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Sugar Beet

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The 1929 experiment was on a more elaborate scale than in 1927, and brought out a curious result: the superphosphate increased the crop so long as no nitrogen was given, but it apparently decreased the crop in presence of nitrogen and potash. At the outside centres the effects of superphosphate have varied, again mainly as the result of soil variations. There was a gain at Wisbech of 6.6 cwt. potatoes per cwt. of superphosphate used as compared with 4 cwt. potatoes per cwt. of super. at Rothamsted, but no gains at Bangor, Sutton Bonington or Owmbly Cliff.

The work this year has been extended to include a full examination of the influence of manuring on the cooking and keeping qualities of the crop. Nearly four hundred samples were examined by Dr. Lampitt, of Messrs. Lyons' laboratories, and the very extensive data are being worked up. Certain results are already emerging: chipped potatoes were not affected in any uniform or definite way either in colour, flavour or consistency, but boiled potatoes were improved by potassic fertilisers in colour both "outside" and "mashed." Muriate of potash gave the best results, sulphate came second, and potash manure salts third: at times, indeed, the latter was somewhat harmful. For flavour the potassic fertilisers came out in the same order, but only the best of the samples were equal to those grown without potash, and the others were inferior.

Number of Plants per acre. The potatoes are planted 15 inches apart in rows which are 27 inches apart. The total possible number of plants per acre is 15,490. Actually the numbers found per acre in 1929 at Rothamsted were:—

Number found per acre, no artificials	...	14,480
" " " complete artificials..	...	14,870
Average of all plots	...	14,593
Total possible	...	15,490

There is thus very little variation in number on the plots, though the numbers were all less than was expected. At Woburn, the numbers were smaller owing to depredations of pheasants.

SUGAR BEET.

The sugar beet experiments again emphasised the need for new varieties better suited to English conditions than those now grown. With no scheme of manuring is it possible to obtain the impressive yield increases given by mangolds or potatoes; the leaves respond but the roots do not, and it is not yet possible to control the leaves so as to make them send more material into the root. One ton of leaf may give from a few hundredweights up to about 3 tons of root, but rarely more, and the factors determining this are not in our control. Certain consistent features stand out. Nothing is gained by the large dressings of farmyard manure or of artificials sometimes given on the Continent,* the fertiliser must

* As an example: The Bernburg investigators find that the best manuring for sugar beet gives 400 dz. per hectare or 16 tons per acre. This manuring is:—

	Kgm per ha.	lb. per acre	Fertiliser per acre
N	160	143	9 cwt. nitrate of soda
P ₂ O ₅ ..	60	54	3 cwt. superphosphate
K ₂ O ..	180	160	320 lb. sulphate of potash

in general be complete; potash and nitrogen are closely linked and each acts best in the presence of the other. The nitrogen should go on early. Potash manure salts are more effective than the sulphate or the muriate, and salt has a special value additional to that of potash. But when it comes to detailed recommendations the position is more difficult, as fertilisers behave differently towards different varieties.

Thus, in 1929 at Rothamsted, Kuhn on the whole did better than Kleinwanzleben, but it responded rather differently to fertilisers: it did better with sulphate of ammonia (along with salt, super. and muriate of potash) than with nitrate of soda, while Kleinwanzleben did better with nitrate of soda than with sulphate of ammonia. Cyanamide has given more promising results at the western than at the eastern centre.

The nitrogenous manures tend to depress the sugar content, but not by much, and so long as the dressings are not too high the loss is more than offset by the gain in yield. Salt and potash manure salts both slightly increase the sugar content. So long as additional fertiliser increases the yield of roots it does not, in our experience, have much effect on the sugar content, and our advice to farmers is to aim at yield and not worry about sugar. When, however, too much nitrogen is given, the excess that does not increase the yield lowers the sugar content. Apart from this, season has more to do with sugar content than manuring.

Owing to the high value of the tops as stock food, they have to be taken into account in assessing the value of fertilisers. 1 cwt. nitrate of soda or sulphate of ammonia has not infrequently given us an extra ton of tops which, as food for sheep, would have not much less value than a ton of turnips and for cattle more value than a ton of mangolds.* They must however be kept free from dirt and should therefore be raked up in heaps before carting of roots begins, so as to avoid damage by the carts.

Our experiments are not yet sufficiently advanced to indicate definite fertiliser recipes, and in view of the fact that some varieties respond better than others to manuring, we are always hoping that new varieties will be discovered that will respond still better and will therefore pay for more intensive manuring. For the present we suggest as a basis for trial: 10 tons farmyard manure ploughed under in autumn, $1\frac{1}{2}$ cwt. sulphate of ammonia or nitrate of soda, $2\frac{1}{2}$ cwt. superphosphate, 2 cwt. potash manure salt, and 1 cwt. salt per acre applied at or before the time of seeding. It is almost certain the mixture would need modification in different regions of different soil and climatic conditions: for example, where the soil is known to be rich the whole dressing could be reduced and the mixture given at the rate of 4 or 5 cwt. only per acre instead of the 7 cwt. here suggested.

The effect of fertilisers on the yield of roots in 1929 is shown in the following summary of the Rothamsted results in tons per acre:—

* The Cambridge workers put five tons of tops as equal to eight tons of mangolds.

		NO NITROGEN		SULPHATE OF AMMONIA		NITRATE OF SODA	
		No Phosphate	Phosphate	No Phosphate	Phosphate	No Phosphate	Phosphate
No Potash	Klein	6.42	6.78	7.14	7.41	7.18	6.97
Muriate of Potash	Klein	6.83	6.44	7.19	7.31	7.34	7.78
No Potash	Kuhn	7.16	7.90	7.80	7.85	7.76	8.58
Muriate of Potash	Kuhn	7.00	7.04	7.50	8.84	8.08	8.10
Standard Error = 0.193							

The complete fertiliser gave the best results and its action was improved by a dressing of salt:—

	Roots	Tops	Sugar %
No Salt	7.33	5.24	18.33
Salt	7.54	5.58	18.40
Standard Error	0.055	0.033	0.02

It is very easy to go wrong about the manuring of sugar beet. Taking all our experiments together, there have been many occasions when manuring did not pay, when indeed it depressed the sugar content and sometimes even the yield. The numbers of gains and losses have been:—

Manures.	Weight of Roots.			Weight of Tops.			Sugar per cent.			No. of times when financial result was:		
	Increase.	Decrease.	No Change.	Increase.	Decrease.	No Change.	Increase.	Decrease.	No Change.	Gain.	Loss.	No Change.
Nitrogenous *	26	6	0	25	0	0	3	19	1	20	12	0
Potassic ..	17	8	1	15	10	1	10	6	10	13	13	0
Potash Manure												
Salts ..	6	1	0	5	1	1	4	2	1	5	2	0
Phosphatic ..	7	6	1	7	7	0	6	4	4	6	8	0

* Up to 3 cwt. per acre but not more.

Using reasonably good fertiliser mixtures the gains per cwt. of fertiliser have been:—

	Sulphate of Ammonia or Nitrate of Soda.	Potash Manure Salts.	Salt.	Super-phosphate.
Roots, cwt.	6-9	3-9	3-5	2
Tops, cwt.	12-17	Nil.	4-10	2
Sugar, per cent. ..	—0.15	+0.10	+0.05	Nil.
Cash Increase ..	7/- to 18/-	10/- to 18/-	8/- to 14/-	Nil.

These figures show the need for improving our varieties and methods.

The care of the plant is more important than the manuring: proper seeding on a good seed-bed and proper care at singling are absolutely essential. There should not be much loss of plant: in 1929 we obtained about 85-90% of what was expected from the setting out, though in 1928 we had obtained only 70%. The figures are:—

Spacing as set out	<i>Rothamsted.</i>		<i>Woburn.</i>	
	1928 24-inch rows. 10-inch singling.	1929 22-inch rows. 8-inch singling.	1929 I 22-inch rows. 8-9-inch singling.	1929 II 22-inch rows. 8-9-inch singling.
No. of plants expected ..	26,000	36,000	35,000	35,000
No. harvested ..	17,715	30,350	31,800	32,700
Plants obtained as percentage of what was expected ..	68%	83%	88%	94%
Yield tons per acre average ..	9.15	7.43	8.07	8.23
Average weight per root (lb.) ..	1.16	0.55	0.57	0.56

MANGOLDS.

The Barnfield mangold experiments bring out clearly the harmful effects of failure to balance nitrogenous manure with potash. So long as the complete fertiliser is given the plant grows well and responds to heavy dressings of manure: when potash is omitted, however, the leaves lose efficiency, they make much less root and tend to become diseased, and the whole plant is weakened so that the mortality is considerable. The plants are grown in rows 26½ inches apart: there are on the completely manured plots some 30,000 to 34,000 per acre. But where high nitrogen manuring is not balanced by potash the number of plants is much less and the roots are smaller.

This is shown in the following table:—

Barnfield Mangolds, 1924-29.

No. of plants and yield per acre *Roots* and *Leaves*.

Year	Heavy Nitrogenous Manuring with Potash (Plot 4 A.C.)			Heavy Nitrogenous Manuring without Potash (Plot 5 A.C.)		
	No. of Plants	Roots Yield per acre tons	Leaves Yield per acre tons	No. of Plants	Roots Yield per acre tons	Leaves Yield per acre tons
1924 ..	3328	34.16	5.62	2573	15.81	4.83
1925 ..	3201	22.43	6.05	2356	6.30	4.51
1926 ..	3035	25.77	4.12	1996	8.29	2.25
1927* ..	3423	13.42	3.89	3263	12.79	3.59
1928 ..	2978	29.22	5.01	2225	9.55	2.83
1929 ..	3075	20.67	3.94	1741	4.71	2.09

* Swedes.

BARLEY.

In 1929 comparisons were made between sulphate of ammonia, muriate of ammonia, cyanamide and nitrate of soda. Of these, nitrate of soda gave the largest increase, possibly as the result of the dry conditions; the others, however, came out practically alike. One cwt. of sulphate of ammonia gave its usual return of 6 bushels of barley, a second cwt. gave an additional 4 bushels. It has been our usual experience that cyanamide does as well as sulphate of ammonia. This year, in common with muriate of ammonia, it