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## Yields of the Field Experiments 1984

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

#### Rothamsted Research

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84/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 fourth year, potatoes, s. barley, s. beans, w. wheat.

For previous years see 81-83/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 R plots, treatments repeated each autumn:

|          | P <sub>2</sub> O <sub>5</sub> (kg) | K <sub>2</sub> O(kg) | Tool              |              |
|----------|------------------------------------|----------------------|-------------------|--------------|
| - - -    | 0                                  | 0                    | Plough            | (duplicated) |
| P6 K6 T  | 1000                               | 500 to topsoil       | "                 | ( " )        |
| - - S    | 0                                  | 0 " "                | Wye double-digger | (four plots) |
| - - SR   | 0                                  | 0 " "                | " " "             | (duplicated) |
| P2 - SR  | 63                                 | 0 to subsoil         | " " "             |              |
| P3 - S   | 125                                | 0 " "                | " " "             |              |
| P4 - S   | 250                                | 0 " "                | " " "             |              |
| P5 - S   | 500                                | 0 " "                | " " "             | (duplicated) |
| P6 - S   | 1000                               | 0 " "                | " " "             |              |
| - K2 SR  | 0                                  | 31 " "               | " " "             |              |
| - K3 S   | 0                                  | 63 " "               | " " "             |              |
| - K4 S   | 0                                  | 125 " "              | " " "             |              |
| - K5 S   | 0                                  | 250 " "              | " " "             | (duplicated) |
| - K6 S   | 0                                  | 350 " "              | " " "             |              |
| P1 K1 SR | 31                                 | 16 " "               | " " "             |              |
| P1 K3 SR | 31                                 | 63 " "               | " " "             |              |
| P2 K2 SR | 63                                 | 31 " "               | " " "             |              |
| P3 K1 SR | 125                                | 16 " "               | " " "             |              |
| P3 K3 SR | 125                                | 63 " "               | " " "             |              |
| P3 K4 S  | 125                                | 125 " "              | " " "             |              |
| P4 K3 S  | 250                                | 63 " "               | " " "             |              |
| P4 K4 S  | 250                                | 125 " "              | " " "             |              |
| P4 K5 S  | 250                                | 250 " "              | " " "             | (duplicated) |
| P4 K6 S  | 250                                | 350 " "              | " " "             |              |
| P5 K4 S  | 500                                | 125 " "              | " " "             | (duplicated) |
| 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 " "              | " " "             |              |

84/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 other than R were conventionally ploughed in autumn 1981, 1982 and 1983.
- (4) The rate of 350 kg  $K_2O$  applied was in error for 500 kg  $K_2O$ .

Standard applications:

- Potatoes: Manures: (10:10:15 + 4.5 Mg) at 1960 kg. Weedkillers: Paraquat at 0.50 kg ion with linuron at 1.3 kg in 500 l. Glyphosate at 1.4 kg in 250 l. Fungicides: Fentin hydroxide at 0.28 kg in 200 l on seven occasions, with the insecticide on the first, third, fourth and sixth occasions. Insecticide: Pirimicarb at 0.14 kg on four occasions. Haulm desiccant: Diquat at 0.56 kg ion in 200 l.
- S. barley: Manures: (20:10:10) at 630 kg. Weedkillers: 3, 6-dichloropicolinic acid at 0.07 kg and bromoxynil at 0.34 kg with mecoprop (as 'CMPP' at 4.2 l) applied with the fungicide in 250 l. Fungicide: Tridemorph at 0.52 kg.
- S. beans: Weedkillers: Glyphosate at 1.4 kg in 250 l. Simazine at 1.2 l in 250 l. Insecticide: Phorate at 5.6 kg.
- W. wheat: Manures: (0:18:36) at 350 kg. 'Nitro-Chalk' at 750 kg. Weedkillers: Mecoprop at 2.0 kg, ioxynil at 0.25 kg and bromoxynil at 0.25 kg in 200 l. Fungicide: Propiconazole at 0.25 kg in 500 l. Insecticide: Pirimicarb at 0.14 kg in 250 l.

Seed: Potatoes: Pentland Crown.

- S. barley: Triumph, dressed with triadimenol and fuberidazole, sown at 160 kg.
- S. beans: Minden, sown at 240 kg.
- W. wheat: Avalon, sown at 190 kg.

Cultivations, etc.:-

- All crops: Treatments applied by double digger: 7-10 Nov, 1983. Ploughed: 11 Nov.
- Potatoes: Glyphosate applied: 6 Oct, 1983. Heavy spring-tine cultivated twice: 16 Jan, 1984 and a third time: 14 Feb. NPK Mg applied: 3 Apr. Spiked rotary cultivated, potatoes planted: 4 Apr. Rotary ridged: 6 Apr. Linuron and paraquat applied: 3 May. Fentin hydroxide with the insecticide applied: 19 June, 17 July, 30 July, 28 Aug. Fentin hydroxide applied: 3 July, 13 Aug, 11 Sept. Haulm mechanically destroyed: 3 Oct. Desiccant applied: 4 Oct. Lifted: 24 Oct.
- S. barley: Spring-tine cultivated: 14 Nov, 1983. Heavy spring-tine cultivated: 14 Feb, 1984. NPK applied: 7 Mar. Spring-tine cultivated, rotary harrowed, seed sown: 8 Mar. Weedkillers and fungicide applied: 23 May. Combine harvested: 17 Aug.
- S. beans: Glyphosate applied: 6 Oct, 1983. Heavy spring-tine cultivated twice: 16 Jan, 1984, and a third time: 14 Feb. Insecticide applied, heavy spring-tine cultivated, rotary harrowed, seed sown: 20 Mar. Simazine applied: 22 Mar. Combine harvested: 31 Aug.
- W. wheat: Glyphosate applied: 6 Oct, 1983. Spring-tine cultivated, PK applied, spring-tine cultivated, rotary harrowed, seed sown: 14 Nov. N applied: 9 Apr, 1984. Weedkillers applied: 19 Apr. Fungicide applied: 14 June. Insecticide applied: 26 June. Combine harvested: 22 Aug.

84/R/RN/17

SERIES II POTATOES

TOTAL TUBERS TONNES/HECTARE

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

| TREATMNT |      |
|----------|------|
| - - -    | 57.7 |
| P6 K6 T  | 66.1 |
| - - S    | 61.3 |
| - - SR   | 56.8 |
| P2 - SR  | 53.1 |
| P3 - S   | 52.3 |
| P4 - S   | 59.0 |
| P5 - S   | 63.0 |
| P6 - S   | 57.7 |
| - K2 SR  | 60.1 |
| - K3 S   | 62.4 |
| - K4 S   | 61.3 |
| - K5 S   | 64.1 |
| - K6 S   | 58.1 |
| P1 K1 SR | 52.4 |
| P1 K3 SR | 62.3 |
| P2 K2 SR | 55.7 |
| P3 K1 SR | 61.5 |
| P3 K3 SR | 60.8 |
| P3 K4 S  | 58.3 |
| P4 K3 S  | 58.9 |
| P4 K4 S  | 59.3 |
| P4 K5 S  | 65.1 |
| P4 K6 S  | 61.8 |
| P5 K4 S  | 63.1 |
| P5 K5 S  | 65.6 |
| P5 K6 S  | 64.2 |
| P6 K4 S  | 62.0 |
| P6 K5 S  | 60.9 |
| P6 K6 S  | 65.6 |
| MEAN     | 60.8 |

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

| TABLE | TREATMNT*    |
|-------|--------------|
| SED   | 2.91 MIN REP |
|       | 2.30 MAX-MIN |

\* SED APPLIES 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 THE REMAINDER

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

| STRATUM | DF | SE   | CV% |
|---------|----|------|-----|
| WP      | 10 | 2.06 | 3.4 |

84/R/RN/17

SERIES II POTATOES

PERCENTAGE WARE 3.81 CM (1.5 INCH) RIDDLE

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

| TREATMNT |      |
|----------|------|
| - - -    | 98.0 |
| P6 K6 T  | 98.4 |
| - - S    | 98.0 |
| - - SR   | 98.0 |
| P2 - SR  | 98.1 |
| P3 - S   | 98.3 |
| P4 - S   | 98.8 |
| P5 - S   | 97.6 |
| P6 - S   | 98.2 |
| - K2 SR  | 97.7 |
| - K3 S   | 98.2 |
| - K4 S   | 98.6 |
| - K5 S   | 98.7 |
| - K6 S   | 97.7 |
| P1 K1 SR | 99.2 |
| P1 K3 SR | 98.8 |
| P2 K2 SR | 98.9 |
| P3 K1 SR | 98.3 |
| P3 K3 SR | 98.8 |
| P3 K4 S  | 99.1 |
| P4 K3 S  | 98.7 |
| P4 K4 S  | 98.0 |
| P4 K5 S  | 98.0 |
| P4 K6 S  | 98.1 |
| P5 K4 S  | 98.2 |
| P5 K5 S  | 98.4 |
| P5 K6 S  | 98.5 |
| P6 K4 S  | 97.6 |
| P6 K5 S  | 98.4 |
| P6 K6 S  | 97.7 |
| MEAN     | 98.2 |

PLOT AREA HARVESTED 0.00210

84/R/RN/17

SERIES III SPRING BARLEY

GRAIN TONNES/HECTARE

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

| TREATMNT |      |
|----------|------|
| - - -    | 9.22 |
| P6 K6 T  | 9.37 |
| - - S    | 9.17 |
| - - SR   | 9.13 |
| P2 - SR  | 9.22 |
| P3 - S   | 9.31 |
| P4 - S   | 9.47 |
| P5 - S   | 9.21 |
| P6 - S   | 9.71 |
| - K2 SR  | 9.01 |
| - K3 S   | 9.51 |
| - K4 S   | 9.01 |
| - K5 S   | 9.20 |
| - K6 S   | 8.72 |
| P1 K1 SR | 9.06 |
| P1 K3 SR | 9.37 |
| P2 K2 SR | 9.17 |
| P3 K1 SR | 9.33 |
| P3 K3 SR | 9.37 |
| P3 K4 S  | 8.80 |
| P4 K3 S  | 9.19 |
| P4 K4 S  | 9.41 |
| P4 K5 S  | 9.41 |
| P4 K6 S  | 9.54 |
| P5 K4 S  | 9.15 |
| P5 K5 S  | 9.45 |
| P5 K6 S  | 9.37 |
| P6 K4 S  | 9.25 |
| P6 K5 S  | 9.40 |
| P6 K6 S  | 9.35 |
| MEAN     | 9.25 |

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

| TABLE | TREATMNT* |         |
|-------|-----------|---------|
| SED   | 0.196     | MIN REP |
|       | 0.155     | MAX-MIN |

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

| STRATUM | DF | SE    | CV% |
|---------|----|-------|-----|
| WP      | 10 | 0.139 | 1.5 |

GRAIN MEAN DM% 85.7

PLOT AREA HARVESTED 0.00286

84/R/RN/17

SERIES IV SPRING BEANS

GRAIN TONNES/HECTARE

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

|          |      |
|----------|------|
| TREATMNT |      |
| - - -    | 4.50 |
| P6 K6 T  | 4.06 |
| - - S    | 4.14 |
| - - SR   | 4.42 |
| P2 - SR  | 4.73 |
| P3 - S   | 4.89 |
| P4 - S   | 4.57 |
| P5 - S   | 4.61 |
| P6 - S   | 3.23 |
| - K2 SR  | 6.06 |
| - K3 S   | 4.15 |
| - K4 S   | 4.31 |
| - K5 S   | 4.25 |
| - K6 S   | 4.86 |
| P1 K1 SR | 4.67 |
| P1 K3 SR | 4.16 |
| P2 K2 SR | 4.80 |
| P3 K1 SR | 5.22 |
| P3 K3 SR | 4.41 |
| P3 K4 S  | 5.00 |
| P4 K3 S  | 3.78 |
| P4 K4 S  | 3.62 |
| P4 K5 S  | 4.62 |
| P4 K6 S  | 4.41 |
| P5 K4 S  | 3.89 |
| P5 K5 S  | 3.74 |
| P5 K6 S  | 4.04 |
| P6 K4 S  | 4.04 |
| P6 K5 S  | 3.88 |
| P6 K6 S  | 3.95 |
| MEAN     | 4.34 |

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

| TABLE | TREATMNT*     |
|-------|---------------|
| SED   | 0.453 MIN REP |
|       | 0.358 MAX-MIN |

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

| STRATUM             | DF      | SE    | CV% |
|---------------------|---------|-------|-----|
| WP                  | 10      | 0.320 | 7.4 |
| GRAIN MEAN DM%      | 88.0    |       |     |
| PLOT AREA HARVESTED | 0.00386 |       |     |

84/R/RN/17

SERIES I WINTER WHEAT

GRAIN TONNES/HECTARE

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

| TREATMNT |       |
|----------|-------|
| - - -    | 9.84  |
| P6 K6 T  | 10.34 |
| - - S    | 9.73  |
| - - SR   | 10.56 |
| P2 - SR  | 11.19 |
| P3 - S   | 11.92 |
| P4 - S   | 10.66 |
| P5 - S   | 10.48 |
| P6 - S   | 10.94 |
| - K2 SR  | 11.02 |
| - K3 S   | 10.32 |
| - K4 S   | 10.13 |
| - K5 S   | 9.97  |
| - K6 S   | 10.44 |
| P1 K1 SR | 10.06 |
| P1 K3 SR | 10.36 |
| P2 K2 SR | 10.04 |
| P3 K1 SR | 10.37 |
| P3 K3 SR | 11.49 |
| P3 K4 S  | 9.75  |
| P4 K3 S  | 10.64 |
| P4 K4 S  | 10.36 |
| P4 K5 S  | 10.26 |
| P4 K6 S  | 10.24 |
| P5 K4 S  | 10.76 |
| P5 K5 S  | 10.04 |
| P5 K6 S  | 10.40 |
| P6 K4 S  | 10.03 |
| P6 K5 S  | 9.08  |
| P6 K6 S  | 10.08 |
| MEAN     | 10.32 |

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

| TABLE | TREATMNT |         |
|-------|----------|---------|
| SED   | 0.449    | MIN REP |
|       | 0.355    | MAX-MIN |

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

| STRATUM | DF | SE    | CV% |
|---------|----|-------|-----|
| WP      | 10 | 0.317 | 3.1 |

GRAIN MEAN DM% 86.7

PLOT AREA HARVESTED 0.00286