

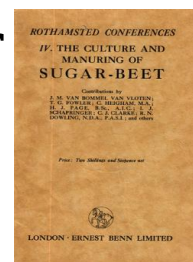
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The Culture and Manuring of Sugar-beet

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If full advantage could be taken of the crop, and the area under it extended over suitable land, it should do more to put the farming industry on a sound basis than any other crop we have to select from.

EXPERIENCE WITH SUGAR-BEET IN THE MIDLAND COUNTIES

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IN 1924, when the Notts. Education Committee decided to draw up and carry out a scheme of manurial experiments on the sugar-beet crop along certain definite lines, it was understood that numerous experiments and field trials had been carried out in various parts of the country, which had, in a general way, demonstrated the value of manurial dressings. It was felt, however, that more evidence was required as to the economic returns obtained under varying classes of soil, bearing in mind its natural or acquired fertility, previous cropping and manurial treatment, and climatic conditions prevailing over a series of years. I should like to mention the fact that Mr N. Howard assisted in carrying out the whole of the work.

It was decided to arrange the experiments so that each series would aim to answer one definite question, such being in each case—

Series 1. The effect of nitrogenous top dressings.

Series 2. The effect of potash.

Series 3. The maximum profitable manuring.

The first two series have been running for three years, and Series 3 for two years, each being tried on two or three farms each year.

Although, as with all experiments on the manuring of sugar-beet, the results over the whole period would appear at first glance to be somewhat contradictory, as a matter of fact definite information has been obtained which will be of practical value. All the plots were duplicated to ensure reliability and to prevent errors due to any abnormal conditions.

Climatic Conditions.—Knowing the enormous influence of varying climatic conditions it was considered advisable to keep careful records of rainfall and temperature from seed-time to harvest.

Series 1—Nitrogenous :

Objects : To test the effect of a complete dressing of artificials
(a) without a top dressing of nitrogen ; (b) with one top dressing of nitrogen ; (c) with two top dressings of nitrogen.

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Scheme of manuring per acre :

Plot 1. Control (No Manure).

Plot 2. Complete Dressing $\left\{ \begin{array}{l} 1 \text{ cwt. sulphate of ammonia.} \\ 4 \text{ cwt. 30 per cent. superphosphate.} \\ 1\frac{1}{2} \text{ cwt. muriate of potash.} \end{array} \right.$

Plot 3. As Plot 2, plus 1 cwt. nitrate of soda at singling time.

Plot 4. As Plot 3, plus a second top dressing of 1 cwt. nitrate of soda two or three weeks later.

1925 *Trials*.—Three centres were selected in the neighbourhood of Newark, the nature of the soil in each case being—

Centre 1. Light sand with gravel.

Centre 2. Good sandy loam in good "heart."

Centre 3. Light loam with gravel.

No farmyard manure was applied directly to the sugar-beet crops. At Centre 1 the adverse effect of drought was most pronounced.

TABLE I

SHOWING YIELD OF WASHED AND TOPPED BEET PER ACRE

Centre	Plot 1 Control		Plot 2 Complete Dressing		Plot 3 Complete, + one Top Dressing of Nitrate of Soda		Plot 4 Complete, + two Top Dressings of Nitrate of Soda	
	tons	cwt.	tons	cwt.	tons	cwt.	tons	cwt.
1	4	11	5	6	5	12	6	4
2	10	15	10	19	11	19	12	4
3	6	6	7	10	7	12	7	11

It will be seen that the application of one top dressing at singling gave very little increase of crop over the Complete Mixture Plot at Centres 1 and 3, whereas at Centre 2 there was an increase of one ton per acre, which gave a money return over the Control Plot of £1, 7s. 9d. per acre.

The second top dressing which was applied three weeks later gave a profitable increase at Centres 1 and 2, but a loss at Centre 3.

Nitrogenous Series, 1926.—This season was very favourable to the beet crop, and the effects of dressings of artificial manures were much more pronounced than in 1925. The judicious application of manures proved most beneficial, and 10 to 12 tons of washed and topped beets per acre were obtained on sand soil. Both centres were on the lighter types of soils and at neither was farmyard manure applied direct to the crop.

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TABLE II
NITROGENOUS SERIES

Centre	Plot	Yield per Acre Washed and Topped Beets		Per cent. Sugar	Duplicate Plots		
		tons	cwt.		Yield per Acre Washed and Topped Beets	Per cent. Sugar	tons
Ranby . . .	1	9	5	19.3	9	0	19.5
	2	10	7	20.0	9	0	20.0
	3	11	13	20.1	10	15	20.0
	4	12	13	20.2	12	16	20.2
Warsop . . .	1	9	6	19.1	9	6	19.1
	2	11	7	19.7	12	9	19.3
	3	9	3	18.3	11	15	19.2
	4	10	2	19.2	11	2	19.4

This Table shows the results obtained from the duplicate plots at both centres. A bare comparison of the figures from the two centres appears at first somewhat confusing, but when they are considered in conjunction with the previous cropping and manuring, definite conclusions may be drawn.

At Ranby no very pronounced increase was obtained by the application of a complete dressing (compare Plots 1 and 2), but the net returns over the No Manure Plots were very substantially increased when the top dressing was applied in addition to a complete dressing, and still further increased when a second top dressing was given.

Plots	Average Yield Washed Beets per Acre		Value at 54s. per ton + 2s. 6d. per unit of Sugar over 15.5 per cent.		
	tons	cwt.	£	s.	d.
No. 4. Complete, + two Top Dressings .	12	14	41	16	9
No. 1. No Manure . .	9	2	29	1	8
Increase due to Manures .	3	12	12	15	1
Less Cost of Manures			3	11	0
			£9	4	1

Thus for an expenditure of £3, 11s. on manures there was a net gain of £9, 4s. 1d. per acre.

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The same series at Warsop gave very different results. The application of a complete dressing, costing £2, 1s. per acre, gave an average increase of 2 tons 12 cwt. of washed beet per acre, worth £9, 1s. 7d., leaving a net increase of £7, 0s. 7d. due to the dressing. When, however, the top dressings were added, this substantial gain was lost owing to the increased cost of manures and a lower yield. At the Warsop Centre the land was heavily dressed with farmyard manure during the two previous years, and it is probable that the additional nitrogenous top dressings supplied an excess of nitrogen, which resulted in a too-luxurious growth of leaves, and a resulting lower yield owing to late ripening and the non-transference of food materials (with sugar) from the leaves to the root. In contrast with this, the Ranby Centre had received very little farmyard manure during previous years, and the same quantities of nitrogenous top dressings produced very profitable increases in crop.

Series 2—Potash:

These experiments were carried out in 1925 at the same centres alongside the nitrogenous plots and under similar conditions.

Scheme of Manuring per acre:

Plot 1. Control (No Manure).

Plot 2. Complete Dressing { 1 cwt. sulphate of ammonia.
4 cwt. 30 per cent. superphosphate.
1½ cwt. muriate of potash.

Plot 3. As Plot 2, less the potash.

Plot 4. As Plot 2, plus an extra 1½ cwt. muriate of potash.

TABLE III

SHOWING YIELD OF WASHED AND TOPPED BEET PER ACRE

Centre	Plot 1	Plot 2	Plot 3	Plot 4
	tons cwt. qrs.	tons cwt. qrs.	tons cwt. qrs.	tons cwt. qrs.
1	4 12 3	5 8 3	4 15 0	6 1 1
2	10 15 0	10 19 2	10 12 0	11 10 3
3	6 6 2	7 13 0	6 2 0	7 4 2

A comparison of Plots 1, 2 and 3 shows the effect of a Complete Manure (Plot 2) over the Control (Plot 1); also over the No Potash (Plot 3). Practically no effect is produced by adding phosphate and nitrogen alone, but when potash is included a distinct increase is brought about at each centre. When the potash is doubled (Plot 4) an increase is shown at two of the centres, one of which is notably short of potash.

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1926 *Trials*.—These experiments were carried out at the same centres alongside the Nitrogenous Series and under similar conditions of soil and previous treatment.

TABLE IV
POTASH SERIES

Centre	Plot	Yield per Acre Washed and Topped Beet		Per cent. Sugar	Duplicate Plots		Per cent. Sugar
		tons	cwt.		Yield per Acre Washed and Topped Beet	Per cent. Sugar	
Ranby . . .	1	9	8	19.8	9	10	19.1
	2	8	15	19.6	8	19	19.6
	3	10	16	19.8	9	12	20.8
	4	9	17	19.9	9	2	20.6
Warsop . . .	1	9	1	18.7	9	3	18.5
	2	10	16	19.1	11	6	19.0
	3	10	4	18.8	8	4	18.8
	4	12	15	19.7	11	7	18.5

Again, the two centres produced different results from similar manuring, and reference to the previous treatment of the land will show that at Ranby where substantial dressings of potash had been applied during the two previous years no benefit was obtained by a dressing of potash to the crop, and a comparison of yields with those obtained on the top-dressed plots in Series I on the same field will show that nitrogen was more urgently needed at this centre.

At Warsop the highest average net return was obtained on Plot 4—*i.e.*, that receiving a double dressing of potash—and reference to the Nitrogenous Series at the same centre shows that a definite increase was obtained by the introduction of potash in the complete mixture (Plot 2, Series I), but the yield could not be further raised until the potash was increased as shown in Plot 4—Potash Series, as shown by the following Table :

	Duplicate Plots	Average Yield Washed Beet per Acre	
		Tons	Cwt.
Potash Series 1.	No manure	9	3
Potash Series 3.	Super and nitrogen	9	4
Potash Series 2.	Potash, super and nitrogen	11	4
Potash Series 4.	Potash, super and nitrogen plus extra potash	12	1

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Series 3—Maximum Profitable Manuring:

This series was carried out at three centres in 1925 and at the Warsop Centre in 1926 (soil and previous treatment as before).

Objects: To ascertain the maximum dressing of fertilizers which may be economically used.

Scheme of Manuring per acre:

Plot 1. Control (No Manure).

Plot 2. Complete Dressing $\left\{ \begin{array}{l} 1 \text{ cwt. sulphate of ammonia.} \\ 1\frac{1}{2} \text{ cwt. muriate of potash.} \\ 4 \text{ cwt. 30 per cent. superphosphate.} \end{array} \right.$

Plot 3. As Plot 2 plus 1 cwt. sulphate of ammonia and $1\frac{1}{2}$ cwt. muriate of potash.

Plot 4. As Plot 2, plus 2 cwt. sulphate of ammonia and 3 cwt. muriate of potash.

Plot	Yield Washed Beet per Acre		Per cent. Sugar	Duplicate Plots			
	tons	cwt.		Yield Washed Beet per Acre		Per cent. Sugar	
1	9	1	18.7	9	3	18.5	
2	10	16	19.1	11	6	19.0	
3	12	19	19.0	14	4	18.7	
4	12	6	18.0	10	19	19.7	

Plot 3 has given the highest yield in both cases and it appears from this and from previous years' results that dressings greater than that given to Plot 3 actually have a depressing effect on yield.

CONCLUSIONS

Nitrogen.—Under normal conditions top dressings of nitrogen, applied early, produce economic increased yields. If, however, the land is rich in organic matter, or is in a high state of fertility and has received heavy dressings of farmyard manure to the beet or previous crop, it is possible that an excess of nitrogen applied by top dressings may not only not increase the yield, but may be positively harmful.

Potash.—A shortage of potash may seriously limit the yield of sugar-beet. If potash has been supplied during the rotation, and the soil contains a sufficiency, any further dressing direct to the beet will not increase the yield and may even be detrimental.

General.—(1) There can be no hard-and-fast rule or standard dressing of manures for sugar-beet, and any scheme of manuring must be based on a knowledge of the soil, previous cropping and manuring.

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(2) There is a fairly sharp limit to the quantity of artificials which may be applied with success, and beyond this yields may even be depressed.

(3) *Sugar Content.*—It may be stated with confidence that judicious manurial treatment with artificials is likely to promote quality, but that, on the whole, climate conditions, seed and soil play a more important rôle in this respect. An examination of all the Control— or No Manure—Plots will show that a slightly lower sugar return was obtained throughout than on the manurial plots. Excess of nitrogen is generally responsible for poor quality, but this may be negated by a sufficiency of other necessary fertilizing constituents, or by favourable climatic conditions. A shortage of potash may also have a depressing effect on quality.

CULTIVATION TRIALS ON SUGAR-BEET. CENTRE—HADSOCK PRIORY

The object of these trials was to obtain definite information regarding the effects of cultivations on the yield of beet, and it is proposed to repeat them during a number of seasons. It should be clearly understood that no definite conclusions can be drawn from this one trial.

In the case of the number of hoeing trials, the object was to test the effect of soil movement, the killing of weeds being a secondary consideration.

Plot	Number of Horse-hoeings		
1	Two—on June 2nd (before singling) and	June 22nd	
2	Three	June 22nd and July 10th	
3	Four	June 22nd and July 10th and 17th	
4	Five	June 22nd and July 10th 17th and 23rd	

Plot	Yields per Acre			Per cent. Sugar
	Tons	Cwt.	Qrs	
1	14	6	0	19.2
2	13	16	1	18.5
3	12	19	3	19.4
4	13	11	1	19.1

No increased crop resulted from hoeings in excess of two—i.e. one before singling and one after.

Plot	Width in In.	Yields per Acre			Per cent. Sugar
		Tons	Cwt.	Qrs.	
1	16½	13	16	3	18.9
2	19	13	13	2	19.4
3	23	13	19	2	19.3

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There was practically no difference in yields. It appears that the additional number of roots per acre does not necessarily mean a greater yield per acre. The difference in the size of the roots was very apparent when the plots were lifted and topped.

Plot	Date of Singling	Tons	Cwt.	Qrs.	Per cent. Sugar
1	June 7th	13	3	0	20.3
2	„ 11th	12	16	2	19.5
3	„ 16th	12	18	0	19.5
4	„ 21st	12	6	2	20.0

The singling on Plot 1 was carried out as early as the plants could be handled—*i.e.* when showing fourth leaf, and the results show an increase of nearly 1 ton over the plot singled last; also the sugar content of the crop from this plot was the highest obtained at this centre.

It is too early to draw definite conclusions, further work being necessary.

THE DISCUSSION

SIR FREDERICK KEEBLE, in opening the discussion, said that he was greatly impressed, or depressed, by the smallness of the average yield of beet in this country.

He was convinced that this could be greatly bettered by more thorough cultivation of the soil.

The difference between farming and gardening was mainly one of soil conditions, and the difference between the yield of the same crops under the two conditions was enormous.

He thought that the first step to better yield should be cultivation, aimed at the making of good soil conditions, and that this might be followed by improved manuring.

He ascribed the very small increases of yield obtained with nitrogen manures in some of the experiments put before the conference to the operation of the law of limiting factors and not to any essential failure of artificial nitrogen as a manure for sugar-beet. Unless the other factors of growth were in balance, no plant could use the manure given to it to advantage.

He mentioned that in the near future large supplies of new types of nitrogenous and mixed manures would be available on the English market as the produce of our own industries; and that these should prove interesting to sugar-beet growers and other intensive farmers.

Sir FREDERICK HIAM said that he had had satisfactory results with beet grown in rows 21 in. apart. He got these by using a 7 ft. drill equipped with four coulters.