

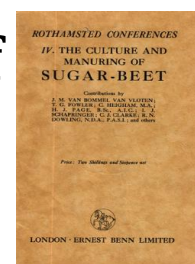
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The Culture and Manuring of Sugar-beet

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What the Factory Wants and How the Farmer Can Supply It

T. G. Fowler

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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.

I do not propose to touch upon the first point, as I fear to frighten farmers away from producing sugar-beet altogether, and to deprive a large body of men from earning an honest livelihood who at present use their brains and labour in producing machinery, both mechanical and chemical, for combating the various difficulties which are to be met with in the farm and in the factory in the production of beet-sugar.

I shall endeavour to explain the commercial side of the English sugar-beet industry on a broad basis gleaned from the comparatively short experience I have gained at Cantley since 1920, and quite realize I am probably laying myself open to severe criticism from those who have enjoyed as many years experience in the industry as I have years of life.

Although I realize that this conference is to-day chiefly concerned with the production of sugar-beet on the farm, I think it will not be out of place to touch briefly on the marketing of the sugar-beet, as there are probably several farmers here to-day who have never grown sugar-beet, and before they commence to do so would, I imagine, naturally desire to know under what terms and conditions they can sell their sugar-beet crop.

Up to the present—and I imagine it will always remain so—sugar-beet growing is not undertaken by a farmer until he has first made a contract with a factory for a specified acreage for a period of one, two or three years.

Unlike the production of barley, wheat, potatoes and fruit, etc., there are few markets for sugar-beet, so unless a farmer enters into a contract with a factory before he drills his crop he has no market for his crop other than as a medium for converting his stock into meat. Similarly, a factory, in order that the necessary coal, limestone, bags, etc., can be purchased, and the factory plant put into order for the ensuing cutting season, must know, approximately at least, some six months before the crop is ready to harvest the quantity of beet it will have to deal with in a season.

Therefore the factory and the farmer frame a universal contract covering one or a series of years, and the term and conditions under which the beet will be delivered to and paid for by a certain factory. Such contracts are either offered by the factory subject to acceptance or rejection by the grower, or are arrived at after collective bargaining by the factory with a representative body such as the headquarters of the N.F.U.

I know only too well that the farmer all over the world enjoys a day out at a market, and a deal, and for many years I honestly believe many farmers did not grow sugar-beet, or as big an acreage as they were able to do, purely because the selling of sugar-beet was so dull—a few strokes of the pen and your signature and it was all over, and you were tied up for one or several years. A few adventurous farmers have experimented in growing without a contract, with the prospect

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that they might find a factory willing to offer them a higher price during the cutting season, but I am afraid they have always met with bitter disappointment, as this practice, if generally adopted, would soon land the industry in difficulties.

The contract requires the farmer to grow a specified acreage of sugar-beet from seed supplied by the factory, and deliver all the crop from this acreage to the factory in a reasonably clean state and in a perfectly sound, healthy condition. The factory reserves the unqualified right to supply the seed, though quite prepared to permit the grower to choose one or any of the chosen varieties recommended and purchased by the factory.

It is vitally important to the factory and to the grower that only the best seed should be used, and if the choice of seed was left to the inexperienced farmer the result would invariably be disastrous, for many farmers would be induced by gullible and well-meaning salesmen—who themselves are not in a position to prove and test that the seed is good sugar-beet seed, but have to rely in all good faith on the source of origin—to purchase seed purporting to produce sugar-beet of 20 to 24 per cent. sugar content, or even higher, whereas the ultimate result may be far below the recognized standard.

The factory retails the seed to its growers at cost price, and usually the price per pound is some 30 per cent. below the cost of mangold and turnip seed. Some farmers believe that factories reserve the right to supply the seed as it is a source of lucrative income, but I can assure you that in my experience the result is often a loss on the total transaction.

The price paid for the beet varies year by year according to different factors which govern the situation—such as the price of sugar, excise duty payable on the sugar, or subsidy obtained by the manufacturer.

From a commercial standpoint a factory firstly desires to purchase its raw material as cheaply as possible; and secondly, it requires in total the maximum tonnage it can deal with in the season delivered regularly, in order to ensure economic working costs. The price a factory can pay depends upon its manufacturing costs and the world's price of sugar, which controls the selling price of its finished article.

Therefore it is to the advantage of the grower, as well as the factory, to see that the beets are supplied regularly in accordance with the contract, and that the factory has sufficient beets for a full campaign.

In order that the factory can obtain a full crop they must see that the price they offer per ton is one that with an average yield will give the farmer a fair profit. The factory is, therefore, always endeavouring to make the crop profitable to the grower, and employs a large agricultural staff of expert advisers who are at the beck and call of the growers, free of charge.

I have just mentioned that regular deliveries are a great economic

asset to a factory, and before passing on to other subjects I should like to enlarge on this most important point, especially as this paper is called "What the Factory wants."

The manufacturing period is approximately from 1st October to 15th January, but varies a few weeks on either side of these opening and closing dates; and there is a certain period in each season during which the sugar-beet reaches its maximum sugar content—deliveries before and after will show a lower sugar content.

The delivery clause of the contract is framed so that a grower may deliver a part of his crop before it has attained its maximum sugar content, another part during the highest period, and the balance during the declining period.

The majority of growers I have had to deal with, in spite of having signed a contract agreeing to certain delivery conditions, make every endeavour to deliver their crops when it has its highest sugar content; consequently a factory is starved of its necessary supplies at the commencement and end of its season and is overwhelmed during the middle period.

I know farming operations are largely controlled by climatic conditions, but still there is a lot of room for improvement in this branch of the industry. Farmers must look ahead and make careful plans for regular delivery of their crops, and always have their lifting operations ahead of their delivery programme, so that in the event of unsuitable lifting conditions they can still continue to supply the factory regularly. In other words, they must not live day by day but preferably month by month.

Before I leave the delivery question there are three "factory don't wants" closely connected with this subject.

Firstly, badly topped beets are a serious handicap, for if the beets are placed in silos badly topped they quickly commence to grow again at the eyes or leaf buds which have not been removed on the field, and this growing sets up heating, and causes serious losses in sugar content and weight. Beets found in the tare sample which are incorrectly topped are properly topped and go to increase the tare; but the grower is paid nothing for these tops—though he has to pay carriage on the weight of tops—whereas, if retained on the farm they are a valuable stock food or manure.

Secondly, weeds, hedge trimmings, leaves and straw, etc., are a big difficulty to contend with, and although elaborate mechanical devices are to be found at most factories for dealing with these nuisances these devices are not perfect when dealing with hundreds and thousands of tons of beets per day.

These weeds, etc., quickly put the cutting mill knives out of action, for they bind themselves round the knives and so prevent the knives from slicing up the beets. Weeds do not offer a sufficiently firm structure for the knives to cut up as the beets do.

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Sugar-beet has rightly been described as a magnificent cleaning crop, and so it is if the correct cultivations are carried out at the correct time, but unfortunately many farmers do not keep their land as clean as they should do, and by using beet lifters and ball-pointed beet forks they consign to the factory all their rubbish along with their beets, quite overlooking the fact that the factory is not the receptacle for their botanical collections.

Lastly, stones, harrow chains, and horseshoes, etc., cause frequent havoc and devastation in a factory's slicing department, for in a single season many tons of such geological and mineral specimens are delivered along with the beets. These three pests cause the loss of many precious hours of capacity during a season.

I will now return to the land and the production of the crop itself, and would again repeat that it is one of the factory's chief and foremost thoughts in England to induce and educate its growers into producing a greater yield per acre.

It may appear to you that no inducement should be necessary to encourage a farmer to produce more beets per acre, and that only education and teaching are required, but I assure you I know of many farmers in East Anglia who strongly resent being pressed to increase their production, contending that their present yield is quite satisfactory, and that the more concentrated and careful manipulations and manuring that we suggest are too much trouble to carry out.

As my own personal opinion I issue a solemn warning that unless the yield per acre is not on the average increased by some 2 to 3 tons per acre before the subsidy expires the industry as a national one is doomed.

The average yield per acre as calculated on a factory's total crop of, say, 15,000 to 20,000 acres is absurdly low, it should be 10 to 12 tons per acre; and this is not an impossible yield per acre, for each year there is a sufficient percentage of growers who attain and even exceed this yield.

I read recently of a very intensive and thorough campaign that was carried on in the States on this same important point of increased yield per acre, and I understand that in a single season the average yield was raised nearly 2 tons per acre.

From my experience I have found that the average farmer thinks far too much of the sugar content of the beet he is going to raise and not nearly enough of the tonnage of the sugar-beet per acre he is going to produce. A degree of sugar content under the existing contract is worth 2s. 6d. per ton over 15½ per cent., whereas a ton of beet at 15½ is 54s. On the average, the sugar content of the beets produced in England is highly satisfactory, and compares very favourably with—and in many cases exceeds—the sugar content of beets grown in Europe and the States. You will therefore perceive that it is the yield per acre which is the outstanding vital point in this promising new industry,

and it is one that factory promoters and agricultural experimental stations must co-operate together on, and leave no stone unturned to improve.

Within reasonable limits it is the number of beets produced or grown on a square yard or on an acre of land which governs the yield per acre.

Continental practices reduced to our measurements lay down that, theoretically, an acre of land should have a stand of 38,000 to 40,000 beets at harvest time—or 8 beets per square yard.

Eight beets per square yard necessitates either very close singling or narrow drilling. As I mentioned before, this theory has its practical limits, and from careful investigations it has been found that beets will not flourish and mature if left closer than about 8 in. in the row, so the limits of singling are restricted; therefore the only economy left is in the distance apart of the rows or drills.

Beets drilled in rows 18 in. apart and cut out and singled 9 in. apart in the rows will give the grower 8 beets to the square yard—or 38,720 beets per acre—provided he has an absolutely full plant.

Now 8 beets to the square yard—or 38,720 beets to the acre—if each beet has an average weight of only 16 oz., will give a yield of 17 tons to the acre; and similarly 6 and 4 beets per square yard will give 12 and 8½ tons per acre respectively.

These figures are ideally theoretical, but they do, in my opinion, open up the way to obtain an increased yield per acre over and above that at present obtained. I have put the beets as weighing only 16 oz. each, whereas the average weight of a beet produced in East Anglia is about 20 oz.; therefore, with 8 beets to the square yard, and each beet at harvest weighing 20 oz., there would be a yield per acre of over 21 tons.

Our trouble in East Anglia is that the farmers for generations have been accustomed to growing the wasteful and unprofitable mangold on 24 in. or even 27 in. balks, and singling them out from 12 to 15 in. apart, and if they were to endeavour to grow 8 sugar-beet to the square yard on 24 or 27 in. balks they would have to leave the beets about 6 to 6½ in. apart—which is far too close and would restrict the growth.

This wide mangold drilling has become so firmly set in the masters' and labourers' minds that the suggestion they should drill on 16 to 18 flat work was received with horror and suspicion, and from the commencement this advice was prejudicial to sugar-beet growing, but I am glad to say that of recent years sugar-beet growers are gradually placing their rows closer.

Again, the singling and leaving the beet regularly in the row has presented many difficulties. I have seen many thousands of mangold acreages but I can never recollect seeing a really full plant of mangolds, the best has been about 70 per cent. Farmers take a pride in growing

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great bulky watery mangolds sooner than a number of smaller good-quality roots.

During the summer I visit many of our growers, and I am afraid I frequently cause disappointment when I am taken on to a field and the owner with pride points out a big 4 or 6 lb. sugar-beet, sitting in a big bare patch of land like an oasis in a desert, and asks if I do not think he has a record crop of 12 to 15 tons and I have to disagree with him, and put his yield down at 7 to 8 tons. Two or three beets, weighing from 1 to 1½ lb. each, will very soon weigh far more than a few bigger brothers.

Again, the average grower is very nervous at growing his beet on the recommended 16 to 18 in. work, contending he cannot use his horse-hoes at this distance, but I am confident he can do so if he will use the right kind of horse driven by an intelligent team-man.

The ordinary root horse-hoe found on the average farm is a clumsy and difficult implement to control, but modern sugar-beet hoes will do splendid work on 16 to 18 in. work and will clean the land admirably and at the same time leave the plant intact. To ensure satisfactory horse-hoeing on 16 to 18 in. work, great care must be taken when drilling to see that the drills are carefully and accurately joined and that they are straight. I have in mind a concrete example on a large scale supporting this narrow-drilling theory. For the past two years endeavours have been made to establish beet-growing in the West Country, and the crops that have been grown on land that is not materially better than that used for beet in East Anglia have, as far as I can ascertain, averaged several tons per acre more than they do in Norfolk; and I am quite confident that this better yield is mainly due to the fact that these West Country farmers are accustomed to drill their ordinary mangolds on 16 to 18 in. flat work, therefore the factory's advice to do their sugar-beet in the same way has presented no difficulties.

I hope if I have not convinced the present company on this subject that I have started a train of thought, and that the ultimate result will be fruitful.

It is comparatively easy on paper to prove that it is the number of beets on an acre that gives the yield, but it is a very different matter to get the desired number in practice on the farm. Let us first start with the seed. The majority of mangold growers use 7 lb. per acre, or less, which, in my opinion, accounts for their 70 per cent. stand; but experienced sugar-beet growers always use 15 to 20 lb. per acre according to the season, and not because sugar-beet seed germinates badly or that the seed supplied is of poor germination. They look upon a good heavy seeding as the foundation of the crop, and unless the foundation is good the building will not be a success. A few extra pounds of seed at 6d. to 7d. per lb. is money well spent, and is as good as a life insurance policy. If the grower does not get a good plant in the first case it is a

heartless, uphill battle throughout the growing season, ending with a poor return.

I meet opposition and objections on all sides on this question, and am quoted instances of good crops produced on 7 to 8 lb. of seed. I quite admit, under favourable conditions of weather, 7 to 8 lb. of good seed per acre will give a full plant, but it is the adverse conditions you require to protect yourself against; the conditions may be admirable at the time of drilling, but may be quickly followed in our variable climate by many weeks of cold wet weather. Further, if you commence with only a bare full plant you are going to lose a lot of plants in hoeing, or by birds and pests before the crop is ready to harvest.

Some farmers believe that as the factory purchases and supplies the seed they are making money out of it, and therefore wish to encourage the liberal use; or that the seed is poor and therefore a lot must be used to produce the desired result. I have already mentioned that the factory is most careful about the quality of its seed, and the grower himself is protected by the Seeds Act of 1922.

Next to liberal seeding comes the correct preparation of the seed bed. Like other root crops, sugar-beet requires a good firm fine seed bed to produce the best results, and particular attention should be paid to the rolling.

The poor stand of sugar-beet which is obtained by a great many growers is due in many cases to insufficient rolling before and after drilling. I have known growers who have been at great pains and expense to prepare a beautiful mould and have not obtained a good germination, and in my opinion it is due to the fact that the seed has been buried too deep, which can be most easily done on a loose seed bed; and also, the seed has not been firmly surrounded by soil and so has germinated slowly. The seed must not be buried too deep, one inch is ample—better be shallower than deeper than an inch; many crops would produce better plants if seed were only just covered and rolled in afterwards. I have investigated many cases of supposed bad germination of the contended poor seed supplied by the factory, and in almost all such cases a good plant can be discovered on the headlands and on the sides of the furrows, with a few stragglers in the centre of the field, which clearly proves that where the soil was firmer—such as on the headlands—the seed could not so easily be buried too deep, and the surrounding soil was afterwards more firmly rolled; for the turning of the harrows, drill and roller on the headland all tend to make this part of the field harder than the centre.

Now we come to the drill itself and the manipulation of the drill—a most important part of the culture of sugar-beet, and one that, I am sorry to say, in England, is too frequently sadly neglected.

If I were a farmer I would make a point of being present and would walk behind the drill myself while the seed was being drilled, and

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then if I did not get a plant I would have chiefly myself to blame. I believe, though I am open to contradiction, that this most important work is left to the team-man and the foreman, and quite frequently the latter is absent.

In the first case it is no good trying to put on 15 to 20 lb. of seed when your drill is mechanically unable to pass this quantity of seed. I am not very *au fait* with different types of drills, but I am sure that with a little ingenuity and the assistance of the local blacksmith the majority of flat-work drills can be made to put on the desired quantity of seed, and so avoid the expense of purchasing a special sugar-beet drill. However the proper drill should always be purchased by a grower whose acreage exceeds two figures, and smaller growers should combine together and purchase the right implement, for the outlay will, I am confident, bring in a good return year by year.

It must not be imagined that even the best drill will solve the difficulty and produce a good plant, for all drills must be carefully attended and watched. The mind of a farm labourer drifting across the field behind a drill on a beautiful spring day is apt to turn to thoughts of love and the maiden he hopes to meet in the evening, or the glass of beer he will find a home for later on, and while his thoughts are thus straying the drill blocks up, or temporarily fails to deliver its correct quota of seed. Therefore it is imperative that the owner of the farm and the gentleman who has to meet his bank manager occasionally should be present himself from beginning to end of the drilling.

As far as I can discover, few farmers, except the smallholders, can spare the time on what appears to be so trivial a task, and when such important matters as markets and other similar social amenities have to be attended.

The perfect farmer, having prepared the right seed bed, drilled the full amount of seed correctly, and not spared the roller, has now only to pray for some suitable weather, and in ten to twenty days, according to the temperature and precipitation prevailing, he should see the first indications of a good plant.

The getting of a good plant in England is not easy, and the retaining of it is still harder, especially if the acreage be over-large for the farm, and the labour of indifferent quality.

The singling of the crop can make or spoil it even though a perfect stand may have been ready for the hoe. I have frequently heard it said that singling is a most difficult job to do properly, and cannot be undertaken by unskilled men, but I think a few moments' careful study of what really has to be done will demonstrate that patience and care are the only two attributes really required, and if the worker does not have these qualities they can be supplied by strict supervision.

It is truly painful in the spring to see the many splendid crops in the making ruined by either late singling or careless singling, and in many cases both. The average farm labourer is the best labourer in the world, but the worst supervised: he is left too much on his own, and consequently, like all human beings, is inclined at times to become slack and careless.

I know of cases where gangs of unemployed have been practically, as you might say, turned adrift into a sugar-beet field to single a crop after a few brief hours', or even minutes', tuition, and then left for a day or two alone, consequently with disastrous results. As in the case of drilling, the farmer who wants to get a good 12 to 14 ton yield must be present practically every hour of the day when singling is going on, and, though his time may be valuable, he will ultimately receive a good financial return for his trouble. Singling day in and day out must be a monotonous job for the labourer, and I consider farmers would be well advised to pay for this work at piecework rates, plus a bonus per ton on the ultimate yield, instructing his men that the full plant is going to produce the best bonus.

You have all no doubt heard of the German statistics on early singling, but as I consider these so important I will take the liberty of repeating:

	<i>Tons per Acre</i>
Beets singled at the correct time, having 3 to 4 leaves, yielded	15
" " 1 week later " " "	13½
" " 2 weeks later " " "	10
" " 3 weeks later " " "	7

And if any of you desire confirmation you should communicate with Mr Amos, of the Cambridge University Farm, who, I believe, has carried out similar experiments with parallel results.

The last cultural job is to keep the horse- and hand-hoes going till the leaves meet in the rows and so put a stop to such work.

I am afraid I have spent an unduly long time on the cultural side of the sugar-beet crop, which may appear to you to be outside the title of my paper, but, as I said earlier, the factory wants to live, and to manufacture sugar at a profit, and to do this the farmers must increase the present yield.

I honestly believe, and am bold enough to say at this conference, that it is in the cultivating of the crop that the average farmer is making mistakes, and not so much in the manuring; and if large numbers of growers were to carry out the correct manual operations at the correct time, and use no manures, they would obtain an increased yield amounting to 1 to 2 tons per acre; but let me hasten to add that if they could combine also the correct manuring as well, then they might hope for, and even obtain, an increased yield of 4 to 6 tons per acre. I refer, of

course, to crops which at present yield 3 to 4 tons per acre only, but in higher yields the increase would not be so large. I hope you follow what I mean—the best manure applied liberally will not give a good crop if, in the first place, there is only a 40 to 60 per cent. stand.

MANURIAL EXPERIMENTS WITH SUGAR-BEET AT ROTHAMSTED AND WOBURN

BY C. HEIGHAM, M.A., AND H. J. PAGE, B.Sc., A.I.C.

Rothamsted Experimental Station

THE sugar-beet is comparatively new to British husbandry, and there is very little information in our agricultural literature about its responses to manuring. Sir John Lawes grew it at Rothamsted as long ago as 1871-75, and a certain Mr Duncan had a factory at Lavenham in Suffolk from 1869-1875. The beets at that time apparently yielded well, for Lawes got up to 24 tons per acre on his beet plots, but the sugar percentages were very low—9 to 12 per cent.¹

In 1898 a large series of experiments was carried out in England, Wales and Scotland, and reports from some forty-seven of these are available. This series was controlled by a special committee of the Central Chamber of Agriculture, and the results, which were extremely interesting, do not seem to have received the attention which they deserve. The mean yield of topped beet at all the centres was as high as 16·3 tons, and the average percentage of sugar was 14·48 per cent.²

In 1911 the Board of Agriculture arranged a series of trials, which were carried out at some seven centres up and down the country, in which sugar-beet was grown with the cultural and manurial treatment common to mangolds in the districts concerned. These trials were not accurate experiments in the modern sense and they had the misfortune to be carried through in a season remarkable for summer and autumn drought. Despite this, they gave ground for a general recommendation as to the treatment of the crop, which has been fully confirmed in much subsequent practice. The general result showed that sugar-beet could be grown fairly well where mangolds would grow, and with much the same treatment, and that the result to be expected in yield of beets delivered to the factory was about 40 per cent. of the weight of mangolds which a farmer could expect from the same land. Thus, land which would normally produce 24 tons of mangolds would yield 9·6 tons of sugar-beet per acre.

¹ *J.R.A.S.E.*, 1898, 9, 344.

² *J.B.A.*, 1899-1900, 6, 45.