15 kg in 220 l applied: 28 Apr, 1990. Manures: N applied at 40 kg: 8 Mar and at 160 kg: 17 Apr as 'Nitram'. Fungicides: Propiconazole at 0.12 kg with chlorothalonil at 0.50 kg in 300 l applied: 22 May. Combine harvested: 7 Aug.

CA RA: W. wheat straw baled and carted: 22 Aug, 1989. Ploughed: 29 Aug. Rolled: 1 Sept. Rotary cultivated with crumbler attached, Italian ryegrass seed sown at 25 kg and rolled: 7 Sept. Topped: 18 May, 1990, 5 July and 11 Sept.

SA CA FA: W. wheat straw chopped: 22 Aug, 1989. Ploughed: 29 Aug. Rolled: 1 Sept. Rotary cultivated with crumbler attached, Giant forage rape seed sown at 10 kg and rolled: 7 Sept. Topped: 18 May, 1990, 5 July and 11 Sept.

CA CS: W. wheat straw baled and carted: 22 Aug, 1989. Ploughed: 29 Aug. Weedkillers: Paraquat at 0.80 kg ion in 250 l applied: 12 Jan, 1990 and 15 Mar. Cultivated with 'thistle bar': 25 May and 17 July.

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Standard applications, seed and cultivations, etc.:-

SA CS: W. wheat straw chopped: 22 Aug, 1989. Shallow-tine cultivated: 30 Apr, 1990 and 11 June.

WT: W. wheat straw baled and carted: 22 Aug, 1989. Topped: 18 May, 1990, 5 July and 11 Sept.

WT CS TS: W. wheat straw baled and carted: 22 Aug, 1989. Topped, ploughed, rotary harrowed, Virgo Pajayere trefoil seed, inoculated with Rhizobium, sown at 10 kg: 15 May, 1990. Topped: 11 Sept.

Previous crops: Potatoes 1988, w. wheat 1989.

NOTE: Soil nitrogen, dry matter and plant cover were assessed in autumn, spring and summer.

GRAIN TONNES/HECTARE (CA WW PLOT ONLY) 4.91

MEAN DM% 89.4

PLOT AREA HARVESTED 0.00528

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90/W/CS/347

GREEN CROPS FOR SET-ASIDE

Object: To obtain information on the establishment and maintenance of sown crops and unsown vegetation in a long term, up to five-year, set-aside area given no chemical inputs. Effects on soil nitrate and leaching after ploughing are also studied - Woburn, Horsepool Lane Close II.

Sponsors: R.D. Prew, E.T.G. Bacon, M.V. Hewitt, D.P. Yeoman.

Design: 6 blocks of 6 plots.

Whole plot dimensions: 6.5 x 26.0.

The first year, w. wheat, ryegrass, clover.

Treatments in first year:

CROPS	Crops:
RY LF	Ryegrass, cuttings left in situ
RY+CL LF	Ryegrass + clover, cuttings left in situ
RY+CL RE	Ryegrass + clover, cuttings removed
RY+N RE	Ryegrass given 100 kg N in spring, cuttings removed
TU LF	Tumbledown, natural regrowth, cuttings left in situ
W WHEAT	Winter wheat

NOTE: Yields were taken from the w. wheat and from the ley plots from which cuttings were removed.

Standard applications:

All crops except w. wheat and tumbledown: Manure: N at 100 kg as 'Nitram' to RY+N RE plots only.

W. wheat: Manures: N at 40 kg and at 160 kg as 'Nitram'. Weedkillers: Isoproturon at 1.5 kg with isoxaben at 75 g in 200 l. Bromoxynil at 0.34 kg and clopyralid at 0.07 kg with fluroxypyr at 0.15 kg in 220 l. Flamprop-M-isopropyl at 0.60 kg in 300 l. Fungicides: Propiconazole at 0.12 kg with chlorothalonil at 0.50 kg in 300 l.

Seed: Perennial ryegrass: Melle, sown at 15 kg and resown at same rate.
Perennial ryegrass and white clover: Melle, sown at 15 kg and Huia at 4 kg, resown at same rate.
W. wheat: Mercia, sown at 150 kg.

Cultivations, etc.:-

All crops except w. wheat and tumbledown: Ploughed: 30 Aug, 1989. Rolled: 1 Sept. Rotary harrowed with crumbler attached, twice, seed sown, rolled: 6 Sept. Spike harrowed and seed resown: 15 Mar, 1990. N applied: 21 Mar. Cut: 17 May, 5 July and 24 Oct. Cuttings removed from RY+CL RE and RY+N RE plots: 14 June, 12 July and 7 Nov.

Tumbledown plots: Topped: 17 May, 5 July and 7 Nov, 1990.

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90/W/CS/347

Cultivations, etc.:-

W. wheat: Ploughed: 30 Aug, 1989. Rolled: 1 Sept. Rotary harrowed with crumbler attached: 25 Sept. Seed sown: 26 Sept. Isoproturon and isoxaben applied: 11 Dec. N applied: 21 Mar, 1990 and 17 Apr. Bromoxynil, clopyralid and fluroxypyr applied: 28 Apr. Flamprop-M -isopropyl applied: 17 May. Fungicides applied: 23 May. Combine harvested: 7 Aug.

Previous crops: S. barley 1988, w. oats 1989.

NOTE: Assessments were made of numbers and species of seeds in the soil in autumn, of soil nitrogen in autumn and spring and of plant numbers and plant cover in spring and autumn.

GRASS

1ST CUT (17/5/90) DRY MATTER TONNES/HECTARE

***** Tables of means*****

CROPS	RY+CL RE	RY+N RE	Mean
	2.87	4.17	3.52

*** Standard errors of differences of means ***

CROPS
0.391

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	5	0.677	19.2

1ST CUT MEAN DM% 21.9

2ND CUT (5/7/90) DRY MATTER TONNES/HECTARE

***** Tables of means*****

CROPS	RY+CL RE	RY+N RE	Mean
	1.02	1.20	1.11

*** Standard errors of differences of means ***

CROPS
0.138

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	5	0.239	21.6

2ND CUT MEAN DM% 28.4

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90/W/CS/347

GRASS

3RD CUT (24/10/90) DRY MATTER TONNES/HECTARE

***** Tables of means*****

CROPS	RY+CL RE	RY+N RE	Mean
	0.64	0.84	0.74

*** Standard errors of differences of means ***

CROPS
0.115

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	5	0.200	27.0

3RD CUT MEAN DM% 28.4

TOTAL OF 3 CUTS DRY MATTER TONNES/HECTARE

***** Tables of means*****

CROPS	RY+CL RE	RY+N RE	Mean
	4.53	6.21	5.37

*** Standard errors of differences of means ***

CROPS
0.299

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	5	0.518	9.6

TOTAL OF 3 CUTS MEAN DM% 26.2

PLOT AREA HARVESTED 0.00264

WHEAT

GRAIN TONNES/HECTARE 7.60

GRAIN MEAN DM% 89.4

PLOT AREA HARVESTED 0.00572

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90/R/WW/1

WINTER WHEAT

VARIETIES

Object: To study a selection of newer varieties of w. wheat - Highfield VI.

Sponsor: R. Moffitt.

Design: 2 blocks of 2 whole plots split into 10 sub plots.

Whole plot dimensions: 39.0 x 12.0.

Treatments: All combinations of:-

Whole plots

1. **FUNGCIDE**	Fungicide:	
	NONE	None
	SPRAYED	Prochloraz at 0.40 kg with fenpropimorph at 0.75 kg in 200 l on 8 May, 1990. Propiconazole at 0.12 kg with carbendazim at 0.25 kg and maneb at 1.6 kg in 200 l on 14 June.

Sub plots:

2. **VARIETY**	Varieties:	
	APOLLO	Apollo
	APOSTLE	Apostle
	CAMPREMY	Camp Remy
	DEAN	Dean
	FORTRESS	Fortress
	HORNET	Hornet
	MERCIA	Mercia
	PARADE	Parade
	PASTICHE	Pastiche
	RIBAND	Riband

NOTE: VARIETY - DEAN and RIBAND were dressed with triadimenol and fuberidazole.

Basal applications: Manures: 'Nitram' at 120 kg and later at 460 kg. Weedkillers: Isoproturon at 1.7 kg in 200 l. Bromoxynil at 0.19 kg and ioxynil at 0.19 kg with fluroxypyr at 0.20 kg in 200 l.

Seed: Varieties sown at 180 kg.

Cultivations, etc.:- Heavy spring-tine cultivated: 19 Aug, 1989. Deep-tine cultivated with vibrating tines: 1 Nov. Ploughed: 7 Nov. Rotary harrowed, seed sown: 13 Nov. Isoproturon applied: 20 Nov. First N applied: 2 Mar, 1990. Second N applied: 10 Apr. Remaining weedkillers applied: 12 Apr. Combine harvested: 10 Aug. Previous crops: Mixed cereals 1988, w. wheat 1989.

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90/R/WW/1

GRAIN TONNES/HECTARE

***** Tables of means *****

FUNGCIDE VARIETY	NONE	SPRAYED	Mean
APOLLO	8.72	8.80	8.76
APOSTLE	8.53	8.86	8.70
CAMPREMY	7.00	7.34	7.17
DEAN	8.71	9.13	8.92
FORTRESS	6.94	7.49	7.22
HORNET	7.36	8.66	8.01
MERCIA	8.30	8.57	8.43
PARADE	7.74	8.50	8.12
PASTICHE	7.24	7.58	7.41
RIBAND	8.56	9.43	8.99
Mean	7.91	8.44	8.17

*** Standard errors of differences of means ***

	FUNGCIDE	VARIETY	FUNGCIDE VARIETY
	0.369	0.375	0.624
Except when comparing means with the same level(s) of FUNGCIDE			0.530

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
WP.SP	18	0.530	6.5

GRAIN MEAN DM% 88.8

SUB PLOT AREA HARVESTED 0.00245

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90/R/WW/2

WINTER WHEAT

CONTROL OF VOLUNTEERS

Object: To compare methods of volunteer control in winter wheat after w. and s. barley - Delafield, Fosters Corner.

Sponsors: R. Moffitt, D.G. Christian.

Design: 3 replicates of 8 x 3 criss-cross.

Column plot dimensions: 6.0 x 20.0.

Treatments: All combinations of:-

Column plots

1. **PRIMCULT**		Primary cultivations:
	NONE	None until just before sowing
	DYNDRIVE	'Bomford Dynadrive'
	PLOUGH	Plough
	TINE	Tine
2. **CULTDATE**		Date of cultivations:
	EARLY	25 July, 1989 (Delafield) 17 Aug (Fosters Corner)
	LATER	15 Aug (Delafield) 7 Sept (Fosters Corner)

Row plots

3. **PRSOWCON**		Pre-sowing volunteer control:
	GLYPHOS	Glyphosate at 0.27 kg in 200 l on 18 Oct, 1989 (Delafield), 1 Nov and 13 Nov (Fosters Corner)
	PARAQUAT	Paraquat at 0.60 kg ion in 200 l on 18 Oct (Delafield), 1 Nov (Fosters Corner)
	NONE	None

NOTES: (1) The 'Bomford Dynadrive' has a frame similar to a rotary cultivator but it has two rotating shafts containing flat, slightly twisted, spade-shaped tines. The front shaft drives the rear, it is fitted with twice the number of blades and rotates at about one third the speed of the rear shaft.

(2) A 1 m strip of Plaisant w. barley was broadcast on the surface, by drill at 120 kg on one end of each plot. It was broadcast before any treatments were applied on 25 July, 1989 (Delafield) and 17 Aug (Fosters Corner).

(3) All plots were heavy spring-tine cultivated on 1 Nov, 1989 (Delafield), 14 Nov (Fosters Corner) then rotary harrowed and seed sown by drill 7 Nov (Delafield), 15 Nov (Fosters Corner). The seed was spring-tine cultivated in, (Delafield), and harrowed in, (Fosters Corner), after sowing.

(4) **PRIMCULT** TINE was heavy spring-tine cultivated twice.

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90/R/WW/2

Basal applications: Manures: 'Nitram' at 120 kg and later at 460 kg. Weedkillers: Chlorotoluron at 3.5 kg in 200 l. Bromoxynil at 0.25 kg, ioxynil at 0.25 kg and mecoprop at 2.0 kg with the prochloraz in 200 l (Delafield). Bromoxynil at 0.28 kg, ioxynil at 0.28 kg and mecoprop at 2.2 kg with the prochloraz in 200 l (Fosters Corner). Fungicides: Prochloraz at 0.40 kg. Chlorothalonil at 0.50 kg with propiconazole at 0.12 kg in 200 l (Delafield). Fenpropimorph at 0.75 kg in 200 l.

Seed: Mercia, sown at 180 kg.

Cultivations, etc.:- Chlorotoluron applied: 21 Nov, 1989 (Fosters Corner), 23 Nov (Delafield). N applied: 9 Mar, 1990 and 12 Apr. Bromoxynil, ioxynil and mecoprop with prochloraz applied: 10 Apr (Delafield), 25 Apr (Fosters Corner). Chlorothalonil applied with the propiconazole (Fosters Corner): 31 May. Fenpropimorph applied: 29 June. Combine harvested: 10 Aug (Delafield), 13 Aug (Fosters Corner). Previous crops: W. oilseed rape 1988, w. barley 1989 (Delafield); sunflowers 1988, s. barley 1989 (Fosters Corner).

NOTES: (1) Ears of volunteer plants were counted at anthesis of the sown crop.
(2) Percentage contamination of harvested grain by volunteer grain was measured.

90/R/WW/2 DELAFIELD W.WHEAT AFTER W.BARLEY

GRAIN TONNES/HECTARE

***** Tables of means *****

CULTDATE	EARLY	LATER	Mean
PRIMCULT			
NONE	5.73	5.83	5.78
DYNDRIVE	5.48	5.80	5.64
PLOUGH	6.30	6.43	6.36
TINE	5.84	5.89	5.86
Mean	5.84	5.99	5.91

PRSOWCON	GLYPHOS	PARAQUAT	NONE	Mean
PRIMCULT				
NONE	6.11	5.79	5.44	5.78
DYNDRIVE	5.85	5.94	5.14	5.64
PLOUGH	6.76	6.38	5.95	6.36
TINE	6.08	6.24	5.27	5.86
Mean	6.20	6.09	5.45	5.91

PRSOWCON	GLYPHOS	PARAQUAT	NONE	Mean
CULTDATE				
EARLY	6.10	5.92	5.50	5.84
LATER	6.30	6.25	5.40	5.99
Mean	6.20	6.09	5.45	5.91

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90/R/WW/2 DELAFIELD W.WHEAT AFTER W.BARLEY

GRAIN TONNES/HECTARE

***** Tables of means *****

PRIMCULT	PRSOWCON / CULTDATE	GLYPHOS	PARAQUAT	NONE
NONE	EARLY	6.18	5.57	5.44
	LATER	6.05	6.00	5.44
DYNDRIVE	EARLY	5.75	5.70	4.99
	LATER	5.94	6.17	5.29
PLOUGH	EARLY	6.61	6.22	6.08
	LATER	6.92	6.54	5.81
TINE	EARLY	5.85	6.18	5.48
	LATER	6.30	6.31	5.06

*** Standard errors of differences of means ***

PRIMCULT	CULTDATE	PRSOWCON	PRIMCULT CULTDATE
0.167	0.118	0.296	0.236

PRIMCULT PRSOWCON	CULTDATE PRSOWCON	PRIMCULT CULTDATE PRSOWCON
0.369	0.325	0.445

Except when comparing means with the same level(s) of

PRIMCULT	0.354		
CULTDATE		0.317	
PRSOWCON	0.248	0.175	0.350
PRIMCULT.CULTDATE			0.419

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP1	4	0.363	6.1
BLOCK.WP2	14	0.288	4.9
BLOCK.WP1.WP2	28	0.388	6.6

GRAIN MEAN DM% 89.5

PLOT AREA HARVESTED 0.00075

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90/R/WW/2 FOSTERS CORNER W.WHEAT AFTER S.BARLEY

GRAIN TONNES/HECTARE

***** Tables of means *****

CULTDATE	EARLY	LATER	Mean
PRIMCULT			
NONE	5.61	5.75	5.68
DYNDRIVE	5.43	5.83	5.63
PLOUGH	5.69	5.78	5.73
TINE	5.56	5.65	5.60
Mean	5.57	5.75	5.66

PRSOWCON	GLYPHOS	PARAQUAT	NONE	Mean
PRIMCULT				
NONE	5.74	5.43	5.87	5.68
DYNDRIVE	5.59	5.52	5.77	5.63
PLOUGH	5.73	5.59	5.88	5.73
TINE	5.55	5.48	5.78	5.60
Mean	5.65	5.51	5.83	5.66

PRSOWCON	GLYPHOS	PARAQUAT	NONE	Mean
CULTDATE				
EARLY	5.55	5.40	5.77	5.57
LATER	5.75	5.61	5.89	5.75
Mean	5.65	5.51	5.83	5.66

	PRSOWCON	GLYPHOS	PARAQUAT	NONE
PRIMCULT	**CULTDATE**			
NONE	EARLY	5.72	5.36	5.76
	LATER	5.76	5.50	5.98
DYNDRIVE	EARLY	5.43	5.32	5.55
	LATER	5.76	5.73	5.99
PLOUGH	EARLY	5.60	5.47	5.99
	LATER	5.86	5.71	5.78
TINE	EARLY	5.46	5.46	5.75
	LATER	5.64	5.50	5.80

*** Standard errors of differences of means ***

PRIMCULT	**CULTDATE**	**PRSOWCON**	**PRIMCULT CULTDATE**
0.083	0.059	0.236	0.118

PRIMCULT PRSOWCON	**CULTDATE PRSOWCON**	**PRIMCULT CULTDATE PRSOWCON**
0.265	0.246	0.300

Except when comparing means with the same level(s) of

PRIMCULT	0.264		
CULTDATE		0.246	
PRSOWCON	0.140	0.099	0.197
PRIMCULT.CULTDATE			0.298

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90/R/WW/2 FOSTERS CORNER W.WHEAT AFTER S.BARLEY

GRAIN TONNES/HECTARE

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP1	4	0.289	5.1
BLOCK.WP2	14	0.144	2.5
BLOCK.WP1.WP2	28	0.238	4.2

GRAIN MEAN DM% 89.1

PLOT AREA HARVESTED 0.00080

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90/R/WW/3

WINTER WHEAT

N AND CROP PHYSIOLOGY

Object: To study the relationship between N supply to crops of different size and their nitrate contents, N uptakes, growth rates and yield - Little Knott I.

Sponsors: G.F.J. Milford, R.J. Darby.

Design: 3 randomised blocks of 15 plots.

Whole plot dimensions: 3.0 x 14.0.

Treatments: All combinations of:-

1. **SOW DATE** Dates of sowing:

6 SEP	6 September, 1989
9 OCT	9 October
15 NOV	15 November

2. **N R T S** Nitrogen fertilizer (kg N) as 'Nitro-Chalk' (27% N), rates, times and plot shading:

NONE	None	
115 E	40 kg N on 16 Mar, 1990 + 75 kg N on 9 Apr	
230 E	80 " " " " " + 150 " " " " "	(duplicated)
230 L	" " " " 9 Apr " " " " " " 26 Apr	

NOTES: (1) Shading, to reduce light to 44% of normal, was erected on 28 Mar, 1990 for the first two sowing dates, on 20 Apr for the third on sampled areas only of one of the duplicates of **N R T S** 230 E.
(2) Deltamethrin at 6.2 g in 220 l was applied to **SOW DATE** 6 SEP on 10 Oct, 1989.
(3) Deltamethrin at 6.2 g with chlorotoluron at 3.5 kg in 300 l was applied to **SOW DATE** 6 SEP and **SOW DATE** 9 OCT on 9 Nov, 1989.
(4) Chlorotoluron at 3.5 kg in 300 l was applied to **SOW DATE** 15 NOV on 15 Nov, 1989.
(5) Each sowing date was rotary harrowed before drilling.
(6) Irrigation was applied to the whole site, 12 mm on each occasion, on 25 Sept and 27 Sept.

Basal applications: Weedkillers: Glyphosate at 1.4 kg in 200 l. Fluroxypyr at 0.20 kg with bromoxynil at 0.19 kg, ioxynil at 0.19 kg and diclofop-methyl at 1.1 kg in 300 l. Fungicides: Chlorothalonil at 0.75 kg with fenpropimorph at 0.75 kg in 300 l. Tridemorph at 0.52 kg with pirimicarb in 300 l. Insecticides: Pirimicarb at 0.14 kg. Omethoate at 0.64 kg in 300 l.

Seed: Mercia, dressed triadimenol and fuberidazole, sown at 180 kg.

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90/R/WW/3

Cultivations, etc.:- Glyphosate applied: 5 Aug, 1989. Deep-tine cultivated with vibrating tines: 22 Aug. Ploughed: 24 Aug. Rotary harrowed, spike rotary cultivated twice: 5 Sept. Omethoate applied: 23 Feb, 1990. Remaining weedkillers applied: 27 Mar. Chlorothalonil with fenpropimorph applied: 25 May. Tridemorph with pirimicarb applied: 26 June. Combine harvested: 11 Aug. Previous crops: W. wheat 1988, w. oats 1989.

NOTE: Soils were sampled, to 90 cm depth, for ammonium and nitrate contents on four occasions from mid-October to the end of February. Crop samples were taken from November to June at fortnightly intervals to measure stem nitrate concentrations and at similar intervals from April to the end of June to measure crop growth and total N contents.

GRAIN TONNES/HECTARE

***** Tables of means *****

N R T S	NONE	115 E	230 E	230 L	Mean
SOW DATE					
6 SEPT	4.36	8.22	9.18	8.43	7.55
9 OCT	5.19	8.25	9.51	8.42	7.84
15 NOV	4.61	7.62	8.81	7.69	7.18
Mean	4.72	8.03	9.17	8.18	7.52

*** Standard errors of differences of means ***

SOW DATE	N R T S	SOW DATE N R T S	
	0.261	0.451	min.rep
0.202	0.226	0.391	max-min
		0.319	max.rep

N R T S	
max.rep	230 E only
min.rep	any of the remainder
max-min	230 E v any of the remainder

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	31	0.553	7.0

GRAIN MEAN DM% 89.6

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90/R/WW/3

STRAW TONNES/HECTARE

***** Tables of means *****

N R T S SOW DATE	NONE	115 E	230 E	230 L	Mean
6 SEPT	1.71	4.05	4.07	3.03	3.22
9 OCT	1.96	3.35	4.54	2.72	3.14
15 NOV	1.52	3.47	3.58	2.59	2.79
Mean	1.73	3.62	4.06	2.78	3.05

STRAW MEAN DM% 86.6

PLOT AREA HARVESTED 0.00172

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90/R/WW/7

WINTER WHEAT

STRAW TREATMENT AND EYESPOT

Object: To study the effects of straw treatment and sowing depth on eyespot development and on the yield of w. wheat - W. Barnfield I.

Sponsors: J.F. Jenkyn, M. Jalaluddin.

Design: 3 randomised blocks of 8 plots.

Whole plot dimensions: 10.0 x 10.0.

Treatments: All combinations of:-

1. **STRAW** Straw treatment, on 24 Aug, 1989:

BALED	Baled
BURNT	Burnt
CHOP 1	Chopped at normal rate
CHOP 2	Chopped at twice normal rate

2. **SOWDEPTH** Depths of sowing seed (cm):

SHALLOW	3.5
DEEP	7.0

NOTE: All plots were shallow cultivated (10 cm) by rotary grubber on 25 Aug, 1989, after application of straw treatments.

Basal applications: Manure: 'Nitram' at 580 kg. Weedkillers: Glyphosate at 0.27 kg in 200 l. Chlorotoluron at 3.0 kg with cyanazine at 0.75 kg in 200 l. Bromoxynil at 0.34 kg and clopyralid at 0.07 kg with fluroxypyr at 0.15 kg in 200 l.

Seed: Pastiche, sown at 190 kg.

Cultivations, etc.:- Glyphosate applied: 21 Sept, 1989. Spiked rotary cultivated: 10 Oct. Seed sown: 12 Oct. Chlorotoluron with cyanazine applied: 10 Nov. N applied: 12 Apr, 1990. Bromoxynil, clopyralid and fluroxypyr applied: 3 May. Combine harvested: 13 Aug. Previous crops: W. wheat 1988 and 1989.

NOTE: Plant samples were taken in spring and summer to assess eyespot and other diseases.

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90/R/WW/7

GRAIN TONNES/HECTARE

***** Tables of means *****

STRAWTRT / SOWDEPTH	BALED	BURNT	CHOP 1	CHOP 2	Mean
SHALLOW	6.63	7.20	6.26	6.57	6.67
DEEP	6.55	7.41	6.51	6.57	6.76
Mean	6.59	7.30	6.38	6.57	6.71

*** Standard errors of differences of means ***

STRAWTRT	SOWDEPTH	STRAWTRT SOWDEPTH
0.308	0.218	0.436

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	14	0.533	7.9

GRAIN MEAN DM% 89.8

PLOT AREA HARVESTED 0.00230

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90/R/WW/9

WINTER WHEAT

FOLIAR POTASSIUM NITRATE

Object: To study the effects of foliar applications of potassium nitrate and urea on the yield and nutrient composition of w. wheat - Great Harpenden II.

Sponsor: P.B. Barraclough.

Design: 5 randomised blocks of 8 plots.

Whole plot dimensions: 3.0 x 15.0.

Treatments:

FOLIAR N	Foliar nitrogen; all applications were divided equally and applied on two succesive days:
NONE	None
K20E	20 kg K as potassium nitrate at GS 41 on 16 and 17 May, 1990
K20EU40E	" " " " " " plus 40 kg N as urea on 16 and 17 May
U40E	40 kg N as urea on 16 and 17 May
K5M	5 kg K as potassium nitrate at GS 55 on 26 and 27 May
K20M	20 kg K " " " " " " " 26 and 27 May
K20EK20M	" " " " " on 16 and 17 May repeated on 26 and 27 May
K20MK20L	" " " " " on 26 and 27 May repeated GS 71 on 13 and 14 June

NOTE: All plots received N at 131 kg as 'Nitram' applied on 12 Apr, 1990.

Basal applications: Weedkillers: Bromoxynil at 0.19 kg and ioxynil at 0.19 kg with metsulfuron-methyl at 6.0 g in 200 l. Fungicides: Chlorothalonil at 0.50 kg with propiconazole at 0.12 kg in 200 l. Tridemorph at 0.52 kg in 200 l.

Seed: Mercia, sown at 180 kg.

Cultivations, etc.:- Heavy spring-tine cultivated twice: 16 Oct, 1989. Deep-tine cultivated with vibrating tines, disced, rotary harrowed, seed sown: 17 Oct. Weedkillers applied: 24 Apr, 1990. Chlorothalonil with propiconazole applied: 27 May. Tridemorph applied: 26 June. Combine harvested: 7 Aug. Previous crops: W. barley 1988, potatoes 1989.

NOTES: (1) Leaf samples were taken approximately five days after foliar treatment applications to measure N and K contents.
(2) Components of yield were measured.

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90/R/WW/9

GRAIN TONNES/HECTARE

***** Tables of means *****

FOLIAR N	
NONE	9.98
K20E	10.29
K20EU40E	10.05
U40E	9.94
K5M	10.26
K20M	10.15
K20EK20M	10.10
K20MK20L	9.92
Mean	10.09

*** Standard errors of differences of means ***

FOLIAR N
0.226

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	28	0.358	3.5

GRAIN MEAN DM% 90.4

STRAW TONNES/HECTARE

***** Tables of means *****

FOLIAR N	
NONE	6.97
K20E	7.07
K20EU40E	6.60
U40E	6.27
K5M	6.82
K20M	6.89
K20EK20M	6.54
K20MK20L	6.45
Mean	6.70

STRAW MEAN DM% 87.2

PLOT AREA HARVESTED 0.00230

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90/R/B/1

WINTER BARLEY

CONTROL OF VOLUNTEERS

Object: To compare methods of volunteer control in winter barley after w. wheat - Whittlocks.

Sponsors: R. Moffitt, D.G. Christian.

Design: 3 replicates of 8 x 3 criss-cross.

Column plot dimensions: 6.0 x 20.0.

Treatments: All combinations of:-

Column plots

1. **PRIMCULT** Primary cultivations:

NONE	None until just before sowing
DYNDRIVE	'Bomford Dynadrive'
PLOUGH	Plough
TINE	Tine

2. **CULTDATE** Dates of cultivation:

EARLY	17 Aug, 1989
LATER	7 Sept

Row plots

3. **PRSOWCON** Pre-sowing volunteer control:

GLYPHOS	Glyphosate at 0.27 kg in 200 l on 18 Oct, 1989
PARAQUAT	Paraquat at 0.60 kg ion in 200 l on 18 Oct
NONE	None

NOTES: (1) The 'Bomford Dynadrive' has a frame similar to a rotary cultivator but it has two rotating shafts containing flat, slightly twisted, spade-shaped tines. The front shaft drives the rear, it is fitted with twice the number of blades and rotates at about one third the speed of the rear shaft.
(2) A 1 m strip of Squarehead's Master, w. wheat, was broadcast on the surface at one end of each plot, at 100 kg, on 17 Aug, 1989 before any primary cultivations.
(3) All plots were heavy spring-tine cultivated on 1 Nov, 1989, then rotary harrowed, the seed was sown and spring-tine cultivated in on 14 Nov.

Basal applications: Manure: 'Nitram' at 120 kg and later at 350 kg.
Weedkiller: Chlorotoluron at 3.5 kg in 200 l.

Seed: Magie, sown at 160 kg.

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Cultivations, etc.:- Weedkiller applied: 21 Nov, 1989. First N applied: 9 Mar, 1990. Second N applied: 17 Apr. Combine harvested: 24 July. Previous crops: W. oilseed rape 1988, w. wheat 1989.

NOTES: (1) Ears of volunteer plants were counted at anthesis of the sown crop.
(2) Percentage contamination of harvested grain by volunteer grain was measured.

GRAIN TONNES/HECTARE

***** Tables of means *****

CULTDATE	EARLY	LATER	Mean
PRIMCULT			
NONE	4.43	4.44	4.44
DYNDRIVE	4.42	4.56	4.49
PLOUGH	4.70	4.53	4.61
TINE	4.65	4.71	4.68
Mean	4.55	4.56	4.56

PRSOWCON	GLYPHOS	PARAQUAT	NONE	Mean
PRIMCULT				
NONE	4.61	4.37	4.33	4.44
DYNDRIVE	4.49	4.64	4.34	4.49
PLOUGH	4.64	4.51	4.69	4.61
TINE	4.65	4.77	4.62	4.68
Mean	4.60	4.57	4.49	4.56

PRSOWCON	GLYPHOS	PARAQUAT	NONE	Mean
CULTDATE				
EARLY	4.55	4.64	4.46	4.55
LATER	4.64	4.51	4.53	4.56
Mean	4.60	4.57	4.49	4.56

PRIMCULT	**PRSOWCON** **CULTDATE**	GLYPHOS	PARAQUAT	NONE
NONE	EARLY	4.49	4.44	4.38
	LATER	4.74	4.30	4.28
DYNDRIVE	EARLY	4.37	4.62	4.28
	LATER	4.60	4.66	4.41
PLOUGH	EARLY	4.62	4.76	4.71
	LATER	4.66	4.26	4.67
TINE	EARLY	4.73	4.75	4.47
	LATER	4.57	4.79	4.77

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GRAIN TONNES/HECTARE

*** Standard errors of differences of means ***

	PRIMCULT	CULTDATE	PRSOWCON	PRIMCULT CULTDATE
	0.155	0.110	0.074	0.219

	PRIMCULT PRSOWCON	CULTDATE PRSOWCON	PRIMCULT CULTDATE PRSOWCON
	0.187	0.136	0.259

Except when comparing means with the same level(s) of

PRIMCULT	0.123		
CULTDATE		0.093	
PRSOWCON	0.180	0.127	0.255
PRIMCULT.CULTDATE			0.167

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP1	4	0.091	2.0
BLOCK.WP2	14	0.268	5.9
BLOCK.WP1.WP2	28	0.196	4.3

GRAIN MEAN DM% 89.6

PLOT AREA HARVESTED 0.00080

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90/R/B/2

WINTER BARLEY

SOWING DATES, APHIDS AND BYDV

Object: To study the relationship of aphid numbers in suction trap samples to crop populations and the incidence of barley yellow dwarf virus (BYDV) on winter barley sown on a range of dates - Highfield IV.

Sponsors: G.M. Tatchell, R.T. Plumb.

Design: 4 randomised blocks of 10 plots.

Whole plot dimensions: 3.0 x 21.0.

Treatments: All combinations of:-

1. **SOWDATE** Dates of sowing:

5 SEPT	5 September, 1989
18 SEPT	18 September
29 SEPT	29 September
9 OCT	9 October
18 OCT	18 October

2. **APHICIDE** Aphicide:

NONE	None
CYPERMET	Cypermethrin at 0.025 kg in 300 l on 6 Nov, 1989

NOTES: (1) All **SOWDATE** treatments were heavy spring-tine cultivated on 19 Aug, 1989, rotary cultivated on 22 Aug, rotary harrowed on 5 Sept and rotary harrowed again on the day of sowing.
(2) **SOWDATE** 5 SEPT and 18 SEPT had fenpropimorph at 0.75 kg in 200 l on 19 Oct, 1989 as well as the basal application on 3 May, 1990.
(3) The experiment was netted from mid-May to mid-July to prevent damage by birds.

Basal applications: Manures: (0:18:36) at 930 kg. 'Nitram' at 460 kg. Weedkillers: Glyphosate at 0.27 kg in 200 l. Isoproturon at 1.7 kg in 200 l. Bromoxynil at 0.24 kg, clopyralid at 0.05 kg with mecoprop at 2.4 kg applied with the carbendazim and prochloraz in 200 l. Fungicides: Carbendazim at 0.15 kg and prochloraz at 0.40 kg. Fenpropimorph at 0.75 kg in 300 l.

Seed: Magie, sown at 160 kg.

Cultivations, etc.:- PK applied: 30 Aug, 1989. Glyphosate applied: 4 Sept. Isoproturon applied: 23 Nov. N applied: 22 Mar, 1990. Remaining weedkillers with carbendazim and prochloraz applied: 28 Mar. Fenpropimorph applied: 3 May. Combine harvested: 20 July. Previous crops: W. oats 1988, w. wheat 1989.

NOTES: (1) Aphid numbers were sampled from September to May.
(2) BYDV was assessed by enzyme-linked immunosorbent assay from November to May and by visual symptoms during May.
(3) Components of yield were measured.

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90/R/B/2

GRAIN TONNES/HECTARE

***** Tables of means *****

APHICIDE / SOWDATE	NONE	CYPERMET	Mean
5 SEPT	4.42	5.95	5.18
18 SEPT	6.51	7.77	7.14
29 SEPT	7.29	7.75	7.52
9 OCT	7.40	7.69	7.54
18 OCT	7.02	7.42	7.22
Mean	6.53	7.32	6.92

*** Standard errors of differences of means ***

SOWDATE	APHICIDE	SOWDATE APHICIDE
0.209	0.132	0.295

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	27	0.418	6.0

GRAIN MEAN DM% 90.5

PLOT AREA HARVESTED 0.00204

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90/R/B/3

SPRING BARLEY

SPRAY TIMINGS AND BYDV

Object: To investigate the optimum strategy for controlling barley yellow dwarf virus (BYDV) in spring barley in relation to sowing date, aphid immigration and subsequent population development - Long Hoos I/II.

Sponsors: N. Carter, R.T. Plumb.

Design: 3 randomised blocks of 16 plots.

Whole plot dimensions: 3.0 x 10.0.

Treatments:

S P DATE	Dates of sowing and of applying pirimicarb, at 0.14 kg in 300 l on each occasion:
E 0	Sown 15 March, 1990 no pirimicarb
E D1	" " " pirimicarb applied 9 Apr
E D2	" " " " " 2 May
E D3	" " " " " 14 May
E D1 D2	" " " " " 9 Apr and 2 May
E D1 D3	" " " " " 9 Apr and 14 May
E D2 D3	" " " " " 2 May and 14 May
E D1D2D3	" " " " " 9 Apr, 2 May and 14 May
L 0	Sown 11 April, no pirimicarb
L D2	" " " pirimicarb applied 2 May
L D3	" " " " " 14 May
L D4	" " " " " 22 May
L D2 D3	" " " " " 2 May and 14 May
L D2 D4	" " " " " 2 May and 22 May
L D3 D4	" " " " " 14 May and 22 May
L D2D3D4	" " " " " 2 May, 14 May and 22 May

Basal applications: Manure: 'Nitram' at 350 kg. Weedkillers: Bromoxynil at 0.20 kg, ioxynil at 0.20 kg and mecoprop at 1.6 kg applied with the fungicide in 200 l. Fungicide: Fenpropimorph at 0.75 kg.

Seed: Klaxon, dressed triadimenol and fuberidazole, sown at 160 kg.

Cultivations, etc.:- Ploughed: 2 Nov, 1989. N applied: 13 Mar, 1990. Spring-tine cultivated: 14 Mar. Early-sown plots rotary harrowed, seed sown: 15 Mar. Late-sown plots rotary harrowed, seed sown: 11 Apr. Weedkillers with the fungicide applied: 14 May. Combine harvested: 14 Aug. Previous crops: S. beans 1988, potatoes 1989.

NOTES: (1) Aphids were sampled from early April until early July.
(2) Shoot samples were taken from some plots to identify and count shoot borers.
(3) BYDV was assessed visually on five occasions during May and June and leaves from some plots were tested by enzyme-linked immunosorbent assay to determine virus strains present.
(4) Components of yield were measured.

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90/R/B/3

GRAIN TONNES/HECTARE

***** Tables of means *****

S P DATE	
E 0	5.98
E D1	5.82
E D2	5.78
E D3	6.28
E D1 D2	6.16
E D1 D3	6.17
E D2 D3	6.25
E D1D2D3	6.18
L 0	4.51
L D2	4.82
L D3	5.00
L D4	4.99
L D2 D3	4.61
L D2 D4	5.22
L D3 D4	5.07
L D2D3D4	5.37
Mean	5.51

*** Standard errors of differences of means ***

S P DATE
0.401

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	30	0.491	8.9

GRAIN MEAN DM% 88.7

PLOT AREA HARVESTED 0.00204

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90/R/B/4

SPRING BARLEY

VARIETIES AND N

Object: To compare the quality, yield and dormancy of two varieties of s. barley at two rates of nitrogen - Long Hoos I/II.

Sponsors: D.G. Christian, R. Moffitt.

Design: 3 randomised blocks of 4 plots.

Whole plot dimensions: 3.0 x 15.0.

Treatments: All combinations of:-

Whole plots

1. **VARIETY** Varieties:

   KLAXON
   TRIUMPH

2. **N** Nitrogen fertilizer (kg N), as 'Nitram' on 8 Mar, 1990:

   100
   140

Basal applications: Weedkillers: Bromoxynil at 0.20 kg, ioxynil at 0.20 kg and mecoprop at 1.6 kg with the fungicide in 200 l. Fungicide: Fenpropimorph at 0.75 kg.

Seed: Varieties, dressed triadimenol and fuberidazole, sown at 160 kg.

Cultivations, etc.:- Ploughed: 2 Nov, 1989. Spring-tine cultivated, rotary harrowed, seed sown: 8 Mar, 1990. Weedkillers applied with the fungicide: 14 May. Combine harvested: 14 Aug. Previous crops: S. beans 1988, sunflowers 1989.

NOTES: (1) Crop samples were taken from June to maturity to measure shoot numbers, dry weights and nitrogen uptakes.
(2) Ear samples were taken from June to maturity for measurements of grain growth and assessment of grain dormancy.
(3) Components of yield were measured at maturity.

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90/R/B/4

GRAIN TONNES/HECTARE

***** Tables of means *****

N	100	140	Mean
VARIETY			
KLAXON	5.37	5.73	5.55
TRIUMPH	5.24	5.51	5.38
Mean	5.30	5.62	5.46

*** Standard errors of differences of means ***

VARIETY	N	VARIETY N
0.068	0.068	0.096

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	6	0.118	2.2

GRAIN MEAN DM% 88.6

PLOT AREA HARVESTED 0.00204

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90/R/RA/1

WINTER OILSEED RAPE

VARIETIES, SEED RATES, FUNGICIDES AND GROWTH REGULATOR

Object: To study the separate and combined effects of seed rates, fungicides and a growth regulator on the yield of four low-glucosinolate varieties - Bylands/Black Horse I.

Sponsors: C.J. Rawlinson, V.J. Church, D.P. Yeoman.

Design: 2 replicates of 4 x 2 x 2 x 2 arranged in 4 blocks of 16 plots.

Whole plot dimensions: 3.0 x 21.0.

Treatments: All combinations of:-

1. **VARIETY** Varieties:

CAPRCORN	Capricorn
COBRA	Cobra
LIBRAVO	Libravo
TAPIDOR	Tapidor

2. **SEEDRATE** Seed rates:

4 KG
8 KG

3. **FUNGCIDE** Fungicides:

NONE	None
PRO+IPRO	Prochloraz at 0.50 kg in 200 l on 7 Dec, 1989 and 28 Mar, 1990 + iprodione at 0.50 kg in 260 l on 23 May

4. **GROWREG** Growth regulator:

NONE	None
TRIAPEN	Triapenthanol at 0.70 kg in 300 l on 28 Mar, 1990

Basal applications: Manures: (0:17:34) at 980 kg. 'Nitram' at 140 kg, later at 290 kg and a third time at 290 kg. Weedkillers: Diquat at 0.24 kg ion and paraquat at 0.36 kg ion in 180 l. Metazachlor at 0.75 kg in 200 l. Fluazifop-P-butyl at 0.19 kg with a wetting agent, 'Enhance' at 0.20 l, in 200 l. Benazolin at 0.30 kg and clopyralid at 0.05 kg in 200 l. Insecticides: Deltamethrin at 6.2 g in 200 l on two occasions. Triazophos at 0.42 kg in 260 l. Desiccant: Diquat at 0.60 kg ion with a wetting agent, 'Enhance' at 0.52 l, in 520 l (to two blocks only).

Cultivations, etc.:- PK applied: 18 July, 1989. Rotary cultivated: 19 July. Cultivated by rotary grubber: 2 Aug. Diquat and paraquat applied: 21 Aug. First N applied, rotary harrowed: 30 Aug. Seed sown: 31 Aug. Metazachlor applied: 4 Sept. Fluazifop-P-butyl with wetting agent applied: 17 Oct. First deltamethrin applied: 7 Nov. Second deltamethrin applied: 9 Nov. Second N applied: 16 Feb, 1990. Benazolin and clopyralid applied: 22 Feb. Third N applied: 14 Mar.

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90/R/RA/1

Cultivations, etc.:-
Triazophos applied: 23 May. Desiccant with wetting agent applied (**FUNGCIDE** NONE and **GROWREG** NONE plots of two blocks only): 12 July, and the remaining plots of these blocks: 17 July. Combine harvested (**FUNGCIDE** NONE and **GROWREG** NONE plots in the two blocks given desiccant and wetting agent): 19 July, remaining plots in these blocks: 23 July. Other two blocks (except for **VARIETY** TAPIDOR) combine harvested: 2 Aug. **VARIETY** TAPIDOR, on these blocks, combine harvested: 11 Aug. Previous crops: W. wheat 1988, w. barley 1989.

NOTE: Disease assessments were made on seven occasions from November - July. Adult cabbage stem flea beetle damage was assessed in October and April. Establishment counts were made in October and plant populations noted prior to harvest. Crop heights, pollen beetle and frost damage were assessed in May and plant vigour in March and June. Components of yield were measured in June. Glucosinolate and oil content of the seed were measured after harvest.

GRAIN (AT 90% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

SEEDRATE	4 KG	8 KG	Mean
VARIETY			
CAPRCORN	2.50	2.69	2.59
COBRA	2.62	2.31	2.46
LIBRAVO	2.29	2.22	2.25
TAPIDOR	2.14	2.31	2.23
Mean	2.39	2.38	2.38

FUNGCIDE	NONE	PRO+IPRO	Mean
VARIETY			
CAPRCORN	2.52	2.66	2.59
COBRA	2.41	2.52	2.46
LIBRAVO	2.11	2.39	2.25
TAPIDOR	2.30	2.16	2.23
Mean	2.34	2.43	2.38

FUNGCIDE	NONE	PRO+IPRO	Mean
SEEDRATE			
4 KG	2.37	2.41	2.39
8 KG	2.31	2.46	2.38
Mean	2.34	2.43	2.38

GROWREG	NONE	TRIAPEN	Mean
VARIETY			
CAPRCORN	2.70	2.49	2.59
COBRA	2.38	2.55	2.46
LIBRAVO	2.15	2.36	2.25
TAPIDOR	2.15	2.31	2.23
Mean	2.34	2.43	2.38

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90/R/RA/1

GRAIN (AT 90% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

GROWREG	NONE	TRIAPEN	Mean
SEEDRATE			
4 KG	2.32	2.46	2.39
8 KG	2.37	2.40	2.38
Mean	2.34	2.43	2.38

GROWREG	NONE	TRIAPEN	Mean
FUNGCIDE			
NONE	2.34	2.33	2.34
PRO+IPRO	2.34	2.53	2.43
Mean	2.34	2.43	2.38

	SEEDRATE	4 KG		8 KG	
VARIETY	FUNGCIDE	NONE	PRO+IPRO	NONE	PRO+IPRO
CAPRCORN		2.40	2.59	2.64	2.73
COBRA		2.71	2.53	2.11	2.51
LIBRAVO		2.07	2.50	2.15	2.29
TAPIDOR		2.27	2.01	2.32	2.30

	SEEDRATE	4 KG		8 KG	
VARIETY	GROWREG	NONE	TRIAPEN	NONE	TRIAPEN
CAPRCORN		2.64	2.36	2.75	2.62
COBRA		2.47	2.77	2.29	2.32
LIBRAVO		2.13	2.45	2.17	2.28
TAPIDOR		2.04	2.25	2.26	2.37

	FUNGCIDE	NONE		PRO+IPRO	
VARIETY	GROWREG	NONE	TRIAPEN	NONE	TRIAPEN
CAPRCORN		2.66	2.38	2.73	2.59
COBRA		2.21	2.61	2.55	2.48
LIBRAVO		2.06	2.16	2.23	2.56
TAPIDOR		2.44	2.15	1.85	2.47

	FUNGCIDE	NONE		PRO+IPRO	
SEEDRATE	GROWREG	NONE	TRIAPEN	NONE	TRIAPEN
4 KG		2.15	2.58	2.48	2.33
8 KG		2.54	2.08	2.20	2.72

		FUNGCIDE	NONE		PRO+IPRO	
VARIETY	SEEDRATE	GROWREG	NONE	TRIAPEN	NONE	TRIAPEN
CAPRCORN	4 KG		2.41	2.40	2.87	2.31
	8 KG		2.92	2.37	2.59	2.87
COBRA	4 KG		2.20	3.23	2.75	2.32
	8 KG		2.23	1.99	2.36	2.65
LIBRAVO	4 KG		1.83	2.31	2.42	2.58
	8 KG		2.29	2.01	2.04	2.54
TAPIDOR	4 KG		2.17	2.38	1.90	2.13
	8 KG		2.71	1.93	1.80	2.81

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90/R/RA/1

GRAIN (AT 90% DRY MATTER) TONNES/HECTARE

*** Standard errors of differences of means ***

VARIETY	SEEDRATE	FUNGCIDE	GROWREG
0.158	0.112	0.112	0.112

VARIETY SEEDRATE	VARIETY FUNGCIDE	SEEDRATE FUNGCIDE	VARIETY GROWREG
0.223	0.223	0.158	0.223

SEEDRATE GROWREG	FUNGCIDE GROWREG	VARIETY SEEDRATE FUNGCIDE	VARIETY SEEDRATE GROWREG
0.158	0.158	0.316	0.316

VARIETY FUNGCIDE GROWREG	SEEDRATE FUNGCIDE GROWREG	VARIETY SEEDRATE FUNGCIDE GROWREG
0.316	0.223	0.447

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
REP.WP	31	0.447	18.7

GRAIN MEAN DM% 89.2

PLOT AREA HARVESTED 0.00483

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90/R/RA/2

WINTER OILSEED RAPE

VARIETIES AND FUNGICIDES

Object: To investigate the effects of fungicides on a range of low glucosinolate varieties - Bylands/Black Horse I S.

Sponsors: C.J. Rawlinson, V.J. Church, C.H. Bock.

Design: 4 randomised blocks of 12 plots.

Whole plot dimensions: 3.0 x 21.0.

Treatments: All combinations of:-

1.	**VARIETY**	Varieties:
	CAPRCORN	Capricorn
	COBRA	Cobra
	LIBRAVO	Libravo
	LICTOR	Lictor
	SCORE	Score
	TAPIDOR	Tapidor
2.	**FUNGCIDE**	Fungicides:
	NONE	None
	PRO+IPRO	Prochloraz at 0.50 kg in 200 l on 7 Dec, 1989 and 28 Mar, 1990. Iprodione at 0.50 kg in 260 l on 23 May.

Basal applications: Manures: (0:17:34) at 980 kg. 'Nitram' at 140 kg, later at 290 kg and a third time at 290 kg. Weedkillers: Diquat at 0.24 kg ion and paraquat at 0.36 kg ion in 180 l. Metazachlor at 0.75 kg in 200 l. Fluazifop-P-butyl at 0.19 kg with a wetting agent, 'Enhance' at 0.20 l, in 200 l. Benazolin at 0.30 kg and clopyralid at 0.05 kg in 200 l. Insecticides: Deltamethrin at 6.2 g in 200 l on two occasions. Triazophos at 0.42 kg in 260 l. Desiccant: Diquat at 0.60 kg ion with a wetting agent, 'Enhance' at 0.52 l, in 520 l (to two blocks only).

Seed: Varieties, sown at 8.0 kg.

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90/R/RA/2

Cultivations, etc.:- PK applied: 18 July, 1989. Rotary cultivated: 19 July. Cultivated by rotary grubber: 2 Aug. Diquat and paraquat applied: 21 Aug. First N applied, rotary harrowed: 30 Aug. Seed sown: 31 Aug. Metazachlor applied: 4 Sept. Fluazifop-P-butyl with wetting agent applied: 17 Oct. First deltamethrin applied: 7 Nov. Second deltamethrin applied: 9 Nov. Second N applied: 16 Feb, 1990. Benazolin and clopyralid applied: 22 Feb. Third N applied: 14 Mar. Triazophos applied: 23 May. Desiccant with wetting agent applied (**FUNGCIDE** NONE plots of two blocks only): 12 July, and to **FUNGCIDE** PRO+IPRO plots of the same blocks: 17 July. Combine harvested (**FUNGCIDE** NONE plots in the two blocks given desiccant and wetting agent): 19 July, remaining plots in these blocks: 23 July. Other two blocks (except for **VARIETY** TAPIDOR) combine harvested: 2 Aug. **VARIETY** TAPIDOR, on these blocks, combine harvested: 11 Aug. Previous crops: W. wheat 1988, w. barley 1989.

NOTE: Disease assessments were made from November - July. Plant vigour and pollen beetle assessments were made in April and aborted pods were assessed in May. Glucosinolate and oil content of the seed were measured after harvest.

GRAIN (AT 90% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

FUNGCIDE / **VARIETY**	NONE	PRO+IPRO	Mean
CAPRCORN	2.28	2.71	2.49
COBRA	1.88	2.32	2.10
LIBRAVO	1.53	2.14	1.84
LICTOR	1.83	1.86	1.84
SCORE	2.30	2.22	2.26
TAPIDOR	1.61	2.44	2.03
Mean	1.91	2.28	2.09

*** Standard errors of differences of means ***

VARIETY	**FUNGCIDE**	**VARIETY FUNGCIDE**
0.231	0.133	0.326

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	33	0.462	22.1

GRAIN MEAN DM% 87.3

PLOT AREA HARVESTED 0.00483

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90/R/RA/3

WINTER OILSEED RAPE

EFFECTS OF ISOTHIOCYANATES

Object: To study the effects of two formulations of plant-derived isothiocyanates on insect pests, diseases and yield - Black Horse I S.

Sponsors: L.E. Smart, K. Doughty.

Design: A quasi-complete 5 x 5 Latin square.

Whole plot dimensions: 3.0 x 10.0.

Treatments:

CHEMICAL	Chemicals:
NONE	None
BUTENYL	3,5-bis(3-butenyl)-1,3,5-thiadiazine-2-thione at 350 g a.i.
PHENYL	3,5-bis(2-phenylethyl)-1,3,5-thiadiazine-2-thione at 250 g a.i.
PHEN+BUT	Phenylethyl + butenyl products as above at 125 g a.i. + 175 g a.i. respectively
STANDARD	Prochloraz at 0.50 kg in 400 l and gamma-HCH at 0.56 kg in 400 l on 6 Nov, 1989 Prochloraz at 0.50 kg in 400 l and gamma-HCH at 0.28 kg in 400 l on 4 Apr, 1990. Iprodione at 0.50 kg applied with triazophos at 0.42 kg in 270 l on 23 May

NOTES: (1) Chemical treatments, except for STANDARD, were applied in tetrahydrofurfuryl alcohol at 4.2 l using a hand-held electrostatic sprayer on 6 Nov, 1989 repeated on 4 Apr, 1990 and 23 May.
(2) STANDARD treatments were applied with a hydraulic sprayer.

Basal applications: Manures: (0:17:34) at 980 kg. 'Nitram' at 140 kg, later at 290 kg and a third time at 290 kg. Weedkillers: Diquat at 0.24 kg ion and paraquat at 0.36 kg ion in 180 l. Metazachlor at 0.75 kg in 200 l. Fluazifop-P-butyl at 0.19 kg with a wetting agent ('Enhance' at 0.20 l) in 200 l. Benazolin at 0.30 kg and clopyralid at 0.05 kg in 200 l. Desiccant: Diquat at 0.60 kg ion with a wetting agent ('Enhance' at 0.52 l) in 520 l.

Seed: Cobra, dressed fenpropimorph, gamma-HCH and thiram, sown at 8.0 kg.

Cultivations, etc.:- PK applied: 18 July, 1989. Rotary cultivated: 19 July. Cultivated by rotary grubber: 2 Aug. Diquat and paraquat applied: 21 Aug. First N applied, rotary harrowed: 30 Aug. Seed sown: 1 Sept. Metazachlor applied: 4 Sept. Fluazifop-P-butyl with wetting agent applied: 17 Oct. Second N applied: 16 Feb, 1990. Benazolin and clopyralid applied: 22 Feb. Third N applied: 14 Feb. Desiccant with wetting agent applied: 17 July. Combine harvested: 23 July. Previous crops: W. wheat 1988, w. barley 1989.

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90/R/RA/3

NOTES: (1) Damage by cabbage stem flea beetle was assessed in autumn and winter.
(2) Pollen beetle adults, eggs and larvae were counted in spring.
(3) Seed weevils and pod midge damage were assessed in late May.
(4) Fungal diseases were assessed during the season.

GRAIN (AT 90% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

CHEMICAL	
NONE	1.52
BUTENYL	1.48
PHENYL	1.47
PHEN+BUT	1.50
STANDARD	2.24
Mean	1.64

*** Standard errors of differences of means ***

CHEMICAL
0.120

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
ROW.COL	12	0.189	11.5

GRAIN MEAN DM% 88.3

PLOT AREA HARVESTED 0.00230

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90/R/RA/7

WINTER OILSEED RAPE

BACTERIAL INOCULANTS

Object: To study the effects of two bacterial inoculants on the growth and yield of w. oilseed rape - Little Hoos.

Sponsors: J. Tann, J.M. Day, P.H. Williams, I.J. Webster.

Design: 4 randomised blocks of 10 plots.

Whole plot dimensions: 4.0 x 10.0.

Treatments: All combinations of:-

1. **INOCLANT** Bacterial inoculants:

B SUBT 1	Bacillus subtilis, strain 1
B SUBT 2	" " " 2

2. **FORMULAT** Formulations:

BROTH	Liquid broth to seed
SLURRY	Slurry, pre-coated to seed

3. **SEEDRESS** Seed dressings:

NONE	None
FE+LI+TH	Fenpropimorph, lindane and thiram

plus two extra treatments:

EXTRA

BO SO	No bacterial inoculant, no seed dressing
BO SFLT	No bacterial inoculant, seed dressed fenpropimorph, lindane and thiram

NOTES: (1) Irrigation was applied at 17 mm on 10 Oct, 1989.
(2) The FORMULAT - BROTH treatment was applied as a bacterial culture in standard nutrient broth dripped into the seed furrow at planting.

Basal applications: Manures: 'Nitram' at 290 kg on two occasions. Weedkillers: Paraquat at 0.60 kg ion in 200 l. Fluazifop-P-butyl at 0.12 kg with metazachlor at 1.2 kg and a wetting agent, 'Enhance' at 0.40 l, in 400 l.

Seed: Cobra, sown at 7.0 kg.

Cultivations, etc.:- Cultivated by rotary grubber: 27 July, 1989. Paraquat applied: 18 Aug. Rotary harrowed: 22 Aug and 18 Sept. Seed sown: 19 Sept. Remaining weedkillers with wetting agent applied: 25 Oct. First N applied: 16 Feb, 1990. Second N applied: 14 Mar. Combine harvested: 25 July. Previous crops: S. wheat 1988, w. barley 1989.

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90/R/RA/7

NOTE: Seedling emergence counts were made and vigour was assessed during the season. Dates of flowering were noted.

GRAIN (AT 90% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

FORMULAT	BROTH	SLURRY	Mean
INOCLANT			
B SUBT 1	2.50	2.78	2.64
B SUBT 2	2.61	2.76	2.68
Mean	2.56	2.77	2.66

SEEDRESS	NONE	FE+LI+TH	Mean
INOCLANT			
B SUBT 1	2.75	2.53	2.64
B SUBT 2	2.77	2.60	2.68
Mean	2.76	2.56	2.66

SEEDRESS	NONE	FE+LI+TH	Mean
FORMULAT			
BROTH	2.61	2.50	2.56
SLURRY	2.91	2.63	2.77
Mean	2.76	2.56	2.66

	SEEDRESS	NONE	FE+LI+TH
INOCLANT	**FORMULAT**		
B SUBT 1	BROTH	2.59	2.40
	SLURRY	2.91	2.65
B SUBT 2	BROTH	2.63	2.59
	SLURRY	2.91	2.60

EXTRA	BO SO	BO SFLT	Mean
	2.41	2.83	2.62

GRAND MEAN 2.65

*** Standard errors of differences of means ***

INOCLANT	**FORMULAT**	**SEEDRESS**	**INOCLANT FORMULAT**
0.090	0.090	0.090	0.127

INOCLANT SEEDRESS	**FORMULAT SEEDRESS**	**INOCLANT FORMULAT SEEDRESS**	**EXTRA**
0.127	0.127	0.180	0.180

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90/R/RA/7

GRAIN (AT 90% DRY MATTER) TONNES/HECTARE

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	27	0.255	9.6

MEAN DM% 87.0

PLOT AREA HARVESTED 0.00230

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90/R/LP/1

WINTER LUPINS

VARIETIES AND GROWTH REGULATORS

Object: To study the effects of two growth regulators on the growth, maturity and yield of two winter lupin varieties - Long Hoos VI/VII 5.

Sponsors: J. McEwen, J.M. Day, D.P. Yeoman.

Design: 2 randomised blocks of 16 plots.

Whole plot dimensions: 1.8 x 9.0.

Treatments: All combinations of:-

Whole plots

1. **VARIETY** Varieties:

C 8	C 8
LUCKY	Lucky

2. **GROW REG** Growth regulators:

2 CHLORO	2-chloroethylphosphonic acid
TRIAPENT	Triapenthanol

3. **G R RATE** Rates of growth regulator (g):

	2 CHLORO	TRIAPENT
1	100	150
3	300	450
6	600	900

plus two extra treatments:

EXTRA

C 8 0	C8 without growth regulator
LUCKY 0	Lucky without growth regulator

NOTES: (1) Each block contained two additional EXTRA plots for ancillary studies.
(2) Plots were netted from October to April.
(3) Growth regulators were applied in 300 l on 17 May, 1990.

Basal applications: Manures: (0:18:36) at 1.1 t. Weedkillers: Terbuthylazine at 0.42 kg and terbutryn at 0.98 kg in 200 l. Fluazifop-P-butyl at 0.19 kg applied with a wetting agent, 'Vassgrow', in 220 l. Insecticides: Deltamethrin at 7.5 g in 200 l. Dimethoate at 0.34 kg in 400 l. Irrigation: 25 mm. Previous crops: Lupins 1988, s. barley 1989.

Seed: Sown at 60 seeds per square metre.

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90/R/LP/1

Cultivations, etc.:- PK applied: 22 Aug, 1989. Ploughed: 29 Aug. Rotary cultivated: 13 Sept. Spiked rotary cultivated and harrowed: 14 Sept. Seed sown, chain harrowed and rolled: 15 Sept. Terbuthylazine and terbutryn applied: 19 Sept. Irrigation applied: 25 Sept. Fluazifop-P-butyl with wetting agent applied: 8 Dec. Hand weeded: 27 Mar, 1990 - 6 Apr. Deltamethrin applied: 25 Apr. Dimethoate applied: 17 May. Combine harvested: 11 Sept.

NOTE: Plants were counted at establishment and in spring. Plant heights were measured and flowering dates were recorded. Components of yield were measured at maturity.

GRAIN (AT 90% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

GROW REG	2 CHLORO	TRIAPENT	Mean
VARIETY			
C 8	4.03	4.59	4.31
LUCKY	0.45	1.38	0.91
Mean	2.24	2.98	2.61

G R RATE	1	3	6	Mean
VARIETY				
C 8	4.30	4.33	4.29	4.31
LUCKY	0.26	0.98	1.50	0.91
Mean	2.28	2.66	2.90	2.61

G R RATE	1	3	6	Mean
GROW REG				
2 CHLORO	2.15	2.20	2.37	2.24
TRIAPENT	2.41	3.11	3.43	2.98
Mean	2.28	2.66	2.90	2.61

	G R RATE	1	3	6
VARIETY	**GROW REG**			
C 8	2 CHLORO	4.29	3.96	3.83
	TRIAPENT	4.30	4.71	4.76
LUCKY	2 CHLORO	0.00	0.44	0.91
	TRIAPENT	0.51	1.52	2.09

EXTRA	C 8 0	LUCKY 0	Mean
	4.20	0.87	2.54

GRAND MEAN 2.59

GRAIN MEAN DM% 66.9

PLOT AREA HARVESTED 0.00130

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90/R/LP/2

WINTER LUPINS

VERNALIZATION STUDY

Object: To study the effects of vernalizing imbibed seed of the lupin variety C 8 on flowering date, maturity and yield when sown in autumn - Long Hoos VI/VII 4.

Sponsors: J.E. Leach, D.P. Yeoman, G.F.J. Milford.

Design: 4 randomised blocks of 2 plots.

Whole plot dimensions: 3.6 x 4.6.

Treatments:

SEED TRT	Seed treatment:
NONE	None
VERNALIZ	Imbibed seed vernalized at 1 C for six weeks before sowing

NOTE: Plots were netted against birds and mammals from Oct 1989 to Aug 1990.

Basal applications: Manure: Muriate of potash at 520 kg. Weedkillers: Terbuthylazine at 0.42 kg and terbutryn at 0.98 kg in 220 l. Molluscicide: Methiocarb at 0.22 kg. Insecticides: Dimethoate at 0.34 kg in 380 l. Deltamethrin at 7.5 g in 220 l. Irrigation: 12 mm on each of five occasions and 25 mm on the second occasion.

Seed: C 8, sown at 25 seeds per square metre.

Cultivations, etc.:- K applied: 21 Aug, 1989. Ploughed: 29 Aug. Rotary cultivated: 13 Sept. Rolled, rotary cultivated: 4 Oct. Seed sown: 5 Oct. Weedkillers and molluscicide applied: 6 Oct. Irrigation applied: 6 Oct, 4, 10, 18, 24 and 31 May, 1990. Hand weeded: 17 Apr, 2 May and 15 June. Dimethoate applied: 17 May. Deltamethrin applied: 14 June. Hand harvested: 2 Oct. Previous crops: Potatoes 1988, s. barley 1989.

NOTE: Plants were counted after emergence and at harvest. Leaf numbers were assessed fortnightly from December to April. Assessments were made of flower composition, pod-bearing branches and pod numbers.

GRAIN (AT 90% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

SEED TRT	NONE	VERNALIZ	Mean
	1.70	1.69	1.69

GRAIN MEAN DM% *

PLOT AREA HARVESTED (MEAN) 0.00068

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90/R/LP/3

SPRING LUPINS

VERNALIZATION STUDY

Object: To study the effects of vernalizing imbibed seed of the lupin varieties C 8 and Vladimir on flowering date, maturity and yield when sown in spring - Long Hoos VI/VII 4.

Sponsors: J.E. Leach, D.P. Yeoman, G.F.J. Milford.

Design: 4 randomised blocks of 4 plots.

Whole plot dimensions: 3.6 x 4.6.

Treatments: All combinations of:-

1. **VARIETY** Varieties:

   C 8
   VLADIMIR

2. **SEED TRT** Seed treatment:

   NONE — None
   VERNALIZ — Imbibed seed vernalized at 1 C for six weeks before sowing

NOTE: Plots were netted against birds and mammals from late April to late August.

Basal applications: Manure: Muriate of potash at 520 kg. Weedkillers: Terbuthylazine at 0.42 kg and terbutryn at 0.98 kg in 220 l. Molluscicide: Methiocarb at 0.18 kg. Insecticides: Dimethoate at 0.34 kg in 380 l. Deltamethrin at 7.5 g in 220 l. Irrigation: 25 mm on the first and last occasion, 12 mm on the second, third, fourth and fifth occasions and 19 mm on the sixth occasion, (total 120 mm).

Seed: Sown at 25 seeds per square metre.

Cultivations, etc.:- K applied: 21 Aug, 1989. Ploughed: 29 Aug. Rotary cultivated: 16 Mar, 1990 and 19 Mar. Seed sown: 20 Mar. Rolled: 23 Mar. Weedkillers and molluscicide applied: 26 Mar. Irrigation applied: 4, 10, 18, 24 May, 27 June, 16 and 26 July. Dimethoate applied: 17 May. Deltamethrin applied: 14 June. Hand harvested, Vladimir: 28 Aug, C 8: 24 Oct. Previous crops: Potatoes 1988, s. barley 1989.

NOTES: (1) Plants were counted after emergence and at harvest. Leaf numbers were assessed fortnightly from May to June. Assessments were made of flower composition, pod bearing branches, pod and seed numbers.
(2) VLADIMIR plots produced very low yields and standard errors are not presented.

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90/R/LP/3

GRAIN (AT 90% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

SEED TRT / VARIETY	NONE	VERNALIZ	Mean
C 8	0.99	1.30	1.15
VLADIMIR	0.16	0.04	0.10
Mean	0.58	0.67	0.62

GRAIN MEAN DM% *

PLOT AREA HARVESTED (MEAN) 0.00117

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90/R/SU/1

SUNFLOWERS

VARIETIES AND SOWING DATES

Object: To study the effects of five sowing dates on the rates of vegetative and floral development, days to maturity, disease and yield of two varieties of sunflowers - Great Harpenden I.

Sponsors: V.J. Church, C.J. Rawlinson.

Design: 3 randomised blocks of 10 plots.

Whole plot dimensions: 3.5 x 10.0.

Treatments: All combinations of:-

1. **VARIETY** Varieties:

SUNB 246	Sunbred 246
S 47	S47

2. **SOWDATE** Sowing date:

15 MAR	15 March, 1990
5 APR	5 April
18 APR	18 April
30 APR	30 April
10 MAY	10 May

NOTE: Plots were netted against birds from sowing until harvest.

Basal applications: Manures: (13:13:21) at 380 kg. Weedkillers: Trifluralin at 1.1 kg in 220 l. Linuron at 0.50 kg in 220 l. Desiccant: Diquat at 0.60 kg ion in 220 l. Irrigation: 22 mm applied on two occasions.

Seed: Sown at 20 seeds per square metre.

Cultivations, etc.:- Ploughed: 1 Sept, 1989. Rolled: 4 Sept. Deep-tine cultivated: 24 Nov. Spring-tine cultivated, NPK applied: 12 Mar, 1990. Trifluralin applied and rotary cultivated: 14 Mar to **SOWDATE** 15 MAR, 4 Apr to **SOWDATE** 5 APR, 18 Apr to **SOWDATE** 18 APR, 30 Apr to **SOWDATE** 30 APR and 9 May to **SOWDATE** 10 MAY. Seed sown as **SOWDATE**. Rolled: 16 Mar to **SOWDATE** 15 MAR, 5 Apr to **SOWDATE** 5 APR, 18 Apr to **SOWDATE** 18 APR, 30 Apr to **SOWDATE** 30 APR and 10 May to **SOWDATE** 10 MAY. Linuron applied: 16 Mar to **SOWDATE** 15 MAR, 5 Apr to **SOWDATE** 5 APR, 19 Apr to **SOWDATE** 18 APR, 1 May to **SOWDATE** 30 APR and 10 May to **SOWDATE** 10 MAY. Irrigation applied: 3 and 25 May. Desiccant applied: 13 Aug to **VARIETY** S 47 **SOWDATE** 15 MAR, 22 Aug to **VARIETY** S 47 **SOWDATE** 5 APR and 18 APR, 29 Aug to **VARIETY** S 47 **SOWDATE** 30 APR and **VARIETY** SUNB 246 **SOWDATE** 15 MAR, 31 Aug to **VARIETY** S 47 **SOWDATE** 10 May, 5 Sept to **VARIETY** SUNB 246 **SOWDATE** 5 APR and 18 APR, 14 Sept to **VARIETY** SUNB 246 **SOWDATE** 30 APR and 26 Sept to **VARIETY** SUNB 246 **SOWDATE** 10 MAY. Hand harvested: 17 Aug **VARIETY** S 47 **SOWDATE** 15 MAR,

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90/R/SU/1

Cultivations, etc.:-
29 Aug **VARIETY** S 47 **SOWDATE** 5 APR and 18 APR, 4 Sept **VARIETY** S 47 **SOWDATE** 30 APR and **VARIETY** SUNB 246 **SOWDATE** 15 MAR, 10 Sept **VARIETY** S 47 **SOWDATE** 10 MAY, 13 Sept **VARIETY** SUNB 246 **SOWDATE** 5 APR and 18 APR, 24 Sept **VARIETY** SUNB 246 **SOWDATE** 30 APR and 2 Oct **VARIETY** SUNB 246 **SOWDATE** 10 MAY. Previous crops: W. wheat 1988 and 1989.

NOTE: Plant heights and head diameters were measured and plants counted at maturity. Botrytis was assessed on ten occasions in late summer. Severely distorted and male sterile heads were counted.

GRAIN (AT 90% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

SOWDATE / **VARIETY**	15 MAR	5 APR	18 APR	30 APR	10 MAY	Mean
SUNB 246	2.91	3.11	3.30	3.48	3.53	3.27
S 47	0.83	1.72	2.01	2.39	2.26	1.84
Mean	1.87	2.41	2.66	2.93	2.89	2.55

*** Standard errors of differences of means ***

VARIETY	**SOWDATE**	**VARIETY SOWDATE**
0.039	0.062	0.088

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	18	0.107	4.2

GRAIN MEAN DM% 76.5

PLOT AREA HARVESTED 0.00150

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90/R/SU/2

SUNFLOWERS

ROW SPACINGS AND SEED RATES

Object: To study the effects of three row spacings and three seed rates on growth, disease and yield of sunflowers - Great Harpenden I.

Sponsors: V.J. Church, C.J. Rawlinson.

Design: 4 randomised blocks of 9 plots.

Whole plot dimensions: Wide and narrow rows: 3.0 x 10.0
Medium rows: 3.04 x 10.0.

Treatments: All combinations of:-

1. **ROW SPAC** Spacing between rows:

NARROW	25 cm
MEDIUM	38 cm
WIDE	50 cm

2. **POPULATN** Seeds sown per hectare:

80	80,000
120	120,000
160	160,000

NOTE: Plants were netted against birds from sowing until harvest.

Basal applications: Manures: (13:13:21) at 380 kg. Weedkillers: Trifluralin at 1.1 kg in 200 l. Linuron at 0.50 kg in 200 l. Desiccant: Diquat at 0.60 kg ion applied with a wetting agent, 'Vassgrow' at 0.22 l, in 220 l. Irrigation: 22 mm on each of two occasions.

Seed: Vincent.

Cultivations, etc.:- Ploughed: 1 Sept, 1989. Rolled: 4 Sept. Deep-tine cultivated: 24 Nov. Spring-tine cultivated, NPK applied: 12 Mar, 1990. Trifluralin applied, spring-tine cultivated twice: 24 Apr. Seed sown: 26 Apr. Linuron applied: 1 May. Irrigation applied: 3 and 25 May. Desiccant applied: 5 Sept. Hand harvested: 12 Sept. Previous crops: W. wheat 1988 and 1989.

NOTE: Plant heights and head diameters were measured and plants counted at maturity. Botrytis was assessed in late summer.

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90/R/SU/2

GRAIN (AT 90% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

POPULATN	80	120	160	Mean
ROW SPAC				
NARROW	3.17	3.55	3.03	3.25
MEDIUM	3.25	3.28	2.85	3.13
WIDE	3.43	3.26	3.18	3.29
Mean	3.28	3.37	3.02	3.22

*** Standard errors of differences of means ***

ROW SPAC	POPULATN	ROW SPAC POPULATN
0.127	0.127	0.220

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	24	0.311	9.7

GRAIN MEAN DM% 76.3

PLOT AREA HARVESTED NARROW 0.00125
PLOT AREA HARVESTED MEDIUM 0.00114
PLOT AREA HARVESTED WIDE 0.00150

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90/R/SU/3

SUNFLOWERS

METHODS OF APPLYING FUNGICIDES

Object: To compare the effects of mist-blown and hydraulic applications of fungicide on the control of Botrytis and on the yield of sunflowers - Great Harpenden I.

Sponsors: V.J. Church, C.J. Rawlinson.

Design: 6 randomised blocks of 4 plots.

Whole plot dimensions: 3.5 x 10.0.

Treatments:

SPRAYER	Sprayers:
NONE	None
HYD	Standard hydraulic sprayer
HYD DLN	Hydraulic sprayer with drop leg nozzles
MIST BLO	Mist blower

NOTE: The sprayers applied carbendazim at 0.15 kg and prochloraz at 0.40 kg with vinclozolin at 0.75 kg in 440 l in HYD and MIST BLO and in 600 l in HYD DLN on 17 and 25 July, 1990.

NOTE: Plots were netted against birds from sowing until harvest.

Basal applications: Manures: (13:13:21) at 380 kg. Weedkillers: Trifluralin at 1.1 kg in 200 l. Linuron at 0.50 kg in 200 l. Desiccant: Diquat at 0.60 kg ion applied with a wetting agent, 'Vassgrow' at 0.22 l, in 220 l. Irrigation: 22 mm on each of two occasions and 25 mm on a third.

Seed: S47, sown at 16 seeds per square metre.

Cultivations, etc.:- Ploughed: 1 Sept, 1989. Rolled: 4 Sept. Deep-tine cultivated: 24 Nov. Spring-tine cultivated, NPK applied: 12 Mar, 1990. Trifluralin applied, spring-tine cultivated twice: 24 Apr. Seed sown, rolled: 25 Apr. Linuron applied: 1 May. Irrigation applied: 3, 25 May and 27 July. Desiccant applied: 29 Aug. Hand harvested: 4 Sept. Previous crops: W. wheat 1988 and 1989.

NOTE: Botrytis was assessed on four occasions during August. Plants were counted at harvest.

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90/R/SU/3

GRAIN (AT 90% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

SPRAYER	NONE	HYD	HYD DLN	MIST BLO	Mean
	2.37	2.26	2.28	2.51	2.35

*** Standard errors of differences of means ***

SPRAYER
0.075

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	15	0.129	5.5

GRAIN MEAN DM% 79.0

PLOT AREA HARVESTED 0.00150

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90/R/SU/4

SUNFLOWERS

DIMETHIPIN AND MATURITY

Object: To study the effects of dimethipin and diquat on dates of maturity, amounts of disease and yield of sunflowers - Great Harpenden I.

Sponsors: V.J. Church, C.J. Rawlinson.

Design: 3 randomised blocks each containing 2 replicates of 3 treatments.

Whole plot dimensions: 3.5 x 10.0.

Treatments:

CHEMICAL	Chemical sprays:
NONE	None
DIMETHIP	Dimethipin at 0.50 kg in 220 l applied on 22 Aug, 1990
DIQUAT	Diquat at 0.60 kg ion applied with a wetting agent, 'Vassgrow' at 0.22 l, in 220 l, applied on 5 Sept

NOTE: Plots were netted against birds from sowing until harvest.

Basal applications: Manures: (13:13:21) at 380 kg. Weedkillers: Trifluralin at 1.1 kg in 200 l. Linuron at 0.50 kg in 200 l. Irrigation: 22 mm on each of three occasions.

Seed: Vincent, sown at 16 seeds per square metre.

Cultivations, etc.:- Ploughed: 1 Sept, 1989. Rolled: 4 Sept. Deep-tine cultivated: 24 Nov. Spring-tine cultivated, NPK applied: 12 Mar, 1990. Trifluralin applied, spring-tine cultivated, rotary cultivated, seed sown, rolled: 24 Apr. Linuron applied: 1 May. Irrigation applied: 3, 10 and 25 May. Hand harvested: 10, 13 and 18 Sept for **CHEMICAL** DIMETHIP, DIQUAT and NONE respectively. Previous crops: W. wheat 1988 and 1989.

NOTE: Samples were assessed for seed moisture content during flowering. Botrytis was assessed three times during late summer. Plants were counted at harvest.

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90/R/SU/4

GRAIN (AT 90% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

CHEMICAL	NONE	DIMETHIP	DIQUAT	Mean
	2.71	2.51	2.67	2.63

*** Standard errors of differences of means ***

CHEMICAL
0.075

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	13	0.131	5.0

GRAIN MEAN DM% 80.8

PLOT AREA HARVESTED 0.00150

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90/R/LN/1

LINSEED

PESTS & DISEASES

Object: To study the effects of insecticidal and fungicidal treatments on the pests, pathogens and yields of linseed - Hoosfield.

Sponsors: A.W. Ferguson, B.D.L. Fitt.

Design: 6 randomised blocks of 4 plots.

Whole plot dimensions: 3.0 x 15.0.

Treatments: All combinations of:-

1. **INSCTCDE** Insecticides:

NONE	None
HC DE TR	Gamma HCH at 0.28 kg in 300 l on 11 Apr, 1990 and 25 Apr Deltamethrin at 7.5 g in 300 l on 11 Apr, 25 Apr, 9 May, 22 May, 11 July and 26 July Triazophos at 0.42 kg in 300 l on 5 June

2. **FUNGCIDE** Fungicides:

NONE	None
IP+PR+CM	Iprodione at 0.50 kg in 300 l on 14 June, 1990 Prochloraz at 0.50 kg in 300 l on 26 June Carbendazim at 0.25 kg and maneb at 1.6 kg in 300 l on 3 July Prochloraz (as seed dressing) at 0.40 g/kg seed

Basal applications: Manure: 'Nitram' at 250 kg. Weedkillers: Clopyralid at 0.10 kg with bentazone at 0.72 kg in 200 l. Desiccant: Diquat at 0.60 kg ion with a wetting agent ('Enhance' at 0.20 l) in 320 l.

Seed: Antares, sown at 90 kg.

Cultivations, etc.:- Ploughed: 4 Dec, 1989. N applied, spring-tine cultivated, rotary harrowed twice, seed sown: 22 Mar, 1990. Weedkillers applied: 14 May. Desiccant with wetting agent applied: 9 Aug. Combine harvested: 23 Aug. Previous crops: S. wheat 1988, linseed 1989.

NOTE: Insects and diseases were assessed regularly during he season.

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90/R/LN/1

GRAIN (AT 90% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

FUNGCIDE	NONE	IP+PR+CM	Mean
INSCTCDE			
NONE	1.86	1.98	1.92
HC DE TR	1.85	2.07	1.96
Mean	1.86	2.03	1.94

*** Standard errors of differences of means ***

INSCTCDE	FUNGCIDE	INSCTCDE FUNGCIDE
0.037	0.037	0.052

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK	5	0.107	5.5
BLOCK.WP	15	0.091	4.7

GRAIN MEAN DM% 93.0

PLOT AREA HARVESTED 0.00276

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90/W/NB/1

NAVY BEANS

SEEDBED AND LATE N

Object: To study the effects of seedbed and late nitrogen fertilizer on the growth and yield of navy beans inoculated with Rhizobium - Woburn, Great Hill Bottom I.

Sponsors: J.M. Day, M.L. Lovell.

Design: 3 randomised blocks of 18 plots.

Whole plot dimensions: 1.5 x 6.0.

Treatments: All combinations of:-

1. **SD BED N** Nitrogen fertilizer (kg N) as 'Nitro-Chalk' (27% N), applied to seedbed:

   20
   40
   60

2. **APP METH** Methods of applying seedbed nitrogen fertilizer:

BCAST	Broadcast by hand after drilling
COM DRLL	Combine drilled with seed

3. **FLOWR N** Nitrogen fertilizer (kg N) as 'Nitro-Chalk', applied at flowering on 28 June, 1990:

   0
   120

plus four extra treatments :

EXTRA

0 0 0	No nitrogen fertilizer (duplicated)
0 0 120F	120 kg N at flowering (duplicated)
120S 0 0	120 kg N broadcast to seedbed
120S 120F	120 kg broadcast to seedbed, repeated at flowering

Basal applications: Manures: (0:24:24) at 200 kg. Weedkillers: Paraquat at 0.80 kg ion in 220 l. Trifluralin at 0.84 kg in 220 l. Monolinuron at 0.56 kg in 220 l. Fungicide: Benomyl at 0.55 kg in 220 l. Irrigation: 24 mm (12 mm applied on two occasions).

Seed: Albion, sown at 40 seeds per square metre.

Cultivations, etc.:- Ploughed: 22 Nov, 1989. Paraquat applied: 3 May, 1990. PK applied: 18 May. Spring-tine cultivated: 21 May. Trifluralin applied and cultivated: 22 May. Seed sown and seedbed N treatments applied: 24 May. Monolinuron applied: 31 May. Irrigation applied: 1 and 20 June. Remaining N treatments applied: 28 June. Fungicide applied 22 Aug. Hand harvested and threshed by stationary combine harvester: 27 Oct. Previous crops: S. wheat 1988, s. barley 1989.

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90/W/NB/1

NOTE: Times of flowering were noted:

GRAIN (AT 85% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

APP METH	BCAST	COM DRLL	Mean
SD BED N			
20	2.19	2.30	2.25
40	1.99	1.99	1.99
60	2.16	2.02	2.09
Mean	2.11	2.10	2.11

FLOWR N	0	120	Mean
SD BED N			
20	2.17	2.33	2.25
40	2.19	1.78	1.99
60	2.21	1.97	2.09
Mean	2.19	2.03	2.11

FLOWR N	0	120	Mean
APP METH			
BCAST	2.13	2.09	2.11
COM DRLL	2.25	1.96	2.10
Mean	2.19	2.03	2.11

APP METH	BCAST		COM DRLL	
SD BED N FLOWR N	0	120	0	120
20	1.97	2.41	2.36	2.24
40	2.17	1.81	2.22	1.76
60	2.26	2.06	2.17	1.88

EXTRA	0 0 0	0 0 120F	120S 0 0	120S 120F	Mean
	2.29	2.11	2.32	2.39	2.25

GRAND MEAN 2.16

*** Standard errors of differences of means ***

SD BED N	APP METH	FLOWR N	SD BED N APP METH	
0.173	0.141	0.141	0.245	

SD BED N FLOWR N	APP METH FLOWR N	SD BED N APP METH FLOWR N	EXTRA	
0.245	0.200	0.347	0.347	min.rep
			0.300	max-min
			0.245	max.rep

EXTRA	
min.rep	120S 0 0 v 120S 120F
max-min	0 0 0 or 0 0 120F v 120S 0 0 or 120S 120F
max.rep	0 0 0 v 0 0 120F

GRAIN MEAN DM% * PLOT AREA HARVESTED 0.00045

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90/W/NB/2

NAVY BEANS

VARIETIES, RHIZOBIUM AND N

Object: To study the responses of five varieties of navy beans to Rhizobium inoculation and nitrogen fertilizer - Woburn, Great Hill Bottom I.

Sponsors: J.M. Day, M.L. Lovell.

Design: 3 randomised blocks of 80 plots.

Whole plot dimensions: 1.5 x 3.0.

Treatments: All combinations of:-

1. **VARS IT** Varieties used in inoculation test:

   ALBION
   EDMUND
   SAJA X1
   SAJA X2
   SEAFARER

2. **INOCULUM** Inoculants of Rhizobium phaseoli applied as granules with the seed:

NONE	
I 1	RCR 3622
I 2	RCR 3639
I 3	CIAT 274
I 4	CIAT 632
I 5	PGRO 1

3. **N** Nitrogen fertilizer (kg N) as 'Nitro-Chalk' to seedbed:

   0
   40

together with all combinations of:-

1. **VARS NT** Varieties, uninoculated, used in nitrogen test:

   ALBION
   EDMUND
   SAJA X1
   SAJA X2
   SEAFARER

2. **N R T** Nitrogen rates (kg N) as 'Nitro-Chalk' and times:

80 S	80 broadcast to seedbed
120 S	120 broadcast to seedbed
160 S	160 broadcast to seedbed
160S+80F	160 broadcast to seedbed + 80 at flowering

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90/W/NB/2

Basal applications: Manures: (0:24:24) at 200 kg. Weedkillers: Paraquat at 0.80 kg ion in 220 l. Trifluralin at 0.84 kg in 220 l. Monolinuron at 0.56 kg in 220 l. Fungicide: Benomyl at 0.55 kg in 220 l. Irrigation 24 mm: (12 mm applied on two occasions).

Seed: Sown at 40 seeds per square metre.

Cultivations, etc.:- Ploughed: 22 Nov, 1989. Paraquat applied: 3 May, 1990. PK applied: 18 May. Spring-tine cultivated: 21 May. Trifluralin applied and cultivated: 22 May. Seed sown: 23 May. Seedbed N applied: 24 May. Monolinuron applied: 31 May. Irrigation applied: 1 and 20 June. Fungicide applied: 22 Aug. Hand harvested and threshed by stationary combine harvester: 27 Oct. Previous crops: S. wheat 1988, s. barley 1989.

NOTES: (1) Times of flowering were noted.
(2) 19 plots failed to mature enough for combine harvesting and the yields were lost, those with treatment combinations

VARS IT	ALBION	SEAFARER	ALBION	SEAFARER	ALBION	ALBION
INOCULUM	I 2	I 3	I 4	I 1	I 3	NONE
N	0	40	0	40	40	40

VARS IT	SAJA X1	SEAFARER	SAJA X2	ALBION	SAJA X1
INOCULUM	NONE	I 4	I 2	I 5	I 2
N	40	40	0	40	0

VARS NT	SEAFARER	EDMUND	SAJA X2	SAJA X1
N R T	160S+80F	80 S	120 S	160S+80F

VARS NT	SEAFARER	SAJA X2	ALBION	SEAFARER
N R T	160 S	160S+80F	160S+80F	80 S

Estimated values were used in the analysis.

GRAIN (AT 85% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

INOCULUM	NONE	I 1	I 2	I 3	I 4	I 5	Mean
VARS IT							
ALBION	2.75	2.76	2.82	2.65	3.04	2.51	2.75
EDMUND	2.97	2.76	3.06	2.27	2.60	2.93	2.77
SAJA X1	2.18	2.26	2.02	1.91	2.03	1.90	2.05
SAJA X2	2.21	2.39	2.50	2.29	2.70	2.80	2.48
SEAFARER	3.09	2.85	2.72	2.78	2.82	3.07	2.89
Mean	2.64	2.60	2.63	2.38	2.64	2.64	2.59

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90/W/NB/2

GRAIN (AT 85% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

N	0	40	Mean
VARS IT			
ALBION	2.76	2.75	2.75
EDMUND	2.72	2.81	2.77
SAJA X1	1.98	2.13	2.05
SAJA X2	2.40	2.57	2.48
SEAFARER	2.85	2.92	2.89
Mean	2.54	2.64	2.59

N	0	40	Mean
INOCULUM			
NONE	2.51	2.77	2.64
I 1	2.48	2.72	2.60
I 2	2.53	2.72	2.63
I 3	2.44	2.32	2.38
I 4	2.61	2.67	2.64
I 5	2.67	2.62	2.64
Mean	2.54	2.64	2.59

N		0	40
VARS IT	INOCULUM		
ALBION	NONE	2.48	3.02
	I 1	2.53	2.98
	I 2	2.69	2.95
	I 3	2.98	2.32
	I 4	3.11	2.97
	I 5	2.75	2.27
EDMUND	NONE	2.96	2.99
	I 1	2.62	2.89
	I 2	2.76	3.37
	I 3	2.37	2.17
	I 4	2.49	2.70
	I 5	3.11	2.75
SAJA X1	NONE	1.88	2.48
	I 1	2.17	2.34
	I 2	2.16	1.88
	I 3	1.79	2.04
	I 4	2.06	2.01
	I 5	1.80	2.01
SAJA X2	NONE	2.20	2.22
	I 1	2.31	2.48
	I 2	2.38	2.62
	I 3	2.35	2.22
	I 4	2.41	3.00
	I 5	2.74	2.86
SEAFARER	NONE	3.03	3.15
	I 1	2.79	2.90
	I 2	2.64	2.80
	I 3	2.73	2.83
	I 4	2.98	2.65
	I 5	2.93	3.21

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90/W/NB/2

GRAIN (AT 85% DRY MATTER) TONNES/HECTARE

***** Tables of means *****

N R T VARS NT	80 S	120 S	160 S	160S+80F	Mean
ALBION	2.58	2.67	2.64	2.51	2.60
EDMUND	2.70	3.26	2.92	2.42	2.83
SAJA X1	2.26	1.55	1.68	2.18	1.92
SAJA X2	2.45	2.37	2.02	2.47	2.33
SEAFARER	3.17	2.40	2.65	3.44	2.92
Mean	2.63	2.45	2.38	2.61	2.52

GRAND MEAN 2.57

*** Standard errors of differences of means ***

INOCULUM	VARS IT	N	VARS NT
0.107	0.098	0.062	0.169

N R T	INOCULUM VARS IT	N VARS IT	N INOCULUM
0.151	0.239	0.138	0.151

N R T VARS NT	INOCULUM VARS IT N
0.338	0.338

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	153	0.414	16.1

GRAIN MEAN DM% *

PLOT AREA HARVESTED 0.00045

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90/R/P/1 and 90/W/P/1

POTATOES

FUNGICIDES WITH THE SEED

Object: To study the effects of fungicides applied with the seed at planting on the yield and tuber diseases of potatoes - Rothamsted, Fosters West (R), Woburn, Butt Furlong (W).

Sponsors: R. Moffitt, G.A. Hide.

Design: 2 randomised blocks of 18 plots.

Whole plot dimensions: 1.5 x 6.0.

Treatments: All combinations of:-

1. **VARIETY** Varieties:

   DESIREE
   ESTIMA
   MARFONA

2. **SOILFUNG** Fungicides, per t of seed, applied in the ridge at planting:

THIA+IMA	Thiabendazole at 30 g plus imazalil at 10 g
TOLC MET	Tolclofos methyl at 250 g

3. **FUNGMETH** Methods of applying fungicides:

PLANTING	At planting
SEEDRESS	As a seed application prior to planting

plus three extra treatments:

EXTRA

DES NONE	Desiree not given fungicides to the seed (duplicated)
EST NONE	Estima not given fungicides to the seed (duplicated)
MAR NONE	Marfona not given fungicides to the seed (duplicated)

NOTES: (1) **SOILFUNG** applications were made with a powder applicator placing the fungicide alongside the potatoes at planting.
(2) SEEDRESS treatments were applied to tubers by electrostatic sprayer in 0.44 l of water per tonne of seed on 21 Feb, 1990 to Estima and Desiree, 9 Mar to Marfona.

Basal applications:
Fosters West (R): Manures: FYM at 41 t. (13:13:21) at 1.5 t. Weedkillers: Glyphosate at 1.4 kg in 200 l. Linuron at 1.6 kg in 200 l. Fungicides: Maneb at 0.96 kg and zinc oxide at 0.022 kg in 200 l applied on two occasions, with the insecticide on the first and with a wetting agent, 'Bond' at 200 ml, on the second. Mancozeb at 1.0 kg in 200 l applied on two occasions. Fentin hydroxide at 0.27 kg in 200 l. Insecticide: Pirimicarb at 0.14 kg. Irrigation: 25 mm applied on each of four occasions. Desiccant: BOV at 280 l.

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90/R/P/1 and 90/W/P/1

Basal applications:

Butt Furlong (W): Manures: (0:18:36) at 690 kg. (13:13:20) at 1.6 t. Weedkiller: Linuron at 1.6 kg in 220 l. Fungicide: Mancozeb at 1.0 kg with a wetting agent, 'Bond' at 200 ml, in 220 l, applied on two occasions. Mancozeb at 1.4 kg, with 'Bond' at 200 ml, in 220 l. Fentin hydroxide at 0.27 kg applied on three occasions in 220 l. Nematicide: Oxamyl at 5.5 kg. Irrigation: 12 mm applied on each of ten occasions. Desiccant: BOV at 220 l.

Cultivations, etc.:-

Fosters West (R): Glyphosate applied: 26 Sept, 1989. FYM applied: 15 Nov. Ploughed: 23 Nov. NPK applied: 19 Mar, 1990. Spring-tine cultivated, rotary harrowed, potatoes planted and rotary ridged: 4 Apr. Linuron applied: 5 Apr. Irrigation applied: 6, 26 June, 16 July and 1 Aug. Maneb, zinc oxide and pirimicarb applied: 15 June. Mancozeb applied: 29 June and 13 July. Maneb, zinc oxide and wetting agent applied: 27 July. Fentin hydroxide applied: 13 Aug. Haulm mechanically destroyed: 23 Aug. Desiccant applied: 28 Aug. Potatoes lifted: 24 Oct. Previous crops: S. wheat 1988, w. oats 1989.

Butt Furlong (W): PK applied: 2 Sept, 1989. Subsoiled with tines 150 cm apart and 45 cm deep: 11 Sept. Ploughed: 16 Nov. Nematicide applied, NPK applied, spring-tine cultivated and seed planted: 11 Apr, 1990. Weedkiller applied: 19 Apr. Mancozeb at lower rate with wetting agent applied: 26 June and 11 July and at higher rate: 24 July. Irrigation applied: 27, 29 June, 2, 11, 17, 20, 23 July, 3, 6 and 10 Aug. Fentin hydroxide applied: 7, 21 Aug and 10 Sept. Haulm mechanically destroyed: 12 Sept. Desiccant applied: 17 Sept. Potatoes lifted: 19 Oct. Previous crops: S. barley 1988 and 1989.

NOTE: Tuber diseases were assessed after harvest.

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90/R/P/1 FOSTERS WEST (R)

TOTAL TUBERS TONNES/HECTARE

***** Tables of means *****

SOILFUNG	THIA+IMA	TOLC MET	Mean
VARIETY			
DESIREE	40.1	41.9	41.0
ESTIMA	44.0	43.2	43.6
MARFONA	44.0	48.7	46.4
Mean	42.7	44.6	43.7

FUNGMETH	PLANTING	SEEDRESS	Mean
VARIETY			
DESIREE	41.2	40.9	41.0
ESTIMA	42.8	44.4	43.6
MARFONA	47.8	44.9	46.4
Mean	43.9	43.4	43.7

FUNGMETH	PLANTING	SEEDRESS	Mean
SOILFUNG			
THIA+IMA	42.4	43.0	42.7
TOLC MET	45.4	43.8	44.6
Mean	43.9	43.4	43.7

SOILFUNG	THIA+IMA		TOLC MET	
VARIETY	FUNGMETH	PLANTING	SEEDRESS	PLANTING	SEEDRESS
DESIREE		38.9	41.4	43.5	40.3
ESTIMA		42.4	45.6	43.2	43.1
MARFONA		45.9	42.1	49.7	47.8

EXTRA	DES NONE	EST NONE	MAR NONE	Mean
	45.2	46.5	45.8	45.8

GRAND MEAN 44.4

*** Standard errors of differences of means ***

VARIETY	SOILFUNG	FUNGMETH	VARIETY SOILFUNG
2.51	2.05	2.05	3.55

VARIETY FUNGMETH	SOILFUNG FUNGMETH	VARIETY SOILFUNG FUNGMETH	EXTRA
3.55	2.90	5.02	3.55

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	20	5.02	11.3

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90/R/P/1 FOSTERS WEST (R)

PERCENTAGE WARE 3.81CM (1.5 INCH) RIDDLE

***** Tables of means *****

SOILFUNG	THIA+IMA	TOLC MET	Mean
VARIETY			
DESIREE	95.5	96.1	95.8
ESTIMA	94.8	96.2	95.5
MARFONA	97.7	97.5	97.6
Mean	96.0	96.6	96.3

FUNGMETH	PLANTING	SEEDRESS	Mean
VARIETY			
DESIREE	96.0	95.6	95.8
ESTIMA	95.2	95.7	95.5
MARFONA	97.5	97.7	97.6
Mean	96.2	96.4	96.3

FUNGMETH	PLANTING	SEEDRESS	Mean
SOILFUNG			
THIA+IMA	95.7	96.4	96.0
TOLC MET	96.8	96.4	96.6
Mean	96.2	96.4	96.3

	SOILFUNG	THIA+IMA		TOLC MET	
VARIETY	**FUNGMETH**	PLANTING	SEEDRESS	PLANTING	SEEDRESS
DESIREE		95.4	95.7	96.6	95.6
ESTIMA		94.0	95.6	96.5	95.9
MARFONA		97.7	97.8	97.3	97.7

EXTRA	DES NONE	EST NONE	MAR NONE	Mean
	96.0	96.9	96.4	96.4

GRAND MEAN 96.3

PLOT AREA HARVESTED 0.00075

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90/W/P/1 BUTT FURLONG (W)

TOTAL TUBERS TONNES/HECTARE

***** Tables of means *****

SOILFUNG	THIA+IMA	TOLC MET	Mean
VARIETY			
DESIREE	59.5	54.7	57.1
ESTIMA	55.7	49.3	52.5
MARFONA	75.8	61.1	68.5
Mean	63.7	55.0	59.4

FUNGMETH	PLANTING	SEEDRESS	Mean
VARIETY			
DESIREE	60.2	54.0	57.1
ESTIMA	50.1	54.9	52.5
MARFONA	67.1	69.8	68.5
Mean	59.1	59.6	59.4

FUNGMETH	PLANTING	SEEDRESS	Mean
SOILFUNG			
THIA+IMA	62.8	64.6	63.7
TOLC MET	55.5	54.6	55.0
Mean	59.1	59.6	59.4

	SOILFUNG	THIA+IMA		TOLC MET	
VARIETY	**FUNGMETH**	PLANTING	SEEDRESS	PLANTING	SEEDRESS
DESIREE		61.8	57.2	58.6	50.8
ESTIMA		46.9	64.5	53.2	45.4
MARFONA		79.6	72.1	54.7	67.6

EXTRA	DES NONE	EST NONE	MAR NONE	Mean
	62.1	58.6	68.2	63.0

GRAND MEAN 60.6

*** Standard errors of differences of means ***

VARIETY	**SOILFUNG**	**FUNGMETH**	**VARIETY SOILFUNG**
4.68	3.82	3.82	6.62

VARIETY FUNGMETH	**SOILFUNG FUNGMETH**	**VARIETY SOILFUNG FUNGMETH**	**EXTRA**
6.62	5.41	9.36	6.62

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	20	9.36	15.5

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90/W/P/1 BUTT FURLONG (W)

PERCENTAGE WARE 3.81CM (1.5 INCH) RIDDLE

***** Tables of means *****

SOILFUNG	THIA+IMA	TOLC MET	Mean
VARIETY			
DESIREE	90.0	88.4	89.2
ESTIMA	91.0	93.5	92.2
MARFONA	94.4	93.1	93.7
Mean	91.8	91.7	91.7

FUNGMETH	PLANTING	SEEDRESS	Mean
VARIETY			
DESIREE	90.1	88.2	89.2
ESTIMA	90.8	93.7	92.2
MARFONA	93.8	93.7	93.7
Mean	91.6	91.9	91.7

FUNGMETH	PLANTING	SEEDRESS	Mean
SOILFUNG			
THIA+IMA	91.1	92.4	91.8
TOLC MET	92.0	91.3	91.7
Mean	91.6	91.9	91.7

	SOILFUNG	THIA+IMA		TOLC MET	
VARIETY	**FUNGMETH**	PLANTING	SEEDRESS	PLANTING	SEEDRESS
DESIREE		90.1	89.8	90.0	86.7
ESTIMA		88.8	93.2	92.7	94.2
MARFONA		94.4	94.3	93.1	93.1

EXTRA	DES NONE	EST NONE	MAR NONE	Mean
	89.8	91.4	94.7	92.0

GRAND MEAN 91.8

PLOT AREA HARVESTED 0.00090

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90/W/P/2

POTATOES

CHEMICAL CONTROL OF GLOBODERA PALLIDA

Object: To determine whether yield and control of G. pallida are increased by adding to oxamyl chemicals with different effects on the nematodes - Woburn, Lansome/Mill Dam Close III.

Sponsors: A.G. Whitehead, A.J.F. Nichols.

Design: 3 randomised blocks of 2 plots split into 6 sub plots.

Whole plot dimensions: 6.0 x 13.3.

Treatments: All combinations of:-

1. **IRRIGATN** Irrigation:

NONE	None
FULL	Full, to reduce a soil moisture deficit of 37 mm to 25 mm

Sub plots

2. **CHEMICAL** Chemicals:

NONE	None
OXAMYL	Oxamyl at 5.6 kg
OX CARBO	Oxamyl at 5.6 kg + carbofuran at 5.6 kg
OX ETHOP	Oxamyl at 5.6 kg + ethoprophos at 5.6 kg
OX FORMA	Oxamyl at 5.6 kg + formalin at 1170 kg in 3000 l
OX SODME	Oxamyl at 5.6 kg + sodium metavanadate at 36 kg

NOTES: (1) Irrigation was applied on 21 occasions; at 12 mm on each.
(2) Formalin was applied on 13 Feb, 1990, the other chemicals on 23 Apr.

Basal applications: Manures: (13:13:20) at 1.6 t. Weedkillers: Glyphosate at 1.4 kg in 220 l. Linuron at 1.6 kg in 220 l. Fungicides: Mancozeb at 1.0 kg on the first two occasions and at 1.4 kg on the third, applied with a wetting agent, 'Bond' at 200 ml, in 220 l. Fentin hydroxide at 0.27 kg in 220 l, applied on three occasions.

Variety: Desiree.

Cultivations, etc.:- Glyphosate applied: 1 Sept, 1989. Ploughed: 13 Nov. NPK applied: 20 Apr, 1990. Rotary cultivated, potatoes planted: 23 Apr. Rotary ridged: 26 Apr. Linuron applied: 3 May. Irrigation treatment applied: 9, 15, 18, 22, 31 May, 5, 8, 13, 15, 19, 26, 29 June, 2, 11, 16, 20, 23, 26 July, 3, 6 and 10 Aug. Mancozeb and wetting agent applied: 26 June, 11 and 24 July. Fentin hydroxide applied: 7, 10 Aug and 10 Sept. Haulm mechanically destroyed: 14 Sept. Potatoes lifted: 19 Sept. Previous crops: Potatoes 1988, s. barley 1989.

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90/W/P/2

NOTE: Populations of G. pallida eggs in soil were assessed before planting and after harvest.

TOTAL TUBERS TONNES/HECTARE

***** Tables of means *****

IRRIGATN / CHEMICAL	NONE	FULL	Mean
NONE	18.6	34.1	26.4
OXAMYL	22.5	44.2	33.3
OX CARBO	22.6	39.3	30.9
OX ETHOP	21.0	43.8	32.4
OX FORMA	23.0	43.5	33.2
OX SODME	20.5	36.0	28.3
Mean	21.4	40.1	30.8

*** Standard errors of differences of means ***

CHEMICAL	IRRIGATN* CHEMICAL
3.27	4.63

* Within the same level of **IRRIGATN** only

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP.SP	20	5.67	18.4

PERCENTAGE WARE 4.4CM (1.75 INCH) RIDDLE

***** Tables of means *****

IRRIGATN / CHEMICAL	NONE	FULL	Mean
NONE	80.7	87.9	84.3
OXAMYL	84.9	90.6	87.8
OX CARBO	86.4	88.3	87.4
OX ETHOP	82.7	89.2	85.9
OX FORMA	79.8	89.2	84.5
OX SODME	85.9	89.0	87.5
Mean	83.4	89.1	86.2

PLOT AREA HARVESTED 0.00057

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90/W/P/3

POTATOES

RESISTANT VARIETIES AND PCN CONTROL

Object: To assess yields of, and control of a mixed population of Globodera rostochiensis and G. pallida by, six varieties of potato differing in heir susceptibilities to the potato cyst nematodes (PCN) - Woburn, Lansome/Mill Dam Close III.

Sponsors: A.G. Whitehead, A.J.F. Nichols.

Design: 2 randomised blocks of 2 plots split into 12 sub plots.

Whole plot dimensions: 6.0 x 27.4.

Treatments: All combinations of:-

Whole plots

1. **IRRIGATN** Irrigation:

NONE	None
FULL	Full, to reduce a soil moisture deficit of 37 mm to 25 mm

Sub plots

2. **VARIETY** Varieties:

DESIREE
MORAG
NADINE
ROCKET
SANTE
STROMA

3. **NEMACIDE** Nematicide:

NONE	None
OXAMYL	Oxamyl at 5.6 kg applied to the seedbed

NOTE: Irrigation was applied on 20 occasions; at 25 mm on the second occasion, at 12 mm on the rest.

Basal applications: Manures: (13:13:20) at 1.6 t. Weedkillers: Glyphosate at 1.4 kg in 220 l. Linuron at 1.6 kg in 220 l. Fungicides: Mancozeb at 1.0 kg on the first two occasions and at 1.4 kg on the third applied with a wetting agent, 'Bond' at 200 ml, in 220 l. Fentin hydroxide at 0.27 kg in 220 l, applied on three occasions.

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90/W/P/3

Cultivations, etc.:- Glyphosate applied: 1 Sept, 1989. Ploughed: 13 Nov. NPK applied: 20 Apr, 1990. Spring-tine cultivated: 23 Apr. Nematicide treatment applied, rotary cultivated and potatoes planted: 24 Apr. Rotary ridged: 26 Apr. Linuron applied: 3 May. Irrigation treatment applied: 15, 18, 22, 31 May, 5, 8, 13, 15, 19, 26, 29 June, 2, 11, 16, 20, 23, 26 July, 3, 6 and 10 Aug. Mancozeb and wetting agent applied: 26 June, 11 and 24 July. Fentin hydroxide applied: 7, 21 Aug and 10 Sept. Haulm mechanically destroyed: 14 Sept. Potatoes lifted: 19 Sept. Previous crops: Potatoes 1988 and 1989.

NOTE: Populations of G. pallida eggs in soil were assessed before planting and after harvest.

TOTAL TUBERS TONNES/HECTARE

***** Tables of means *****

IRRIGATN	NONE	FULL	Mean
VARIETY			
DESIREE	14.7	25.2	19.9
MORAG	13.9	40.7	27.3
NADINE	10.4	33.2	21.8
ROCKET	13.3	35.8	24.5
SANTE	11.0	24.9	17.9
STROMA	15.5	31.3	23.4
Mean	13.1	31.8	22.5

NEMACIDE	NONE	OXAMYL	Mean
VARIETY			
DESIREE	18.9	21.0	19.9
MORAG	20.3	34.3	27.3
NADINE	14.7	29.0	21.8
ROCKET	23.4	25.7	24.5
SANTE	14.9	21.0	17.9
STROMA	22.6	24.2	23.4
Mean	19.1	25.8	22.5

NEMACIDE	NONE	OXAMYL	Mean
IRRIGATN			
NONE	11.5	14.7	13.1
FULL	26.7	37.0	31.8
Mean	19.1	25.8	22.5

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90/W/P/3

TOTAL TUBERS TONNES/HECTARE

***** Tables of means *****

VARIETY	NEMACIDE IRRIGATN	NONE	OXAMYL
DESIREE	NONE	12.8	16.5
	FULL	24.9	25.4
MORAG	NONE	12.9	14.8
	FULL	27.6	53.7
NADINE	NONE	9.2	11.6
	FULL	20.1	46.3
ROCKET	NONE	11.4	15.2
	FULL	35.3	36.2
SANTE	NONE	10.1	11.9
	FULL	19.7	30.1
STROMA	NONE	12.8	18.2
	FULL	32.4	30.2

*** Standard errors of differences of means ***

VARIETY	NEMACIDE	IRRIGATN* VARIETY
3.74	2.16	5.29

IRRIGATN* NEMACIDE	VARIETY NEMACIDE	IRRIGATN* VARIETY NEMACIDE
3.05	5.29	7.48

* Within the same level of **IRRIGATN** only

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP.SP	22	7.48	33.3

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90/W/P/3

PERCENTAGE WARE 4.4CM (1.75 INCH) RIDDLE

***** Tables of means *****

IRRIGATN VARIETY	NONE	FULL	Mean
DESIREE	67.2	80.0	73.6
MORAG	70.6	83.1	76.8
NADINE	71.1	75.2	73.2
ROCKET	76.6	86.7	81.6
SANTE	71.8	78.1	75.0
STROMA	74.1	81.4	77.7
Mean	71.9	80.7	76.3

NEMACIDE VARIETY	NONE	OXAMYL	Mean
DESIREE	74.2	72.9	73.6
MORAG	72.3	81.3	76.8
NADINE	68.9	77.4	73.2
ROCKET	79.4	83.9	81.6
SANTE	73.1	76.8	75.0
STROMA	75.6	79.8	77.7
Mean	73.9	78.7	76.3

NEMACIDE IRRIGATN	NONE	OXAMYL	Mean
NONE	69.1	74.7	71.9
FULL	78.7	82.8	80.7
Mean	73.9	78.7	76.3

VARIETY	NEMACIDE IRRIGATN	NONE	OXAMYL
DESIREE	NONE	65.7	68.7
	FULL	82.8	77.2
MORAG	NONE	67.6	73.5
	FULL	77.1	89.1
NADINE	NONE	69.6	72.6
	FULL	68.2	82.3
ROCKET	NONE	71.9	81.2
	FULL	86.8	86.6
SANTE	NONE	72.3	71.4
	FULL	73.9	82.3
STROMA	NONE	67.6	80.5
	FULL	83.6	79.2

PLOT AREA HARVESTED 0.00057

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90/W/P/4

POTATOES

SUSCEPTIBLE VARIETIES AND G. PALLIDA CONTROL

Object: To assess the control of Globodera pallida by oxamyl on a range of susceptible varieties - Woburn, Lansome/Mill Dam Close III.

Sponsors: A.G. Whitehead, A.J.F. Nichols.

Design: 2 randomised blocks of 22 plots.

Whole plot dimensions: 3.0 x 4.6.

Treatments: All combinations of:-

1. **VARIETY** Varieties:

BARD	Maris Bard
CARA	Cara
COSTELLA	Costella
DESIREE	Desiree
ESTIMA	Estima
JAVELIN	Pentland Javelin
PIPER	Maris Piper
RECORD	Record
ROMANO	Romano
SQUIRE	Pentland Squire
WILJA	Wilja

2. **NEMACIDE** Nematicide:

NONE	None
OXAMYL	Oxamyl at 5.6 kg applied to the seedbed

Basal applications: Manures: (13:13:20) at 1.6 t. Weedkillers: Glyphosate at 1.4 kg in 220 l. Linuron at 1.6 kg in 220 l. Fungicides: Mancozeb at 1.0 kg on the first two occasions and at 1.4 kg on the third, applied with a wetting agent, 'Bond' at 200 ml, in 220 l. Fentin hydroxide at 0.27 kg in 220 l, applied on three occasions. Irrigation: 12 mm applied on each of 17 occasions.

Cultivations, etc.:- Glyphosate applied: 1 Sept, 1989. Ploughed: 13 Nov. NPK applied: 20 Apr, 1990. Spring-tine cultivated: 23 Apr. Oxamyl treatments applied, rotary cultivated, potatoes planted: 25 Apr. Rotary ridged: 26 Apr. Linuron applied: 3 May. Irrigation applied: 15, 18, 22, 31 May, 5, 8, 13, 15, 19, 26, 29 June, 2, 11, 16, 20, 23 and 26 July. Mancozeb and wetting agent applied: 26 June, 11 and 24 July. Fentin hydroxide applied: 7, 21 Aug and 10 Sept. Haulm mechanically destroyed: 14 Sept. Potatoes lifted: 18 Sept. Previous crops: Potatoes 1988, s. barley 1989.

NOTE: Populations of G. pallida eggs in soil were assessed before planting and after harvest.

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90/W/P/4

TOTAL TUBERS TONNES/HECTARE

***** Tables of means *****

NEMACIDE / VARIETY	NONE	OXAMYL	Mean
BARD	27.6	33.5	30.5
CARA	33.2	43.2	38.2
COSTELLA	43.5	58.0	50.7
DESIREE	27.6	43.4	35.5
ESTIMA	35.1	49.4	42.2
JAVELIN	28.4	31.8	30.1
PIPER	43.3	49.9	46.6
RECORD	23.5	28.1	25.8
ROMANO	36.3	33.2	34.7
SQUIRE	40.4	44.5	42.4
WILJA	35.4	36.3	35.8
Mean	34.0	41.0	37.5

*** Standard errors of differences of means ***

VARIETY	NEMACIDE	VARIETY NEMACIDE
5.26	2.24	7.44

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	21	7.44	19.8

PERCENTAGE WARE 4.4CM (1.75 INCH) RIDDLE

***** Tables of means *****

NEMACIDE / VARIETY	NONE	OXAMYL	Mean
BARD	89.1	90.2	89.7
CARA	86.6	82.0	84.3
COSTELLA	88.2	90.7	89.4
DESIREE	89.8	92.3	91.0
ESTIMA	90.7	93.0	91.9
JAVELIN	82.4	87.3	84.9
PIPER	83.9	87.3	85.6
RECORD	80.6	87.6	84.1
ROMANO	80.2	86.0	83.1
SQUIRE	93.4	91.0	92.2
WILJA	83.1	88.1	85.6
Mean	86.2	88.7	87.4

PLOT AREA HARVESTED 0.00069

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90/R/M/1

WINTER WHEAT AND WINTER BARLEY

APHIDS AND BYDV

Object: To study the effects of barley yellow dwarf virus (BYDV) on winter cereals - Appletree.

Sponsors: N. Carter, R.T. Plumb.

Design: 3 randomised blocks of 8 plots.

Whole plot dimensions: 9.0 x 10.0.

Treatments: All combinations of:-

1. **CROP** Crops:

   W BARLEY — Winter barley
   W WHEAT — Winter wheat

2. **AUT INS** Autumn insecticide:

   NONE — None
   CYPERMET — Cypermethrin at 25 g in 200 l on 1 Nov, 1989

3. **FLO INS** Insecticide at flowering:

   NONE — None
   PIRIMICA — Pirimicarb at 0.14 kg in 200 l on 17 May, 1990 (to barley) and 11 June (to wheat)

Basal applications: Manure: 'Nitram' at 350 kg. Weedkillers: Isoproturon at 1.7 kg in 200 l. Bromoxynil at 0.19 kg, ioxynil at 0.19 kg with mecoprop at 2.4 kg applied with the prochloraz in 200 l. Fungicides: Prochloraz at 0.40 kg. Propiconazole at 0.12 kg in 200 l.

Seed: W. wheat: Mercia, sown at 180 kg.
W. barley: Magie, sown at 160 kg.

Cultivations,etc.:- Rotary cultivated: 1 Aug, 1989. Deep-tine cultivated with vibrating tines: 2 Aug. Ploughed: 21 Aug. Rotary harrowed: 16 Sept. Rotary harrowed, seed sown: 18 Sept. Isoproturon applied: 20 Nov. N applied: 22 Mar, 1990. Remaining weedkillers with prochloraz applied: 30 Mar. Propiconazole applied: 4 May. Combine harvested: 24 July (barley) and 7 Aug (wheat). Previous crops: W. barley 1988, w. oilseed rape 1989.

NOTES: (1) Aphids were sampled from mid-October to early July.
(2) BYDV was assessed visually on four occasions during May and June and leaves from some plants were tested by enzyme-linked immunosorbent assay to determine virus present.
(3) Components of yield were measured.

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90/R/M/1

GRAIN TONNES/HECTARE

***** Tables of means *****

AUT INS	NONE	CYPERMET	Mean
CROP			
W BARLEY	8.30	8.56	8.43
W WHEAT	8.87	8.67	8.77
Mean	8.58	8.61	8.60

FLO INS	NONE	PIRIMICA	Mean
CROP			
W BARLEY	8.35	8.50	8.43
W WHEAT	8.70	8.83	8.77
Mean	8.53	8.67	8.60

FLO INS	NONE	PIRIMICA	Mean
AUT INS			
NONE	8.44	8.72	8.58
CYPERMET	8.62	8.61	8.61
Mean	8.53	8.67	8.60

	AUT INS	NONE		CYPERMET	
CROP	**FLO INS**	NONE	PIRIMICA	NONE	PIRIMICA
W BARLEY		8.28	8.32	8.43	8.69
W WHEAT		8.60	9.13	8.81	8.53

*** Standard errors of differences of means ***

CROP	**AUT INS**	**FLO INS**	**CROP AUT INS**
0.129	0.129	0.129	0.182

CROP FLO INS	**AUT INS FLO INS**	**CROP AUT INS FLO INS**
0.182	0.182	0.258

***** Stratum standard errors and coefficients of variation *****

Stratum	d.f.	s.e.	cv%
BLOCK.WP	14	0.316	3.7

GRAIN MEAN DM% 90.4

PLOT AREA HARVESTED 0.00230

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METEOROLOGICAL RECORDS 1990 – ROTHAMSTED

(Departure from 30-year means in brackets)

MONTH	Total sunshine: hours	Mean temperature: C Air(1)	Dew point	In ground under grass 30cm	100cm
JAN	61 (+11)	5.8 (+3.0)	4.2	6.4	7.7
FEB	95 (+33)	7.0 (+3.9)	4.0	6.4	7.2
MAR	150 (+42)	7.8 (+2.6)	4.5	7.6	7.6
APR	228 (+88)	7.5 (-0.2)	3.6	8.6	8.3
MAY	264 (+76)	12.1 (+1.0)	7.6	12.5	10.5
JUNE	130 (-67)	13.2 (-0.8)	9.3	13.8	12.0
JULY	268 (+87)	16.8 (+1.1)	11.0	16.0	13.7
AUG	250 (+83)	18.1 (+2.5)	12.7	17.4	15.2
SEPT	155 (+15)	12.9 (-0.6)	9.2	14.5	14.7
OCT	129 (+29)	11.7 (+1.5)	9.2	12.5	13.0
NOV	59 (-2)	6.5 (+0.5)	5.1	9.0	10.9
DEC	51 (+5)	3.7 (-0.4)	1.4	5.9	8.4
YEAR*	1840 (+399)	10.3 (+1.1)	6.8	10.9	10.8

MONTH	Ground frosts (2)	Total rainfall:mm 12.7cm (5 in) gauge	Rain days (3)	Drainage through 50.8cm (20 in) soil:mm	Wind km per hour (4)
JAN	17	97 (+34)	22	78	10.9
FEB	17	109 (+57)	17	69	15.8
MAR	18	16 (-36)	5	3	10.3
APR	23	27 (-21)	14	0	8.2
MAY	17	2 (-50)	3	0	5.0
JUNE	6	52 (-6)	14	0	5.4
JULY	3	15 (-37)	6	0	6.8
AUG	0	52 (-9)	10	10	6.6
SEPT	7	37 (-22)	12	5	7.3
OCT	8	91 (+31)	14	55	8.6
NOV	14	39 (-30)	17	23	8.4
DEC	23	62 (-7)	16	47	9.4
YEAR*	153	597 (-96)	150	290	8.6

30-year means are for the period 1951-80

(1) Mean of maximum and minimum

(2) Number of nights grass min. was below 0.0 C

(3) Number of days rainfall was 0.2 mm or more

(4) At 2 metres above ground level

*Mean or total

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METEOROLOGICAL RECORDS 1990 - WOBURN

(Departure from 30-year means in brackets)

Mean temperature: C

MONTH	Total sunshine: hours		Air(1)		Dew point	In ground under grass 30 cm	100 cm	Ground frosts (2)	Total rainfall: mm 12.7 cm (5in)		Rain days (3)	Wind km per hour (4)
JAN	56	(+6)	6.6	(+3.4)	4.2	6.1	7.7	9	71	(+18)	19	12.4
FEB	95	(+34)	7.7	(+4.3)	3.6	6.4	7.3	4	96	(+54)	15	16.2
MAR	146	(+39)	8.4	(+3.1)	4.3	7.7	7.8	10	18	(-32)	4	12.0
APR	210	(+77)	7.5	(-0.2)	3.5	8.6	8.4	18	29	(-16)	14	8.3
MAY	240	(+56)	12.0	(+1.0)	7.4	13.9	11.0	10	3	(-47)	4	5.1
JUNE	114	(-78)	13.7	(-0.3)	9.4	15.1	12.8	1	37	(-19)	13	7.0
JULY	266	(+90)	16.7	(+0.9)	11.7	17.8	14.8	1	29	(-21)	6	7.3
AUG	245	(+83)	18.5	(+3.0)	13.8	18.9	16.4	0	24	(-42)	6	6.8
SEPT	145	(+10)	13.1	(-0.4)	9.6	15.2	15.6	1	31	(-23)	11	7.2
OCT	112	(+12)	12.2	(+2.0)	9.7	12.5	13.6	1	37	(-15)	11	9.3
NOV	46	(-17)	6.7	(+0.5)	4.7	8.5	11.3	9	28	(-31)	13	6.6
DEC	44	(-2)	4.2	(-0.1)	1.9	5.3	8.5	15	57	(-2)	15	8.1
YEAR*	1718	(+310)	10.6	(+1.5)	7.0	11.3	11.3	79	461	(-176)	131	8.9

30-year means are for the period 1951-80

(1) Mean of maximum and minimum

(2) Number of nights grass min. was below 0.0 C

(3) Number of days rainfall was 0.2 mm or more

(4) At 2 metres above ground level

*Mean or total

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CONVERSION FACTORS

Factors for the Conversion of Imperial to Metric Units

1 inch (in.)	= 2·540 centimetres (cm)
1 foot (ft) (=12 in.)	= 30·48 cm
1 yard (yd) (=3 ft)	= 0·9144 metre (m)
1 square yard (yd²)	= 0·8361 m²
1 acre (ac) (=4840 yd²)	= 0·4047 hectare (ha)
1 ounce (oz)	= 28·35 grams (g)
1 pound (lb)	= 0·4536 kilogram (kg)
1 hundredweight (cwt) (=112 lb)	= 50·80 kg
1 ton (=2240 lb)	= 1016 kg = 1·016 metric tons (tonnes) (t)
1 pint	= 0·5682 litre (l)
1 gallon (gal) (=8 pints)	= 4·546 litres
1 fluid ounce = 1/20 pint	= 0·02841 litre = 28·41 ml
1 cubic foot	= 28·32 litres

To convert	*Multiply by*
oz ac^{-1} to g ha^{-1}	70·06
lb ac^{-1} to kg ha^{-1}	1·121
cwt ac^{-1} to kg ha^{-1}	125·5
cwt ac^{-1} to t ha^{-1}	0·1255
ton ac^{-1} to kg ha^{-1}	2511
ton ac^{-1} to t ha^{-1}	2·511
gal ac^{-1} to l ha^{-1}	11·233

The following factors are accurate to about 2 parts in 100:

1 lb ac^{-1} = 1·1 kg ha^{-1}
1 gal ac^{-1} = 11 litres ha^{-1}
1 ton ac^{-1} = 2·5 t ha^{-1}

In general reading of the text there will be no great inaccuracy in regarding:

1 lb = 0·5 kg
1 lb ac^{-1} = 1 kg ha^{-1}

Temperatures

To convert °F into °C subtract 32 and multiply by $\frac{5}{9}$ (0.556)
To convert °C into °F multiply by $\frac{9}{5}$ (1·8) and add 32

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CONVERSION FACTORS

Factors for the Conversion of Metric to Imperial Units

1 centimetre (cm)	=	0·3937 inch (in.) = 0·03281 ft
1 metre (m)	=	1·094 yards (yd)
1 square metre (m^2)	=	1·196 square yards (yd^2)
1 hectare (ha)	=	2·471 acres (ac)
1 gram (g)	=	0·03527 ounce (oz)
1 kilogram (kg)	=	2·205 pounds (lb)
1 kg	=	0·01968 hundredweight (cwt) = 0·0009842 ton
1 metric ton (tonne) (t)	=	0·9842 ton
1 litre	=	1·760 pints = 0·2200 gallon (gal)

1 litre = 1000 millilitres (ml) = 35·20 fluid ounces = 0·03531 cubic foot (ft^3)

To convert	*Multiply by*
g ha^{-1} to oz ac^{-1}	0·01427
kg ha^{-1} to lb ac^{-1}	0·8921
kg ha^{-1} to cwt ac^{-1}	0·007966
t ha^{-1} to cwt ac^{-1}	7·966
kg ha^{-1} to tons ac^{-1}	0·0003983
t ha^{-1} to tons ac^{-1}	0·3983
l ha^{-1} to gal ac^{-1}	0·08902

Plant nutrients

Plant nutrients are best stated in terms of amounts of the elements (P, K, Na, Ca, Mg, S); the old 'oxide' terminology (P_2O_5, K_2O, Na_2O, CaO, MgO, SO_3) is still used in work involving fertilisers and liming since Regulations require statements of P_2O_5, K_2O, etc.

For quick conversions

(accurate to within 2%) the following factors may be used:

$2\frac{1}{3} \times P = P_2O_5$	$\frac{3}{7} \times P_2O_5 = P$
$1\frac{1}{5} \times K = K_2O$	$\frac{5}{6} \times K_2O = K$
$1\frac{2}{5} \times Ca = CaO$	$\frac{7}{10} \times CaO = Ca$
$1\frac{2}{3} \times Mg = MgO$	$\frac{3}{5} \times MgO = Mg$

For accurate conversions:

To convert	*Multiply by*	*To convert*	*Multiply by*
P_2O_5 to P	0·4364	P to P_2O_5	2·2915
K_2O to K	0·8301	K to K_2O	1·2047
CaO to Ca	0·7146	Ca to CaO	1·3994
MgO to Mg	0·6031	Mg to MgO	1·6581

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