

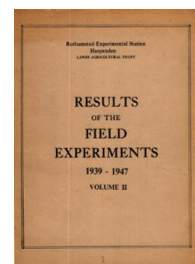
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# Yields of the Field Experiments 1939-1947 Volume 2

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## F Cropping of Newly Ploughed Grassland

### Rothamsted Research

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### CROPPING OF NEWLY PLOUGHED GRASSLAND

A series of three experiments.

#### 1. Great Knott II, 1939-40

Six crops were grown in 1939. Superphosphate was tested on all of them, potash on beans and potatoes only. In 1940 wheat was grown, testing sulphate of ammonia and the residual effects of the previous crops and fertilizers. Two fumigants, naphthalene and calcium sulphide, were used against wireworm in 1939 and their effects on the six crops were also measured.

Design; 24 randomized plots, each split into three for fumigants in 1939 and for sulphate of ammonia in 1940, the sub-plots under beans and potatoes in 1939 being split again into two for potash. In 1940 the experiment was treated as two randomized blocks of 12 plots each.

Area of each sub-plot ( $\frac{1}{3}$  whole plot); 0.0248 acre.

#### First Season, 1939

Crops; Spring wheat, barley, oats, flax, spring beans, potatoes.

#### Treatments

Superphosphate; None, 1 cwt.  $P_2O_5$  per acre

Sulphate of potash (to potatoes); None, 1 cwt.  $K_2O$  per acre

Muriate of potash (to beans); None, 0.5 cwt.  $K_2O$  per acre

Fumigants; None, naphthalene (15 cwt. per acre), calcium sulphide (350 lb. per acre). Fumigants applied before ploughing in February.

Basal Manuring; 0.4 cwt. N per acre as sulphate of ammonia, to potatoes.

#### Crop Notes

Grass, 11 years old, ploughed; Feb. 1-13. Rolled; Feb. 13.  
Harrowed; Feb. 20 - Mar. 4

Crop	Variety	Sown	Harvested
Spring wheat	Red Marvel	March 10	August 28
Barley	Plumage Archer	March 3	August 28
Oats	Star	March 3	August 14
Flax	Liral Monarch	April 11	September 13
Beans	Spring	March 3	August 28
Potatoes	Ally	May 20	September 22

Wireworms; Three sample estimates of the wireworm populations were made from series of 6" square soil samples. The first series was of 11 random samples from the field, the others were of one sample from each sub-plot.



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Cropping of Newly Ploughed Grassland

Second Season, 1940

Wheat

Treatments

Residual effects of 1939 cropping, and of superphosphate and sulphate of potash.

Sulphate of ammonia: None, 0.2, 0.4 cwt. N per acre, applied as a top dressing.

Crop Notes

Variety: Wilma. Seed sown: Nov. 10, 1939. Harvested: Aug. 12.



2. West Barnfield, 1940-41

and

3. Appletree, 1941-42

Eight crops were grown in the first year, testing sulphate of ammonia (on potatoes and sugar beet only in 1940), superphosphate, muriate of potash and salt. In the following year the direct effect of sulphate of ammonia and the residuals of the different crops and fertilizers were investigated, the test crops being wheat in 1941 and oats in 1942.

Design; 4 randomized blocks of 8 plots each, every plot being split into four for fertilizer treatments in the first season, two out of each four sub-plots receiving sulphate of ammonia in the second season. Certain interactions confounded with block differences.

Area of each sub-plot; 0.0167 acre.

First Seasons, 1940 and 1941

Crops; Wheat, barley, oats, beans, flax, potatoes, sugar beet, hay.

Treatments

Sulphate of ammonia;

To potatoes and sugar beet in 1940 and 1941; None, 0.6 cwt. N per acre.

To all other crops in 1941 only; None, 0.3 cwt. N per acre

Superphosphate; None, 0.6 cwt.,  $P_2O_5$  per acre

Muriate of potash; None, 0.75 cwt.  $K_2O$  per acre

Agricultural salt; None, 3 cwt. per acre.

No fertilizers were applied to the permanent grass left unploughed to provide the experimental hay crops; instead, the four artificials were applied directly to the second-year cereal crops.

Crop Notes

West Barnfield. Grass, 12 years old, ploughed: Oct. 10-20, 1939.

Rolled: Oct. 21. Springtime harrowed: Nov. 13

Appletree. Grass, many years old, ploughed: Oct. 18-24, 1940.

1 ton per lime applied and disc harrowed: Nov. 30.



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Cropping of Newly Ploughed Grassland

Crop	Variety	Sown	Harvested
1940			
Wheat	Wilma	20/11/39	August 13
Barley	Plumage Archer	March 13	August 5
Oats	Star	March 22	August 5
Beans	Spring	March 22	August 13
Flax	Liral Monarch	March 22	July 18
Potatoes	Arran Banner	April 27	September 24
Sugar Beet	Klein E	May 3	October 15
Hay			June 17
1941			
Wheat	Wilhelmina	4/12/40	August 27
Barley	Plumage Archer	March 22	August 27
Oats	Star	March 22	August 26
Beans	Spring	March 22	August 27
Flax	Liral Prince	April 17	August 20
Potatoes	Arran Banner	April 30	October 16
Sugar Beet	Klein E	April 26	October 30
Hay			June 30 and November

Second Seasons, 1941 and 1942

Wheat or Oats

Treatments

Residual effects of first seasons' cropping and of superphosphate, muriate of potash and salt.

Sulphate of ammonia: None, 0.3 cwt. N per acre

The plots that were under hay in the first seasons received all their artificials in the seed bed for wheat or oats.

Half the sugar beet and potato plots received 0.6 cwt. N per acre in 1940, but there was no residual effect of this treatment.

Crop Notes

Year	Crop	Variety	Sown	Harvested
1941	Wheat	Wilhemina	November 26	August 30
1942	Oats	Star	March 27	August 20

One plot which had carried flax in 1940 was damaged by an oil bomb in the autumn of 1940, and new soil was added.



Great Knott, 1939

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	Standard Errors per sub-plot (4 d.f.)		per split sub-plot (6 d.f.)	
	per acre	%	per acre	%
Wheat, grain	2.07 cwt.	10.8		
Barley, grain	3.14 "	10.2		
Oats, grain	1.07 "	3.1		
Flax, seed	1.45 "	15.0		
Flax, straw	5.47 "	15.3		
Beans, grain	2.51 "	13.5	4.27 cwt.	22.9
Potatoes, total tubers	0.55 tons	7.6	0.91 tons	12.5

Fumigants	Superphosphate		Mean	Superphosphate		Mean
	Absent	Present		Absent	Present	
	Grain; cwt. per acre			Straw; cwt. per acre		
	Spring Wheat					
	$\pm 1.47$		$\pm 1.04$			
None	20.5	16.3	18.4	37.4	25.6	31.5
Naphthalene	20.5	20.7	20.6	30.1	32.0	31.0
Calcium Sulphide	19.5	17.8	18.6	32.6	32.0	32.3
Mean	20.2	18.3	19.2	33.4	29.9	31.6
	Barley					
	$\pm 2.22$		$\pm 1.57$			
None	33.0	27.5	30.2	32.5	24.8	28.6
Naphthalene	32.4	26.5	29.4	29.4	26.6	28.0
Calcium Sulphide	32.6	32.0	32.3	31.1	34.3	32.7
Mean	32.7	28.7	30.7	31.0	28.6	29.8
	Oats					
	$\pm 0.753$		$\pm 0.533$			
None	36.2	35.2	35.7	34.1	35.5	34.8
Naphthalene	33.7	33.8	33.8	32.6	34.0	33.3
Calcium Sulphide	35.5	31.4	33.4	32.8	34.3	33.6
Mean	35.1	33.5	34.3	33.2	34.6	33.9
	Flax					
	$\pm 1.03$		$\pm 0.725$	$\pm 3.87$		$\pm 2.74$
None	9.3	10.8	10.0	35.6	41.5	38.6
Naphthalene	9.1	10.0	9.6	32.4	37.1	34.8
Calcium Sulphide	7.2	11.6	9.4	26.4	41.8	34.1
Mean	8.5	10.8	9.7	31.5	40.1	35.8

Standard errors shown are for use in vertical comparisons, and have 4 d.f.



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Cropping of Newly Ploughed Grassland

Great Knott, 1939

	Superphosphate		Potash		Mean
	Absent	Present	Absent	Present	
Spring Beans: Grain, cwt. per acre					
	$\pm 1.78^a$		$\pm 2.14^b$		$\pm 1.26^a$
None	16.9	17.1	18.7	15.3	17.0
Naphthalene	21.7	19.7	20.9	20.6	20.7
Calcium sulphide	17.4	19.2	19.4	17.1	18.3
Mean	18.7	18.7	19.7	17.7	18.7
			$\pm 1.23$		
Spring Beans: Straw, cwt. per acre					
None	23.5	20.8	22.6	21.7	22.2
Naphthalene	23.8	22.5	23.5	22.7	23.1
Calcium sulphide	22.5	24.1	24.1	22.5	23.3
Mean	23.3	22.5	23.4	22.3	22.9
Potatoes: Total tubers, tons per acre					
	$\pm 0.392^a$		$\pm 0.456^b$		$\pm 0.277^a$
None	7.25	8.29	7.39	8.16	7.78
Naphthalene	7.17	7.06	6.64	7.59	7.12
Calcium sulphide	6.26	7.71	6.53	7.44	6.98
Mean	6.89	7.69	6.85	7.73	7.29
			$\pm 0.263^b$		
Potatoes: Percentage Ware					
None	86.8	89.9	89.1	87.6	88.3
Naphthalene	86.8	88.4	87.4	87.8	87.6
Calcium sulphide	84.1	89.0	85.2	88.0	86.6
Mean	85.9	89.1	87.2	87.8	87.5

Standard errors

(a) For fumigant comparisons, 4 d.f.

(b) For potash comparisons, 6 d.f.

Wireworm Population: thousands per acre

Before fumigation.

July, 1938: 253 ( $\pm 59$ )

Aug. 11-24, 1938: 112 ( $\pm 16$ )

After fumigation	No fumigant	Naphthalene	Calcium sulphide	Mean
April 18-26, 1939	298	312 $\pm 60$	326	312

These standard errors have 46 d.f.



Cropping of Newly Ploughed Grassland  
Great Knott, 1940

	per whole plot (11 d.f.)		Standard Errors per sub-plot (24 d.f.)		per split sub-plot (12 d.f.)		
	per acre	%	per acre	%	per acre	%	
Wheat, grain	3.25 cwt.	8.3	3.38 cwt.	8.6	3.18 cwt.	7.8	
Wheat, straw	4.79 cwt.	10.1	4.08 cwt.	8.6	4.03 cwt.	7.8	
Crops in 1939	cwt. N 0.0	per acre 0.2	1940 0.4	cwt. P <sub>2</sub> O <sub>5</sub> 0.0	per acre 1.0	1939 Mean	Response to potash 1939

Grain: cwt. per acre

	$\pm 1.69^a$			$\pm 2.30$		$\pm 1.62$	$\pm 1.30^b$
Wheat	35.1	39.6	40.4	37.2	39.6	38.4	-
Barley	36.6	37.4	38.3	39.9	34.9	37.4	-
Oats	39.3	36.5	40.8	37.2	40.5	38.8	-
Flax	39.4	38.6	41.4	35.0	44.6	39.8	-
Beans <sup>†</sup>	39.7	39.8	39.5	42.2	37.2	39.8	0.9
Potatoes <sup>†</sup>	38.3	41.7	41.8	39.6	41.6	40.6	0.5
Mean	38.1	38.9	40.4	38.5	39.7	39.1	0.7
	$\pm 0.69^a$			$\pm 0.94$			$\pm 0.92^b$

Straw: cwt. per acre

	$\pm 2.04^a$			$\pm 3.39$		$\pm 2.40$	$\pm 1.65^b$
Wheat	40.9	45.4	46.4	43.1	45.3	44.2	-
Barley	41.2	42.6	45.4	45.4	40.7	43.0	-
Oats	46.0	41.9	50.5	44.2	48.1	46.2	-
Flax	45.2	45.0	50.5	40.2	53.7	47.0	-
Beans <sup>†</sup>	48.7	51.3	49.9	56.0	43.9	50.0	1.3
Potatoes <sup>†</sup>	47.9	56.5	53.3	47.9	57.2	52.6	0.5
Mean	45.0	47.2	49.4	46.2	48.2	47.2	0.9
	$\pm 0.83^a$			$\pm 1.38$			$\pm 1.17^b$

cwt. P <sub>2</sub> O <sub>5</sub>	Grain: cwt. per acre				Straw: cwt. per acre			
	cwt. N per acre 1940			Mean	cwt. N per acre 1940			Mean
	0.0	0.2	0.4		0.0	0.2	0.4	
	$\pm 0.98^a$			$\pm 0.94$	$\pm 1.18^a$			$\pm 1.38$
0.0	36.7	38.9	39.9	38.5	43.5	46.5	48.5	46.2
1.0	39.4	39.0	40.8	39.7	46.5	47.9	50.2	48.2
Response to Phosphate	2.7	0.1	0.9	1.2	3.0	1.4	1.7	2.0
	$\pm 1.23$			$\pm 1.33$	$\pm 1.69$			$\pm 1.95$

Standard errors: (a) for nitrogen comparisons, 24 d.f.  
(b) for residual potash comparisons, 12 d.f.  
The other standard errors have 11 d.f.

† Except for the last column, these figures are for half-plots which received no potash in 1939, and so are comparable with the yields from the wheat, barley, oats and flax plots.



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Cropping of Newly Ploughed Grassland

2. West Barnfield, 1940

Standard errors per sub-plot

		%		%
Wheat, grain	1.53 cwt./acre	5.4	Flax	
straw	1.40 " "	4.0	total produce	3.46 cwt./acre 7.5
Barley, grain	1.23 " "	3.4	desceded straw	2.20 " " 8.0
straw	1.00 " "	2.8	scutched fibre	0.743 " " 15.5
Oats, grain	1.50 " "	4.1	scutching rug	0.720 " " 9.8
straw	2.75 " "	6.0	seed and chaff	0.974 " " 8.1
Beans, grain	1.52 " "	10.0	Sugar beet	
straw	0.821 " "	4.2	total sugar	3.86 " " 7.8
Potatoes tubers			roots (washed)	0.864 tons/acre 6.8
total	0.740 " "	8.2	tops	0.433 " " 3.3
% ware	2.69		sugar %	0.462

All standard errors are based on 6 d.f. except those for potatoes and sugar beet, which are based on 8 d.f.

Mean yields and responses to fertilizers

	Mean	N	P	K	S	Standard errors
Wheat						
Grain, cwt. per acre	28.3		1.8	3.9	1.4	±0.76
Straw, " " "	34.8		1.3	3.2	0.2	±0.70
Barley						
Grain, " " "	36.4		1.0	1.7	1.8	±0.62
Straw, " " "	35.6		0.3	0.8	0.5	±0.50
Oats						
Grain, " " "	36.7		-1.1	0.3	0.3	±0.75
Straw, " " "	46.2		-2.8	3.2	3.4	±1.38
Beans						
Grain, " " "	15.2		0.3	1.8	0.0	±0.76
Straw, " " "	19.4		0.9	1.2	0.4	±0.41
Flax						
Total produce, cwt. per acre	46.0		1.0	1.4	-0.1	±1.73
Desceded straw, " " "	27.3		0.6	1.2	0.7	±1.10
Scutched fibre " " "	4.8		0.1	1.3	1.1	±0.37
Scutching rug, " " "	7.4		0.2	-0.4	0.6	±0.36
Seed and chaff, " " "	12.0		0.1	-0.1	-0.6	±0.49
Potatoes,						
Total tubers, tons per acre	9.02	0.87	0.38	2.37	0.04	±0.370
Percentage ware	86.0	0.2	-2.1	5.6	1.2	±1.34
Sugar Beet						
Total sugar, cwt. per acre	49.9	0.3	0.8	0.7	4.1	±1.93
Roots (washed), tons per acre	12.67	0.23	0.27	0.15	0.72	±0.432
Sugar percentage	19.66	-0.45	-0.16	0.09	0.55	±0.231
Tops, tons per acre	13.22	1.10	0.20	0.76	1.01	±0.216
Hay, cwt. per acre	47.1					



West Barnfield, 1941

Wheat

Standard Errors

(a) Excluding hay plots

Per whole plot

Grain, 1.09 cwt. per acre or 3.4%, 18 d.f.

Straw, 2.02 cwt. per acre or 4.7%, 18 d.f.

Per sub-plot

Grain, 1.93 cwt. per acre or 5.9%, 56 d.f.

Straw, 2.94 cwt. per acre or 6.9%, 56 d.f.

(b) Hay plots only

Per sub-plot

Grain, 0.922 cwt. per acre or 3.0%, 8 d.f.

Straw, 1.55 cwt. per acre or 3.4%, 8 d.f.

Mean yields and responses

1940 Crop	Grain: cwt. per acre					Straw: cwt. per acre				
	Mean	Responses				Mean	Responses			
		Direct	Residual effects				Direct	Residual effects		
		N	P	K	S		N	P	K	S
	±0.55	±0.97				±1.01	±1.47			
Wheat	30.9	-0.3	0.2	1.4	-0.3	39.7	1.9	2.0	2.6	0.1
Oats	31.2	0.5	1.5	2.4	0.4	38.1	1.3	1.1	4.7	0.1
Barley	31.6	1.7	1.3	0.2	0.9	39.7	3.5	2.1	2.2	2.0
Beans	33.0	0.0	0.4	1.6	-0.4	43.7	1.7	1.6	2.9	-0.2
Flax	33.5	2.6	0.5	1.5	0.0	45.8	5.2	1.7	1.0	1.3
Sugar beet	34.0	1.4	0.4	0.5	-0.5	45.2	3.0	0.6	1.2	-0.3
Pota- toes	33.9	-0.2	-0.7	1.2	0.1	45.4	1.1	0.8	1.6	-0.1
Mean	32.6	0.8	0.5	1.3	0.0	42.5	2.5	1.4	2.3	0.4
		±0.37					±0.56			
		Direct effects					Direct effects			
Hay	30.5	0.3	1.2	1.9	0.2	45.7	1.4	-0.1	1.4	2.9
		±0.46					±0.77			



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Cropping of Newly Ploughed Grassland

3. Appletree, 1941

Standard Errors per Sub-plot

Crop				Crop			
			%				%
Wheat, grain	1.40	cwt./acre	4.9	Flax			
straw	2.96	" "	8.8	total produce	3.21	cwt./acre	6.0
Barley, grain	2.04	" "	7.3	deseeded straw	2.07	" "	5.4
straw	1.76	" "	4.6	scutched fibre	0.803	" "	13.6
Oats, grain	1.24	" "	5.1	scutching rug	1.95	" "	14.6
straw	2.19	" "	5.4	seed and chaff	1.21	" "	20.4
Beans, grain	2.79	" "	19.5	Sugar beet			
straw	4.48	" "	18.1	total sugar	1.95	" "	5.7
Potatoes				roots (washed)	0.506	" "	5.0
total tubers	0.604	tons/acre	7.0	tops	1.49	tons/acre	7.3
% ware	2.21			sugar %	0.542		

All standard errors are based on 8 d.f.

Mean yields and responses to fertilizers

		Mean	Response to			Standard
			N	P	K	S errors
Wheat	Grain, cwt. per acre	28.5	-0.4	1.2	2.1	-0.9 ±0.70
	Straw, cwt. per acre	33.7	1.8	-0.1	5.2	1.1 ±1.48
Barley	Grain, " " "	27.9	0.7	0.2	2.3	1.2 ±1.02
	Straw, " " "	36.0	3.1	-1.4	3.8	3.0 ±0.88
Spring	Grain, " " "	24.2	-0.1	0.2	1.3	-0.2 ±0.62
Oats	Straw, " " "	40.9	0.4	1.3	1.3	4.4 ±1.09
Spring	Grain, " " "	14.3	1.9	1.5	1.7	-1.1 ±1.40
Beans	Straw " " "	24.7	3.7	-1.8	2.8	3.3 ±2.24
Flax	Total produce, cwt. per acre	53.6	-0.1	-6.0	0.5	-1.4 ±1.60
	Deseeded straw, " " "	38.3	-0.7	-3.3	0.3	0.2 ±1.04
	Scutched fibre, " " "	5.9	0.0	0.2	-0.3	-0.4 ±0.40
	Scutching rug, " " "	13.4	1.1	-1.1	0.3	-0.8 ±0.97
	Seed and chaff " " "	5.9	0.3	-0.8	-0.6	-0.4 ±0.60
Sugar beet	Total sugar, " " "	34.3	-0.1	2.2	5.7	6.3 ±0.97
	Roots (washed), tons per acre	10.10	0.10	0.65	1.55	1.68 ±0.253
	Sugar percentage	16.92	-0.22	0.05	0.30	0.29 ±0.271
	Tops, tons per acre	20.46	2.96	1.83	2.17	3.74 ±0.746
Potatoes	Total tubers, tons per acre	8.59	0.28	0.40	1.86	-0.22 ±0.302
	Percentage ware	86.3	-0.6	1.2	0.7	-1.3 ±1.11
Hay	1st Crop, cwt. per acre	23.7				
	2nd Crop, " " "	32.5				



Appletree Field, 1942

Standard Errors Spring Oats

(a) Excluding hay plots

Per whole plot:

Grain, 3.17 cwt. per acre or 20.4%, 18 d.f.  
 Straw, 6.04 cwt. per acre or 23.8%, 18 d.f.

Per sub-plot:

Grain, 3.51 cwt. per acre or 22.6%, 56 d.f.  
 Straw, 5.06 cwt. per acre or 19.9%, 56 d.f.

(b) Hay plots only

Per sub-plot

Grain, 2.41 cwt. per acre or 12.4%, 8 d.f.  
 Straw, 3.50 cwt. per acre or 13.3%, 8 d.f.

Mean yields and responses to fertilizers

1941 Crop	Grain: cwt. per acre					Straw: oct. per acre						
	Mean	Responses				Mean	Responses					
		Direct	Residual	effects			Direct	Residual	effects			
		N	P	K	S		N	P	K	S		
	±1.58		±1.75				±3.02		±2.53			
Wheat	18.7	-0.9	1.9	0.0	2.1	28.2	-1.1	3.2	1.7	2.3		
Oats	9.6	1.4	5.2	1.4	0.0	18.7	1.6	7.7	3.9	-0.3		
Barley	14.8	3.0	1.1	3.7	-2.6	25.7	6.0	-0.6	7.3	-0.8		
Beans	28.5	-1.0	0.3	2.0	-1.5	43.2	-1.1	-1.5	2.6	3.9		
Flax	12.2	1.2	2.7	0.2	2.1	23.2	4.6	3.8	0.5	0.5		
Sugar Beet	14.9	-0.3	0.3	4.3	-1.4	22.9	1.1	1.7	3.4	-3.1		
Potatoes	9.8	1.5	0.2	-4.9	1.3	15.7	1.8	0.5	-5.4	1.3		
Mean	15.5	0.7	1.7	1.0	0.0	25.4	1.8	2.1	2.0	0.5		
			±0.66						±0.96			
Hay	19.4	Direct effects				Direct effects						
		5.3	4.1	1.5	-0.1	26.2	6.1	4.4	5.4	3.7		
		±1.20					±1.75					

1941 Crop	Wireworms; thousands per acre	
	May 1941	June 1942
Wheat	725	725
Oats	525	550
Barley	750	900
Beans	950	225
Flax	800	725
Sugar Beet	875	625
Potatoes	775	650
Hay	550	650