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## Yields of the Field Experiments 1986

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### 86/R/RN/17 Rates of P and K to the Subsoil - Potatoes, S. Barley, S. Beans, W. Wheat

#### Rothamsted Research

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# 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 sixth year, potatoes, s. barley, s. beans, w. wheat.

For previous years see 81-85/R/RN/17.

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

Whole plot dimensions: 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:

|          | P205(kg) | K20(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 " "        | " "               |               |

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- 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. Weedkillers: Paraquat at 0.60 kg ion in 200 l. Linuron at 1.3 kg in 500 l. Fungicide: Mancozeb at 1.4 kg in 200 l on four occasions, applied with the pirimicarb on the third and fourth. Fentin hydroxide at 0.28 kg in 200 l on two occasions, with the pirimicarb on the first. Insecticide: Pirimicarb at 0.14 kg on three occasions with the fungicides. Desiccant: Diquat at 0.60 kg ion in 200 l.
- S. barley: Manures: (20:10:10) at 630 kg. Weedkillers: Clopyralid at 0.07 kg, bromoxynil octanoate at 0.34 kg and mecoprop at 2.5 kg in 200 l applied with the tridemorph. Fungicides: Tridemorph at 0.52 kg. Propiconazole at 0.12 kg in 200 l. Desiccant: Glyphosate at 1.4 kg in 200 l.
- S. beans: Weedkillers: Paraquat at 0.60 kg ion in 200 l. Simazine at 1.2 kg with paraquat at 0.50 kg ion in 200 l. Insecticides: Phorate at 4.5 kg. Pirimicarb at 0.14 kg in 200 l. Desiccant: Diquat at 0.60 kg ion with a wetting agent ('Agral' at 0.075 l) in 500 l.
- W. wheat: Manures: (0:18:36) at 350 kg. 'Nitram' at 520 kg. Weedkillers: Clopyralid at 0.07 kg, bromoxynil octanoate at 0.34 kg, mecoprop at 2.5 kg and isoproturon at 2.1 kg in 200 l. Fungicide: Propiconazole at 0.12 kg in 200 l. Desiccant: Glyphosate at 1.4 kg in 200 l.

Seed: Potatoes: Pentland Crown.

- S. barley: Klaxon, sown at 160 kg.
- S. beans: Minden, sown at 300 kg.
- W. wheat: Avalon, sown at 190 kg.

Cultivations, etc.:-

- All crops: Treatments applied by double-digger: 4 Nov, 1985 and 5 Nov. Ploughed: 6 Nov. Heavy spring-tine cultivated: 7 Nov, 8 Nov.
- Potatoes: Paraquat applied: 23 Sept, 1985. NPK Mg applied: 12 May, 1986. Rotary harrowed, potatoes planted: 13 May. Rotary ridged: 19 May. Linuron applied: 30 May. Mancozeb applied: 30 June, 14 July. Mancozeb with pirimicarb applied: 28 July, 12 Aug. Fentin hydroxide with pirimicarb applied: 29 Aug. Fentin hydroxide applied: 11 Sept. Haulm mechanically destroyed: 19 Sept. Desiccant applied: 27 Sept. Lifted: 15 Oct.
- S. barley: NPK applied, spring-tine cultivated, rotary harrowed, seed sown: 17 Mar, 1986. Weedkillers with tridemorph applied: 16 May. Propiconazole applied: 25 June. Desiccant applied: 12 Aug. Combine harvested: 29 Aug.

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- S. beans: Paraquat alone applied: 23 Sept, 1985. Phorate applied, spring-tine cultivated, rotary harrowed, seed sown: 11 Apr, 1986. Simazine with paraquat applied: 25 Apr. Pirimicarb applied: 16 July. Desiccant with wetting agent applied: 17 Sept. Combine harvested: 23 Sept.
- W. wheat: PK applied, rotary harrowed, seed sown: 8 Nov, 1985. N applied: 24 Apr, 1986. Weedkillers applied: 30 Apr. Fungicide applied: 25 June. Desiccant applied: 12 Aug. Combine harvested: 30 Aug.

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SERIES IV POTATOES

TOTAL TUBERS TONNES/HECTARE

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

| TREATMNT |      |
|----------|------|
| - - -    | 46.0 |
| P6 K6 T  | 40.6 |
| - - S    | 40.9 |
| - - SA   | 44.2 |
| - - SF   | 45.9 |
| P2 - SA  | 48.7 |
| P3 - SF  | 46.2 |
| P4 - S   | 45.6 |
| P5 - S   | 49.4 |
| P5 - SF  | 47.4 |
| P6 - S   | 44.2 |
| - K2 SA  | 46.2 |
| - K3 SF  | 48.3 |
| - K4 S   | 46.9 |
| - K5 S   | 43.5 |
| - K5 SF  | 45.2 |
| - K6 S   | 46.2 |
| P1 K1 SA | 43.1 |
| P1 K3 SA | 43.8 |
| P2 K2 SA | 45.0 |
| P3 K1 SA | 45.6 |
| P3 K3 SA | 43.6 |
| P3 K4 SF | 50.3 |
| P4 K3 SF | 39.7 |
| P4 K4 S  | 39.5 |
| P4 K5 S  | 47.2 |
| P4 K5 SF | 47.7 |
| P4 K6 S  | 44.3 |
| P5 K4 S  | 39.6 |
| P5 K4 SF | 45.0 |
| P5 K5 S  | 37.4 |
| P5 K6 S  | 41.8 |
| P6 K4 S  | 43.2 |
| P6 K5 S  | 39.3 |
| P6 K6 S  | 47.5 |
| MEAN     | 44.3 |

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

| TABLE | TREATMNT     |
|-------|--------------|
| ----- | -----        |
| SED   | 3.08 MIN REP |
|       | 2.51 MAX-MIN |

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

| STRATUM | DF | SE   | CV% |
|---------|----|------|-----|
| WP      | 5  | 2.18 | 4.9 |

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SERIES IV POTATOES

PERCENTAGE WARE 3.81 CM (1.5 INCH) RIDDLE

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

|          |      |
|----------|------|
| TREATMNT |      |
| - - -    | 98.3 |
| P6 K6 T  | 97.8 |
| - - S    | 97.7 |
| - - SA   | 98.4 |
| - - SF   | 98.1 |
| P2 - SA  | 98.3 |
| P3 - SF  | 98.1 |
| P4 - S   | 97.4 |
| P5 - S   | 98.3 |
| P5 - SF  | 98.8 |
| P6 - S   | 97.2 |
| - K2 SA  | 97.9 |
| - K3 SF  | 98.4 |
| - K4 S   | 98.3 |
| - K5 S   | 98.7 |
| - K5 SF  | 98.4 |
| - K6 S   | 97.3 |
| P1 K1 SA | 97.4 |
| P1 K3 SA | 96.7 |
| P2 K2 SA | 97.3 |
| P3 K1 SA | 98.6 |
| P3 K3 SA | 98.3 |
| P3 K4 SF | 98.3 |
| P4 K3 SF | 97.5 |
| P4 K4 S  | 96.9 |
| P4 K5 S  | 98.0 |
| P4 K5 SF | 97.7 |
| P4 K6 S  | 98.2 |
| P5 K4 S  | 98.1 |
| P5 K4 SF | 97.1 |
| P5 K5 S  | 97.7 |
| P5 K6 S  | 96.9 |
| P6 K4 S  | 97.7 |
| P6 K5 S  | 97.5 |
| P6 K6 S  | 97.5 |
| MEAN     | 97.9 |

PLOT AREA HARVESTED 0.00210

\* SEDs APPLY ONLY TO - - -, P6 K6 T, - - S, - - SR, P5 - S,  
- K5 S, P4 K5 S AND P5 K4 S

|          |                          |
|----------|--------------------------|
| TREATMNT |                          |
| MAX-MIN  | - - S V ANY OF REMAINDER |
| MIN REP  | ANY OF REMAINDER         |

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SERIES I SPRING BARLEY

GRAIN TONNES/HECTARE

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

| TREATMNT |      |
|----------|------|
| - - -    | 7.71 |
| P6 K6 T  | 7.61 |
| - - S    | 7.91 |
| - - SA   | 7.85 |
| - - SF   | 8.01 |
| P2 - SA  | 8.01 |
| P3 - SF  | 7.82 |
| P4 - S   | 7.90 |
| P5 - S   | 7.96 |
| P5 - SF  | 7.87 |
| P6 - S   | 8.05 |
| - K2 SA  | 7.81 |
| - K3 SF  | 7.34 |
| - K4 S   | 7.80 |
| - K5 S   | 7.80 |
| - K5 SF  | 8.11 |
| - K6 S   | 7.76 |
| P1 K1 SA | 7.92 |
| P1 K3 SA | 7.80 |
| P2 K2 SA | 7.72 |
| P3 K1 SA | 8.05 |
| P3 K3 SA | 7.63 |
| P3 K4 SF | 8.37 |
| P4 K3 SF | 7.90 |
| P4 K4 S  | 8.10 |
| P4 K5 S  | 7.66 |
| P4 K5 SF | 7.72 |
| P4 K6 S  | 7.45 |
| P5 K4 S  | 7.98 |
| P5 K4 SF | 7.85 |
| P5 K5 S  | 8.15 |
| P5 K6 S  | 7.74 |
| P6 K4 S  | 7.86 |
| P6 K5 S  | 7.87 |
| P6 K6 S  | 7.51 |
| MEAN     | 7.84 |

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

| TABLE | TREATMNT |         |
|-------|----------|---------|
|       | -----    |         |
| SED   | 0.301    | MIN REP |
|       | 0.246    | MAX-MIN |

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

| STRATUM        | DF   | SE                  | CV%     |
|----------------|------|---------------------|---------|
| WP             | 5    | 0.213               | 2.7     |
| GRAIN MEAN DM% | 80.4 | PLOT AREA HARVESTED | 0.00286 |

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SERIES II SPRING BEANS

GRAIN TONNES/HECTARE

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

|          |      |
|----------|------|
| TREATMNT |      |
| - - -    | 4.86 |
| P6 K6 T  | 5.75 |
| - - S    | 5.19 |
| - - SA   | 5.37 |
| - - SF   | 5.41 |
| P2 - SA  | 5.13 |
| P3 - SF  | 4.74 |
| P4 - S   | 4.92 |
| P5 - S   | 5.12 |
| P5 - SF  | 4.98 |
| P6 - S   | 4.84 |
| - K2 SA  | 5.16 |
| - K3 SF  | 5.18 |
| - K4 S   | 5.05 |
| - K5 S   | 4.50 |
| - K5 SF  | 5.36 |
| - K6 S   | 4.74 |
| P1 K1 SA | 5.15 |
| P1 K3 SA | 5.38 |
| P2 K2 SA | 5.13 |
| P3 K1 SA | 4.98 |
| P3 K3 SA | 5.61 |
| P3 K4 SF | 5.69 |
| P4 K3 SF | 5.40 |
| P4 K4 S  | 5.19 |
| P4 K5 S  | 4.91 |
| P4 K5 SF | 4.96 |
| P4 K6 S  | 5.22 |
| P5 K4 S  | 4.99 |
| P5 K4 SF | 4.50 |
| P5 K5 S  | 4.82 |
| P5 K6 S  | 5.43 |
| P6 K4 S  | 5.39 |
| P6 K5 S  | 5.22 |
| P6 K6 S  | 5.22 |
| MEAN     | 5.15 |

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

| TABLE | TREATMNT      |
|-------|---------------|
| ----- | -----         |
| SED   | 0.386 MIN REP |
|       | 0.315 MAX-MIN |

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

| STRATUM        | DF   | SE                  | CV%     |
|----------------|------|---------------------|---------|
| WP             | 5    | 0.273               | 5.3     |
| GRAIN MEAN DM% | 84.5 | PLOT AREA HARVESTED | 0.00386 |

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SERIES III WINTER WHEAT

GRAIN TONNES/HECTARE

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

| TREATMNT |       |
|----------|-------|
| - - -    | 8.95  |
| P6 K6 T  | 9.60  |
| - - S    | 8.84  |
| - - SA   | 9.56  |
| - - SF   | 8.50  |
| P2 - SA  | 8.90  |
| P3 - SF  | 9.34  |
| P4 - S   | 9.80  |
| P5 - S   | 8.95  |
| P5 - SF  | 9.12  |
| P6 - S   | 10.37 |
| - K2 SA  | 8.67  |
| - K3 SF  | 9.38  |
| - K4 S   | 8.13  |
| - K5 S   | 9.16  |
| - K5 SF  | 9.09  |
| - K6 S   | 8.84  |
| P1 K1 SA | 8.53  |
| P1 K3 SA | 9.78  |
| P2 K2 SA | 8.93  |
| P3 K1 SA | 9.42  |
| P3 K3 SA | 8.86  |
| P3 K4 SF | 8.38  |
| P4 K3 SF | 8.52  |
| P4 K4 S  | 8.68  |
| P4 K5 S  | 9.66  |
| P4 K5 SF | 9.36  |
| P4 K6 S  | 9.44  |
| P5 K4 S  | 9.75  |
| P5 K4 SF | 9.60  |
| P5 K5 S  | 9.50  |
| P5 K6 S  | 9.35  |
| P6 K4 S  | 8.88  |
| P6 K5 S  | 9.50  |
| P6 K6 S  | 8.81  |
| MEAN     | 9.15  |

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

| TABLE | TREATMNT      |
|-------|---------------|
| ----- | -----         |
| SED   | 0.968 MIN REP |
|       | 0.790 MAX-MIN |

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

| STRATUM        | DF   | SE                  | CV%     |
|----------------|------|---------------------|---------|
| WP             | 5    | 0.684               | 7.5     |
| GRAIN MEAN DM% | 80.4 | PLOT AREA HARVESTED | 0.00286 |