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FIELD ROOTS

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Field Roots

BY

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INTRODUCTION

The production of field roots such as swedes, mangels and carrots for livestock feeding purposes and growing of swedes for human consumption is of considerable importance in Canadian agriculture. Root growing for livestock is especially important in those areas in which corn for ensilage cannot be grown successfully. Apart from their high digestibility and nutritive value in the rations of farm stock, roots are notable for their palatability and succulence. The feeding of roots enables a greater utilization of dry roughages of inferior quality that may be available on the farm. The use of swedes as a table vegetable is well recognized and in recent years this crop has been grown extensively for export to the United States.

This bulletin has been written to answer the numerous inquiries regarding the growing, harvesting, storing, feeding and methods of producing seed of field roots. No attempt is made here to deal with sugar beets, since this crop is confined to certain definite areas and is grown specifically for the commercial production of sugar. Such a crop requires certain special considerations which are too extensive to be dealt with in a bulletin of this kind.

DISTRIBUTION OF FIELD ROOTS

Although the production of field roots (carrots, mangels and swedes) in Canada varies somewhat from year to year, an average of approximately 200,000 acres are grown annully. Some roots are grown in every province, but about 90 per cent of all roots are grown east of Manitoba. Slightly over one-half of the total roots in Canada are grown in Ontario.

The extent to which field roots are produced in the various provinces and the trend in production from 1919 to 1945 as reported by the Dominion Bureau of Statistics is shown in Table I.

An examination of the data contained in Table 1 indicates considerable fluctuation in acreage throughout the 26-year period. There was a general decline in total acreage from 1919 to 1923 while production remained steadily around 180,000 to 200,000 acres from 1923-1941. Following that period a further decline in acreage took place.

In 1945 the acreage in the Maritime Provinces and Quebec reached a low point for the past quarter century. The total production in Canada in 1945 was less than one-half that of 1919.

These wide fluctuations in acreage of field roots reflect variations in labour conditions. The growing of field root crops requires considerable amounts of labour in hoeing, thinning, cultivating, harvesting and storing. Consequently when labour is short acreage is reduced. No serious effort at mechanization of field root production has been attempted in this country although relatively simple and inexpensive harvesting implements have been developed and used successfully in some other countries.

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TABLE 1.—ACREAGE OF ROOTS IN CANADA

Year	B.C.	Alberta	Sas-katchewan	Manitoba	Ontario	Quebec	New Brunswick	Nova Scotia	Prince Edward Island	Total
1919	7,387	12,500	13,932	6,045	123,029	87,496	24,279	30,291	12.237	317,196
1920	7,403	12,300	10,449	7,404	119,744	83,613	20,030	19,946	9,397	390,286
1921	6,809	8,202	7,870	4,411	104,157	53,084	17,745	15,436	9,961	227,675
1922	7,347	9,289	8,666	4,630	105,033	48,812	16,202	16,162	8,115	224,256
1923	7,188	9,254	5,235	4,987	102,091	33,948	10,799	12,382	8,628	194,512
1924	6,435	6,599	5,364	4,619	108,196	33,600	10,657	12,643	9,847	197,920
1925	6,919	8,555	4,876	4,732	110,538	34,000	11,711	13,353	9,692	204,376
1926	6,780	8,596	3,387	4,411	107,181	34,000	12,235	14,858	11,334	202,782
1927	7,082	5,835	3,329	3,932	104,887	34,000	12,283	15,299	10,530	197,177
1928	7,000	5,197	3,197	4,606	107,360	34,000	13,873	15,852	11,422	202,507
1929	7,226	4,858	3,196	4,642	104,674	40,437	13,790	15,561	11,116	205,500
1930	7,000	3,100	3,830	4,800	105,000	59,300	13,600	15,800	13,500	225,930
1931	4,063	3,200	3,100	4,500	87,431	25,648	8,898	8,795	8,512	154,147
1932	4,500	1,800	2,100	4,400	100,000	33,300	10,300	9,500	8,900	174,800
1933	4,900	1,900	2,800	6,100	100,300	36,400	11,100	10,700	9,700	183,900
1934	5,100	1,700	2,300	5,800	100,200	38,800	11,600	11,200	10,700	187,400
1935	5,300	1,800	2,200	6,400	98,100	37,800	11,700	11,800	10,100	185,200
1936	5,900	2,600	2,000	3,100	96,200	37,200	11,800	11,700	12,000	182,500
1937	5,500	2,700	2,400	5,500	97,200	37,600	11,500	11,700	11,600	185,700
1938	6,000	2,700	2,500	6,200	99,000	37,600	12,200	11,900	11,400	187,500
1939	6,000	3,000	3,000	6,000	98,000	38,000	13,000	21,000	11,000	199,000
1940	6,000	3,000	2,000	6,000	98,000	37,000	13,000	12,000	11,000	188,000
1941	5,000	2,000	2,000	7,000	92,000	37,000	13,000	11,000	10,000	179,000
1942	4,000	4,000	3,000	3,000	58,000	42,000	16,000	14,000	14,000	158,000
1943	3,000	4,000	4,000	4,000	59,000	44,000	16,000	15,000	13,000	162,000
1944	3,000	4,000	4,000	3,000	59,000	36,000	13,000	12,000	13,000	147,000
1945	2,000	4,000	3,000	3,000	58,000	31,000	14,000	12,000	12,000	139,000
27 yr. Ave	5,735	5,061	4,212	4,934	96,382	41,690	13,493	14,144	10,840	196,491

Another factor which may have accounted for some of the fluctuations in acreage was the prevalence of brown-heart, a physiological disease which makes swedes unfit for table use. However, this condition has been largely remedied through the application of boron to the soil.

Distribution in Relation to Uses

The greatest use for mangels and turnips is in connection with the feeding of livestock, especially beef and dairy cattle and sheep. This is reflected particularly in the production in the predominantly dairy and beef section of southwestern Ontario. The counties of Bruce, Oxford, Waterloo, Wellington, Ontario and York, each produce 3,000 acres or more of roots per year. Similarly in central and southern Quebec, the production is over 1,000 acres each, in the five counties of Lotbiniere, Nicolet, Joliette, Portneuf and Quebec.

The livestock produced throughout most of Eastern Canada, to a much lesser degree in Western Canada, consume most of the roots. In many sections, however, a considerable acreage is produced for human consumption. Near the large urban centres a steady market for this type of production is maintained. In certain sections in Eastern Canada, swedes for table use are grown extensively for export to United States. These are distributed largely to the larger cities of the Northeastern States and along the Atlantic seaboard. Such markets have a steadying influence on production since the returns for the crop for this purpose are much higher than for livestock feed. The high cost of producing root crops demands a comparatively high return value to interest the grower in their production.

In the Prairie Provinces the relatively few roots grown are produced largely for livestock feed. Their growth is limited to the more northerly sections where mixed farming is practised. Very few roots are grown in the more strictly wheat growing areas. The drier climate of the prairies is not favourable for the growing of field roots.

Yield and Value of Root Crops

The total production of root crops in Canada has averaged in the last eight years 34,399,000 cwt. or 1,719,950 tons. This production has been valued at an average of $16,611,000. The average yield per acre varies considerably in the different provinces. During the eight-year period, 1938 to 1945 the average yield per acre for Canada was 10·1 tons per acre. In Prince Edward Island the yield was 12·9 tons per acre. Nova Scotia 12·3 tons, New Brunswick 11·7 tons, Quebec 9·4 tons, Ontario 10·6 tons, Manitoba 5·1 tons, Saskatchewan 4·1 tons, Alberta 5 tons, and British Columbia 10 tons per acre. These yields indicate the difficulty of growing roots in the Prairie Provinces. The yield under the dry conditions which predominate in these areas is only about one-half or less that of the more humid areas of Eastern Canada and British Columbia.

VARIETIES OF FIELD ROOTS TO GROW

Mangels

Based upon the shape or form of the roots there are six general types of mangels grown in Canada. These are long, half-long, intermediate, ovoid, tankard and globe. Within each of these types white, red and yellow coloured varieties may be obtained. The choice of type depends largely upon individual preference, although the half-long and intermediate types are most widely grown. On soils that are deep, friable and high in fertility the long or half-long sorts produce high yields. For the average soils the intermediate and ovoid types are generally preferred, while tankard and globe types are recommended for shallow soils.

The varieties most commonly grown in Canada are briefly described below. While some of the others widely grown or of only local interest are listed also.

Prince.—This variety may be described as half-long, skin colour above ground greenish white to greyish green. The underground parts of the roots are white. The flesh is white. This variety produces high yields per acre, but is relatively low in dry-matter content. It is well adapted to growing on deep fertile soils.

Tip-Top.—The roots are intermediate in type with some variants approaching the half-long and ovoid types. The underground portions of the roots are reddish-orange in colour, while the above ground parts are orange-yellow. The flesh is mostly white in colour. This variety is not a high yielder in terms of tons of roots per acre, but the roots are unusually high in dry-matter content. Its keeping qualities are good. This variety has shown marked resistance to damage from the cercospora leaf-spot disease.

Yellow Intermediate (Moore's).—The skin colour above ground is olive-green grading to smoky-grey. Below ground parts are wax-yellow. Flesh is white in colour. This variety is intermediate in dry-matter content and keeps well in storage.

Frontenac.—This is an intermediate type which is relatively uniform, smooth and free from coarse shoulders and pronginess. The below ground parts of the root are a deep-orange colour. Above ground parts vary from smoky-yellow to orange-yellow. The flesh is white. The dry-matter content of this variety is intermediate to high and its keeping qualities are good. This variety has considerable resistance to the cercospora leaf-spot disease.

Giant White Sugar.—This is of the half-long type varying in colour from light-green to smoky-grey above ground to white below ground. The flesh is also white. This variety stands high in yield of tons per acre. It is intermediate in dry-matter content.

Other varieties less commonly grown in Canada include:—Mammoth Long Red, Danish Sludstrup, Yellow and Red Leviathan, Yellow and Red Eckendorf, Superlative, Alliance Globe, Yellow Globe, Golden Tankard, Golden Giant Intermediate, etc.

Reference to the data in Tables 2 and 3 shows that wide differences occur in green yields per acre of the different varieties of mangels. It is interesting to note, however, that due to marked variations in dry-matter content of the different varieties, yields in terms of tons of dry matter per acre are relatively similar for all varieties. High feeding value per ton and good keeping qualities are associated with high dry-matter content.

TABLE 2.—GREEN YIELDS IN TONS PER ACRE OF FIVE VARIETIES OF MANGELS COMMONLY GROWN IN CANADA.

Experiment Farm or Station	No. Yrs	Varieties				
		Prince	Giant White Sugar	Tip Top	Frontenac	Yellow Interm.
Charlottetown, P.E.I.	3	33·24	25·15	17·40	27·35	23·15
Fredericton, N.B.	4	30·43	21·93	16·70	22·50	18·24
Nappan, N.S.	7	29·33	21·90	22·53	23·59	21·13
Lennoxville, Que.	5	18·40	14·70	13·10	15·10	14·20
Ottawa, Ont.	5	38·65	21·39	25·86	31·18	28·55
Indian Head, Sask.	3	23·05	20·59	15·21	20·76	20·94
Lacombe, Alta.	3	29·08	25·27	21·16	23·50	24·64
Average		28·88	22·99	18·85	23·43	21·55

TABLE 3.—YIELDS OF DRY MATTER IN TONS PER ACRE OF FIVE VARIETIES OF MANGELS COMMONLY GROWN IN CANADA

Experimental Farm or Station	No. Yrs	Varieties				
		Prince	Giant White Sugar	Tip Top	Frontenac	Yellow Interm.
Charlottetown, P.E.I.	3	3·32	3·28	2·68	3·46	2·84
Fredericton, N.B.	4	3·17	2·89	2·58	2·84	2·30
Nappan, N.S.	7	2·79	2·50	2·85	2·80	2·24
Lennoxville, Que.	5	1·35	1·52	1·76	1·62	1·54
Ottawa, Ont.	5	3·28	3·29	3·30	3·26	2·84
Indian Head, Sask.	3	2·24	2·49	2·32	2·52	2·46
Lacombe, Alta.	3	1·77	1·53	2·50	1·54	1·95
Average		2·56	2·50	2·57	2·58	2·31

Swedes

Based upon root shape or form, swedes are classified into four general types. These are globe, flat, ovoid and tankard. There is not the same relationship between type of root and adaptation to various soil conditions as in the case of mangels. The varieties most commonly grown are of the globe type.

Choice of variety in swedes depends largely upon climatic adaptation, resistance to disease and utilization of the crop. In areas infested with the club-root disease the Wilhelmsburger variety is recommended. Some strains of Bangholm also show resistance to this disease. Where this disease is not a limiting factors in production, varieties such as Ditmars, Acadia and Laurentian are widely grown. The last named variety leads in popularity as a table turnip. A few of the most widely grown varieties are briefly described below.

Acadia.—This is a high yielding variety which is widely grown for stock feeding purposes. It is characterized by a large top with the leaves held well up on a relatively coarse neck. Quarter cracks frequently occur which gives the root a rough appearance. The root is of the globe type with purple top and yellow flesh. While the root is relatively rough in appearance this variety is rated very high in cooking quality, although it is grown chiefly for stock feeding purposes.

Ditmars.—A variety characterized by high yield, smooth, globe-shape greenish or bronze-topped roots. The flesh is yellow and of good flavour. This variety is popular with stockmen.

Wilhelmsburger.—This variety leads all others in resistance to the club-root disease. It is characterized by large, green-topped, globe-shaped roots. The flesh is of a lighter yellow colour than most other varieties. It is widely grown in areas where the club-root disease is prevalent.

Laurentian.—A medium sized variety characterized by smooth, purple-top, globe-shaped roots, short necks and relatively small leaf growth. The flesh is yellow and of a fine even grain. It is widely grown as a table vegetable.

Other Varieties.—Most of these are globe in type and may be divided into three classes on the basis of the colour of the above-ground parts of the root. Purple top varieties include:—Bangholm, American Purple Top, Elephant, Canadian Gem, Hall's Westbury, Superlative, Jumbo, Masterpiece, Perfecta, Imperial, Purple King, etc. Bronze top varieties would include:—Kangaroo, Lord Derby, Hazard's Improved, Invicta, etc. There are a few green varieties among which may be found Improved Yellow Swedish, Wintergreen, Green Top, etc.

The yields of six varieties of swedes grown at a number of Experimental Farms and Stations in Canada are given in Tables 4 and 5.

TABLE 4.—GREEN YIELDS IN TONS PER ACRE OF SIX VARIETIES OF SWEDES COMMONLY GROWN IN CANADA

Experimental Farm or Station	No. Yrs	Varieties					
		Acadia	Ditmars	Hall's Westbury	Wilhelms-burger	Bangholm	Laurentian
Charlottetown, P.E.I	7	30·51	30·87	30·19	27·90	26·83	24·91
Fredericton, N.B	8	28·61	30·24	26·42	25·47	21·60	26·63
Nappan, N.S	8	29·27	29·35	30·00	27·57	26·80	26·51
Lennoxville, Que	5	23·80	25·90	—	26·80	21·10	22·30
Ste. Anne, Que	5	21·94	22·97	20·83	19·54	19·75	29·96
Ottawa, Ont	6	25·44	26·42	24·99	23·03	22·67	22·07
Kapuskasing, Ont	4	9·61	9·52	8·86	10·85	10·09	11·08
Indian Head, Sask	7	12·18	12·29	9·63	11·16	10·29	12·42
Lacombe, Alta	7	26·11	23·69	18·32	17·44	18·46	15·22
Average		23·05	23·47	21·16	21·08	19·73	20·23

TABLE 5.—YIELDS OF DRY MATTER IN TONS PER ACRE OF SIX VARIETIES OF SWEDES COMMONLY GROWN IN CANADA

Experimental Farm or Station	No. Yrs	Varieties					
		Acadia	Ditmars	Hall's Westbury	Wilhelms-burger	Bangholm	Laurentian
Charlottetown, P.E.I	7	3·93	2·93	3·04	2·80	2·65	2·43
Fredericton, N.B	8	3·44	3·42	3·17	3·07	2·71	2·84
Nappan, N.S	8	2·99	2·82	3·02	2·80	2·76	2·44
Lennoxville, Que	5	2·22	2·28	—	2·40	1·94	1·84
Ste. Anne, Que	5	2·34	2·60	2·30	2·24	2·28	2·14
Ottawa, Ont	6	2·82	2·84	2·75	2·35	2·53	2·30
Kapuskasing, Ont	4	1·01	1·01	1·01	1·21	1·19	1·10
Indian Head, Sask	7	1·52	1·42	1·18	1·30	1·30	1·41
Lacombe, Alta	7	2·86	2·36	2·39	1·81	2·16	1·58
Average		2·57	2·41	2·36	2·22	2·17	2·01

While yields of different varieties vary at different stations the two highest yielding varieties throughout all tests are Acadia and Ditmars. This applies both to tons of roots produced per acre and to tons of dry matter per acre.

The percentage of dry matter or the yield of dry matter per acre may be taken as a good indication of the feeding value of the roots. For stock feeding purposes the choice of variety should be determined largely on the basis of the largest return in pounds of dry matter per acre.

Field Carrots

There are three main types of field carrots grown in Canada. These are long, intermediate and short types and range in colour from white to red. Of the long type, White Belgian, Yellow Belgian and Champion are the most popular varieties. Danish Champion, Mammoth Intermediate White and Half Long White are satisfactory varieties of the intermediate type. The short types of field carrots are represented by fewer varieties than the other classes. The two main varieties in this class are Oxheart and James, although Mammoth Short White is sometimes placed in this class also, but in reality it is of the short intermediate type.

The intermediate types of field carrots have given the highest yields of roots as harvested, but when this yield was reduced to a dry-matter basis the short types have produced just as much dry matter per acre. The long varieties in tests conducted at the Central Experimental Farm, Ottawa, have given relatively low yields per acre.

In Table 6 it may be seen that the average yield of carrots grown at a number of Experimental Farms and Stations was 16·55 tons per acre. This is considerably lower than the yields of mangels or swedes as shown in Tables 2 to 5. The yields of dry matter were 1·77 tons per acre, which is also lower than that obtained from mangels or swedes. It may be also seen that the white varieties were slightly more productive than the yellow sorts.

TABLE 6.—AVERAGE YIELDS IN TONS PER ACRE OF FIELD CARROTS MOST COMMONLY GROWN IN CANADA, BASED ON 18 TESTS.

Variety	Green Yields	Dry Matte Yields
Danish Champion	14·92	1·55
Yellow Belgian	14·96	1·74
White Belgian	17·44	1·89
Improved White Intermediate	17·48	1·89
Mammoth White	17·97	1·81
Average	16·55	1·77

GROWING FIELD ROOTS

Climatic Adaptation

Mangels and carrots give highest yields in a warm or even a hot climate, while swedes and turnips do best where the climate is cool. For maximum yields all kinds of roots require soil moisture in abundance and rainy seasons suit them best. Prolonged hot spells are very detrimental to swedes, and are disastrous if accompanied by dry weather, but mangels after the first two months of growth will withstand drought better than any other root crop.

Soil

Roots will grow successfully on almost any kind of soil that is deep, fertile and well drained. Mangels do particularly well on loams and black muck areas, swedes and turnips prefer a clay loam and carrots are best adapted to sand or sandy loam. Mangels and carrots require more fertility and better soil conditions generally than swedes and turnips.

Crop Rotations for Roots

While mangels, swedes or carrots usually do not occupy large areas on any individual farm, one or other of the root crops are grown on a large number of farms. In a survey made in Eastern Canada in 1933, information was obtained from 673 representative farmers located at various points throughout the five Eastern Provinces. Over sixty per cent of these men grew either mangels or swedes and the average area grown by each was 1½ acres. Roots are usually grown in conjunction with some other hoed crop such as corn or potatoes in the rotation. Where grown for livestock feed, the rotation usually includes two years of grain and two or three years of hay or pasture. It is preferable to grow roots in a long rotation, like the above, so that they do not return to the same area more often than once in four or five years. This provides for

FIG. 1—Thorough spring seed-bed preparation or late summer or fall ploughed land is desirable for roots.

FIG. 2—Ridging up land for field roots. These ridges are then rolled and flattened down ready for seeding as shown on the left.

more adequate plant food balance in the soil and aids in controlling weeds, disease and insect infestation. When swedes are grown as a cash crop for table use, they are sometimes grown in a shorter rotation but even for this purpose they should not return to the same land more often than once in four years. In the rotation, roots usually follow sod and preferably a clover or alfalfa sod.

Preparation of Land

In preparing sod land for roots, it is usually recommended that the land be ploughed in late summer. This is particularly true if weeds are troublesome. After ploughing, the land should be cultivated at frequent intervals to destroy weed growth and also hasten the decomposition of the sod. This should be continued until late fall. If manure is available, it may be applied in the fall and ploughed in fairly shallow. If the manure is to be applied in the winter, it may be distributed evenly over the field and disked in as soon as possible in the spring. In this case too strawy material should be avoided since it would interfere with subsequent cultivation and seeding operations. Where weeds are not prevalent the land may be ploughed late in the fall and thus the cultivations following summer ploughing may be eliminated. The manure may be ploughed in at the same time or applied in spring as suggested above. On sloping, erodible land where spring runoff is likely to wash the manure away, it is recommended that the manure be piled in a compact heap at some convenient place in the field during the winter. In the spring when danger of washing has passed, and it is convenient to disk the manure in immediately, it may then be spread on the field. On light sandy loam soil spring ploughing is quite satisfactory. For heavy soils spring ploughing is not recommended.

Where roots follow stubble in the rotation, it is usually not possible nor is it so necessary, to plough in late summer. Stubble land is more easily worked down to a satisfactory tilth than is sod land, so late fall ploughing is usually satisfactory.

A good seed-bed is required for sowing roots. In the spring with the ploughing and manuring completed, the land should be well cultivated or disked, drag harrowed, rolled and ridged ready for seeding. Some growers prefer to seed on the level and if this is done the ridging operation of course is eliminated.

Manure and Commercial Fertilizers

Since roots, as mentioned previously, are generally grown for livestock feed, there is usually manure available for the crop and there is nothing better for maintaining the fertility of the soil, although where no manure is available, root yields can be satisfactorily maintained with commercial fertilizers. An experiment has been conducted for a period of 33 years at the Central Experimental Farm at Ottawa in which the yields of mangels from various manurial and commercial fertilizer treatments have been compared. The mangels in each case have followed timothy sod in a rotation of mangels, oats, clover, timothy.

The following table shows the treatments and average yields for this experiment.

Manure and Fertilizer for Mangels

Treatment	Average Yield 33 Years
No manure	6·87 tons per acre
Manure only	22·64 " "
Commercial fertilizer only	20·55 " "
Manure and commercial fertilizer	22·14 " "

The area which received manure only was given a dressing of 15 tons per acre in the fall before ploughing for the mangel crop. The area receiving complete fertilizer had an application of 100 pounds of nitrate of soda, 300 pounds of superphosphate, and 75 pounds muriate of potash per acre broadcast just before ridging the land for seeding the mangels. Where both manure and fertilizer were applied, the rate for each was one-half the above.

Where it is possible to apply comparatively heavy applications of 15 to 20 tons per acre of manure, very little, if any, commercial fertilizer should be required. A dressing of 200 or 300 pounds of superphosphate may be beneficial under such circumstances.

Where manure is limited or entirely unavailable, commercial fertilizer should be used. Different soil types under varying systems of management will differ in their fertilizer requirements and many factors must be taken into consideration in arriving at the most economical rates and grades of fertilizer to use but the following general recommendations will serve as a guide for swedes and mangels:

Clay loams manured lightly	300 lb. per acre of	2–12–6
Clay loams not manured	600 lb. per acre of	4–12–6
Sandy loams manured lightly	400 lb. per acre of	2–12–6
Sandy loams not manured	800 lb. per acre of	2–12–10 or 5– 9–8

Under conditions existing in the Maritime Provinces, rates somewhat higher than those suggested above are often recommended.

In areas where water core or brown-heart of swedes occur, applications of 15 to 20 pounds of borax per acre are recommended as a control for this disorder. It is often possible to purchase commercially mixed fertilizer with one or two per cent of borax mixed with the fertilizer. This is a convenient and satisfactory way of adding borax where it is needed.

For carrots 800 to 1,000 pounds per acre of 2-12-10 fertilizer is sometimes recommended. Sometimes applications of nitrogen induces splitting in carrots. This may be particularly true on muck soils. Where this occurs, a formula such as 0-8-16 or 0-8-24 might be more suitable.

Sowing the Seed

There appears to be little difference in the average yields from roots sown on ridges and on the flat. The young plants, however, are more easily thinned when the seed is sown on ridges and, as it is more desirable to work the soil slightly away, rather than towards the young roots, this can be more easily accomplished by sowing on ridges. On the other hand, on very light soils or where the soil tends to dry out seriously during the growing season, sowing on the flat is recommended. If ridges are used they should be rolled before sowing and if the soil is dry it will be found good practice to roll again after sowing. Mangel and carrot seed should be put in as soon as possible after the spring cereal crops have been sown. In the vicinity of Ottawa early May sowing is desirable. The results of many experiments show the necessity of early sowing if maximum yields are to be obtained. Swedes may be sown two or three weeks later than mangels but very late June sowing will result in reduced yields. From 6 to 8 pounds of mangel seed, 3 to 4 pounds of swede seed and 3 to 4 pounds of carrot seed should be sown per acre in rows 26 to 32 inches apart. The rougher and coarser the land the more seed should be sown, and the drier the land the more seed is required. Only fresh seed which is high in percentage germination should be used. Hand seeders are more satisfactory for sowing mangel and carrot seed than horse seeders. Swedes may also be sown with the hand seeder but the one-horse two-row turnip seeder gives very good results and is much quicker.

FIG. 3—The wheel-hoe is particularly useful to stir up the soil and to destroy small weeds after the roots have emerged.

The seed is usually sown one-half to one inch deep. It should be well covered and in contact with moist soil. The deeper seeding should be practised on light soils and the shallower on soils of a heavier type. It is better to be liberal with seed and not risk getting a poor stand. The cost of seed is small when compared with other items of expense in raising roots and therefore it pays to sow enough seed to ensure a good stand.

Early cultivation of the young plants is very desirable. Just as soon as the plants appear through the surface and the row can be followed, cultivation should begin with the hand wheel-hoe and horse cultivator. The wheel-hoe is particularly useful to stir the soil near the rows. It may be arranged so that it will work the soil within half an inch of the plants, thereby destroying many small weeds, loosening the surface soil that has been packed by the roller, breaking up any crust formed by frequent showers and allowing the air to enter and warm the soil to hasten the growth of the young plants. The single-horse cultivator or scuffler should follow the wheel-hoe, to kill weeds between the rows. When a wheel-hoe is not available, the horse cultivator may, when driven with care, be made to cut close to the rows.

It has been suggested that when roots are grown on the flat a tilting harrow or a weeder mounted on wheels may be used about three weeks after planting, when the plants are ready to thin, to give the field a stroke crosswise of the rows. This will destroy many weeds, stir the soil and remove many superfluous plants.

Thinning should be done as soon as possible after the first pair of true leaves develop between the cotyledons or seed leaves. The seed leaves, in the case of the turnip, are the first pair of green kidney-shaped shoots or leaves to appear above the ground. In the case of the mangel, the seed leaves are strap shaped. Early thinning like early seeding gives highest yields. Mangels should be thinned

FIG. 4—The single horse cultivator or scuffler should follow the wheel-hoe to kill weeds between the rows of mangels or swedes.

9 to 10 inches, swedes 10 to 12 inches and carrots 2 to 3 inches apart in the row. In thinning mangels and swedes one plant only should be left in each place. If two are left together only small and inferior roots will develop.

While the ordinary garden or weeding hoe is generally used in thinning mangels and swedes, some growers prefer to cut their hoe to a length of 4 to 6 inches, square the corners, sharpen three edges and straighten the neck a little so that the hoe may be used to push or pull out the undesirable plants. For thinning carrots a special carrot-hoe is desirable. The blade should be $2\frac{1}{2}$ inches wide with square corners. Hoes should always be kept sharp by using a file.

The strongest-growing 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 closer together at either end in order to 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 when thinning roots 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 manoeuvring of the hoe to clear away the weeds and the other small mangels or turnips 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 edge.

It is a good plan to go over the ground a second time two or three weeks after thinning in order to remove any surplus plants that had not been taken out at the first thinning.

FIG. 5—Thinning or singling of the root crops is slow and tedious but should be done carefully to ensure a good stand.

The roots should be kept free of weeds all summer by frequent cultivations which should be continued until the leaves are fully developed and so shade the soil that weed growth is smothered. Two hoeings may be necessary to remove weeds during the growing season, the first being done when thinning.

Harvesting Roots for Feed

The harvesting of roots is always delayed until cool weather prevails. They are usually the last crop to be brought into storage. Swedes in particular make their best growth during the cool weather in the fall but other roots also continue to grow until fairly late in the season. Several degrees of frost will not materially injure the keeping qualities of swedes, but mangels and carrots should be harvested before any heavy frosts occur. Mangels and carrots which are still standing in the rows untopped should not be harmed by 4 to 5 degrees of frost, but lower temperatures are likely to cause injury, and even 5 degrees of frost might injure pulled roots lying uncovered on the ground. Swedes will stand several degrees more frost than mangels and carrots. Care must be exercised, however, to prevent the exposure of all kinds of roots to heavy frosts as they will, if badly frozen, become a complete loss when placed in storage. The average date of harvesting mangels at the Central Experimental Farm at Ottawa is October 15 and the average harvest date of swedes is October 20.

Mangels are usually pulled by hand and the tops twisted off. Cutting the tops off with a knife, unless very carefully done, will break the skin, and rotting of the mangels in storage is likely to result. All the green leaves as well as any that have turned brown should be removed from the roots. A man may advantageously pull two rows at a time, throwing the roots in a row either to the right or left of him as the case may be, but throwing them so that on his return trip the roots from the next two rows may be thrown with

those from the first two, so that what grew in four rows standing will 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.

Swedes may be harvested in a manner similar to mangels but as they are not so susceptible to injury from rough handling as mangels, the usual method of harvesting them is to cut off the tops with a sharp hoe and drag them out of the ground with a drag-harrow by going across the rows. In the case of some varieties it may be necessary to use the plough to remove them.

In removing carrots it is frequently necessary to run a plough parallel with the row leaving an inch or two of earth along beside the roots. The roots may then be pulled sideways, the tops twisted by hand or cut off with a knife and the carrots loaded into a cart or wagon.

FIG. 6—Roots are pulled from four rows standing into one row so that there is room for a cart or wagon to pass along and be loaded from both sides.

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

Storage of Roots

The best place of storage is a root-cellar near where they are to be used for feeding. Such a cellar may be part of a barn or basement or may be built

conveniently near the stable. The root-house or cellar should be well drained and well ventilated. A sandy soil and high ground provide ideal conditions. otherwise very careful drainage of the foundation will be necessary. The isolated cellar should be in a sheltered position with a south entrance, if possible. Roots should not be stored in the stable all winter as the temperature is likely to be too high and the roots, particularly swedes, may taint the air. Farmers sometimes find it necessary, however, because of absence of other space to store the roots in the stable for a month or two before opening the silo for winter feeding. In this case only sufficient roots should be grown to feed the stock until the transition period, between outside and inside feeding, is passed. A well-drained earth floor for the cellar or root-house is much to be preferred to a cement bottom or wooden floor. To keep out the frost the root-cellar should be at least two-thirds below the surface of the earth and even then it may be necessary about the middle of December to bank up with manure the outside top of the cellar which is not under the earth. Light in the cellar is not necessary. Local conditions materially influence the method of construction and the material used. Stone and cement walls will prove very satisfactory. Care should be taken to see that the roots may be easily put in and taken out. Ventilation intakes and outlets should be arranged in such a way that they can be closed during periods of severe frost. During the fall the doors and windows, in addition to the regular ventilators, should be kept open day and night, and especially at night, until there is danger of frost. If the roots are deprived of a circulation of air at any time during their storage period they will mould and spoil. The circulation of air in the cellar may be increased by using slatted ventilators or shafts placed vertically, from the floor to the ceiling at various places in the cellar or house. These should be 10 to 12 feet apart each way, and the roots piled around them. In very severe weather some cellars located away from buildings may require that heat be provided in some manner. A small stove for instance would supply the necessary condition.

When a cellar or root-house is not available, roots may be stored outside in a pit. The construction of a pit is described on page .. of this bulletin. If care is exercised in placing the roots in storage and if precautions are taken to see that the cellar, house or pit is properly constructed and cared for during the storage period, the roots should come through the winter in good shape.

COST OF PRODUCING ROOT CROPS

The cost of producing roots as well as other common farm crops has been studied by the Dominion Experimental Farms throughout Canada for many years. Detailed information with regard to the method of arriving at the costs are published in bulletins No. 168, Cost of Producing Farm Crops in Eastern Canada, and No. 159, Cost of Producing Farm Crops in the Prairie Provinces.

The cost of production will vary from year to year and from province to province depending largely on labour costs. Other factors also will influence the cost such as price of seed, the amount and cost of manure or commercial fertilizer applied and the price of land. With such variations, it is only possible to show a statement outlining how costs may be calculated. To determine the cost for a particular location in any one year the actual prices for given circumstances might replace those presented herewith. The following table is based on a statement of costs at the Central Experimental Farm, Ottawa, in 1945.

COST PER ACRE OF PRODUCING MANGELS

Item of Cots	Statement	Amount
		$ cts.
Use of land and buildings	Interest on value of land plus taxes	4·50
Manure	40 per cent of 20 tons @ $1.50	12·00
Seed	8 pounds at 60 cents	4·80
Machinery	Annual fixed charge	2·85
Manual labour	160.2 hrs. at 30 cents per hour	48·06
Horse labour	50 hrs. at 13 cents per hour	6·50
Tractor work	3·5 hrs. at 75 cents per hour	2·62
Total	Cost per acre	$81·33
	Yield per acre 19·99 tons	
	Cost per ton $4·07	

The cost per acre of growing swedes will vary somewhat from the above figure for mangels. Inasmuch as swedes do not require as careful handling in thinning and harvesting as do mangels, the labour cost is slightly lower. The cost per acre will also be correspondingly lower.

On the other hand, the thinning of carrots is a very slow and time consuming operation and the manual labour hours are increased accordingly. In 1945 it required 88 hours more manual labour for carrots than for mangels. This increased the cost per acre by $26.40. Furthermore, the cost of carrot seed required was almost three times as high as for mangel seed. The total cost of producing carrots in 1945 was $116.43 per acre.

FEEDING OF ROOTS TO LIVESTOCK

In the feeding of livestock, roots occupy a rather unique position in that their value lies not alone in the nutrients that they contain but also on their tonic effect. They are, what might be called, a watery concentrate in that their fibre content is low and the digestibility of the dry matter is high and it is in this latter attribute that their peculiar value lies. When added to the ration of any class of stock they assist in bringing about increased health and vigour because of their ease of digestibility, their succulence and their slightly laxative effect. Roots are very palatable and encourage the maximum consumption of other feeds which in turn increases production.

Digestibility of Dry Matter Content of Roots

Roots normally are compared with silage as a feeding stuff but this comparison is not completely valid since silage because of its fibre content and relatively low digestibility, is more like a watery roughage than a concentrate. Digestion trials carried out at the Central Experimental Farm, Ottawa, using steers as the experimental animals have shown that the dry matter of mangels contains 78 per cent digestible nutrients as compared with 62 per cent for corn silage. Swedes fed to sheep gave a total digestible nutrient content of 82 per cent with corn silage once again at 62 per cent.

It must, however, be borne in mind that the dry matter percentages of these feeds, as fed, are as follows: corn silage 20 per cent, mangels 10 per cent and swedes 12·5 per cent. Therefore, pound for pound, as fed, corn silage contains

more digestible nutrient than do either swedes or mangels. These figures simply mean that on the basis of total digestible nutrients a ton of swedes is worth only 83 per cent as much as a ton of corn silage and mangels 63 per cent as much. Since all three of these feeds are essentially carbohydrate feeds the question of protein content has not been taken into consideration.

Vitamin Content of Roots

With the exception of yellow carrots, roots are not a good source of vitamins. Although swedes contain ample quantities of vitamin C this vitamin is not considered necessary in the feed of farm animals for while they probably need it they are thought to be able to synthesize it from other substances in their feed. On the other hand yellow carrots are an excellent source of vitamin A and if they are available then they are a valuable addition to the ration particularly for pregnant or lactating animals toward the end of the winter when the vitamin content of hay is becoming lower.

Minerals

Calcium is not present in roots in any appreciable amounts and the supply of phosphorus is only fair, therefore when roots are fed in large amounts the animals should have free access to an adequate mineral mixture or ample amounts of mineral should be mixed with their grain ration.

Methods of Feeding

Before they are fed, all excess dirt should be removed from the roots. While they are usually chopped or pulped for dairy cattle this is not necessary if the roots are fed with the hay as it forms a bed which holds the roots so that the cows can handle them more easily. For horses, sheep and beef cattle they are best fed whole although for the latter class of stock it is a fairly common practice to feed chopped straw with chopped roots. This is done by spreading them in layers and allowing them to stand until the straw is moist and soft. Such a practice will appreciably increase the consumption of straw. However, it must be borne in mind that roots are usually an expensive feed and any handling or processing of them will increase the cost, therefore whenever possible they should be fed whole. When fed whole care should be taken that small roots are not given as there is danger of choking, particularly with greedy individuals. While brood sows may be fed whole roots with satisfactory results they should be chopped or pulped for all other classes of swine.

Mangels

Mangels are fed principally to dairy cattle and swine although they are relished by horses, beef cattle and sheep. It is less common for them to be fed to these latter classes of stock as, there is the possibility that heavy feeding will produce urinary calculi in males. Sheep are particularly subject to this condition. Mangels have a dry-matter content of approximately 10 per cent, contain slightly under one per cent digestible crude protein and in the vicinity of 8 per cent total digestible nutrients. Dairy cattle are normally fed 4 pounds of mangels per 100 pounds of live weight along with hay and meal, or if silage is available, 2 pounds of silage and 2 pounds of mangels may be fed instead. Sows will eat up to 15 pounds per head daily. Bacon hogs and young breeding

stock may receive between one and two pounds of roots per pound of meal, but with the former the proportion should be reduced to not more than one pound per pound of grain as the end of the finishing period approaches. Idle horses and mares will eat about a pound of mangels, if carrots or swedes are not available, along with an equal amount of hay and of oat straw per 100 pounds live weight. Such a ration will maintain them in good condition throughout the winter. Foals and yearlings can be fed two to four pounds per day. If mangels are fed to ewes, $1\frac{1}{2}$ to $2\frac{1}{2}$ pounds per head per day may be given along with good quality hay.

Swedes

Swedes are slightly higher in digestible nutrient content than mangels and are therefore considered to be more suitable as a feed for fattening stock. They contain about 12·5 per cent dry matter, approximately 1·5 per cent digestible crude protein and slightly over 10 per cent total digestible nutrients. They are particularly valuable for beef cattle and sheep where maximum gains are desired, however as was previously pointed out, the economy of feeding them must be carefully watched since their cost is usually high. If fed to dairy cattle swedes should be given after milking in order to avoid tainting the milk. Beef cattle will consume very large quantities of swedes, if available, but it is probably wise to restrict the amount fed to between 30 and 40 pounds per head daily. Pregnant ewes can be fed from two to three pounds of swedes per day and if the roots can be kept until late winter and early spring they are an excellent supplement to the ration of nursing ewes before grass is available. Fattening lambs will eat up to 4 pounds per head per day. Horses and swine can be fed approximately the same amounts as those recommended for mangels.

Carrots

There are two main colour types of carrots, white and yellow or red and the latter is the most useful due to its high vitamin A content. Carrots contain between 11 and 12 per cent dry matter, about one per cent digestible crude protein and between 9 and 10 per cent total digestible nutrients. Due to their low yields and high cost per bushel they are not of much importance for live-stock feeding in this country. When available, they are usually fed to horses, and because of their high vitamin A content they can be a valuable adjunct to the ration of pregnant mares. Because of this high vitamin content the feeding of yellow carrots to brood mares will tend to reduce the incidence of joint-ill in the foals.

SEED PRODUCTION OF FIELD ROOTS

Field root seed of high quality can be produced in Canada. Unfortunately the cost of production is somewhat high so that competition from European seed is keen when such seed is available on the Canadian market. During the war years the production of mangel, swede and carrot seed was expanded to the extent that Canadian requirements were readily met and a large quantity made available for export. Now that European seed is available, and the demand has lessened in Canada, seed production has been curtailed.

The main areas of production are the Maritimes, Ontario and British Columbia. At the present time most of the root seed is grown for an assured market and thus the amount produced is governed quite largely by the trade requirements.

Growing and Harvesting Seed Roots

Carrots, mangels, swedes and other field roots of a similar nature are biennials which during the first season, store reserve food material in the so-called "root" and in the second season flower and bear seed. Because of this the production of seed must be carried out in two distinct stages. First, the seed roots must be grown. Seed roots are merely roots which are to be used to grow seed the following season. While the term seed root is generally applied to late sown roots, which are immature when harvested, it may also be applied to mature roots which are to be used to produce seed.

The culture of roots for seed is the same as for roots for feed and the same care must be exercised in order to obtain good roots in abundance.

With field roots which are to be saved as seed roots, considerable care must be exercised in lifting to avoid injury to the body or the crown of the root. Mangels, particularly the intermediate types, and swedes may be pulled, while the long types of mangels and carrots should be lifted with the aid of a digging fork or the soil carefully loosened with a plough. When pulled, the selected roots should be placed on top of the row at right angles to it. It is an advantage in topping to have the roots on each two rows so placed that the tops adjoin each other. The roots to be saved should be carefully selected as to colour, size, shape and freedom from bruises.

The leaves should not be twisted off but cut about two inches from the top of the root. The best tool for this purpose is a sharp heavy knife. With the roots arranged as advised in the previous paragraph, two rows can be done at a time. Dead leaves and green leaves that have been missed in topping may be pulled off when the roots are loaded. In removing the roots from the field, care should be taken to avoid bruising.

Carrying Seed Roots Over Winter

The overwintering of seed roots is probably the biggest problem confronting the seed grower. Success or failure may depend on the percentage of roots that are brought through the winter in sound condition.

Several methods of holding roots over, have met with varying degrees of success depending largely on the climatic conditions. Storage in root cellars, storage in pits, and wintering over without lifting are the most commonly used methods.

Storage of Seed Roots in Cellars

A root cellar, where it is available, is by far the most reliable means of ensuring a high percentage of sound roots in the spring. In using root cellars, it is important that the roots do not dry out too much. For satisfactory storage, temperature should be maintained between 32 to 38°F. Sudden changes and extremely high temperatures may be just as harmful as freezing temperatures.

FIG. 7—Root-pit. Partly filled trench; method of piling to centre; and ventilators in position.

FIG. 8—Root-pit. First covering of earth and straw being put on. V-shaped boards protecting top of pit are removed when pit is dry and cool.

FIG. 9—Root-pit. Final covering of earth and straw being put on. Bags on ventilators for control of temperatures.

Pit Storage of Seed Roots

This method is to be recommended where cellars are not available. Pits should be located on a well drained area, preferably on a sandy knoll or side hill. A trench is dug 10 to 20 inches deep and 4 to 6 feet wide, with the length depending on the amount of storage room desired. For small roots a width of 4 feet is sufficient, while 6 feet is not too wide for the storage of large roots.

As the roots are hauled from the field they should be placed in the pit. They should be piled so that they come to a peak at a height of 24 to 36 inches above ground level. No special order in piling is necessary. As the roots are piled, ventilators should be put in place along the centre of the pit. There should be a ventilator for every four feet of pit, the first one being placed about two feet from the end. Ventilators may be constructed by nailing together four 6-inch boards to form a square pipe. Two of the boards should be solid. On two opposite sides 6-inch openings should be left or cut about a foot apart along the length of the ventilator. The openings in the ventilator should be placed lengthwise to the pit and not extend higher than the top level of the first layer of straw.

When the ventilators have been put in place the roots should be covered lightly with straw and allowed to stand for a few days if there is no danger of harmful frosts. If canvas sheets are available they may be used to protect the roots from rain until a further covering of straw and earth is applied.

When the roots have been allowed to sweat for a few days the covering of straw should be increased to a foot in thickness and the whole surface of the pile except a foot-wide strip along the top covered with 6 to 10 inches of earth. In obtaining earth for this purpose care should be taken to avoid creating a condition which would allow water to drain into the pit.

The opening along the top of the pit is protected by covering with two boards nailed in the shape of a V, and inverted. This opening along the top allows for further loss of heat from the pit and can be left protected by the boards until the pit is cool and dry. The boards are then removed and the opening covered with earth and straw.

With the first layer of earth in place the pit should be left until this covering is frozen sufficiently hard to bear the weight of a man. Then a further 6 or 8 inches of straw is put on followed by another 6 or 8 inches of earth. The pits are now ready for the winter, but they require attention throughout the season. Thermometers placed inside the ventilators should be used in order to have a check on the temperatures in the pits. One thermometer to every three ventilators is sufficient and it may be moved to different ventilators from time to time. If there is rotting in the pits a continued and definite rise in temperature will result, and by moving the thermometers from one ventilator to another the source of trouble can be definitely located. With the source located an opening can be made in the pit and the cause, generally the result of a damaged or rotten root, removed.

Jute bags nailed to the ventilator tops are handy for conrolling pit temperatures as they can be used to plug the ventilators during periods of extremely cold weather and when warm weather occurs following periods of cold weather.

In the spring the outer covering of earth and straw should not be removed until the frost starts to come out of the inside covering. The pits should not be opened before planting time. In this way the roots will go into the ground in a fresh and crisp condition.

Field Wintering of Seed Roots

In areas where very mild winters are the rule, it has been found possible to winter roots over in the field. This method involves seeding in mid-summer

and leaving the roots in the ground without thinning or further attention over winter, to produce seed the following season.

Planting Seed Roots for Seed

Sorting

It is important to carefully examine the roots before planting so that rotten and off-type roots which would be unproductive may be discarded. It is advisable to grade the roots roughly as to size so as to permit roots of approximately the same size to be planted together. This will facilitate harvesting because as a general rule the larger roots mature seed earlier than smaller ones.

FIG. 10—Mangels for seed being set in furrow.

FIG. 11—Planting mangels for seed. A single furrow plough covers the roots. A two furrow plough follows, roots being again set in the third furrow.

Choice of Land and Location

If the land chosen is not in a high state of fertility the venture is doomed to failure. Furthermore, the land should be in good physical condition. It should be manured and ploughed the previous fall since it must be ready early in the spring. If at all possible it should be thoroughly worked in the fall and ridged up. In the spring about 300 pounds to the acre of a fertilizer high in phosphate and potash should be applied. Garden beets, sugar beets and mangels intercross readily, and it is therefore necessary that at least one-quarter mile separate seed plots of these species.

Time of Planting Seed Roots

Spring conditions will naturally govern the time of planting. An effort should be made, however, to plant as early in the spring as possible.

Methods of Planting Seed Roots

Some of the larger growers have devised methods of their own to plant seed roots. Generally, however, the small grower either digs the roots in with a spade, or sets the roots in a furrow following a plough. On the whole better results are obtained when the roots are dug in, especially where only a limited acreage is used. Digging in is a laborious operation, however.

Before digging the roots in, the land should be marked out by whatever means are available so that the rows will be 3 feet apart and the roots 2 feet apart in the rows. The holes are dug deep and large enough so that when the roots are put in, the crowns will just be visible above the ground level. The roots are then placed in the holes and the earth firmed around them. If the roots are too long to be placed upright they may be placed at a slight angle in the hole. Small roots may be planted close together.

If the seed roots are small, as is frequently the case with mangels and carrots a tile spade is a good tool to use. This is inserted in the ground and then pressed forward. This makes a wedge-shaped hole into which the small roots can be placed and the ground firmed around them with the feet.

The plough may be used to plant seed roots with fairly good results. In planting with a plough the roots are set in every third furrow and covered with the next furrow-slice. Roots should be set in at a slight angle so that when the earth is firmed around them the crowns of the roots are level with the ground.

As a general rule, the stand will be reduced from 15 to 20 per cent if the roots are ploughed in as compared with hand planting. This is due to damage to roots by the horses and plough and to roots falling from their place with the consequent improper covering. It is also very difficult at times to plough deep enough to accommodate large roots with the result that these roots are only partially covered. Cultivation is also made more difficult since uniform planting is seldom obtained.

FIG. 12—Mangel seed crop in stock.

FIG. 13—Hauling mangel seed to thresher. The use of sheets saves a large percentage of seed.

Handling the Seed Crop

Cultivation and Hoeing

Cultivation is essential in the production of a good seed crop. Since the period in which cultivation can be performed is limited the work should be thorough. In order to destroy weeds missed by the cultivator hoeing is necessary. A clean seed crop is the most profitable one.

Time of Harvesting Seed

The swedes are ready to harvest as soon as the seed pods begin to get papery and the seed becomes fairly firm. Mangels are harvested when the seeds on the stalks have started to turn brown. Poor quality mangel seed is obtained when the crop is cut too early and a serious loss of seed results if the crop is cut too late.

Carrots do not ripen uniformly and cannot all be harvested at the same time. Individual seed-clusters must be picked when they become brown and several pickings are necessary to harvest the crop in best condition. Machinery is used for large scale harvesting.

Method of Harvesting

The root seed crop is usually harvested by hand with a sickle. When cut the seed is put in piles to cure. Some growers find it advantageous to throw the stalks as cut on canvas or jute sheets. They are then tied in sheaves and stooked. This method, however, involves more labour and is of doubtful value since the seed does not cure so readily in the bound sheaves. In some areas it has been found possible to cut mangels with a swather and let the crop cure on the ground without further attention until threshing time. The crop should be left out until it is thoroughly dry and all the seeds hard and mature. Since most root seed will shatter readily when dry it should be handled as little as possible before threshing. Canvas sheets should be placed in the bottom of the wagons before the crop is loaded.

FIG 14—Harvesting swede seed crop. Stalks as cut can be piled on sheets.

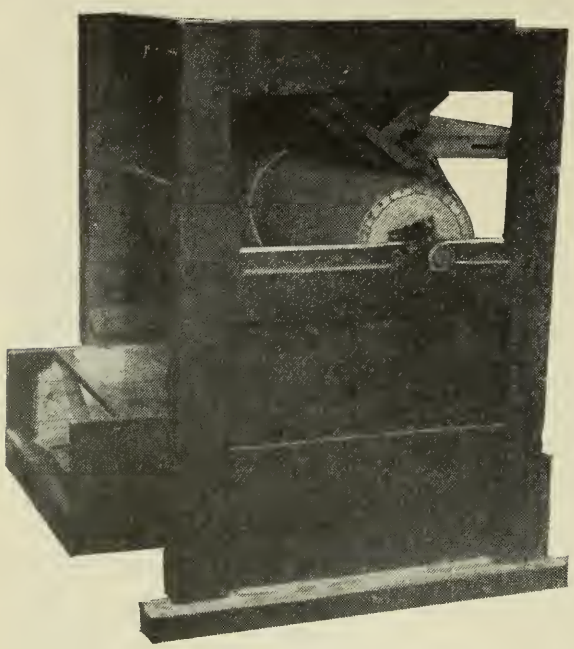

FIG. 15
Carrot-seed rubber (part of case removed). A corrugated rubber-covered cylinder running against a canvas apron. Can be operated by hand or power.

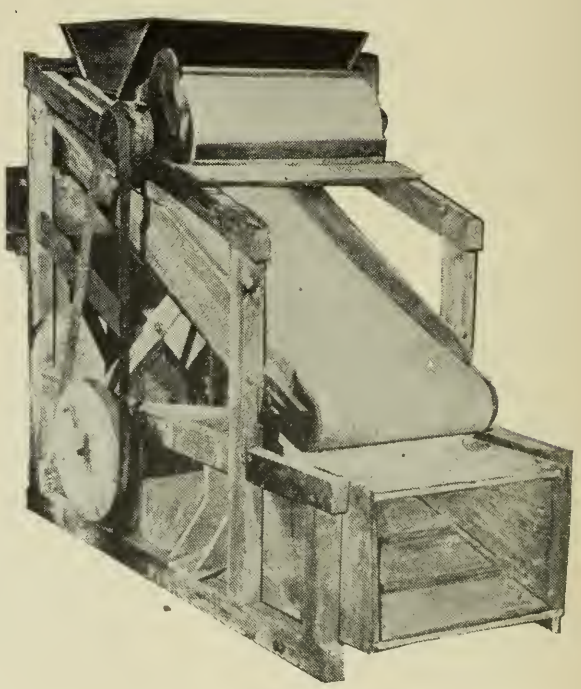

FIG. 16
Small mangle seed cleaning machine. Belt travelling upwards. The seed is fed on to belt near top and rolls to the bottom. Sticks are carried up by belt and discharged at top of machine.

Threshing

The ordinary grain thresher may be used. The seed threshes readily so that it is not necessary to have the concaves set close. One three-row set of concaves and a pea grate make a good combination. A combine will handle swede seed satisfactorily.

Cleaning and Storing Seed

A rough cleaning should be given the seed immediately after threshing. The ordinary cleaning or fanning mill does a good job. In this way all the larger pieces of stalks can be removed as well as small shrunken seeds, weed seeds, earth, etc. It will be observed that the mill will not remove all the small pieces of stems from mangel seed. This will have to be done with a machine called a "draper". The principle of the "draper" is that of a slowly moving canvas belt set at an incline. The seed is fed into this machine, and being round, rolls to the bottom while the sticks are carried on the belt and discharged over the top. Carrot seed has small spines and these cause the seed to cling together. Before cleaning, the seed must be put through a rubbing machine to remove the spines. One type of rubbing machine is a corrugated-rubber-covered cylinder with a fine wire, canvas or rubber apron to act as a concave.

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