

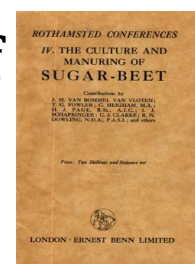
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The Culture and Manuring of Sugar-beet

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Continental Experience With the Growth of Sugar-beet

J. M. Van Bommel Van Vloten

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CONTINENTAL EXPERIENCE WITH THE GROWTH OF SUGAR-BEET

By J. M. VAN BOMMEL VAN VLOTEN

Expert to the Netherland Sugar Industry

WHEN I received by intermediary of the Dutch Department of Agriculture your invitation to speak before this conference about some questions concerning sugar-beet culture, I at first hesitated to accept it. In the first place, I wish to state that it is very difficult for me to speak in a language which is not familiar to me, and in the second place, the circumstances in England are so different from those in Holland that I can hardly be expected to be an expert for your country.

However, the consideration that sugar-beet culture is rather a new one in England, and the fact that I greatly appreciated the honour conferred upon me by asking me to speak before this conference, made me decide to accept your invitation.

In a paper read by Mr Alfred Wood, Secretary to the British Sugar Society, to a meeting of the Farmers' Club, in March 1925, he explained how sugar-beet culture and sugar industry are dependent on each other. He has called the ten years during which the subsidy is given to the British sugar industry, an educational period for the farmers. It seems to me that he is quite right, and that during these ten years not only your practical farmers and your labourers must gain the experience by which the best results will be obtained, but that also your British agricultural scientists must prepare, by several researches, for the time when your sugar industry will have to face the competition of the production of other countries.

It is about these researches that I should like to speak to you.

In your country you have the advantage that from the very beginning you can profit by the experience of the Continent. Now the question is whether this "Continental" experience will be of value to you or not. The varieties of seed used on the Continent—are they suitable for your circumstances? Would the distance between the drill rows, which has proved to be efficient on the Continent, prove also to be appropriate for England? And then there is finally the important question of manuring, which depends so much on local circumstances.

First of all I will treat the question, which variety of seed is to be chosen.

The choice of the variety of seed is, as far as I know, not yet a problem which is very much discussed by the English farmers. The seed is provided by the factory and the farmer does not influence the choice. Yet it is of great importance to him that a variety is chosen which will suit him best.

SCHEME I

1	2	3	4	5	6	1	2	3	4	5	6
2	3	4	5	6	1	2	3	4	5	6	1
3	4	5	6	1	2	3	4	5	6	1	2
4	5	6	1	2	3	4	5	6	1	2	3
5	6	1	2	3	4	5	6	1	2	3	4
6	1	2	3	4	5	6	1	2	3	4	5
1	2	3	4	5	6	1	2	3	4	5	6
2	3	4	5	6	1	2	3	4	5	6	1
3	4	5	6	1	2	3	4	5	6	1	2
4	5	6	1	2	3	4	5	6	1	2	3
5	6	1	2	3	4	5	6	1	2	3	4
6	1	2	3	4	5	6	1	2	3	4	5
1	2	3	4	5	6	1	2	3	4	5	6
2	3	4	5	6	1	2	3	4	5	6	1
3	4	5	6	1	2	3	4	5	6	1	2
4	5	6	1	2	3	4	5	6	1	2	3
5	6	1	2	3	4	5	6	1	2	3	4
6	1	2	3	4	5	6	1	2	3	4	5

SUGAR-BEET

7

On the Continent, yearly, a great number of experiments are made by which different varieties are tested on yield and sugar content, for the choice of the variety can be made only if the results of careful and scientific experiments are known.

Therefore I will begin to tell you briefly how the experiments are made in Holland. A field is chosen in which the soil can be considered to be homogeneous. The number of varieties to be compared is about six. The field then is divided into 36 plots in the way as shown in Scheme I.

Those 36 plots are marked out on the field, each consisting of five rows of 100 beets. They must be rather small, otherwise the total of the experimental field will be too large, and the danger of the soil not being homogeneous will be greater. This is also the reason why no larger number of varieties can be compared.

The seed is sown by hand, the little hand-drills not being so suitable for this work.

By sowing the varieties of seed in this way they will all be distributed nicely over the field, and the influence of the soil is eliminated as much as possible. After sowing is done the most careful attention must be given to the crop to prevent sugar-beet being missing. Each missing root influences the results of the experiments.

In October the yield of each plot is weighed and the middle row is transported to a factory where the tare and sugar content are determined.

Of each variety about 600 beets are tested on sugar content. It is of great importance that the transport to the factory and the determination of the sugar content is done as quickly as possible, to avoid alterations on account of drying out or other causes.

The average weight and sugar content of the six plots of each variety is calculated, and conclusions drawn in the modern scientific way. If there is no good conformity between the results of the six plots of each variety it is advisable to consider the experiment to have been a failure.

It cannot be sufficiently emphasized that the experiments on sugar-beet culture must be made very carefully, for otherwise there is a great risk that wrong conclusions will be drawn.

The experimental commission of the Netherland sugar industry each year has, besides making experiments, about eight of these experimental fields in various parts of the country, all surveyed by two agricultural specialists who are solely in their service.

The results of the experiments have always shown that there is a great difference in quality between the various varieties of beet seed which can be bought. Several Continental producers of seed select their varieties in three directions, and by doing so they enable the factories to choose those varieties which are esteemed to be the most

efficient for the special circumstances under which their farmers are living.

These three types of varieties are frequently indicated by the letters E, N and Z.

E is a type giving a great yield with a low sugar content, whereas the Z type contains more sugar but yields a smaller weight. The type N (normal) stands, concerning sugar content as well as yield, between the types E and Z.

The question, which of these types is to be preferred, is much discussed. The answer depends not only on circumstances of soil and climate but also on the opinion of the farmers and the manufacturers. The opinion of the farmer and the manufacturer is often divided about this subject. The way in which the sugar-beets are paid for is closely connected with this problem. I shall deal with this question afterwards, when I shall be speaking about the subject: how in general the results of experiments must be judged.

An important matter which also can be solved by these experimental fields is the inclination of the different varieties to run to seed. The forming of bolters not only depends on conditions of growth but without a doubt is a hereditary property of the variety.

In Holland, for each variety the percentage of the roots which run to seed is determined, and I dare say that every year always the same varieties show the largest number of bolters.

It is my deliberate opinion that the producers of seed must be able to reduce the forming of bolters to a minimum.

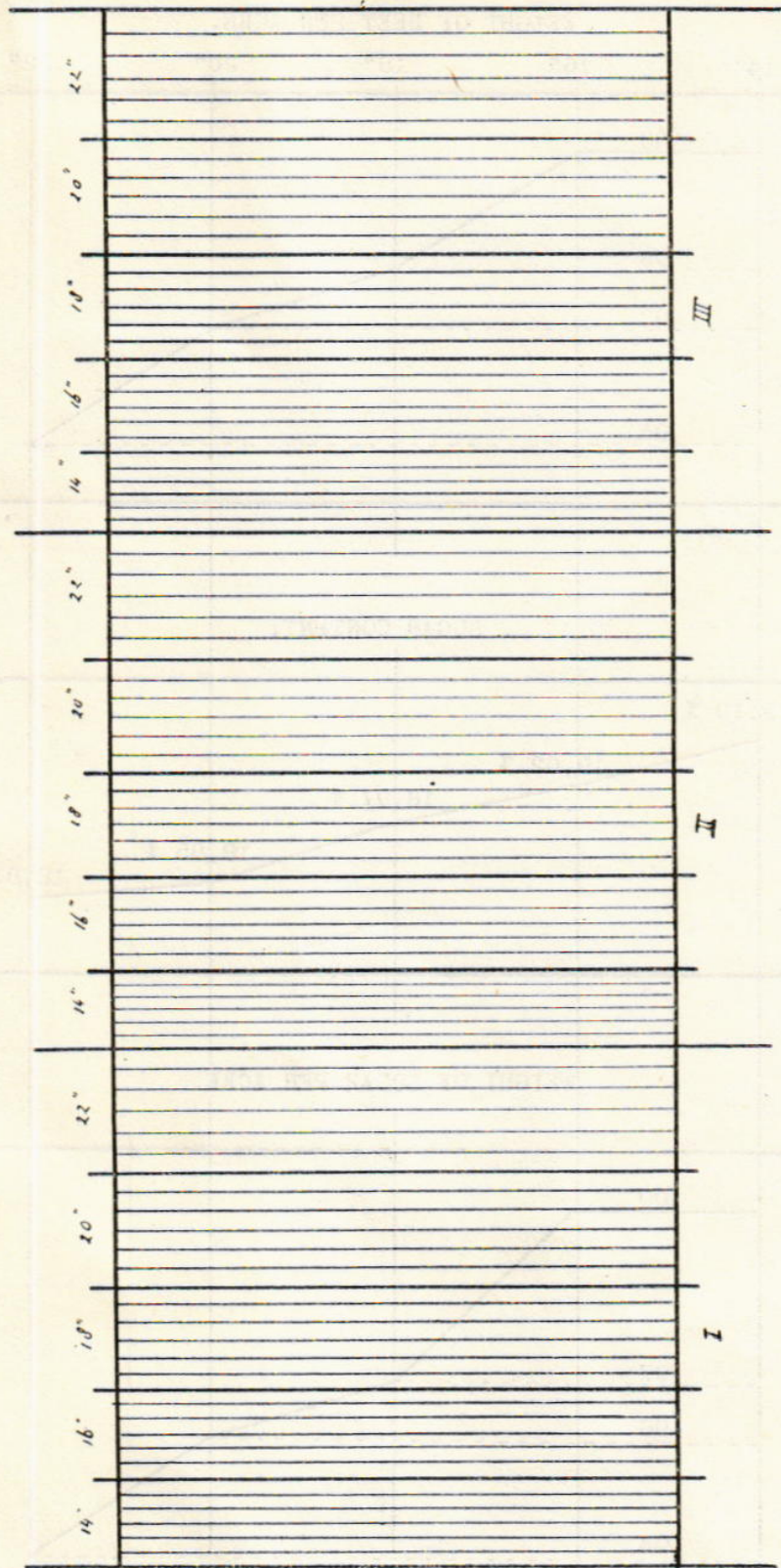
Out of the circumstances which influence the choice of the variety I shall only mention the soil. It is a matter of common knowledge that there are some soils which give a greater yield and a lower sugar content than others—I think the Fen district is a part of your country where such soils are found. I would advise not to choose for these soils the varieties of type E, because the beets, in all likelihood, would not be of high quality.

I shall now pass on to the second problem which I mentioned—the distance between the drill rows. Perhaps this problem is of peculiar importance for the English farmers, because I have the impression that drilling is too wide in England.

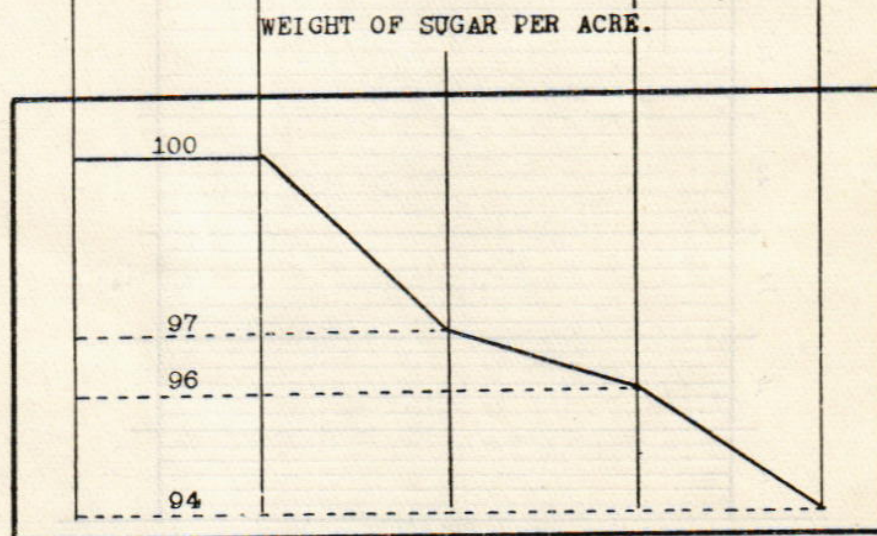
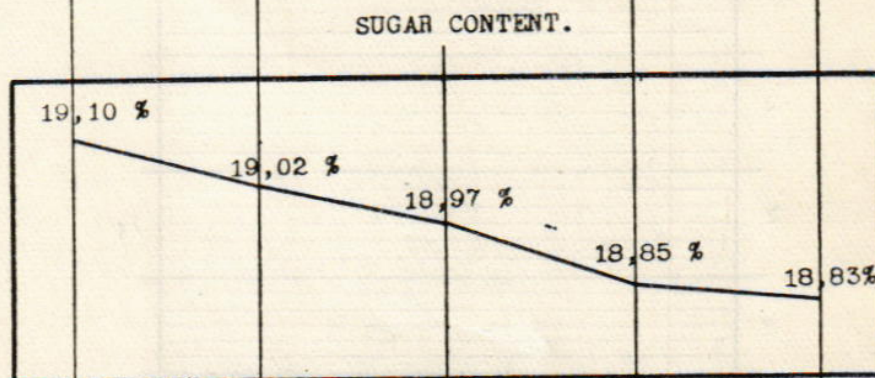
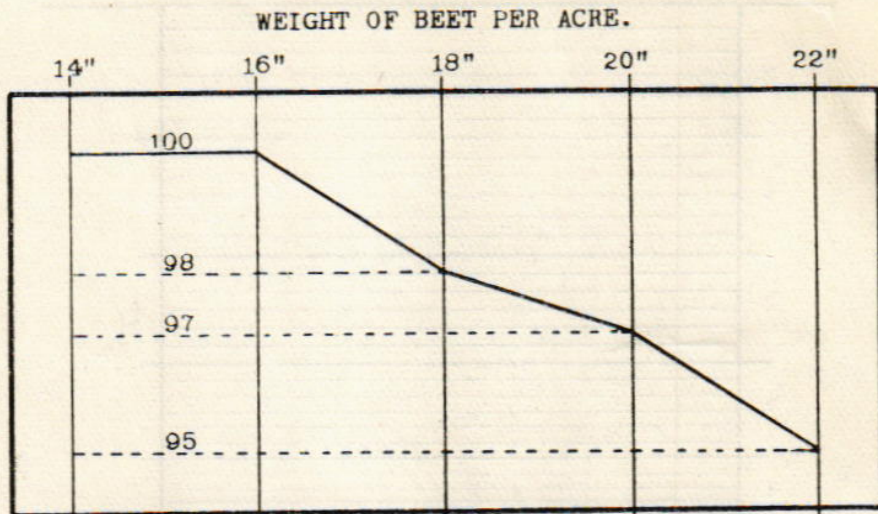
Wide drilling gives the advantage that horse-hoeing can be done easily and as long as possible. The number of rows is smaller; bunching, singling and also the lifting and topping of the beets will require less labour; on the other hand, however, the wider the drilling is done the lower the yield and the sugar content, and the larger the roots will be. But the increase of the weight of each root does not counterbalance the decrease of the number of beets.

In Holland we have drills covering about 6 ft. and fitted with five or six coulter, which means a distance between the rows of about 16 in. and 13 in.

SCHEME II



SCHEME III



SUGAR-BEET

11

The distance of 16 in. is considered rather wide in Holland, but perhaps it is the most suitable one for your country. This must be ascertained by careful experiments.

I have no knowledge of experiments on this subject during the last years in Holland, but the Institute of the Czecho-Slovakian Sugar Industry published the results of many experiments in that country, which I suppose will interest you.

The experiments were made with the object of comparing the results to be obtained with a distance between the rows of 14, 16, 18, 20 and 22 in., and a distance between the plants in the rows of about 12 in.

The field was marked as shown in Scheme II. Beginning at A, at first seven rows, distanced 14 in., are marked out; then six rows follow, distanced 16 in.; then, again, six rows with a distance of 18 in., and so on. This method of marking is repeated three times.

After lifting, the five inner rows of each plot are weighed. By doing so the same number of roots of each plot is weighed, at least in theory. The yield per acre of each plot can be determined by conversion.

The average result of twenty-four of these experiments is shown in Table I and Scheme III.

TABLE I

<i>Distance</i>	<i>Weight of Beets</i>	<i>Sugar Content</i>	<i>Weight of Sugar</i>
14 in. . .	100 ¹	19.10 per cent.	100 ¹
16 „ . .	100	29.02 „	100
18 „ . .	98	18.97 „	97
20 „ . .	97	18.85 „	96
22 „ . .	95	18.83 „	94

The following conclusions can be drawn.

There is no great difference in the results of drilling at a distance of 14 or 16 in. As soon as the distance is larger, the weight of beets, the sugar content and the weight of sugar per acre are decreasing.

It is evident that the differences are not very large. The principal reason why I advised to keep small distances is that sugar-beet culture always gives the best results if an even stand or plant is obtained.

There are many reasons why the roots will grow thin and gappy: an uneven germination, a bad preparation of the soil, the wireworm and other pests are all dangers which always must be feared. The

¹ The weight of beets and the weight of sugar per areal unit, when the distance between the rows is 14 in., is supposed to be 100.

SUGAR-BEET

consequences of these dangers are so much the worse if the distance between the drill rows is wide.

The third question which I mentioned was the manuring of sugar-beet. As I already have said, the solution of this problem depends very much on local circumstances; and because Mr Page and Mr Heigham will speak about this question it seems to me preferable, now, to pass on to the problem of how the results of experiments in general must be judged.

The results of experiments are of consequence to the farmers as well as to the manufacturers. Both parties, however, look upon this matter in a different way. At first I shall explain how the farmer must judge the results of experiments, and then I shall speak about the standpoint of the manufacturer.

I take it that the price of 1 ton of roots, containing $15\frac{1}{2}$ per cent. of sugar, delivered to the factory sidings, is 54s., and that for each per cent. of sugar (or a fraction thereof) over $15\frac{1}{2}$ per cent. is added 2s. 6d. (or a fraction thereof).

The cost of production by the farmer, haulage and transport to the factory are supposed to be :

Cost of production per acre	£20	0	0
Cost of haulage per ton	0	4	0
Cost of transport per ton	0	5	0

I take it, further, that the results of the experiments are as follows :

- Case I. 11 tons per acre, sugar content 18 per cent.
- Case II. 11 tons 10 cwt. per acre, sugar content $17\frac{1}{2}$ per cent.
- Case III. 12 tons per acre, sugar content 17 per cent.

The profit obtained by the farmer in each of these cases is shown in Table II.

TABLE II

Per Acre	I 11 tons 18%				II 11 tons 10 cwt. $17\frac{1}{2}$ %				III 12 tons 17%			
	tons	cwt.	qr.	lb.	tons	cwt.	qr.	lb.	tons	cwt.	qr.	lb.
Weight of sugar	11	19	2	11	2	0	0	22	2	0	2	34
Gross price .	£	s.	d.		£	s.	d.		£	s.	d.	
Cost of Production .	33	2	9		33	18	6		34	13	0	
Profit .	24	19	0		25	3	6		25	8	0	
	8	3	9		8	15	0		9	5	0	

SUGAR-BEET

It is clear that the farmer obtains the largest profit in the third case. The yield per acre does not interest the manufacturer. He only takes into account the value of 1 ton of roots. In order to calculate the value of 1 ton of roots I take it that :

- (1) The net return of sugar per cwt. is 42s.—inclusive subsidy and exclusive excise duty and all costs of selling and delivery ;
- (2) The return of the by-products (molasses, pulp, etc.) is 15s. per ton of roots ;
- (3) The waste of sugar (that is, the difference between the quantity of sugar in the beets and the quantity of refined sugar obtained in the factory) is $3\frac{1}{2}$ per cent. ;
- (4) The working expenses of the factory amount to £1 per ton.

The value of 1 ton of roots, then, can be calculated as shown in the following Table :

TABLE III

<i>Per Ton</i>	I 18%			II 17½%			III 17%		
	cwt.	qr.	lb.	cwt.	qr.	lb.	cwt.	qr.	lb.
Weight of sugar . . .	2	3	17	2	3	6	2	2	22
Return of sugar . . .	£	s.	d.	£	s.	d.	£	s.	d.
Return of by-products . .	6	1	10	5	17	7	5	13	5
Returns per ton . . .	0	15	0	0	15	0	0	15	0
Working expenses and purchase price of beets .	6	16	10	6	12	7	6	8	5
Net return	4	0	3	3	19	0	3	17	9
	2	16	7	2	13	7	2	10	8

First of all I must emphasize that this calculation is not absolutely right. The figures which I mention are based upon the suppositions which I made, and although I think that they don't deviate very much from the reality I must warn you not to consider them to be exact. I mentioned these figures only to be able to give an instance.

Moreover, the supposition that the waste of sugar and the working expenses are equal in all three cases is not right. They depend on the quality of the beets, which again depends on their purity. The prevalent opinion is that the sugar content and the purity of the juice which is to be obtained are proportional. Therefore it may be expected that the less sugar the beets contain the higher the working expenses and the waste of sugar per ton will be. Mr Fowler will be more able to treat of this question than I.

Anyhow we may say that for the manufacturer there is a difference in value between the beets of 18 per cent. and 17 per cent. of at least 5s. 11d. per ton in the circumstances which I mentioned; so the manufacturer will prefer Case I., whereas the farmer obtains the largest profit in Case III.

In looking upon this matter neither from the standpoint of the farmer nor from that of the manufacturer, but in a general way, obviously the results of experiments can be judged only by combining both calculations which I made. By doing so we consider sugar-beet culture and sugar industry as *one process of production, and I think that this is the only way in which the most efficient method of sugar production can be found.*

It would carry us too far to make these calculations, and, for the present, they are not of much importance for the English farmers, because neither the farmers nor the manufacturers combine sugar-beet culture and sugar industry in this way: they both look only for their own interests. In Holland, where the greater part of all sugar-beets are delivered to co-operative factories, the combined calculation is of more importance.

So the farmers in England, in judging the results of experiments, have to make the calculation which I showed you in Table II., and it is clear that it pays them best to grow beets giving a larger yield, with a smaller sugar content. It is a matter of fact that it is easier for the farmer to increase the weight of sugar per acre by growing these beets than by growing beets which contain more sugar.

For instance, by augmenting the quantity of nitrogenous manures the farmer is able to increase his crop. By doing so, however, the sugar content and the purity of the beets decrease, which is against the interest of the manufacturer. If the manufacturer wants the farmers to grow beets of high quality, with a good sugar content and purity, he must enable them to do so by paying for it.

When studying your sugar-beet contract it struck me that the farmer is not sufficiently paid for rich beets in proportion to beets of lower sugar content. For the first 15½ per cent. of sugar 54s. is paid—that is, 3s. 5d. for each percentage—whereas for the percentages over 15½ only 2s. 6d. is paid, notwithstanding that these percentages are of greater value to the manufacturer. It may be possible that the calculation of Table III. is not entirely right—the working expenses may be higher or lower, or there may be other reasons—but in any case this will not influence the *difference* which exists between the value of the various types of beets.

This calculation proves that the difference between the value of beets of 17 per cent. and 18 per cent. must be at least 8s. 5d.—of which the farmer receives only 2s. 6d.

It may seem that by making these remarks I have wandered from my subject, but I considered it worth while to make them because

SUGAR-BEET

15

I am convinced that only by a good method of payment of the sugar-beets can be brought together the divergent interests of the farmer and the manufacturer. Only if there is no large contrast between these interests can be found the most economical method of sugar production.

The last problem on which I should like to fix your attention is the question of the ripening of the beets.

Unripe beets contain less sugar, and their purity is low. The property of early and late ripening of the beets not only depends on conditions of growth, but also seems to be a hereditary property of the variety. At least, the producers of seed assert that the varieties of type *È* are late-ripening and that the *Z* types ripen early. I have no knowledge of experiments proving that this is right.

As to the conditions of growth, I will remark that large dressings of nitrogenous manures—and especially late top dressings—cause late ripening of the beets. It seems to me of interest to the farmers as well as to the manufacturers that, for the first deliveries to the factories of each campaign, beets are chosen of *Z* varieties, and that in any case no beets are chosen to which late top-dressings of nitrogenous manures have been applied.

I think that I ought now to finish, for the time which is reserved for my paper is over. I hope that what I have told you about experiments on sugar-beet culture and how to judge beets has interested you, and that it will contribute to the development of your sugar production.

I have still to make a request. If there are gentlemen who would like to ask me some questions I shall gladly try to answer them. But please speak as distinctly and slowly as possible, because it will be difficult for me to understand.

WHAT THE FACTORY WANTS AND HOW THE FARMER CAN SUPPLY IT

BY T. G. FOWLER

Cantley Beet-Sugar Factory

THE title of this paper was given to me by Sir John Russell, but I should have preferred to have designated it under a broader title.

You will readily apprehend that this subject can be discussed from two chief points of view. Firstly, the ideal mechanical and chemical aspect from the purely selfish manufacturing point of view of the manager of a sugar-beet factory; and secondly, from the commercial standpoint as it influences the purchasing, transporting and manufacturing of the sugar-beet into sugar, pulp and molasses, and the marketing of these finished products.