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Canada

DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
DOMINION EXPERIMENTAL FARMS

REPORT OF THE

DIVISION OF FORAGE PLANTS

G. P. McROSTIE, Ph.D., DOMINION AGROSTOLOGIST

FOR THE YEAR 1929

Inbreeding desirable alfalfa plants at the Central Experimental Farm, Ottawa.

Published by Authority of the Hon. W. R. Motherwell, Minister of Agriculture, Ottawa, 1930

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DIVISION OF FORAGE PLANTS

REPORT OF THE DOMINION AGROSTOLOGIST, G. P. McROSTIE, Ph.D.

INTRODUCTION

The seasonal activities of the Forage Crop Division of the Central Experimental Farm during the growing season of 1929 were characterized by the planting out of a much larger number of individual plants than usual. The increased area of land now available for forage crop improvement has made possible this extension of the breeding activities. A quantity of red clover seed was also harvested from an increase block of a superior strain of the plant in question, which had been produced at the Central Experimental Farm.

With the exception of the hindrances encountered by the exceptionally dry period of midsummer and fall, the breeding activities at the Central Experimental Farm were carried through with gratifying success. The forage crop work being conducted at the Dominion Experimental Station at Harrow, Ont., and the Dominion Range Experiment Station, Manyberries, Alta., also progressed quite favourably during the past year.

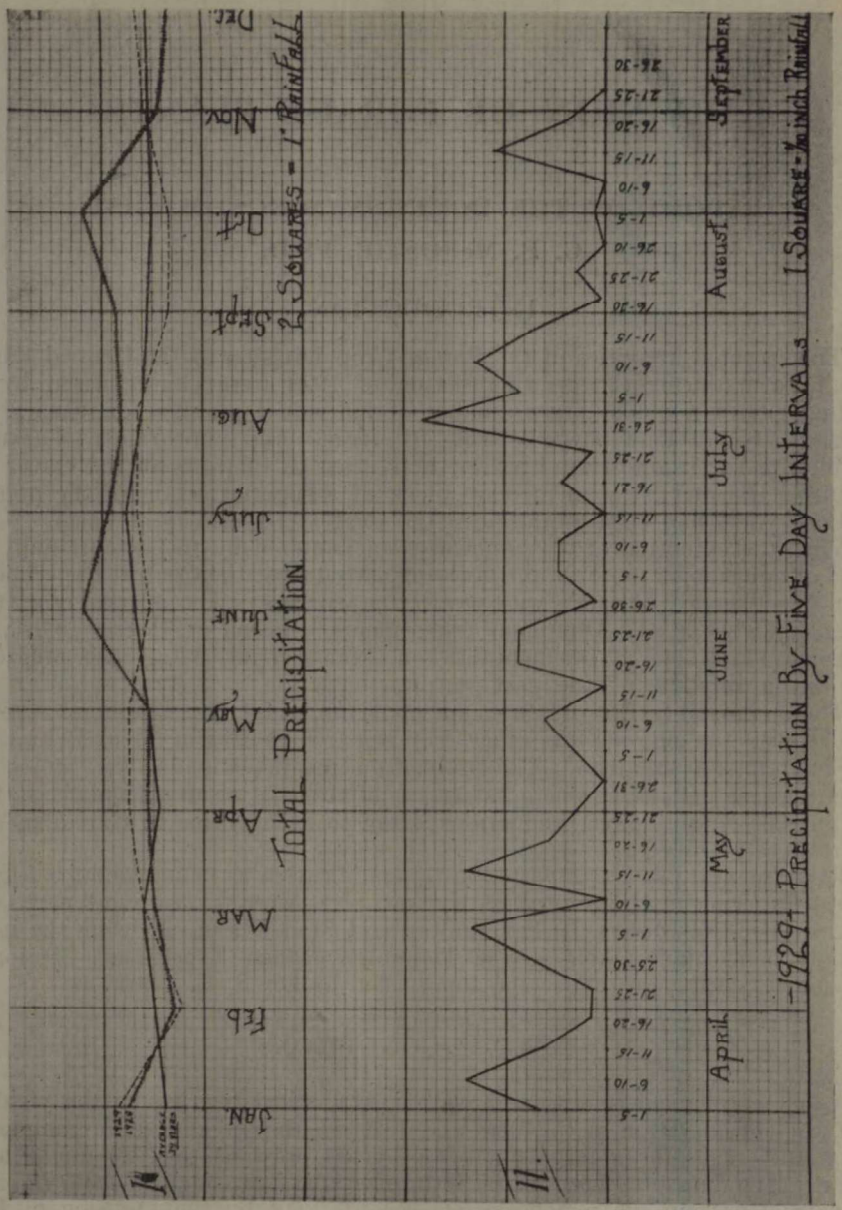
The summer of 1929 presented an opportunity for the Dominion Agrostologist to visit the outstanding forage crop research centres in Great Britain and the Scandinavian countries. The problems being investigated were noted and the various methods of carrying out research studied. Seeds and plant cuttings of a number of the newer productions likely to be of value to Canadian agriculture were obtained.

Experimental projects reported in this publication as being conducted at the Central Experimental Farm and at Harrow, Ont., were for the most part under the supervision of Messrs. R. I. Hamilton and Fred Dimmock, while the investigations being undertaken at the Dominion Range Experiment Station at Manyberries, Alta., are under the supervision of Dr. S. E. Clark.

SEASONAL CONDITIONS

As meteorological conditions have a very distinct bearing on the yields of crops, the consideration of the 1928 and 1929 weather conditions in comparison with the averages for a large number of years previous to 1929 might be of interest. The data presented in the form of graphs are compiled from information extracted from the meteorological records kept by the Division of Field Husbandry.

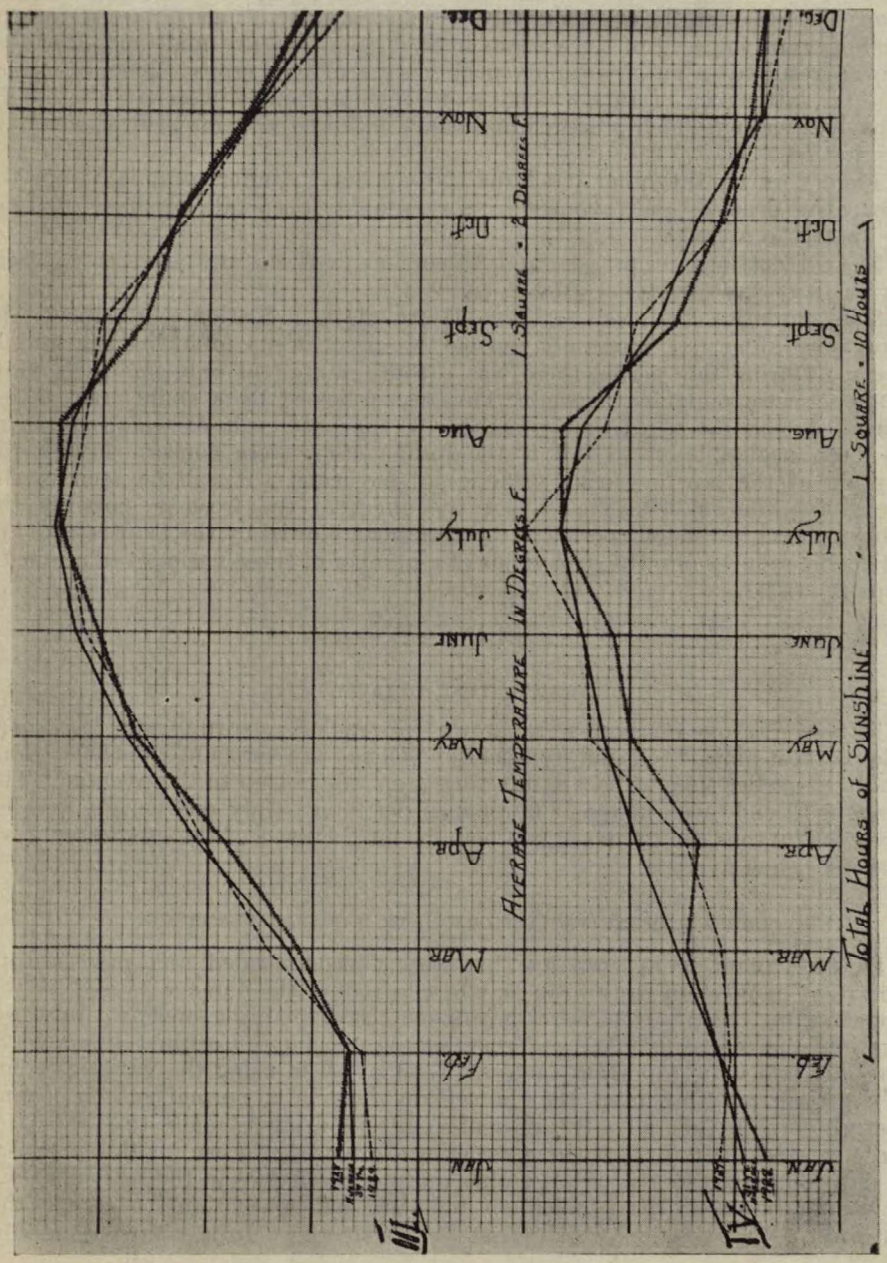
The duration of sunlight, average temperature and total precipitation all have a very decided bearing on the yield of the different types of forage crops. As various crops have a different requirement with regard to temperature and precipitation, the reaction to abnormal variations produces different end results. This statement will be borne out by a consideration of the graph showing the total precipitation by months for the years 1928-1929, in comparison with the average of the past 39 years. In conjunction with the preceding, a graph has been made also indicating the distribution of the rainfall for the growing season of 1929 by five-day intervals.



Graphs Nos. I and II.—Illustrating precipitation.

An examination of graph 1 will reveal the fact that the precipitation for the year 1929 approached much nearer to the average for the last thirty-nine years than did the precipitation for 1928. An outstanding feature of the total precipitation for the year 1929 is the fact that the rainfall was considerably heavier than normal during the early spring season and that it fell off until appreciably below normal for the midsummer and fall periods. Only in one period of the month of August was the total precipitation above the thirty-nine year average. Nineteen twenty-eight on the other hand showed a precipitation for almost the entire growing period that was very appreciably higher than the thirty-nine year average.

Graph 2 illustrates at five-day intervals the distribution of the rainfall during the growing season of the year 1929. Here again it will be seen that only in the latter part of July and the first few days in August was precipitation sufficient to penetrate the ground to any considerable distance. It will be seen, therefore, that not only was precipitation for the midsummer period of 1929 considerably below the total average for the growing season but that the distribution of the rainfall itself was such that fairly long periods of dry weather occurred during the season when the temperatures were the highest.



Graphs Nos. III and IV.—Illustrating temperature and sunshine.

An examination of graphs 3 and 4 will demonstrate the fact that the summer of 1929 was not only lower in precipitation but that the temperatures also ran lower than the average for the thirty-nine-year period. With regard to sunshine it is evident that from May until after the middle of July, the total hours of sunshine during 1929 were on the whole above the average for a thirty-one year period, and very appreciably above the average for the year 1928.

The net result of the meteorological conditions illustrated was that the growing season of 1929 with its comparatively high initial rainfall provided conditions quite suitable to the production of satisfactory first cuttings of the various grasses and clovers. Equally satisfactory conditions obtained for the germination of the seed of the various hoed crops. The dry midsummer period, however, resulted in an abnormally poor growth of root crops. Even the rainfall in the latter part of July was not sufficient duration to overcome the handicap of dry weather which preceded and which followed that interval of adequate precipitation.

Field corn on the other hand did not appear to suffer as much from the comparative drought and favoured by a reasonably open fall, produced a stand well up to the average.

Second cuttings of grasses and clovers as well as any seed crops from such cuttings were light.

The climatic conditions at the Harrow, Ont., Station throughout the season were abnormal, especially during the eight weeks following the middle of July. During this period there was a total rainfall of only one inch while the temperature remained normal. This was followed by a slight frost which occurred during the night of September 19, the net result of which seems to have been negligible in so far as the forage crops were concerned with the exception of the late maturing varieties of soybeans. It will be seen in the table giving the soybean yields that the effect of the frost or possibly the combined effect of the long period of dry weather followed by the frost resulted in a noticeable reduction in the seed yields of a number of those varieties in maturity groups 2 and 3.

FIELD CORN

VARIETY TEST, OTTAWA

Fifty-eight lots of corn were grown in regular quadruplicate $\frac{1}{200}$ acre single row test plots. Soil and weather conditions were very unfavourable. Fall frosts were earlier than usual and the corn crop was not up to the average. The average field yield was 13 tons, 309 pounds per acre. Only one variety yielded better than 20 tons, *i.e.* 24 tons 1,049 pounds but the most of the lots tested gave yields far below average.

CORN BORER CONTROL—NORMAL VS. DELAYED PLANTING

Delayed planting of corn has both been recommended and practised to some extent in Western Ontario in an effort to reduce the damage caused by the European corn borer. If it were only a matter of planting one, two or three weeks late the matter would be a very simple one but unfortunately we have to consider two very important factors. First of all in using the varieties commonly grown, planting later than a certain date in a normal season means immature corn in the fall. If sufficiently late planting is made to escape the borer it is almost certain that these varieties are too late to use for this purpose. This naturally suggests the use of earlier maturing varieties in the late planting. Here again, however, the problem of planting sufficiently late to escape the borer presents a situation which must be considered. It is quite commonly

TABLE 1—CORN BORER CONTROL—NORMAL VS. DELAYED PLANTING

Yields for 1929 and averages for 2 years (1928-1929)

Variety	Source of seed	Date of planting	Date ripe	Days to maturity	Height	Yield of Ears per Acre											
						1929						Average 1928-1929					
						No. 1	No. 2	No. 3	No. 4	Total	Marketable ears, No. 1 and No. 2	No. 1	No. 2	No. 3	No. 4	Total	Marketable ears, No. 1 and No. 2
					ft. in.	bush.	bush.	bush.	bush.	bush.	bush.	bush.	bush.	bush.	bush.	bush.	bush.
Twitchell's Pride	Experimental Farm, Fredericton, N.B.	May 25	Sept. 2	100	5 3	.....	2·96	13·58	3·21	19·75	2·96	1·87	4·69	10·64	2·40	19·59	6·56
		June 1	" 10	101	.....	0·48	8·07	10·92	0·49	19·96	8·55	3·00	9·12	8·14	0·78	21·04	12·12
		" 8	" 16	100	.....	2·40	7·79	6·89	.....	17·08	10·19	5·51	7·32	6·04	0·22	19·09	12·83
Quebec No. 28	Macdonald College, Que.	May 25	Aug. 28	95	5 4	.....	2·58	11·69	3·24	17·51	2·58	2·90	4·37	9·59	1·77	18·63	7·27
		June 1	Sept. 6	97	.....	0·45	9·95	9·66	0·73	20·80	10·40	4·52	10·71	8·00	0·78	24·01	15·23
		" 8	" 13	97	.....	1·19	12·63	6·27	0·73	20·82	13·83	6·83	10·98	5·33	0·63	23·76	17·81
Northwestern Dent	Experimental Farm, Brandon, Man.	May 25	Aug. 28	95	5 1	.....	12·87	7·65	1·53	22·04	12·87	0·55	10·97	7·84	1·22	20·57	11·52
		June 1	Sept. 6	97	.....	.....	15·25	7·65	0·72	23·63	15·25	4·39	10·88	7·10	1·16	23·53	14·76
		" 8	" 11	99	.....	5·44	13·19	3·86	.....	22·50	18·63	10·18	7·83	4·24	0·07	22·32	18·01
Minnesota No. 13	Northrup King	May 25	Sept. 16	114	6 8	2·26	19·77	6·69	.....	28·72	22·03	17·82	12·61	4·18	.....	34·61	30·43
		June 1	" 21	112	.....	11·62	21·55	3·43	.....	36·59	33·17	25·17	14·27	4·02	.....	43·45	39·44
		" 8	Oct. 5	119	.....	21·40	17·38	0·51	.....	39·29	38·78	34·24	10·62	1·62	.....	46·48	44·86
Northwestern Dent	Dakota Imp. Seed Co.	May 25	Sept. 10	108	6 0	.....	21·64	6·48	.....	28·13	21·64	18·08	17·97	3·96	.....	40·01	36·05
		June 1	" 24	115	.....	7·45	23·99	4·19	.....	35·60	31·41	22·06	20·21	3·47	.....	45·73	42·26
		" 8	Oct. 3	117	.....	13·60	16·42	2·09	.....	32·11	30·02	30·88	9·32	1·74	.....	41·94	40·20
Northwestern Dent	Macdonald College, Que.	May 25	Sept. 10	108	6 8	0·46	22·56	5·85	0·19	29·07	23·03	12·36	14·89	5·62	0·10	32·97	27·25
		June 1	" 25	116	.....	10·63	26·15	2·51	.....	39·29	36·78	18·73	17·94	2·71	.....	39·38	36·67
		" 8	Oct. 3	117	.....	21·54	14·18	3·88	.....	39·60	35·72	31·22	10·25	2·40	.....	43·86	41·47
Longfellow	R. J. Johnston	May 25	Sept. 14	112	6 4	.....	10·89	10·62	1·48	22·98	10·89	16·71	11·34	8·20	0·74	36·98	28·05
		June 1	" 21	112	.....	2·12	19·89	8·99	1·45	32·45	22·01	15·23	15·80	7·24	1·12	39·38	31·03
		" 8	Oct. 2	116	.....	12·09	15·02	4·65	.....	31·76	27·11	26·62	11·12	5·32	.....	43·06	37·74
Pride Yellow Dent	Dakota Imp. Seed Co.	May 25	Sept. 26	124	7 2	0·38	29·73	9·05	.....	39·16	30·12	8·28	17·75	8·20	.....	34·23	26·03
		June 1	Oct. 3	124	.....	22·44	21·89	4·47	.....	48·81	44·33	24·66	14·74	3·84	.....	43·24	39·40
		" 8	" 10	124	.....	35·95	13·49	1·61	.....	51·05	49·44	30·57	7·82	2·97	.....	41·36	38·39
Bailey	D. Bondy	May 25	Sept. 28	126	8 2	6·72	23·87	5·40	.....	36·00	30·59	27·97	12·98	4·47	0·30	45·72	40·95
		June 1	Oct. 7	128	.....	34·38	8·49	1·69	.....	44·56	42·87	36·94	7·40	3·09	.....	47·43	44·3
		" 8	" 16	130	.....	32·72	7·87	1·77	.....	42·36	40·59	39·65	6·65	2·68	.....	48·97	46·30
*Wisconsin No. 7	Experimental Station, Harrow, Ont.	May 25	Sept. 27	125	7 8	5·69	24·31	5·56	.....	35·56	30·00	22·78	13·28	4·47	0·36	40·88	36·06
		June 1	Oct. 10	131	.....	25·09	20·94	2·22	.....	48·25	46·03	32·97	13·21	3·20	.....	49·38	46·18
		" 8	" 17	131	.....	32·19	14·13	2·86	.....	49·18	46·32	39·38	9·78	3·22	.....	52·32	49·16
Lancaster	Hoffman	May 25	Oct. 8	136	8 10	21·49	18·46	4·00	.....	43·94	39·95	42·58	9·23	3·07	.....	54·87	51·81
		June 1	" 17	138	.....	38·04	11·66	0·93	.....	50·62	49·70	47·68	6·97	3·99	.....	58·64	54·65
		" 8	" 18	*132	.....	38·83	4·48	4·34	.....	47·65	43·31	48·85	2·24	3·80	.....	54·89	51·09
*Burr Leaming	G. S. Carter	May 25	Oct. 6	134	8 4	21·49	29·21	2·53	.....	53·22	50·70	39·11	14·61	4·80	.....	58·01	53·72
		June 1	" 17	138	.....	38·33	14·80	1·49	.....	54·63	53·13	48·52	11·01	1·55	.....	61·08	59·53
		" 8	" 18	*132	.....	39·81	11·20	1·31	.....	52·32	51·01	49·15	7·15	2·42	0·32	59·04	56·30

No. 1. Good ears (no borer). No. 2. Good ears (with some borer)—both marketable.
No. 3. Poor ears, fit for feed. No. 4. Poor ears, unfit for feed—both unmarketable.
Average moisture content of ears (1928 and 1929) approx. 10 per cent. *Harvested in late dough stage (third planting). x Silver King 1, 1928.

known that plants do not as a rule develop and produce normally when seeded at other than the usual time. Planting in June, especially after the first week, may be quite different from planting during the second or third week in May. Where the practice of late planting is followed greater dependence is placed upon both soil and seasonal conditions and should these not chance to be favourable success can hardly be expected; late corn will be immature and early corn will be unproductive.

In order therefore to determine the advantage, if any, of delayed over normal planting this test commenced in 1928, has been continued. Beginning with the normal seeding on May 25 two successive delayed plantings were made, one on June 1, followed by the other on June 8. It would probably have been as well to make an additional late planting as a number of farmers are undoubtedly planting their corn after June 8.

Table 1 shows the results obtained from the different plantings in which early, medium and late varieties were used for this year and the average for the two years (1928-1929).

As show in the table, the ears were separated into four grades at the time of harvest.

It is quite apparent that the three early maturing varieties, Twitchell's Pride, Quebec No. 28, and Northwestern Dent (Brandon) are too unproductive to receive consideration in any scheme of planting under the conditions of this experiment. The percentage of partially or totally destroyed ears is higher for these varieties also than for the medium or late varieties.

For the medium maturing varieties the second and third plantings yielded approximately the same, both being higher than that obtained from the first planting. While the yields of good corn are not exceptionally high an average of about 40 bushels for these varieties can be considered as reasonably good.

The medium late varieties, Pride Yellow Dent, Bailey and Wisconsin No. 7 also gave better yields in the last two plantings than in the first planting. There appears to be little gained by planting these varieties later than June 1.

Considering the late varieties, Lancaster and Burr Leaming, the normal planting has resulted in almost as high yields as the second planting and this year the corn planted on June 8 failed to reach maturity.

It would appear from these results that a good medium to late variety with strong, sturdy stems, planted about June 1, should prove more valuable than any of the early varieties used in this test.

BREEDING

Inbreeding was continued with about one hundred strains selected in 1928. A considerable number of crosses and recombinations were made in 1928 and planted this year but the damage from the corn borer was so extensive that the test had to be abandoned. A small number of them were tested at Ottawa for ensilage purposes and the results of this test are shown in table 2.

It might be mentioned here that as a result of observations made during the past few years with regard to corn borer infestation a total count of the borers in five plants of each strain was made this year. The degree of infestation showed a variation of from 14 to 187. Further studies will be made in this connection to determine whether or not the strains with small counts possess any form of resistance. A few crosses will be made of low count strains in 1930 to be tested in 1931.

The breeding block of early inbred corn strains.

TABLE 2—TEST OF RECOMBINATIONS AND CROSSES FOR ENSILAGE, OTTAWA, 1929

Variety	Strain numbers	Date cut	Stage of maturity	Yield of fodder			
				Green weight		Moisture free weight	
				tons	lb.	tons	lb.
Canada Flint	30 x 29	Sept. 23	L.M.-E.D.	16	186	3	1,467
White Flint	4 x 3	" 20	Glazed	15	895	3	636
Minnesota No. 13	(25·4) x (27·1)	" 19	"	15	814	5	14
Yellow x Minn. No. 13	46 x 17	" 23	Dough	14	1,846	4	1,234
Yellow x Minn. No. 13	51 x 12	" 19	Glazed	14	1,846	4	1,512
N.W.D. (Macdonald)	9 x 12	" 22	L. D.	15	169	3	695
N.W.D. (Macdonald)	9 x 15	" 19	Glazed	15	1,943	4	1,682
N.W.D. (Macdonald)	12 x 15	" 19	"	13	1,265	..	....
Variegated	60 x 55	" 21	"	16	1,315	4	1,891
Golden Glow	7 x 8	" 19	"	12	764	—	—
S. King x Wisc. No. 7	44 x 56	" 22	E. D.	13	458	3	1,998
Wisconsin No. 7	54 x 71	" 20	Glazed	17	686	5	350
Wisconsin No. 7	56 x 58	" 23	L. M.	15	7	4	18
Wisconsin No. 7	69 x 71	" 23	Dough	14	797	4	953
Wisconsin No. 7	71 x 72	" 22	Glazed	16	266	5	57
Yellow	47 x 48	" 22	Dough	17	605	4	1,842
Yellow x Lancaster	46 x 75	" 23	Milk	18	219	4	1,790
Lancaster x Yellow	80 x 46	" 23	E. D. - D.	19	74	6	671
Lancaster	75 x 78	" 23	Late milk	18	783	4	1,593
Lancaster	78 x 79	" 23	"	12	1,813	2	1,666
Lancaster	81 x 79	" 23	"	15	1,782	2	1,635
Wisconsin	Average 8 checks	" 23	Milk	16	285	3	225

L.M.—late milk.
D.—dough.
E.D.—early dough.
L.D.—late dough.

Each recombination and cross replicated three times.

As mentioned previously the recombinations and crosses included in this test, while grown at Ottawa, were produced at Harrow.

In addition to yield, the degree of maturity at the time of harvesting must be considered. These are both shown in the table and can be compared with the yield and maturity of the check variety, Wisconsin No. 7, grown every tenth row throughout the plot. Eight check rows in all were grown and the average yield for the eight rows is given.

A study of the moisture-free yields shows that a number of the recombinations and crosses considerably outyielded the Wisconsin No. 7 check variety, a result brought about chiefly by the greater degree of maturity which they achieved.

Two hundred lots of corn were included in the breeding work at Ottawa. Most of these have been inbred for several years but additional lots were included this year for the first time. All lots were inbred and a large number of strains were crossed and recombined to be tested in 1930.

About 200 strain recombinations and crosses made in 1928 were tested this year for yield of corn (seed) and compared with a standard check variety (Quebec No. 28) and a number of other standard varieties included in the same test.

As the test is purely a preliminary one intended only to indicate the possibilities of the various recombinations and crosses one replication only is shown in table 3.

TABLE 3—TEST OF RECOMBINATIONS AND STRAINS FOR SEED, OTTAWA, 1929

Row No.	Variety	Strain numbers	Days to mature	Average height		Rate of yield per acre (shelled corn)
				ft.	in.	bush.
2	Quebec No. 28 (check)	.....	118	6	6	70·62
4	Howe's Alberta	.....	104	3	10	32·54
5	" "	4 x 7	105	3	7	34·87
6	" "	5 x 4	103	4	2	57·63
7	" "	5 x 7	107	4	9	65·76
8	" "	6 x 7	107	4	6	65·79
9	" "	9 x 4	104	4	2	54·56
10	" "	10 x 6	105	4	2	63·69
11	" "	10 x 8	105	3	10	33·28
12	Chippewa Flint x Howe's	36 x 4	106	4	1	70·13
14	Quebec No. 28 (check)	.....	118	6	4	70·93
16	Howe's x Gehu	9 x 38	114	4	5	85·97
17	Falconer x Howe's	50 x 11	114	4	5	73·57
18	Twitchell's Pride x Howe's	63 x 6	107	5	2	65·09
19	" "	63 x 7	113	4	8	67·53
20	" "	64 x 6	107	4	9	65·89
21	" "	67 x 8	109	4	9	71·95
22	Quebec Yellow x Howe's	72 x 6	107	4	10	90·11
23	Howe's x Minnesota No. 13	8 x 98	118	5	7	79·45
24	Ruthenian Flint	17 x 20	110	4	4	66·87
26	Quebec No. 28 (check)	.....	118	5	7	50·71
28	Ruthenian Flint	20 x 15	109	4	6	46·37
29	" "	20 x 18	109	4	5	71·08
30	Ruthenian Fl. x Dak. Wh. Fl.	17 x 43	110	4	6	50·24
31	" Quebec No. 28	17 x 60	112	4	8	60·61
32	" Perly Davis	18 x 95	109	4	11	76·06
33	" Quebec No. 28	19 x 57	112	6	0	84·11
34	" "	20 x 59	110	5	5	84·45
35	King Flint	26 x 27	110	3	5	46·68
36	"	26 x 29	109	4	6	52·26
38	Quebec No. 28 (check)	.....	119	5	10	67·90
40	King Flint	29 x 27	113	5	0	47·54
41	King Flint x Ruthenian Fl.	26 x 20	109	3	6	54·10
42	King Flint x Dakota Wh. Flint	27 x 43	110	4	2	61·68
43	Twitchell's Pride x Holbeck	64 x 30	113	5	2	74·95
44	" "	70 x 30	117	5	4	94·99

TABLE 3—TEST OF RECOMBINATIONS AND STRAINS FOR SEED, OTTAWA, 1929—*Con.*

Row No.	Variety	Strain numbers	Days to mature	Average height		Rate of yield per acre (shelled corn)
				ft.	in.	bush.
45	Missing.					
46	Geisner x Assiniboine	114 x 33	120	5	6	78·79
47	Griswold x Ruthenian Fl.	31 x 20	111	4	0	80·18
48	Griswold x Chippewa Flint	31 x 36	113	4	6	88·21
50	Quebec No. 28 (check)	.....	119	5	7	56·78
52	Nova Scotia Yellow x Griswold	32 x 31	113	4	1	73·44
53	Assiniboine Yellow x Chippewa Flint	34 x 35	109	4	9	88·77
54	Missing.					
55	Gehu	40 x 38	114	3	9	44·22
56	Gehu (D.I.S. Co.)	.....	118	4	9	86·04
57	White Flour x Dak. Wh. Fl.	42 x 44	113	4	7	91·36
58	Dakota White Flint x Ruthenian Fl.	43 x 20	109	4	5	52·53
59	Dakota White Flint x White Flour	43 x 42	109	4	8	81·20
60	Dakota White Flint	43 x 45	110	4	8	85·93
62	Quebec No. 28 (check)	.....	119	5	5	56·53
64	Holbeck x Quebec No. 28	30 x 59	116	5	2	78·86
65	Holbeck x Quebec Yellow	30 x 72	110	5	0	67·98
66	Nova Scotia Yellow x Brome County	32 x 118	113	4	5	79·46
67	Quebec No. 28 x Gehu	60 x 38	112	5	2	102·82
68	Gehu x Quebec No. 28	39 x 59	112	5	6	86·26
69	Gehu x Brome County	39 x 118	114	5	2	78·33
70	Dakota White Flint x Squaw	44 x 76	112	4	8	108·48
71	Dakota White Flint x Perly D	45 x 97	111	5	3	106·85
72	Poirer x Quebec No. 28	46 x 58	111	5	3	112·47
74	Quebec No. 28 (check)	.....	120	5	1	72·57
76	Poirer x Quebec No. 28	46 x 59	123	5	4	97·09
77	Poirer	47 x 46	123	6	0	65·72
78	Poirer x Quebec No. 28	47 x 53	120	5	8	53·18
79	Poirer x Quebec No. 28	47 x 57	118	6	8	92·75
80	Poirer x McConnell's	47 x 87	123	6	0	67·31
81	Poirer x Salzer's	47 x 117	123	4	0	46·53
82	Poirer x Quebec Yellow	48 x 73	121	5	2	53·95
83	Poirer x Gray	48 x 91	123	4	9	46·46
84	Geisner x Poirer	114 x 48	130	4	5	Missing
86	Quebec No. 28 (check)	.....	121	5	5	79·31
88	Falconer x Dal. White Flint	49 x 44	122	3	5	75·04
89	Falconer x Twitchell's Pride	49 x 64	120	3	7	90·67
90	Falconer	51 x 49	120	3	5	85·71
91	Falconer	52 x 51	122	4	1	69·08
92	Falconer x Quebec No. 28	51 x 57	121	5	1	129·71
92	Falconer x Northwestern Dent	51 x 108	130	5	3	88·73
94	Falconer x Twitchell's Pride	52 x 70	128	6	2	105·29
95	Minnesota No. 13 x Falconer	99 x 52	129	6	3	110·56
96	Falconer x Northwestern Dent	52 x 108	130	6	1	90·72
98	Quebec No. 28 (check)	.....	121	5	10	73·69
100	Falconer x Geisner	52 x 114	130	5	3	106·07
101	Quebec No. 28	54 x 55	122	5	6	64·31
102	" "	55 x 53	121	5	9	89·31
103	" "	55 x 57	130	5	5	Missing
104	" "	57 x 54	120	6	3	99·79
105	" "	57 x 59	120	5	5	90·53
106	" "	57 x 60	121	5	6	78·52
107	" "	58 x 56	121	5	6	64·10
108	" "	58 x 61	125	5	9	67·91
110	Check	.....	121	6	2	73·46
112	Quebec No. 28	58 x 62	121	6	8	94·59
113	" "	59 x 56	121	6	4	58·84
114	" "	59 x 58	120	5	8	77·16
115	" "	60 x 62	120	6	3	96·34
116	" "	61 x 55	121	6	6	79·72
117	" "	61 x 60	120	5	9	80·49
118	" "	61 x 62	126	6	5	52·30
119	" "	62 x 54	125	7	0	61·93
120	" "	62 x 55	126	6	6	76·02
122	" " (check)	.....	125	6	0	76·63
124	" "	62 x 57	127	6	3	87·74
125	Quebec No. 28 x Gehu	62 x 41	130	7	2	66·59
126	Quebec No. 28 x Salzer's	54 x 105	128	7	6	77·89
127	" "	56 x 117	129	6	10	69·29
128	" "	57 x 117	130	7	0	72·10
129	" "	60 x 116	129	7	3	72·68
130	" "	61 x 116	128	7	6	61·08

TABLE 3—TEST OF RECOMBINATIONS AND STRAINS FOR SEED, OTTAWA, 1929—*Con.*

Row No.	Variety	Strain numbers	Days to mature	Average height		Rate of yield per acre (shelled corn)
				ft.	in.	bnsh.
131	Quebec No. 28 x Twitchell's Pride	61 x 65	121	7	0	79·08
132	" "	62 x 65	123	6	2	77·59
134	Quebec No. 28 (check)	.....	123	5	4	72·59
136	Quebec No. 28 x Salzer's	62 x 105	128	8	1	81·12
137	Missing.					
138	Twitchell's Pride x Quebec 28	63 x 59	125	5	1	68·87
139	Twitchell's Pride	63 x 66	121	7	0	79·77
140	" "	63 x 70	125	5	6	80·65
141	" "	64 x 69	125	5	9	83·17
142	" "	65 x 67	119	5	2	52·98
143	" "	65 x 69	121	7	0	80·91
144	" "	66 x 67	120	5	8	Missing
146	Quebec No. 28 (check)	.....	121	5	3	74·63
148	Twitchell's Pride	67 x 63	121	5	6	66·03
149	" "	68 x 63	121	5	8	62·82
150		68 x 66	121	5	6	66·92
151		70 x 67	121	5	6	91·60
152	Twitchell's Pride	.....	121	5	7	65·2
153	Twitchell's Pride x Gehu	65 x 41	127	6	4	60·66
154	Twitchell's Pride x Quebec Yellow	65 x 71	124	6	3	68·75
155	Twitchell's Pride x N.W. Fl	66 x 45	125	6	4	77·85
156	Missing.					
158	Quebec No. 28 (check)	.....	123	6	4	76·05
160	Twitchell's Pride x Quebec No. 28	68 x 58	124	6	7	67·01
161	" " x Quebec Yellow	69 x 71	127	7	3	69·38
162	" " "	70 x 75	128	7	2	76·31
163	Quebec Yellow	71 x 73	131	6	2	70·95
164	"	71 x 74	123	6	14	67·67
165	"	72 x 71	122	5	10	97·00
166	"	72 x 74	125	5	6	88·42
167	"	75 x 74	127	6	0	69·90
168	Quebec Yellow x Twitchell's Pride	72 x 70	128	5	6	81·79
170	Quebec No. 28 (check)	.....	124	5	4	82·92
172	Quebec Yellow x Twitchell's Pride	73 x 69	128	5	3	79·45
173	Man. Amber x Que. Yellow	77 x 44	123	4	7	72·18
174	Man. Amber x Squaw	77 x 76	122	5	8	63·53
175	McConnell's x Gray	86 x 90	130	5	7	94·45
176	McConnell's	87 x 85	130	4	6	68·07
177	"	87 x 86	130	5	5	51·26
178	"	88 x 85	131	4	10	70·07
179	" x Bedard	87 x 126	123	6	7	70·88
180	" x Gray	89 x 90	130	5	7	100·25
182	Quebec No. 28 (check)	.....	122	5	3	68·82
184	Gray	90 x 92	131	5	11	71·93
185	"	91 x 90	131	5	9	78·21
186	Gray x McConnell	92 x 89	131	6	0	Missing
187	Perley x Gray	94 x 92	125	5	3	123·75
188	Perley Davis	95 x 94	128	5	0	56·33
189	"	95 x 97	128	5	3	58·74
190	"	96 x 94	128	5	0	89·59
191		96 x 95	128	5	7	64·53
192		97 x 94	128	6	0	53·84
194	Quebec No. 28 (check)	.....	125	6	6	60·60
196	Minn. No. 13 (Unsworth)	.....	132	7	2	81·03
197	Minn. No. 13 N. W. Dent	99 x 100	132	6	5	87·54
198	Northwestern Dent	100 x 109	131	6	7	86·52
199	" "	104 x 109	131	4	9	82·25
200	" "	108 x 106	132	5	2	40·93
201	" "	109 x 106	132	5	8	43·59
202	" "	110 x 106	132	5	5	48·12
203	" "	111 x 106	132	5	3	40·67
204	" "	111 x 108	130	5	11	59·20
206	Quebec No. 28 (check)	.....	124	6	6	57·42
208	Northwestern Dent	111 x 109	132	6	5	59·07
209	Northwestern Dent (Brandon)	.....	125	6	6	59·08
210	N. W. Dent x Golden Moe	100 x 139	130	8	0	69·74
211	Salzer's x Twitchell's Pr	105 x 70	129	7	3	77·58
212	Salzer's Squaw	105 x 76	123	7	0	76·40
213	N.W. Dent x P. Davis	106 x 95	124	6	5	68·26
214	N.W. Dent x Geisner	107 x 114	129	6	4	55·39

TABLE 3- -TEST OF RECOMBINATIONS AND STRAINS FOR SEED, OTTAWA, 1929--*Conc.*

Row No.	Variety	Strain numbers	Days to mature	Average height		Rate of yield per acre (shelled corn)
				ft.	in.	bush.
215	Geisner x Northwestern Dt.	113 x 110	128	5	9	52·37
216	Missing.					
218	Quebec No. 28 (check)	.....	125	6	4	66·29
220	Geisner x Northwestern Dent	114 x 109	127	5	7	70·55
221	" " "	114 x 111	125	5	3	74·31
222	Geisner	114 x 115	125	6	6	52·99
223	Salzer's x Perley Davis	116 x 94	127	7	6	75·97
224	Salzer's	116 x 117	129	5	5	33·83
225	Salzer's x Squaw	117 x 76	126	6	4	64·06
226	Salzer's x McConnell's	117 x 89	132	6	11	75·28
227	Proulx x McConnell	124 x 86	125	6	4	80·08
228	Proulx x Bedard	125 x 127	124	6	0	68·60
230	Quebec No. 28 (check)	.....	124	6	1	70·34
232	Bedard	126 x 128	125	5	9	72·61
233	Bedard x Quebec No. 28	127 x 57	122	5	8	75·19
234	" "	127 x 62	123	6	5	66·27
235	Bedard	128 x 127	123	5	9	68·01
236	Bedard x Lauzon	128 x 129	129	6	8	69·11
237	Lauzon x Quebec No. 28	129 x 56	128	6	6	73·89
238	Lauzon x Perley Davis	129 x 96	127	6	8	96·53
239	Yellow (47) x Howe's	Harrow	123	6	4	70·80
240	Yellow (48) x Howe's	Harrow	122	6	3	78·43
242	Quebec No. 28 (check)	.....	124	5	6	77·28
244	Yellow (51) Howe's	Harrow	122	6	0	69·69
245	Wisconsin No. 7 (58) Howe's	"	126	6	10	81·49
246	Wisconsin No. (71) x Howe's	"	125	6	9	80·16
247	Ex. Early Minn. 13 (Haney)	.....	129	6	10	76·13
248	N.W. Dent (Macdonald Col.)	.....	.....	6	9	84·43
250	Quebec No. 28 (check)	.....	125	5	0	56·85

Shelled corn contains uniform moisture content of 10 per cent throughout.

It will be seen in the table that the check variety, Quebec No. 28, appears as it was grown in the test, every tenth row. The yields of the recombined strains and crosses, and also the standard varieties must be compared with that of the nearest check or checks in order to obtain some idea of their yielding capacity. As maturity is a very important consideration, the length of time required by each lot to mature is shown and can be compared with that required by the checks.

It is plainly evident that while a number of the recombinations and crosses yielded less and were in some cases later in maturing than the checks, a great many not only yielded higher but were also as early or earlier in maturity.

As many as possible of the same recombinations and crosses have been made this year and will be tested again in 1930 in order to determine whether or not the above results will be duplicated.

BROOM CORN

VARIETY TEST

Eighteen varieties of broom corn representing standard, intermediate and dwarf types were tested again this year. This is the fourth consecutive year that this test has been conducted and the relative merits of the different varieties have been fairly definitely established. The experiment will probably be completed in 1930.

Table 4 gives the yields, etc., for this year and also the averages for the four years (1926-1929).

TABLE 4—BROOM CORN—VARIETY TEST

Yield, etc., for 1929 and Average for 4 years (1926–1929)

Variety	Type	Original source of seed	Date of planting	Date of harvesting: Brush	Date of harvesting: Seed	Average Height	Air-dry yield of brush per acre: 1929 Good	1929 Poor	1929 Total	Average 4 years 1926-1929 Good	Average 4 years 1926-1929 Poor	Average 4 years 1926-1929 Total	Length of brush: 1929 Good	1929 Poor	Average 4 years, 1926-1929 Good	Average 4 years, 1926-1929 Poor	Yield of fodder per acre: 1929 Green weight	Average 4 years 1926-1929 Green weight
						ft. in.	lb.	lb.	lb.	lb.	lb.	lb.	in. approx.	in. approx.	in. approx.	in. approx.	tons lb.	tons lb.
Longbrush Evergreen 26-g.o.	Standard	U.S. Dept. Agriculture.	May 31	Sept. 16	Oct. 2	9 10	777	197	974	500	313	814	21	17½	19½	17	7 1,619	9 1,495
Longbrush Evergreen 56-g-o-3	"	" " ..	" 31	" 16	" 1	10 0	571	265	836	460	275	735	20	19	19	17½	7 1,619	10 1,144
Standard C.I. No. 583	"	" " ..	" 31	" 16	" 2	9 10	835	90	925	578	239	817	20½	17	19½	16	7 1,619	10 745
Standard (Illinois)	"	Salzer, Illinois	" 31	" 16	Sept. 30	10 6	828	142	970	579	252	831	21	18	19½	17	8 1,362	10 922
Black Spanish	"	Oklahoma	" 31	" 16	" 26	9 10	714	158	872	545	284	829	19	16½	20	17	7 1,184	9 116
	"	Pfeifer, Illinois	" 31	" 16	" 24	9 9	714	109	823	525	265	790	18½	17	19½	16	7 1,246	8 1,716
Illinois Favorite	"	"	" 31	" 16	Oct. 5	9 9	821	130	951	632	237	869	21	17	19½	16	8 1,549	10 1,015
Canada Evergreen	Intermediate.	C.E. Farm, Ottawa	" 31	Aug. 24	Sept. 15	6 8	410	315	725	506	311	817	20	17½	20	18	5 766	7 911
Black Seeded	"	Robert (Ste. Eustache) C.E.F.	" 31	" 24	" 15	6 3	315	412	727	449	385	834	19½	18	19	15½	5 1,637	7 1,284
Black Seeded, Que.	"	C.E.F., Ottawa	" 31	" 24	" 15	6 10	373	369	732	474	334	808	18	16	19	15	6 632	7 146
Black Seeded (1921)	"	"	" 31	" 24	" 15	6 10	428	340	768	457	347	804	20	18	19	16	5 1,836	6 1,829
C.E.F. (1922)	"	"	" 31	" 24	" 17	7 0	469	334	803	508	360	868	20	18	18½	15	6 1,628	7 1,466
Acme C.I. No. 243	Dwarf	U.S. Dept. Agriculture.	" 31	Sept. 17	Sept. 30	4 10	1,013	111	1,124	826	151	977	20	14	19	15	7 499	9 1,290
Jap Dwarf C.I. No. 442	"	" " ..	" 31	" 17	" 26	3 7	735	154	889	504	249	753	16	13½	16	13	6 944	8 1,387
European C.I. No. 559	"	" " ..	" 31	" 17	Oct. 6	4 10	1,192	161	1,353	734	435	1,169	20	15½	19	16½	7 375	10 449
Dwarf Evergreen	"	Salzer, Illinois	" 31	" 17	Sept. 26	4 11	830	101	931	636	205	841	18	15	18	14	5 1,699	8 311
Scarbough	"	Oklahoma	" 31	" 17	Oct. 1	5 2	986	115	1,101	681	257	938	19	14½	18	16	7 1,246	10 675
Improved Evergreen	"	Steele Briggs, Toronto	" 31	" 17	" 1	4 11	776	109	885	670	136	806	18½	15	17½	14	6 259	8 962

Brush harvested when seed in milk—early dough stage.
Poor brush includes those with (a) large central stems.
(b) twisted straws.
(c) crooked heads.
Fodder=whole plant minus the brush.
Rows 3½ feet apart. Plants approx. 6 inches apart in rows.

It appears evident from the yields obtained that this year was quite favourable for broom corn production.

With the exception of the intermediate type, all varieties exceeded their average yields for past years. The standard and dwarf types, especially the latter, yielded exceptionally well and only one variety of these two types exceeded 200 pounds of poor brush. The Acme and European still lead all varieties in yielding capacity, and, as is true of practically all dwarf varieties, the brush is somewhat finer in quality than that of the standard varieties. The varieties of the intermediate type produce a fairly coarse brush which to a large extent opens widely into a spreading panicle before it is ready to harvest. This is a very undesirable feature and is responsible to some extent for the high percentage of poor brush obtained from these varieties.

Concerning harvesting it is quite obvious that the brush of the dwarf can be much more easily harvested than that of either the intermediate or standard varieties.

Breeding has been carried on throughout the past four years by selection of desirable individuals and selfing these merely by placing a bag over the heads.

SUNFLOWERS

VARIETY TEST

Five lots of sunflowers were tested in the regular variety tests. Seeding was done in quadruplicate single row plots. The rows were 36 inches apart and the plants were thinned to 6 inches apart in the row. In common with other crops, sunflowers suffered from drought and gave comparatively low yields as indicated in the following table:—

TABLE 5—YIELD OF SUNFLOWER VARIETIES

Variety	Source	Green yield as cut	
		tons	lb.
Mammoth Russian	Dakota Imp. Seed Co.	25	500
Mammoth Russian	K. McDonald	23	250
Manchurian	A. E. McKenzie	19	1,350
Ottawa 76	C. E. F.	19	50
Mennonite	Rosthern	12	1,650

In addition to regular variety tests some 28 lots of sunflowers were tested in small duplicate plots. These lots included breeding material from Ottawa and also the 5 lots sown in regular variety tests. Land available for these tests was exceptionally good as indicated by the fact that Mammoth Russian yielding 25 tons 500 pounds in the variety test yielded over 30 tons in this test. Unfortunately seed of all lots except commercial was limited, consequently plots had to be too small to use for absolute comparison. As indication of progress it may be mentioned that Mammoth Russian (corn) yielded 30 tons 419 pounds while some of the hybrid material and even some of the inbred strains yielded well over this figure, the range yields being from 13 to 60 tons green material per acre.

Breeding activities with sunflowers were continued. The isolation of selected pure lines was continued. Limited bulk quantities of seed were grown from a number of very desirable types obtained by continued selfing. These were grown in blocks at considerable distance one from the other and excellent sets of seed obtained.

Pure lines of sunflowers. Some of them are outyielding the commercial varieties.

FIELD ROOTS

VARIETY TESTS

The yield of field roots secured in 1929 was exceptionally light. The area made available for testing of field roots had been turned over to the Forage Crop Division too late in the spring to enable the proper preparation of the land to be made. The rather low fertility of the land coupled with the dry midsummer period resulted in an abnormally light yield of all of the field root varieties. As usual, quadruplicate plantings were made of each variety under test.

MANGELS

In all, 102 lots of mangels were sown. This operation was carried out on May 10 and harvesting accomplished on October 15 and 16. Included with the material intended for variety test, were lots of mangels and swedes received from the Seed Branch for verification observations. The average yield of all varieties was 23 tons, 163 pounds. As usual, the intermediate and half long types gave the highest yields. Comparison of the average yields secured in

1929 with that of previous years will bear out the observations previously made as to the unsuitability of the ecological conditions under which the crop was produced in 1929.

CARROTS

The field carrots appeared to stand the dry weather better than either the mangels or the swedes. Yields on the whole were well up to or perhaps higher than the average of previous years. Thirty-seven lots were grown in quadruplicate plots and an average yield of 33 tons, 680 pounds to the acre was secured. One lot gave a yield of over 40 tons per acre.

SWEDES

The swedes, of which 38 lots were sown, presented such a poor stand that no attempt was made to record comparative yields.

FALL TURNIPS

The field turnips suffered even more severely than the swedes and by midsummer the greater proportion of this crop had decayed to such an extent that harvesting was impossible.

SUGAR BEETS—OTTAWA

Nine lots of sugar beets were tested in quadruplicate plots. These also suffered quite severely through unfavourable growing conditions. In the following table is recorded the yields secured along with the sugar content of the different varieties.

TABLE 6—YIELDS OF VARIETIES OF SUGAR BEETS TESTED AT OTTAWA

Variety	Field yield		Sugar in juice	Coefficient of purity
	tons	lb.	%	%
Rathethge & Giesecke	21	87	19·34	91·11
Uladovka	19	1,298	18·22	90·53
Ivanovka	19	148	19·09	91·10
Billotzerkov	18	7	19·78	92·14
Kallinik	15	1,678	20·26	93·05
Verchniatchka	19	670	19·89	92·58
Ramon	17	1,456	19·24	91·65
Horning	23	1,125	19·18	92·36
Fredericksen	26	314	18·76	91·32

Practically all of the varieties generally grown throughout the sugar beet area of Western Ontario were tested for yield in addition to a large number of strains. Seed of the varieties was obtained through the generosity of the Dominion Sugar Co. Ltd., Chatham, Ont., which company also made all the sugar determinations. Seed of the various strains was obtained through the courtesy of the United States Dept. of Agriculture. Unfortunately it was impossible to obtain seed of some of the most promising strains tested in 1927 and 1928. A few strains and varieties of Russian origin were obtained through Prof. Geo. Stewart of the Utah State Agricultural College.

The aim and object of this experiment is to finally increase the sugar production per acre. There are three ways in which this may be accomplished; by increasing (a) the tonnage, (b) the sugar content, or (c) tonnage and sugar content combined. It is hoped that this preliminary test followed by subsequent breeding work will help to attain the object in view.

Plots were again located at three different points:—one at the Dominion Experiment station, Harrow, Ont.; one at Chatham, Ont.; and one at Kingsville, Ont. The results for the individual plots appear in table 7.

TABLE 7—SUGAR BEETS, 1929—

Variety or strain	Source of seed	Dominion Experimental Station, Harrow, Ont.* — Beets — Yield per acre		Average weight per beet	Per cent sugar	Purity	Sugar (sucrose), per acre, (% sugar x yield)	Relative yield of sugar	Tops, yield per acre, green weight		Per cent stand
		tons	lb.	lb.	%		lb.		tons	lb.	%
60500	Michigan St. Coll	13	835	1·1	15·9	85·7	4,267	947·0	14	1,430	98·5
61100	" "	16	1,602	1·4	15·7	89·5	5,276	117·1	12	480	98·5
62500	" "	13	1,336	1·2	17·2	88·6	4,702	104·4	11	1,760	94·0
64900	" "	13	2	1·1	16·8	89·7	4,368	97·0	10	880	97·0
66300	" "	16	1,003	1·4	16·3	88·6	5,379	119·4	12	120	97·0
Re. Gr. No. 19	" "	13	1,002	1·2	17·0	89·7	4,590	101·9	12	120	98·5
" No. 25	" "	13	1,669	1·3	17·1	89·5	4,731	105·0	10	880	88·0
" No. 28	" "	15	336	1·4	16·7	88·1	5,066	112·5	12	480	91·0
" No. 30	" "	14	1,336	1·3	16·3	90·7	4,782	106·2	12	480	97·0
" No. 37	" "	12	335	1·0	18·7	87·8	4,551	101·0	12	840	100·0
554-24	U.S.D.A., Ft. Collins College	9	1	0·8	17·9	90·7	3,222	71·5	9	1,080	95·5
882-24	" "	14	669	1·2	17·1	90·8	4,902	108·8	10	880	97·0
1340-23	" "	13	1,669	1·2	17·3	87·8	4,787	106·3	11	320	95·5
1612-24	" "	15	669	1·4	16·9	90·4	5,183	115·1	11	680	95·5
1749-24	" "	13	1,336	1·2	15·7	89·5	4,292	95·3	9	360	94·0
2361-24	" "	12	1,335	1·2	16·4	86·0	4,155	92·3	8	560	91·0
4477-24	" "	11	335	1·0	15·1	85·9	3,373	74·9	11	680	94·0
Schreiber	Dom. Sugar Co., Chatham, Ont.	14	336	1·2	16·9	92·8	4,789	106·3	10	1,960	97·0
R. & G.	" "	14	2	1·3	18·4	91·4	5,152	114·4	11	320	94·0
Horning	" "	15	336	1·3	17·8	90·0	5,400	119·9	12	120	97·0
Strube	" "	13	1,669	1·2	16·8	88·4	4,648	103·2	11	1,760	94·0
Home Grown	" "	14	2	1·2	16·5	90·1	4,620	102·6	13	280	95·5
Dippe	" "	12	669	1·2	17·3	91·2	4,268	94·8	9	0	89·5
Dippe	" "	14	1,502	1·2	16·3	88·7	4,809	106·8	11	140	100·0
Frederiksen	" "	10	1,668	1·0	15·8	86·6	3,424	76·0	11	1,040	94·0
Braune	" "	12	669	1·1	16·7	88·6	4,120	91·5	11	680	95·5
Billotzerkov	Russia	12	1,335	1·1	16·5	90·0	4,180	92·8	12	1,200	95·5
Kallinik	"	10	1,335	0·9	17·9	89·9	3,819	84·8	11	680	97·0
Vierchniatchka	"	13	335	1·2	16·8	90·0	4,424	98·2	12	1,560	95·5
Ivanovka	"	13	1,336	1·3	17·0	88·1	4,647	103·2	11	320	91·0
Ramon	"	13	2	1·2	16·7	86·0	4,342	96·4	11	680	88·0
Uladovka	"	11	1,669	1·1	16·3	87·0	3,858	85·7	10	520	94·0

*Soil—sandy loam to light clay loam somewhat gravelly. † Heavy clay loam. †† Sandy loam to light clay loam.
Rows 22 inches apart—Beets at Harrow thinned to 12 inches apart.
Beets at Chatham and Kingsville thinned by contract labour similar to rest of field in which the plots were grown. Per cent stand calculated on basis of beets 12 inches apart.
Per cent sugar—Figure obtained from analyses made by Dominion Sugar Co., Ltd., Chatham, Ont.
Sugar per acre—Per cent sugar x yield.
Relative yield of sugar—Comparison with average yield of sugar of all varieties and strains in each individual test (average =100).

Chatham, Ont.†										Kingsville, Ont.††									
Beets							Tops, yield per acre, green weight		Per cent stand	Beets							Tops, yield per acre		Per cent stand
Yield per acre		Average weight per beet	Per cent sugar	Purity	Sugar (sucrose), per acre, (% sugar x yield)	Relative yield of sugar				Yield per acre		Average weight per beet	Per cent sugar	Purity	Sugar (sucrose), per acre, (% sugar x yield)	Relative yield of sugar			
tons	lb.	lb.	%		lb.		tons	lb.	%	tons	lb.	lb.	%		lb.		tons	lb.	%
9	896	1·0	15·9	88·4	3,004	66·4	6	960	75·8	9	1,778	1·2	16·4	87·4	3,244	88·9	7	2,480	69·7
12	961	1·5	17·7	92·3	4,418	97·7	7	490	69·7	10	1,186	1·1	17·9	89·0	3,792	103·9	7	1,840	78·8
10	529	1·4	16·8	90·9	3,449	76·3	6	600	63·6	8	1,731	1·0	17·7	90·0	3,138	86·0	8	200	75·8
10	1,462	1·2	15·3	90·3	3,284	72·6	4	1,990	75·8	9	414	1·1	18·0	91·2	3,315	90·8	5	980	69·7
15	482	1·8	15·9	87·9	4,847	107·2	3	1,920	72·7	11	1,188	1·1	16·5	91·1	3,326	104·8	6	1,320	89·4
11	1,561	1·4	17·3	93·0	4,076	90·1	8	650	69·7	11	505	1·0	17·2	91·3	3,871	106·1	8	1,640	92·4
14	305	1·6	17·0	90·7	4,812	106·4	6	870	75·8	10	1,483	1·0	18·5	91·1	3,974	108·9	7	400	89·4
10	1,384	1·3	16·2	91·1	3,464	76·6	4	820	69·7	9	1,436	1·1	17·4	90·6	3,382	92·7	5	1,880	74·2
17	836	1·8	15·0	88·3	5,225	115·5	6	1,410	81·8	12	1,233	1·3	18·1	90·1	4,567	125·1	6	960	81·8
12	494	1·5	16·8	89·1	4,115	91·0	6	1,005	69·7	11	505	1·1	18·2	86·6	4,096	112·2	6	1,080	89·4
9	1,362	1·4	15·1	90·2	2,924	64·6	5	1,430	57·6	8	1,050	0·9	17·4	92·1	2,967	81·3	6	960	77·3
16	1,748	1·8	16·2	90·0	5,467	120·9	6	330	78·8	9	1,778	1·1	17·0	86·7	3,362	92·1	5	440	78·8
14	1,277	1·6	16·6	86·3	4,860	107·5	7	445	75·8	11	164	1·1	16·5	89·8	3,657	100·2	9	1,440	86·4
14	1,238	1·8	17·2	88·6	5,029	111·2	5	1,880	69·7	10	110	1·1	17·0	91·2	3,420	93·7	6	1,320	78·8
14	849	1·6	15·0	87·2	4,327	95·7	5	440	75·8	10	1,141	1·1	17·4	92·2	3,679	100·8	7	1,120	83·3
14	616	1·7	14·4	84·4	4,120	91·1	5	1,790	69·7	8	197	1·0	15·7	87·1	2,543	69·7	4	1,540	69·7
13	1,760	1·8	15·7	86·1	4,358	96·4	7	220	66·7	7	1,004	0·9	16·3	86·8	2,446	67·0	4	1,720	66·7
13	127	1·8	16·9	85·1	4,415	97·6	5	1,475	60·6	12	1,233	1·3	17·8	88·7	4,491	123·0	7	1,480	78·8
13	672	1·8	16·7	90·3	4,454	98·5	7	760	63·6	10	1,141	1·1	17·8	88·6	3,703	103·1	5	1,880	81·8
14	1,471	2·0	17·3	90·4	5,098	112·7	5	1,440	60·6	10	800	1·0	16·9	89·3	3,515	96·3	6	600	86·4
14	1,471	1·9	17·4	84·6	5,128	113·4	7	1,930	66·7	10	1,824	1·0	18·2	89·0	3,972	108·8	6	1,320	95·5
15	1,415	1·9	17·1	84·7	5,372	118·8	8	500	69·7	10	460	1·0	18·1	90·6	3,703	101·5	6	240	89·4
12	1,739	1·7	16·7	91·5	4,298	95·0	7	350	63·6	10	1,141	1·2	18·7	88·8	3,953	108·3	5	440	72·7
13	516	1·5	17·2	87·9	4,561	100·8	6	510	72·7	9	755	0·9	19·2	91·4	3,601	98·7	4	1,720	84·8
14	1,549	1·7	16·6	89·9	4,905	108·4	6	1,140	72·7	10	1,483	1·2	17·7	86·5	3,802	104·2	5	80	77·3
15	171	1·9	15·8	88·8	4,767	105·4	6	960	66·7	10	1,483	1·0	17·5	87·0	3,760	103·0	5	80	90·9
15	482	1·8	16·5	88·5	5,030	111·2	7	130	69·7	10	1,483	1·0	18·4	86·7	3,953	108·3	5	1,520	89·4
11	1,250	1·4	17·5	88·3	4,069	90·0	6	330	69·7	8	1,731	0·9	18·8	87·1	3,333	91·3	4	1,360	81·8
15	326	1·6	17·8	91·0	5,398	119·3	7	940	78·8	11	505	0·9	17·5	88·0	3,938	107·9	6	600	100·0
16	348	1·5	16·0	88·5	5,176	114·4	8	1,280	91·0	11	505	1·1	17·8	91·7	4,006	109·8	5	1,520	89·4
16	348	1·6	16·8	87·1	5,434	120·1	7	670	84·8	13	256	1·3	17·6	89·5	4,621	126·6	6	600	86·4
14	616	1·7	16·9	87·4	4,836	106·9	6	960	72·7	9	1,095	0·9	16·3	90·2	3,112	85·3	5	1,160	87·9

TABLE 8—SUGAR BEETS—RELATIVE YIELDS OF SUGAR FOR 1927, 1928 AND 1929; THE AVERAGES FOR THE TESTS IN EACH LOCALITY AND FOR ALL TESTS

Variety or strain	Harrow				Chatham					Kingsville			
					1927								
	1927	1928	1929	Average	(1)	(2)	1928	1929	Average	1928	1929	Average	Average for all tests 1927-1929
60550	98·6	102·6	94·7	98·6	106·6	107·2	100·3	66·4	95·1	102·5	88·9	95·7	96·4
s61000	97·5	94·2	.....	95·8	109·1	87·2	102·7	.....	99·7	116·1	.....	116·1	101·1
61100	103·8	115·2	117·1	112·0	88·6	84·2	110·7	97·7	95·3	95·0	103·9	99·5	101·8
62500	78·5	76·8	104·4	86·6	84·1	90·5	104·4	76·3	88·8	77·2	86·0	81·6	86·5
64900	110·1	111·3	97·0	106·1	107·3	102·2	94·0	72·6	94·0	125·9	90·8	108·4	101·2
s65700	99·8	130·4	.....	115·1	101·7	112·3	133·7	.....	115·9	121·4	.....	121·4	116·6
66300	101·9	99·0	119·4	106·8	104·9	99·3	121·7	107·2	108·3	121·8	104·8	113·3	108·9
s68200	112·6	106·6	.....	109·6	134·9	112·8	119·0	.....	122·2	73·6	.....	73·6	109·9
s69100	102·0	92·2	.....	97·1	126·9	123·0	99·3	.....	116·4	93·4	.....	93·4	106·1
sRe. Gr. No. 19	.....	89·1	101·9	95·5	.....	.....	96·8	99·1	93·5	91·8	106·1	99·0	96·0
sRe. Gr. No. 25	.....	97·1	105·0	101·1	.....	.....	89·3	106·4	97·9	101·8	108·9	105·4	101·4
sRe. Gr. No. 28	.....	104·2	112·5	108·4	.....	.....	96·8	76·6	86·7	89·6	92·7	91·2	95·4
sRe. Gr. No. 30	.....	88·5	106·2	97·4	.....	.....	118·7	115·5	117·1	106·1	125·1	115·6	110·0
sRe. Gr. No. 37	.....	88·4	101·0	94·7	.....	.....	100·2	91·0	95·6	108·5	112·2	110·4	100·2
*Re. Gr. No. 38	.....	100·6	.....	100·6	.....	.....	84·2	.....	84·2	132·3	.....	132·3	105·7
554–24	92·5	85·4	71·5	83·1	83·9	88·3	85·7	64·6	80·6	90·3	81·3	85·8	82·6
882–24	91·5	116·6	108·8	105·6	87·4	105·7	84·9	120·9	99·7	114·1	92·1	103·1	102·4
1340–23	104·6	104·3	106·3	105·1	80·1	99·3	90·3	107·5	94·3	83·7	100·2	92·0	97·4
1612–24	116·1	110·1	115·1	113·8	114·4	91·6	118·7	111·2	109·0	118·4	93·7	106·1	109·9
1749–24	98·9	106·7	95·3	100·3	92·9	81·7	77·1	95·7	86·9	88·0	100·8	94·4	93·0
2361–23	85·5	100·8	92·3	92·9	89·9	97·1	106·0	91·1	96·0	88·9	69·7	79·3	91·3
4477–24	84·8	98·1	74·9	85·9	78·5	97·9	110·5	90·4	95·8	104·8	67·0	85·9	90·3
Schreiber	119·8	109·7	106·3	111·9	92·3	115·2	90·1	97·6	98·8	90·3	123·0	106·7	104·9
R. & G.	104·0	103·4	114·4	107·3	113·3	104·7	100·1	98·5	104·2	90·7	103·1	96·9	103·6
Horning	108·8	95·1	119·9	107·9	.....	111·1	86·1	112·7	103·3	101·6	96·3	99·0	104·0
Strube	117·9	91·9	103·2	104·3	.....	.....	106·2	113·4	109·8	93·2	108·8	101·0	104·9
Home Grown	86·8	96·5	102·6	95·3	100·9	84·8	94·6	118·8	99·8	82·6	101·5	92·1	96·6
Dippe	100·8	92·0	94·8	95·9	.....	.....	79·0	95·0	87·0	85·8	108·3	97·1	93·7
*Dippe (dec)	.....	.....	106·8	106·8	.....	.....	.....	100·8	100·8	.....	98·7	98·7	102·1
sBuszcynski	94·7	77·8	.....	86·3	.....	.....	92·6	.....	92·6	102·3	.....	102·3	91·9
sFrederiksen	.....	115·1	76·0	95·6	.....	.....	106·7	108·4	107·6	108·7	104·2	106·5	103·2
*Braune	.....	.....	91·5	91·5	.....	.....	.....	105·4	105·4	.....	103·0	103·0	100·0
*Brelotzerkov	.....	.....	92·8	92·8	.....	.....	.....	111·2	111·2	.....	108·3	108·3	104·1
*Kallinik	.....	.....	84·8	84·8	.....	.....	.....	90·0	90·0	.....	91·3	91·3	88·7
*Vierchniatchka	.....	.....	98·2	98·2	.....	.....	.....	119·3	119·3	.....	107·9	107·9	108·5
*Ivanovka	.....	.....	103·2	103·2	.....	.....	.....	114·4	114·4	.....	109·8	109·8	109·1
*Ramon	.....	.....	96·4	96·4	.....	.....	.....	120·1	120·1	.....	126·6	126·6	114·4
*Uladovka	.....	.....	85·7	85·7	.....	.....	.....	100·9	100·9	.....	85·3	85·3	92·6

Relative yield of sugar=comparison with average yield of sugar of all varieties and strains in each individual test. (Average yield of sugar=100.) *Tested one year only. sTested two years only.

The reliability and accuracy of the results in the tables is measured largely by the per cent of stand obtained. In the test at Harrow it is seen to be very high, approaching very close to 100 per cent throughout, while at Chatham and Kingsville the percentage is considerably lower, thus reducing to some extent the reliability of these tests. The results obtained at Chatham, and Kingsville should be related to those at Harrow rather than studied individually.

In spite of rather dry conditions during the latter half of the summer the yields throughout appear to be well up to average and the percentage sugar, if anything, slightly above average.

The yield of tops at Harrow was exceptionally high, in some cases being higher than the yield of beets. High nitrogen content of the soil probably accounted for this.

To permit of comparison between the different varieties and strains the yield of sugar per acre has been placed on a relative basis. The average for each individual test is placed at 100 and the yields of the varieties and strains given in relation to this figure.

A study of the tables shows that several of the varieties and strains were consistent in giving yields of sugar higher than the average in all three tests.

Table 8 summarizes the results for the past three years in so far as the yield of sugar per acre is concerned. It gives a summary of nine individual tests conducted in the three different localities and makes comparison more

easy. Unfortunately it has been impossible to test all of the varieties and strains in each of the three years but there is sufficient evidence to indicate that some of the lots being tested are quite promising.

BREEDING

A number of beets were selected from the high-yielding varieties and strains in 1928 and stored for seed production. These were shipped to Ottawa and planted out this year but unfortunately very little or no seed was produced.

A hand refractometer has been secured which will make possible the testing of seed beets in the field. This will be used in 1930 to aid in making the beet selections.

BREEDING AND SEED RAISING

Stecklings of mangels, swedes and field carrots pitted in the fall of 1928 came through the winter in excellent condition. The pits were located on well drained sandy soil and were constructed as follows: A shallow trench 1 foot deep and five feet wide was dug to a sufficient length to accommodate the desired number of roots. The stecklings were then piled so that the trench was completely filled and heaped up in a wedge shape to a height of about 2 feet above the ground level. The roots were allowed to stand for a sufficient length of time to allow surface moisture to disappear. A thick layer of straw was then placed over the top of the pit and following this a 6 inch covering of earth was put on. As soon as the first covering had frozen sufficiently hard to bear a man's weight a second covering of straw and earth was placed over the pit. Ventilation was supplied by square upright ventilators placed approximately five feet apart, extending from the bottom of the pit to approximately one foot above the top of the pit when the final covering was in place. Excellent results have been obtained with the type of pit under discussion, as there has not yet been serious deterioration of roots stored in this manner.

The pits were opened around the end of the third week of April, after which a very rigid selection of the stecklings was made. All off-types or roots with small decayed parts were discarded. The land on which the stecklings were planted was rather light and unproductive. However, fair seed yields were secured. The plants were placed in the field 3 feet apart each way in the case of the mangels and swedes, while the carrots were planted in rows 3 feet apart with a space of 2 feet being allowed between each of the plants in the row.

In addition to the raising of a seed crop of the field root types being developed at the Central Farm, a crop of stecklings was also grown and pitted in the late fall for seed growing in 1930.

The Yellow Intermediate Mangel, the Purple Top Swede and the Half Long Field Carrot types being developed by the Central Farm are still producing gratifying increases in yield over commercial varieties in the comparative tests being conducted by the Forage Crop Division.

FLESHY ANNUALS

The various types of fleshy annual crops tested in previous years were again planted in quadruplicate plots to check their reaction to the ecological conditions obtaining in 1929. Unfortunately, the land available for the growing of these varieties was mostly of a light sandy nature and the ensuing warm dry summer provided conditions that were very poorly suited to the production

of fleshy annual forage crops. Plants were seeded in rows 27 inches apart and the germination was reasonably satisfactory. In the following table is presented the yield data obtained:—

TABLE 9—YIELDS OF FLESHY ANNUALS

	Green yield per acre		Dry matter yield per acre	
	tons	lb.	tons	lb.
Dwarf Essex rape	9	253	1	1,819
Green Stem Marrow kale	10	918	1	1,520
Improved 1,000 Headed kale	7	1,352	1	1,243
Purple Stem Marrow kale	8	312	1	1,058
1,000 Headed kale	7	620	1	986
Common rape (plant)	5	947	1	954
Large Seeded Winter rape	6	942	1	823
Giant rape	6	309	1	787
Curled Sheep kale	4	474	0	1,739

A comparison of the yields for the current year and those secured in previous years will bear out the foregoing statement with regard to the unsuitable ecological conditions for the maximum production of the crop under discussion. In spite of these unsuitable conditions, however, several of the varieties under test produced a reasonably large yield of green material.

SOYBEANS

VARIETY TEST

Two methods of planting were used in testing the soybean varieties this year, namely, row planting and planting in drills. The same varieties were grown in both tests but while yields of both fodder and seed were obtained in the case of the row planting the yields of fodder only were taken in the drilled plot.

Table 10 gives the results obtained from the plot planted in rows. The yields of both fodder and seed for this year are given along with the average yields for the whole period during which this test has been conducted.

TABLE 10—SOYBEAN VARIETY TEST—ROW PLANTING—YIELD PER ACRE OF FODDER AND SEED FOR 1929 AND AVERAGES FOR SIX YEARS (1924–1929)

Variety	Original source of seed	Date planted	Days to Maturity		Maturity group, 1929	Average height, 1929	Fodder				Seed			
							Green Weight		Moisture Free weight		As Harvested		Moisture Free	
			1929	Average 6 years 1924–29			1929	Average 6 years 1924–29	1929	Average 6 years 1924–29	1929	Average 6 years 1924–29	1929	Average 6 years 1924–29
						ft. in.	tons lb.	tons lb.	tons lb	tons lb.	bush.	bush.	bush.	bush.
Ste. Anne's No. 92	Macdonald College, Que.	May 25	113	108·0	1	1 11½	6 661	5 519	1 1,541	1 675	22·11	21·68	19·97	19·27
*Early Brown	Salmon Arm, B.C.	" 25	113	109·0	1	2 1½	6 836	5 1,592	1 1,651	1 1,277	24·56	25·90	22·15	22·98
†Mandarin	United States Department of Agriculture.	" 25	115	113·0	1	2 4	8 350	6 869	2 496	1 1,449	29·19	29·53	26·33	26·14
Yellow 210	China ?	" 25	123	117·5	2	2 4	8 611	6 842	2 646	1 1,352	26·59	30·87	24·04	25·97
Yellow 17	"	" 25	122	118·0	2	2 9½	10 1,025	7 1,386	2 1,355	1 1,949	31·10	31·22	27·99	27·75
Chinaton Echo	"	" 25	123	117·5	2	2 7	9 1,224	7 422	2 1,002	1 1,656	28·39	27·64	25·83	24·57
*Italian	?	" 25	122	119·5	2	2 6½	8 1,308	7 1,023	2 652	2 15	27·60	30·19	24·90	26·59
†O.A.C. No. 211	Ontario Agricultural College, Guelph, Ont.	" 25	124	121·0	2	2 6½	10 1,257	8 74	2 1,780	2 338	32·13	33·78	28·98	29·48
O.A.C. No. 81	" " "	" 25	122	117·5	2	2 8	8 1,424	7 463	2 602	1 1,801	26·06	28·71	23·45	25·29
Summerland	Summerland Experimental Farm.	" 25	124	119·5	2	2 11½	9 731	7 1,570	2 1,722	2 30	24·11	23·94	21·92	21·28
Black (China)	China	" 25	121	117·5	2	2 3	9 5	7 470	2 1,148	1 1,732	25·43	25·84	22·94	22·73
Early Korean	"	" 25	126	123·5	2	2 8½	11 70	8 1,282	3 259	2 349	30·87	35·48	28·00	31·01
Green	J. Noble, Harrow, Ont.	" 25	125	122·0	2	2 1	8 1,366	7 503	2 1,238	2 7	29·16	34·25	26·33	30·35
Manchu	Dakota Improved Seed Co.	" 25	127	123·0	3	3 2½	11 12	8 1,020	3 89	2 449	29·59	34·88	26·69	30·68
Black Eyebrow	" " "	" 25	126	122·5	2	3 3	10 1,577	8 946	3 423	2 431	30·72	34·96	27·65	30·90
Ito San	J. Noble, Harrow, Ont.	" 25	128	123·0	3	3 3	9 586	8 636	2 1,169	2 233	21·84	29·60	19·68	25·96
Golden	" "	" 25	129	125·5	3	3 2½	10 183	8 856	2 1,439	2 350	28·78	35·48	26·05	31·09
†A. K	United States Department of Agriculture.	" 25	129	126·5	3	3 6	10 967	9 806	2 1,504	2 894	27·45	37·44	24·90	32·63

* Averages for 4 years only (1926–29).
† Averages for 5 years only (1925–29).
Add 15 per cent moisture to yield of moisture free weight of fodder to obtain approximate yields of hay.
(Rows 2½ feet apart. Plants in rows 3 to 4 inches apart.)

A glance at the table is sufficient to show that the season was quite favourable to plant growth, in so far as soybeans were concerned. All varieties yielded well above their own average for past years both in green weight and absolute dry weight of fodder which is splendid evidence that soybeans will give good yields of fodder under rather dry conditions. Several varieties produced the equivalent of $3 \cdot 3\frac{1}{2}$ tons of hay per acre. When the seed yields are considered it will be seen that while most of the early and medium varieties produced yields equalling their averages the later-maturing varieties yielded considerably below their averages for past seasons. The only apparent cause for this was the early frost which occurred during the night of September 19.

The condition of the seed of the early and medium early varieties at the time the frost occurred was evidently such that the frost had little or no effect upon it, while the seed condition of the later varieties was affected in such a way as to considerably reduce its yield. Evidence of this was quite apparent in the seed harvested from the plot. That of the early varieties was plump and well filled while that of the later varieties was somewhat shrivelled in appearance.

In spite of somewhat adverse weather conditions, however, the yield of seed throughout the whole range of varieties varied from 22 to 32 bushels per acre. The average yield of seed during the past six years for the different varieties included in this test has been from $21\frac{1}{2}$ to $37\frac{1}{2}$ bushels per acre, which is sufficient evidence to show that the district in which this test is being conducted is well suited to the production of soybean seed.

Table 11 gives the yields of fodder obtained from drilled planting and makes possible a comparison between this method of planting and that of planting in rows.

TABLE 11—SOYBEANS, 1929—DRILL PLANTING—VARIETY TEST FOR FODDER

Variety	Date planted	Date cut	Stage of development (pods)	Yield per acre	
				Green weight	Moisture free weight
				tons lb.	tons lb.
St. Anne's No. 92	May 27	Aug. 19	Completely filled	7 1,428	2 230
Early Brown	" 27	" 19	"	8 759	2 936
Mandarin	" 27	" 21	"	9 1,965	2 1,552
Yellow 210	" 27	" 21	"	10 26	2 1,383
Yellow 17	" 27	" 26	"	10 1,901	2 1,596
Chinaton Echo	" 27	" 26	"	9 1,360	2 1,672
Italian	" 27	" 26	"	9 1,723	2 1,485
O.A.C. 211	" 27	" 26	"	10 1,478	2 1,872
O.A.C. 81	" 27	" 26	"	9 1,723	2 1,455
Summerland	" 27	" 30	Half filled	9 1,965	3 21
Black (china)	" 27	" 30	"	9 997	2 1,462
Early Korean	" 27	" 29	"	11 1,172	3 83
Green	" 27	" 29	"	9 271	2 1,439
Manchu	" 27	" 29	"	10 1,175	2 1,857
Black Eyebrow	" 27	" 29	"	11 385	3 944
Ito San	" 27	Sept. 6	"	10 933	2 1,053
Golden	" 27	" 6	"	12 684	3 307
A.K.	" 27	" 6	"	13 136	3 513

Rate of seeding—1 to $1\frac{1}{2}$ bushels of seed per acre according to size of seed.
Add 15 per cent moisture to moisture free weight of fodder to obtain approximate yields of hay.

In comparing the moisture free weights of fodder obtained by the two methods of planting it will be seen that in nearly all cases the same varieties in the drill planting gave somewhat higher yields than in the row planting. The increase in yield is most noticeable in the early and medium early varieties. It must be borne in mind, however, that it takes from two to three times as much seed to plant in drills as it does to plant in rows. Cultivation is necessary when the planting is done in rows but it is obviously impossible to cultivate where the seed is drilled. If therefore soybeans are to be seeded on a field that is known to be weedy the row method of planting should be used.

It is claimed that soybeans grown in drills give a finer quality of hay than when grown in rows, and while this is probably true it depends to some extent upon the thickness of planting in the rows.

INTRODUCTION OF NEW VARIETIES

A number of new varieties and strains were introduced from various sources and tested to determine their suitability for Canadian conditions. Among the most promising are two or three selections obtained from the Royal Botanic Gardens, London, England, and these will be included in the variety test in 1930.

Wilson Black (Hoffman) and Wilson (Stumpp & Walter) are varieties which while making very prolific growth are much too late for any part of Canada and should not be considered for hay or seed purposes in this country.

SOYBEAN VARIETIES—FAT AND PROTEIN CONTENT

CROPS 1928-29

During recent years a very decided increase in interest has developed concerning the possibility of the establishment of an industry in Canada utilizing the soybean as its raw material. In order that information might be available to meet such inquiries, soybean seed of the various varieties under test at the Harrow Experimental Station and the Central Farm at Ottawa was sent to the Chemistry Division for analysis of protein and fat. Table 12 presents the information secured from the analysis by the Division previously mentioned.

A few features of this table are of rather outstanding interest. One is the apparent tendency for the variety with a high protein content to have a low fat percentage. This correlation seems to be fairly well established throughout the different varieties and has an economic bearing on the profitable production of the varieties listed. As a usual procedure the manufacturers of soybean oil dispose of the residue after the oil has been extracted, in the form of soybean meal or cake. This product is sold on an analysis basis, consequently its value is largely determined by its protein content. The particular variety chosen to be grown would therefore be determined largely by the relative value of the oil and the residual cake on the available markets. It seems rather significant, however, that the A. K. variety which has been one of the outstanding yielders of seed should also be the highest producer of fat. On an acre basis it is just

possible that even with a lower protein content of its dry matter, the A.K. variety because of its higher yield might produce more protein to the acre as well as considerably more fat.

TABLE 12—SOYBEAN VARIETIES—FAT AND PROTEIN CONTENT

Crops 1928-29

Variety	Weight of 100 Beans	Water-free protein (N. x 6·25)	Fat
	grams	p.c.	p.c.
Grown at Harrow, Ont., Crop of 1928			
Ste. Annes 92	19·18	45·43	18·14
E. Brown	22·83	43·38	18·21
Mandarin	18·96	44·84	18·52
Yellow 210	23·77	42·85	19·13
Yellow 17	19·94	41·92	19·86
Chin Echo	14·48	43·10	18·78
Italian	19·24	42·96	18·11
O. A. C. 211	19·99	44·38	18·34
O. A. C. 81	19·77	43·38	18·56
Summerland	17·21	46·05	17·42
B.K. China	17·15	44·70	17·72
E. Korean	25·21	42·19	19·45
Green	28·25	45·41	18·50
Manchu	18·18	41·80	19·76
B. K. Eyebrow	19·18	44·25	17·78
Ito San	17·59	45·56	17·56
Golden	18·59	42·85	1.·95
A. K	15·17	40·82	20·18
Grown at Harrow, Ont., Crop of 1929			
Ste. Annes 92	22·43	48·78	17·71
E. Brown	27·25	46·12	17·22
Mandarin	21·15	48·93	18·07
Yellow 210	26·31	48·53	16·51
Yellow 17	19·87	45·80	18·10
Chin Echo	15·32	46·13	17·13
Italian	19·32	47·29	16·69
O. A. C. 211	23·25	48·08	16·57
O. A. C. 81	21·23	47·65	16·90
Summerland	17·71	49·27	15·43
B. K. China	18·23	49·14	15·18
E. Korean	25·23	46·43	17·30
Green	30·63	49·25	15·78
Manchu	18·45	45·81	17·16
Bk. Eyebrow	19·85	47·37	16·17
Ito San	17·55	49·25	14·96
Golden	17·81	45·37	17·06
A. K	14·38	44·21	18·79
Grown at Ottawa, Ont., Crop of 1929			
"A" Variety	18·22	38·29	17·62
"B" Variety	16·77	39·66	18·58
"C" Variety	20·93	39·82	17·92
"D" Variety	18·84	39·80	18·06
"J" Variety	26·96	38·96	18·00
"O" Variety	16·28	41·41	18·84
Wis. Black	13·82	35·65	20·78
Mandarin (Ottawa)	20·84	42·85	18·40

GRASSES AND CLOVERS

BREEDING

In 1928 isolations were made of desirable strains of timothy, meadow fescue and red top. Seed from the plants thus selected was planted out as individual plants in 1929. Replantings were made of the various strains of western rye grass for the purpose of maintaining the breeding material of these crops. The western rye grass strains which have been developed at the Central Farm have been turned over to the Western Canada Experimental Farms and Stations for final tests as to yield and suitability. Pure strains are maintained at Ottawa, however, in order to insure that foundation material will be available at any time if needed. Isolations were also made of several desirable strains of Orchard grass and a sufficient amount of seed secured for carrying on the breeding work of 1930.

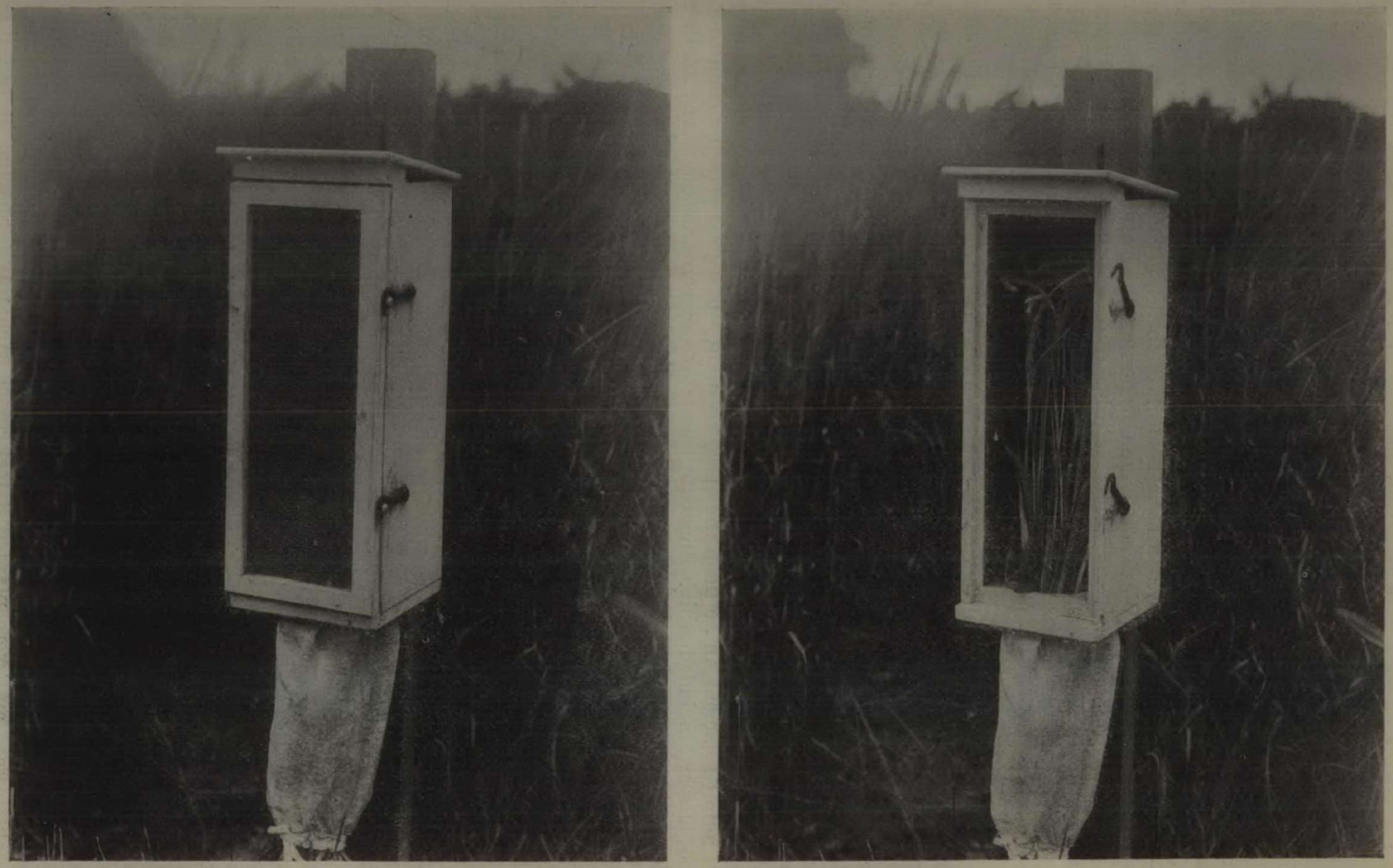
Previous to 1929 cotton cages which have been illustrated in previous publications had been used quite extensively for the isolation of grasses. Paper bags of various kinds and manipulated in various manners had also been tried out. With the latter, seed setting had usually been somewhat light. Through the kindness of Dr. J. W. Gregor of the Scottish Plant Breeding Station, Corstorphine, Scotland, samples and a detailed description was secured of a special breeding cage used at the station in question. A number of these small cages were made and tried out in 1929. The results secured at the Central Farm were very gratifying as the set of seed was abnormally good, due no doubt to the fact that the cage has a tendency to provide a normal temperature and admit sufficient air to keep the enclosed plants in a good growing condition. Two cuts are included which illustrate the details of construction. Any further information concerning these cages will be gladly furnished by the Forage Crop Division.

RED CLOVER

Because of a rearrangement in the breeding areas devoted to forage crop improvement, no plots of red clover were seeded in 1928. During the summer of 1929, however, an extensive collection of red clovers were planted in individual plant rows for hardiness tests. This collection included Russian, Northern Europe, French and English clovers. In addition, a collection of clovers secured from different sections of Canada was also included. In spite of the dry mid-summer conditions a fair stand was secured and detailed records were taken of the number and condition of the various lots of clovers in the late fall.

For a number of years past the Division of Forage Plants has been endeavouring to select a strain of red clover which would be hardy, a heavy yielder and reasonably uniform. The method followed has been to select individual plants of outstanding merit and of a predetermined type. These selected plants were set out in isolated locations and allowed to intercross. Each succeeding generation of young plants was subjected to rigid inspection, and all diseased and obviously off-type plants eliminated. In order to avoid cross fertilization with the general crop of red clover growing on the Central Farm, the selected plants were kept cut so that blossoming would occur after the main crop had been harvested. There was thus only a minimum of crossing with the isolated plants which might have escaped the ordinary harvesting operations.

In addition to the main crop of seed being raised in the manner previously mentioned, 1,000 individual plants were set out in 1928. These had been started in cold frames and were planted 3 feet apart each way. Spacing at this dis-



A special type of breeding cage designed by the Scottish Society for Plant Breeding was used with gratifying success in 1929 on the grass breeding block on the Central Farm.

tance allowed of very careful observations being made as to the morphological characteristics of the individual plants. A more severe selection was practised with this block than that followed with the main seed crop.

A few individual plants still remain from the original parents set out about ten years ago. Seed from these original plants is harvested each year and small blocks of plants set out from the seed thus secured. In this way a continuous progressive selection of the most desirable plants is being carried out.

In the year 1928, odd corners of some irregularly shaped breeding fields were filled with rows of the selected red clover and in 1929 a satisfactory seed crop was produced. On the whole a very gratifying advance has been made in the production of a red clover which under conditions on the Central Farm is quite strongly perennial and which outyields by a profitable margin other strains with which it has been tested.

ALFALFA

In 1929 a number of varieties and strains of Alfalfa were planted out in replicated plots for yield and suitability tests. In addition to these, plots of individual plants of different lots were set out for more definite determinations of the percentage of winter-killing and for the determination of off-types. One thousand individual plants of Registered Grimm alfalfa and one thousand individual plants of certified Ontario Variegated alfalfa were set out for further selection in 1930. From similar material planted in 1928 a number of the more desirable plants were caged and hand pollinated. Excellent sets of seed were secured from these isolated plants.

ALSIKE

One thousand individual plants of Alsike clover were set out. These were secured from seed of Canadian origin and from the best alsike crop localities in Canada. An intensive selection of the more desirable types is contemplated for 1930.

MISCELLANEOUS FORAGE PLANTS

A definite start was made in 1929 towards the establishment of a plant introduction garden. A fairly large number of seed lots were secured from foreign countries. These lots consisted of grasses and clovers as well as other types of plants which have proven valuable in foreign countries from a forage standpoint. Definite observations are made on the rates of growth of the various types in the plant introduction area. Importations which give promise of being valuable to Canadian agriculture are to be included in preliminary tests in comparison with the more commonly grown forage crops of the country. Preparations are being made to extend this type of work very materially in 1930.

TURF GRASS EXPERIMENTS

The experimental work with turf grasses has consisted principally in the testing of the available grasses for ordinary lawn purposes and for use as putting greens or other forms of sporting turf. For testing the comparative suitability of the grasses for lawn purposes the plots were seeded and given much the same treatment as would be received by an ordinary lawn. That is, they were only cut when necessity demanded this operation and were not artificially watered. The plots chosen to test the value of the grasses for putting green purposes were laid out and treated in the same manner as the average putting or bowling green.

Tests to date of the suitability of the grasses used for lawn purposes indicate that Kentucky Blue grass has been one of the most satisfactory single grasses for the soil and climatic conditions found on the Central Farm. The addition of a small amount of red top or the finer growing brown top has been found to thicken up the bottom growth to some extent, particularly in the early stages of establishment. Where White Dutch clover is not considered objectionable the addition of a small quantity of seed of this plant may also be considered to be of advantage. In fact it is very difficult under average growing conditions in the Ottawa district to secure a lawn entirely free from the clover under discussion, particularly if the soil is nearly neutral or slightly alkaline in reaction.

Where the ultimate in uniformity and fineness of turf is desired, the finer growing brown top, creeping bent and velvet bent may be used. These grasses, however, require much more careful handling than those mentioned in the foregoing paragraph. Careful and frequent cutting, consistent watering and regular fertilizing are necessary to produce and maintain a high-grade lawn with the finer grasses.

Experiments having to do with the maintenance of a lawn indicate that fairly frequent cutting and judicious watering coupled with reasonable fertilization will maintain a satisfactory lawn with most of the grasses tested. No lawn can be expected to continue indefinitely to present a pleasing appearance unless it receives some attention in the form of care and feeding. Early spring growth can be speeded up by the addition of artificial fertilizers with a fairly high nitrogen content. Throughout the summer a dressing every four to six weeks with a nitrate fertilizer applied in solution and well watered in will aid greatly in maintaining the well-kept appearance of a lawn. Special apparatus is available which can be attached to the ordinary garden hose which provides for the easy application of nitrogenous fertilizers in liquid form.

For putting greens, plots of the following grasses have been established, Chewing fescue, Sheep fescue, commercial mixtures recommended for putting greens, Red Top, Velvet bent, Brown Top and Southern German Mixed bent. In addition to these, plots have also been established of the more promising strains of creeping bent. These latter plots have been planted with vegetative cuttings from the various strains.

Under the conditions obtaining on the Central Farm, a strain of creeping bent known as the Washington bent and secured from the Arlington Farm, Washington, D.C., has given the most satisfactory turf. All of the experimental greens are laid out in strips approximately 50 feet long and from 6 feet to 8 feet wide. Where possible, each strip is replicated. As no pathways are left between the various plots, the whole area lends itself to the cultural and clipping practices normally given on the average golf course. These small experimental greens not only present an opportunity for testing the suitability of any particular seed or strain for the production of a desirable turf but they also enable visitors to the farm, who are particularly interested in turf grasses, to obtain a fairly accurate conception of the kind of turf that would likely be produced by the various grasses under playing conditions.

In the case of plots planted with stolons, different methods of establishing plots have been tried out. Of the various methods the plots on which the stolons have been broadcast quite thickly appear to give the most satisfactory turf in the shortest period. Planting in rows at various distances, which practice has frequently been recommended, has not been as satisfactory under conditions on the Central Farm as has the broadcast system.

Some rather interesting results have been secured in re-establishing sod on worn out pieces of turf, by spreading a covering of compost over the top of old turf and broadcasting stolons in a mat and lightly covering.

Areas thus treated produce an excellent sod in a comparatively short time and obviate the necessity of tearing up the old sod and relevelling the area to be treated.

The establishment of a sod nursery is being recommended where a supply of desirable turf may be multiplied and kept in readiness for emergency use. Many golf courses are finding it to advantage to have a sufficient supply of a creeping bent grass turf to enable them to resod a portion or the whole of a green that may for some reason have become unfit for play.

In common with the two preceding years, many requests for information concerning turf matters were received and answered. Tons of stolons of the more desirable strains were also provided from the nurseries on the Central Farm for the establishment of sod nurseries on golf and bowling greens, in various parts of Canada.

PAPER MULCH EXPERIMENT

During the summer of 1929 the Forage Plant Division conducted a preliminary experiment to determine the value of paper mulch. The crops used in the experiment were as follows: corn, soybeans and sugar beets.

The paper was put down between the rows for all three crops as soon as the seedlings appeared above the ground. In the mulching of the corn the edges of the paper were made to overlap, only a small piece being removed at the occurrence of each hill, while for the soybeans and sugar beets the edges were laid as close to the rows as possible. As soon as the paper was put down, a light covering of soil was placed over the edges to hold it in place. This

No mulch on the left. Paper mulch on the right. Neither the corn nor the soybeans show a very marked effect of the mulch treatment.

proved very successful for on no occasion during the season was any difficulty experienced in keeping the paper down. In spite of some very high winds the paper did not lift at any time.

It might be mentioned, however, that some difficulty was experienced in putting the paper down. Only a comparatively light breeze was blowing at the time of this operation and although three men were engaged in laying the rather small portions of paper, they had considerable difficulty in preventing the wind from tearing the paper as it was taken from the roll. Then the task of covering the edges with soil took considerable time, certainly out of all proportion to the area covered.

No hoeing was necessary throughout the season where the paper mulch was used. A few weeds grew up in the rows of soybeans and sugar beets but these were easily removed by hand. The unmulched portion of the plots was hoed three times during the season but weeds never became troublesome.

Although the weather at times during the summer was fairly hot and rather dry, at no time did it appear evident that the unmulched rows lacked sufficient moisture for the normal growth of the crops involved. The soil on which the experiment was conducted was a sandy loam in good condition and appeared to hold moisture very well.

As the results of a single season might be misleading, the actual figures obtained will be omitted in the present report. Further year's tests should either substantiate or contradict the results of the current year. However, a few comments on the trend of the 1929 findings might not be amiss. In the case of corn, mulching appeared to hasten maturity slightly, while in the case of the soybeans and sugar beets no appreciable difference was noted in this respect. In the tests with the corn and sugar beets no significant increase in yield was obtained. The soybeans, however, gave a significantly higher yield. The mulched plants also remained almost 100 per cent erect, while the unmulched sections lodged quite freely.

The season was undoubtedly favourable to the unmulched plants, which at all times appeared thrifty and vigorous, under less favourable growing conditions it is conceivable that the paper mulch might show up to better advantage.

RANGE INVESTIGATIONS

Considerable progress has been made on a large number of projects pertaining to range management and pasture improvement, at the Dominion Range Experiment Station, near Manyberries, Alta. Much attention has been given also to other range areas and to the growing of cultivated forage crops in co-operation with a number of ranchers and farmers throughout the Western Provinces.

PASTURE CONDITIONS

On the whole, pasture conditions on the range lands lying south of the C.P.R. main line were fairly favourable for all classes of live stock, although in some cases, especially in the eastern sections there was a shortage of water during the late summer and fall months.

In the Manyberries district there were frequent showers during April, May and the first two weeks of June and a light rain during the first week of July. Following this there was no rainfall of any account during the remainder of the summer and fall months. During this long dry period, temperatures were abnormally high. There was much wind and a high rate of evaporation.

Most of the native forage species, however, are very early and therefore got a good start. Very early species such as *Carex filifolia* and *Poa confusa* made a good growth and produced much seed. Second early species such as *Stipa comata, Koeleria gracilis, Poa laevigata, Agropyron Smithii, Agropyron*

dasystachyum and *Agrostis hyemalis*, made a fair growth and produced a small amount of seed. Late species including *Bouteloua gracilis*, *Mulhenbergia cuspidata* and *Calamagrostis Montanensis* made very little growth, and did not reach the flowering stage. The native legumes and most of the other broad-leaved species made a rather vigorous growth. On the whole the pasture was fairly good and the grasses cured well, thus making good forage for the winter months.

The west side of Crow's Nest mountain, where reseeding experiments are being conducted. The standing timber has been killed by fire and large areas are almost devoid of vegetation.

On the range areas lying between the C.P.R. main line and the Red Deer river, pasture conditions were generally poor. These areas did not get as much rain during the spring and early summer months, and as a result the grass made very little growth. This in turn led to overgrazing and many areas were grazed bare. This condition was most marked near watering places as most of the sloughs and water holes dried up.

The ground went into the winter in a very dry condition and if 1930 proves to be a dry year pasture conditions will not be very good on many range areas.

A STUDY OF THE NATIVE VEGETATION

A large number of native plants were collected, identified and placed in the herbarium. Collections were made on the short grass plain area, in the Cypress Hills, and on the Forest Reserve at Coleman, Alta. Good progress was made too in the morphological studies.

Observations were made on the palatability of different species, at different growth stages, and under different environmental conditions. Certain species are not eaten by cattle at all, others are palatable in certain growth stages but not in others. Artemisia frigida is eaten more readily on the hills and ridges than on lower ground, and to a greater extent during the winter than in the summer months.

A list of a few of the more common of the broad-leaved plants, classified on the basis of their forage value, is presented in table 13.

TABLE 13—SOME COMMON BROAD-LEAVED PLANTS CLASSIFIED ON THE BASIS OF THEIR FORAGE VALUE

Plants valuable as forage	Plants of little forage value	Poisonous plants
Salt sage *(Atriplex Nuttallii)*	Yarrow *(Achillea Lanulosa)*	Purple Loco weed *(Aragallus galioides)*
Purple vetch *(Vicia sparsifolia)*	Cat-Paws *(Antennaria microphylla)*	Yellow Loco weed *(Aragallus gracilis)*
Winter fat *((Eurotia lanata)*	Prairie sage *(Artemisia frigida)*	Dwarf Larkspur *(Delphinium bicolor)*
Buffalo bean *(Geoprumnon crassicarpum)*	Sage brush *(Artemisia cana)*	Horse Tail *(Equisetum arvense)*
Russian Thistle *(Salsola pestifer)*	Golden aster *(Chrysopsis villosa)*	Prairie Bean *(Thermopsis rhombifolia)*
White vetchling *(Lathyrus ochroleucus)*	Rabbit brush *(Chrysothamnus frigidus)*	Death camas *(Toxicoscordion venenosum)*
Blue vetch *(Vicia Americana)*	Bastard toadflax *(Comandra pallida)*	Water Hemlock *(Cicuta maculata)*
Bush Pea *(Diholcos bisulcatus)*	Sea blite *(Dondia depressa)*	
Straggling white pea *(Ctenophyllum pectinatum)*	Gum weed *(Grindelia squarrosa)*	
Trailing white pea *(Homalobus tenellus)*	Brown weed *(Gutierrezia Sarothrae)*	
	Colorado Rubber Plant *(Hymenoxys Macounii)*	
	Sand vetch *(Psoralea lanceolata)*	

Two hundred samples of native vegetation were collected and forwarded to the Division of Chemistry for analysis. These samples represent various species in several growth stages, and as found growing under different soil and climatic conditions. Samples were taken from several hay meadows, and from plots that had been treated with commercial fertilizers.

The samples collected during 1927 and 1928 have been analyzed by the Division of Chemistry. The data on the analysis of the 1927 samples have been presented by Dr. Shutt in his report for the year ending March 31, 1928. The data for the two years samples are summarized in table 14.

TABLE 14—COMPOSITION OF NATIVE PLANTS COLLECTED ON THE RANGE LANDS OF ALBERTA IN 1927 AND 1928—MOISTURE FREE

No.	Name	Date of collection	Stage of growth	Protein		Crude Fat		Nitrogen Free Extract		Crude Fibre		Ash	
				1927	1928	1927	1928	1927	1928	1927	1928	1927	1928
1	Stipa comata (Spear grass)	Mar. 25, 1928	1927 growth	.....	2·83	.....	1·46	.....	49·72	.....	40·13	.....	5·86
2	Stipa comata (Spear grass)	June 3, 1928	Emerging from sheath	.....	14·51	.....	3·63	.....	48·82	.....	28·30	.....	4·74
3	Stipa comata (Spear grass)	June 27	Flowering	8·12	.....	3·21	.....	33·97	.....	48·70	.....	6·00	.....
4	Stipa comata (Spear grass)	July 27	Late milk	5·61	.....	2·63	.....	50·71	.....	36·40	.....	4·65	.....
5	Stipa comata (Spear grass)	July 4	Dough	.....	8·60	.....	1·84	.....	49·21	.....	36·20	.....	4·15
6	Stipa comata (Spear grass)	Nov. 20, 1928	Cured	.....	4·91	.....	2·55	.....	53·58	.....	29·39	.....	9·57
7	Stipa comata (Spear grass)	Nov. 1	Cured	2·00	.....	2·02	.....	49·63	.....	39·84	.....	6·51	.....
8	Koeleria gracilis (June grass)	Mar. 25, 1928	1927 growth	.....	2·29	.....	0·97	.....	50·34	.....	38·78	.....	7·62
9	Koeleria gracilis (June grass)	May 23, 1928	Emerging from sheath	.....	15·53	.....	2·14	.....	46·56	.....	28·61	.....	7·16
10	Koeleria gracilis (June grass)	June 27	Flowering	5·99	.....	3·13	.....	49·63	.....	36·01	.....	6·14	.....
11	Koeleria gracilis (June grass)	July 1, 1928	Late flowering	.....	9·72	.....	1·84	.....	45·46	.....	33·96	.....	9·02
12	Koeleria gracilis (June grass)	July 4, 1928	Dough	.....	8·20	.....	1·41	.....	36·34	.....	33·86	.....	10·19
13	Koeleria gracilis (June grass)	July 18	Dough	4·89	.....	3·67	.....	47·95	.....	35·60	.....	7·89	.....
14	Koeleria gracilis (June grass)	Nov. 1	Cured	1·37	.....	1·04	.....	46·24	.....	35·61	.....	15·72	.....
15	Agropyron Smithii (Blue Joint)	Mar. 25, 1928	1927 growth	.....	3·32	.....	1·82	.....	47·45	.....	40·81	.....	6·60
16	Agropyron Smithii (Blue Joint)	Mar. 25, 1928	1927 growth	.....	2·53	.....	1·26	.....	51·31	.....	32·25	.....	12·65
17	Agropyron Smithii (Blue Joint)	June 5, 1928	Pre-flowering	.....	16·44	.....	1·37	.....	44·02	.....	28·03	.....	10·14
18	Agropyron Smithii (Blue Joint)	July 26	Flowering	7·62	.....	2·58	.....	45·86	.....	36·84	.....	7·10	.....
19	Agropyron Smithii (Blue Joint)	July 4, 1928	Late flowering	.....	15·86	.....	1·56	.....	44·51	.....	31·18	.....	6·89
20	Agropyron Smithii (Blue Joint)	July 26, 1927	Dough	6·49	.....	2·06	.....	50·10	.....	34·73	.....	6·62	.....
21	Agropyron Smithii (Blue Joint)	Nov. 20, 1928	Cured	.....	3·33	.....	1·16	.....	59·39	.....	28·00	.....	8·12
22	Agropyron Smithii (Blue Joint)	Nov. 1	Cured	3·54	.....	2·94	.....	45·53	.....	33·12	.....	14·87	.....
23	Bouteloua gracilis (Blue Grama grass)	Mar. 25, 1928	1927 growth	.....	2·87	.....	0·71	.....	51·53	.....	36·42	.....	8·47
24	Bouteloua gracilis (Blue Grama grass)	July 4, 1928	Early flowering	.....	11·54	.....	1·15	.....	48·70	.....	32·06	.....	6·55
25	Bouteloua gracilis (Blue Grama grass)	July 28	Flowering	7·59	.....	1·84	.....	48·04	.....	32·63	.....	8·89	.....
26	Bouteloua gracilis (Blue Grama grass)	Aug. 12	Dough	5·65	.....	2·12	.....	54·74	.....	31·53	.....	5·96	.....
27	Bouteloua gracilis (Blue Grama grass)	Aug. 27, 1928	Nearly ripe	.....	8·09	.....	1·94	.....	50·04	.....	34·26	.....	5·67
28	Bouteloua gracilis (Blue Grama grass)	Nov. 25, 1928	Cured	.....	3·33	.....	1·37	.....	55·69	.....	31·39	.....	8·23
29	Bouteloua gracilis (Blue Grama grass)	Nov. 1	Cured	2·14	.....	1·69	.....	50·83	.....	33·70	.....	11·55	.....
30	Agropyron spicatum (Blue-bunch wheat grass)	Sept. 25	Cured	6·02	.....	3·32	.....	42·55	.....	36·24	.....	11·87	.....
31	Poa laevigata (Meadow grass)	Mar. 25, 1928	1927 growth	.....	2·47	.....	1·20	.....	49·14	.....	41·27	.....	5·92
32	Poa laevigata (Meadow grass)	May 23, 1928	Emerging from sheath	.....	13·84	.....	2·02	.....	47·07	.....	31·21	.....	5·66
33	Poa laevigata (Meadow grass)	July 15	Late dough	5·36	.....	3·21	.....	50·25	.....	35·46	.....	5·72	.....
34	Poa laevigata (Meadow grass)	Nov. 1	Cured	0·99	.....	1·70	.....	48·75	.....	42·50	.....	6·55	.....
35	Poa Reflexa (Tall Meadow grass)	July 26	Dough	2·13	.....	2·35	.....	49·99	.....	40·68	.....	4·85	.....
36	Poa triflora (Feather grass)	Aug. 1	Dough	5·44	.....	1·44	.....	51·96	.....	34·18	.....	6·98	.....
37	Poa laevigata (Dwarf Meadow grass) (Upland poa)	June 26	Flowering	5·84	.....	2·96	.....	47·54	.....	36·69	.....	6·97	.....
38	Stipa viridual (Short awned needle grass)	July 26	Dough	9·20	.....	1·78	.....	45·53	.....	35·54	.....	7·95	.....
39	Calamovilfa longifolia (Sand grass)	July 30	Flowering	7·86	.....	1·89	.....	47·40	.....	37·28	.....	5·57	.....
40	Calamovilfa longifolia (Sand grass)	June 14, 1928	Pre-flowering	.....	10·57	.....	1·56	.....	52·72	.....	31·12	.....	4·03
41	Beckmania erucaeformis (Slough grass)	July 27	Dough	3·40	.....	3·57	.....	51·57	.....	32·47	.....	8·99	.....

TABLE 14—COMPOSITION OF NATIVE PLANTS COLLECTED ON THE RANGE LANDS OF ALBERTA IN 1927 AND 1928—MOISTURE FREE—*Concluded*

No.	Name	Date of collection	Stage of growth	Protein		Crude Fat		Nitrogen Free Extract		Crude Fibre		Ash	
				1927	1928	1927	1928	1927	1928	1927	1928	1927	1928
42	Beckmania erucaeformis (Slough grass)	June 25, 1928	Early flowering	.....	11·36	.....	1·56	.....	46·05	.....	34·22	.....	6·81
43	Festuca scabrella (Tall Fescue grass)	July 14, 1928	Early dough	.....	5·97	.....	1·58	.....	47·25	.....	37·18	.....	8·02
44	Hordeum jubatum (Wild barley)	May 25, 1928	Pre-flowering	.....	28·59	.....	4·05	.....	32·94	.....	23·27	.....	11·15
45	Avena Hookerii (Hooker's oats)	July 14. 1928	Late flowering	.....	6·27	.....	1·56	.....	45·49	.....	36·65	.....	10·03
46	Festuca ovina (Sheep's fescue)	June 24, 1928	Late flowering	.....	6·20	.....	2·18	.....	51·62	.....	33·27	.....	6·73
47	Deschampsia atropurpurea (Swamp grass)	June 28, 1928	Pre-flowering	.....	7·53	.....	1·63	.....	38·29	.....	42·23	.....	10·32
48	Deschampsia atropurpurea (Swamp grass)	July 27	Dough	5·22	.....	1·81	.....	44·03	.....	39·62	.....	9·32	.....
49	Schizachyrium scoparium (Beard grass)	Aug. 27, 1928	Ripe	.....	4·93	.....	2·31	.....	50·01	.....	37·97	.....	4·78
50	Mulhenbergia cuspidate (Mulhenbergia)	Mar. 25, 1928	1927 growth	.....	4·10	.....	2·73	.....	52·93	.....	33·45	.....	6·79
51	Calamagrostis Montanensis (Blue-stem)	Mar. 25, 1928	1927 growth	.....	2·26	.....	1·54	.....	44·73	.....	39·52	.....	11·95
52	Calamagrostis Langsdorfii (Pine grass)	Oct. 15, 1928	Cured	.....	3·56	.....	2·33	.....	20·21	.....	54·43	.....	19·47
53	Distichlis stricta (Alkali grass)	Mar. 25, 1928	1927 growth	.....	3·43	.....	1·88	.....	61·91	.....	24·43	.....	8·35
54	Distichlis stricta (Alkali grass)	June 13, 1928	Pre-flowering	.....	15·43	.....	1·95	.....	47·60	.....	26·69	.....	8·33
55	Sporobolus cryptandrous (Drop seed grass)	Aug. 23	Cured	5·52	.....	2·22	.....	52·10	.....	33·82	.....	6·34	.....
56	Carex filifolia (Thread leaved sedge)	Aug. 10	Cured	6·23	.....	4·34	.....	52·03	.....	26·71	.....	10·69	.....
57	Carex sp. (Wire grass)	Aug. 10	Flowering	10·93	.....	1·89	.....	47·72	.....	30·25	.....	9·21	.....
58	Carex sp. (Slough grass)	May 24, 1928	Pre-flowering	.....	22·18	.....	2·81	.....	42·67	.....	21·38	.....	10·96
59	Salsola pestifer (Russian Thistle)	June 4, 1928	Pre-flowering	.....	13·71	.....	2·08	.....	46·98	.....	12·00	.....	25·23
60	Salsola pestifer (Russian Thistle)	Aug. 12	Early flowering	20·22	.....	1·85	.....	34·99	.....	20·59	.....	22·36	.....
61	Homalobus caespitosus (Dwarf pea)	May 23, 1928	Flowering	.....	16·59	.....	2·61	.....	41·06	.....	31·28	.....	8·46
62	Homalobus tenellus (Dwarf white pea)	May 23, 1928	Flowering	.....	15·66	.....	2·59	.....	39·50	.....	33·11	.....	9·14
63	Astragalus sp. (Purple vetch)	May 24, 1928	Flowering	.....	21·52	.....	2·70	.....	46·21	.....	20·45	.....	9·12
64	Gutierrezia Sarothrae (Brown weed)	May 25, 1928	Pre-flowering	.....	19·40	.....	4·10	.....	51·81	.....	13·82	.....	10·87
65	Diholcos bisulcatus (Bushy purple pea)	May 27, 1928	Early flowering	.....	9·39	.....	2·82	.....	43·86	.....	24·02	.....	9·91
66	Artemisia gnaphaloides (Sage Brush)	May 22, 1928	Pre-flowering	.....	18·31	.....	6·86	.....	43·31	.....	23·20	.....	8·32
67	Artemisia gnaphaloides (Sage Brush)	Aug. 10	Flowering	12·15	.....	6·85	.....	44·48	.....	29·69	.....	6·89	.....
68	Artemisia gnaphaloides (Sage Brush)	Nov. 1	Cured	8·40	.....	4·24	.....	47·37	.....	35·42	.....	4·57	.....
69	Artemisia frigida (Prairie Sage)	May 30, 1928	Pre-flowering	.....	14·77	.....	5·79	.....	42·94	.....	28·09	.....	8·41
70	Artemisia frigida (Prairie Sage)	Aug. 10	Flowering	7·78	.....	4·41	.....	45·57	.....	37·81	.....	4·43	.....
71	Artemisia frigida (Prairie Sage)	Sept. 25	Late flowering	11·37	.....	6·64	.....	44·08	.....	30·13	.....	7·78	.....
72	Artemisia frigida (Prairie Sage)	Nov. 1	Cured	4·81	.....	3·07	.....	46·08	.....	42·40	.....	3·64	.....
73	Psoralea lanceolata (Sand vetch)	June 24	Flowering	.....	15·79	.....	6·94	.....	49·62	.....	21·14	.....	6·51
74	Dondia depressa (Sea blite)	May 25	Pre-flowering	.....	29·39	.....	3·37	.....	25·71	.....	9·79	.....	31·74
75	Ctenophyllum pectinatum (Bushy white pea)	May 22	Flowering	.....	24·22	.....	3·17	.....	41·17	.....	23·37	.....	8·07
76	Astragalus tenellus (Decumbent white pea)	May 30, 1928	Early flowering	.....	14·62	.....	3·32	.....	46·17	.....	30·18	.....	5·71
77	Astragalus sp. (Decumbent purple pea)	May 27, 1928	Flowering	.....	19·87	.....	1·61	.....	43·59	.....	22·46	.....	12·47
78	Tium Drummondii (Silver pea)	May 27, 1928	Flowering	.....	28·43	.....	2·58	.....	38·98	.....	21·02	.....	8·99
79	Eurotia lanata (Silver Sage)	May 30, 1928	Pre-flowering	.....	19·47	.....	2·21	.....	32·24	.....	29·47	.....	16·61
80	Eurotia lanata (Sweet Sage)	Aug. 10	Late flowering	14·23	.....	2·17	.....	38·74	.....	31·51	.....	13·35	.....
81	Atriplex Nuttallii (Salt Sage)	May 25, 1928	Pre-flowering	.....	20·84	.....	2·49	.....	39·69	.....	13·04	.....	23·94
82	Atriplex Nuttallii (Salt Sage)	Aug. 10	Flowering	14·18	.....	2·15	.....	42·43	.....	22·40	.....	18·84	.....

Some of the outstanding points brought out by this work are as follows: (1) The high protein content of the grasses while in the early growth stages. *Hordeum jubatum* in the pre-flowering stage contains 28·59 per cent protein, *Agropyron Smithii* contains 16·44 per cent *Koeleria gracilis* 15·53 per cent and *Stipa comata* 14·51 per cent. As the plants approach maturity and become cured there is a marked decrease in protein content. (2) The ash content of most species varies greatly, evidently depending largely upon the composition of the soil. Samples 15 and 16 consist of *Agropyron Smithii* collected from two different areas; one sample contains 6·60 per cent ash while the other contains 12·65 per cent or nearly twice as much. (3) The high protein content of many of the broad-leaved plants,

Sage Brush with 18·31 per cent.
Silver Pea with 28·43 per cent.
Silver Sage with 19·47 per cent.
Salt Sage with 20·84 per cent.

(4) The high fat content of sage brush and of prairie sage (5) The high protein and ash contents of certain unpalatable species such as Sea Blite and Brown weed.

Plant succession on a field that has been abandoned for six years. Prairie sage (*Artemisia frigida*) and Blue Joint (*Agropyron Smithii*) are taking the place of the Russian thistle and tumbling mustard. The light coloured clumps are prairie sage.

A survey of soil types and vegetative species was made on townships 1 to 7 inclusive, range 4, west of the 4th M. This strip of country extends from the valley of the Milk River on the Montana border to the top of the Cypress Hills ridge and therefore, it varies widely as regards topography, exposure, slope, altitude, soil type, climatic conditions and vegetative cover. It was found that certain plant species are fairly reliable indicators of soil types. This survey was made in co-operation with Mr. S. Barnes, soils specialist of the Field Husbandry Division. The data obtained are being prepared for publication.

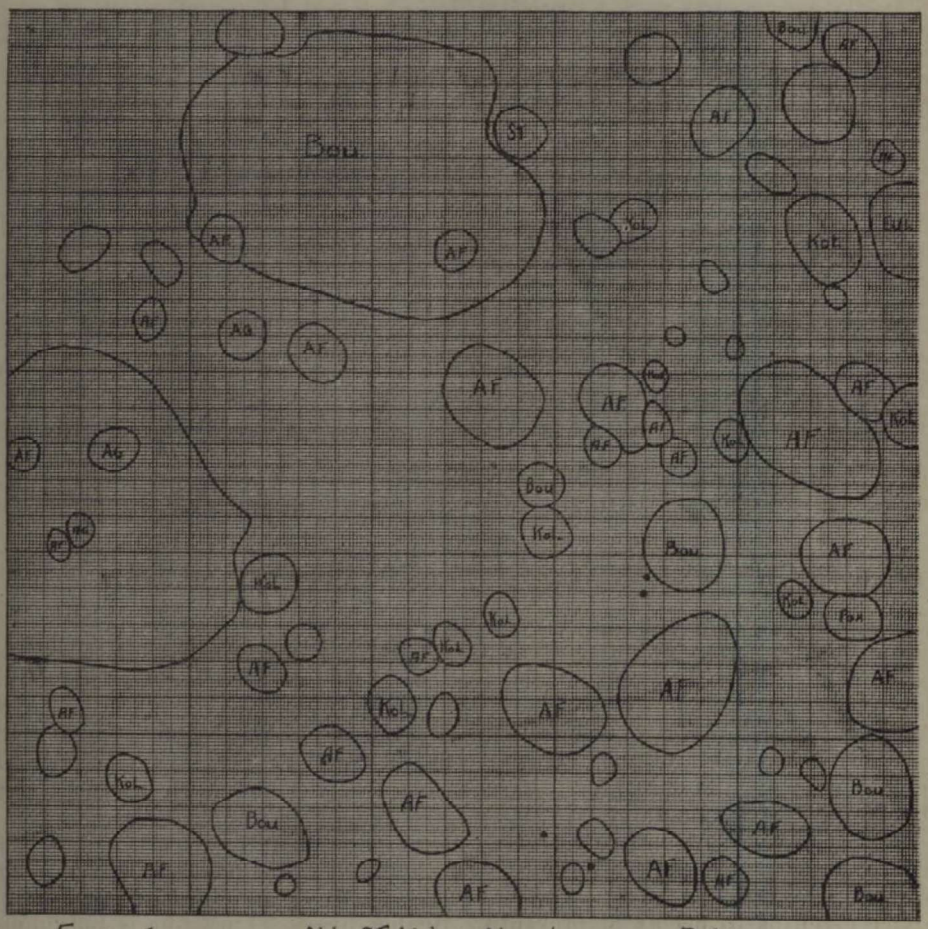
Some time was devoted to a study of poisonous plants. Death camas was very prevalent on nearly all range areas and quite a number of sheep were poisoned by eating this weed. Several cases of poisoning were investigated and advice given as to means of preventing further losses. Larkspur is poisonous to cattle but has little or no effect on sheep.

Plant succession is being studied on the many permanent quadrats and transects that have been staked out and charted. In addition to these, special plots, or perquadrats, have been established on all the fields and on areas that are subjected to different intensities of grazing. On these plots certain species only are under observation, the purpose being to determine the effects of various intensities of grazing on these particular species. Each perquadrat is charted and listed for the plants under observation and general notes taken on all species on the plot.

A STUDY OF THE EFFECTS OF DIFFERENT GRAZING PRACTICES UPON THE VEGETATIVE COVER

Twenty-five additional permanent quadrats have been marked out on each of the four fields. All of these quadrats have been mapped and the area occupied by each species has been determined and recorded. The map of quadrat B—14/29 is shown in fig. 1.

FIG. 1



QUADRAT NO. B-14/29

1. Date Charted September 25, 1929.
2. Location Sec. 26 N-E. 150 yards E of Little Coulee.
3. Character of Site. (*a*) Elevation 3,100 feet. Open prairie.
   (*b*) Exposure and slope: A south slope of 5 degrees.
   (*c*) Soil: A light sandy loam.
4. Plant Type. (*a*) Principal species on major quadrat: Bou. St. Koel. Poa Ag. A.F. Eu. L. S.O.
   (*b*) Density of vegetative cover: A fair cover, large patches of Bou.
   (*c*) Height of vegetation: St. 6 inches to 12 inches Bou. 2 inches-5 inches.
   (*d*) Seed production: A small amount of St. and Kol.

SUMMARY OF MINOR QUADRAT DATA

5.

(*a*) Grasses.

Symbol	Bou.	St.	Kol.	Ag.	Poa	.....	.....	.....	TOTALS
Number of specimens	8	27	12	3	1	.....	.....	.....	51
Nutritive index	.....	.....	.....	.....	.....	.....	.....	.....	.....
Yield index	.....	.....	.....	.....	.....	.....	.....	.....	.....
Area occupied (sq. cm.	1,932	332	256	36	28	.....	.....	.....	2,584
Area occupied (%)	19·32	3·32	2·56	·36	·28	.....	.....	.....	25·84
Relative forage value	.....	.....	.....	.....	.....	.....	.....	.....	.....

(*b*) Broad Leaved Plants.

Symbol	A.F.	Eu. L.	.....	.....	.....	.....	.....	.....	TOTALS
Number of specimens	30	1	.....	.....	.....	.....	.....	.....	31
Nutritive index	.....	.....	.....	.....	.....	.....	.....	.....	.....
Yield index	.....	.....	.....	.....	.....	.....	.....	.....	.....
Area occupied (sq. cm.	1,212	50	.....	.....	.....	.....	.....	.....	1,262
Area occupied (%)	12·12	·50	.....	.....	.....	.....	.....	.....	12·62
Relative forage value	.....	.....	.....	.....	.....	.....	.....	.....	.....

6. Relative Forage Value of Minor Quadrat.
7. Distance of Quadrat from nearest watering place 1½ miles.
8. Remarks

Bou. = *Bouteloua gracilis* (grama grass).
St. = *Stipa comata* (spear grass).
Kol. = *Koeleria gracilis* (June grass).
Ag. = *Agropyron Smithii* (Blue Joint).
Poa. = *Poa laevigata* (Meadow grass).
A.F. = *Artemisia frigida* (Prairie sage).
Eu. L. = *Eurotia lanata* (Winter fat).

It will be observed that on this quadrat 25·84 per cent of the area is occupied by grasses of five different species and 12·62 per cent by two kinds of weeds. Thus 61·54 per cent of the area of this quadrat is devoid of vegetation. When this plot is recharted it will be an easy matter to detect and measure any changes that have taken place in the vegetal covering, and grazing practices are judged chiefly by the effects produced upon the vegetative cover of the pastures.

On each of the four fields eight plots of four square rods each have been permanently fenced. These are used (*a*) for a comparison of the vegetation on grazed and ungrazed areas, (*b*) for a study of plant succession, (*c*) for the conducting of yield tests of native forage species.

Sweet clover, grown in co-operation with a rancher in Southern Alberta. That on the left is yellow blossom, while that on the right is the higher growing white sweet clover.

On field D, which is grazed continuously from early spring until late in the fall, thirty-two plots were protected from early spring grazing by means of hurdles or temporary fences. Cattle were placed on this field on April 10, and sixteen of the protected plots were opened to grazing on May 5, thus being protected for a period of 25 days, or until the early grass species such as *Koeleria gracilis, Stipa comata, Poa confusa, Poa laevigata, Carex filifolia* and *Agropyron,* had made a new growth of from 1 to 3 inches in height. The remaining sixteen plots were protected until June 1 or for a period of 50 days. At this time the early grasses had grown to a height of from four to six inches and in many cases were in the boot stage. Quadrats have been charted on each of these plots and also on adjacent unprotected areas as checks.

THE IMPROVEMENT OF PASTURES BY ARTIFICIAL MEANS

In order to determine the effects of discing on the native vegetation two sites were selected, representing different conditions of soil, slope, exposure and vegetative cover. Some of the plots on each site were single disced, some double disked and others disked three times. Every 4th plot was left untreated as a check. Disking was done both early in the spring and late in the fall. A few plots had been disked in 1928 and on these the grass produced about twice as much seed as it did on the untreated checks. Double disking appeared to be much more effective than single disking.

A number of plots were burned off in the fall of 1928 and others in the spring of 1927. Fall burning injured the grass to a very marked extent while the plots burned early in the spring produced about the same amount of new growth during the summer of 1929 as did the unburned checks.

Reseeding experiments are being conducted (1) on range pastures that have become depleted through being over grazed, (2) on abandoned fields, (3) on burnt-over areas on the Forest Reserve near Coleman, Alberta. On abandoned fields crested wheat grass, sweet clover, brome grass, western rye grass and western wheat grass are giving promising results.

On the Forest Reserve north of Coleman, Alta., there are large burnt-over areas on which there is very little vegetation and the species that are becoming established are largely weeds. An attempt is being made to establish patches

of grass or of other forage plants, from which the adjacent areas could be reseeded. Ten sites were selected on the west slope of Crow's Nest mountain. These sites represent ten different altitudes ranging from about 4,500 feet in the valley to about 8,000 feet, which is above the timber line. On each site separate plots were sown to each of fourteen different grass species and four kinds of legumes. The seed was sown broadcast by hand and the plots then lightly raked over with a garden rake. A mixture of the eighteen kinds of seed was scattered along several of the water courses. In this way we hope to be able to determine which species do best at different altitudes under the particular soil and climatic conditions prevailing over these areas.

The effects of the application of commercial fertilizers on the native vegetation, are being tested. The fertilizers used are superphosphate, potassium sulphate, potassium muriate, ammonium sulphate and sodium nitrate. Twelve different treatments were tested, the fertilizer being sown broadcast at the rate of 100 pounds per acre. Each treatment was replicated four times and every fifth plot was left untreated as a check. Quadrats have been charted on each plot in order to determine the effects on plant succession. Samples were collected from each plot and sent to the Division of Chemistry for analysis. The vegetation was harvested from small areas on each plot as a yield test, and the average yields of the four replicates were compared with the yields of the nearest checks.

In the case of eleven out of the twelve treatments tested the treated plots outyielded the untreated checks.

These tests will be continued with and extended to include different rates and dates of application.

CULTIVATED FORAGE CROPS

Experimental work in the growing of forage crops under different soil and climatic conditions is being done in co-operation with ranchers and farmers throughout the Western Provinces. This work is giving very promising results. In several districts the acreage of alfalfa, sweet clover and crested wheat grass has been greatly increased. This work is helping to solve the problem of winter feed for range stock.

At Maple Creek, Sask., 100 strains of corn were tested for earliness of maturity, and yielding ability. The summer of 1929 was not a favourable one for corn production in the Maple Creek district, as there was not sufficient moisture during July and August. However, ripe corn was harvested from 70 of the 100 strains and some fair yields were obtained. Data concerning some of the most promising sorts are presented in table 15.

At the Dominion Range Experiment Station a large dam has been constructed on a coulee just north of the building site. This reservoir will hold about 18 acre feet of water and additional water can be stored up either by extending this dam or by constructing a secondary one. This water can be used to irrigate the trees and gardens, and also fields for the growing of forage crops. Land is being broken up, chiefly on areas that can be irrigated, thus, it will be possible to test different forage crops under both irrigated and dry land conditions.

Over 4,000 trees, supplied by the Dominion Forestry Station at Indian Head, Sask., and a number of fruit bushes and perennial flowers and shrubs from the Dominion Experimental Station at Morden, Manitoba, were set out in the spring of 1929 and made a good growth during the summer months.

TABLE 15—YIELDS OF SHELLED CORN OBTAINED FROM THE MOST PROMISING STRAINS GROWN ON THE CORN TESTING PLOTS AT MAPLE CREEK, SASK. IN 1928–1929

Variety	Strain	Yield per acre		
		1928	1929	2-year average
		bush.	bush.	bush.
Northwestern Dent	Maple Creek selection	.....	42	42
" "	Medicine Hat selection	.....	33	33
" "	Brooks selection	.....	30	30
" "	Lethbridge selection	.....	29·5	29·5
" "	Crookston, N.K.	27	26	26·5
" "	Brandon	29	23	26
" "	Oscar Will	29	.....	29
Minnesota No. 13	Medicine Hat selection from Haney strain	34	28	31
" "	Haney, N.K.	30	25	27·5
" "	Haney, Man. selection	.....	21	21
" "	Double Cross, N.K.	24	22	23
Howesota Cross	N.K.	.....	23	23
Golden Glow Howes Cross	N.K.	.....	17	17
Square Deal	Oscar Will, local selection	34	34	34
Falconer	Oscar Will, Alta. selection	30	24	27
Paynes White Dent	Bucholz	.....	26	26
Minnesota No. 23	Maple Creek selection	27	22	24
Pioneer	Oscar Will	26	22	24
Dakota White Flint	Maple Creek, selection	36·5	24	30·25
" "	Oscar Will	34	20	27
Improved Squaw	Medicine Hat selection	.....	27·5	27·5
"	Maple Creek, selection	.....	31	31
Twitchell's Pride	Experimental Farm, Fredericton	25	24	24·5
Quebec No. 28	McDonald College	30	30	30
Gehu	Medicine Hat selection	34	29	31·5
Gehu	Maple Creek, Sask.	.....	21·5	21·5
Manitoba Flint	Man. Agr. College	30	22	26
Manalta	Man. Agr. College	15	21	18
Duncan's Alta Flint	.....	13	20	16·5
Howe's Alta Flint	.....	12	20	16

Buildings at the Dominion Range Experimental Station. On December 15, the snow was 1½ feet deep, on the level. There is usually ample snow to provide enough water to fill the reservoirs, thus providing water for the stock and for small irrigation schemes.

INVESTIGATIONS ON OTHER RANGE AREAS

A reconnaissance was made of a part of the range lands situated north of Ashcroft, B.C. On this plateau which is cut by the Fraser Canyon, large areas are used as open range on which stock can be pastured at a very low charge per head, many of the stockmen have separate breeding pastures which are fenced.

Cattle can graze out all winter in the valleys, while up on the plateau the grass is covered deep with snow. In most cases the number of cattle which a rancher can keep is determined by the amount of hay he can put up as winter feed. Many of the pastures were found to be overgrazed and their carrying capacity greatly lowered. Arrangements have been made to conduct reseeding experiments in co-operation with a number of ranchers. There is a great need for research work pertaining to range management and pasture improvement on the mountain range lands of British Columbia.

A few days were devoted to a study of conditions on Buffalo Park at Wainwright, Alberta. The Buffalo, elk and other animals on the range appeared to be well fleshed and in a fine healthy condition. While this area is an ideal place for buffalo, parts of the range have been overgrazed. As a result of many dry years some of the water holes have dried up and therefore parts of the range are a long distance from water. A separate report containing certain recommendations has been submitted to the National Parks Branch of the Department of Interior.

MISCELLANEOUS ACTIVITIES

The determinations of dry matter are constantly increasing in volume. The drying apparatus developed by the Forage Crop Division serves at the present time for dry matter determinations of samples for all forage crop plots in Eastern Canada as well as for the majority of field husbandry plots. In addition, a start has been made on placing the yields secured on the Illustration Station on an absolute dry matter basis. Where this practice has been followed, shrinkage samples were sent to the Forage Crop Division, Ottawa, for dry matter determination. The drying apparatus is still functioning with a great deal of satisfaction, in spite of the fact that during a six week period last fall it was necessary to operate the machine both day and night.

In addition to the regular dry matter determinations a few experiments were conducted to secure information concerning the relative value of immediately dried and air dried samples. Some first cutting of alfalfa was immediately dried, following which it was ground into meal. The meal was sent to the Chemistry Division for analyses, and the following report was secured:—

Moisture	7·16 per cent
Crude protein	20·46 "
Crude fat	3·72 "
Carbohydrates	36·60 "
Fibre	23·55 "
Ash	8·51 "

It will be seen at once that the crude protein is very much higher than that found in the alfalfa meal of commerce, which usually averages between 15 to 16 per cent protein. On an absolute dry matter basis the crude protein of the immediately dry alfalfa would run slightly over 22 per cent. There are at least two contributing causes responsible for this increase in protein, first and probably most important, is that material dried immediately possesses all of the

leaves. Even under the best field drying conditions a large amount of the leaves and finer plant lots are lost and with them of course is lost a good proportion of protein. In addition to this loss of leaf it would appear that the slow drying process itself is associated with protein losses.

The whole question of the artificial drying of forage crops is being given considerable attention and all information possible is being secured in connection with the commercial feasibility of this system of handling fodder.

The Forage Crop Division also spent considerable time in the growing season of 1929 in the collection and preparation of material for exhibition. A representative of the Forage Crop Division was also in attendance at several of the more important of the Eastern Canada Exhibitions.

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