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# Report for 1948

*Full Table of Content*

Rothamsted Experimental Station
Harpenden

LAWES AGRICULTURAL TRUST

REPORT
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# Irrigation Experiments

## Rothamsted Research

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# Irrigation Experiments, 1947 and 1948

At the request of the Sugar Beet Research and Education Committee of the Ministry of Agriculture, Rothamsted undertook the control of experiments on the irrigation of sugar beet. Members of the Physics and Chemistry departments and the Field Experiments Section took part in the work.

A preliminary trial took place in 1947 on the farm of Mr. F. A. Secrett at Milford, Surrey, and in the following year a much bigger experiment was laid down on the same farm.

The main points in regard to these two trials are briefly recorded below.

The soil at Hurst Farm, Milford, is a deep sandy loam derived from the Greensand formation. It is intensively manured for market garden crops with bulky and concentrated organic manures and also fertilizers. Overhead irrigation with oscillating spray lines is an essential part of the system and for certain crops a very dilute solution of potassium nitrate (one part in at least 5000 parts of water) is applied through the spray lines instead of pure water.

In 1947 half an acre of sugar beet was drilled after a crop of spinach had been harvested. This small area was used for a pilot experiment whose main object was to gain experience of the practical problems arising in the carrying out of irrigation trials. Two plots each of $\frac{1}{6}$ acre received the irrigation, four others of 1/24 acre were dry controls. The provision of water was from the main commercial installation, which was naturally being used simultaneously in other parts of the farm, consequently strict control of water supply, and more particularly of the supply of nutrients in the water was difficult to achieve. The treatments were:—

| | |
|---|---|
| 1 and 2 | No water. |
| 3 | Irrigation with water only. |
| 4 | Irrigation with water containing potassium nitrate. |
| 5 and 6 | No water, but dry potassium nitrate top dressed in amount equivalent to 4. |

The season was a particularly dry one especially in summer and autumn. The period July-October inclusive gave only 3·3″ rain, whereas the average for 55 years in the neighbourhood was 10·1″.

On June 25th irrigation started. The crop at this time was a practically perfect plant, 35,000 per acre, in full vigour of growth, with the promise of very heavy yields. Seven irrigations in all at approximately fortnightly intervals were given ending on September 26th, the total quantity of water applied being approximately 10″. In the very dry summer weather the effects of the water were visible three days after application, and showed in larger leaf area and brighter and fresher leaf colours. The crop was lifted on November 4th. The dry potassium nitrate application, and the potassium nitrate applied in the irrigation water, estimated as 121 lb. per acre, had effects so small that in a non-replicated trial they might easily occur by chance, so they are omitted for the following presentation of the main results.

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| | Dry plots (1, 2, 5, 6) | Irrigated plots (3, 4) | Effect of 10″ water |
|---|---|---|---|
| Clean roots tons per acre | 20·10 | 29·76 | +9·66 |
| Sugar per cent ... ... | 19·22 | 16·71 | —2·51 |
| Sugar cwt. per acre ... | 77·3 | 99·5 | +22·2 |
| Tops tons per acre ... | 9·25 | 14·48 | +5·23 |
| Plants thousands per acre | 35·6 | 34·4 | —1·2 |
| Noxious N ... ... | 43 | 42 | —1 |

There was a first rate crop without irrigation, a result largely due to the very high plant population. In this dry summer the effect of watering was very striking indeed, it increased the yield of clean roots by 9·66 tons to give the astonishing figure of nearly 30 tons per acre. It increased the average root weight from 1·26 lb. to 1·94 lb. The sugar content of the roots was depressed by watering to the extent of 2·5 per cent. There was a gain of 22·2 cwt. sugar per acre. Tops on the dry plots were fairly heavy for such a droughty year, but they were increased by a further 5·2 tons by irrigation. Plant number and noxious nitrogen were practically unaffected.

In 1948 a much larger experiment was put down on the same farm, in this case on a field that had recently been taken over and never before irrigated. It had not received the long course of heavy manuring practised on the older land. A special pumping plant was installed completely under the control of the experimenter, the water being supplied from a nearby lake. Arrangements were made for the introduction of dilute potassium nitrate solution into the water system as required. A full time supervisor, Mr. A. B. Venables, was seconded from the British Sugar Corporation to take charge of the experiment. A meteorological station was set up on the plots and a small laboratory for nitrate determinations.

The design of the experiment was a six by six Latin Square with plots of $\frac{1}{16}$ acre to carry the irrigation treatments. Within each main plot 4 sub-plots tested supplementary fertilizer treatments with nitrogen and potash. The basal treatment was 30 tons of dung per acre applied in January 1948, and 7 cwt. I.C.I. compound fertilizer No. 1 containing 12% N; 12% $P_2O_5$; and 15% $K_2O$ with 3 cwt. agricultural salt per acre in addition.

The treatments were:—

Main plots:—

1 and 2 No water
3 Full irrigation at Mr. Secrett's discretion
4 As 3 with dissolved potassium nitrate
5 Restricted irrigation based on climatic data
6 As 5 with dissolved potassium nitrate

Sub-plots:—

a. No additional fertilizers
b. 2 cwt. of nitrate of soda per acre
c. 1 cwt. of muriate of potash (60%) per acre
d. Nitrate of soda + muriate of potash

The crop was sown very early (March 23rd) and singled (April 27th) and almost immediately suffered from a bad attack of fleabeetle which was energetically combated by dusting, but none

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the less some plants were lost. The result was that the plant population was 29·2 thousand instead of the 35,000 attained in the previous year. Subsequently the crop grew exceedingly well without any checks apart from a severe infestation with virus yellows. The crop was lifted on October 18th while still in full growth.

The season was in great contrast to the previous year as the following figures show:—

| | Rainfall inches 1948 | 1947 | Excess in 1948 |
|---|---|---|---|
| May ... ... ... ... | 2·06 | 1·67 | 0·39 |
| June ... ... ... ... | 2·60 | 2·14 | 0·46 |
| July ... ... ... ... | 0·96 | 1·06 | —0·10 |
| August ... ... ... ... | 4·02 | 0·52 | 3·50 |
| Total ... ... ... ... | 9·64 | 5·39 | 4·25 |

The summer of 1948 was dull and distinctly wetter than 1947, particularly in August. There was a dry period in early May at the time of the beetle attack and a second dry period in July.

Full irrigation with and without salts was given on 6 occasions, starting on 12th May and finishing on 30th July to provide a total of 4·7″ water. Restricted irrigation with and without salts was applied on three occasions May 22nd, July 18th, and August 4th to a total of 2·6″. The salts included in the irrigation water were estimated at 83 lb. per acre for the full and 59 lb. for the restricted irrigation. These salts at most supplied 11 per cent of the nitrogen and 33 per cent of the potash given in the basal dressing. The effects of irrigation were seldom apparent in the cool, dull summer of 1948, only on one occasion during a hot spell in July it was noted that the dry plots were wilting while the irrigated plots were not. The results were as follows:—

*Sugar Beet, Milford,* 1948

Effect of irrigation ; dissolved salts, fertilizer N and K

(Each set of comparisons averaged over all other factors)

| | Water, inches 0 | 2·6 | 4·7 | | Increase for dissolved $KNO_3$ | | Increase for 2 cwt. Nitrate of Soda | 1 cwt. Muriate of Potash | |
|---|---|---|---|---|---|---|---|---|---|
| Clean roots tons/acre .. | 22·0 | 22·6 | 21·9 | ±0·19 | −0·2 | ±0·26 | −0·4 | 0·2 | ±0·18 |
| Sugar percentage .. | 14·9 | 14·7 | 14·7 | ±0·37 | −0·1 | ±0·52 | −0·3 | 0·2 | ±0·09 |
| Sugar, cwt./acre .. | 65·5 | 66·7 | 64·1 | ±0·76 | −0·8 | ±1·07 | −2·5 | 1·3 | ±0·68 |
| Tops, tons/acre .. | 30·6 | 31·6 | 32·8 | ±0·35 | −0·2 | ±0·50 | 1·4 | 0·2 | ±0·23 |
| Plant No., thous./acre .. | 29·0 | 29·5 | 29·2 | ±0·29 | −0·6 | ±0·41 | −0·2 | 0·2 | ±0·22 |

There were 22 tons of clean roots per acre with the rather low sugar content of 14·8 per cent, giving a mean sugar production per acre of 65·4 cwt. The plant number at 29 thousands was high, but considerably lower than the perfect plant secured in the year before. The tops at 31 tons were the heaviest ever recorded in any Rothamsted experiment. The precision was satisfactory.

Watering did practically nothing so far as yield of sugar per acre was concerned under the conditions prevailing in 1948. It tended to reduce the sugar content of the roots and increased the top yield significantly. Plant number was unaffected. The effect of added

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salts was small and non-significant. Fertilizer nitrate of soda reduced the yield of roots and the percentage of sugar significantly. As usual nitrogen increased the top yield. Muriate of potash gave a slight increase in sugar per acre. There were no significant interactions between any of the treatments.

So far as they have gone these preliminary trials have encountered extreme conditions under which water either gave an enormous increase or practically no increase at all. They have been valuable in enabling a start to be made on working out the technique of such trials. Two further experiments are being laid down for 1949.