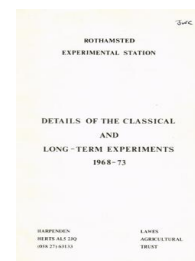


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Details of the Classical and Long-term Experiments 1968-73



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W/RN/3 Ley/ARABLE - Leys, Barley, Potatoes, Wheat, Rye, Carrots

Rothamsted Research

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LEY-ARABLE ROTATION WOBURN, STACKYARD FIELD (W/RN/3)

This experiment, which was started in 1938, was designed to test the effects on soil fertility of a three-year grazed ley, three years of lucerne and a three course arable rotation including one year hay in comparison with a rotation without leys measured by the yields of two successive test crops. (*Details 1967*, pp. 105-114).

Large differences in the yields of potatoes grown in contrasting conditions in 1966 led to the introduction of a number of studies in soil pathogens. Initially the tests were applied to the treatment crops of potatoes but in 1971 potatoes were re-introduced as the first test crop. A number of other changes were made including the substitution of S123 red clover for sainfoin which had often failed to survive three years. These are summarised below and set out in detail in table 2.

Treatment crops

| | 1st year | 2nd year | 3rd year |
|---------------------------|---------------------------------|---|---------------------------------|
| Ley (L) | Grazed to 1968 Cut from 1969 | Grazed to 1968 Cut from 1969 | Grazed to 1969 Cut from 1970 |
| Sainfoin (cut) (S) | Till 1971 | Till 1971 | Till 1971 |
| S123 Clover (cut) (C1) | 1972- | Sown July 1971 | Sown July 1971 |
| Arable (roots) (A) | Potatoes (P) | 1968-71 Rye (R) | 1968-71 Carrots (C) |
| Arable (hay) (AH) | Potatoes | 1972 - Barley (B) 1968-71 Rye 1972 - Barley | 1972 - Barley Hay* (H) |

*the seeds were undersown in the preceding cereals in some seasons.

Test crops

| | 1st | 2nd |
|-------------|----------|--------|
| 1968-70 | Barley | Barley |
| 1971 | Potatoes | Barley |
| 1972 & 1973 | Potatoes | Wheat |

Treatments

(i) Potatoes

(a) Treatment crops

1968 None v. thiram (approx. 8 kg a.i.) applied to tuber

NOTE: Thiram-dressed seed was chitted, untreated seed was not chitted (on 1/24 plots)

1968-70 (a) None v. 448 kg chloropicrin (on 1/4 plots)

(b) 125 v. 188 v. 251 kg N (on 1/12 plots)

1969 & 1970 None v. 11 kg aldicarb (on 1/24 plots)

1972 None v. 448 kg chloropicrin plus 5.6 kg aldicarb (on 1/4 plots)

1973 None v. 448 kg chloropicrin plus 6.7 kg aldicarb (applied also in error to the 1/4 plots of the 1st year ley and 1st year clover on 'alternating' rotations.

- (b) *Test crops* (Note: FYM no longer applied to test crop)
 1971 None v. 448 kg chloropicrin plus 11.2 kg aldicarb
 Varieties: Maris Piper v. Pentland Crown
 On 1/2 plots after ley and sainfoin and 1/4 plots after arable and arable with ley (1971 only; other years Maris Piper only).
 1972 & 1973 None v. 448 chloropicrin plus:
 1972 5.6 kg aldicarb,
 1973 6.7 kg aldicarb.

(ii) *Other test crops*

- (a) Barley as first test crop 1968-70 (on 1/8 plots) after A and AH rotations: 50 v. 100 v. 150 v. 200 kg N. After L and S rotations: 0 v. 50 v. 100 v. 150 kg N.
 (b) Wheat as second test crop 1972 and 73. (on 1/8 plots) 0 v. 63 v. 126 v. 188 kg N.

Residual effects of the farmyard manure applied prior to 1968 and of fumigants from 1968 have been tested in a number of crops as shown in Table 2.

Table 2
Cropping Sequences and Residuals Tested

Phase 1

| | | Continuous | | | Alternating rotations | | | |
|------|----|------------|-----|---------|-----------------------|----|-----|-----|
| 1967 | L1 | S1 | P | P | P | P | L1 | S1 |
| 1968 | L2 | S2+ | R+ | R+ | R+ | R+ | L2 | S2+ |
| 1969 | L3 | S3 | H | C | H | C | L3 | S3 |
| 1970 | | | | BARLEY+ | | | | |
| 1971 | | | | BARLEY | | | | |
| 1972 | L1 | C11 | P*+ | P*+ | C11 | L1 | P*+ | P*+ |
| 1973 | L2 | C12 | B+F | B+F | C12 | L2 | B+F | B+F |

- NOTES:* (1) FYM at 38 t last applied to 1st test crop (Sugar beet) 1965
 Residual effect measured in crops marked (+)
 (2) Fumigant test applied to potato crops (*)
 Residual effect measured in crops marked (F)

Phase 2

| | | Continuous | | | Alternating rotations | | | |
|------|----|------------|----|---------|-----------------------|----|-----|----|
| 1967 | L2 | S2 | R | R | R | R | S2 | L2 |
| 1968 | L3 | S3+ | H+ | C+ | C+ | H+ | S3+ | L3 |
| 1969 | | | | BARLEY+ | | | | |
| 1970 | | | | BARLEY | | | | |
| 1971 | L1 | S/C1 | P+ | P+ | S/C1 | L1 | P+ | P+ |
| 1972 | L2 | C12 | B | B | C12 | L2 | B | B |
| 1973 | L3 | C13 | H | B+ | C13 | L3 | B+ | H |

- NOTES:* (1) FYM at 38 t last applied to 1st test crop (Sugar beet) 1964
 Residual effect measured in crops marked (+)

Phase 3

| | | Continuous | | | Alternating rotations | | | | |
|------|----|------------|-----|------------|-----------------------|-----|-----|-----|--|
| 1967 | | | | | BARLEY | | | | |
| 1968 | L1 | S1+ | P* | P* | S1+ | L1 | P* | P* | |
| 1969 | L2 | S2 | R+F | R+F | S2 | L2 | R+F | R+F | |
| 1970 | L3 | S3 | H | C+F | S3 | L3 | H | C+F | |
| 1971 | | | | POTATOES+* | | | | | |
| 1972 | | | | WHEAT+F | | | | | |
| 1973 | L1 | C11 | P*+ | P*+ | P*+ | P*+ | C11 | L1 | |

- NOTES:* (1) FYM at 38 t last applied to 1st test crop (Sugar beet) 1966
Residual effect measured in crops marked (+)
(2) Fumigants applied to potatoes (*)
Residual effect measured in crops marked (F)

Phase 4

| | | Continuous | | | Alternating rotations | | | | |
|------|----|------------|-----|------------|-----------------------|----|-----|-----|--|
| 1967 | L3 | S3 | H | C | H | C | L3 | S3 | |
| 1968 | | | | BARLEY+ | | | | | |
| 1969 | | | | BARLEY | | | | | |
| 1970 | L1 | S1 | P*+ | P*+ | S1 | L1 | P*+ | P*+ | |
| 1971 | L2 | S2/C1 | R+F | R+F | S2/C1 | L2 | R+F | R+F | |
| 1972 | L3 | C13 | H | B | C13 | L3 | B | H | |
| 1973 | | | | POTATOES*+ | | | | | |

- NOTES:* (1) FYM at 38 t last applied to 1st test crop (Sugar beet) 1963
Residual effect measured in crops marked (+)
(2) Fumigants applied to potatoes (*)
Residual effect measured in crops marked (F)

Phase 5

| | | Continuous | | | Alternating rotations | | | | |
|------|----|------------|-----|------------|-----------------------|----|-----|-----|--|
| 1967 | | | | SUGAR BEET | | | | | |
| 1968 | | | | BARLEY+ | | | | | |
| 1969 | L1 | S1 | P*+ | P*+ | S1 | L1 | P*+ | P*+ | |
| 1970 | L2 | S2 | R+F | R+F | S2 | L2 | R+F | R+F | |
| 1971 | L3 | S3 | H | C+F | S3 | L3 | C+F | H | |
| 1972 | | | | POTATOES*+ | | | | | |
| 1973 | | | | WHEAT+F | | | | | |

- NOTES:* (1) FYM at 38 t last applied to 1st crop (Sugar beet) 1967
Residual effect measured in crops marked (+)
(2) Fumigant test applied to potato crops (*)
Residual effect measured in crops marked (F)

Standard manurial dressings (kg)

Treatment crops

| | N | P ₂ O ₅ | K ₂ O | Material | Application |
|-----------------|-----|-------------------------------|------------------|------------|-------------|
| <i>Potatoes</i> | | | | | |
| 1968-70 | — | 115 | 225 | (0-14-28) | On the flat |
| 1971- | 251 | 251 | 387 | (13-13-20) | On the flat |

| | | | | | |
|-------------------------------------|-------------------------|-------------------------------|------------------|----------------------------|-----------------------------|
| <i>Rye</i> | | | | | |
| 1968 | 75 | 40 | 75 | 'N-Chalk, & (0-14-28) | Top-dressed combine drilled |
| 1969- | 40 | 40 | 75 | 'N-Chalk' & (0-14-28) | Top-dressed combine drilled |
| <i>Barley</i> | | | | | |
| 1972- | 63 | 63 | 63 | (15-15-15) | Combine drilled |
| <i>Carrots</i> | | | | | |
| 1968-71 | 75 | 75 | 225 | 'N-Chalk', Super & Muriate | Seedbed |
| <i>One year ley (hay)</i> | | | | | |
| 1968 | 125 | 75 | 150 | 'N-Chalk' & (0-14-28) | In spring |
| | 75 | — | 75 | (16-0-16) | After 1st cut |
| 1969-73 | Spring dressing as 1968 | | | | |
| | 75 | — | 50 | (25-0-16) | After 1st cut |
| <i>Ley—first year</i> | | | | | |
| 1968-73 | 50 | 188 | 125 | 'N-Chalk', Super & Muriate | Seedbed |
| 1968 (grazed) | 75 | — | 75 | (16-0-16) | 1 top dressing |
| 1969, 1970, 1972 & 1973 (cut) | 100 | — | 63 | (25-0-16) | 2 dressings |
| 1971 (cut) | 50 | — | 32 | (25-0-16) | 1 dressing |
| | N | P ₂ O ₅ | K ₂ O | Material | Application |
| <i>Ley-second & third years</i> | | | | | |
| 1968 (cut) | 100 | — | 100 | (16-0-16) | 2 dressings |
| 2nd year | | | | | |
| 1969 (cut) | 100 | — | 63 | (25-0-16) | 2 dressings |
| 3rd year | | | | | |
| 1969 (grazed) | 150 | — | 93 | (25-0-16) | 3 dressings |
| 2nd & 3rd year | | | | | |
| 1970-73 (cut) | 150 | — | 93 | (25-0-16) | 3 dressings |
| <i>Sainfoin 1st year</i> | | | | | |
| 1968-71 | 63 | 188 | 126 | 'N-Chalk', Super & Muriate | Seedbed |
| 2nd & 3rd year | | | | | |
| 1968-71 | 63 | — | 188 | 'N-Chalk' & Muriate | 1 dressing |
| <i>Clover</i> | | | | | |
| 1st year 1972 | 63 | 188 | 126 | 'N-Chalk', Super & Muriate | To Seedbed |
| 2nd & 3rd years | | | | | |
| 1972- | 63 | — | 188 | 'N-Chalk' & Muriate | 1 dressing |

Magnesium sulphate (as Epsom salts) was applied to first treatment crops in the seedbed:—
 1968 and 1969 620 kg (62 kg Mg)
 1970 375 kg (37 kg Mg) — the smaller quantity applied in error.

| Test crops | N | P ₂ O ₅ | K ₂ O | Material | Application |
|----------------------------|-----|-------------------------------|------------------|-------------------|-------------|
| <i>Barley – 1st test</i> | | | | | |
| 1968-70 | – | 63 | 63 | (0-20-20) | Seedbed |
| <i>Barley – 2nd test</i> | | | | | |
| 1968 | 75 | 40 | 0 | 'N-Chalk' & Super | Seedbed |
| 1969-71 | 63 | 63 | 63 | (15-15-15) | Seedbed |
| <i>Potatoes – 1st test</i> | | | | | |
| 1971-73 | 250 | 250 | 385 | (13-13-20) | Seedbed |
| <i>Wheat – 2nd test</i> | | | | | |
| 1972-73 | | 60 | 60 | (0-20-20) | Seedbed |

Table 3
Corrective K dressings (kg K₂O) applied to first test crop as
muriate of potash, half before ploughing and half after

| <i>Continuous rotations</i> | 1968 | | 1969 | | 1970 | | 1971 | | 1972 | | 1973 | | | | | | |
|--|------|-----|-------|------|------|------|------|-----|------|------|------|-----|------|---|--|------|---|
| | O | D | O | D | O | D | O | D | O | D | O | D | | | | | |
| Leys (L) | 0 | 126 | 188 | 0 | 200 | 0 | 126 | 126 | 251 | 251 | 502 | 502 | | | | | |
| Sainfoin (S) (Clover from 1972 (C1)) | 377 | 377 | 439 | 314 | 439 | 377 | 126 | 126 | 0 | 0 | 126 | 126 | | | | | |
| Arable with hay (AH) | 628 | 502 | 502 | 439 | 628 | 628 | 188 | 188 | 314 | 251 | 314 | 376 | | | | | |
| Arable (A) | 251 | 251 | 377 | 377 | 377 | 251 | 0 | 0 | 314 | 314 | 439 | 439 | | | | | |
| <i>Alternating rotations (Last two rotations in order)</i> | | | | | | | | | | | | | | | | | |
| | 1968 | | | 1969 | | | 1970 | | | 1971 | | | 1972 | | | 1973 | |
| | O | D | | O | D | | O | D | | O | D | | O | D | | O | D |
| AH/L | 0 | 63 | A/L | 251 | 251 | AH/L | 251 | 63 | | | | | | | | | |
| A/S | 628 | 377 | AH/S | 377 | 251 | A/S | 439 | 314 | | | | | | | | | |
| L/AH | 628 | 377 | LU/AH | 502 | 502 | L/AH | 502 | 502 | | | | | | | | | |
| LU/A | 628 | 377 | L/A | 377 | 377 | LU/A | 439 | 439 | | | | | | | | | |
| | 1971 | | | 1972 | | | 1973 | | | 1971 | | | 1972 | | | 1973 | |
| | O | D | | O | D | | O | D | | O | D | | O | D | | O | D |
| A/L | 188 | 439 | A/L | 439 | 376 | L/A | 439 | 439 | | | | | | | | | |
| AH/S | 126 | 126 | H/C1 | 126 | 126 | S/AH | 439 | 502 | | | | | | | | | |
| L/AH | 63 | 63 | L/AH | 251 | 251 | A/L | 502 | 502 | | | | | | | | | |
| S/A | 188 | 314 | C/A | 376 | 376 | AH/C | 251 | 0 | | | | | | | | | |

O = No FYM half plots D = FYM half plots

Liming

Lime was applied in the autumn to the plots intended for the second test crop.

1968 Ground Magnesium limestone at 5.6 t
1969 Ground Magnesium limestone at 5.0 t
1970 Ground Chalk at 5.0 t
1971-73 Ground Magnesium limestone at 5.0 t

Varieties

| | | | | | |
|----------------|---------------------|------------------------|--------------------------|------------------|------------------------|
| 1968-70 | Common Sainfoin | Maris Badger Barley | Maris Piper Potatoes | King II Rye | Autumn King Carrots |
| 1971 | S.123 Red Clover | Julia Barley | Maris Piper* Potatoes | King II Rye | Autumn King Carrots |
| 1972 & 1973 | S.123 Red Clover | Julia Barley | Maris Piper Potatoes | Capelle Wheat | |

* Pentland Crown was also grown in the test crop plots.

Seeds mixtures

Hay 21 kg S.24 Perennial ryegrass,
10 kg Late flowering Red clover, 2 kg Alsike clover
Ley 22 kg S.23 Perennial ryegrass, 12 kg S.143 Cocksfoot,
7 kg Late flowering Red clover, 3 kg S.100 White clover.

Soil series Cottenham and Flitwick.

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The effects of ley and arable cropping systems on the amounts of soil organic matter in the Rothamsted and Woburn ley arable experiments.

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