ROTHAMSTED RESEARCH

Report for 1930

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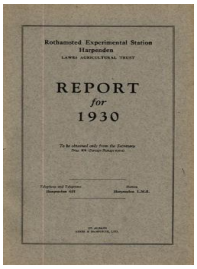

Potatoes

Rothamsted Research

Rothamsted Research (1931) *Potatoes ;* Report For 1930, pp 27 - 33 **- DOI: https://doi.org/10.23637/ERADOC-1-63**

Dr. Brenchley's observations show that the value of bare fallowing for weed eradication depends largely upon the species it is desired to eliminate. Some species, as Shepherd's Purse (*Capsella Bursapastoris*), which germinate and flower throughout the year, are not reduced by fallowing, because they grow and form seed so quickly that they re-stock the ground in the interval between autumn ploughing and the first spring cultivation. Others, as Poppy (*Papaver sp.*), have so long a period of natural dormancy, that they leave enough viable seeds in the soil to yield a big crop even after the fallowing. On the other hand, Black Bent (*Alopecurus agrestis*) and others with a short period of dormancy, are so reduced by fallowing that they can be kept within bounds; sufficient viable seeds are, however, left in the ground to recolonise the land rapidly unless adequate cultivation be given.

Fallowing also improves the physical condition of the soil. It had so marked an effect on the tilth that we were able in the first year of cropping to obtain a seed-bed with no more cultivation than harrowing. However this effect soon passed away, and in the second year the seed-bed was no more easy to obtain than usual; it was less fine than in the first year.

It is proposed in future to continue the separate harvestings and to continue the fallowing indefinitely but in a somewhat different way. In 1930-31 Strip 1 is being fallowed (the west end); in 1931-32 Strip 2 will be fallowed, and so throughout. In each year, therefore, one-fifth of the field will be under fallow and four-fifths under crop, of which one-fifth is in the first year after fallow, another in the second year, and the others in the third and fourth years respectively. This will give opportunities of studying the effects of fallowing and also of keeping the field clean.

POTATOES

The variety planted was again Ally. It yields less on our land than Kerr's Pink, which we grew from 1921 till 1926, but it matures earlier and fits in better with our programme of autumn work.

There were two sets of experiments, both in the same field and with the same variety; in one the maximum yield was 11 tons, in the other with equally efficient mixtures of artificial fertilisers, it was 7 tons only. The heavy yielding crop had had farmyard manure, the other had not. In general one would not have expected so marked a difference[1], but in 1930 the crop receiving farmyard manure continued growing well throughout the latter part of the season, while the crop without it weakened early and became smothered in weeds, mainly chickweed (*Stellaria media*); no fertiliser scheme helped much, although no fewer than 13 were tried; the yield without nitrogen, like that without potash, was 4 tons per acre; this was raised to 7 by the heaviest dressings of artificials. The number of plants per acre averaged 14,760. In the other set the crop gave a yield of 7.5 tons from farmyard manure without any artificials. One cwt. sulphate of ammonia gave an additional 30 cwt. of potatoes as also did 1.6 cwt. sulphate of potash so long as sufficient superphosphate was given, otherwise the increase was only 24 cwt. Superphosphate (3 cwt. per acre)

1 See Report for1923-24, pp. 120, 121, for and 1921-22, p. 98

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gave the very satisfactory increase of 36 cwt. of potatoes per acre so long as there was sufficient nitrogen and potash ; with insufficient quantities the increase was only 11 cwt. The results are as follows :

Average yield in tons per acre.

Sulphate of Ammonia, cwt. per acre.		Without Phosphate. 0	1	2	With Phosphate. 0	1	2
Sulphate of Potash, or equivalent cwt. per acre	0	7.55	8.12	8.78	7.89	8.32	9.75
	1	7.64	9.29	9.00	8.30	9.84	10.16
	2	8.01	9.53	9.22	8.85	10.25	11.00
		Mean 8.57 tons.			Mean 9.37 tons.		

General mean — 8.97 tons. Standard error for above table —0.215 tons or 2.40 per cent.
Mean number of plants per acre, 14,341.
All plots received farmyard manure.

As betweeen the various potassic fertilisers sulphate of potash, muriate of potash and potash manure salts all gave approximately equal yields when used with a complete fertiliser. When, however, superphosphate was omitted the muriate and the manure salts were less effective than the sulphate suggesting that the potato needs sulphate as well as nitrogen, potassium, and phosphorus ; a result also obtained at Woburn (p. 152).

The maximum yield was 11 tons per acre ; it is remarkable how often this figure has been attained as the highest on our farm. The number of plants per acre was about 14,500.

No quality determinations were made this year, but chemical analyses were made of the tubers of the heavier crop. The percentage of dry matter in the tubers was about 23 ; it was not affected by nitrogenous, or phosphatic manuring, or by sulphate of potash ; it was, however, lowered by chlorides ; thus potash manure salts in the larger dressing lowered it from 23.3 per cent to 22.1 per cent. The nitrogen content of the tubers was about 0.3 per cent ; it was raised by nitrogenous but lowered by phosphatic and potassic manuring, and by the chlorides ; it was, however, least affected by sulphate of potash. The figures are given in Table III.

TABLE III.—Composition of Potatoes as influenced by Manuring.
Potatoes, Long Hoos, 1930.
Percentage of Dry Matter.

		No Superphosphate given. No S/Amm.	Single S/Amm.	Double S/Amm.	Superphosphate given. No S/Amm.	Single S/Amm.	Double S/Amm.
	No Potash	22.94	23.37	22.94	22.83	23.14	23.54
Single Potash	Sulphate	23.25	22.66	23.87	23.26	22.95	22.97
	Muriate	22.95	23.25	22.98	23.32	23.04	22.56
	Potash Salts	22.82	22.72	23.22	22.35	23.15	22.59
Double Potash	Sulphate	23.39	23.56	23.28	22.61	23.68	23.47
	Muriate	22.29	22.94	22.51	22.42	23.03	22.81
	Potash Salts	22.43	21.99	22.05	22.32	21.99	21.73
Mean		22.87	22.93	22.98	22.73	23.00	22.81
General Mean		22.92			22.85		

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Potatoes, Long Hoos, 1930.

Percentage of Nitrogen.

		No Superphosphate given			Superphosphate given		
		No S/Amm.	Single S/Amm.	Double S/Amm.	No S/Amm.	Single S/Amm.	Double S/Amm.
	No Potash	.320	.342	.354	.298	.320	.342
Single Potash	Sulphate	.313	.331	.350	.297	.318	.288
	Muriate	.318	.317	.335	.293	.298	.333
	Potash Salts	.321	.327	.359	.295	.322	.322
Double Potash	Sulphate	.316	.334	.358	.330	.324	.338
	Muriate	.286	.331	.322	.286	.311	.323
	Potash Salts	.294	.310	.334	.295	.292	.318
	Mean	.310	.327	.345	.299	.312	.323
General Mean			.327			.312	
In dry matter— Means		1.316	1.426	1.501	1.315	1.357	1.416
General Mean			1.427			1.365	

Summary of Potassic Manures : Mean of all.

Amount of K_2O cwt. per acre.	Dry matter : per cent. in tubers.	Nitrogen per cent. in fresh tubers.	Nitrogen per cent. in dry matter.
None	23.1	0.329	1.42
0.4	23.0	0.319	1.38
0.8	22.7	0.317	1.39
Standard error	0.10	0.0028	

Effect of Different Salts.

	Dry matter per cent. in tubers.		Nitrogen per cent. in fresh tubers.		Nitrogen per cent. in dry matter.	
Amount of K_2O cwt. per acre	0.4	0.8	0.4	0.8	0.4	0.8
As Sulphate	23.2	23.3	0.316	0.334	1.36	1.43
As Muriate	23.0	22.7	0.316	0.310	1.37	1.36
As 30 per cent. P.M.S.	22.8	22.1	0.324	0.307	1.47	1.39
Standard errors	0.17		0.0049			

The potatoes at Woburn (also Ally) yielded even better than at Rothamsted giving up to 13 tons per acre. The most marked effects were from nitrogenous manuring ; phosphatic and potassic fertilisers had less effect, contrary to expectation on this light soil. In another experiment cyanamide and sulphate of ammonia were found equally effective, as also were superphosphate and basic slag, compared on the basis of equal amounts of nitrogen and of phosphoric acid respectively. Another experiment indicated, like the one at Rothamsted, that a certain amount of sulphate, in the forms of sulphates of magnesium, potassium and calcium, had been beneficial ; larger amounts, however, were not (p. 152).

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In our Rothamsted and Woburn experiments we have commonly obtained very satisfactory yields from the following mixture of fertilisers :

10 tons farmyard manure ploughed under in autumn or winter.
3 or 4 cwt. sulphate of ammonia.
3 or 4 cwt. sulphate of potash.
4 cwt. super. (17 per cent P_2O_5)

applied in the drills at the time of setting the seed ; the 3, 3, 4 mixture correspond to the proportions 1N : $2.5K_2O$: $1P_2O_5$. Where muriate of potash or potash manure salts are used instead of the sulphate the amount of chlorine (Cl) should not be more than double the nitrogen (N).

Experiments were also made at other centres in various parts of England. The most striking result has been the marked benefit from superphosphate, the average increase at the seven responsive centres per cwt. of 36 per cent super. (17 per cent P_2O_5) having been 12 cwt. per acre ; the same figure as is obtained at Rothamsted. The actual increase varied ; at one of the centres the response was only 3 cwt., at another it was 24 cwt. ; at three centres there was no response. The average increases for the past three seasons per cwt. of 36 per cent superphosphate (17 per cent P_2O_5) are given in Table IV.

TABLE IV.—Increases in Yield of Potatoes per cwt. of 36 per cent. super.

	1928 cwt.	1929 cwt.	1930 cwt.
Wisbech	2	6	10*
Stowbridge	19	—	—
Woburn	9	–2	—
Rothamsted	6	6	12
Owmby Cliff	–14	Nil	8
Bangor	–2	–4	—
Midland Agric. College ..	—	–2	10
Haverfordwest	—	—	13
Nateby	—	—	3
Welshpool	—	—	24

* British Queen : King Edward gave no increase.
Details are given on p. 00.

The result at Owmby Cliff is especially interesting because it was here that super. had apparently depressed the yield in 1928, a result similar to that at Kirton. In 1929 it had no effect, and in 1930 it has increased the yield. However the depression may have been caused, it is obviously only an exceptional occurrence and we are not yet prepared to account for it.

A number of experiments have now been made to ascertain how heavily a crop can advantageously be fertilised with superphosphate. In general the effect depends on the level of nitrogen and of potash given, and the broad results are (1) that these two fertilisers can act well only when the crops are sufficiently well supplied with phosphate ; and (2) that superphosphate is effective even in large dressings where the level of crop production varies from 9 to 14 tons per acre—the usual case in good potato districts —but it had little action where the yields without it, or with only a small dressing, were below 8 tons or above 14 tons per acre :

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Yield of potatoes when only one dose of super-phosphate was given.	No. of experiments.	Average yield, tons per acre. No Super.	Super. given. Single dose.	Double dose.	Quadruple dose.
Below 8 tons ..	4	6.92	6.54	6.66	6.65
9–14 tons	8	9.97	11.19	11.40	11.77
Above 14 tons	5	15.37	15.39	15.80	15.80

The details are given in Table V the " dose " is usually 2 cwt. 36 per cent. super. per acre.

TABLE V.—Effect of Superphosphate on Yield of Potatoes : Tons per acre.

Year	Centre.	Soil.	No Super.	Single dose[1]	Double dose.	Quadruple dose.
1927	Woburn[3]	Light sand	4.06	4.10	3.96	4.08
1928	Woburn[3]	,,	12.25	13.43	14.00	14.69
1928	Stowbridge, Norfolk ..	Black fen	8.10	10.05	10.97	12.57
1928	Owmby Cliff, Lincs. ..	Oolitic limestone	8.18	6.79	7.73	7.25
1929	Owmby Cliff ..	,, ,,	7.42	7.44	7.34	7.30
1928	Bangor	Light gravelly loam	15.78	15.62	16.12	16.03
1929	Bangor		14.66	14.25	14.53	14.66
1929	Midland Agric. Coll...	Light loam	8.00	7.82	7.63	7.97
1928	Wisbech[4]	Deep silt	16.98	17.32	17.55	17.75
1929	Wisbech[2]	,, ,,	11.67	12.48	12.82	13.11
1930	Owmby Cliff ..		11.37	12.19	11.85	12.34
1930	Midland Agric. Coll. ..		10.03	10.98	9.05	9.70
1930	Wisbech[4]		13.18	14.14	14.42	14.62
1930	Wisbech[2]		16.27	15.60	16.39	15.93
1930	Haverfordwest ..	Hungry sand	7.94	9.21	9.68	9.96
1930	Nateby (Lancs.) ..	Moss soil in deep peat	9.24	9.54	9.50	9.44
1930	Welshpool	County School garden	9.18	11.64	13.29	12.36
1930	Bourne[5]	Light black fen	10.22	—	12.07	12.18

[1] Single dose usually 2 cwt. superphosphate per acre.
[2] King Edward. Single dose 2½ cwt.
[3] Single, double and treble doses, unit 3 cwt. in this case.
[4] British Queen. Single dose 2½ cwt.
[5] Single dose 2½ cwt.

Both at Bourne and at Wisbech 5 cwt. of super. gave profitable returns : 1.85 tons of potatoes at the former, and 1.24 at the latter centre ; at Wisbech, however, the response was confined to British Queen and there was no gain with King Edward. These differences in behaviour of different varieties are now being studied.

At Bourne the first 2 cwt. of sulphate of potash increased the yield of potatoes by 1 ton per acre, and the second 2 cwt. gave a further increase of 16 cwt. per acre, both profitable.

Perhaps the most dramatic result at the outside centres is that obtained at Tunstall by Mr. A. W. Oldershaw on a light sandy soil in Suffolk, reckoned as hopelessly bad, which yet when chalked and given a dressing of 3½ cwt. superphosphate and 4 cwt. nitrate of soda per acre, yielded over 13 tons of potatoes per acre.

Finally, in experiments on light land at Biggleswade and at Burford, and on heavy land at Hull, we this year compared inor-

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TABLE VI.—Comparison of Artificial Manures with Organic Manures.
Outside Centres, 1930.
Potatoes, tons per acre.

Locality.	Soil.	Sulphate of Ammonia. Super.	Dried Blood. Steamed bone flour.	Sulphate of Ammonia. Steamed bone flour.	Dried Blood. Super.	Standard error.	Significant results.
Sailors' Orphan Home Hull	Heavy alluvium	11.69	9.01	9.86	10.88	0.425	Super. better than bone flour. Sulphate of Ammonia better than blood.
Grammar School, Burford.	Light loam on limestone	9.05	8.82	9.03	9.91	0.554	No difference.
Mr. H. Inskip, Stanford, Beds.	Light sand	5.52	5.06	5.31	5.28	0.127	No difference. No significant effect was produced by potassic fertilisers. With potash 5.44 Without potash 5.14 Standard error—0.124
Ditto.	Heavy clay	15.03	14.50	14.55	14.84	0.311	No difference.
Mr. H. Inskip, Stanford, Beds.	Heavy clay	16.09	Fish Meal. 16.11			0.346	No difference.

All plots had potassic fertiliser unless otherwise stated.

The comparison between artificial and organic nutrients was on the basis of equal amounts of nitrogen and equal amounts of phosphoric acid per acre.

No farmyard manure was given.

ganic with organic manuring for potatoes, testing dried blood against sulphate of ammonia and steamed bone flour against superphosphate. On the light land there was no difference in effect, on the heavy soil the organic fertilisers were distinctly inferior, super. giving 1.85 tons more than steamed bone flour, and sulphate of ammonia 0.83 tons more than blood on yields of about 10 tons (Table VI). The organic fertilisers certainly require little knowledge for handling, and they are convenient for garden use, but we have no evidence that they ever act better than, or even as well as, the artificial fertilisers.

The effect of the bulky organic manures, farmyard manure and rotted straw, is shown on pp. 130-1.

SUGAR BEET

The variety grown was again Kuhn (Johnson's Perfection). The average yield of washed roots was the same as last year; the percentage of sugar was slightly higher while the yield of tops was considerably higher. It was a good growing season and the leaves did well but the roots could not keep pace. The results bring out strikingly the variation in efficiency of the tops from season to season, and their low efficiency as compared with that of the mangold. The results of recent years have been :

	Sugar Beet. (*washed*)			*Mangolds.*[1] (*scraped*)		
Year.	Yield of tops in tons per acre.	Yield of roots in tons per acre.	1 part of top makes of root	Yield of tops in tons per acre.	Yield of roots in tons per acre.	1 part of top makes of root
1926	25.23	12.10*a*	0.48	6.05	22.43	6.25
1927	10.82	3.38	0.31	3.89	13.42	3.45
1928	11.43	9.15	0.80	5.01	29.22	5.83
1929	5.41	7.43	1.37	3.94	20.67	5.25
1930	9.15	7.44	0.81	6.23	26.78	4.30
Mean	12.41	7.85	0.75	5.02	22.50	5.02

(*a*) The figures given in the 1926 Report on p. 142 are for unwashed beet.
[1] Barnfield, Plot 4 A.C.

The yields of tops vary a good deal according to season and manuring, but the yields of roots vary much less.[1] The root is able to keep pace with the top up to a certain stage, but then it can do no more, no matter how much the top grows. Mangold roots, on the other hand, can continue growth much further and so keep pace with the better leaf growth of good seasons. This restriction or congestion of the root of the sugar beet may result from its constitution; its sap is so highly concentrated that new soluble material from the leaf may not readily enter so that the process of translocation from leaf to root may be considerably retarded. Increased concentration of the leaf sap might improve matters; this may explain the special value of salt as a fertiliser.

The manurial results show that the leaves behave normally giving their full increase with fertilisers, but the roots do not. Thus in Rotation II the yields for varying dressings of nitrogen were :

1 Excluding 1927 ,where the failure was due to very late sowing.

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