ROTHAMSTED RESEARCH

# Yields of the Field Experiments 1987

*Full Table of Content*

## Rotations

### Rothamsted Research

Rothamsted Research (1988) *Rotations ;* Yields Of The Field Experiments 1987, pp 34 - 76 **- DOI: https://doi.org/10.23637/ERADOC-1-37**

## 87/R/RN/1 and 87/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: A.E. Johnston.

The 39th year, old grass, leys, w. wheat.

For previous years see 'Details' 1967 and 1973 and 74-86/R/RN/1 and 2.

The experiment is duplicated on:-

HIGHFIELD — A site with much organic matter initially (ploughed out from permanent grass) (87/R/RN/1)

FOSTERS — A site with little organic matter initially (87/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.



*https://doi.org/10.23637/ERADOC-1-37* 

87/R/RN/1 and 87/R/RN/2

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

Sub plots

FYMRES68 Farmyard manure residues, last applied 1968:

NONE None
FYM 30 tonnes on each occasion

Sub plots

N Nitrogen fertilizer in 1987 (kg N) as 'Nitram':

0
50
100
150

Standard applications:
3rd Treatment crops:
All crops: Manures: Chalk at 5.8 t (Highfield only).
Lucerne: Manures: (0:18:36) at 630 kg.
All-grass ley: Manures: (0:18:36) at 420 kg. (25:0:16) at 300 kg in spring and after the first cut.
Clover-grass ley: Manures: (0:18:36) at 420 kg.
S. oats: Manures: (20:10:10) at 350 kg. Weedkillers: Clopyralid at 0.07 kg, bromoxynil at 0.34 kg and mecoprop at 2.5 kg in 500 l.
3rd Test crop:
W. wheat: Manures: (0:24:24), combine drilled at 210 kg. Weedkillers: Isoproturon at 2.5 kg, clopyralid at 0.07 kg, bromoxynil at 0.34 kg and mecoprop at 2.5 kg in 200 l.
Reseeded grass and old grass: Manures: Chalk at 5.8 t (to plots in 3rd treatment crop blocks on Highfield and to plots in 3rd test crop blocks on Fosters). (0:18:36) at 420 kg. All-grass half plots: (25:0:16) at 300 kg in spring and after each cut except the last.

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

Cultivations, etc.:-
3rd Treatment crops:
All Crops: Chalk applied (Highfield only): 28 Nov, 1986.
Lucerne: PK applied: 24 Feb, 1987. Cut: 1 June, 11 Aug.
All-grass ley and clover-grass ley: PK applied: 24 Feb, 1987. NK applied to all-grass ley: 31 Mar, 3 June. Cut: 1 June, 11 Aug.
S. oats: Ploughed: 28 Nov, 1986. Spring-tine cultivated: 19 Mar, 1987. NPK applied, spring-tine cultivated, seed sown: 21 Mar. Weedkillers applied: 8 May. Combine harvested: 9 Sept.
3rd Test crop wheat: Ploughed: 30 Sept, 1986 (Fosters), 1 Oct (Highfield). PK applied: 1 Oct. Rotary harrowed: 3 Oct. Seed sown: 4 Oct. N applied: 14 Apr, 1987. Weedkillers applied: 15 Apr. Combine harvested: 1 Sept.
Reseeded grass and old grass: Chalk applied: 28 Nov, 1986. PK applied: 24 Feb, 1987. NK applied to all-grass half plots: 31 Mar, 3 June, 29 Aug. Cut: 1 June, 27 Aug, 2 Dec.



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87/R/RN/1 AND 87/R/RN/2

DRY MATTER: TONNES/HECTARE

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

| | HIGHFIELD | FOSTERS |
|---|---|---|
| CLOVER-GRASS LEY | | |
| TOTAL OF 2 CUTS | 7.10 | 7.37 |
| MEAN DM% | 19.0 | 17.8 |
| ALL-GRASS LEY | | |
| TOTAL OF 2 CUTS | 7.69 | 7.74 |
| MEAN DM% | 25.5 | 23.4 |
| LUCERNE | | |
| TOTAL OF 2 CUTS | 8.58 | 9.00 |
| MEAN DM% | 19.3 | 18.4 |

| OLD GRASS | HIGHFIELD | |
|---|---|---|
| TOTAL OF 3 CUTS | C | N |
| 39TH EXPTL YEAR | | |
| BLOCKS 1 & 4 | 6.46 | 10.07 |
| BLOCK 2 | 6.73 | 10.67 |
| MEAN DM% | 20.5 | 21.4 |

RESEEDED GRASS

TOTAL OF 3 CUTS

| | | HIGHFIELD | | | FOSTERS | |
|---|---|---|---|---|---|---|
| | BLOCKS | C | N | BLOCKS | C | N |
| 39TH EXPTL YEAR | 1 & 4 | 7.12 | 10.09 | 1 & 3 | 7.42 | 10.85 |
| 39TH EXPTL YEAR (SEEDED 1949 RESEEDED 1973) | 2 & 3 | 6.46 | 11.76 | 2 & 4 | 7.93 | 10.45 |
| MEAN DM% | | 19.5 | 20.9 | | 19.0 | 23.0 |

OATS:

| | HIGHFIELD | FOSTERS |
|---|---|---|
| GRAIN TONNES/HECTARE | 7.51 | 7.35 |
| MEAN DM% | 84.6 | 83.5 |



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87/R/RN/1 HIGHFIELD W.WHEAT 3RD TEST CROP

GRAIN TONNES/HECTARE

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

| FYMRES68 | NONE | FYM | Mean |
|---|---|---|---|
| ROTATION | | | |
| LUCERNE | 5.34 | 5.48 | 5.41 |
| CLOGRA | 5.96 | 5.97 | 5.97 |
| GRASS | 5.79 | 5.50 | 5.64 |
| ARABLE | 5.10 | 5.17 | 5.14 |
| Mean | 5.55 | 5.53 | 5.54 |

| N | 0 | 50 | 100 | 150 | Mean |
|---|---|---|---|---|---|
| ROTATION | | | | | |
| LUCERNE | 3.70 | 5.26 | 6.42 | 6.28 | 5.41 |
| CLOGRA | 4.02 | 6.07 | 6.44 | 7.34 | 5.97 |
| GRASS | 3.50 | 5.55 | 6.35 | 7.17 | 5.64 |
| ARABLE | 3.26 | 4.83 | 5.74 | 6.71 | 5.14 |
| Mean | 3.62 | 5.43 | 6.24 | 6.88 | 5.54 |

| N | 0 | 50 | 100 | 150 | Mean |
|---|---|---|---|---|---|
| FYMRES68 | | | | | |
| NONE | 3.78 | 5.53 | 6.21 | 6.68 | 5.55 |
| FYM | 3.46 | 5.33 | 6.27 | 7.07 | 5.53 |
| Mean | 3.62 | 5.43 | 6.24 | 6.88 | 5.54 |

| | N | 0 | 50 | 100 | 150 |
|---|---|---|---|---|---|
| ROTATION | FYMRES68 | | | | |
| LUCERNE | NONE | 3.78 | 5.76 | 5.77 | 6.07 |
| | FYM | 3.62 | 4.76 | 7.07 | 6.48 |
| CLOGRA | NONE | 4.21 | 5.69 | 6.75 | 7.20 |
| | FYM | 3.83 | 6.44 | 6.13 | 7.48 |
| GRASS | NONE | 3.98 | 5.63 | 6.94 | 6.60 |
| | FYM | 3.03 | 5.47 | 5.75 | 7.75 |
| ARABLE | NONE | 3.17 | 5.03 | 5.37 | 6.84 |
| | FYM | 3.36 | 4.64 | 6.12 | 6.57 |

GRAIN MEAN DM% 82.7

PLOT AREA HARVESTED 0.00663



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87/R/RN/2 FOSTERS W.WHEAT 3RD TEST CROP

GRAIN TONNES/HECTARE

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

| FYMRES68 ROTATION | NONE | FYM | Mean |
|---|---|---|---|
| LUCERNE | 5.35 | 5.61 | 5.48 |
| CLOGRA | 5.29 | 5.24 | 5.27 |
| GRASS | 5.34 | 5.53 | 5.43 |
| ARABLE | 4.95 | 4.73 | 4.84 |
| Mean | 5.23 | 5.28 | 5.25 |

| N ROTATION | 0 | 50 | 100 | 150 | Mean |
|---|---|---|---|---|---|
| LUCERNE | 3.42 | 5.31 | 5.96 | 7.23 | 5.48 |
| CLOGRA | 3.56 | 5.24 | 5.87 | 6.41 | 5.27 |
| GRASS | 3.69 | 5.19 | 6.13 | 6.72 | 5.43 |
| ARABLE | 2.86 | 4.73 | 5.63 | 6.14 | 4.84 |
| Mean | 3.38 | 5.12 | 5.90 | 6.62 | 5.25 |

| N FYMRES68 | 0 | 50 | 100 | 150 | Mean |
|---|---|---|---|---|---|
| NONE | 3.42 | 5.10 | 5.85 | 6.56 | 5.23 |
| FYM | 3.34 | 5.13 | 5.94 | 6.69 | 5.28 |
| Mean | 3.38 | 5.12 | 5.90 | 6.62 | 5.25 |

| N | FYMRES68 | 0 | 50 | 100 | 150 |
|---|---|---|---|---|---|
| ROTATION | | | | | |
| LUCERNE | NONE | 3.11 | 5.32 | 5.87 | 7.12 |
| | FYM | 3.73 | 5.29 | 6.06 | 7.35 |
| CLOGRA | NONE | 3.74 | 5.10 | 5.97 | 6.36 |
| | FYM | 3.37 | 5.38 | 5.77 | 6.45 |
| GRASS | NONE | 3.74 | 5.26 | 5.77 | 6.58 |
| | FYM | 3.64 | 5.12 | 6.49 | 6.85 |
| ARABLE | NONE | 3.09 | 4.73 | 5.80 | 6.19 |
| | FYM | 2.64 | 4.72 | 5.46 | 6.09 |

GRAIN MEAN DM% 81.4

PLOT AREA HARVESTED 0.00663



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87/W/RN/3

LEY/ARABLE

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

Sponsor: A.E. Johnston.

The 50th year, leys, w. beans, w. wheat, s. barley.

For previous years see 'Details' 1967 & 1973 and 74-86/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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87/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. FYMRES66 — Farmyard manure residues, last applied 1966:

   NONE — None
   FYM — 38 tonnes on each occasion

1/8 plots

3. N — Nitrogen fertilizer (kg N) as 'Nitro-Chalk':

   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



*https://doi.org/10.23637/ERADOC-1-37* 

87/W/RN/3

1/2 plots

2. FYMRES65 Farmyard manure residues, last applied 1965:

| | |
|---|---|
| NONE | None |
| FYM | 38 tonnes on each occasion |

1/8 plots

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

0
60
120
180

Treatments to leys:

FYM RES Farmyard manure residues:

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

Corrective K dressings (kg K20) 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 | 339 | 276 |
| LC | 126 | 75 |
| AF | 540 | 552 |
| AB | 452 | 527 |
| **Ex-alternating rotations** | | |
| LN 8 ploughed for w. wheat | 163 | 213 |
| LN 8 not ploughed | 301 | 351 |
| LC 8 ploughed for w. wheat | 100 | 213 |
| LC 8 not ploughed | 0 | 100 |

Standard applications:-

Grass ley and clover/grass ley, 1st year: Manures: (0:18:36) at 410 kg. N at 77 kg to grass ley and 50 kg to clover/grass as 'Nitram'. (25:0:16) at 300 kg to grass ley, K20 at 48 kg as muriate of potash to clover/grass ley. Weedkillers: Glyphosate at 1.4 kg in 200 l. Paraquat at 0.40 kg ion in 200 l.

Grass ley, 2nd, 3rd, 4th, 5th, 6th, 7th and 8th years: Manures: Magnesian limestone at 5.0 t to 5th year only. (0:18:36) at 410 kg. (25:0:16) at 300 kg in spring and after each cut except the last.

Clover/grass ley, 2nd, 3rd, 4th, 5th, 6th, 7th and 8th years: Manures: Magnesian limestone at 5.0 t to 5th year only. (0:18:36) at 410 kg. K20 at 48 kg as muriate of potash in spring and after each cut except the last.



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S. barley, 1st and 2nd treatment crops: Manures: (20:10:10) at 400 kg. Weedkillers: Glyphosate at 1.4 kg in 200 l. Clopyralid at 0.05 kg, bromoxynil at 0.24 kg with mecoprop at 2.5 kg in 200 l applied with the tridemorph. Fungicides: Tridemorph at 0.52 kg. Triadimenol at 0.062 kg with tridemorph at 0.37 kg in 200 l.

W. beans, 3rd treatment crop: Manures: (0:20:20) at 200 kg. Weedkillers: Glyphosate at 1.4 kg in 200 l. Trietazine at 0.72 kg with simazine at 0.10 kg in 240 l.

Fallow, 1st treatment year only: Weedkiller: Glyphosate at 1.4 kg in 200 l.

W. wheat, 1st test crop: Manures: (0:24:24) at 260 kg. Weedkillers: Glyphosate at 1.5 kg in 200 l. Clopyralid at 0.07 kg, bromoxynil at 0.34 kg with mecoprop at 2.5 kg in 240 l. Fungicides: Fenpropimorph at 0.75 kg with chlorothalonil at 0.75 kg in 200 l. Propiconazole at 0.12 kg with carbendazim and maneb (as 'Septal' at 2.5 kg) in 200 l. Insecticide: Carbofuran at 7.5 kg.

S. barley, 2nd test crop: Manures: Magnesian limestone at 5.0 t, (0:20:20) at 310 kg. Weedkillers: Glyphosate at 1.4 kg in 200 l. Clopyralid at 0.05 kg, bromoxynil at 0.24 kg with mecoprop at 2.5 kg in 200 l applied with the tridemorph. Fungicides: Tridemorph at 0.52 kg. Triadimenol at 0.062 kg with tridemorph at 0.38 kg in 200 l. Insecticide: Carbofuran at 7.5 kg.

Seed: Grass ley: Climax timothy at 17 kg and meadow fescue at 17 kg, mixture sown at 34 kg.
Clover/grass ley: Climax timothy at 16 kg, meadow fescue at 14 kg and Huia white clover at 4.0 kg, mixture sown at 34 kg.
S. barley: Klaxon, sown at 160 kg.
W. beans: Bourdon, sown at 250 kg.
W. wheat: Mercia, sown at 190 kg.

Cultivations, etc.:- Treatment crops:

Grass ley and clover/grass ley, 1st year: Glyphosate applied: 19 Sept, 1986. Ploughed: 4 Dec. Spring-tine cultivated: 6 May, 1987 and 12 May. N and PK applied: 29 May. Paraquat applied, spike harrowed with crumbler attached, seed sown and rolled: 1 June. NK applied to grass ley, K applied to clover/grass ley: 17 Aug. Cut: 12 Aug and 15 Dec.

Grass ley and clover/grass ley, 2nd, 3rd, 4th, 5th, 6th, 7th and 8th years: Magnesian limestone applied to 5th year only: 28 Nov, 1986. Corrective K applied to 4th year only: 26 Jan, 1987. PK applied: 10 Mar. NK applied to grass ley and K applied to clover/grass ley: 2 Apr, 26 June and 17 Aug. Cut: 16 June, 12 Aug and 15 Dec.

S. barley, 1st and 2nd treatment crops: Glyphosate applied: 19 Sept, 1986. Ploughed: 1st treatment crop: 4 Dec, 2nd treatment crop: 1 Dec. Spike harrowed with crumbler attached, NPK applied, seed sown: 17 Mar, 1987. Clopyralid, bromoxynil, mecoprop and tridemorph applied: 29 May. Triadimenol and tridemorph applied: 4 July. Combine harvested: 21 Aug.

W. beans, 3rd treatment crop: Glyphosate applied: 19 Sept, 1986. PK applied, seed sown, ploughed, harrowed: 12 Nov. Trietazine and simazine applied: 13 Nov. Combine harvested: 26 Sept, 1987.

Fallow, 1st and 2nd treatment years: Glyphosate applied to 1st year only: 19 Sept, 1986. Ploughed; 1st year: 4 Dec, 2nd year: 1 Dec. Spring-tine cultivated: 6 and 12 May, 1987. Cultivated with thistlebar: 29 June.



*https://doi.org/10.23637/ERADOC-1-37* *pp 10*

87/W/RN/3

Test crops:
W. wheat, 1st test crop: Glyphosate applied: 19 Sept, 1986. Ploughed: 30 Sept. Rolled, PK applied: 1 Oct. Carbofuran applied, rotary cultivated with crumbler attached, seed sown, harrowed: 2 Oct. Corrective K applied: 26 Jan, 1987. N applied, clopyralid, bromoxynil and mecoprop applied: 14 Apr. Fenpropimorph and chlorothalonil applied: 15 June. Propiconazole, carbendazim and maneb applied: 29 June. Combine harvested: 7 Sept.
S. barley, 2nd test crop: Glyphosate applied: 19 Sept, 1986. Magnesian limestone applied: 28 Nov. Ploughed: 1 Dec. Spike harrowed with crumbler attached, PK applied, carbofuran applied, harrowed, seed sown: 17 Mar, 1987. N applied: 8 Apr. Clopyralid, bromoxynil, mecoprop and tridemorph applied: 29 May. Triadimenol and tridemorph applied: 4 July. Combine harvested: 21 Aug.

LEYS

1ST CUTTING OCCASION (16/6/87) DRY MATTER TONNES/HECTARE

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

| FYM RES | NONE | FYM | Mean |
|---|---|---|---|
| LEY | | | |
| LC1 | * | * | * |
| LC2 | 5.80 | 6.34 | 6.07 |
| LC3 | 5.06 | 5.22 | 5.14 |
| LN1 | * | * | * |
| LN2 | 6.69 | 6.56 | 6.63 |
| LN3 | 5.37 | 5.54 | 5.45 |
| LLC1 | * | * | * |
| LLC2 | 6.07 | 4.99 | 5.53 |
| LLC3 | 4.67 | 4.65 | 4.66 |
| LLC4 | 5.86 | 6.05 | 5.95 |
| LLC5 | 5.71 | 6.50 | 6.10 |
| LLC6 | 5.43 | 5.01 | 5.22 |
| LLC7 | 4.21 | 5.33 | 4.77 |
| LLC8 | 5.13 | 5.25 | 5.19 |
| LLN1 | * | * | * |
| LLN2 | 7.93 | 7.72 | 7.82 |
| LLN3 | 7.30 | 6.87 | 7.08 |
| LLN4 | 7.27 | 6.53 | 6.90 |
| LLN5 | 6.02 | 6.89 | 6.46 |
| LLN6 | 6.90 | 7.60 | 7.25 |
| LLN7 | 6.81 | 6.78 | 6.80 |
| LLN8 | 7.30 | 6.32 | 6.81 |
| Mean | 6.08 | 6.12 | 6.10 |

1ST CUT MEAN DM% 22.0



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87/W/RN/3

LEYS

2ND CUTTING OCCASION (12/8/87) DRY MATTER TONNES/HECTARE

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

| FYM RES LEY | NONE | FYM | Mean |
|---|---|---|---|
| LC1 | 2.96 | 3.24 | 3.10 |
| LC2 | 1.23 | 1.34 | 1.28 |
| LC3 | 2.62 | 2.70 | 2.66 |
| LN1 | 2.98 | 2.59 | 2.78 |
| LN2 | 2.82 | 3.06 | 2.94 |
| LN3 | 2.36 | 3.41 | 2.88 |
| LLC1 | 1.75 | 1.86 | 1.80 |
| LLC2 | 2.03 | 2.43 | 2.23 |
| LLC3 | 2.65 | 2.62 | 2.63 |
| LLC4 | 2.95 | 2.91 | 2.93 |
| LLC5 | 1.97 | 2.02 | 1.99 |
| LLC6 | 1.01 | 0.94 | 0.98 |
| LLC7 | 1.08 | 1.01 | 1.04 |
| LLC8 | 2.11 | 2.07 | 2.09 |
| LLN1 | 2.20 | 2.18 | 2.19 |
| LLN2 | 2.61 | 2.53 | 2.57 |
| LLN3 | 2.83 | 2.84 | 2.83 |
| LLN4 | 2.46 | 2.31 | 2.38 |
| LLN5 | 2.84 | 2.85 | 2.84 |
| LLN6 | 4.00 | 3.88 | 3.94 |
| LLN7 | 3.30 | 3.47 | 3.38 |
| LLN8 | 2.87 | 3.62 | 3.25 |
| Mean | 2.44 | 2.54 | 2.49 |

2ND CUT MEAN DM% 18.7



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87/W/RN/3

LEYS

3RD CUTTING OCCASION (15/12/87) DRY MATTER TONNES/HECTARE

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

| FYM RES | NONE | FYM | Mean |
|---|---|---|---|
| LEY | | | |
| LC1 | 1.12 | 1.56 | 1.34 |
| LC2 | 1.45 | 1.03 | 1.24 |
| LC3 | * | * | * |
| LN1 | 1.62 | 2.33 | 1.97 |
| LN2 | 2.39 | 2.31 | 2.35 |
| LN3 | * | * | * |
| LLC1 | 2.22 | 1.16 | 1.69 |
| LLC2 | 2.27 | 1.77 | 2.02 |
| LLC3 | 1.48 | 1.18 | 1.33 |
| LLC4 | 1.02 | 0.77 | 0.89 |
| LLC5 | 1.07 | 1.73 | 1.40 |
| LLC6 | 0.54 | 0.77 | 0.65 |
| LLC7 | 1.97 | 0.77 | 1.37 |
| LLC8 | * | * | * |
| LLN1 | 2.60 | 2.63 | 2.62 |
| LLN2 | 2.67 | 2.34 | 2.51 |
| LLN3 | 0.84 | 1.15 | 1.00 |
| LLN4 | 1.45 | 1.86 | 1.66 |
| LLN5 | 1.79 | 1.83 | 1.81 |
| LLN6 | 3.51 | 4.01 | 3.76 |
| LLN7 | 3.49 | 4.48 | 3.99 |
| LLN8 | * | * | * |
| Mean | 1.86 | 1.87 | 1.87 |

3RD CUT MEAN DM% 29.9



*https://doi.org/10.23637/ERADOC-1-37* *pp 13*

87/W/RN/3

LEYS

TOTAL OF 3 CUTTING OCCASIONS DRY MATTER TONNES/HECTARE

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

| FYM RES LEY | NONE | FYM | Mean |
|---|---|---|---|
| LC1 | 4.08 | 4.80 | 4.44 |
| LC2 | 8.48 | 8.71 | 8.59 |
| LC3 | 7.68 | 7.92 | 7.80 |
| LN1 | 4.59 | 4.92 | 4.76 |
| LN2 | 11.90 | 11.93 | 11.91 |
| LN3 | 7.73 | 8.94 | 8.34 |
| LLC1 | 3.97 | 3.03 | 3.50 |
| LLC2 | 10.36 | 9.19 | 9.78 |
| LLC3 | 8.80 | 8.45 | 8.63 |
| LLC4 | 9.83 | 9.73 | 9.78 |
| LLC5 | 8.74 | 10.25 | 9.49 |
| LLC6 | 6.97 | 6.72 | 6.84 |
| LLC7 | 7.26 | 7.11 | 7.18 |
| LLC8 | 7.24 | 7.32 | 7.28 |
| LLN1 | 4.81 | 4.81 | 4.81 |
| LLN2 | 13.21 | 12.59 | 12.90 |
| LLN3 | 10.96 | 10.86 | 10.91 |
| LLN4 | 11.18 | 10.70 | 10.94 |
| LLN5 | 10.65 | 11.58 | 11.11 |
| LLN6 | 14.41 | 15.48 | 14.94 |
| LLN7 | 13.60 | 14.73 | 14.17 |
| LLN8 | 10.16 | 9.94 | 10.05 |
| Mean | 8.94 | 9.08 | 9.01 |

TOTAL OF 3 CUTTING OCCASIONS MEAN DM% 22.9

PLOT AREA HARVESTED 0.00204



*https://doi.org/10.23637/ERADOC-1-37* 

87/W/RN/3

WINTER WHEAT 1ST TEST CROP

GRAIN TONNES/HECTARE

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

| FYMRES66 | NONE | FYM | Mean |
|---|---|---|---|
| ROTATION | | | |
| LN 8 | 6.79 | 6.41 | 6.60 |
| LN 3 | 6.40 | 6.43 | 6.42 |
| LC 8 | 7.16 | 7.43 | 7.30 |
| LC 3 | 7.13 | 6.92 | 7.02 |
| AF | 5.18 | 5.62 | 5.40 |
| AB | 5.84 | 6.74 | 6.29 |
| Mean | 6.42 | 6.59 | 6.50 |

| N | 0 | 70 | 140 | 210 | Mean |
|---|---|---|---|---|---|
| ROTATION | | | | | |
| LN 8 | 4.80 | 6.74 | 7.86 | 7.00 | 6.60 |
| LN 3 | 4.41 | 6.55 | 7.59 | 7.13 | 6.42 |
| LC 8 | 5.26 | 7.48 | 8.31 | 8.13 | 7.30 |
| LC 3 | 5.51 | 7.24 | 7.74 | 7.61 | 7.02 |
| AF | 3.02 | 5.56 | 6.60 | 6.43 | 5.40 |
| AB | 4.39 | 6.18 | 6.75 | 7.84 | 6.29 |
| Mean | 4.56 | 6.62 | 7.47 | 7.36 | 6.50 |

| N | 0 | 70 | 140 | 210 | Mean |
|---|---|---|---|---|---|
| FYMRES66 | | | | | |
| NONE | 4.56 | 6.30 | 7.29 | 7.52 | 6.42 |
| FYM | 4.57 | 6.95 | 7.66 | 7.19 | 6.59 |
| Mean | 4.56 | 6.62 | 7.47 | 7.36 | 6.50 |

| | N | 0 | 70 | 140 | 210 |
|---|---|---|---|---|---|
| ROTATION | FYMRES66 | | | | |
| LN 8 | NONE | 4.93 | 6.76 | 7.75 | 7.72 |
| | FYM | 4.66 | 6.71 | 7.97 | 6.28 |
| LN 3 | NONE | 4.52 | 6.32 | 7.43 | 7.33 |
| | FYM | 4.29 | 6.79 | 7.74 | 6.92 |
| LC 8 | NONE | 4.94 | 6.84 | 8.59 | 8.27 |
| | FYM | 5.58 | 8.12 | 8.04 | 7.98 |
| LC 3 | NONE | 5.55 | 7.06 | 8.01 | 7.91 |
| | FYM | 5.47 | 7.41 | 7.47 | 7.32 |
| AF | NONE | 2.82 | 5.15 | 6.20 | 6.57 |
| | FYM | 3.22 | 5.98 | 7.01 | 6.28 |
| AB | NONE | 4.58 | 5.67 | 5.77 | 7.32 |
| | FYM | 4.19 | 6.68 | 7.73 | 8.35 |

GRAIN MEAN DM% 73.7

PLOT AREA HARVESTED 0.00251



*https://doi.org/10.23637/ERADOC-1-37* 

87/W/RN/3

SPRING BARLEY 2ND TEST CROP

GRAIN TONNES/HECTARE

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

| FYMRES65 | NONE | FYM | Mean |
|---|---|---|---|
| ROTATION | | | |
| LN 8 | 6.24 | 6.10 | 6.17 |
| LN 3 | 5.75 | 5.42 | 5.58 |
| LC 8 | 6.23 | 6.13 | 6.18 |
| LC 3 | 5.78 | 5.86 | 5.82 |
| AF | 4.73 | 4.94 | 4.84 |
| AB | 5.01 | 4.94 | 4.98 |
| Mean | 5.63 | 5.57 | 5.60 |

| N | 0 | 60 | 120 | 180 | Mean |
|---|---|---|---|---|---|
| ROTATION | | | | | |
| LN 8 | 4.81 | 6.77 | 7.03 | 6.07 | 6.17 |
| LN 3 | 4.06 | 5.91 | 6.56 | 5.80 | 5.58 |
| LC 8 | 5.22 | 6.61 | 6.41 | 6.48 | 6.18 |
| LC 3 | 4.83 | 6.59 | 6.31 | 5.57 | 5.82 |
| AF | 2.10 | 4.77 | 6.12 | 6.34 | 4.84 |
| AB | 2.49 | 5.31 | 6.06 | 6.05 | 4.98 |
| Mean | 3.92 | 6.00 | 6.42 | 6.05 | 5.60 |

| N | 0 | 60 | 120 | 180 | Mean |
|---|---|---|---|---|---|
| FYMRES65 | | | | | |
| NONE | 3.89 | 5.96 | 6.48 | 6.18 | 5.63 |
| FYM | 3.95 | 6.03 | 6.35 | 5.92 | 5.57 |
| Mean | 3.92 | 6.00 | 6.42 | 6.05 | 5.60 |

| N | FYMRES65 | 0 | 60 | 120 | 180 |
|---|---|---|---|---|---|
| ROTATION | | | | | |
| LN 8 | NONE | 4.63 | 6.42 | 7.56 | 6.36 |
| | FYM | 4.99 | 7.12 | 6.49 | 5.78 |
| LN 3 | NONE | 4.28 | 6.10 | 6.64 | 5.98 |
| | FYM | 3.84 | 5.73 | 6.47 | 5.62 |
| LC 8 | NONE | 5.11 | 6.69 | 6.68 | 6.46 |
| | FYM | 5.34 | 6.54 | 6.15 | 6.50 |
| LC 3 | NONE | 4.93 | 6.78 | 6.17 | 5.26 |
| | FYM | 4.73 | 6.40 | 6.45 | 5.87 |
| AF | NONE | 2.26 | 4.33 | 5.71 | 6.62 |
| | FYM | 1.95 | 5.22 | 6.53 | 6.06 |
| AB | NONE | 2.13 | 5.42 | 6.09 | 6.42 |
| | FYM | 2.84 | 5.20 | 6.04 | 5.69 |

GRAIN MEAN DM% 86.1

PLOT AREA HARVESTED 0.00251



*https://doi.org/10.23637/ERADOC-1-37* 

87/W/RN/4

MARKET GARDEN

Object: The experiment compared the effects of fertilizers and organic manures applied annually in the period 1942 to 1967, on market garden crops. Residual effects of the organic manures were studied in arable crops from 1968 to 1973. From 1974 until 1982 the site was maintained in grass without yields. A new sequence of cropping started in 1983 to study further the residual effects of the organic manures, particularly the availability of metals from sewage sludge - Woburn Lansome I.

Sponsor: S.P. McGrath.

The 46th year, clover.

For previous years see 'Details' 1967 & 1973, 74-80/W/RN/4 and 83-86/W/RN/4.

Design: 2 series each of 4 blocks of 10 plots split, systematically, into 2.

Whole plot dimensions: 8.15 x 5.18.

Treatments:

To Series A, second year white clover, all combinations of:-

Whole plots

| | | |
|---|---|---|
| 1. OM RESID | | Residues of organic manures: |
| | FYM | Farmyard manure until 1967 |
| | SEWAGE | Sewage sludge until 1961 |
| | SEW COM | Sewage sludge, composted with straw, until 1961 |
| | VEG COM | Vegetable compost until 1962, then farmyard manure until 1967 |
| 2. OM RATE | | Rates of organic manures (t per crop): |
| | 25 | |
| | 50 | |
| | EXTRA | plus one extra treatment (duplicated): |
| | NONE | No organic manures |

Sub plots

| | | |
|---|---|---|
| 3. NPERCUT | | Nitrogen (kg N) per cut, as 'Nitram': |
| | 0 | |
| | 100 | |



*https://doi.org/10.23637/ERADOC-1-37* 

87/W/RN/4

To Series B, fourth year white clover, all combinations of:-

Whole plots

| | | |
|---|---|---|
| 1. OM RESID | | Residues of organic manures: |
| | FYM | Farmyard manure to whole plots until 1964, to half plots until 1967. Untreated half plots received a balancing dressing in 1974 |
| | SEWAGE | Sewage sludge until 1961 |
| | SEW COM | Sewage sludge, composted with straw, until 1961 |
| | VEG COM | Vegetable compost until 1962, then farmyard manure until 1965 |
| 2. OM RATE | | Rates of organic manures (t per crop): |
| | 25 | |
| | 50 | |
| | EXTRA | plus one extra treatment (duplicated): |
| | PEAT | Peat at 31 t per crop to half plots 1965 to 1967. Untreated half plots received a balancing dressing in 1974. |

Sub plots

| | | |
|---|---|---|
| 3. NPERCUT | | Nitrogen (kg N) per cut, as 'Nitram': |
| | 0 | |
| | 100 | |

NOTE: Series B became very weedy and yields were not taken.

Basal applications:
Series A and B: Manures: K20 at 150 kg as muriate of potash. Weedkillers: Benazolin, 2,4-DB and MCPA (as 'Legumex Extra' at 7 l) in 200 l.

Cultivations, etc.:- Basal K and treatment N applied: 3 Apr, 1987. Weedkillers applied: 27 May. Cut: 18 June (Series A): 23 June (Series B). Treatment N applied: 26 June. Cut: 19 Aug (Series A only).



*https://doi.org/10.23637/ERADOC-1-37* 

87/W/RN/4 WHITE CLOVER SERIES A

1ST CUT (18/6/87) DRY MATTER TONNES/HECTARE

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

| OM RESID / OM RATE | FYM | SEWAGE | SEW COM | VEG COM | Mean |
|---|---|---|---|---|---|
| 25 | 3.48 | 3.80 | 3.71 | 3.63 | 3.65 |
| 50 | 3.72 | 3.46 | 3.52 | 3.58 | 3.57 |
| Mean | 3.60 | 3.63 | 3.62 | 3.60 | 3.61 |

| NPERCUT / OM RATE | 0 | 100 | Mean |
|---|---|---|---|
| 25 | 3.67 | 3.63 | 3.65 |
| 50 | 3.63 | 3.51 | 3.57 |
| Mean | 3.65 | 3.57 | 3.61 |

| NPERCUT / OM RESID | 0 | 100 | Mean |
|---|---|---|---|
| FYM | 3.65 | 3.54 | 3.60 |
| SEWAGE | 3.66 | 3.60 | 3.63 |
| SEW COM | 3.62 | 3.62 | 3.62 |
| VEG COM | 3.67 | 3.53 | 3.60 |
| Mean | 3.65 | 3.57 | 3.61 |

| OM RATE | NPERCUT / OM RESID | 0 | 100 |
|---|---|---|---|
| 25 | FYM | 3.47 | 3.48 |
| | SEWAGE | 3.73 | 3.87 |
| | SEW COM | 3.72 | 3.70 |
| | VEG COM | 3.76 | 3.50 |
| 50 | FYM | 3.83 | 3.60 |
| | SEWAGE | 3.58 | 3.34 |
| | SEW COM | 3.51 | 3.54 |
| | VEG COM | 3.59 | 3.57 |

| NONE | NPERCUT | 0 | 100 | Mean |
|---|---|---|---|---|
| | | 3.70 | 3.48 | 3.59 |

Grand mean 3.61

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

| Table | OM RESID | OM RATE | NPERCUT | OM RESID OM RATE |
|---|---|---|---|---|
| s.e.d. | 0.171 | 0.121 | 0.096 | 0.241 |

| Table | OM RESID NPERCUT | OM RATE NPERCUT | OM RESID OM RATE NPERCUT | NONENPER |
|---|---|---|---|---|
| s.e.d. | 0.218 | 0.154 | 0.308 | 0.192 |

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

| | | | |
|---|---|---|---|
| OM RESID | 0.192 | | |
| OM RATE | | 0.135 | |
| OM RESID.OM RATE | | | 0.271 |



*https://doi.org/10.23637/ERADOC-1-37* 

87/W/RN/4 WHITE CLOVER SERIES A

1ST CUT (18/6/87) DRY MATTER TONNES/HECTARE

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

| Stratum | d.f. | s.e. | cv% |
|---|---|---|---|
| BLOCK.WP | 28 | 0.341 | 9.5 |
| BLOCK.WP.SP | 31 | 0.383 | 10.6 |

1ST CUT MEAN DM% 11.1

PLOT AREA HARVESTED 0.00053



*https://doi.org/10.23637/ERADOC-1-37* 

87/W/RN/4 WHITE CLOVER SERIES A

2ND CUT (19/8/87) DRY MATTER TONNES/HECTARE

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

| OM RESID / OM RATE | FYM | SEWAGE | SEW COM | VEG COM | Mean |
|---|---|---|---|---|---|
| 25 | 3.24 | 2.95 | 3.23 | 3.15 | 3.14 |
| 50 | 3.35 | 3.23 | 3.17 | 3.15 | 3.23 |
| Mean | 3.30 | 3.09 | 3.20 | 3.15 | 3.18 |

| NPERCUT / OM RATE | 0 | 100 | Mean |
|---|---|---|---|
| 25 | 3.07 | 3.21 | 3.14 |
| 50 | 3.21 | 3.24 | 3.23 |
| Mean | 3.14 | 3.23 | 3.18 |

| NPERCUT / OM RESID | 0 | 100 | Mean |
|---|---|---|---|
| FYM | 3.20 | 3.40 | 3.30 |
| SEWAGE | 3.04 | 3.14 | 3.09 |
| SEW COM | 3.17 | 3.23 | 3.20 |
| VEG COM | 3.17 | 3.14 | 3.15 |
| Mean | 3.14 | 3.23 | 3.18 |

| OM RATE | NPERCUT / OM RESID | 0 | 100 |
|---|---|---|---|
| 25 | FYM | 3.14 | 3.34 |
| | SEWAGE | 2.81 | 3.08 |
| | SEW COM | 3.14 | 3.32 |
| | VEG COM | 3.20 | 3.11 |
| 50 | FYM | 3.25 | 3.45 |
| | SEWAGE | 3.26 | 3.21 |
| | SEW COM | 3.20 | 3.13 |
| | VEG COM | 3.13 | 3.17 |

| NONE | NPERCUT | 0 | 100 | Mean |
|---|---|---|---|---|
| | | 3.09 | 3.33 | 3.21 |

Grand mean 3.19

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

| Table | OM RESID | OM RATE | NPERCUT | OM RESID OM RATE |
|---|---|---|---|---|
| s.e.d. | 0.140 | 0.099 | 0.079 | 0.198 |

| Table | OM RESID NPERCUT | OM RATE NPERCUT | OM RESID OM RATE NPERCUT | NONENPER |
|---|---|---|---|---|
| s.e.d. | 0.179 | 0.127 | 0.253 | 0.158 |

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

| | | | |
|---|---|---|---|
| OM RESID | 0.158 | | |
| OM RATE | | 0.112 | |
| OM RESID.OM RATE | | | 0.224 |



*https://doi.org/10.23637/ERADOC-1-37* 

87/W/RN/4 WHITE CLOVER SERIES A

2ND CUT (19/8/87) DRY MATTER TONNES/HECTARE

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

| Stratum | d.f. | s.e. | cv% |
|---|---|---|---|
| BLOCK.WP | 28 | 0.280 | 8.8 |
| BLOCK.WP.SP | 31 | 0.316 | 9.9 |

2ND CUT MEAN DM% 12.3

PLOT AREA HARVESTED 0.00052



*https://doi.org/10.23637/ERADOC-1-37* *pp 22*

87/W/RN/4 WHITE CLOVER SERIES A

TOTAL OF 2 CUTS DRY MATTER TONNES/HECTARE

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

| OM RESID / OM RATE | FYM | SEWAGE | SEW COM | VEG COM | Mean |
|---|---|---|---|---|---|
| 25 | 6.72 | 6.75 | 6.94 | 6.78 | 6.80 |
| 50 | 7.07 | 6.69 | 6.69 | 6.73 | 6.80 |
| Mean | 6.89 | 6.72 | 6.82 | 6.76 | 6.80 |

| NPERCUT / OM RATE | 0 | 100 | Mean |
|---|---|---|---|
| 25 | 6.75 | 6.85 | 6.80 |
| 50 | 6.84 | 6.75 | 6.80 |
| Mean | 6.79 | 6.80 | 6.80 |

| NPERCUT / OM RESID | 0 | 100 | Mean |
|---|---|---|---|
| FYM | 6.85 | 6.94 | 6.89 |
| SEWAGE | 6.69 | 6.75 | 6.72 |
| SEW COM | 6.79 | 6.84 | 6.82 |
| VEG COM | 6.84 | 6.67 | 6.76 |
| Mean | 6.79 | 6.80 | 6.80 |

| OM RATE | NPERCUT / OM RESID | 0 | 100 |
|---|---|---|---|
| 25 | FYM | 6.61 | 6.82 |
| | SEWAGE | 6.55 | 6.94 |
| | SEW COM | 6.86 | 7.02 |
| | VEG COM | 6.96 | 6.60 |
| 50 | FYM | 7.09 | 7.05 |
| | SEWAGE | 6.84 | 6.55 |
| | SEW COM | 6.71 | 6.67 |
| | VEG COM | 6.72 | 6.75 |

| NONE | NPERCUT | 0 | 100 | Mean |
|---|---|---|---|---|
| | | 6.78 | 6.81 | 6.79 |

Grand mean 6.80

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

| Table | OM RESID | OM RATE | NPERCUT | OM RESID OM RATE |
|---|---|---|---|---|
| s.e.d. | 0.260 | 0.184 | 0.127 | 0.367 |

| Table | OM RESID NPERCUT | OM RATE NPERCUT | OM RESID OM RATE NPERCUT | NONENPER |
|---|---|---|---|---|
| s.e.d. | 0.315 | 0.223 | 0.446 | 0.253 |

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

| | | | |
|---|---|---|---|
| OM RESID | 0.253 | | |
| OM RATE | | 0.179 | |
| OM RESID.OM RATE | | | 0.358 |



*https://doi.org/10.23637/ERADOC-1-37* *pp 23*

87/W/RN/4 WHITE CLOVER SERIES A

TOTAL OF 2 CUTS DRY MATTER TONNES/HECTARE

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

| Stratum | d.f. | s.e. | cv% |
|---|---|---|---|
| BLOCK.WP | 28 | 0.519 | 7.6 |
| BLOCK.WP.SP | 31 | 0.507 | 7.5 |

TOTAL OF 2 CUTS MEAN DM% 11.7



*https://doi.org/10.23637/ERADOC-1-37* *pp 24*

87/R/RN/5

ARABLE REFERENCE PLOTS

Object: To study the long-term effects of FYM and N, P and K fertilizers on the yield and mineral content of crops - Great Field IV.

Sponsor: A. Penny.

The 32nd year of a rotation, s. barley, ley, potatoes, w. wheat, kale until 1980; w. barley, ley, potatoes, w. wheat, w. oats since 1981. The 28th year of a rotation on the additional plots (as the initial above rotation for 20 years; w. barley, ley, potatoes, w. wheat, w. oats since 1980). The 31st year of permanent grass.

For previous years see 58/Bc/1(t), 59/Bc/1(t), 60/B/3(t), 61-64/B/2, 65/B/2(t), 66/B/2(t), 67/B/2, 68/B/3(t) and 69-86/R/RN/5.

Design: 1 block of 12 plots for each crop on original plots. 1 block of 7 plots for each crop on additional plots.

Whole plot dimensions: 2.13 x 2.44.

Treatments: Fertilizers and farmyard manure:

MANURE

Original plots

0
N1
P
N1P
K
N1K
PK
N1PK
N2PK
D
N1PKD
N2PKD

N1, 2 (kg N): 20, 40 (ley): 100, 200 (w. wheat, w. barley and w. oats): 125, 250 (potatoes, and permanent grass) as 'Nitro-Chalk' (26% N)
P: 63 kg $P_2O_5$ as superphosphate
K: 250 kg $K_2O$ as muriate of potash
D: 38 tonnes FYM (permanent grass): 100 tonnes (to potatoes only - 50 tonnes to potatoes and kale until 1980): none to other crops

NOTES: (1) All w. wheat on these plots receives a standard dressing of 82 kg MgO as Epsom salts.
(2) Cereals receive 20 kg of N1 and 40 kg of N2 in February or March, remainder in April.
(3) In 1987 w. oats on the original plots given MANURE 0, N1, P and NP failed during the winter and were sown to s. oats.



*https://doi.org/10.23637/ERADOC-1-37* *pp 25*

87/R/RN/5

Additional plots

| MANURE | Fertilizers from 1980 to 1987 and in previous years: |
|---|---|
| 1980-87 | Until 1979 |
| 0 | 0 |
| N2PK | N2 PK |
| N2PKMG | N2 PK MG CA |
| N2PKS | N2 PK CA S |
| N2PKMGS | N2 PK MG S |
| N1PKMGS | N2 PK CA MG S |
| N3PKMGS | N2 PK CA MG S TE |

N: In 1987: N1: 20 kg (ley), 120 kg (w. wheat, w. barley and w. oats), 160 kg (potatoes). N2: 30 kg (ley), 160 kg (w. wheat, w. barley and w. oats), 240 kg (potatoes). N3: 40 kg (ley), 200 kg (w. wheat, w. barley and w. oats), 320 kg (potatoes). Until 1979 N2 = larger rate on original plots in these years. As urea in all years. Cereals receive 40 kg N in March, remainder in April.
P: 126 kg P2O5 as potassium dihydrogen phosphate.
K: 251 kg K2O total. As potassium dihydrogen phosphate (83 kg K2O) on all PK plots. In addition plots without S receive 168 kg K2O as potassium chloride, plots with S receive 92 kg K2O as potassium sulphate plus 76 kg K2O as potassium chloride. Since 1978 all PK plots receive, in addition to the standard total, 126 kg K2O for potatoes, applied in autumn as potassium chloride.
MG: 126 kg MgO as magnesium chloride.
CA: 126 kg CaO as calcium carbonate until 1979. In 1980 plots not previously given Ca received calcium carbonate at 7.5 t, except 0 which was given 5.0 t.
S: 30 kg S supplied by the potassium sulphate.
TE: Trace element mixture which included Mn, Cu, Zn, B, Mo, Ca and Fe.

Standard applications:
Original and additional plots:
All cereals: Weedkillers: Mecoprop at 0.72 kg, bromoxynil at 0.16 kg and ioxynil at 0.16 kg in 220 l on two occasions, with isoproturon (except to oats) at 2.1 kg on the first occasion. Fungicides: Prochloraz at 0.37 kg and carbendazim at 0.14 kg with tridemorph at 0.52 kg in 220 l. Propiconazole at 0.13 kg with captafol at 1.0 kg in 220 l. Carbendazim at 0.15 kg, maneb at 1.6 kg and tridemorph at 0.37 kg with chlorothalonil at 1.1 kg and the insecticide in 220 l. Insecticide: Pirimicarb at 0.14 kg.
W. wheat: Manures: MgO at 82 kg as Epsom salts. Growth regulator: Chlormequat at 1.9 kg in 220 l.
W. barley: Growth regulator: Mepiquat chloride at 0.85 kg and 2-chloroethylphosphonic acid at 0.43 kg in 220 l.
W. oats: Growth regulator: Chlormequat at 1.9 kg in 220 l (none to s. oats).
Potatoes: Weedkillers: Linuron at 0.93 kg with paraquat at 0.28 kg ion in 220 l. Fungicides: Mancozeb at 1.3 kg in 220 l on three occasions, applied with the insecticide on the second. Applied on a fourth occasion to later-harvested plots only. Insecticide: Pirimicarb at 0.14 kg.



*https://doi.org/10.23637/ERADOC-1-37* *pp 26*

87/R/RN/5

Seed: W. wheat: Galahad, sown at 210 kg.
W. barley: Panda, sown at 190 kg.
W. oats: Bulwark, sown at 210 kg.
S. oats: Dula, sown at 180 kg.
Potatoes: Cara.
Grass-clover ley: RVP Italian ryegrass and Hungaropoly red clover.

Cultivations, etc.:-
Original and additional plots:
All cereals: Mecoprop, bromoxynil, ioxynil and (except to oats) isoproturon applied: 20 Nov, 1986. First N treatments applied: 24 Mar, 1987. Mecoprop, bromoxynil, ioxynil applied: 10 Apr. Second N treatments applied, prochloraz, carbendazim with tridemorph applied: 24 Apr. Growth regulators applied: 1 May (to barley) and 6 May to wheat and oats (except re-sown plots). Propiconazole and captafol applied: 13 May (to barley), 20 May (to wheat additional plots) and 28 May (to wheat original plots and oats). Carbendazim, maneb, tridemorph, chlorothalonil and pirimicarb applied: 23 June.
W. wheat: Rotary cultivated, P, K, Mg and S applied (S to additional plots only), seed sown and raked in: 25 Sept, 1986. Hand harvested: 17 Aug, 1987.
W. barley: Rotary cultivated, P and K and (to additional plots only) Mg and S applied: 1 Sept, 1986. Seed sown and raked in: 17 Sept. Hand harvested: 31 July, 1987.
W. & s. oats: Rotary cultivated, P and K and (to additional plots only) Mg and S applied: 16 Sept, 1986. Seed sown and raked in: 2 Oct. S. oats sown: 26 Mar, 1987. Hand harvested: 11 Aug. Spring oats harvested: 1 Sept.
Potatoes: Extra K applied (to additional plots except nil only): 2 Oct, 1986. FYM applied to original plots and all original plots dug by hand: 1 Dec. All additional plots dug by hand, P, K and (to additional plots only), Mg and S applied: 2 Dec. N applied, rotary cultivated, potatoes planted: 22 Apr, 1987. Weedkillers applied: 13 May. Mancozeb applied: 24 June, 7 July and 28 July. Insecticide applied: 7 July. Plots given neither FYM nor K on original plots and plot given no fertilizer on additional plots harvested by hand, mancozeb applied to remaining plots: 14 Aug. Remaining plots harvested by hand: 29 Sept (original plots) and 30 Sept (additional plots).
Grass-clover ley: Rotary cultivated: 11 Aug, 1986. Seed sown and raked in: 12 Aug. P, K and (to additional plots only), Mg and S applied: 2 Dec. N applied: 24 Mar, 1987. Cut: 19 May, 20 July and 28 Sept.
Permanent grass: P and K applied: 2 Dec, 1986. FYM applied: 12 Mar, 1987. First N applied: 24 Mar. Cut, second N applied: 19 May. Cut, third N applied: 20 July. Cut: 28 Sept.



*https://doi.org/10.23637/ERADOC-1-37* *pp 27*

87/R/RN/5

ORIGINAL PLOTS

TONNES/HECTARE

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

| | W. WHEAT: | | W. BARLEY: | | LEY : DRY MATTER | | | |
|---|---|---|---|---|---|---|---|---|
| | GRAIN | STRAW | GRAIN | STRAW | 1ST CUT | 2ND CUT | 3RD CUT | TOTAL OF 3 CUTS |
| MANURE | | | | | | | | |
| 0 | 2.41 | 2.60 | 2.62 | 1.94 | 1.20 | 1.75 | 1.16 | 4.11 |
| N1 | 3.21 | 3.81 | 3.73 | 3.40 | 2.30 | 1.85 | 1.25 | 5.40 |
| P | 4.37 | 4.24 | 3.02 | 2.52 | 1.95 | 1.50 | 0.90 | 4.34 |
| N1P | 1.01 | 1.83 | 3.60 | 3.78 | 3.75 | 1.54 | 0.68 | 5.98 |
| K | 4.07 | 4.23 | 2.43 | 2.27 | 2.19 | 2.88 | 1.98 | 7.05 |
| N1K | 5.77 | 6.67 | 4.91 | 4.24 | 2.58 | 2.47 | 1.39 | 6.44 |
| PK | 4.72 | 4.75 | 3.49 | 3.08 | 3.65 | 4.78 | 3.65 | 12.09 |
| N1PK | 8.03 | 7.83 | 7.85 | 5.73 | 4.57 | 4.81 | 3.56 | 12.93 |
| N2PK | 8.57 | 9.26 | 8.46 | 6.33 | 5.58 | 4.43 | 3.59 | 13.60 |
| D | 6.12 | 6.75 | 3.64 | 3.69 | 3.56 | 4.25 | 3.37 | 11.19 |
| N1PKD | 9.50 | 10.35 | 8.24 | 5.76 | 5.16 | 5.16 | 3.95 | 14.27 |
| N2PKD | 9.65 | 11.87 | 9.23 | 7.95 | 5.02 | 5.27 | 3.91 | 14.20 |
| MEAN DM% | 80.6 | 53.7 | 81.2 | 61.9 | 23.4 | 19.2 | 22.4 | 21.7 |

| | W. OATS: | | POTATOES: | PERMANENT GRASS : DRY MATTER | | | |
|---|---|---|---|---|---|---|---|
| | GRAIN | STRAW | TOTAL TUBERS | 1ST CUT | 2ND CUT | 3RD CUT | TOTAL OF 3 CUTS |
| MANURE | | | | | | | |
| 0 | 3.00* | 2.37* | 12.5 | 0.57 | 0.90 | 0.84 | 2.31 |
| N1 | 4.38* | 3.16* | 14.2 | 1.40 | 2.07 | 2.11 | 5.59 |
| P | 2.78* | 2.54* | 8.1 | 0.57 | 1.17 | 0.92 | 2.67 |
| N1P | 2.73* | 2.82* | 7.3 | 1.99 | 2.56 | 2.22 | 6.77 |
| K | 2.76 | 2.88 | 34.4 | 0.74 | 1.01 | 1.03 | 2.78 |
| N1K | 4.94 | 5.16 | 36.7 | 1.56 | 2.60 | 2.05 | 6.22 |
| PK | 3.94 | 4.25 | 50.2 | 0.82 | 1.26 | 1.27 | 3.36 |
| N1PK | 7.64 | 8.12 | 62.7 | 2.40 | 3.02 | 2.90 | 8.32 |
| N2PK | 8.02 | 11.45 | 58.2 | 3.67 | 4.52 | 3.55 | 11.73 |
| D | 4.56 | 5.26 | 71.9 | 3.92 | 2.42 | 2.73 | 9.08 |
| N1PKD | 8.41 | 11.43 | 83.0 | 4.51 | 3.96 | 3.66 | 12.13 |
| N2PKD | 7.71 | 13.46 | 74.6 | 4.70 | 4.99 | 4.41 | 14.09 |
| MEAN DM% | 79.1 | 40.9 | 21.0 | 28.3 | 24.3 | 29.4 | 27.3 |

* S. OATS



*https://doi.org/10.23637/ERADOC-1-37* *pp 28*

87/R/RN/5

ADDITIONAL PLOTS

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

| | W. WHEAT: GRAIN | W. WHEAT: STRAW | W. BARLEY: GRAIN | W. BARLEY: STRAW | W. OATS: GRAIN | W. OATS: STRAW | POTATOES: TOTAL TUBERS |
|---|---|---|---|---|---|---|---|
| MANURES | | | | | | | |
| 0 | 2.85 | 2.70 | 2.70 | 2.07 | 2.73 | 2.74 | 9.1 |
| N2PK | 9.00 | 8.90 | 9.03 | 7.39 | 7.67 | 11.21 | 69.8 |
| N2PKMG | 8.02 | 8.70 | 8.56 | 6.42 | 8.23 | 13.20 | 69.2 |
| N2PKS | 7.52 | 7.85 | 9.04 | 6.97 | 8.01 | 10.31 | 66.5 |
| N2PKMGS | 8.47 | 8.72 | 8.67 | 7.28 | 7.92 | 12.38 | 78.8 |
| N1PKMGS | 8.28 | 8.64 | 8.34 | 6.56 | 8.17 | 11.21 | 74.4 |
| N3PKMGS | 8.69 | 9.35 | 8.99 | 7.21 | 7.40 | 10.69 | 69.4 |
| MEAN DM% | 79.3 | 44.5 | 80.6 | 62.4 | 78.4 | 44.8 | 21.5 |

| | LEY : DRY MATTER 1ST CUT | 2ND CUT | 3RD CUT | TOTAL OF 3 CUTS |
|---|---|---|---|---|
| MANURES | | | | |
| 0 | 1.79 | 1.57 | 1.31 | 4.66 |
| N2PK | 4.99 | 5.36 | 3.52 | 13.87 |
| N2PKMG | 5.04 | 4.79 | 3.90 | 13.73 |
| N2PKS | 5.05 | 4.98 | 4.13 | 14.16 |
| N2PKMGS | 4.24 | 5.07 | 3.92 | 13.24 |
| N1PKMGS | 4.32 | 4.53 | 3.81 | 12.66 |
| N3PKMGS | 4.67 | 4.40 | 3.51 | 12.58 |
| MEAN DM% | 22.1 | 17.2 | 22.1 | 20.5 |



*https://doi.org/10.23637/ERADOC-1-37* *pp 29*

87/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 27th year, w. barley.

For previous years see 'Details' 1967 and 1973 and 74-86/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: 27 Aug, 1986 |
| ROTA DIG | Cultivated by rotary digger: 8 Sept |
| DEEPTINE | Deep-tine cultivated, 3 times: 27 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 twice on 27 August, 1986 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 6 Aug, 1986 and was burnt on XTR BURN on 13 Aug and these plots were spring-tine cultivated on 14 Aug. All plots were sprayed with paraquat at 0.60 kg ion in 200 l on 29 Sept, rotary harrowed on 30 Sept and drilled on 1 Oct.

(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.



*https://doi.org/10.23637/ERADOC-1-37* *pp 30*

87/R/RN/8

Basal applications: Manures: Chalk at 5.0 t. 'Nitram' at 460 kg.
Weedkillers: Isoproturon at 2.5 kg with clopyralid at 0.07 kg and bromoxynil at 0.34 kg and mecoprop at 2.5 kg in 200 l.

Seed: Igri, sown at 150 kg.

Cultivations, etc.:- Chalk applied: 24 Sept, 1986. N applied: 20 Mar, 1987. Weedkillers applied: 16 Apr. Combine harvested: 7 Aug.

GRAIN TONNES/HECTARE

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

| SUBSOIL[82] CLT CHOP | NONE | CNVNTIAL | PARAPLOW | Mean |
|---|---|---|---|---|
| PLOUGH | 5.58 | 5.58 | 5.78 | 5.65 |
| ROTA DIG | 5.78 | 5.61 | 6.19 | 5.86 |
| DEEPTINE | 5.79 | 5.54 | 5.86 | 5.73 |
| Mean | 5.72 | 5.57 | 5.95 | 5.75 |

| XTR BURN | NONE | CNVNTIAL | PARAPLOW | Mean |
|---|---|---|---|---|
| | 5.89 | 4.34 | 4.29 | 4.84 |

Grand mean 5.52

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

| Table | XTR BURN | CLT CHOP SUBSOIL[82] | CLT CHOP SUBSOIL[82] |
|---|---|---|---|
| s.e.d. | 0.463 | 0.267 | 0.463 |

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

| Stratum | d.f. | s.e. | cv% |
|---|---|---|---|
| BLOCK.WP | 11 | 0.463 | 8.4 |

GRAIN MEAN DM% 85.0

PLOT AREA HARVESTED 0.00280



*https://doi.org/10.23637/ERADOC-1-37* 

87/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: A.E. Johnston.

The 23rd year, w. wheat, w. oats, ley.

For previous years see 'Details' 1973 and 74-86/W/RN/12.

Design for w. wheat: 2 blocks of 8 plots split into 6
W. oats: 2 blocks of 4 plots
6th and 8th year leys: 2 blocks of 4 plots.

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 w. wheat in 1987. In addition to leys the second pair included w. oats.

W. wheat 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 | Fertilizer only in both periods rates of P, K and Mg equivalent to amounts in straw (+P) |

Sub plots

2. N — Nitrogen fertilizer in 1987 (kg N) as 'Nitro-Chalk':

0
50
100
150
200
250



*https://doi.org/10.23637/ERADOC-1-37* *pp 32*

87/W/RN/12

W. oats tested:

| | |
|---|---|
| MANURE | Organic manures and fertilizers in 1986 (not applied in 1987), cumulative to 1985, 1983 and 1982 and to those applied in the preliminary period: |
| FYM | Farmyard manure at 50 tonnes |
| STRAW | Straw at 7.5 tonnes plus P205 at 140 kg, K20 at 140 kg, MgO at 50 kg |
| FERT-FYM | P205 at 280 kg, K20 at 560 kg, MgO at 100 kg |
| FERT-STR | P205 at 140 kg, K20 at 280 kg, MgO at 50 kg |

All leys were clover/grass (LC) without N. 6th year leys tested:

| | |
|---|---|
| PREV LEY | Previous ley: |
| LC(LC) | Clover/grass ley in preliminary period |
| LC(LN) | Grass ley with N in preliminary period |

8th year leys tested:

| | |
|---|---|
| PREV MAN | Previous manure: |
| LC(GM) | Green manures in preliminary period |
| LC(PT) | Peat in preliminary period |

Standard applications:
W. wheat: Manures: (0:18:36) at 560 kg. Mn at 0.16 kg as manganese sulphate in 240 l applied with the prochloraz, carbendazim and growth regulator. Weedkillers: Glyphosate at 1.4 kg in 200 l. Chlortoluron at 5.6 kg in 200 l. Clopyralid at 0.07 kg, bromoxynil at 0.34 kg with mecoprop at 2.5 kg in 240 l. Fungicides: Prochloraz at 0.34 kg with carbendazim at 0.13 kg. Fenpropimorph at 0.75 kg with chlorothalonil at 0.75 kg in 200 l. Propiconazole at 0.12 kg with carbendazim and maneb (as 'Septal' at 2.5 kg) in 200 l. Growth regulator: Chlormequat chloride at 1.1 kg. Insecticide: Carbofuran at 7.5 kg. Molluscicide: Methiocarb at 0.22 kg.
W. oats: Manure: N at 90 kg as 'Nitram'. Weedkiller: Clopyralid at 0.07 kg, bromoxynil at 0.34 kg with mecoprop at 2.5 kg in 240 l.
Leys, 6th and 8th years: Manures: MgO at 50 kg as kieserite. (0:18:36) at 780 kg.

Seed: W. wheat: Mercia, sown at 190 kg.
W. oats: Bulwark, sown at 140 kg.

Cultivations, etc.:-
W. wheat: After leys only: Plough and roll: 25 July, 1986. Subsoiled, with 25 cm wings on tines 30 cm deep and 70 cm apart, in two directions at right angles: 28 Aug. All wheat plots: Glyphosate applied: 16 Sept. Methiocarb applied: 18 Sept. Ploughed plots after oats: 24 Sept. PK applied, insecticide applied, rotary harrowed with crumbler attached: 24 Sept. Seed sown: 25 Sept. Chlortoluron applied: 9 Oct. Clopyralid, bromoxynil and mecoprop applied: 14 Apr, 1987. N treatments applied: 16 Apr. Manganese, prochloraz, carbendazim and chlormequat applied: 21 Apr. Fenpropimorph and chlorothalonil



*https://doi.org/10.23637/ERADOC-1-37* *pp 33*

87/W/RN/12

Cultivations, etc.:-

applied: 5 June. Propiconazole, carbendazim and maneb applied: 29 June. Combine harvested: 1 Sept.
W. oats: Ploughed: 25 Sept, 1986. Rotary cultivated with crumbler attached, seed sown: 2 Oct. Clopyralid, bromoxynil and mecoprop applied: 27 Apr, 1987. N applied: 5 May. Combine harvested: 20 Aug.
Leys, 6th and 8th years: PK and Mg applied: 10 Mar, 1987. Cut: 18 June and 12 Aug.

WINTER WHEAT

GRAIN TONNES/HECTARE

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

| N / TREATMNT | 0 | 50 | 100 | 150 | 200 | 250 | Mean |
|---|---|---|---|---|---|---|---|
| LC 8 GM | 5.23 | 7.74 | 8.46 | 8.72 | 8.40 | 7.78 | 7.72 |
| LC 8 PT | 5.32 | 7.37 | 7.51 | 8.43 | 8.37 | 8.39 | 7.57 |
| LC 6 LC | 5.98 | 7.04 | 8.59 | 8.49 | 7.62 | 8.40 | 7.69 |
| LC 6 LN | 6.15 | 7.73 | 8.05 | 7.97 | 8.60 | 8.21 | 7.78 |
| FYM | 4.03 | 5.82 | 7.22 | 6.48 | 7.51 | 8.00 | 6.51 |
| STRAW | 2.95 | 3.89 | 5.82 | 7.16 | 6.50 | 7.75 | 5.68 |
| FERT-FYM | 1.36 | 3.05 | 4.48 | 5.06 | 5.25 | 5.77 | 4.16 |
| FERT-STR | 2.07 | 4.18 | 4.92 | 4.84 | 5.15 | 6.19 | 4.56 |
| Mean | 4.14 | 5.85 | 6.88 | 7.14 | 7.18 | 7.56 | 6.46 |

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

| Table | TREATMNT | N | TREATMNT N |
|---|---|---|---|
| s.e.d. | 0.832 | 0.192 | 0.968 |
| Except when comparing means with the same level(s) of TREATMNT | | | 0.543 |

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

| Stratum | d.f. | s.e. | cv% |
|---|---|---|---|
| BLOCK.WP | 7 | 0.832 | 12.9 |
| BLOCK.WP.SP | 40 | 0.543 | 8.4 |

GRAIN MEAN DM% 81.6

SUB PLOT AREA HARVESTED 0.00254



*https://doi.org/10.23637/ERADOC-1-37* *pp 34*

87/W/RN/12

WINTER OATS

GRAIN TONNES/HECTARE

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

| MANURE | FYM | STRAW | FERT-FYM | FERT-STR | Mean |
|---|---|---|---|---|---|
| | 5.15 | 4.94 | 4.29 | 5.03 | 4.85 |

GRAIN MEAN DM% 83.5

STRAW TONNES/HECTARE

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

| MANURE | FYM | STRAW | FERT-FYM | FERT-STR | Mean |
|---|---|---|---|---|---|
| | 5.59 | 4.81 | 4.14 | 4.80 | 4.84 |

STRAW MEAN DM% 76.6

PLOT AREA HARVESTED 0.00796

6TH YEAR LEY

DRY MATTER TONNES/HECTARE

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

| | 1ST CUT (18/6/87) | 2ND CUT (12/8/87) | TOTAL OF 2 CUTS |
|---|---|---|---|
| PREV LEY | | | |
| LC(LC) | 6.05 | 2.48 | 8.53 |
| LC(LN) | 6.11 | 1.93 | 8.04 |
| MEAN | 6.08 | 2.20 | 8.28 |
| MEAN DM% | 21.6 | 16.9 | 19.2 |

8TH YEAR LEY

DRY MATTER TONNES/HECTARE

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

| | 1ST CUT (18/6/87) | 2ND CUT (12/8/87) | TOTAL OF 2 CUTS |
|---|---|---|---|
| PREV MAN | | | |
| LC(GM) | 4.39 | 2.39 | 6.77 |
| LC(PT) | 4.63 | 2.31 | 6.94 |
| MEAN | 4.51 | 2.35 | 6.86 |
| MEAN DM% | 20.2 | 17.5 | 18.9 |



*https://doi.org/10.23637/ERADOC-1-37* *pp 35*

87/W/RN/13

## INTENSIVE CEREALS

Object: To study the effects of intensive cereal cropping on yield, incidence of soil-borne pathogens and organic matter in the soil - Woburn Stackyard I.

Sponsors: A.E. Johnston, J. McEwen.

The 22nd year, w. wheat.

For previous years see 'Details' 1973 and 74-86/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 wheat experiment 1877-1954 and one in which the cereal was s. barley, sown on part of the site of the classical 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 with all combinations of the following treatments:

Whole plots

1. LEY AGE  Length of ley:

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

Sub plots

2. N  Nitrogen fertilizer in 1987 (kg N) as 'Nitro-Chalk':

   0
   50
   100
   150
   200
   250



*https://doi.org/10.23637/ERADOC-1-37*  *pp 36*

87/W/RN/13

Standard applications: Manures: (0:18:36) at 560 kg. Mn at 0.16 kg as manganese sulphate in 240 l applied with the prochloraz, carbendazim and growth regulator. Weedkillers: Glyphosate at 1.4 kg in 200 l. Chlortoluron at 5.6 kg in 200 l. Clopyralid at 0.07 kg, bromoxynil at 0.34 kg with mecoprop at 2.5 kg in 240 l. Fungicides: Prochloraz at 0.34 kg with carbendazim at 0.13 kg. Fenpropimorph at 0.75 kg with chlorothalonil at 0.75 kg in 200 l. Propiconazole at 0.12 kg with carbendazim and maneb (as 'Septal' at 2.5 kg) in 200 l. Growth regulator: Chlormequat at 1.1 kg. Insecticide: Carbofuran at 7.5 kg. Molluscicide: Methiocarb at 0.22 kg.

Seed: Mercia, sown at 190 kg.

Cultivations, etc.:- Ploughed and rolled: 17 July, 1986. Subsoiled with 25 cm wings on tines 30 cm deep and 70 cm apart, in two directions at right angles: 28 Aug. Glyphosate applied: 16 Sept. Methiocarb applied: 18 Sept. PK applied, carbofuran applied, rotary harrowed with crumbler attached, seed sown: 25 Sept. Chlortoluron applied: 9 Oct. Mn, prochloraz, carbendazim, chlormequat applied: 14 Apr, 1987. Clopyralid, bromoxynil and mecoprop applied subsequently: 14 Apr. N applied: 23 Apr. Fenpropimorph and chlorothalonil applied: 5 June. Propiconazole, carbendazim and maneb applied: 29 June. Combine harvested: 1 Sept.

GRAIN TONNES/HECTARE

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

| N | 0 | 50 | 100 | 150 | 200 | 250 | Mean |
|---|---|---|---|---|---|---|---|
| LEY AGE | | | | | | | |
| 1 YEAR | 4.86 | 6.33 | 7.94 | 7.96 | 7.99 | 8.51 | 7.27 |
| 2 YEARS | 5.82 | 8.22 | 8.73 | 8.87 | 9.01 | 9.08 | 8.29 |
| 3 YEARS | 7.72 | 8.60 | 8.85 | 9.36 | 9.18 | 9.36 | 8.84 |
| 4 YEARS | 8.37 | 8.94 | 8.85 | 9.28 | 9.43 | 8.96 | 8.97 |
| 5 YEARS | 8.37 | 8.94 | 8.85 | 9.28 | 9.06 | 9.22 | 8.95 |
| 6 YEARS | 8.24 | 8.63 | 8.62 | 8.77 | 8.16 | 8.99 | 8.57 |
| Mean | 7.23 | 8.28 | 8.64 | 8.92 | 8.81 | 9.02 | 8.48 |

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

| Table | LEY AGE | N | LEY AGE N |
|---|---|---|---|
| s.e.d. | 0.271 | 0.158 | 0.445 |
| Except when comparing means with the same level(s) of LEY AGE | | | 0.387 |

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

| Stratum | d.f. | s.e. | cv% |
|---|---|---|---|
| BLOCK.WP | 15 | 0.383 | 4.5 |
| BLOCK.WP.SP | 90 | 0.547 | 6.5 |

GRAIN MEAN DM% 82.6

SUB PLOT AREA HARVESTED 0.00165



*https://doi.org/10.23637/ERADOC-1-37* *pp 37*

87/R/RN/17

## RATES OF P AND K TO THE SUBSOIL

Object: To study the effects of a range of rates and frequencies of application of P and K to the subsoil, singly and together, on the yields and nutrient uptakes of a rotation of crops - Meadow.

Sponsors: J. McEwen, A.E. Johnston.

The seventh year, potatoes, s. barley, s. beans, w. wheat.

For previous years see 81-86/R/RN/17.

Design: 4 series (for crops) each of 40 plots.

Whole plotdimensions: 3.0 x 14.0.

Treatments to each series:

TREATMNT — Extra P and K and primary cultivation tool in autumn 1980 only, except on A plots, treatments repeated annually, and F plots treatments repeated four yearly:

| | P2O5(kg) | K2O(kg) | Tool | |
|---|---|---|---|---|
| - - - | 0 | 0 | Plough | (duplicated) |
| P6 K6 T | 1000 | 500 to topsoil | " | ( " ) |
| - - S | 0 | 0 | Wye double-digger | (triplicated) |
| - - SA | 0 | 0 | " " " | (duplicated) |
| - - SF | 0 | 0 | " " " | |
| P2 - SA | 63 | 0 to subsoil | " " " | |
| P3 - SF | 125 | 0 " " | " " " | |
| P4 - S | 250 | 0 " " | " " " | |
| P5 - S | 500 | 0 " " | " " " | |
| P5 - SF | 500 | 0 " " | " " " | |
| P6 - S | 1000 | 0 " " | " " " | |
| - K2 SA | 0 | 31 " " | " " " | |
| - K3 SF | 0 | 63 " " | " " " | |
| - K4 S | 0 | 125 " " | " " " | |
| - K5 S | 0 | 250 " " | " " " | |
| - K5 SF | 0 | 250 " " | " " " | |
| - K6 S | 0 | 350 " " | " " " | |
| P1 K1 SA | 31 | 16 " " | " " " | |
| P1 K3 SA | 31 | 63 " " | " " " | |
| P2 K2 SA | 63 | 31 " " | " " " | |
| P3 K1 SA | 125 | 16 " " | " " " | |
| P3 K3 SA | 125 | 63 " " | " " " | |
| P3 K4 SF | 125 | 125 " " | " " " | |
| P4 K3 SF | 250 | 63 " " | " " " | |
| P4 K4 S | 250 | 125 " " | " " " | |
| P4 K5 S | 250 | 250 " " | " " " | |
| P4 K5 SF | 250 | 250 " " | " " " | |
| P4 K6 S | 250 | 350 " " | " " " | |
| P5 K4 S | 500 | 125 " " | " " " | |
| P5 K4 SF | 500 | 125 " " | " " " | |
| P5 K5 S | 500 | 250 " " | " " " | |
| P5 K6 S | 500 | 350 " " | " " " | |
| P6 K4 S | 1000 | 125 " " | " " " | |
| P6 K5 S | 1000 | 250 " " | " " " | |
| P6 K6 S | 1000 | 350 " " | " " " | |



*https://doi.org/10.23637/ERADOC-1-37* *pp 38*

87/R/RN/17

NOTES: (1) Subsoiling was done with the Wye double-digger which turns a furrow with a conventional plough share, to a depth of 23 cm, and at the same time rotary cultivates the bottom of the adjacent furrow to a further depth of 15 cm. When applying P and K this was distributed ahead of the rotary cultivator.
(2) The topsoil PK dressing was equally divided before and after ploughing.
(3) All plots were conventionally ploughed each autumn unless the Wye double-digging treatment was due.
(4) The rate of 350 kg K20 applied was in error for 500 kg K20.

Standard applications:
Potatoes: Manures: (10:10:15+4.5 Mg) at 1960 kg. Weedkiller: Linuron at 1.6 kg in 500 l. Fungicides: Mancozeb at 1.4 kg in 200 l on four occasions, applied with the pirimicarb on the second occasion. Fentin hydroxide at 0.28 kg in 200 l on two occasions. Insecticide: Pirimicarb at 0.14 kg: Desiccant: Diquat at 0.80 kg ion in 300 l.
S. barley: Manures: (20:10:10) at 630 kg. Weedkillers: Clopyralid at 0.07 kg, bromoxynil at 0.34 kg and mecoprop at 2.5 kg in 200 l. Fungicide: Tridemorph at 0.52 kg in 200 l.
S. beans: Weedkillers: Trietazine at 1.2 kg and simazine at 0.17 kg in 500 l. Insecticide: Phorate at 4.5 kg.
W. wheat: Manures: (0:18:36) at 350 kg. 'Nitram' at 590 kg. Weedkillers: Clopyralid at 0.07 kg and bromoxynil at 0.34 kg with mecoprop at 2.5 kg 200 l. Fungicide: Tridemorph at 0.52 kg in 200 l.

Seed: Potatoes: Pentland Crown.
S. barley: Klaxon, dressed triadimenol and fuberidazole, sown at 160 kg.
S. beans: Minden, sown at 260 kg.
W. wheat: Avalon, sown at 200 kg.

Cultivations, etc.:-
All crops: Treatments applied by double-digger: 29 Oct, 1986 and 30 Oct. Ploughed: 31 Oct.
Potatoes: Heavy spring-tine cultivated: 20 Feb, 1987. NPK+Mg applied: 14 Apr. Heavy spring-tine cultivated: 15 Apr. Rotary harrowed, potatoes planted: 16 Apr. Rotary ridged: 27 Apr. Linuron applied: 8 May. Mancozeb applied: 24 June, 8 July, 28 July, 10 Aug. Insecticide applied: 8 July. Fentin hydroxide applied: 28 Aug, 9 Sept. Desiccant applied: 21 Sept. Haulm mechanically destroyed: 3 Oct. Lifted: 19 Oct.
S. barley: Heavy spring-tine cultivated: 20 Feb, 1987. NPK applied, spring-tine cultivated: 16 Mar. Rotary harrowed, seed sown: 17 Mar. Weedkillers applied: 6 May. Fungicide applied: 24 June. Combine harvested: 20 Aug.
S. beans: Heavy spring-tine cultivated: 20 Feb, 1987. Phorate applied, spring-tine cultivated: 16 Mar. Rotary harrowed, seed sown: 18 Mar. Weedkillers applied: 30 Mar. Combine harvested: 18 Sept.
W. wheat: PK applied, rotary harrowed, seed sown: 7 Nov, 1986. N applied: 17 Apr, 1987. Weedkillers applied: 8 May. Fungicide applied: 24 June. Combine harvested: 31 Aug.



*https://doi.org/10.23637/ERADOC-1-37* *pp 39*

87/R/RN/17

SERIES III POTATOES

TOTAL TUBERS TONNES/HECTARE

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

| TREATMNT | |
|---|---|
| - - - | 64.6 |
| P6 K6 T | 60.0 |
| - - S | 61.7 |
| - - SA | 62.2 |
| - - SF | 63.6 |
| P2 - SA | 62.4 |
| P3 - SF | 71.5 |
| P4 - S | 50.7 |
| P5 - S | 65.4 |
| P5 - SF | 66.9 |
| P6 - S | 68.1 |
| - K2 SA | 62.6 |
| - K3 SF | 65.0 |
| - K4 S | 68.1 |
| - K5 S | 70.1 |
| - K5 SF | 66.6 |
| - K6 S | 70.8 |
| P1 K1 SA | 61.8 |
| P1 K3 SA | 67.6 |
| P2 K2 SA | 69.5 |
| P3 K1 SA | 67.9 |
| P3 K3 SA | 65.7 |
| P3 K4 SF | 71.8 |
| P4 K3 SF | 63.0 |
| P4 K4 S | 62.3 |
| P4 K5 S | 65.0 |
| P4 K5 SF | 68.8 |
| P4 K6 S | 68.1 |
| P5 K4 S | 68.7 |
| P5 K4 SF | 67.8 |
| P5 K5 S | 70.5 |
| P5 K6 S | 64.6 |
| P6 K4 S | 67.0 |
| P6 K5 S | 67.7 |
| P6 K6 S | 69.2 |
| Mean | 65.4 |

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

| Table | TREATMNT | |
|---|---|---|
| s.e.d. | 7.14 | min.rep |
| | 5.83 | max-min |

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

| Stratum | d.f. | s.e. | cv% |
|---|---|---|---|
| WP | 5 | 5.05 | 7.7 |



*https://doi.org/10.23637/ERADOC-1-37* *pp 40*

87/R/RN/17

SERIES III POTATOES

PERCENTAGE WARE 3.81 CM (1.5 INCH) RIDDLE

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

| TREATMNT | |
|---|---|
| - - - | 97.6 |
| P6 K6 T | 98.5 |
| - - S | 98.2 |
| - - SA | 98.5 |
| - - SF | 97.6 |
| P2 - SA | 97.8 |
| P3 - SF | 98.8 |
| P4 - S | 97.7 |
| P5 - S | 98.5 |
| P5 - SF | 98.0 |
| P6 - S | 98.3 |
| - K2 SA | 98.5 |
| - K3 SF | 98.1 |
| - K4 S | 97.7 |
| - K5 S | 97.7 |
| - K5 SF | 98.3 |
| - K6 S | 98.1 |
| P1 K1 SA | 96.7 |
| P1 K3 SA | 98.4 |
| P2 K2 SA | 98.2 |
| P3 K1 SA | 99.1 |
| P3 K3 SA | 97.3 |
| P3 K4 SF | 98.8 |
| P4 K3 SF | 98.2 |
| P4 K4 S | 97.9 |
| P4 K5 S | 98.3 |
| P4 K5 SF | 97.9 |
| P4 K6 S | 98.5 |
| P5 K4 S | 97.5 |
| P5 K4 SF | 98.1 |
| P5 K5 S | 99.3 |
| P5 K6 S | 96.9 |
| P6 K4 S | 98.4 |
| P6 K5 S | 98.1 |
| P6 K6 S | 99.3 |
| Mean | 98.1 |

PLOT AREA HARVESTED 0.00210

* SEDs apply only to - - -, P6 K6 T, - - S and - - SA

| | TREATMNT |
|---|---|
| max-min | - - S v any of remainder |
| min.rep | any of remainder |



*https://doi.org/10.23637/ERADOC-1-37* *pp 41*

87/R/RN/17

SERIES IV WINTER BARLEY

GRAIN TONNES/HECTARE

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

| TREATMNT | |
|---|---|
| - - - | 7.02 |
| P6 K6 T | 6.92 |
| - - S | 6.95 |
| - - SA | 7.22 |
| - - SF | 6.73 |
| P2 - SA | 7.42 |
| P3 - SF | 7.12 |
| P4 - S | 6.99 |
| P5 - S | 6.98 |
| P5 - SF | 7.23 |
| P6 - S | 6.50 |
| - K2 SA | 7.28 |
| - K3 SF | 7.10 |
| - K4 S | 7.21 |
| - K5 S | 7.37 |
| - K5 SF | 7.05 |
| - K6 S | 6.92 |
| P1 K1 SA | 7.10 |
| P1 K3 SA | 6.82 |
| P2 K2 SA | 6.90 |
| P3 K1 SA | 6.82 |
| P3 K3 SA | 7.40 |
| P3 K4 SF | 7.18 |
| P4 K3 SF | 7.10 |
| P4 K4 S | 7.01 |
| P4 K5 S | 7.30 |
| P4 K5 SF | 7.33 |
| P4 K6 S | 7.12 |
| P5 K4 S | 7.09 |
| P5 K4 SF | 6.86 |
| P5 K5 S | 7.08 |
| P5 K6 S | 7.05 |
| P6 K4 S | 6.58 |
| P6 K5 S | 6.36 |
| P6 K6 S | 7.00 |
| Mean | 7.03 |

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

| Table | TREATMNT | |
|---|---|---|
| s.e.d. | 0.206 | min.rep |
| | 0.168 | max-min |

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

| Stratum | d.f. | s.e. | cv% |
|---|---|---|---|
| WP | 5 | 0.146 | 2.1 |

GRAIN MEAN DM% 86.0 PLOT AREA HARVESTED 0.00286



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87/R/RN/17

SERIES I SPRING BEANS

GRAIN TONNES/HECTARE

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

| TREATMNT | |
|---|---|
| - - - | 4.50 |
| P6 K6 T | 4.31 |
| - - S | 4.51 |
| - - SA | 4.83 |
| - - SF | 4.14 |
| P2 - SA | 4.34 |
| P3 - SF | 4.43 |
| P4 - S | 4.07 |
| P5 - S | 4.14 |
| P5 - SF | 4.97 |
| P6 - S | 4.68 |
| - K2 SA | 4.74 |
| - K3 SF | 4.77 |
| - K4 S | 4.80 |
| - K5 S | 4.41 |
| - K5 SF | 4.81 |
| - K6 S | 4.72 |
| P1 K1 SA | 4.63 |
| P1 K3 SA | 4.53 |
| P2 K2 SA | 4.88 |
| P3 K1 SA | 4.70 |
| P3 K3 SA | 4.01 |
| P3 K4 SF | 4.75 |
| P4 K3 SF | 4.32 |
| P4 K4 S | 3.82 |
| P4 K5 S | 4.50 |
| P4 K5 SF | 4.27 |
| P4 K6 S | 4.63 |
| P5 K4 S | 5.04 |
| P5 K4 SF | 4.93 |
| P5 K5 S | 4.43 |
| P5 K6 S | 4.80 |
| P6 K4 S | 4.55 |
| P6 K5 S | 4.44 |
| P6 K6 S | 4.44 |
| Mean | 4.54 |

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

| Table | TREATMNT | |
|---|---|---|
| s.e.d. | 0.430 | min.rep |
| | 0.351 | max-min |

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

| Stratum | d.f. | s.e. | cv% |
|---|---|---|---|
| WP | 5 | 0.304 | 6.7 |

GRAIN MEAN DM% 81.9 PLOT AREA HARVESTED 0.00386



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87/R/RN/17

SERIES II WINTER WHEAT

GRAIN TONNES/HECTARE

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

| TREATMNT | |
|---|---|
| - - - | 6.69 |
| P6 K6 T | 7.41 |
| - - S | 6.62 |
| - - SA | 6.90 |
| - - SF | 5.93 |
| P2 - SA | 7.10 |
| P3 - SF | 7.79 |
| P4 - S | 7.15 |
| P5 - S | 7.28 |
| P5 - SF | 6.99 |
| P6 - S | 6.85 |
| - K2 SA | 6.81 |
| - K3 SF | 5.53 |
| - K4 S | 7.35 |
| - K5 S | 6.74 |
| - K5 SF | 7.08 |
| - K6 S | 5.17 |
| P1 K1 SA | 7.58 |
| P1 K3 SA | 7.24 |
| P2 K2 SA | 7.49 |
| P3 K1 SA | 7.56 |
| P3 K3 SA | 7.27 |
| P3 K4 SF | 8.14 |
| P4 K3 SF | 7.24 |
| P4 K4 S | 7.29 |
| P4 K5 S | 6.65 |
| P4 K5 SF | 7.01 |
| P4 K6 S | 7.88 |
| P5 K4 S | 6.33 |
| P5 K4 SF | 7.31 |
| P5 K5 S | 6.29 |
| P5 K6 S | 6.82 |
| P6 K4 S | 6.90 |
| P6 K5 S | 6.63 |
| P6 K6 S | 7.10 |
| Mean | 6.96 |

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

| Table | TREATMNT | |
|---|---|---|
| s.e.d. | 0.624 | min.rep |
| | 0.510 | max-min |

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

| Stratum | d.f. | s.e. | cv% |
|---|---|---|---|
| WP | 5 | 0.441 | 6.3 |

GRAIN MEAN DM% 83.0 PLOT AREA HARVESTED 0.00274



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