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Woburn Experimental Farm :

Dr J. A. Voelcker

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THE WOBURN EXPERIMENTAL FARM

RECENT CHANGES.

In 1876 the Duke of Bedford started and carried on for many years an experimental farm at Woburn, on a light sandy soil, at which the Rothamsted experiments on wheat and barley were repeated in a modified form. Three other investigations were included: the effect of lime on an acid soil, the manurial value of cake and corn fed to farm animals, and the effect of green-manuring on a light soil. The Royal Agricultural Society was responsible, through their chemist (Dr. A. Voelcker till 1890, after that Dr. J. A. Voelcker), for the conduct of the experiments, and in 1912 took over the farm entirely. In 1921 they gave it up, and Dr. J. A. Voelcker then carried it on with the aid of a grant obtained through Rothamsted: in 1926 it was taken over entirely by Rothamsted, the laboratory was refitted and the pot culture station put into full work. Since 1927, Dr. H. H. Mann has been in charge, with Mr. T. W. Barnes as assistant. A grant has been obtained from the Royal Agricultural Society enabling us to make a statistical examination of the whole of the data assembled during the entire period. This is proceeding and is promising interesting results. It is too early to discuss the crop relationships, but some of the effects of fertilisers on the light sandy soil are being discovered by Dr. Crowther and his colleagues. There is no evidence that the addition of lime has increased the availability of the potash, nor that potassic and phosphatic manures have used up the lime (the exchangeable calcium): nitrate of soda, indeed, has a slightly conserving effect; sulphate of ammonia, on the other hand, exhausted it and made the soil acid, not, however, as acid as it might become, because as the acidification progressed so the loss of lime by leaching became less. It is interesting that superphosphate, even when applied every year for 50 years, has no tendency to make the soil acid, although the Woburn soil contains little or no calcium carbonate and readily becomes acid. Sulphate of ammonia did not reduce the exchangeable potassium. The work has been simplified by certain modifications in procedure designed by Mr. Basu and Dr. Crowther.

For the first time since 1905, the Lansome Field green-manuring plots gave good yields, and tares proved better than mustard; we cannot at present offer an explanation for this.

REPORT FOR 1929.

By DR. J. A. VOELCKER, C.I.E., M.A.

The early part of the season was rainy, and followed by a cold and windy January and February, 1929. Fairly dry weather prevailed until May, and from June onwards there were continued spells of drought until harvest time. This enabled the corn harvest to be gathered in well, but roots, green crops, and potatoes suffered, and grass grew only moderately.

RAINFALL.

Month.					Inches.	No. of Days where 0.2 mm. or more fell
October	1928	..	..	..	3.69	19
November	"	..	..	..	2.35	21
December	"	..	..	..	2.43	17
January	1929	..	..	..	1.16	17
February	"	..	..	..	.72	9
March	"	..	..	..	.10	5
April	"	..	..	..	1.85	15
May	"	..	..	..	1.68	10
June	"	..	..	..	.87	12
July	"	..	..	..	1.10	12
August	"	..	..	..	.42	10
September	"	..	..	..	.17	2
					16.54	149

FIELD EXPERIMENTS.

1.—CONTINUOUS GROWING OF WHEAT AND BARLEY
(STACKYARD FIELD), 51st SEASON.*Wheat.*

After the cleaning fallows of 1927 and 1928, "Million" wheat was sown on October 31st, 1928, withholding all manures, to ascertain the effects of fallowing and the residual manurial influences. It came up well. At first, plot 11b (farmyard manure) looked best. In December, plots 4 (minerals only) and 5 (lime) looked well; 2a (sulphate of ammonia) was the worst and nearly bare; 2b was better; and 2bb better still.

The wheat grew only slowly, but by January it covered the ground and had suffered little damage from game or rabbits.

In January, 11b and 4 no longer stood out; 2a and b, however remained the worst. By mid-April, 4 once more stood out superior to 1 and 7 (unmanured), and 2, 5 and 8 superior to 3, 6, 9: possibly, however, because the soils of 2, 5 and 8 appeared drier than those of 3, 6, 9. In May, the limed plots 8aa and bb were remarkably superior to the unlimed, and 3a (double nitrate of soda) to 3b (single nitrate of soda); 11b, however, was no longer superior to the rest.

The summer drought checked the wheat, and numerous weeds appeared: mayweed on unmanured and mineral plots, spurry on sulphate of ammonia plots, and coltsfoot, poppy and vetch on the remainder. Evidently on this weedy light land, two years' intensive cleaning is insufficient.

In the winter the soil on the nitrate of soda plots was noticeably darker, and wetter in appearance, than that on the sulphate of ammonia plots.

The yields are given in Table I. The yield of the unmanured plots (1 and 7) exceeded that of the previous 12 crops, being about equal to the 50-year average. In spite of the appearance of the crop, residual effects were produced by farmyard manure and minerals, especially potash, and by lime, but none by sulphate of ammonia and nitrate of soda.

Barley.

The longer interval available for cultivations had kept this crop cleaner than the wheat, and the two years' fallow was very effective. The yields obtained (Table II) were the best for the past 20 years, although some spurry again appeared and the crop looked yellow on the unlimed plots. Throughout growth the best plot was the farmyard manure plot (11b); the worst were sulphate of ammonia without lime (2a, 5a, 8a, 8b). The awns of the barley were darker on those plots where no phosphate had been given than on the rest.

TABLE I.

CONTINUOUS GROWING OF WHEAT, 1929. (After 2 years' fallow.)

Stackyard Field—Produce per acre.

Plot.	Manures Applied Annually. (Before the Fallow). For amounts see Report 1927-28. No Manures in 1929.	Dressed Corn per acre. bushel.	Total Corn per acre. cwt.	Weight per bushel. lb.	Straw, Chaff, etc., per acre. cwt.
1	Unmanured	11.1	5.98	59.2	11.11
2a	Sulphate of Ammonia	0.3	0.14	—	0.61
2aa	As 2a, with Lime, Jan., 1905, repeated 1909, 1910, 1911	1.7	0.89	—	1.54
2b	As 2a, with Lime, December, 1897	1.1	0.57	—	1.25
2bb	As 2b, with Lime, repeated Jan., 1905	5.4	2.82	—	4.21
3a	Nitrate of Soda	12.8	6.86	58.5	8.30
3b	Nitrate of Soda	9.5	4.93	57.0	6.53
4	Mineral Manures (Superphosphate and Sulphate of Potash)	17.8	9.71	60.6	16.38
5a	Mineral Manures and Sulphate of Ammonia	10.9	5.84	58.7	8.32
5b	As 5a, with Lime, Jan., 1905	13.3	7.04	57.7	12.13
6	Mineral Manures and Nitrate of Soda	12.8	6.72	57.7	9.88
7	Unmanured	8.5	4.62	59.5	7.50
8a	Mineral Manures and, in alternate years, Sulphate of Ammonia	2.7	1.39	—	2.79
8aa	As 8a, with Lime, Jan., 1905, repeated Jan., 1918 Mineral Manures and Sulphate of Ammonia (omitted in alternate years)	7.9	4.14	—	5.86
8b	As 8b, with Lime, Jan., 1905, repeated Jan., 1918 Mineral Manures and, in alternate years, Nitrate of Soda	2.9	1.50	—	2.61
8bb	As 8b, with Lime, Jan., 1905, repeated Jan., 1918 Mineral Manures and, in alternate years, Nitrate of Soda	9.4	4.89	—	7.04
9a	Mineral Manures and, in alternate years, Nitrate of Soda	17.2	9.30	59.5	13.43
9b	Mineral Manures and Nitrate of Soda (omitted in alternate years)	17.0	8.96	58.4	10.89
10a	Superphosphate and Nitrate of Soda	9.3	4.98	58.5	6.93
10b	Rape Dust	5.6	2.86	—	5.05
11a	Sulphate of Potash and Nitrate of Soda	16.5	8.84	59.0	14.27
11b	Farmyard Manure	21.3	11.48	59.2	20.95

TABLE II.

CONTINUOUS GROWING OF BARLEY, 1929. (After 2 years' fallow.)

Stackyard Field — Produce per acre.

Plot.	Manures Applied Annually. (Before the Fallow). For amounts see Report 1927-28. No Manures in 1929.	Dressed Corn per acre.	Total Corn per acre.	Weight per bushel.	Straw, Chaff, etc., per acre.
		bushel.	cwt.	lb.	cwt.
1	Unmanured	20.4	9.54	50.4	12.42
2a	Sulphate of Ammonia	2.7	1.21	—	2.61
2aa	As 2a, with Lime, Mar., 1905, repeated 1909, 1910, 1912, and 1923	14.9	7.07	—	10.36
2b	As 2a, with Lime, Dec., 1897, repeated 1912	24.9	11.37	49.5	15.10
2bb	As 2a, with Lime, Dec., 1897, repeated Mar., 1905	20.0	9.29	49.7	11.50
3a	Nitrate of Soda	33.4	16.21	51.7	18.89
3aa	As 3a, with Lime, Jan., 1921	16.0	7.82	51.5	7.82
3b	Nitrate of Soda	27.2	12.82	51.0	14.89
3bb	As 3b, with Lime, Jan., 1921	18.3	8.61	49.7	9.61
4a	Mineral Manures (Superphosphate and Sulphate of Potash)	21.1	9.93	50.4	12.84
4b	As 4a, with Lime, 1915	24.8	11.17	48.7	14.05
5a	Mineral Manures and Sulphate of Ammonia	5.8	2.34	—	4.14
5aa	As 5a, with Lime, Mar., 1905, repeated 1916	15.0	7.18	—	8.79
5b	As 5a, with Lime, Dec., 1897, repeated 1912	24.2	11.29	49.5	14.46
6	Mineral Manures and Nitrate of Soda	30.6	14.36	52.0	15.31
7	Unmanured	20.2	9.19	50.1	12.12
8a	Mineral Manures and, in alternate years, Sulphate of Ammonia	1.1	0.57	—	0.43
8aa	As 8a, with Lime, Dec., 1897, repeated 1912	29.2	13.46	50.0	18.41
8b	Mineral Manures and Sulphate of Ammonia (omitted in alternate years)	3.7	1.81	—	0.85
8bb	As 8b, with Lime, Dec., 1897, repeated 1912	30.3	14.50	51.5	18.38
9a	Mineral Manures and, in alternate years, Nitrate of Soda	33.9	16.05	51.4	17.80
9b	Mineral Manures and Nitrate of Soda (omitted in alternate years)	36.0	17.23	52.0	20.68
10a	Superphosphate and Nitrate of Soda	21.1	10.11	51.1	10.16
10b	Rape Dust	5.4	2.75	—	4.46
11a	Sulphate of Potash and Nitrate of Soda	29.1	14.39	52.2	16.02
11b	Farmyard Manure	34.7	16.87	52.9	16.79

2. ROTATION EXPERIMENT.

THE UNEXHAUSTED MANURIAL VALUE OF CAKE AND CORN (STACKYARD FIELD).

Series C.

The small clover aftermath of 1928 was not fed off, but ploughed in with a tractor plough. This possibly explains the growth of veronica, chickweed and groundsel in the young wheat, and the thistles that came later. Hand-hoeing was effective, but the crop, as usual, was poor :—

Wheat (after Red Clover, 1928) Produce per acre.

Plot.	Head Corn.		Tail Corn. Weight.	Straw, Chaff, &c.
	Bushels.	Wt. per Bushel.		
		lb.	lb.	cwt.
1 (Corn)	19.6	59.3	19	13.5
2 (Cake)	17.0	59.2	16	12.0

WOBURN EXPERI DATES OF SOWING AND HARVE

Field.	Acres.	Crop and previous one.	Cultivation.	Manuring. cwt. per acre.	Date of Manuring.*
Lansome Piece	3	Sugar Beet after Grass	Ploughed March 12. Roll, cultivated and harrowed May 20, on 22 ins. ridges	Bedford refuse 10 tons per acre ..	May 22
	3	Early Potatoes, after Barley (Eclipse) ..	Stubble, tractor cultivated in autumn and ploughed. Ploughed, harrowed and cross cultivated March 26. Bouted up April 1-2, 27 ins. . .	3 Super., 2 S/Amm. 2 M/Pot. ..	Apr. 1
	1	Potatoes (own seed, Ally) ..		15 tons Bedford dung	Mar. 20
	3	Soiling crop after Potatoes, 3 bush. Rye, 1 bush. Vetches, 1 bush. Beans	Cross cultivated after Potatoes and drilled ..	2 tons Lime ..	Sept. 19
Great Hill	10½	Rye and Vetches (3:1) after Spring Oats. Barley after Rye and Vetches (Plumage Archer)	Stubble ploughed and harrowed. Ploughed April 11-20, harrowed and drilled	1 M/Amm. 2 tons Lime ..	Jan. 4 Feb. 24
				1 S/Amm., 2 Super. 1 M/Pot. ..	May 23
Road Piece	4	Grass after Barley	Harrowed	2 S/Amm., 2 Super. 1 M/Pot. ..	Apr. 11
	4	Forage after Grass	Ploughed, cross cultivated and harrowed. Drilled ..	—	—
	5	Kale: 3 acres after Mustard (eaten off by sheep). 2 acres after Forage ..	Ploughed, rolled, harrowed, and drilled ..	2 S/Amm., 3 Super.	July 8
	5	Rye: 3 acres after Mustard, 2 acres after Forage ..	Tractor ploughed, rolled, harrowed, drilled ..	—	—
Butt Close	7	Potatoes after Barley	Stubble cultivated Oct. 3. Twice ploughed and cultivated. Bouted 27 ins.	2 tons Lime, 2 S/Amm., 2 Super., 2 M/Pot., 12 tons Bedford dung ..	Jan. Apr. 29 Apr. 21
	1½	Sugar Beet after Barley	Stubble cultivated Oct. 3. Twice ploughed and cultivated. Bouted 27 ins. . .	2 S/Amm., 3 Super, 3 Kainit	May 23
Butt Furlong	8½	Barley after Sugar Beet and Potatoes	Beet tops ploughed in, Dec.	1 S/Amm., 2 Super., 1 M/Pot.	May 16
		Barley after Swedes	—	As above, with 12 tons dung	Jan.
Warren Field	4	Fallow	3 times ploughed, cultivated and harrowed ..	2 S/Amm., 3 Super.	July 30
Warren Field	10	Wheat after Fallow	Fallow ploughed, by steam tackle, and cultivated with horses. Twice horse cultivated and twice tractor cultivated and harrowed	1 S/Amm. 2 Super. 1 M/Pot.	May 14

* All 1929 except where otherwise stated.

CENTAL STATION ING, AND YIELD PER ACRE, 1929

Date and rate of sowing.*	Any further Cultivation.	Harvest.	Carted.	Thrashed.	Yield per acre.	Notes.
May 23 16 lb. per acre	Four horse hoeings Two hand hoeings	Oct. 22-31	Oct. 22-31	—	see p. 111	
Apr. 4-5 20 cwt. per acre ..	Chain harrow and horse hoe. Twice bouted up .. Ditto	July 15 .. Sept. 16 ..	— —	— —	35 cwt. 5 tons	
Sept. 26 .. 3 bush. per acre	—	—	—	—	—	
Sept. 28-29 (1928) 2½ bush. per acre	Thistles cut out ..	Aug. 17 ..	Aug. 27 ..	Nov. 17	13 cwt. ..	
April 21 3 bush. per acre	—	June 28 ..	July 9 ..	—	2 tons	
—	—	—	—	—	—	
July 6 ..	Horse hoed ..	—	—	—	Eaten off by sheep ..	Oats failed in forage crop, so half ploughed up, remainder eaten off by sheep
Sept. 26 ..	—	—	—	—	—	
May 1-6 ..	Potatoes twice harrowed & rebouted	Sept. 14-18	Sept. 16-18	—	see p. 108	
June 1 ..	Rolled, twice horse hoed, once hand hoed	Oct. 2 ..	Oct. 2 ..	—	3 tons ..	Drought prevented germination
Mar. 26 ..	—	Aug. 12 ..	Aug. 19-20	Nov. 18	see p. 106	Grass seeds sown but failed owing to drought
3 bush. per acre ..	—	—	—	—	—	
—	—	—	—	—	—	Forage crop sown at end of drought
Nov. 5-6 ..	Flat rolled. 1 acre killed by frost and ploughed up ..	Aug. 22 ..	Aug. 30 ..	Nov. 20	15 cwt.	

NOTE.—See p. 76 for particulars of permanent experiments on Stackyard and Lansome Fields.

These results show, in common with earlier reports, that the extra nitrogen on the cake-fed plot has no effect on the subsequent wheat crop.

Series D.

Swedes followed the 1928 wheat, and, in spite of drought, aphid attack, and damage from rabbits on Plot 2, gave a fair yield with no sign of "finger and toe." The yields were :—

Swedes (after Wheat, 1928) Produce per acre.

Plot.					Roots.	Tops.
					tons.	cwt.
1 (Corn)	..	..	..	..	7.25	17.5
2 (Cake)	..	..	..	..	4.10	12.5

The produce was divided equally over the area and fed off by sheep, which received also corn and cake as follows :—

Corn-Fed Plot: Barley and oats equivalent to 24.6lb. nitrogen per acre.

Cake-Fed Plot: Linseed and cotton cake equivalent to 56.5lb. nitrogen per acre.

The land was ploughed in February, 1930, in preparation for barley.

3. GREEN CROP AND GREEN-MANURING EXPERIMENTS.

(a) *Stackyard Field—Series A.*

Upper Half : Wheat after Green Crops fed off by sheep.

Following the tares and mustard crops of 1928, wheat was sown. As usual, it showed the initial superiority over the adjoining Permanent Wheat plots, followed in May by poor later growth and low yields :—

Wheat after Green Crops fed off : Produce per acre.

Plot.					Head Corn.		Tail Corn. Weight	Straw, Chaff, etc.
					Bushels.	Weight per Bushel.		
1, after Tares fed off	..	..			8.7	lb. 59.3	lb. 20	cwt. 8.3
2, as 1, Limed 1923	..	..			5.5	58.5	12	7.0
3, after Mustard fed off	..	..			8.0	58.7	12	7.4
4, as 3, Limed 1923	..	..			5.4	58.9	12	5.5
5, adjoining land (Potato plot)	..	..			8.0	58.8	—	6.3

These results are similar to those of previous years, and show also a further drop on the limed plots, Nos. 2 and 4. The possibility that lack of readily available nitrogen is responsible for the low yields is now under investigation in both field and laboratory.

Early and late applications of nitrate of soda, singly and together, were given to small plots on this area, and produced an increased growth of a better colour. This result is being closely followed up.

Lower Half : Green Crops fed off by sheep.

Twitch was prominent in the wheat stubble of 1928, and necessitated vigorous operations before mustard and tares were sown. In spite of the drought, a fair crop was obtained, which was fed off by sheep, receiving in addition 3cwt. per acre cotton cake. The land was then ploughed in preparation for wheat.

(b) *Lansome Field.*

Wheat : after Green Crops ploughed in.

Wheat was drilled after the mustard and tares were ploughed in. It came up well, grew vigorously, and gave very satisfactory results. This result is in marked contrast with the series of wheat failure on this field in previous years. The results were :—

Wheat after Green Crops ploughed in. Produce per acre.

Plot.				Head Corn.		Tail Corn.	Straw, Chaff, etc.
				Bushels.	Weight per Bushel.		
Old Plots.	1, after Mustard			28.5	53.3	64	22.9
	2, after Tares			38.5	54.1	78	29.8
New Plots.	3, after Mustard			25.0	53.0	21	20.0
	4, after Tares			30.6	57.8	32	29.6
	5, Control (no green-crop) ..			18.1	57.3	42	23.9

The table clearly shows the increased yield compared with the control, and—for almost the first time—the yield after tares exceeds that after mustard.

4. MANURING AND LIMING OF GRASS LAND.

Broad Mead.

Plot 1 (basic slag and once kainit) has now been included in an intensive grazing area. The remaining five plots were grazed by ewes and bullocks; the limed plot (4) was closely grazed, while the herbage on the farmyard manure plot (5) was coarse, with but little clover; it was very rough on the unmanured plot (3). The limed plot again showed abundant growth of daisy and contained much clover. Plot 2—basic slag and sulphate of potash—was fresh and green, while Plot 1—super. and sulphate of potash—was dried up.

5. REPLICATED EXPERIMENTS.

The results of the replicated experiments will be found on pp. 106-114.

DATES OF SOWING AND HARVESTING, PERMANENT EXPERIMENTS, 1929

Field.	Crop.	Variety.	Date of Sowing.	Date of Cutting.	Carting Dates.	Yield per acre.
Stackyard Field—						
Permanent Wheat..	Wheat	Million	Oct. 31 (1928)	August 20 ..	August 29-30	see p. 70
Permanent Barley..	Barley	Plumage Archer	March 21 ..	August 20 ..	August 24-26	see p. 71
Series A (a)	Green Crops	Tares	May 30 ..	Fed off August 1-3	..	—
		Mustard	May 30 ..	Fed off July 30-August 1	..	—
Series A (b)	Wheat	Million	Nov. 1 (1928)	August 28 ..	September 3	see p. 74
Series B	Spring Oats	Tartar	May 6 ..	August 14 for Hay	..	—
Series C	Wheat	Million	Nov. 1 (1928)	August 23 ..	September 3	see p. 71
Series D	Swedes	Garton's Magnificent	May 24 ..	Fed off between Dec. 12 and Feb. 1 (1930)	..	—
Lansome Field	Wheat	Million	Nov. 6 (1928)	August 13 ..	August 22 ..	see p. 75