DEPARTMENT OF AGRICULTURE
CENTRAL EXPERIMENTAL FARM
OTTAWA, CANADA

GROWING AND USING

MANGELS, SUGAR MANGELS AND FORAGE SUGAR BEETS

BY

J. H. GRISDALE, B. Agr.,
Dominion Agriculturist.

WITH NOTES ON THEIR CHEMICAL COMPOSITION

BY

FRANK T. SHUTT, M.A.,
Dominion Chemist.

BULLETIN No. 67

Published by order of the Hon. SYDNEY A. FISHER, Minister of Agriculture, Ottawa, Ont.
285—1

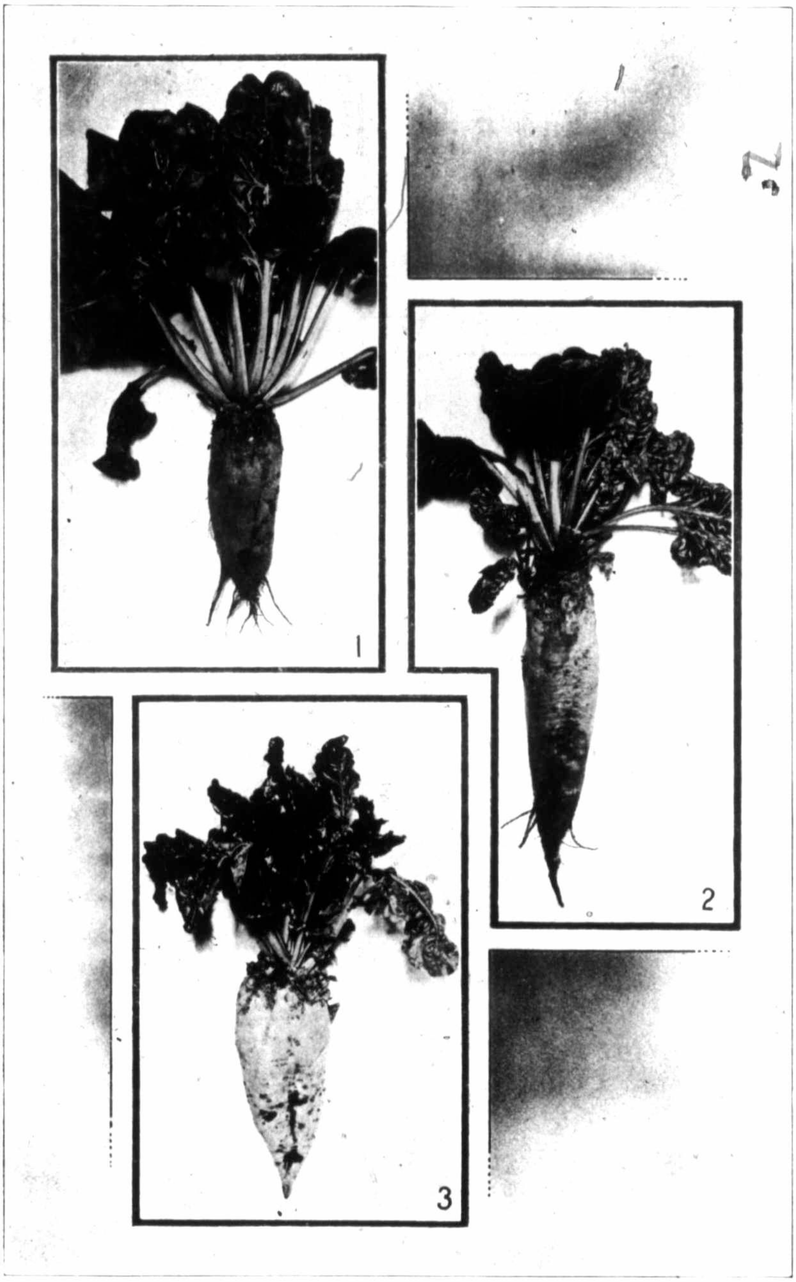

Fig. 1. Gate Post Mangel. Fig. 2. White Sugar Mangel.
Fig. 3. Danish Forage Sugar Beet.

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To the Honourable,
The Minister of Agriculture,
Ottawa.

SIR,—I beg to submit herewith, for your approval, Bulletin No. 67 of the Experimental Farm Series on 'Mangels, Sugar Mangels and Forage Sugar Beets,' prepared by Mr. J. H. Grisdale, Dominion Agriculturist. This Bulletin also contains some notes on the chemical composition of these roots, prepared by Mr. Frank T. Shutt, Dominion Chemist.

In the main part of the bulletin, written by Mr. Grisdale, the question of soils suitable for this crop and their treatment as to cultivation, &c., are referred to, the best fertilizers for mangels are discussed and the best varieties to grow and most favourable time for sowing are also given, with subsequent treatment of the crop. Particulars regarding the harvesting and housing of the roots are given, also the cost of growing per acre. The value of the different sorts of mangels for feeding is also emphasized.

In the chemical notes, prepared by Mr. Shutt, the relative digestibility and nutritive value of these roots are dwelt on. Tables are given, showing the proportions of dry matter and sugar-content of mangels and forage sugar beets grown at the Experimental Farms for some years past.

It is hoped that the publication of the important facts contained in this bulletin, showing the many advantages connected with the general use of mangels as a food for stock, will lead to an increase in the area of land devoted to this crop in the different provinces of the Dominion.

I have the honour to be, Sir,
Your obedient servant,
WM. SAUNDERS,
Director, Experimental Farms.

OTTAWA, January 3, 1911.

INDEX TO SUBJECT MATTER

INDEX AND DESCRIPTION OF PLATES AND CUTS.

No. 1. Cutaway double disc three-horse harrow. A most excellent implement for preparing sod or tough land for roots.

" 2. Double mould board plough for ribbing up.

" 3. Two-row horse seeder.

" 4. Hand seeder

" 5. Hand wheel hoe.

" 6. Walking single cultivator.

" 7. Two-horse, two-row riding cultivator. A most useful implement where roots are grown at all extensively.

Plate 1—

Fig. 1. Gate Post Mangel.
" 2. White Sugar Mangel.
" 3. Danish Forage Sugar Beet.

Plate 2—

Fig. 1. Seeding on ridges.
" 2. Seeding on the flat.
" 3. Man to left is seeding on flat; man to right is seeding on ridges. Team to right is ribbing up with 3-furrow double mould board plough. Team to left is rolling preparatory to seeding.

Plate 3—

Fig. 1. Field of mangels, Ottawa. Yield, 24 tons per acre.
" 2. Pulling and topping.
" 3. Pitting in field.
" 4. Loading.

Plate 4.—Brood sows on Central Experimental Farm at Ottawa, fed on mangels, sugar mangels, sugar beets, and clover hay almost exclusively. Came through winter in excellent shape and gave good litters in early spring.

Plate 5.—Unloading into root cellar. Note slide with slotted bottom.

MANGELS, SUGAR MANGELS AND FORAGE SUGAR BEETS.

Reasons for Growing Mangels and Sugar Beets.

Succulence and palatability in the ration are two of the most important factors making for successful live stock feeding and breeding operations on the farm. There are various ways of adding these qualities to a ration, but probably none more effective and acceptable to almost all classes of farm animals than the including of a fair proportion of roots of some description. Of the various kinds of roots grown, or possible of production in Canada, mangels, sugar mangels and forage sugar beets, are, for several reasons, among those to be most highly recommended. They are possible of cultivation under a great variety of conditions as to soil and climate. They are suitable for and acceptable to almost all classes of live stock. They are easily preserved through the winter and even well on into the summer months, where conditions are fairly favourable.

Mangels, sugar mangels and forage sugar beets may be grown successfully in all known districts of Canada from Cape Breton to the Yukon. They will, in almost every instance, be found highly profitable in all parts of the Dominion where milk, beef, pork or poultry are being produced. The labour required to grow them is considerable, but the crop returns under the average soil and weather conditions are large and of high feeding value.

Suitable Soils.

These roots will grow on almost any kind of soil, provided it is rich in humus or has been recently given a liberal dressing of barnyard manure. The writer has seen excellent crops in the Ottawa Valley growing on sand, sandy loam, clayey loam and black muck land. Probably, the most uniformly good results may be expected from clayey loams, heavy alluvial soils or black muck areas that are well drained, in first class tilth and highly fertile. The roots do well under irrigation and rainy seasons suit them best.

Manurial Requirements.

These classes of roots are most greedy feeders and require a plentiful supply of easily accessible and readily available plant food. A well-applied dressing of from 15 to 30 tons of good barnyard manure per acre may be expected to prove profitable. The quantity to apply will depend upon the condition of the soil, the method of application, the character of the manure and the district where the roots are being grown. Soils poor in humus require a relatively heavy dressing, and, in the case of clay or clayey loam, coarse, strawy manure will usually prove advantageous. On light land, coarse manure should be avoided if possible, and only fine, well-rotted manure, or manure from cattle or horses bedded with cut straw be applied. The use of anything likely to further open up an already porous soil is to be deprecated.

Commercial Fertilizers.

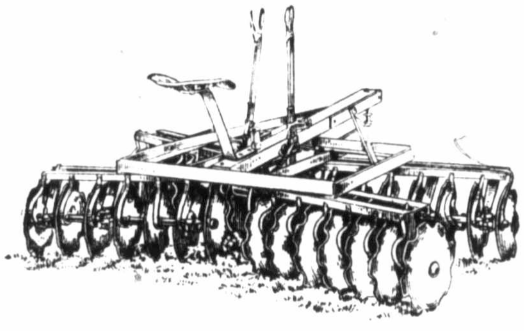
Commercial fertilizers have seldom been used by the writer, but most authorities agree in stating that from 800 to 1,200 lbs. per acre of a fertilizer showing nitrogen 6 per cent, available phosphoric acid 6 per cent and potash 9 per cent is about right.

The nitrogen may be applied in the form of nitrate of soda, sulphate of ammonia or dried blood. The phosphoric acid may be applied in the form of acid phosphate, dissolved bone or bone meal, and the potash as muriate, sulphate or kainit. In British Columbia in those districts where the rainfall exceeds 30 or 35 inches in the year, it has been found profitable to give a liberal dressing of Thomas slag, say from 600 to 1,000 lbs. per acre.

Applying Manure.

The manure may be applied in various ways. Applying in fall, winter or spring on land not yet ploughed and turning under in the spring is a method sometimes followed but not to be recommended.

An evenly distributed dressing applied in July or August of the preceding year, the land ploughed immediately with a shallow furrow, then worked at intervals during the autumn, and fall-ploughed with a slightly deeper furrow, will be found satisfactory, especially on heavy soils.



No. 1.

Ploughing as above and applying the manure during the winter or early spring to be worked in with a disc harrow or some other implement will also prove to be a good method and suitable to a great variety of soils.

EARLY PREPARATION OF THE ROOT FIELD.

Roots do best on well-rotted sod. A clover sod, ploughed at a time to turn some aftermath under, will probably provide the best conditions. If it is not desired to harvest a second crop of clover hay, the ploughing might be done in early August with a shallow furrow, in a moist climate, 3 or 4 inches deep, but in dry areas from 4 to 6 inches deep. The land should then be worked at intervals till late September or early October, then ploughed again slightly deeper, or else, ribbed up with a double mould board plough and left till the next spring. In Manitoba, Saskatchewan and Alberta, however, it will be found advisable to plough slightly deeper than the first time and pack. Where the land is to be ribbed in autumn, the manure might be applied before the ploughing the first time, before ribbing up, or after ribbing, in fact any time before preparation for seeding was necessary the next spring. If it is intended to plough instead of rib in the late fall, then manure should be applied before summer ploughing, or else not till after late fall ploughing, after which operation it might be applied at any time till spring.

PLATE II.

Fig. 1. Seeding on Ridges. Fig. 2. Seeding on Flat.

Fig. 3. Ribbing up and Rolling. Seeding on Flat and Ridges.

PLATE III.

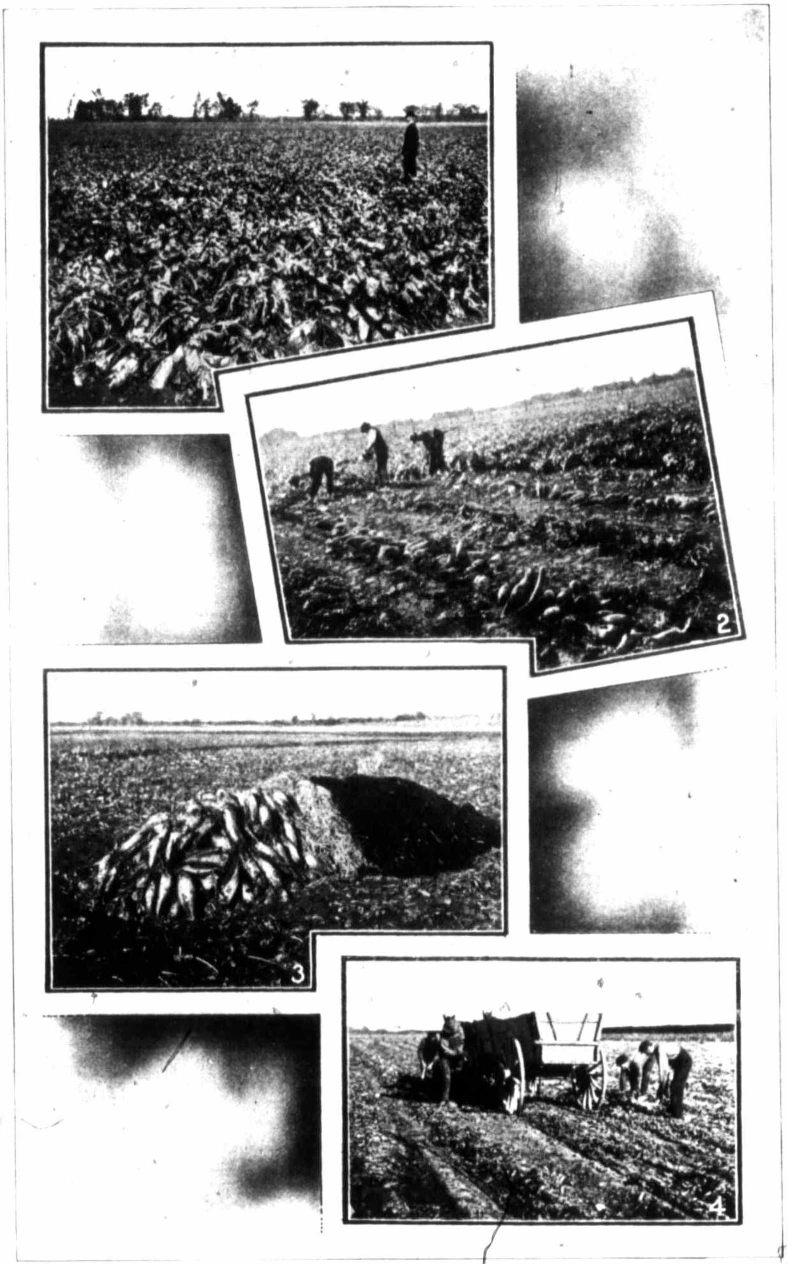


Fig. 1. Field of Mangels, Ottawa.
" 2. Pulling and Topping.

Fig. 3. Pitting in Field.
" 4. Loading.

PLATE IV.

Brood Sows on Central Experimental Farm at Ottawa.

Unloading into Root Cellar.

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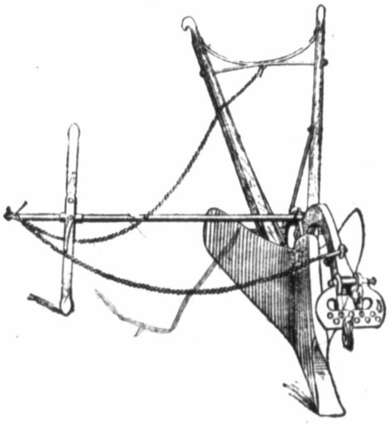
In the case of pasture land or old meadow, it is imperative that summer ploughing and working be done, if returns at all good are hoped for. Much more work in the way of discing and harrowing will be necessary on old sod than in the case of clover sod. Such land it will be found advisable to plough again in the fall rather than rib up. It is usually better also on such land to apply manure before summer ploughing.



No. 2.

Compact the Seed Bed.

Most thorough cultivation and compacting of the seed bed is an absolute necessity. Any openness due to lack of cultivation or other cause is sure to prove injurious.

Subsoiling.

Roots require a somewhat deeper soil than most other farm crops. To provide suitable conditions it is, therefore, often advisable to subsoil. This may be done in two ways: first, by following in the furrow immediately behind the regular plough with a subsoil plough, or with a plough from which the mould board and inside braces have been removed; second, by attaching a simple subsoiling hook or grubber to the plough being used. This latter plan will generally prove satisfactory, but the first described method is the more thorough and more certain to be effective in very heavy soils.

Getting Ready to Sow.

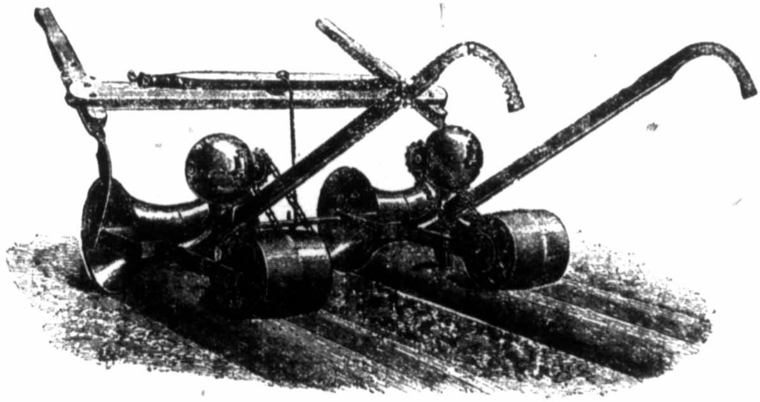
Where the manure is applied in the spring on the surface, great care must be taken to work it in and thoroughly incorporate it in fine particles with the soil, which should be perfect as to tilth before the harrow or other cultural implements are stopped. If the soil is very light or very dry, it should be rolled immediately after harrowing. If it is intended to sow on ridges the field should be ribbed up in uniform ribs 28 to 36 inches apart and 8 or 10 inches high, as soon as it is in proper condition.

Having taken care to first remove any sods, stones or lumps from the tops of the ridges, the field should be rolled lengthwise of the ribs. If the soil is very light and loose, it will be found advantageous to roll more than once, say once or twice before seeding and once after seeding. On light soils or in dry areas, it is often advisable to sow on the flat, in which case the only preparation necessary after the land is sufficiently cultivated and the manure thoroughly incorporated, is the rolling with a moderately heavy roller.

SEEDING.

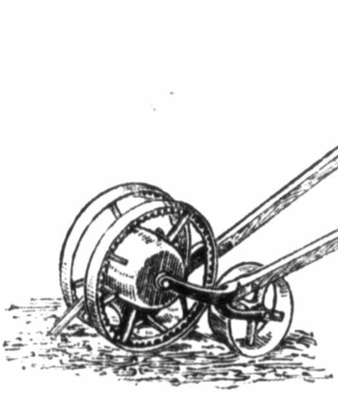
The seeding should be done as soon as the soil is in nice shape in the spring. The date will depend upon the district and upon the local conditions, but it is seldom possible to get them in too early. Any time from April 20th in Western Ontario to early June in Northern Quebec, Athabasca or Yukon, may be taken as suitable dates in parts of Canada lying between these extremes. The chief point is to get the seeds into the soil from 1½ to 2 inches deep and well covered, as soon as the weather is warm enough to insure germination.

Under test, seeds of mangels, sugar beets and sugar mangels often germinate as high as 150%. Nevertheless, a heavy seeding is necessary in order to insure good results. Many seeds fail to germinate when sown, not on account of being infertile, but because of lack of moisture or other adverse conditions. On this account, it is advisable to sow from 6 to 12 lbs. per acre, according to soil and weather conditions. The rougher or coarser the land, the more seed should be sown, and the drier the weather the more seed is required. When the seeding is done on the flat a greater proportion of the seed sown is likely to germinate; especially is this true in dry seasons. If the soil is dry, it will, as indicated above, be found good practice to roll lengthwise again after seeding. This is true whether seeding be done on ridges or on the flat.



No. 3.

Generally speaking, better results may be expected from sowing with the hand seeder than with the horse seeder, but with proper care exercised, either will be found satisfactory. Where no seeder is available, a shallow drill 1½ to 2 inches deep, traced along the smooth surface of the top of the ridge with a dull-pointed stick or the corner of a hoe will serve to receive the seed. The seed sown in the drill by hand may be covered with a hand rake, using the back thereof to draw the soil over the seed, and the same part of the rake or the foot to pack it down firmly.



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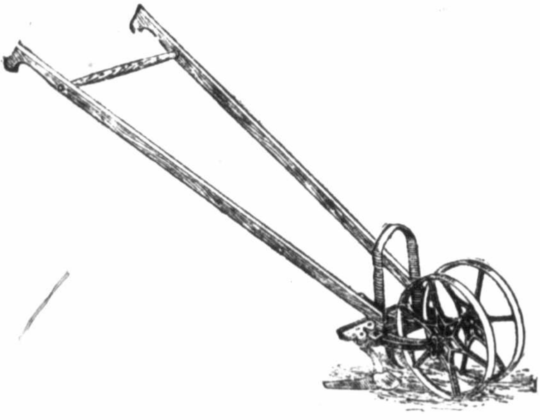
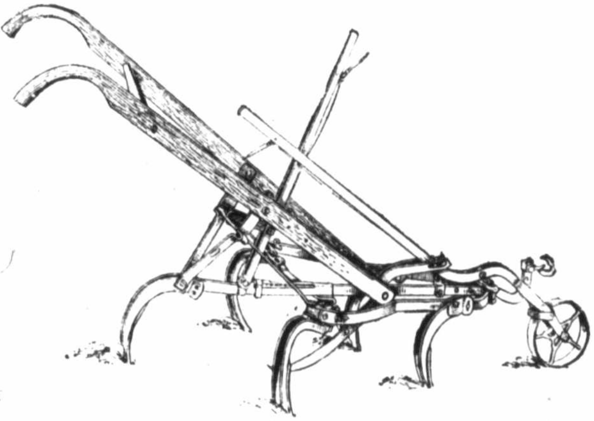


No. 5.

Seed may be sown evenly along the row, or dropped in bunches of four to eight seeds every 8 or 10 inches. The latter plan has proven entirely satisfactory wherever tried, often giving good results where the other method resulted in a very poor stand.

Early Cultivation.

The hand wheel hoe is an almost indispensable implement where roots are grown at all extensively and if available it should be used as soon as the young plants appear above the surface. Its use will break the crust, kill weeds and stimulate the growth of the young roots. It should be sent through whenever needed till the roots are fit to be thinned and cultivated with the horse-hoe.



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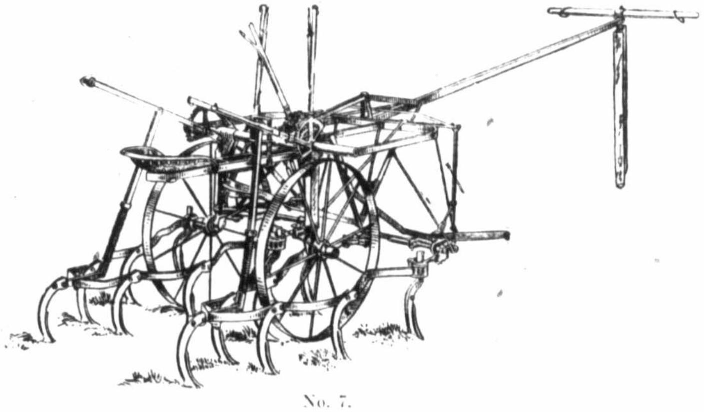

No. 7.

Thinning the Roots.

Thinning is probably the most unpleasant and expensive operation in connection with growing roots. It is, however, susceptible of being made much more expensive and laborious than at all necessary, if no effort be made to render it less so.

In the first place, a suitable hoe should be used. It had better be light handled and should have a thin, shallow and narrow blade, 3 or 4 inches deep, 4 or 5 inches wide and sharp on three edges.

To get the best results, the operator must know how to go about his work. The roots should stand when thinned from 6 inches to one foot or possibly 15 inches apart. This calls for some judgment on the part of the man who thins. The strongestgrowing and most vigorous and healthy-looking plant should be left wherever possible. If a miss or blank occurs of 18 inches or more, it is often well to leave two roots close together at either end and make as much use of the space as possible. Transplanting is sometimes practised but is not always successful. With a little practice, the man who is willing to pay attention to his work will seldom find it necessary to do any hand work, unless the field is very dirty. A clean, firm cross stroke between small clumps where a root is to be left, then a careful, rapid manœuvering of the hoe to clear away the weeds and the other small mangels or beets surrounding, or adjacent to, the favoured one, will be found a practicable and, after a little experience, even a rapid and easy operation. The man should stand sidewise between the rows, facing the row on which he is working. When so placed, he can work to better advantage, pushing and pulling from the favoured root with the sharpened ends of the hoe, and cutting between with the usual edge.

Later Cultivation.

The roots should be kept free from weeds all summer and, in addition, should be cultivated at frequent intervals to keep the soil in good shape and conserve moisture.

Time to Harvest.

The roots should be harvested before any very heavy frosts come to injure them. Unlike turnips, mangels, sugar mangels and sugar beets do not grow much after cold weather comes, and they are also more or less injured by anything over 5 or 6 degrees of frost.

HARVESTING.

The actual harvesting involves several distinct operations. The root must be pulled from the ground. This, not infrequently, requires the exercise of considerable strength and, in the case of sugar mangels, and more especially sugar beets, it is quite often necessary to loosen the soil with a plough to facilitate the work. After pulling, the leaves must be removed. The quickest and best way to do this is to twist them off with the hand. A man may advantageously pull two rows at a time, throwing the roots in a row to either right or left of him as the case may be, but throwing them so that on the return rows, the roots therefrom may be thrown to join those from the first two, making what grew in four rows standing, lie together in one row of pulled roots. This arrangement will leave room for a cart or wagon to pass along and be loaded from both sides.

HOUSING.

The hauling in should be done on dry days if possible, so as to enable the loaders to knock the roots fairly free of soil. Throwing the roots into a wagon and then throwing them out again at the root house on to a slide with slatted bottom will usually insure their going in fairly clean, a condition very necessary to their keeping well.

THE ROOT HOUSE.

The root house should be well ventilated and well drained. Light is not necessary. Local conditions will have to do very materially with the method of constructing and the material used. Stone or cement walls will prove most satisfactory. Care should be taken to see that roots may be easily put in and easily taken out.

Root houses included in the stable are often quite satisfactory.

In many parts, roots not needed till the following spring may be pitted and come out in good shape. Here again, drainage and ventilation are essential for success. A side hill had better be chosen, thus insuring no water lying in the pit. A good size is 5 feet wide, 3 feet deep and 20 feet long. Stack the roots up 3 or 4 feet above ground level, cover with 12 or 15 inches of straw and over all throw earth to the depth of 5 or 6 inches. Every four feet leave a tuft of straw uncovered at the apex to act as a ventilator. (See cut.)

WHERE TO USE.

All these varieties of roots are valuable for dairy cows, beef cattle, calves, swine and poultry. Sugar beets have the highest feeding value, sugar mangels usually come next, but mangels make an excellent forage for any of the above. They should not be fed to sheep, and it is not usual to feed them to horses. They are acceptable to sheep, but are frequently injurious to the males. There is no objection to feeding them to horses, if horses can be induced to eat them.

For Cattle

When feeding to cattle, they may be given whole if fed alone and fed to tied animals. If it is desirable to feed along with other forage, or to feed to cattle running loose, it is better to slice or pulp them. A mixture of chaff, 50 lbs., pulped roots, 200 lbs., and meal to suit, is very palatable, very wholesome and exceedingly valuable as a feed for steers or dairy cattle. The addition of 400 lbs. corn or clover ensilage to the above mixture will be found to give excellent results.

For feeding dairy cattle or for beef production we have found it possible to replace a considerable proportion of the usual meal ration with mangels. When used for this purpose, our experience on the Central Farm, as well as the experience of a number of Experiment Stations in the United States, where similar trials have been conducted, goes to indicate that from 8 to 10 lbs. of mangels is equivalent to one lb. of mixed meal for milk production. Forage sugar beets appear to be worth much more than either mangels or sugar mangels, for either milk or beef production.

All classes of cattle are particularly fond of these three kinds of roots and nothing appears to afford them such keen enjoyment as a few whole roots thrown in their mangers.

As a means of sharpening up a flagging appetite or inducing extra consumption of feed for any purpose, any one or all of these roots are unsurpassed.

As a corrective, as a stimulant, as a tonic, as a gentle laxative, as a diuretic and as a feed having a good influence on the flavour of the milk produced in the case of dairy cattle, sugar mangels and forage sugar beets are not surpassed by any other forage possible of economical production in every part of the Dominion.

For Swine

It is as feeds for swine that mangels, sugar mangels and forage sugar beets excel all other succulent forage crops. They have the advantage of being acceptable to all classes of swine. In addition, they may be counted upon to give good results, no matter what the age of the pigs being fed. Young sucking pigs relish a bit of raw mangel and are benefitted thereby. As feeds for shotes, gilts and young boars they give most satisfactory results, and from 8 to 12 lbs. a day each would be a suitable quantity, fed along with some light meal mixture such as shorts and crushed oats, in the proportion of two to one. Brood sows may be given 12 to 20 lbs. a day of mangels, sugar mangels or forage sugar beets, along with a small amount of a mixture of bran, shorts and crushed oats, and do well at the farrowing. It is, however, necessary to begin to decrease the roots about a month before parturition is due to take place, and not more than 6 to 8 lbs. a day should be fed for a few weeks previous to farrowing. As a feed for encouraging milk production in a sow nursing her young, these roots are unexcelled.

They are of great value as a feed for fattening pigs, but should not be fed very liberally when used in this connection. It is usually most profitable to give from one to two pounds of pulped roots to each pound of meal fed, when cheap and rapid gains are desired.

Generally speaking, mangels, sugar mangels and forage sugar beets should be fed raw to swine. There does not seem to be any advantage in cooking. Nevertheless, feeding them warm and mixed with slop is usually a profitable method in cold weather. For old sows fed under cover, a few whole roots are always acceptable and wholesome.

VARIETIES TO GROW.

Three distinct types of mangels have been evolved, the Gate Post, the Tankard and the Globe. Of these, the Mammoth Long Red or Gate Post varieties are, as a rule, the best to grow, on account of yield per acre and quality of roots produced. (See appendix by Mr. Frank T. Shutt, Dominion Chemist.

Either the Rosy sugar mangel or the White variety does well.

Danish Forage sugar beets are probably the best to grow for forage purposes.

YIELDS.

The yield of mangels may be expected to range from 12 to 50 tons per acre, according to soil and climatic conditions. Sugar mangels are likely to run one-quarter less than this, and sugar beets one-third less.

The smallest crops may be expected off light land in a dry climate or dry season. The largest yields may be looked for on strong alluvial soils, where the rainfall is abundant.

The largest crop the writer has ever seen was at Chilliwack, B.C., where about 50 tons per acre was being harvested.

COST OF GROWING AN ACRE.

The probable cost of growing an acre, labour alone considered, might be itemized about as follows:—

	Cost.	Time.
Ploughing, summer..	$2 00	7 hrs.
Cultivating, harrowing and rolling several times during fall..	4,00	13 "
Ribbing up or packing..	60	2 "
Preparing land in spring..	4 00	13 "
Sowing..	50	3 "
Seed..	1 00	8 lbs.
Hand wheel hoeing (2)..	1 20	8 hrs.
Thinning..	4 50	30 "
Hoeing..	2 40	16 "
Cultivating at intervals (6)..	3 00	10 "
Pulling, topping, &c..	3 45	23 "
Hauling, team..	1 50	5 "
Loading, unloading, &c..	2 55	17 "
Machinery..	30	
	$31 00	
Adding value of manure used per acre..	4 00	
Rent..	3 00	
Making total cost per acre of..	$38 00	

Taking 20 tons as an average crop of mangels or sugar mangels, and 16 tons as an average crop of sugar beets, the average cost of mangels in the root house will be per ton, $1.90, and of sugar beets, $2.37½.

In our field crops of mangels, sugar mangels and sugar beets, at the Central Experimental Farm, the average cost per ton in a number of years has been $1.75, safe in the root house.

COMPOSITION AND FEEDING VALUES.

The following notes on the chemical composition of the three kinds of roots have been prepared for this bulletin by Mr. Frank T. Shutt, M.A., Dominion Chemist.

Mangels, in common with other farm 'roots,' are characterized by a high water-content (in the neighbourhood of 90 per cent) but, in spite of this fact, they constitute a forage crop of very considerable value. This is largely due to the fact that the 'dry matter' is composed chiefly of sugar and pectin, constituents which are non-nitrogenous nutrients (carbohydrates) extremely easy of digestion and of very considerable value in the animal economy, as a source of heat and energy. They may also serve in the animal system for the production of fat, as has been conclusively shown by recent experiments.

Apart from their intrinsic value from the feeding standpoint, there are several qualities or properties possessed by mangels which must not be overlooked. Of these, succulence stands first, mainly because it enhances palatability and associated as it is here with ready and complete digestibility of the nutrients, is undoubtedly a factor of no small importance in the keeping up of the milk flow.

Stock feeders of experience have recognized roots as performing a useful function in keeping animals thrifty and healthy. This is largely owing to their richness in saline matter which consists chiefly of potash compounds. These are mildly laxative and possibly possess other beneficial medicinal properties.

And lastly it would seem that roots may materially aid in the digestion of the rest of the ration and prove useful in the proper distention of the digestive apparatus.

The seeds of many varieties of mangels are to be found on the market and for a number of years past the more important of these varieties have been analyzed in the experimental farm laboratories.

Reference to annual reports of the Chemical Division will show that very considerable differences in the dry matter and sugar-content exist among these varieties. In the following table, the highest and lowest among the mangels examined have been given, for the past ten years.

DRY MATTER AND SUGAR IN MANGELS.

Year.	Number of Varieties.	Dry Matter.		Sugar in Juice.	
		Maximum.	Minimum.	Maximum.	Minimum.
		p.c.	p.c.	p.c.	p.c.
1900	3	11·14	8·19	6·15	2·64
1901	3	9·63	9·10	5·02	4·15
1902	7	16·61	10·24	9·95	5·24
1903	5	14·74	10·89	10·40	6·17
1904	10	13·92	9·24	9·18	4·75
1905	17	12·82	7·52	6·95	1·93
1906	16	13·52	7·99	7·53	2·22
1907	10	14·61	10·78	8·63	6·09
1908	12	13·14	10·66	7·07	3·87
1909	14	12·66	8·94	7·40	4·47

The difference between the richest and the poorest of these roots grown on the same soil and in the same season, is seen to be very considerable and can only be attributed to inherited qualities. Size of root and character of season may profoundly modify the composition of roots, but our experiments have shown that heredity is also a potent factor in influencing the feeding value of mangels. We may further cite the case of two well-known and distinct varieties—Gate Post and Yellow Globe—grown on the Experimental Farm, Ottawa.

DRY MATTER AND SUGAR IN GATE POST AND GIANT YELLOW GLOBE MANGELS.

Seasons of Growth.	Gate Post.				Giant Yellow Globe.			
	Average Weight of One root.		Dry Matter.	Sugar, in Juice.	Average Weight of One Root.		Dry Matter.	Sugar in Juices.
	Lbs.	Oz.	p.c.	p.c.	Lbs.	Oz.	p.c.	p.c.
1900	....	....	11·14	6·15	....	....	8·19	2·64
1901	2	9	9·41	4·15	3	3	9·10	4·08
1902	3	2	13·90	9·39	3	9	10·24	5·24
1903	3	3	12·93	7·38	3	13	10·89	6·17
1904	2	14	12·64	7·62	2	13	9·24	5·26
1905	2	13	12·07	6·83	3	12	8·64	3·55
1906	2	2	12·90	6·59	1	8	12·73	6·45
1907	3	10	12·53	7·25	2	7	10·78	6·34
1908	1	11	12·02	4·94	2	4	10·66	4·47
1909	3	14	11·82	6·64	3	7	10·95	5·82
Average for 10 years	....	....	12·14	6·69	....	....	10·14	5·00

These facts serve to demonstrate the advisability of considering the composition as well as the yield and keeping quality in the selection of a variety.

Sugar Mangels.

When these roots were first introduced, about ten years ago, analysis showed that they were considerably richer in dry matter and sugar than were ordinary mangels, and, consequently, of much higher feeding value. This was especially true of the varieties originated and sent out by Vilmorin & Co., a firm that had made a specialty of breeding sugar beets. However, we have not for some years past been able to discover among the varieties of sugar mangels commonly found on the Canadian market any marked superiority when compared with the better mangels, such as Gate Post.

Forage Sugar Beets.

These, as a rule, are decidedly richer than mangels, but not so rich as the varieties especially grown for sugar production. Like in mangels and other roots, increase in size is usually concomitant with decrease in dry matter and sugar, but apart from this fact, varietal differences of considerable magnitude exist.

The composition, &c., of the roots used in illustrating this bulletin and grown this season on the Experimental Farm, Ottawa, are given in the following table, the examples being taken from the fields, October 15:—

	Gate Post Mangel.	White Sugar Mangel.	Danish Foreign Sugar Beet.
	p.c.	p.c.	p.c.
Dry matter	9·84	8·32	12·99
Sugar in juice	4·35	3·88	5·56
	Lbs. Oz.	Lbs. Oz.	Lbs. Oz.
Weight of root with leaves	11 0	10 2	9 0
Weight of root only	9 3½	8 13	5 15
	Inches.	Inches.	Inches.
Length of root	24	16	14
Diameter of root	6	6½	5

Weight for weight the 'Danish Forage sugar beet' is the most nutritious root of the three and the 'White sugar mangel' the poorest. The relative position in nutritive value here indicated is, we believe, chiefly due to varietal qualities and would be largely maintained on other soils and in other seasons.