DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
DOMINION EXPERIMENTAL FARMS

DIVISION OF FORAGE PLANTS

INTERIM REPORT OF THE DOMINION AGROSTOLOGIST

M. O. MALTE, Ph.D.

FOR THE YEAR ENDING MARCH 31, 1921

Harvesting Variety Plots of Field Roots.

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THE DIVISION OF FORAGE PLANTS

REPORT OF THE DOMINION AGROSTOLOGIST M. O. MALTE, PH.D.

INTRODUCTION

Particularly during the last years of the Great War, the normal work of the Division of Forage Plants was, as may be seen from previous reports, seriously curtailed on account of the necessity of undertaking work of an emergency nature called for by conditions arising out of the war. Thus, the Division was forced to eliminate, for several years, practically all such breeding work with grasses and clovers as required much detailed handling of diversified breeding material. In 1920, however, the Division found itself in a position to resume its breeding work. Indeed, that work was taken up on a much larger scale than it had ever before been conducted on, a fact which was made possible not only because of a large amount of breeding material collected during the war years being available, but also because of the most capable and wholehearted assistance rendered by Mr. R. I. Hamilton, B.S.A., Assistant to the Dominion Agrostologist. Under Mr. Hamilton's direction not less than 140,000 individual plants of grasses and clovers were planted for the purpose of serving as observation and stock material for the development of new varieties.

SEASON

The winter of 1919-1920 was severe on all forage crops, particularly on alfalfa and clovers, which were so very badly killed out that all plots were useless for further record and were consequently ploughed up in the spring. Frost was out of the ground by April 15th, allowing of field work and the planting of seed roots by May 4th. Favourable weather made it possible to have all seeding done, except individual plants, by the end of May, and abundant rainfall with no protracted periods of excessive heat throughout the summer made it possible to put out an immense number of individual plants for breeding work. The growing season was very favourable for the growth of forage plants, mangels and root seed yields being record ones for Ottawa. A long, favourable autumn allowed all late sown breeding material to make excellent growth before the first killing frost occurred on November 1st.

INDIAN CORN FOR ENSILAGE

Thirteen varieties were sown in duplicate 1/100-acre plots on May 26. They were sown in rows 3 feet apart and thinned to 6 inches between the plants in the row. When harvested, the following yields were recorded.

INDIAN CORN—TEST OF VARIETIES

Variety	Stage of Maturity	Height		Yield per acre		Corn and Cobs per acre	
		ft.	in.	tons	lbs.	tons	lbs.
Longfellow	Ripe	9	1	20	265	3	1,752
Golden Glow	Glazed	8	2	19	638	4	1,180
Wisconsin No. 7	Dough	8	2	18	1,591	5	633
Compton's Early	Ripe	9	0	18	1,535	2	1,904
North Dakota	Ripe	7	4	16	1,584	2	1,752
Bailey	Dough to glazing	7	10	16	309	3	740
North Western Dent	Ripe	7	4	15	1,259	2	1,694
Leaming	Milk to dough	8	4	15	1,143	2	1,811
Wh. Cap Yellow Dent	Dough	8	6	13	786	3	1,321
McConnell's Flint	Ripe	5	9	13	495	*2	1,811
Quebec 28 (commercial sample)	Ripe	7	4	12	461	*2	1,694
Twitchell's Pride (Yellow Flint)	Ripe	5	3	10	695	*1	1,428
Quebec 28	Ripe	5	11	9	767	*1	847

Average..... 15 tons 733 lb.

*Weight of cobs only; corn eaten off by birds.

So far, the work with Indian corn at the Central Experimental Farm has, for various reasons, been largely confined to variety tests. Observations made at Ottawa as well as at several Experimental Stations to the north and east have, however, made it quite clear that for certain districts none of the corn varieties now available commercially can be considered ideal. The taller growing and therefore highest yielding varieties, such as Longfellow, for instance, are as a rule too late to reach the proper ensilage stage in the districts alluded to, particularly northern Ontario and northern and eastern Quebec. The lower-growing but extremely early varieties of the Quebec Yellow type are, on the other hand, not capable of producing the tonnage required to make the growing of them as profitable as desired. Under the circumstances it is obvious that a corn variety combining satisfactory yielding power and sufficient earliness is needed for the districts referred to. Furthermore, such a corn variety must be capable of making satisfactory growth at comparatively low temperatures.

During a number of years a yellow flint corn, grown successfully for a long time by Mr. W. H. McConnell, Aylmer, Que., has been observed to approach the type suitable for "extreme" corn growing districts more than any other corn so far grown by the Experimental Farms and Stations in eastern Canada. This corn ripens regularly at Ottawa and has, on Stations in eastern Canada, reached full maturity in seasons when the common ensilage varieties have not even reached the proper ensilage stage. It does not grow as tall as the ensilage varieties proper, but reaches a considerably greater height than the early varieties of the Quebec Yellow type.

As it is not uniform in type, efforts are being made to develop distinct varieties from it. This year a small block was sown from one selected individual ear, and at harvest time a selection of the best ears was made from some of the most desirable individual plants.

Through the courtesy of Dr. R. A. Emerson, Professor of Plant Breeding, Cornell University, Ithaca, N.Y., the Division had also an opportunity to test and observe samples of a few corn types which are being worked with at Cornell, viz: Esperanza, a Mexican variety reputed to grow at comparatively low temperatures; Alvord's Dent, a moderately early variety; a cross between Esperanza and Alvord's Dent; and a cross between Esperanza and Tom Thumb pop corn, the latter one a very early variety.

The various lots were sown in small blocks and isolated in canvas cages. These cages proved, however, to be rather unsatisfactory, the result being that the different lots suffered badly from attacks of diseases. Thus the cross between Esperanza and

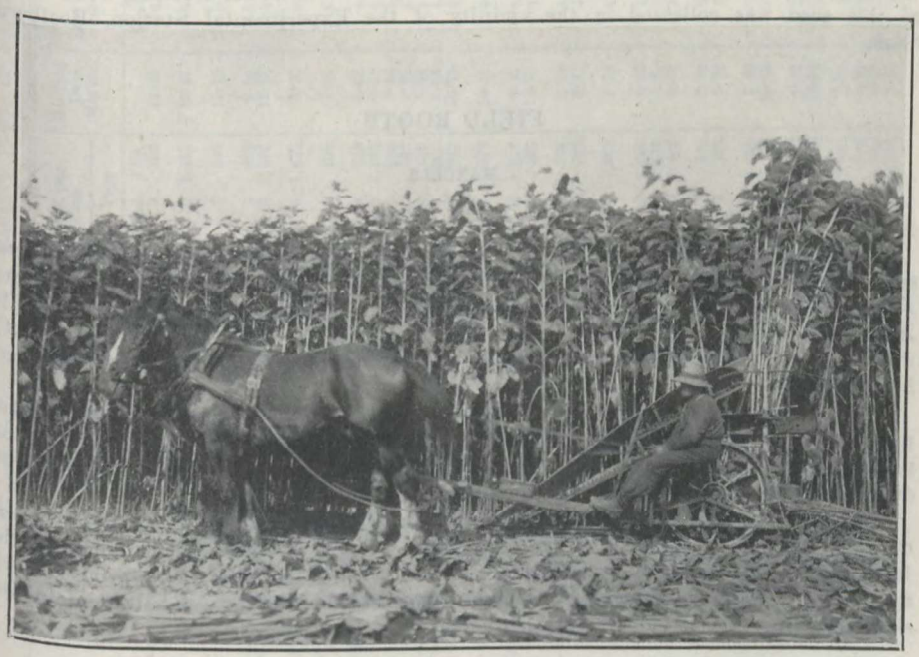
Tom Thumb pop corn was totally destroyed by smut, and of the other lots only a comparatively small number of cobs were harvested. While the Esperanza variety itself appears to be somewhat too late for the Ottawa district, the Alvord's Dent and its cross with Esperanza may, if bred properly, produce a corn type worth further studying and experiments.

SUNFLOWERS FOR ENSILAGE

In view of the widespread interest lately taken in sunflowers as an ensilage crop, the Division arranged to plant one acre to sunflowers, the variety used being the commercial Giant Russian. The sunflower seed was sown on May 27th in rows at different distances apart, as follows:

One quarter acre in rows 24 inches apart.
One quarter acre in rows 30 inches apart.
One quarter acre in rows 36 inches apart.
One quarter acre in rows 42 inches apart.

Cultivation was given the same as for Indian corn with the exception of the section sown in rows 24 inches apart, where horse and later hand cultivation was



Harvesting Sunflowers for Ensilage.

found impracticable on account of the closeness of the rows. The crop was harvested August 30th, when the majority of the heads were in the early milk stage, with a McCormick corn harvester. This machine worked satisfactorily, with the exception of the knotter, which tied too low for best results. After cutting the crop was run through a corn cutter and ensiled.

The recorded yields were as follows:

Distance between rows	Yield per acre Tons	Lb.
24 inches	33	1,556
30 "	29	1,456
36 "	28	1,429
42 "	28	342
Average	30	196

It was observed that, while the heaviest yield was realized from the 24-inch rows, the crop from them was too juicy and, as a consequence, inclined to become somewhat mushy when cut up for ensilage. The crop from the 42-inch rows, on the other hand, was, in addition to being comparatively low in tonnage, decidedly coarse; the leaves were, at harvesting time, comparatively few and coarse and the stalks were rather woody.

Taking everything into consideration, the best results were obtained from the 30-inch and 36-inch planting.

In addition to the experiment just mentioned, a small block of an early flowering type, developed and supplied by the Dominion Cerealist, was grown. This type proved to be decidedly earlier than the Giant Russian variety.

In order to secure material for the development of distinct sunflower varieties, a number of plants showing marked characteristics were left uncut until they had matured their seed. Seed of a large number of individual plants representing different types was also secured with a view to their serving as material for breeding work. Most of this seed was collected in the vicinity of the Experimental Station, Rosthern, Sask.

FIELD ROOTS

MANGELS

Variety Tests

Thirty-nine varieties and types, the seed of which was secured from seedsmen supplying local trade, from exporters in England and Sweden, and from Experimental Farms, were grown in duplicate 1/100-acre plots. They were sown on ridges 27 inches apart on May 14. The land had been a pig run in 1919, and was consequently well fertilized. The season was exceptionally favourable and the mangels made very heavy growth.

All varieties were harvested on October 13 and 14. The roots were counted in each plot, the roots and tops from each plot weighed separately and representative roots photographed in the field. The Chemistry Division was supplied with roots from every plot for analysis of dry matter and sugar content.

Apart from the yields, which are high, the varieties showed a great improvement over the previous 4 years in so far as trueness to type is concerned. Some varieties tested did show, however, a regrettable lack of uniformity, and this was particularly noticeable in half sugar rose and whites, a considerable number of half sugar whites showing signs of red blood, and vice versa.

Variety	Source of Seed	Average yield of two 1-100 acre Plots				Per cent Dry Matter	Dry Matter per acre		
		Roots		Tops					
		Tons	Lbs.	Tons	Lbs.		Tons	Lbs.	
Sel. Gt. Rose Sugar Beet	Wm. Ewing	53	36	9	306	12·40	6	1,148	Half Sugar Rose with light pink skin; 25 p.c. show rose only in crown; 11 p.c. green top white. (17)
Danish Sludstrup	K. Macdonald & Sons	47	694	6	1,121	10·97	5	388	Colour lemon to light orange yellow: a small percentage of red, yellow, and white globes, and white and rose half sugar. (5)
Danish Sugar	Steele-Briggs	46	252	4	602	11·16	5	295	Half sugar rose with medium pink skin; 5 p.c. show rose only in crown; 5 p.c. green top white. (2)
Sugar Mangel	Sutton (England)	53	396	5	498	9·64	5	257	Apparently half sugar white; 25 p.c. show rose in the crown. (26)
Gt. Yellow Intermediate	K. Macdonald & Sons	43	2	6	1,077	11·87	5	208	Majority lemon yellow; a very small percentage half sugar rose and red and yellow globe. (4)
Perfection Mammoth Long Red.	Wm. Rennie	52	772	6	1,455	9·70	5	163	Considerable variation and depth of colour; 3 p.c. appear to be half sugar rose in crown. (15)
Rose Feeding Sugar Beet	Weibull (Sweden)	57	1,399	8	298	8·55	4	1,867	Half sugar rose with deep pink skin; 7 p.c. green top white showing rose in crown. (32).
Gt. Yellow Half Long Interm.	Wm. Rennie	59	1,814	5	735	8·03	4	1,621	Colour light lemon to deep orange yellow; 5 p.c. lemon yellow globe (14)
Yellow Intermediate	Experimental Farm, Ottawa	51	572	5	1,342	9·10	4	1,334	Orange yellow. A very small percentage tend to be light. (40)
Sarimmer	Weibull (Sweden)	51	398	5	388	9·04	4	1·256	Half Sugar white; 20 p.c. show rose in crown. (33)
Long Red Mammoth	Wm. Ewing	47	498	5	752	9·74	4	1,204	Colour dark red and very uniform. (13)
Mammoth Long Red	K. Macdonald & Sons	54	1,294	6	188	8·30	4	1,071	Colour dark red and uniform. (9)
Danish Sludstrup	Wm. Ewing	50	1,482	3	1,002	8·84	4	971	Majority lemon yellow, about 10 p.c. typical colour. (11)
Royal Gt. Sugar Beet	Steele-Briggs	43	1,814	4	992	10·20	4	957	Half Sugar rose with medium pink skins; 12 p.c. show rose only in crown; 8 p.c. green top white. (1)
Imp. Gt. Sugar Beet	Wm. Rennie	42	1,777	5	1,377	10·14	4	937	Half Sugar rose with light pink skin; 10 p.c. show rose only in the crown. (16)
Prize Mammoth Long Red	Steele-Briggs	44	1,775	4	1,323	9·93	4	914	Long red colour, very dark. (3)
Half Sugar White	K. Macdonald & Sons	42	1,168	4	248	10·70	4	898	Half Sugar rose with light pink skin; 8 p.c. show rose only in the crown (36)
Mammoth Long Red	Sutton (England)	46	1,339	5	778	9·52	4	885	Colour uniform. (30)
Danish Sludstrup	Exp. Farm, Summerland	54	132	5	786	8·12	4	780	Colour is fairly uniform, although the tendency is towards lightness. (25)
Danish Sludstrup	Exp. Farm, Kentville	49	1,724	3	1,991	9·35	4	326	Very little uniformity in colour, which is more lemon than orange yellow. (24)
Half Sugar White	Exp. Farm, Charlottetown	44	241	3	1,807	9·36	4	259	Percentage show pink skin; 20 p.c. show rose in the crown. (23)
Eckendorffer Red	Weibull (Sweden)	51	1,406	3	1,555	7·72	3	1,982	Very deep red, a small percentage of white tankard. (34)
Cylinder Barres	Weibull (Sweden)	49	102	3	1,406	8·04	3	1,887	Yellow intermediate in colour, although more orange than usual; 1 p.c. red roots. (35)
Red Intermediate	Sutton (England)	47	1,370	2	179	7·95	3	1,581	Colour uniform, not quite as dark as long red. (20)
Yellow Intermediate	Exp. Farm, Charlottetown	38	3	3	186	9·92	3	1,539	Great variation of colour; majority lemon yellow; 10 p.c. appear to be half sugar rose. (22)
Prize Winner Yellow Globe	Sutton (England)	50	1,109	2	1,269	7·40	3	1,482	Colour very uniform. (27)
Sel. Yellow Intermediate	Exp. Farm, Charlottetown	36	915	4	784	10·23	3	1,459	Light orange yellow; 10 p.c. light lemon yellow; 8 p.c. show red in the crown. (38)
Gt. White Sugar	Wm. Rennie	37	207	3	1,767	9·92	3	1,361	Half Sugar white; 10 p.c. show rose in the crown; 9 p.c. white globes. (12)
Golden Tankard	K. Macdonald & Sons	34	1,086	4	1,019	10·54	3	1,281	Colour uniform, except for a small percentage of yellow and red globe. (6)
Devon, Yellow Globe	Sutton (England	50	726	1	1,844	7·14	3	1,191	Colour very uniform. (18)
Golden Globe	Sutton (England)	41	141	4	544	8·67	3	1,121	Colour uniform. (28)
Yellow Intermediate	Sutton (England)	39	1,236	2	846	8·54	3	766	Colour uniform, light orange yellow. (19)
Eckendorffer Red	K. Macdonald & Sons	41	1,020	2	1,245	7·90	3	558	Small percentage of white tankard and half sugar rose. (8)

VARIETY PLOTS OF MANGELS, 1920—*Concluded*

Variety	Source of Seed	Average yield of two 1-100 acre Plots		Per cent Dry Matter	Dry Matter per acre	
		Roots	Tops			
		Tons Lbs.	Tons Lbs.		Tons Lbs.	
Yellow Leviathan	Exp. Farm, Agassiz	36 1,949	4 981	8·83	3 530	Orange yellow; 7 p.c. light lemon yellow; 1 p.c. red; 3 p.c. show red in the crown. (39)
Yellow Globe	Sutton (England)	44 1,345	2 313	7·02	3 272	Colour uniform. (29)
Golden Tankard	Sutton (England)	32 1,544	2 1,431	8·96	2 1,873	Colour uniform. (21)
Yellow Globe	A. Macdonald & Sons	40 1,906	1 1,839	6·90	2 1,651	Colour very uniform. (37)
Devon, Yellow Interm	Sutton (England)	36 1,868	1 315	7·34	2 1,421	Colour uniform. (31)
Yellow Globe	Wm. Ewing	40 677	1 1,324	6·64	2 1,356	Colour uniform. (10)
	Average	45 1,646	4 678	9·07	4 283	

Numbers in brackets refer to photographs at end of report.

Seed Growing

In 1919 stecklings were grown from Yellow Intermediate seed grown at Ottawa in 1918. These stecklings were pitted in the fall of 1919 and came through the winter well. In the spring of 1920 the pits were opened and a very heavy selection made, enough roots being saved to plant one half-acre.

As the area was small the planting was done by hand, on May 4. The stecklings were set out in rows 3 feet apart with 2½ feet between the roots in the row. The growth was vigorous and a 98 per cent stand was obtained. Three horse cultivations and two hand hoeings were given before growth made it impossible to get through the plot. By the middle of July nothing could be done except leave the plot alone. Flowering, setting of seed and ripening were very uniform, and on August 23 harvesting was started. On account of the heavy growth it was necessary first to cut pathways through the plot and later these were extended until with two cuttings all the seed was cut. When cut, the seed stalks were either tied up in sheaves and stooked in the field or placed on sheets and dried after being brought under cover. When dry, the crop was threshed with an ordinary grain thresher and the seed spread out in a dry, cool room for further drying. All small seeds and sticks were then removed with a fanning mill and a special mangel seed cleaning machine, and samples of every 25 pounds sent to the Seed Branch for test.

This one-half acre yielded 1,020 pounds of cleaned seed, none of which tested lower than 90 per cent germination, i.e., at the rate of over a ton to the acre. This high yield, which was due to the great fertility of the land, the excellence of the stand, and favourable seed producing weather conditions would, it may be added, have been still higher, had it not been for a hailstorm which struck the crop when in stook and caused considerable shattering.

In 1919 there were isolated in bulk 10 roots which showed desirable characters, were uniform, and sank in 4 per cent salt solution. The year 1919 was a very poor one for seed, and only about 8 ounces of seed were obtained from these roots. This seed was sown in one-half acre, in rows 27 inches apart. Growth was good, and the crop showed remarkable uniformity. These roots were pitted for seed raising in 1921.

Breeding

During a number of years the Division has been endeavouring to develop a Yellow Intermediate variety of superior type from common commercial stock. The efforts have been successful so far, and a variety of a remarkable uniformity in type has been developed; the work has now advanced so far that the method of so-called family breeding may successfully be applied. By family breeding is understood the development of breeds or families from isolated, individual roots. The various families are compared with each other and the best one used as material for further breeding.

In 1920 a small number of roots of the most desirable type, which sank in a 5 per cent salt solution and therefore could be expected to represent races having a high dry-matter content, were selected. These roots were tested for dry-matter content by the Division of Chemistry, and then planted under conditions aiming to insure self-fertilization as much as possible.

About half the number of the roots were isolated in cheese cloth cages, but although the cages were large (4 feet square), the formation and maturing of seed were very unsatisfactory. This was, however, to be expected, and the division therefore also arranged to have a number of roots planted, without being encased in cages, in places far away from each other and any other seed-producing roots of mangels or beets.

The roots so planted produced satisfactory quantities of good seed, a fact which evidently shows that self-fertilization as such does not bring about a decrease in the seed production.

If a decrease in seed production from isolated plants takes place, it must therefore be due to more or less abnormal conditions under which the plants are forced to develop rather than to the self-fertilization itself.

In addition to the roots which sank in a 5 per cent salt solution, a small number sinking in 4½ and 4 per cent salt solutions respectively were planted in two small blocks. The seed from these blocks was harvested in bulk, no attempt to isolate the individual plants being made.

Stecklings were also grown from seed of plants self-fertilized in 1919.

SWEDE TURNIPS

Variety Tests

Forty varieties of swedes were tested in duplicate 1/100 acre plots. These were sown May 14 on ridges 27 inches apart. One series of plots were sown on land in pig run 1919, the duplicates being sown on land which in 1919 was planted to timothy (individual plants). Cutworms partially destroyed those plots sown on the timothy land and after being controlled with one application of poisoned bran the destroyed portions were sown in again. In the pig run growth was mostly to tops, and bacterial rot and cabbage-root maggots completed the ruin in the plots.

At harvest each plot was weighed separately and the yield calculated from the 1/100 acre plots. These yields are not, however, representative of the varieties.

TURNIPS—VARIETY TEST

Variety	Source	Yield, 1st Plot		Yield, 2nd Plot		Average, 2 1-100 acre plots		
		Tons	Lb.	Tons	Lb.	Tons	Lb.	
Up-to-date	Sutton (England)	22	4	26	1,550	24	777	Round purple top with some bronze green top inclined to be rough.
Hall's Westbury	Wm. Ewing	18	1,742	26	1,550	22	1,646	Round purple top, inclined to be rough and split.
Magnum Bonum	Sutton (England)	15	1,112	25	1,785	20	1,448	Purple top, with odd bronze top. Mostly oval, but quite a number long or round.
Prize Purple Top	Wm. Rennie	9	810	28	1,893	19	351	Round to oval, mostly purple top with a few green top bronze.
Crimson King	Sutton (England)	13	1,360	23	1,760	18	1,560	Purple, varying from oval to very long, rooty.
Universal Purple Top	K. Macdonald & Sons	13	1,476	22	232	17	1,854	
Improved Lord Derby	Sutton (England)	22	916	11	28	16	1,472	Round. Green with a tendency to bronze.
Good Luck	Steele-Briggs	15	552	17	884	16	718	
Champion Purple Top	K. Macdonald & Sons	16	1,630	14	412	15	1,021	
Magnum Bonum	K. Macdonald & Sons	13	1,474	16	1,744	15	609	
Green Top	Sutton (England)	6	1,908	22	1,421	14	1,664	Green top, round, inclined to be flattish, rough, numerous fine roots holding soil badly.
Ditmars	Exp. Farm, Kentville	8	1,214	20	1,442	14	1,328	Fairly smooth and uniform in shape. Bronze top with tendency to purple.
Skirving's Imp. Purple Top	K. Macdonald & Sons	13	1,702	15	894	14	1,298	
Canadian Gem	Wm. Rennie	16	260	13	61	14	1,160	Purple top varying from oval to round.
Derby Bronze Green Top	Wm. Rennie	14	842	14	500	14	671	Round. Mixture of purple and bronze.
Conqueror	K. Macdonald & Sons	16	1,060	12	54	14	557	
Hall's Westbury	K. Macdonald & Sons	16	604	11	1,940	14	254	
Perfecta	K. Macdonald & Sons	20	1,268	9	1,152	14	210	
Canadian Gem	Exp. Farm, Kentville	8	530	19	1,712	14	121	A mixture of round and oval. Purple and fairly smooth.
Kangaroo	K. Macdonald & Sons	16	34	11	1,484	13	1,759	
Hardy White	Sutton (England)	16	1,402	10	1,780	13	1,591	Mixed green bronze with some tendency to purple. Round to oval.
Jumbo	Steele-Briggs	14	1,745	12	852	13	1,298	
Carter's Imperial Hardy	K. Macdonald & Sons	17	428	9	1,722	13	1,075	
Sel. Prize Elephant	K. Macdonald & Sons	12	738	14	956	13	847	
Monarch	Exp. Farm, Nappan	1	1,762	24	1,703	13	732	Fairly uniform and favourably smooth.
Purple Top	Steele-Briggs	14	386	11	914	12	1,650	
Hartley's Bronze Top	K. Macdonald' & Sons	14	738	10	862	12	800	
Kangaroo	Steele-Briggs	12	1,536	12	54	12	795	
Bangholm	Weibull (Sweden)	13	1,930	10	1,159	12	544	Purple. Oval with a few round.
Kentville Green Top	Exp. Farm, Kentville	8	872	16	111	12	491	Somewhat rough and necky. Mainly oval, but some round.
Caledonian	Sutton (England)	15	324	8	1,684	12	4	
Champion	Exp. Farm, Charlottetown	11	1,452	11	214	11	833	Very rough, somewhat uneven shape, but mostly round.
Invicta	K. Macdonald & Sons	13	220	9	240	11	230	

TURNIPS—VARIETY TEST—*Concluded*

Variety	Source	Yield 1st Plot	Yield 2nd Plot	Average, 2 1-100 acre plots	
		Tons Lbs.	Tons Lbs.	Tons Lbs.	
Good Luck	Exp. Farm, Fredericton	6 1,338	14 667	10 1,002	Very rough and uneven. Oval to round.
Champion	Sutton (England)	8 1,556	9 1,794	9 675	Purple, varying from round through oval to somewhat long.
Good Luck	Exp. Farm, Ste. Anne	4 208	12 1,938	8 1,073	Rough, uniformly purple top.
Norwegian Feeding	Weibull (Sweden)	Fall turnips	all rotted.		
Dale's Hybrid	" "	"	"		
Purple Top Bortfelder	" "	"	"		
Swedish Smooth	" "	"	"		
	Average			14 1,114	

Seed Growing

Swede turnips for seed were an absolute failure in 1920.

Although coming out of the pits in first class shape for cattle feed, a rot which affected particularly the crown rendered the swedes undesirable for seed growing. Some of the worst infected roots were forwarded to the Botanical Division, which diagnosed the trouble as being due to Phycomycetous fungi. The Botany Division's recommendations were followed out in selecting roots for planting. All roots which showed any sign of infection were discarded and, to make the detection of these roots more sure, the roots before being planted were wiped off with cloths and thoroughly dried. Enough apparently sound roots were obtained to plant one-quarter acre in three-feet rows, with two and a half feet between the plants in the row.

All planted roots made growth, but rot and cabbage root maggots, which infected both seed roots and stecklings, soon destroyed all seed roots, which, therefore, were removed and destroyed.

Seed of Purple Top swede grown at Ottawa in 1919 was used to plant out one-half acre of swede turnips for stecklings. Although infected with cabbage root maggot the stand was excellent and a good selection of roots was pitted for seed raising in 1921.

FIELD CARROTS

Variety Tests

Fifteen varieties of field carrots were tested in duplicate 1/100-acre plots. Sown May 14, on the ridge, in rows 27 inches apart, these plots were handled at harvest, October 14, 15, in a similar manner to the mangels, i.e., roots and tops from each plot were weighed separately and representative roots photographed and sent to the Chemical Division for analysis.

The following table gives yield per acre calculated from 1/100-acre plots.

FIELD CARROTS, 1920

Variety	Source	1st Plot		2nd Plot		Average 2 1-100 acre Plots		
		Tons	Lb.	Tons	Lb.	Tons	Lb.	
Giant White Belgian	Sutton (England)	34	538	34	1,700	34	1,119	(45)
Improved Intermediate White	Wm. Ewing	24	904	38	700	31	802	
Mammoth White Intermediate	Wm. Rennie	32	1,476	27	900	30	188	(49)
Matchless White	Sutton (England)	29	1,537	29	1,400	29	1,468	
Improved Short White	Steele-Briggs	25	285	30	200	27	1,242	(50)
Improved White Vosges	K. Macdonald & Sons	26	737	28	300	27	518	
White Intermediate	Exp. Farm, Summerland	26	292	28	700	27	496	(44)
Improved Short White	K. Macdonald & Sons	24	1,511	24	700	24	1,105	
Danish Champion	Exp. Farm, Ottawa	21	617	26		23	1,308	(46)
Improved White Belgian	K. Macdonald & Sons	22	988	22	900	22	944	(55)
Yellow Intermediate	Sutton (England)	14	1,874	26	400	20	1,137	
Danvers Half Long	K. Macdonald & Sons	15	318	18	1,700	17	1,009	(54)
Magnum Bonum	Sutton (England)	19	1,163	15	400	17	781	(48)
Danish Champion	K. Macdonald & Sons	11	1,392	21	1,400	16	1,396	
Imperial Red Intermediate	Sutton (England)	13	129	14	1,900	14	14	(47)
	Average					24	635	

Numbers in brackets refer to photographs at end of report.

Seed Growing

In 1919, stecklings were grown from seed of selected Danish Champion raised at Ottawa. These roots were remarkably uniform, although somewhat small on account of late sowing. They were pitted, after selection, in the fall of 1919 and came out of the pits in the spring of 1920 in excellent condition. A heavy selection was then made, and the bulk of the roots, sufficient to plant half of an acre, set out for seed production. These roots were planted in what had been a pig run in 1919. They were planted in rows 3 feet apart with 2 feet between the plants in the row. Practically a perfect stand was obtained. The flowering and ripening of the seed were very uniform, and harvesting started August 23.

The heads were cut off by hand, collected in baskets, transferred to canvas sheets and in them hauled to the barn. They were there spread out about one foot deep and turned daily to assist drying. When perfectly dry a garden roller was run over this material to thresh the seed off, the de-seeded heads being forked off from time to time. After sifting with a large, coarse hand sieve the material was run through the fanning mill to remove all sticks possible. The spines on the seed, which make it impossible to clean it by ordinary methods, were then removed with a machine made for the purpose. After a final fanning 575 pounds of first-class seed was obtained. This, being the yield from one-half acre, represents a yield of 1,150 pounds carrot seed per acre.

In 1919 seed was obtained from a small specially selected group of Danish Champion carrots grown at Ottawa. This seed was sown for stecklings, one-half acre being seeded in rows 27 inches apart. An excellent stand was obtained of first class roots of very uniform quality. These stecklings were pitted in the fall of 1920 and are available for seed growing 1921.

Breeding

From the Danish Champion stecklings grown in 1919, thirty of the very best roots were selected for family breeding in the spring 1920. The roots were either isolated in cheese cloth cages or grown in isolated positions. The seed which was secured later in the fall from the individual roots, therefore, was obtained as a result of self-fertilization.

A group of high class roots of a similar type was also set out in a small block. No isolation of the individual plants was made, and the seed, therefore, harvested in bulk.

SUGAR BEETS

Variety Tests

Three varieties of sugar beets were grown in duplicate 1/100-acre plots. These were received from the Dominion Sugar Co., and planted May 14 on ridges 27 inches apart. The land was in 1919 used as a pig run. These varieties were harvested October 13 and 14, each plot being weighed separately and representative roots photographed and forwarded to the Chemical Division for analysis.

YIELD OF SUGAR BEETS PER ACRE.

Variety	First Plot		Second Plot		Average	
	Tons	Lb.	Tons	Lb.	Tons	Lb.
Chatham	19	1,187	27	1,538	23	1,362
British Columbia	20	773	25	913	22	1,843
Kitchener	17	350	22	542	19	1,446
Average					22	217

LEGUMINOUS FORAGE PLANTS

RED CLOVER

Breeding

The winter of 1919-20 was particularly severe on the red clover. Plots of red clover seeded in 1916 and 1917 and from which hay and seed crops had been taken in 1917, 1918 and 1919 were totally destroyed, as were also some few individual plants saved for breeding purposes. It may be explained that the winter-killing was caused by heaving of the soil resulting in the snapping-off of the roots a few inches below the crown. The winter-killing was therefore not due to lack of hardiness in the proper sense, i.e., to lack of physiological resistance to low temperatures, but to mechanical injuries caused by the condition of the soil.

Concerning the breeding of red clover it has been announced in previous reports that the division has succeeded in developing a red clover type characterized by an unusually high degree of perennialism. That is to say, it contains a very large percentage of plants which, under Ottawa conditions at least, live more than two years. A small quantity of seed of this new type, which temporarily is called *Ottawa Perennial Red Clover,* was available this year.

Small quantities of it were sent for comparative tests to various branch Experimental Farms and Stations, and the balance used largely at Ottawa. Part of the seed retained for use at Ottawa was sown in rows 30 inches apart, in a block measuring about 4,000 square yards, for seed propagation purposes. The rest was sown in a few small plots with a view to continuing the breeding work toward the development of a variety combining hardiness, durability, and high-yielding power.

Variety Tests

Six lots of red clover seed, representing different types and places of production, were sown in comparative test plots, each lot being sown both broadcast and in rows. The "varieties" seeded for test were as follows:—

1. Ottawa Perennial.
2. Oxdrift.
3. Altaswede.
4. Svalof Improved.
5. Swedish Medium Late.
6. Swedish Late.

Concerning the different lots it may be explained that the *Ottawa Perennial* is a type, developed from ordinary early commercial red clover and named *Perennial* for reasons given in the preceding paragraph. It is not uniform as far as botanical characteristics are concerned.

The *Oxdrift* is simply seed from Oxdrift, Ont., obtained from the Kenora District Co-operative Clover Seed Growers' Association. This "variety" was included in the test largely for the reason that, judging from previous experience, it represents a red clover well suited to Eastern Canada in general.

The *Altaswede,* so-called, was imported from Sweden ten years ago by the Seed Branch of the Dominion Department of Agriculture on recommendation of the writer, its original name being *Late Swedish Red Clover.* Most of it was used for trials in the province of Quebec, but a small quantity found its way to the University of Alberta at Edmonton. The Alberta university has re-named it, giving it the name "Altaswede."

The *Svalof Improved, Swedish Medium Late,* and *Swedish Late* are varieties secured from the Plant Breeding Institution of Svalof, Sweden, through the kindness of Dr. H. Witte, Director of Forage Plant Breeding at the said institution.

All six lots were sown under similar condition and were all clipped once during the season, with the exception of *Ottawa Perennial* and *Oxdrift,* which were lightly clipped as often as necessary to prevent blooming.

ALSIKE CLOVER

Comparatively little, outside of preliminary observations, has so far been done in the matter of alsike breeding. Observations have revealed, however, that the possibilities of improving the Canadian alsike crop are very promising, and that it may be comparatively easy to develop varieties showing a high degree of uniformity. In order to obtain material for breeding work a number of individual plants were set out for observation and eventual breeding. The plants in question were grown from two small samples of seed harvested from two individual plants, one having uniformly green and the other uniformly black seed.

A small sample of alsike received from the Plant Breeding Station at Svalof, Sweden, was sown in a broadcast plot. From the sample a number of individual plants, totalling 300, were also grown and planted in the field in such a manner as to allow observations on the characteristics and potential agricultural value of the individual plants.

ALFALFA

In 1913, the Division of Forage Plants started alfalfa breeding with the object of developing high-yielding and uniform varieties of a hardy type. Within a surprisingly short time distinct varieties were developed, indicating that the breeding methods employed by the division could be used very advantageously for the development of, practically speaking, an unlimited number of well-defined varieties, breeding true to type and easy to identify.

Unfortunately, however, this very promising work had to be abandoned during the war, and it was only in 1919 that it was taken up again. That year a number of alfalfa plants of promising types were isolated and self-fertilized but, on account of unfavourable conditions, very small quantities of seed were obtained from a total of eleven plants only. The seed secured was sown separately in flower pots in the spring of 1920, and the young seedlings later transplanted in the field for observation and further breeding work. They were planted in rows 3 feet apart with 3 feet between the plants in the rows.

A total of 800 individual plants grown from seed of true Grimm's Alfalfa, kindly presented by Mr. A. B. Lyman, Excelsior, Minn., were also set out in the field, 3 x 3 feet apart, with a view to obtaining sufficient material for future breeding work.

In addition, two small plots were sown, broadcast and in rows respectively, with seed obtained from Messrs. Kenneth Macdonald & Sons, Ottawa, under the name of Northern Grown Grimm. These two plots will be used in an endeavour to secure more evidence on the subject of alfalfa seed growing in the Ottawa district.

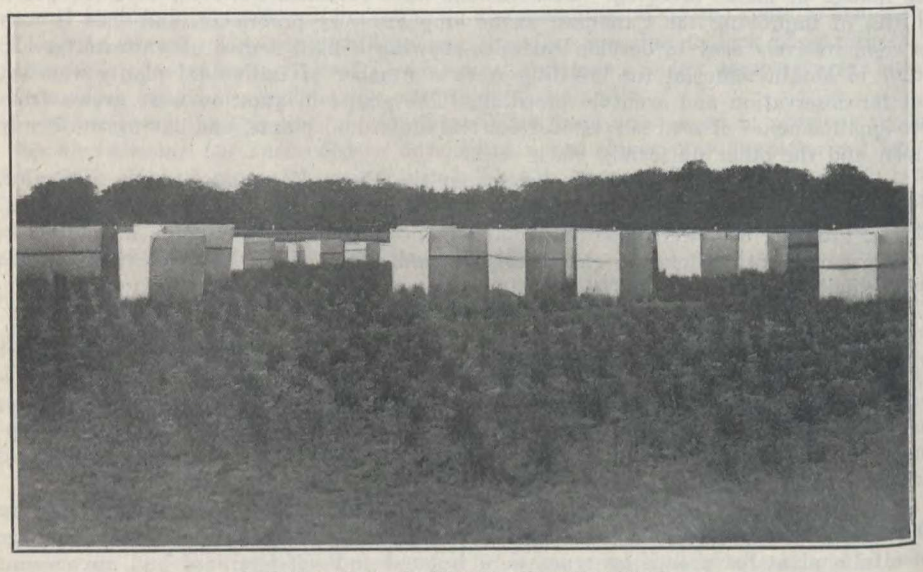
GRASSES

TIMOTHY

BREEDING

Like much other work requiring handling of diversified material, the timothy breeding work, started in 1911, had to be set aside to a great extent during the war. In 1918, however, twenty-three lots of timothy, each representing the progeny of a single, self-fertilized plant of promising type, were transplanted in the field in rows 3 feet apart with 1½ feet between the individual plants in the row.

It was noticed in 1920 that whilst there was considerable uniformity within the lots, enough variation was present to make it advisable to re-select and isolate this year. Accordingly, a number of isolations were made with what is hoped will prove more satisfactory cages than have heretofore been used at Ottawa. Light canvas was used for all but one side of the cages, this one side being of cheese cloth and always facing in the same direction. In all, 36 isolations were made and seed harvested, each lot of seed obtained representing seed from one individual plant, or from two or more plants from among the same lot, isolated together on account of striking similarity of type.



Isolation Cages in Timothy Breeding Block.

A number of individual plants were also planted from seed collected from individual plants outside of Ottawa in 1919.

Variety Tests

Four plots were sown in order to compare timothy strains from different sources. In order to make a comparison between individual plants of each lot under test a number of single plants of each lot were set out along the end of the plots. Plots were all planted at same rate and under similar conditions.

Varieties:—Ohio, 3937 selection; Primus; Gloria; Ottawa bulk selection.

Concerning the varieties in question, it may be added that "Ohio 3937" was received from Mr. M. W. Evans, Director of the U.S. Timothy Breeding Station, North Ridgeville, Ohio; "Primus" and "Gloria" are two varieties developed and supplied by Dr. H. Witte, Svalof, Sweden. "Ottawa bulk selection" represents seed harvested in bulk from non-isolated plants growing in the timothy breeding block at the Central Experimental Farm.

Seed Growing

In 1917, 2 sets of 2 plots each were sown to timothy for seed production, each set consisting of 2 equal-sized plots, one of which was seeded broadcast and the other in rows 30 inches apart. Due to press of work, these plots did not get the attention required and were, at the beginning of the growing season of 1920, very weedy. It

was impossible to get the plots sown broadcast clean, but the row seedlings were not only easy to clean out, but, once clean, easy to keep so. The seed from the broadcast plots was very dirty, whilst the seed from the row-seeded plots was harvested clean of weeds and other grass seeds.

Yields of Timothy sown Broadcast and in Rows 30 inches apart.

	Broadcast	30-inch rows
1st set of plots	134 lb.	206 lb.
2nd set of plots	129 "	256 "

Hulled and Unhulled Seed

In the spring of 1917 the Division of Forage Plants received, from the Seed Branch of the Dominion Department of Agriculture, two samples of timothy seed, viz: one sample of hulled seed and one unhulled, both picked from a seed lot harvested in 1916. Small portions of the two samples have been sown yearly in small comparative tests in an endeavour to ascertain the comparative value of hulled and unhulled seed of the same age.

The results obtained indicate that, while there is no material difference in vitality between hulled and unhulled seed when sown a year after it has been harvested, the hulled seed with age loses its vitality more quickly than does the unhulled seed, as will be seen from the following figures:—

	Yield per acre	
Year of Seeding	Unhulled Seed	Hulled Seed
1919	2 tons, 840 lb.	1 ton, 1,375 lb.

The figures indicate that hulled seed, three years old, is likely to produce a much smaller hay crop than unhulled seed of the same age.

WESTERN RYE GRASS

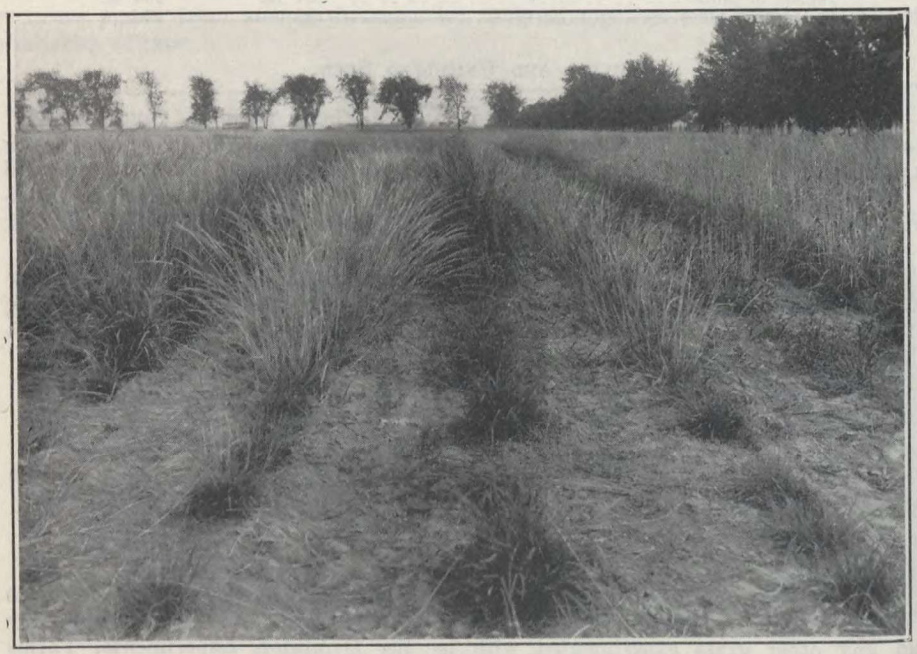
This grass, which in large sections in the West is of an importance comparable to that of timothy in the East, has for several reasons been studied more thoroughly than any other grass experimented with by the Dominion Experimental Farms System. In the following paragraphs a brief outline will be given of the investigations which, as will be seen, have led to results of practical importance.

Western Rye grass, which is a native of Canada, occurs in the wild state in a very large number of forms. When studying them in their natural habitat, the writer observed that the flowering of the various forms takes place in a manner that is fundamentally different from that of wild grasses in general. While wild grasses in general, and cultivated ones too, for that matter, are open-fertilized, i.e., flowering in such a manner that the formation of seed may be a result of either self-fertilization or cross-fertilization, it was observed that the Western Rye grass forms were normally self-fertilized. In other words, their mode of fertilization proved to be exactly like that of wheat.

As it has long ago been established that the comparative ease with which distinct and constant varieties of wheat can be developed is primarily due to the fact that it is normally self-fertilized, it is apparent that the discovery of self-fertilization in Western Rye grass was of considerable interest. For, it was reasoned, if self-fertilization in wheat makes the easy development of countless distinct varieties possible, then there is little reason why self-fertilization in Western Rye grass should not make the development of vast numbers of distinct varieties of it equally easy.

In order to test the soundness of this theoretical deduction, a collection of ripe seeds from a small number of individual plants growing closely together on a vacant lot in Calgary was made in the fall of 1916. The seed was collected separately from the individual plants in question and was sown at Ottawa in 1917. Later, when a few inches high, the seedlings obtained were transplanted in rows, each row representing

the progeny of one individual plant. The following year, when the plants had attained full development, it was clearly shown that each one of the Calgary mother plants from which the seed had been collected was breeding perfectly true to type. In other works, it was proved that distinct varieties, breeding true to type and therefore constant from one generation to another, could be developed simply by propagation of the various forms growing wild practically throughout Canada.



Western Rye Grass Varieties in row, showing types.

Having come to this conclusion, no time was lost in trying to bring together as large a number of different wild forms as the circumstances would permit, for the purpose of studying their relative agricultural value.

In 1918 ripe seed was collected from thirteen individual plants, especially chosen with a view to demonstrating the difference in agricultural value existing between different types. From the thirteen seed samples in question, thirteen lots of Western Rye plots were secured in 1919. In 1920 these had reached full development, and, when observed even very superficially, they were found to be of very different agricultural value, while strikingly uniform within themselves.

The following figures will demonstrate the surprisingly great differences in yielding power existing between the various varieties.

	Yield per 300 plants (straw and seed)
No. 1	37 lb. 3 oz.
2	34 " 15 "
3	55 " 3 "
4	85 " 0 "
5	109 " 5 "
6	73 " 5 "
7	12 " 5 "
8	13 " 9 "
9	21 " 4 "
10	95 " 13 "
11	90 " 11 "
12	52 " 9 "
13	16 " 3 "

After threshing, it was further found that the seed-producing capacity of the different varieties also varies tremendously, a fact, however, that may be more advantageously dealt with in a subsequent report.

In 1918, some 100 individual Western Rye grass plants were also collected, practically all in the Prairie Provinces and the Okanagan Valley in British Columbia, and sent to Ottawa for transplanting. In 1919 seed was secured from most of them. This seed was sown separately in pots in the spring of 1920 and, later, 300 seedlings of each lot were transplanted in the field.

In addition, a number of lots, secured from seed collected from individual plants in 1919, were also transplanted in the field.

In all, about 140 lots of Western Rye grass are grown at Ottawa at present.

ORCHARD GRASS

In 1912, six samples of Orchard grass seed were received from the Plant Breeding Station of Svalof, Sweden. The samples represented different varieties which,

Western Rye Grass Varieties; difference in yielding capacity indicated by distance between stakes.

however, were found not to breed entirely true to type. In order to purify the type and to bring about as complete a uniformity as possible, repeated selections have been made since 1913, the last one being made in 1918 when four individual plants were isolated and self-fertilized. The seed obtained was sown in 1919.

In the spring of 1920 it was found that all the four lots had been completely winter-killed, a fact which was the more discouraging as no sign of lack of cold-resistance had ever been observed in the parent stock. The experience emphasizes the necessity of a most careful selection of the starting material which is to be used in the development of varieties of grasses of a somewhat tender type.

In order to secure diversified material for further breeding work, seed of 29 individual plants, representing different botanical and biological types, was collected

in Victoria, B.C., and vicinity, in 1919. The 29 seed lots were sown in 1920, a number of plants secured from each and transplanted in the field for observation and eventual breeding of desirable types.

A number of individual plants, obtained from two seed samples received from Svalof, Sweden, were also set out with the same object in view.

MEADOW FESCUE

Results of experiments carried on during the past have clearly shown that Meadow fescue is a very valuable grass which ought to be used in grass and clover mixtures to a much greater extent than it is at present.

Anticipating a greater demand for Meadow fescue in the future, the Division of Forage Plants took steps, some years ago, to develop varieties of a greater agricultural value than the Meadow fescue available commercially at present. In 1918, a comparatively small number of seedlings obtained from a sample of commercial seed were planted separately. In 1919, when the fully developed plants were examined, it was found that great differences existed between the different individual plants in respect to earliness, mode of growth, leafiness, stooling power, and other characters. Fourteen of the seemingly most valuable plants were isolated and self-fertilized. The seed obtained was sown separately in pots in the spring of 1920 and, later in the season, a number of seedlings of each lot were transplanted in the field for further observation.

Three lots of Meadow fescue received from Svalof, Sweden, were also sown.

KENTUCKY BLUE GRASS

This grass is, as is well known, one of the most widely distributed grasses, occurring naturally in a tremendously large number of forms, many of which have been described as distinct botanical varieties. Observations made on the grass in Canada have revealed the existence of countless types possessing very different agricultural values. A few outstanding ones have during the last few years been collected, and, as a result, twenty-six different lots were grown at the Central Experimental Farm in 1920. Six of these were planted in 1919, and the balance in 1920.

FIELD BROME GRASS

A plot of this biennial grass, which is recommended especially for light, sandy soil in Northern and Central European countries, was received from Svalof, Sweden. It made a vigorous growth and entered the winter in good condition.

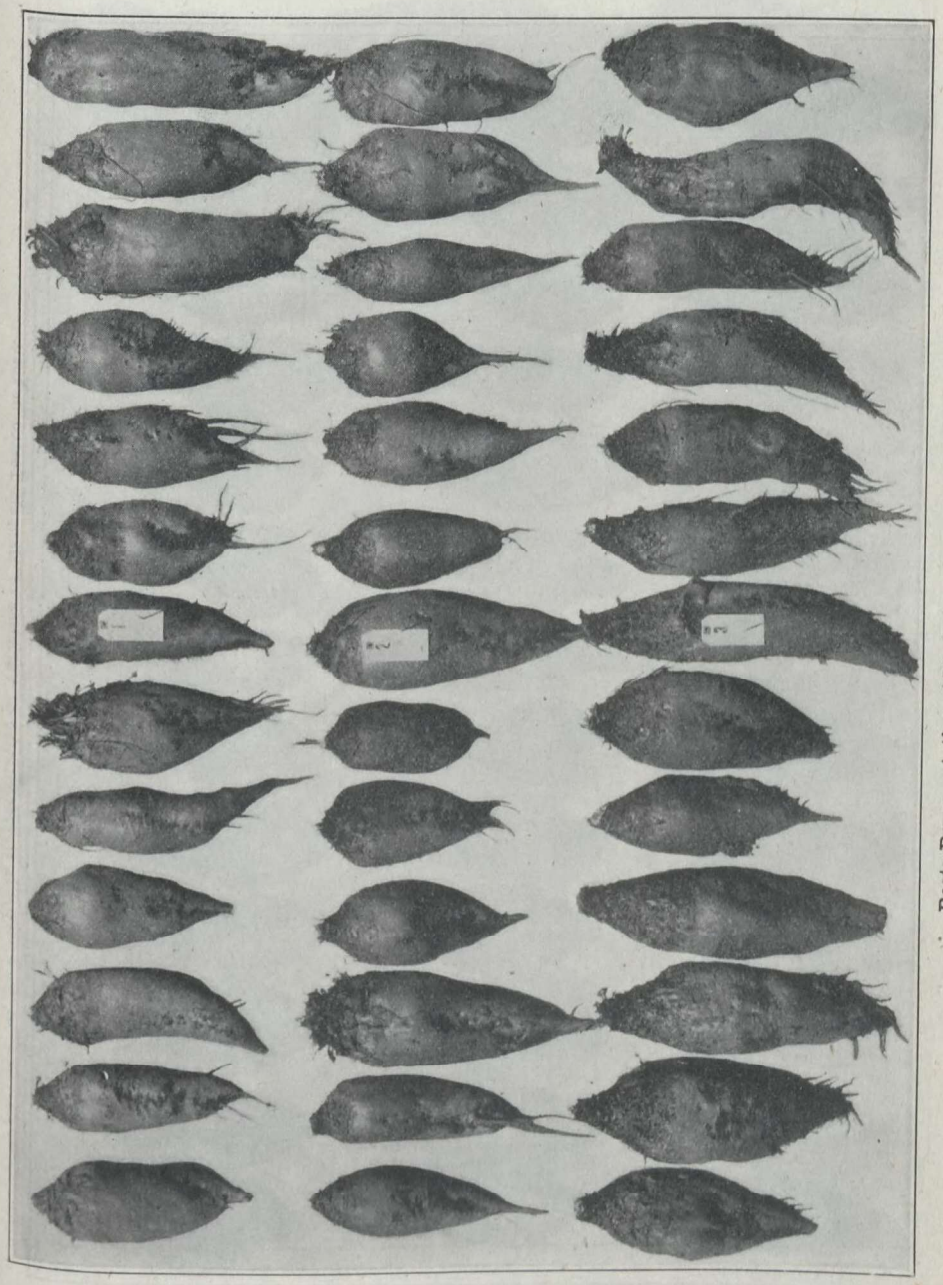
SUDAN GRASS

A small area left vacant through the failure of the swede turnip seed crop was sown to Sudan grass. The seed was broadcast on June 16th, at a rate of 20 lb. per acre, and harrowed in. On August 21 the crop was cut and was found to yield at a rate of 14 tons per acre, green weight. After cutting a thick aftermath, reaching 18 inches in height when the first killing frost appeared, was developed.

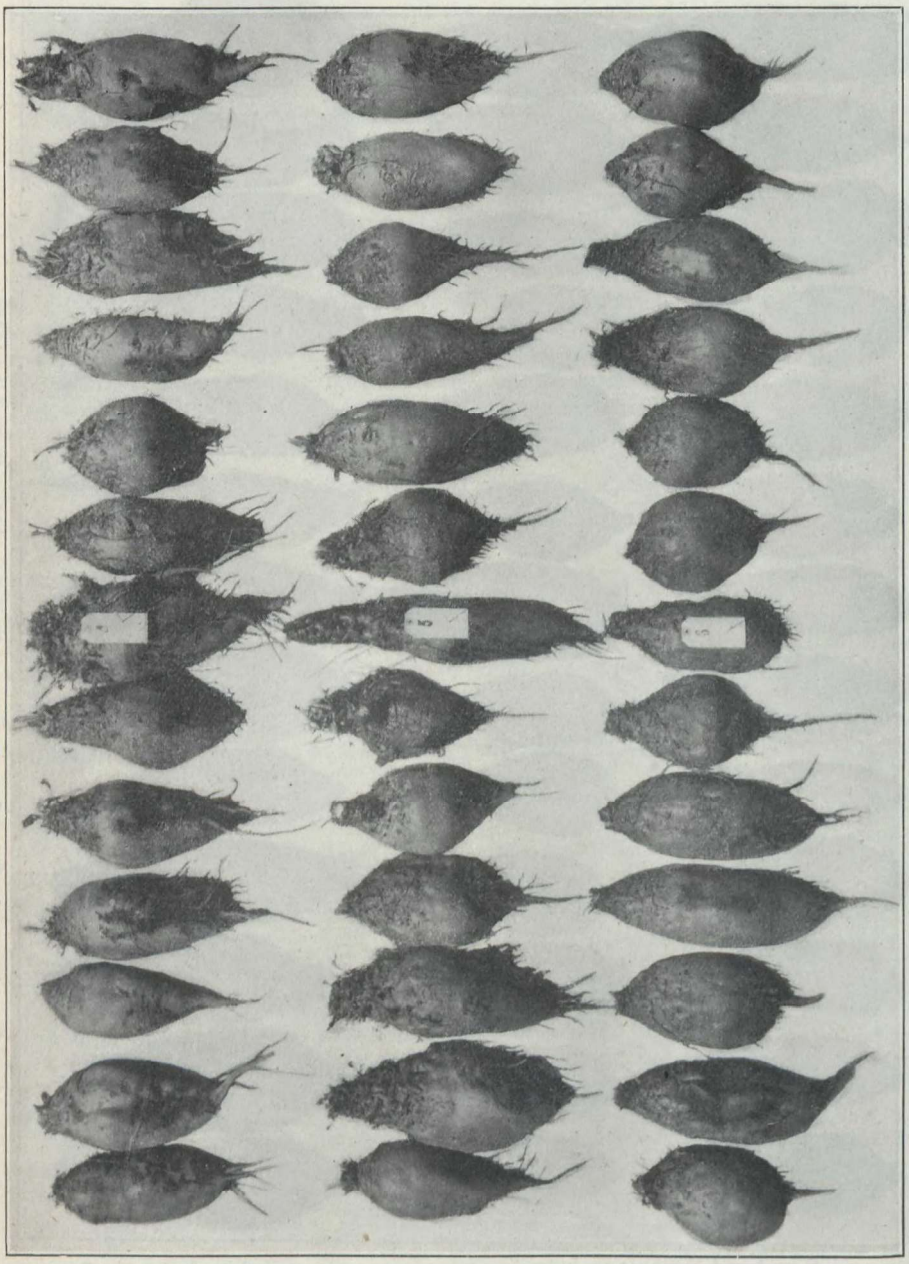
It should be explained, though, that the Sudan grass was grown on very rich land which had previously been in a pig run.

MISCELLANEOUS GRASSES

A few lots of miscellaneous grasses were planted, including Awnless Brome grass, Red Top, Red fescue, Tall Oat grass, etc.



Roots Representative of Varieties of Mangels Tested in 1920.



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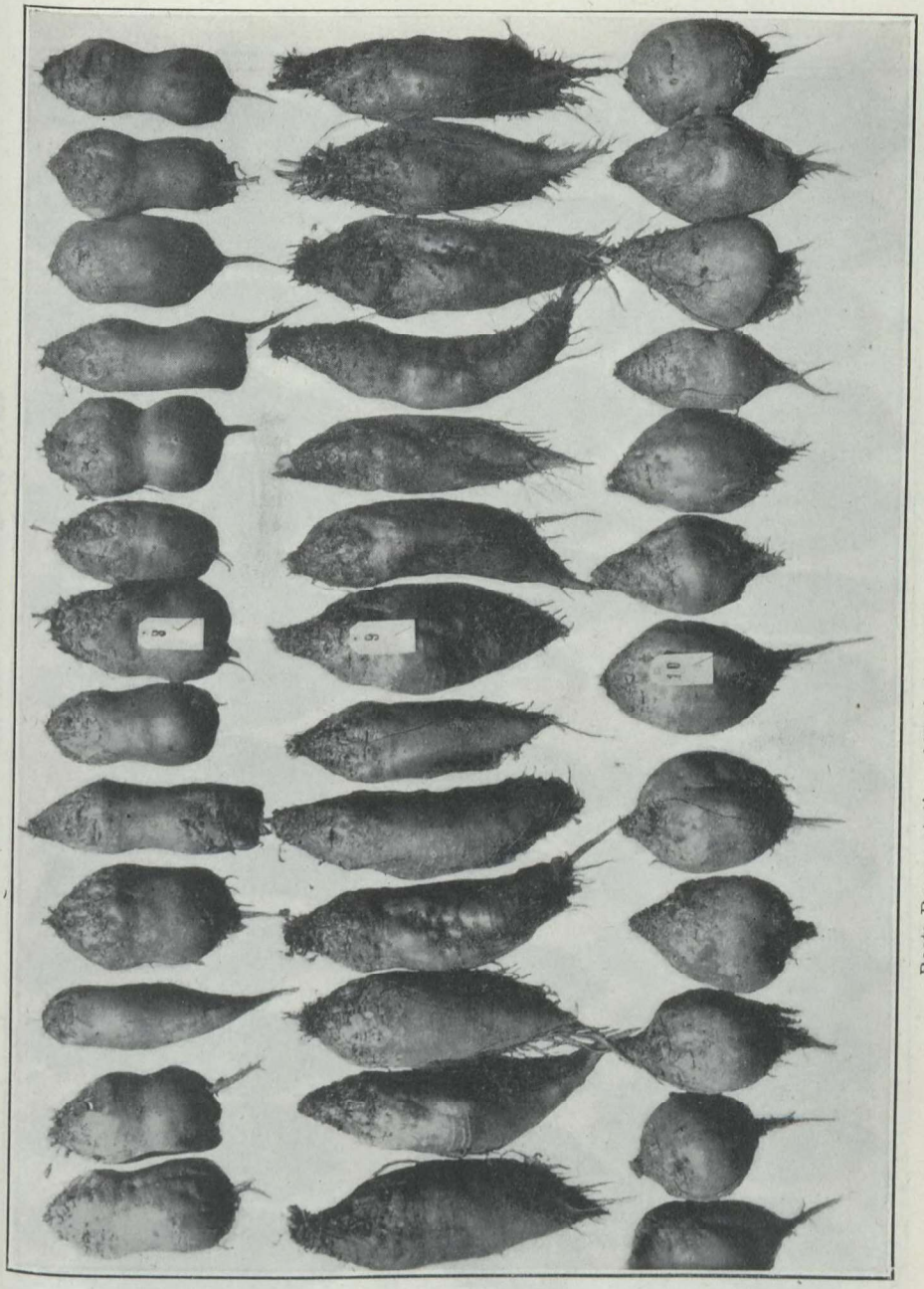

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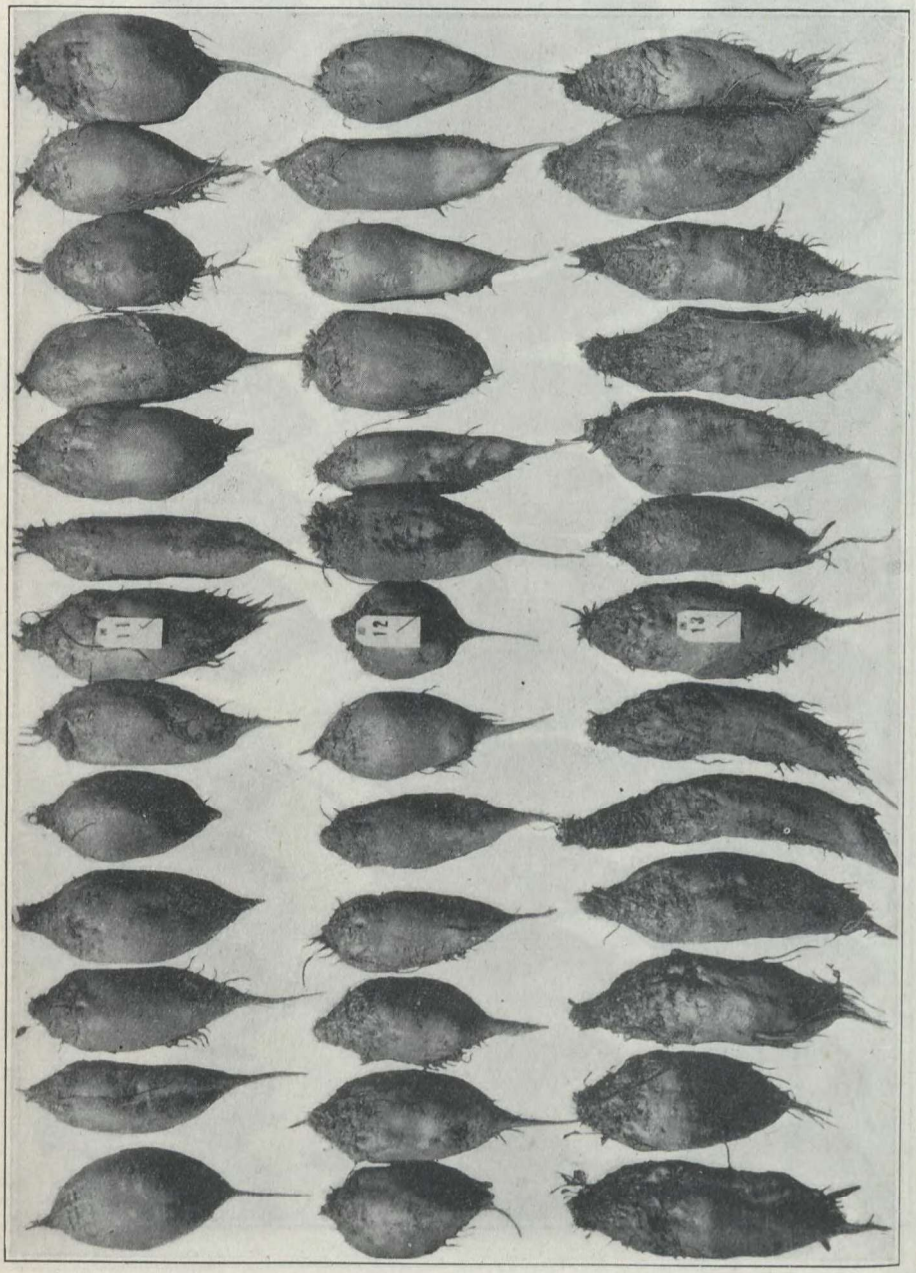

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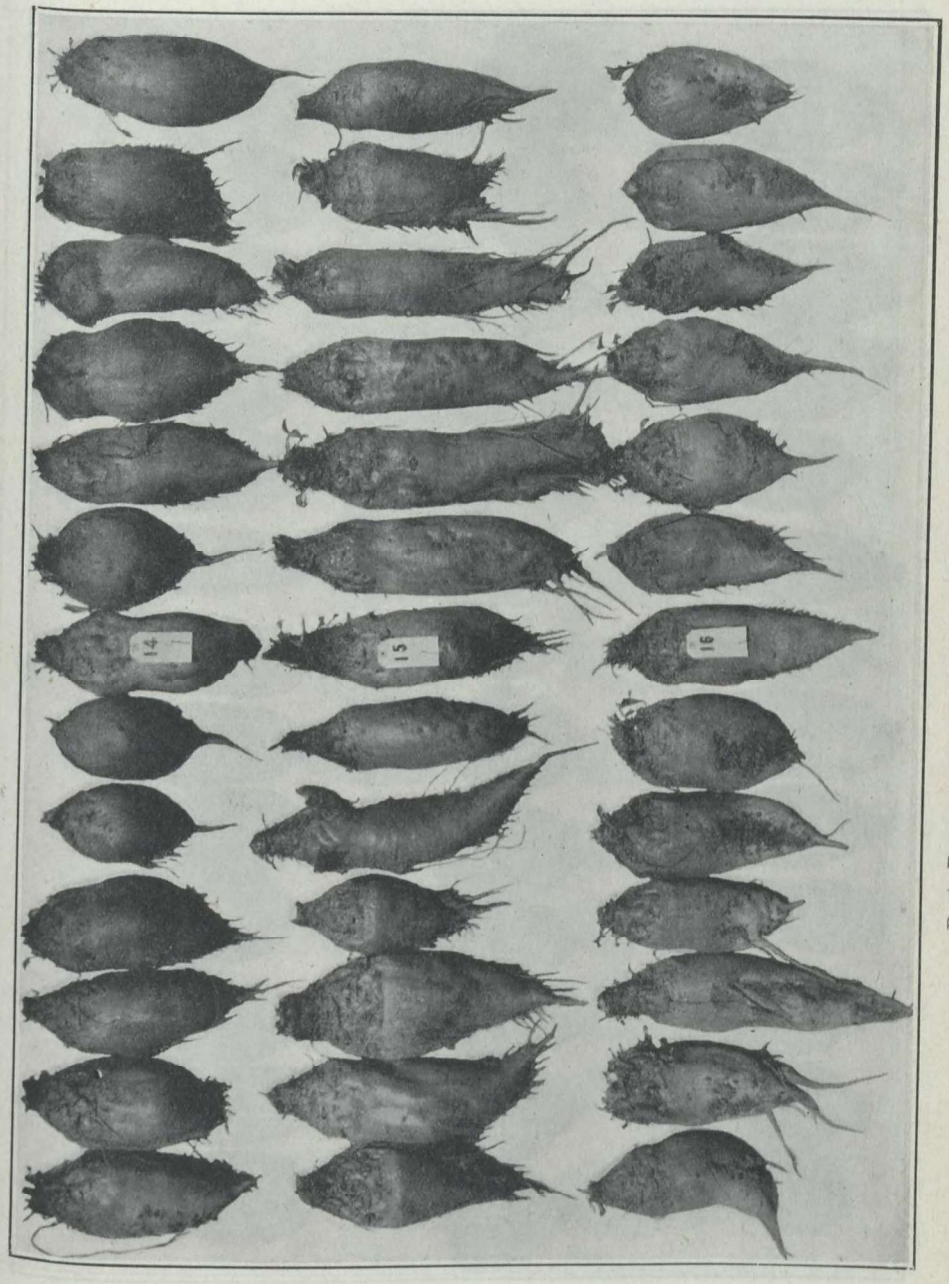

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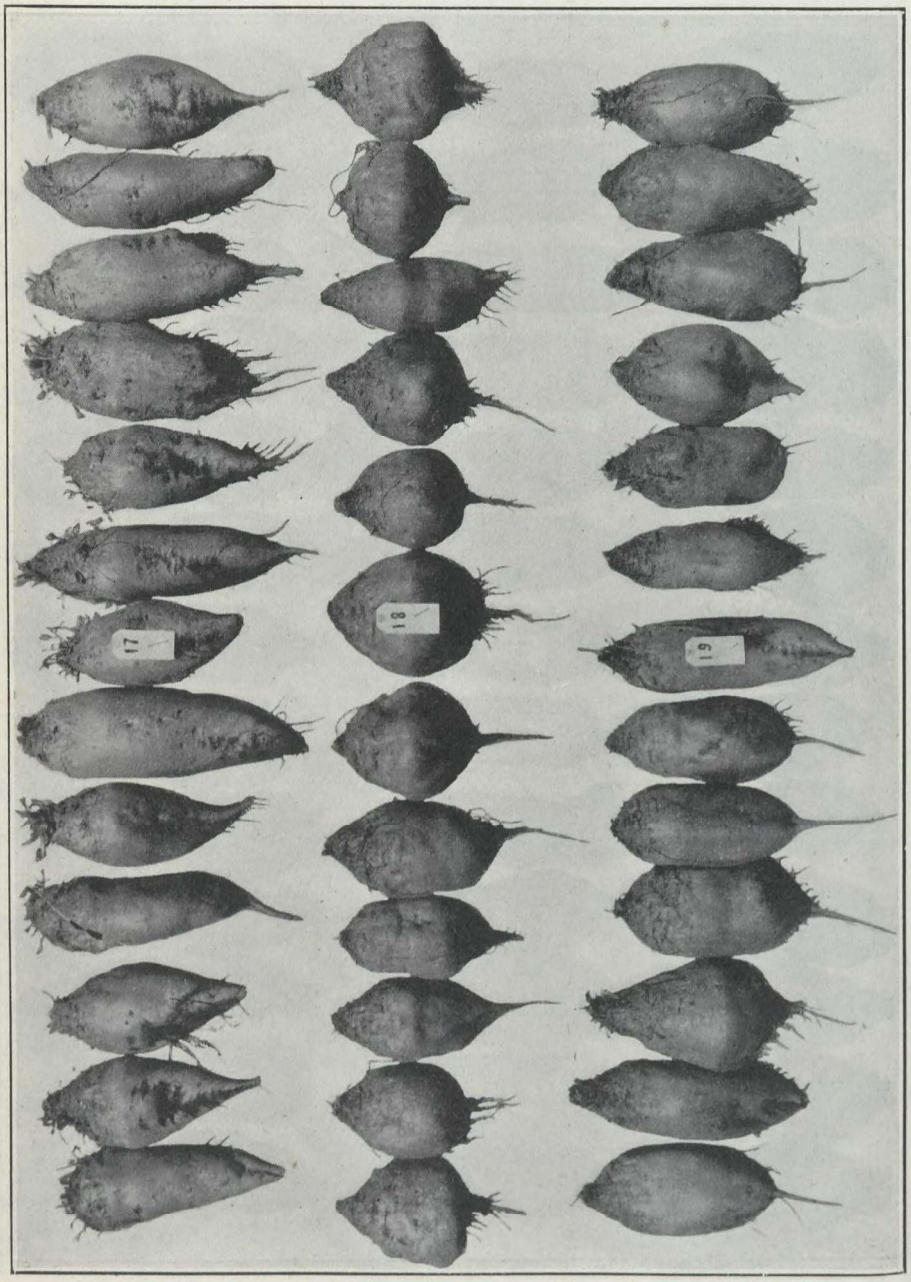

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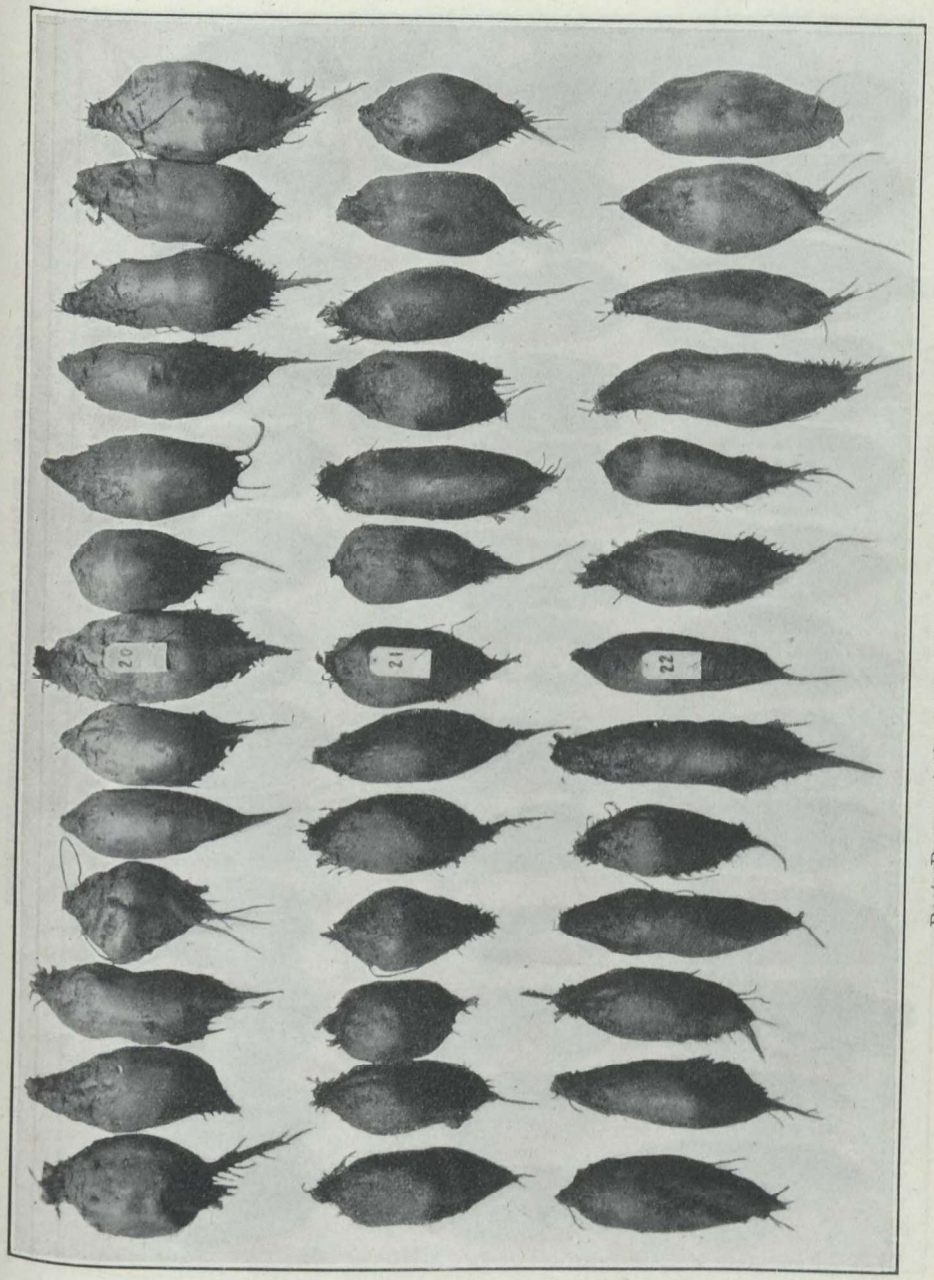

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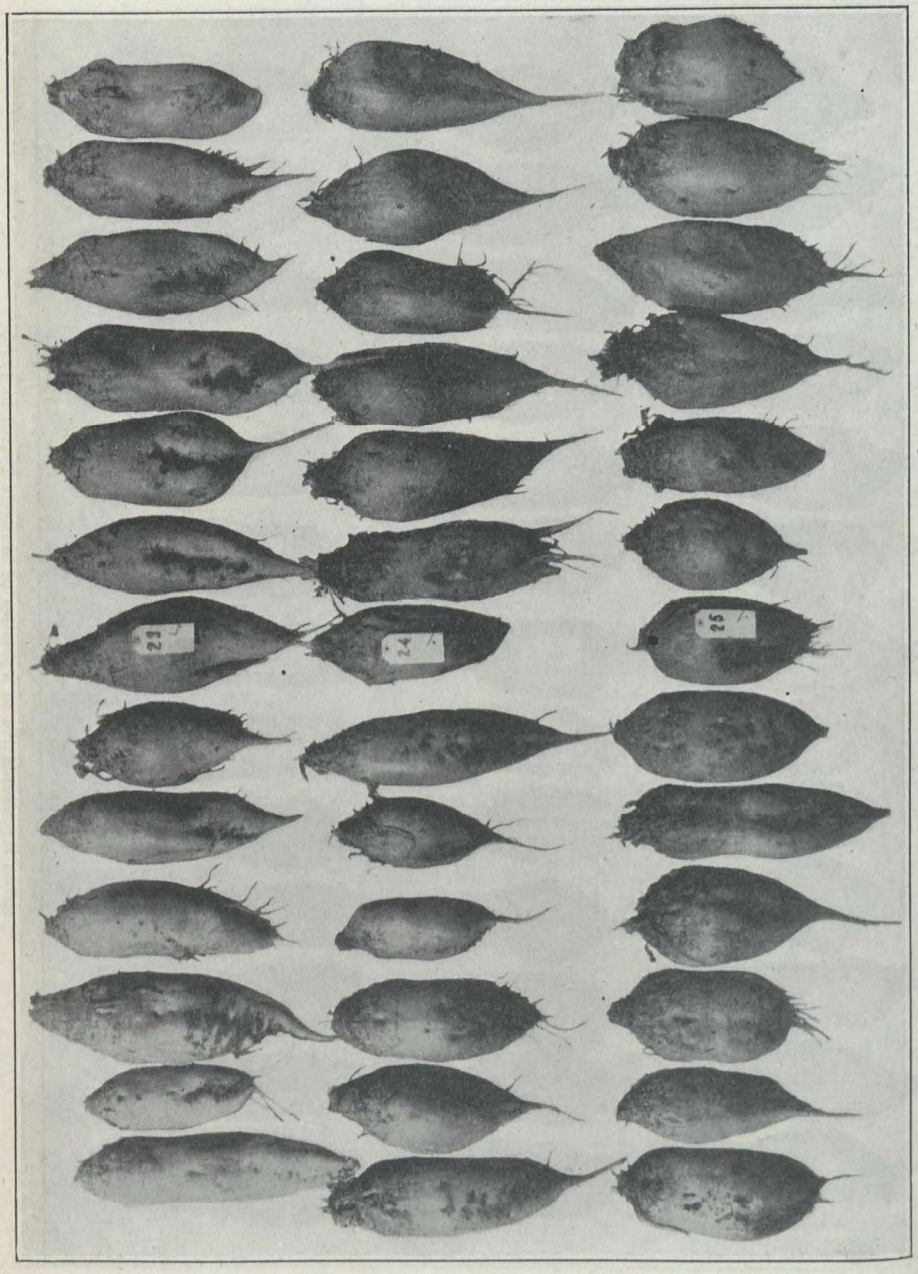

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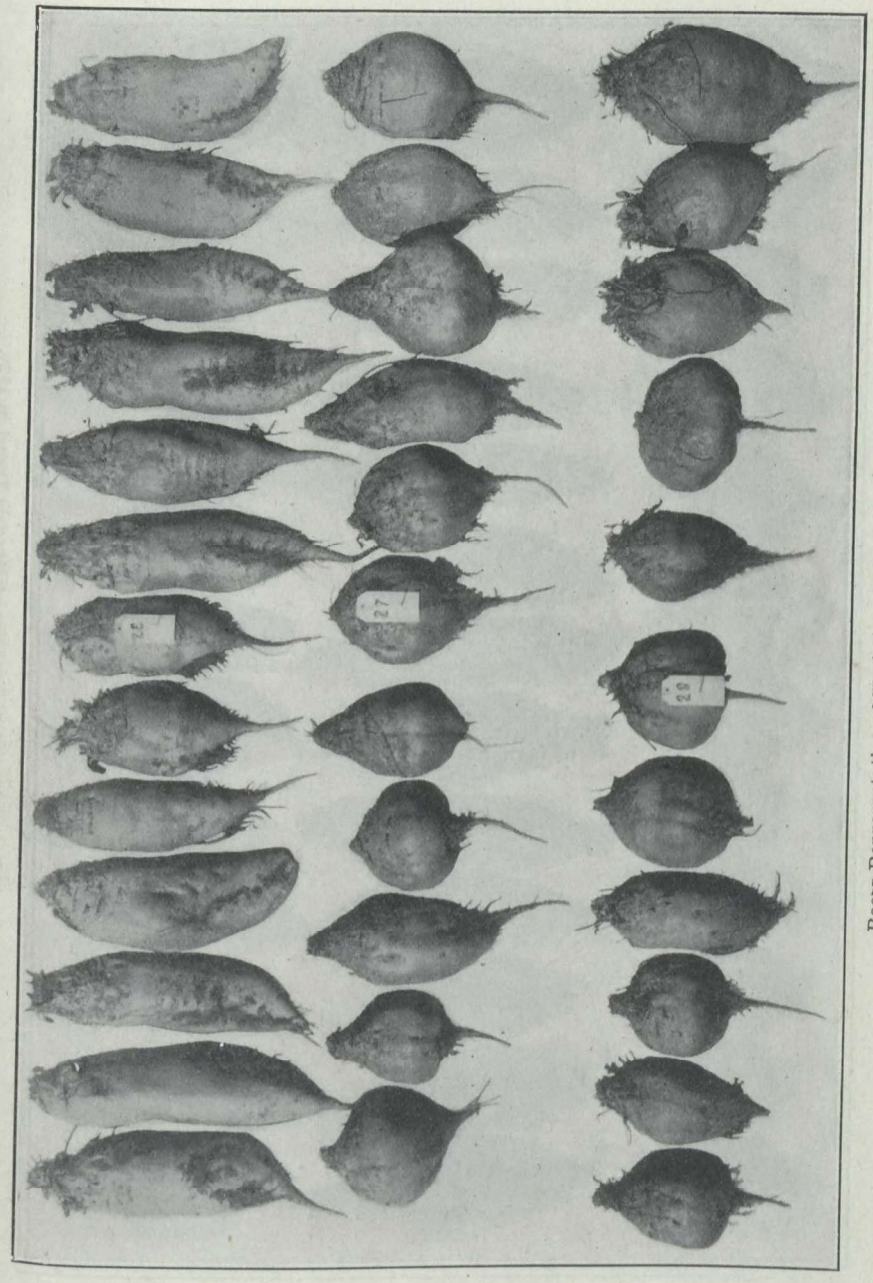

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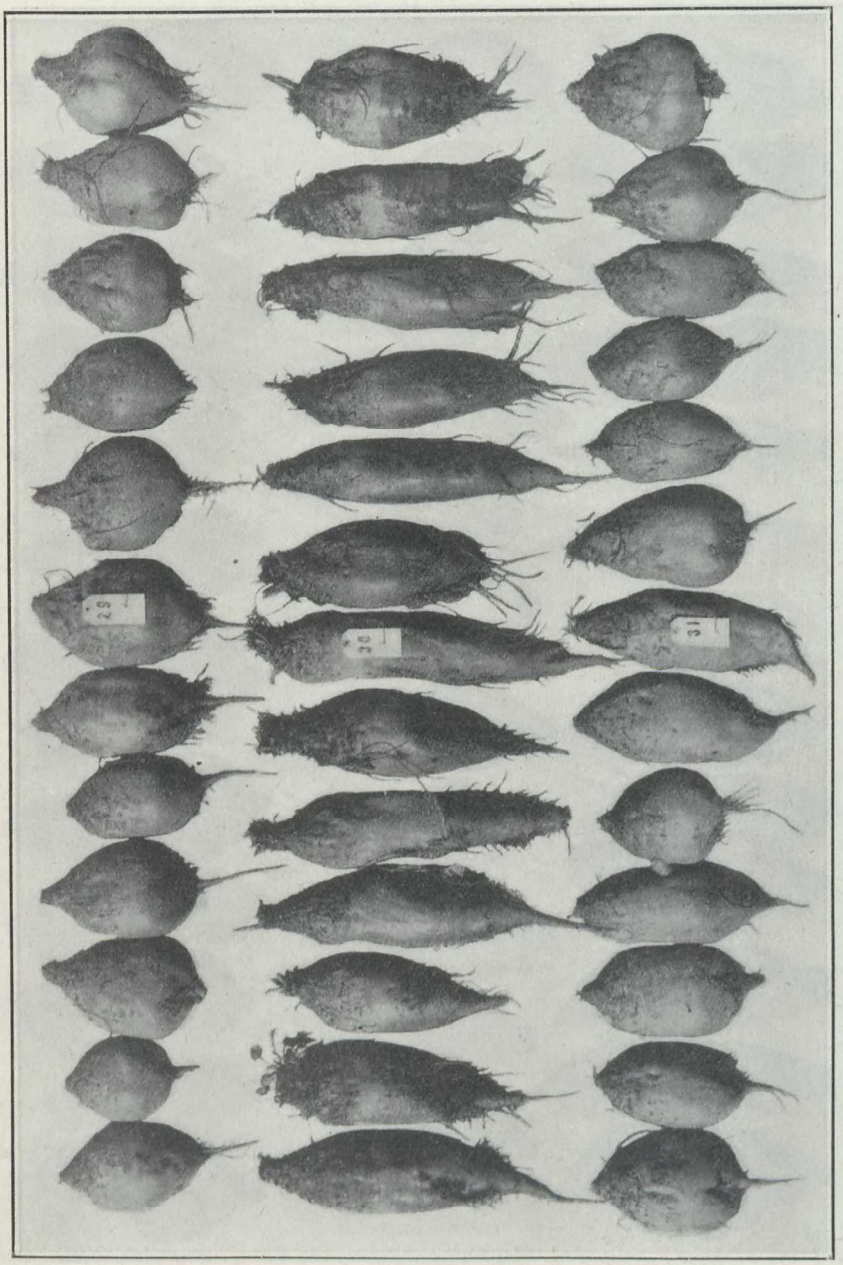

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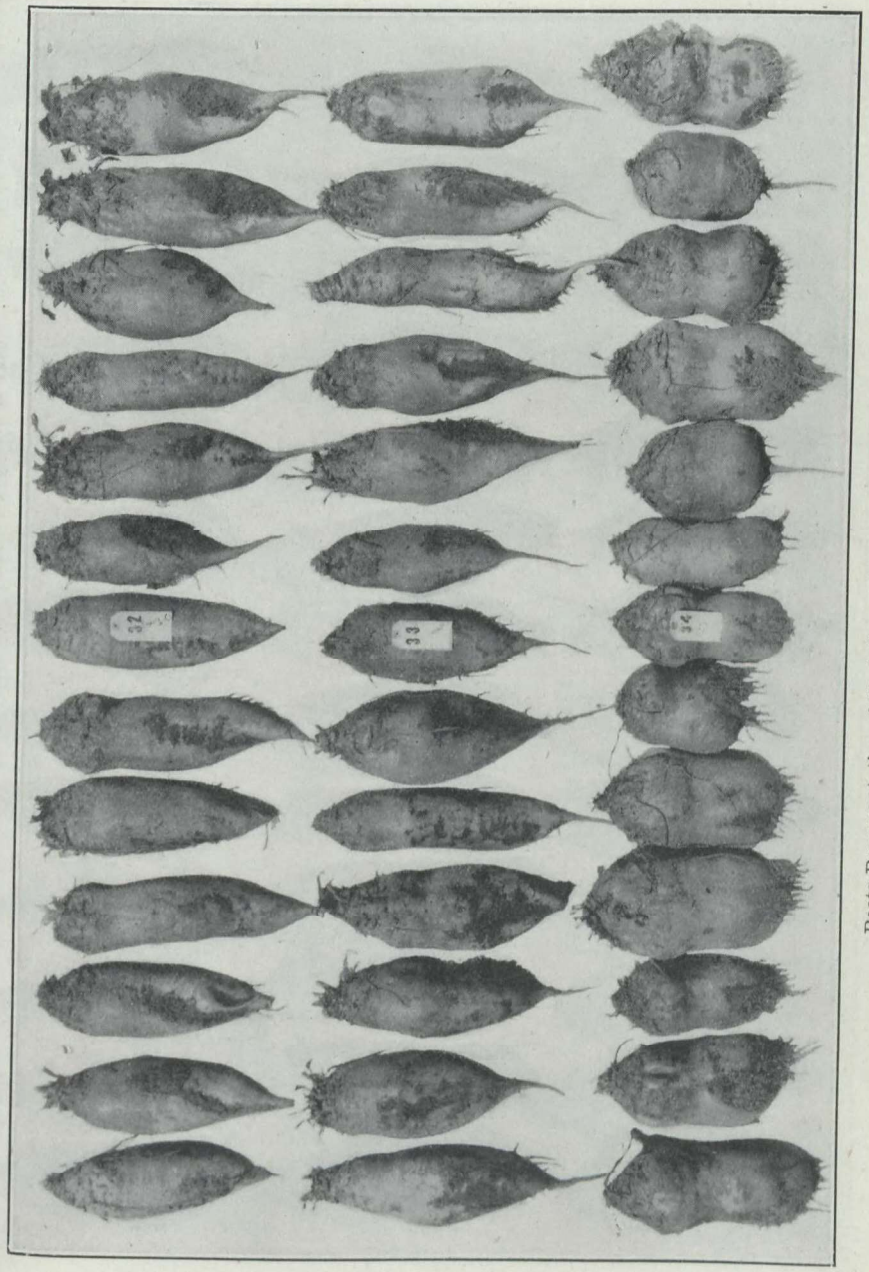

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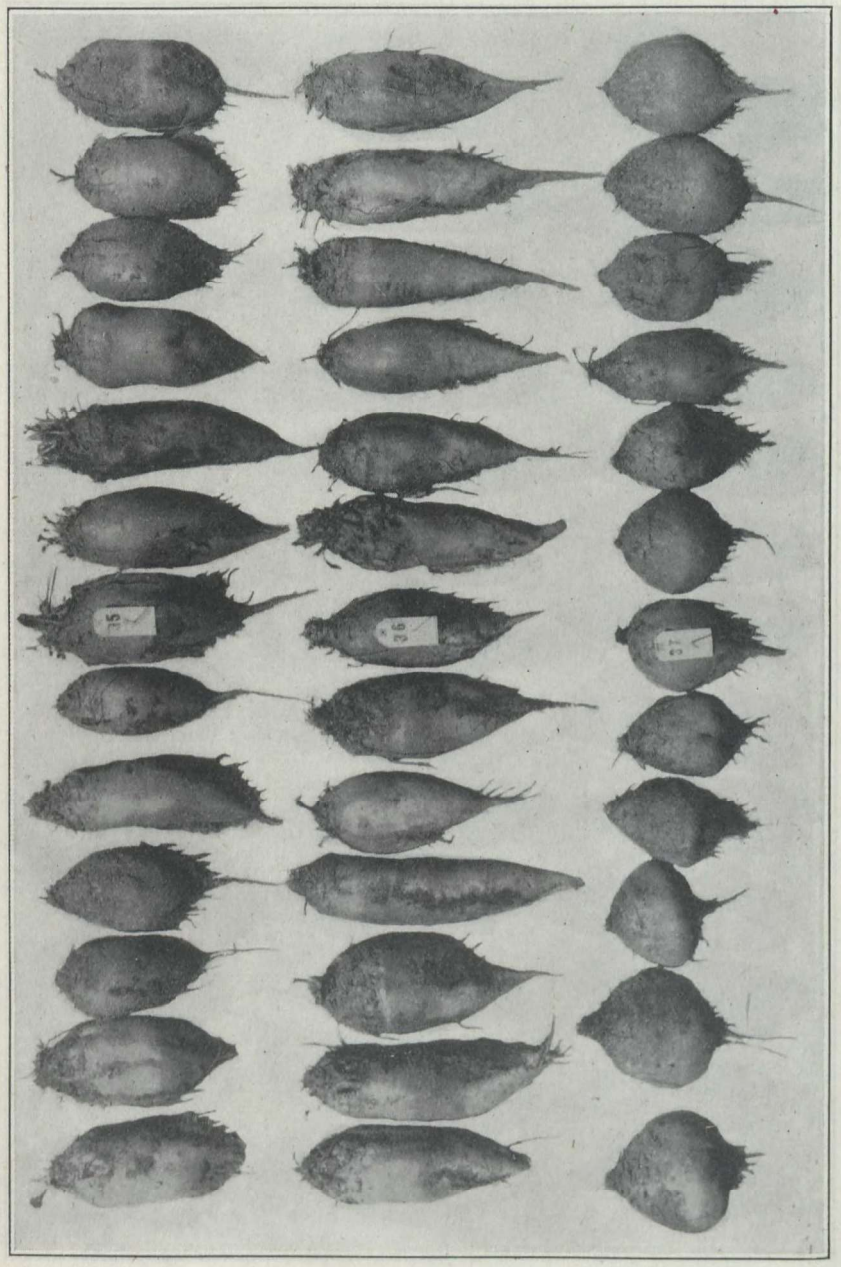

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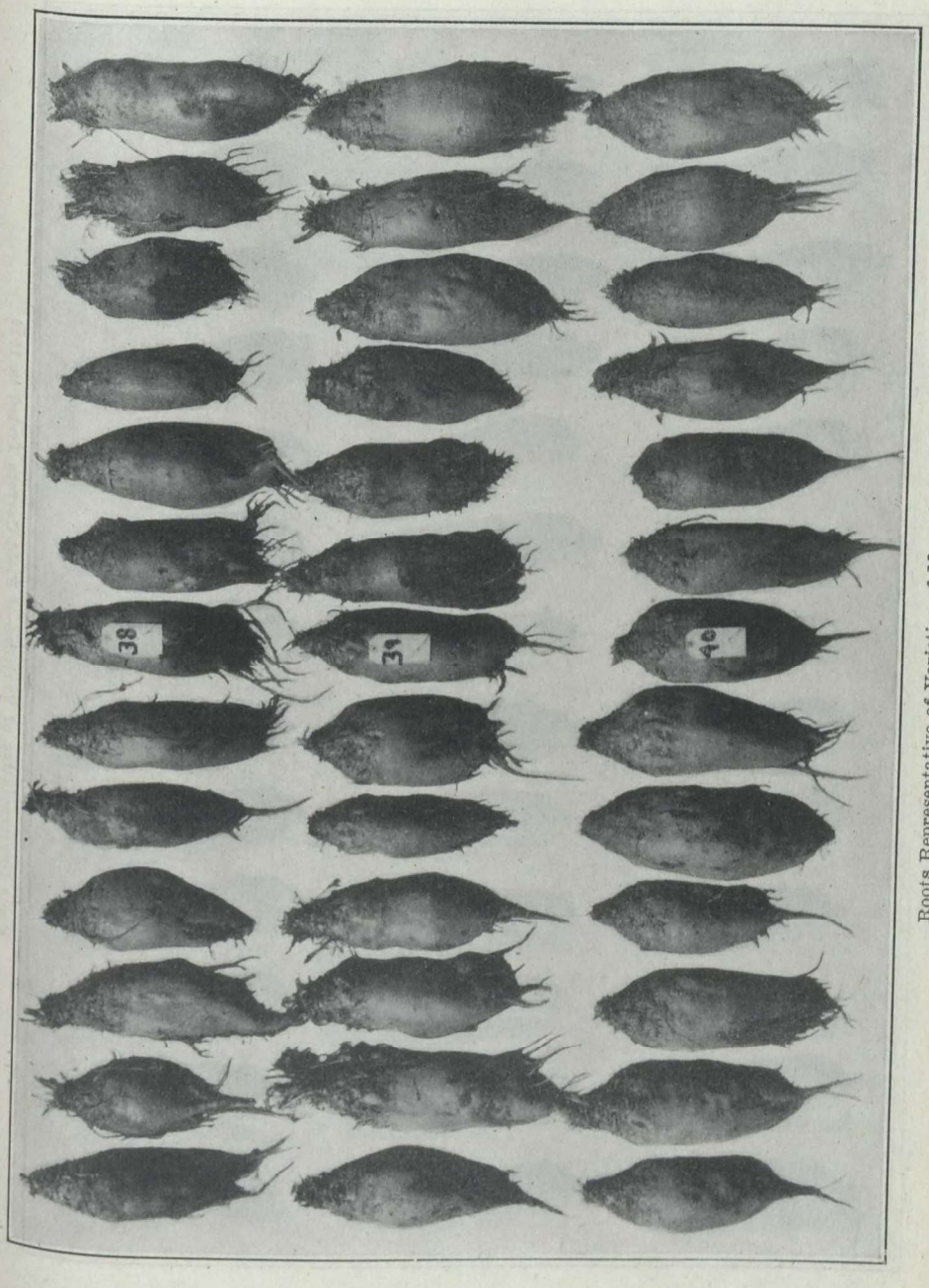

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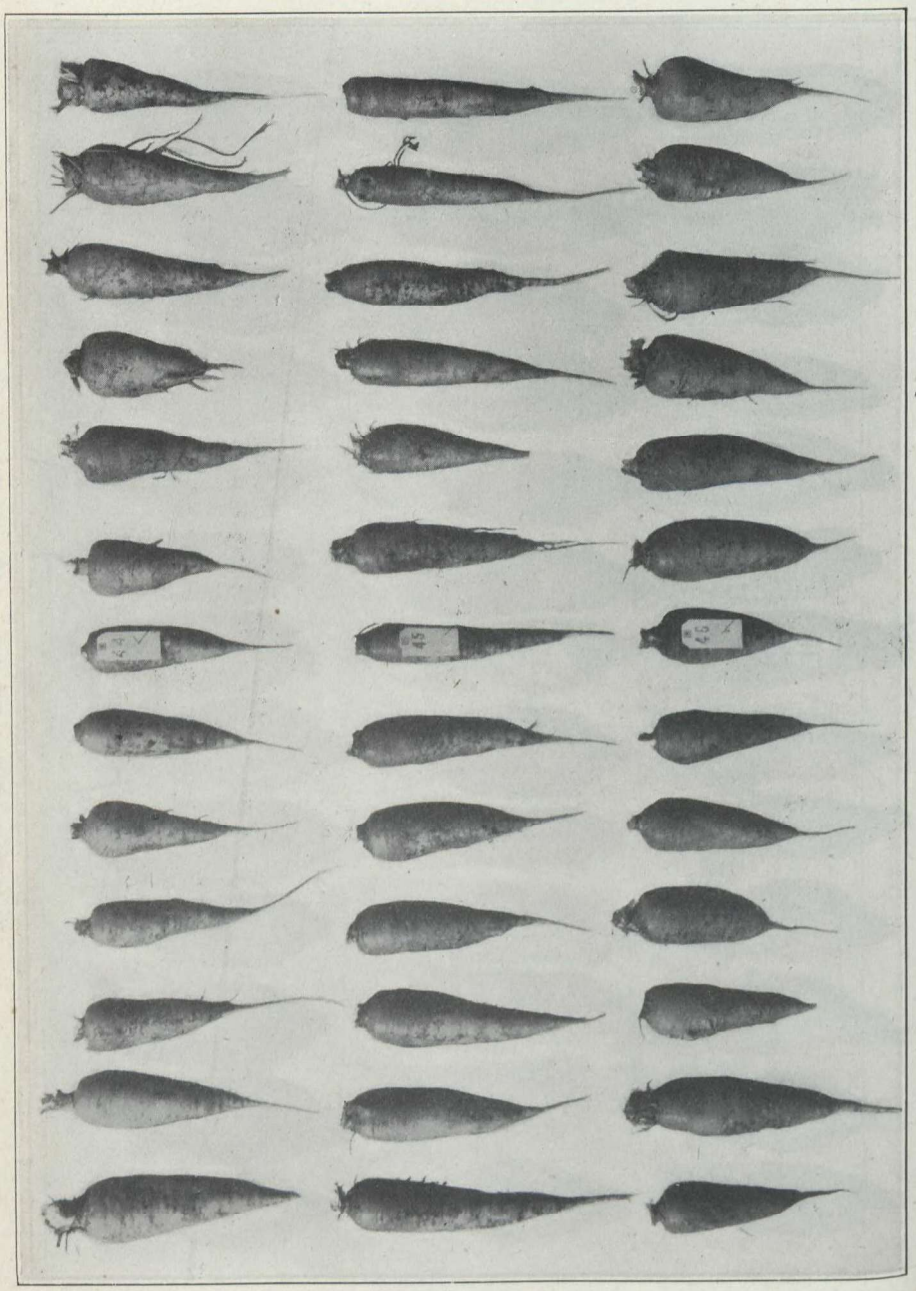
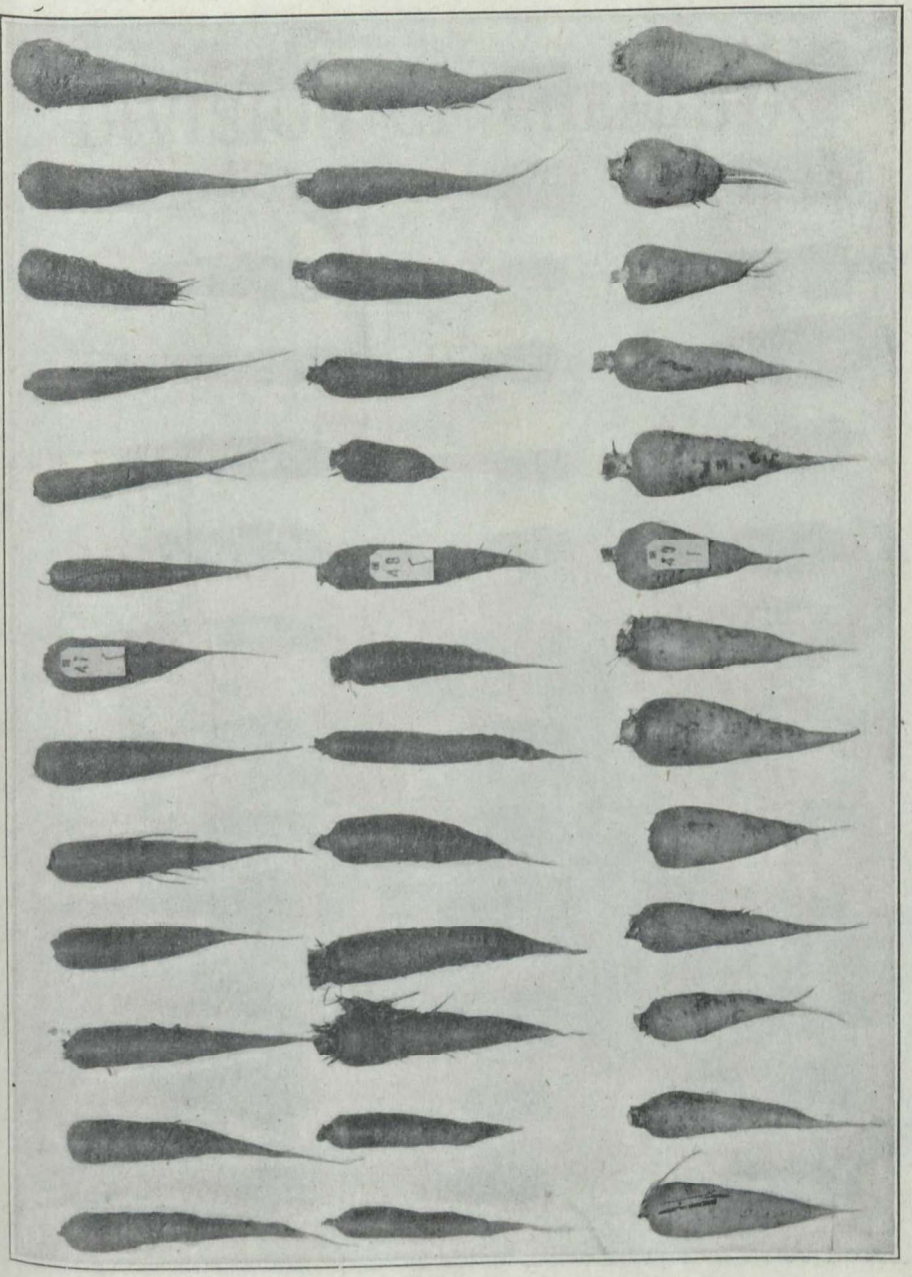


Roots Representative of Varieties of Field Carrots Tested in 1920.



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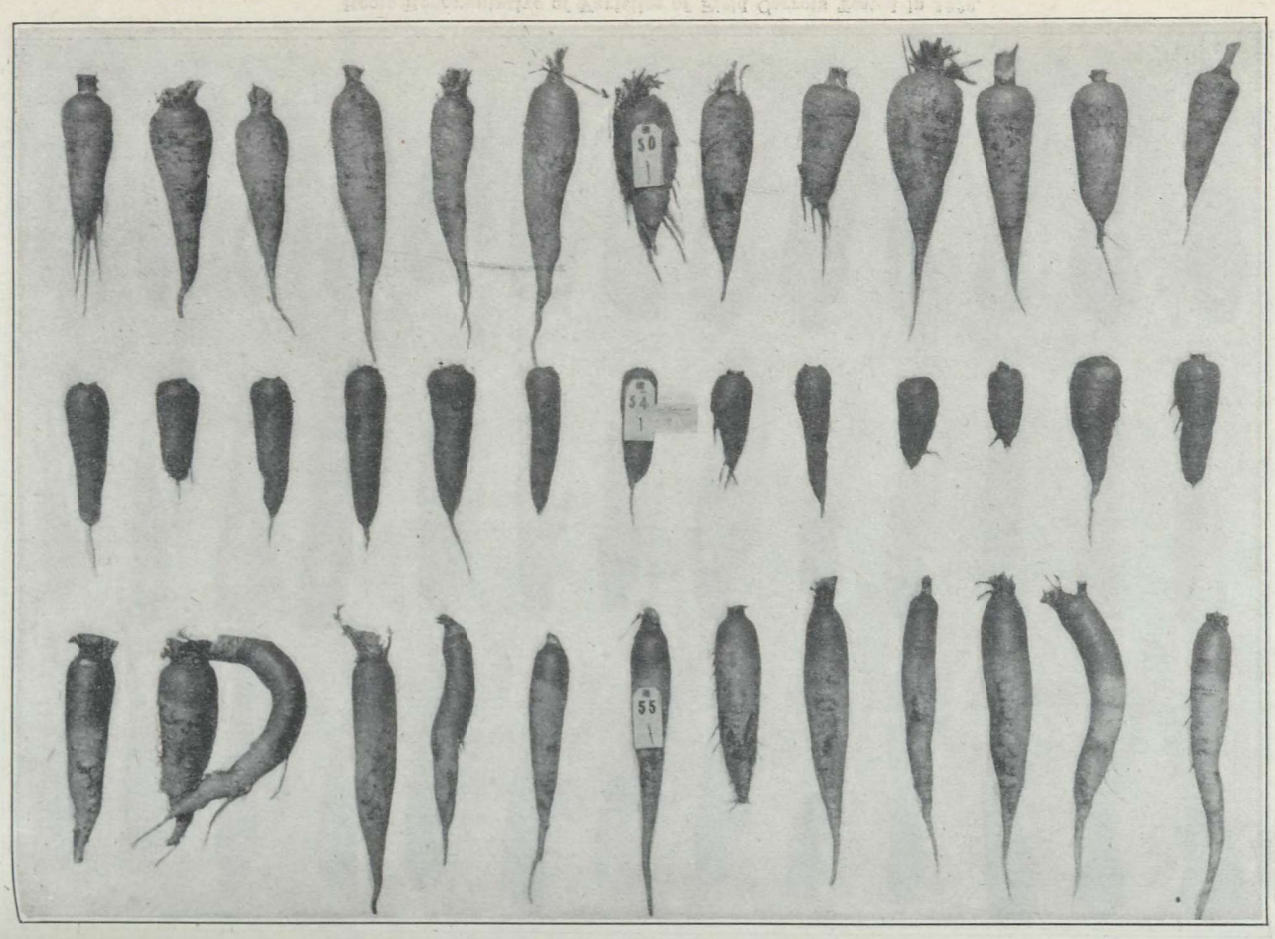

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